

Southern Connecticut State University

Werth Center for Coastal and Marine Studies



WCCMS Annual Report 2015-2016

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Prepared for:

The Werth Family Foundation, Woodbridge, CT

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CCMS Annual Benchmark/Evaluation Report 2015-2016

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 2015-2016 Annual Report are described below.

Academic Science and Laboratory Building, Werth Center for Coastal and Marine Studies

The exciting news this year was the completion and the dedication of the 103,000 ft² Academic Science and Laboratory Building at SCSU. The new science building now houses the Werth Center for Coastal and Marine Studies. The Werth Center space provides faculty offices for Drs. Breslin and Tait, a coastal processes laboratory, and an analytical laboratory in support of research and educational activities. Additionally, the Werth Center resources include a new science teaching laboratory and an aquarium laboratory to support two large display aquaria featuring Long Island Sound fish species. Faculty and students have moved into the space in the Fall 2015 and have now established research and education programs in these facilities.

Links to descriptions of the new facilities can be found at: <http://go.southernct.edu/science/>
A description of the Werth Center can be found by clicking on *Building Features*.

Business New Haven recently published an extensive three-part series on Southern's new science building during the last several months. The following link showcases the Werth Center and the new undergraduate major: https://issuu.com/secondwind/docs/bnh_feb_20162/26

Merging of Departments

The department of *Environmental and Marine Studies* and the department of *Geography* at Southern Connecticut State University have joined together as one department of *the Environment, Geography and Marine Sciences*. We are now transitioning from a department of five faculty to a department of eleven faculty. The new department aims to consolidate a number of academic programs that have an environmental and sustainability focus under one umbrella. The Werth Center for Coastal and Marine Studies continues to be housed within the new department but otherwise remains unaffected by the merger. The merger may, over time, increase collaborations among faculty in the new department. In addition, the department recently developed, and has received approval for, a new undergraduate degree program in Environmental Systems and Sustainability Studies. Coastal Marine Systems is one of the concentrations within the new major. We believe the new department and undergraduate major will create new opportunities for the Werth Center for Coastal and Marine Sciences faculty and students. More info can be found at: <https://www.southernct.edu/academics/schools/arts/departments/egms/index.html>

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 2015; Fall 2015; Spring 2016

Hollie Brandstatter, Graduate Student, Environment, Geography and Marine Sciences
Dylan Steinberg, Undergraduate Student, Environment, Geography and Marine Sciences
Lara Bracci, Undergraduate Student, Environment, Geography and Marine Sciences
Peter Broadbridge, Graduate Student, Environment, Geography and Marine Sciences
Juliann Fiallos, Undergraduate Student, Chemistry

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 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), and pH. Chlorophyll *a* measurements at this location will begin in March 2013.

Results to Date/Significance

To date, we have completed four continuous years of monitoring at this location. Water quality sampling is conducted two times per week, once at high tide and once at noon to determine water quality variability based on tidal stage. 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. The water quality monitoring program is networked with similar citizen/scientist monitoring programs throughout Long Island Sound.

Undergraduate Biology student Dathan Stone was recently added (Spring 2016) 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. Although they are generally not harmful themselves, they indicate the possible presence of pathogenic (disease-causing) bacteria, viruses, and protozoans that also live in human and animal digestive systems. Therefore, their presence suggests that pathogenic microorganisms might also be present and that swimming and eating shellfish might be a health risk.

Historical growth measurements in temperate corals

Faculty Dr. Sean Grace
 Biology, SCSU

Student Participant(s)

Summer 2015; Fall 2015

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

Coral's grew well in the summer months and decreased in growth during the winter as is consistent with published reports. Additionally, competition between corals and other invertebrates (clinoid sponges and white encrusting tunicates) were noted and followed throughout their encounter. When present, the clinoid sponge bio-eroded under the coral and surrounded the skeleton but no over-growing was noticed. Additionally, tunicates grew to the very edge of corals, but decreased in size during the winter months when both organisms experience quiescence.

An Assessment of Plastic Microbead Contamination in New Haven Harbor

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

Student Participants

Summer 2015

Peter Litwin, Undergraduate Student, Physics

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). New Haven harbor water was sampled by towing an 80 µm mesh plankton net at the water surface along four predetermined transects in June 2015. The collected water was filtered and the filter paper examined for the presence of plastic microbeads.

Results to Date/Significance

Plastic microbeads were identified in each of four plankton tows on two separate dates in New Haven harbor. Twenty eight plastic microbeads found in New Haven harbor matched the morphologies of microbeads isolated from cosmetic products. Plastic microbead concentrations ranged from 0.05 to 0.31 microbeads per cubic meter of water. Results of this study confirm the presence of plastic microbeads derived from consumer products in Long Island Sound. Results of this study were used in support of the Connecticut ban on the manufacture and sale of products containing microbeads. Questions concerning the spatial trends in microbead contamination in Long Island Sound led to the development and submission of a research proposal to examine microbead concentrations in other Connecticut harbors in the Spring 2016.

Consequences of Navigation Channel Maintenance Dredging on Sediment Quality in New Haven Harbor

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

Student Participants

Fall 2015; Spring 2016

Sadia Younas, Undergraduate Student, Chemistry
Cody Edson, Undergraduate Student, Chemistry

Cashman Dredging completed the excavation of 810,000 cubic yards of sediment from New Haven harbor in February 2014 to restore the depth of the navigation channel to 35 feet. Studies have shown that dredging can re-suspend contaminated sediment and deposit the sediment outside the confines of the harbor channel.

Utilizing existing sediment metal databases collected by Center for Coastal and Marine Studies (CCMS) researchers over the past four years in New Haven harbor, an opportunity exists to examine the changes in the sediment chemical (zinc, copper, and iron) and physical (grain size and organic carbon content [LOI]) properties pre and post dredging. The goal of this study will be to test the following hypotheses: (1) sediment physical and chemical characteristics of nearby oyster bed habitat will differ from pre-dredging levels due to the presence re-suspended contaminated dredged sediment and (2) the removal of five or more feet of sediment accumulated during the past decade will expose more highly contaminated sediment at the base of the navigation channel. Towards this goal, the specific objectives of this research are to: (1) collect sediment samples from previously sampled geo-referenced stations within the harbor channel and in nearby leased oyster beds; (2) digest the sediment samples and determine the copper, zinc and iron content of the sediment using flame atomic absorption spectrophotometry; (3) determine the physical [grain-size, and organic carbon content (loss on ignition)] properties of the sediment; and (4) using appropriate statistical analyses, compare the chemical and physical properties of the sediment within defined sections of the harbor pre and post dredging

Results to Date/Significance

Two research cruises were conducted during the summer (6/29/2015 and 8/28/15) in support of sediment sampling in the New Haven harbor. A total of nineteen stations were sampled in the harbor channel and turning basin where dredging occurred. These sediment samples have been processed and acid digested and are currently awaiting metals analysis (iron, copper and zinc) by atomic absorption spectrophotometry. Sediment loss on ignition for each sample have been completed.

Sand Dispersal from a U.S. Army Corps of Engineers Beach Replenishment Project in West Haven, CT

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

Student Participants

Summer 2015; Fall 2015; Spring 2016

Ryan Orłowski, Undergraduate (Honors College/ Earth Science)
Dylan Steinberg, Undergraduate Student (Earth Science)
Kaelyn Phillips, Undergraduate Student (Environmental Studies)

Project Description

In the fall of 2014, the U.S. Army Corps of Engineers completed a beach replenishment project for the city of West Haven. Approximately 4500 feet of shoreline has been replenished at a total cost of \$3.79 million. The same beach was subject to four previous replenishment projects (1957, 1973, 1987 and 1994). The cost per linear foot was \$55.41 in 1957. This cost has escalated to \$842.22 in 2014, double the rate of inflation. The cost per cubic yard of sand has skyrocketed from \$ 0.81 in 1957 to \$73.30 in 2014. This is an order of magnitude larger than the rate of inflation.

<http://www.nbcconnecticut.com/news/local/Will-Efforts-to-Protect-West-Haven-Beach-Be-Enough-279365112.html>

The city of West Haven is one of the poorest coastal towns in the state yet maintains the largest public beach in the state (~3.5 miles). Previous studies conducted by Werth Center researchers have suggested that Connecticut's beaches are chronically erosive due to asymmetries in the storm-vs-fair weather wave fields. As a result, in areas where there is an interest in maintaining beaches for recreation, storm protection, or economic benefits, replenishment is also a chronic need. And the cost of doing so is increasing rapidly.

The purpose of this study is to document the rate and direction of dispersal of sand from the replenished beaches. This information will help the city in terms of planning for future replenishment projects. More importantly, such documentation can be used as a basis for proposing changes to state policy that would allow towns such as West Haven to retrieve sand lost via erosion from wherever it is deposited.

Results to Date/Significance

Profile data are still being processed and interpretation is currently underway. Preliminary results are as follows.

- 1) Beaches are mainly inactive and engage in dynamic behavior only during high-energy events.
- 2) Large waves mainly originate from the southwest due to the long, open fetch (~45 km) between Smithtown Bay, N.Y. and New Haven Harbor, CT. and to the large opening between the West Breakwater and the West Haven shoreline.
- 3) Because of 2) much of the sediment transport is alongshore to the northeast with sediment accumulating at Bradley Point.
- 4) Shallow profiles that extend hundreds of meters offshore indicate large stores of subaqueous sand that could potentially be used for beach replenishment.

Cliona celata, bio-eroding and changing temperate reefs from mixed highly biodiverse communities to single low diversity habitats

Faculty Dr. Sean Grace
 Biology, SCSU

Student Participant(s)

Fall 2015

Jennifer Lazor, Undergraduate Student, Biology

Given the propensity for undergrowth experienced by many sessile marine invertebrates in LIS and regional waters, the attachment strength of corals will be examined. This study will examine the force needed to dislodge coral-sponge assemblages from the substrate at 3 subtidal sites in LIS (Groton, Branford, and Stratford). *Astrangia poculata* and *Cliona celata* compete for space subtidally wherever they are found together. Sponges erode under the coral, pushing the coral off the substrate and compromising its' attachment strength. Corals are then dislodged when storms create high enough currents or via wave exposure resulting in a loss of these common sessile organisms. Using SCUBA, 30 coral-sponge assemblages and 30 single colonies (not in an assemblage) will be examined for attachment strength by attaching a force gauge to the coral and pulling the coral in the direction of the water current until dislodged. Data will be examined statistically by comparing the dependent variable (force to dislodge) in a Two-Way ANOVA with factors, Site and Presence/absence of sponge.

Results to Date/Significance

Only preliminary results exist to date, but results indicate a significant difference in attachment strength between corals without sponges and those in a sponge assemblage. The significance of these results is the phase-shift on temperate reefs from mixed biodiverse habitats to single low diverse habitats.

Testing for the Presence of Seasonal Beach Profiles on the Connecticut Coast

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

Student Participants

Fall 2015; Spring 2016

Kaelyn Phillips, Undergraduate Student (Environmental Studies)
Lara Bracci, Undergraduate Student (Marine and Environmental Studies)
Dylan Steinberg, Undergraduate Student (Earth Science)

Project Description

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, impairing their function as storm wave buffers and exposing coastal structures and infrastructure to damages. The predominant model for annual beach behavior posits an annual equilibrium between a robust beach during fair weather waves and a smaller, eroded beach during periods of seasonal storminess. In this model, sand is transferred to offshore bars during storms and then returned to the beach by more moderate fair weather waves. Such changes in sand storage are referred to as seasonal beach profiles. The fair weather waves on most beaches are derived from distant storms and a process called velocity dispersion by which the chaotic wave field of the storm area sorts itself out into highly coherent wave trains (or swell) that are moderate in height and long in period. On the Connecticut coast such waves are filtered out by Long Island.

The current research involves testing the scenario above by measuring beach profiles at five Connecticut beaches on a seasonal (four times per year) basis in order to establish the presence or lack of seasonal beach profiles (i.e., does the beach ever accrete and, if so, is there ever full recovery after a storm?). The beaches included in the study include Sherwood Island State Park, Bayview Beach in Milford, Hammonasset Beach State Park, Rocky Neck State Park, and Ocean Beach Park in New London. Since the Race at the east end of Long Island Sound is a possible entry point for large ocean swell, it is possible that beaches at the eastern end of the Sound exhibit seasonal behavior while beaches further from the Race do not. The results of this study should tell us a great deal about the state of vulnerability of Connecticut beaches.

Results to Date/Significance

This study is in its initial stages. Three profiles have been measured at each of the five beaches and elevation control points have been selected. The study has been joined, at least informally, by Dr. Jennifer O'Donnell, a research faculty in marine sciences at UCONN and a member of Connecticut's Shoreline Preservation Task Force. In addition, we have been contacted by the program director of the Connecticut Institute for Resilience and Climate Adaptation (CIRCA). This may lead to partnership opportunities moving forward.

A Comparison of Cadmium Concentrations in Long Island Sound Harbor Sediments

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

Student Participants

Summer 2015; Fall 2015; Spring 2016

Sadia Younas, Undergraduate Student (Chemistry)

Cadmium is a non-nutritive trace metal and is classified as a Group B1 carcinogen (probable human carcinogen) by the EPA. Cadmium poses an even greater risk to aquatic organisms. It is

exceptionally toxic even at low concentrations and results in acute and chronic effects on aquatic organisms. The aims of this study were to examine sediment cadmium concentrations in Black Rock and Stonington harbor and to determine the covariance of cadmium with respect to copper, iron and zinc sediment concentrations. Cadmium concentrations were measured using electrothermal atomic absorption spectroscopy whereas copper, iron and zinc concentrations were detected utilizing the flame atomizer.

Results to Date/Significance

Data for both harbors indicates cadmium concentrations surpass the crustal abundance (0.2 mg/kg) of the metal. In consideration with NOAA sediment quality guidelines, cadmium concentrations in Stonington harbor are well below the ERL limit (1.2 mg/kg), largely due to the rural setting of the harbor. In contrast Black Rock Harbor is heavily industrialized, with the mean cadmium concentrations of inner Black Rock Harbor exceeding the NOAA ERM threshold (9.6 mg/kg), with some stations in the harbor reporting values of 22.9 and 23.9 mg/kg cadmium. Metal concentrations were found to be higher in the inner harbor due to finer grain sediment and high loss on ignition, while they tended to decrease further out in the harbor due to coarse grain sediment and low loss on ignition. Copper and cadmium concentrations were shown to vary directly with correlation coefficients of 0.83 for Stonington Harbor and 0.96 for Black Rock Harbor. Similar trends were also observed for zinc and cadmium with Black Rock reporting a correlation coefficient of 0.92 and 0.84 for Stonington harbor. Results of this research will be used in preparation of an Honors Thesis in Chemistry.

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 four regional experts during the Spring 2015 to discuss topics concerning the health and quality of Long Island Sound and its environs as part of the **Twelfth Annual Seminar Series on Environmental Issues of Long Island Sound 2015**.

The seminar series consisted of three separate one-hour seminars by invited experts on Long Island Sound environmental issues during the Spring 2015 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 2015 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
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3/31/2015	How Wet Will We Get: Coastal Processes and Shoreline Change in Long Island Sound	27
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Jennifer O'Donnell, CEO/Principal Coastal Ocean Analytics Research Faculty, Marine Sciences, UCONN, Avery Point

In a time of changing climate with rising sea levels and potentially greater storm activity, increasing stresses will be placed on Connecticut's shoreline. A variety of responses will have to be employed or developed in order to confront these changes and to develop coastal resilience. At risk are structures (e.g. homes, schools, medical facilities) and infrastructure (e.g., roads, gas lines, sewer systems, electrical systems). These all face different levels of exposure, vulnerability and risk. Accordingly, different approaches to making the shoreline more resilient will be needed such as seawalls (hard protection), beach nourishment (soft protection), living shorelines (lower energy protection) or managed retreat from the shoreline. In many cases, hybrid approaches may be the most appropriate option. In addition to the built environment, coastal ecosystems are also at various degrees of risk and forward-looking conservation management will need to be developed to protect these natural assets.

4/1/2015	Winter Coastal Storms in a Changing Climate	18
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Kelly Lombardo, Assistant Professor Department of Marine Sciences, UCONN, Avery Point

Heavy precipitation from extratropical cyclones can have tremendous societal impacts along the eastern United States, ranging from heavy snow to inland and coastal flooding. For example, the 8–10 February 2013 blizzard brought more than 30 in. of snow to coastal New York and Connecticut, which led to a loss of power for thousands of northeastern U.S. residents and major disruptions to national airlines. The 7–8 November and 26–27 December 2012 nor'easters created similar damage across the region, with wind gusts as high as 27 m/s in conjunction with snowfall and coastal flooding. This study evaluates future projections in cool season precipitation over two adjacent and topographically varying regions, namely the eastern U.S. coastal plain and the western Atlantic coastal ocean. Precipitation projections associated with cyclones are highlighted and compared to future projections in the cyclone frequency over the regions of interest. Future projections in the frequency of light, moderate, and extreme precipitation events associated with coastal cyclones are presented as well.

4/8/2015	Pathogenic <i>Vibrio parahaemolyticus</i> in Shellfish Growing Areas: An Emerging Hazard	15
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Kristin DeRosia-Banik, Lead Analyst, Shellfish Sanitation Program, Bureau of Aquaculture, Dept. of Agriculture, Milford, CT

Vibrio parahaemolyticus is a naturally occurring marine bacterium in the same family as those that cause cholera and *Vibrio vulnificus* infection. This bacterium lives in brackish saltwater and causes gastrointestinal illness in humans. Prior to 2012, *Vibrio parahaemolyticus* typically caused sporadic food-borne illnesses related to raw molluscan shellfish consumption in the Northeast region of the US. In 2013, the state of Connecticut closed harvest areas associated with illnesses from August 2 to September 17. Illnesses were subsequently determined by serotyping of clinical isolates to be linked to a specific virulent strain of *Vibrio parahaemolyticus*. During 2014, Connecticut's *Vibrio parahaemolyticus* control program managers worked with industry to incorporate more stringent time to temperature requirements in order to minimize the proliferation of this virulent strain of bacteria, and reduce the risk of consumer illness associated with molluscan shellfish. In order to gain a better understanding of *Vibrio parahaemolyticus* levels and their relevance to implementing meaningful *Vibrio* controls in Connecticut growing waters, Connecticut's *Vibrio parahaemolyticus* monitoring plan includes the collection of environmental parameters such as water temperature, air temperature, salinity and depth that may correlate to levels of *Vibrio* bacteria in shellfish. In addition, post-harvest time and temperature controls currently in place as required by Connecticut's *Vibrio parahaemolyticus* Control Plans are evaluated by using continuous temperature data loggers to determine the effectiveness of post-harvest temperature controls and correlating these controls to quantifiable impacts on *Vibrio* levels in shellfish and the associated risk of consumer illness.

4/21/2015 The Future of Floating Forests in a Changing World
Jarret Byrnes, Assistant Professor of Biology
UMASS Boston, MA

Kelp is what we call a 'foundation species'. In ecosystems where it is present (roughly 25% of the world's coastlines!) it is the foundation of the entire ecosystem. It provides food for all manner of herbivores from tiny shrimp to ravenous sea urchins to grazing fish. Speaking of fish, it provides habitat and hiding places for fish and other organisms on the seafloor. It can dampen coastal waves as they sweep in towards shore. And it provides alginate and other ingredients that we find in many household products from cosmetics to ice cream. Loss of kelp forests can have dire consequences for the health, resilience, and productivity of our coastal ecosystems. There is currently no long-term data on kelp canopy changes for most of the globe, so obtaining reliable classifications for any region (South Africa, Tasmania, New Zealand), would be a substantial improvement over our current data. Our ultimate goal would be to obtain global coverage over the entire Landsat time series (1984-present). This time period encompasses vast changes in ocean climate, coastal land-use, and human use of the sea around us. By providing classifications of changes in kelp canopy cover over the past 30 years on global scales, this project will identify regions where kelp forests have experienced significant long-term changes. We will then identify the likely environmental and human drivers of these observed changes.

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 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.

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 all the fish species currently on display in the aquaria.

PerkinElmer, a company headquartered in Massachusetts with a facility in Shelton, CT delivers 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.

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 curriculum, that focus 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

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 (accepted abstract).

S.P. Grace. (Oral Presentation). October 2015. Invited seminar, Rhode Island College Seminar Series in Ecology. "*Growth in intertidal and subtidal populations of the temperate coral *Astrangia poculata**". Providence, Rhode Island.

S.P. Grace. (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

Breslin, V.T. 2015. Microbeads – Macro Problems: The Environmental Consequences of Consumer Plastics in Long Island Sound. 7th Annual Geography Awareness Week Lectures at SCSU. November 19th, 2015. New Haven, CT.

Publications

Ritchie, M. and Tait, J., 2016. Storm Impacts Research: Using SENCER-Modeled Courses to Address Policy. *Science Education and Civic Engagement: An International Journal* (in press).

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. (Participant). 36th Annual Milford Aquaculture Seminar, Courtyard by Marriott, Shelton, CT. January 11-13, 2016.

Tait, J. Association of American Geographers National Meeting, Hilton San Francisco Union Square, San Francisco, CA. March 29-April 2, 2016

Grace, S.P. was invited to become a Co-PI on the KEEN (Kelp Ecosystem Ecology Network), which is a network of researchers examining the effects of global climate change on kelp beds locally in LIS and world-wide. <http://www.kelpecosystems.org/>

Student Theses and Reports/Advisors

Student	Thesis Title	Completion Date
Ryan Orlowski	Dispersal Pattern of Beach Fill Material from a Recent U.S.A.C.O.E. Replenishment Project in West Haven, Connecticut.	May 2016
Sadia Younas	Comparison of Cadmium Concentrations in Long Island Sound Harbor Sediments	May 2016
Cody Edson	Determination of Arsenic Concentration Using Silver Nitrate in Commercially Available Field Test Kits With Digital Image Analysis	May 2016
Todd Massari	Biochemistry of Bio-erosion, Don't Wash Yourself with that Sponge!	May 2016

Grants

Tait, J., 2015. Causation of Chronic Beach Erosion in Connecticut with Implications for Vulnerability to Large Coastal Storms in a Time of Changing Climate, Faculty Creative Activity Research Grant (\$2,500).

Heidkamp, P. and Tait, J., 2015. Masters of Science Program in *Coastal Resilience Assessment and Planning*: A Collaboration between Southern Connecticut State University and Liverpool John Moores University (\$5,000).

Consequences of Navigation Channel Maintenance Dredging on Sediment Quality in New Haven Harbor. Connecticut State University 2015 Research Grant. Project Duration: June 1, 2015– May 30, 2016. PI – V.T. Breslin. Total Funds \$3,750.

Thirteenth Annual Seminar Series on Environmental Issues in Long Island Sound. Southern Connecticut State University Faculty Development Grant. Spring 2016. PIs – V.T. Breslin, S. Grace and J. Tait. Total Funds \$2,500.00.

The Physiology of Dormancy in Temperate Corals. Connecticut State University 2015-2016 Research Grant. Project Duration: July 1, 2015-June 30, 2016. PI- S.P. Grace. Total Funds \$4,127.00.

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.

Outreach

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

Dr. Breslin spoke at a press conference with Senator Christopher Murphy on Friday Oct 16th at 9:45 am where Senator Murphy announced his support of a federal ban on microbeads in consumer cosmetic products.

Additional Microbead news coverage:

The following is a link to a Channel 61 story:

<http://foxct.com/2015/09/28/microbeads-from-cleansers-harming-the-sound/>

The following is a link to a Channel 8 story:

<http://wtnh.com/2015/09/28/common-products-found-to-be-polluting-the-sound/>

The Hartford Courant posted an online piece as part of the paper's Capitol Watch blog.

The following is a link to the Courant article:

<http://www.courant.com/politics/capitol-watch/hc-researchers-document-microbead-pollution-in-new-haven-harbor-20150928-story.html>

James Taits' work examining shoreline beach erosion and the vulnerability of Connecticut beaches to rising sea levels received the following media attention:

The Condition of Connecticut's Coastline and Beaches (WNPR Interview)

<http://wnpr.org/post/condition-connecticuts-coastline-and-beaches>

The threat of coastal flooding due to Global Warming and Sea Level Rise (WTNH News 8 Interview)

<http://wtnh.com/2015/11/11/report-threat-of-coastal-flooding-from-global-warming/>

West Haven Beach Nourishment Project

<http://www.nbcconnecticut.com/news/local/Will-Efforts-to-Protect-West-Haven-Beach-Be-Enough-279365112.html>

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

Undergraduate Research and Creativity Conference

Southern Connecticut State University

Werth Center for Coastal and Marine Studies Participants

March 28th, 2015

Students	Presentation Title
Ryan Orlowski and Dylan Steinberg	Dispersal Pattern of Beach Fill Material from a Recent U.S.A.C.O.E. Replenishment Project in West Haven, Connecticut
Michelle Ritchie and Fatima Cecunjanin	Assessing Coastal Vulnerability in East Haven in the Wake of Irene and Sandy
Kaitlyn Stobierski and Catherine Cota	Beach Stability and Beach Maintenance Options for West Haven, Connecticut
Jeremy Flanders	Variations in Sediment Mercury Contamination in Coastal Embayments Along the Connecticut Coastline
Jihan Hallawa and Samantha Andrews	Comparison of Sediment Arsenic Contamination in an Urban and Suburban Connecticut Coastal Embayment
Hollie Brandstatter	New Haven Harbor Water Quality

VI. Accounting, Budget Expenditures and Grant Writing

Academic Year 2015-2016 Itemized Budget Justification

Funds totaling \$75,000 were requested for Year 10 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 (\$ 7,780 expended)

Werth Foundation funds were used in support of salaries for faculty mentoring students during the Summer 2015. Professors Breslin (\$3,000), Tait (\$2,000) and Grace (\$1,000) 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 \$11,566.

Melisa Krisak was paid an honorarium (\$700) in support of the completion of her thesis research concerning phytoplankton abundance on oyster health and populations. We expect additional funds to be used this Spring 2016 semester in support of a student to assist us with updating the WCCMS website.

Student Research Fellowships (\$29,800 expended)

A major portion of the Center budget consists of funds in support of undergraduate and graduate student summer 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 2015 (10 students; \$14,400), Fall 2015 (9 students; \$8,300) and Spring 2016 (7 students; \$7,100). Fellowship amounts per student ranged from \$400-\$2,000 per semester (40-200 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 Studies, Marine Studies, Earth Sciences, and Honors) in support of faculty-directed research projects during this past year totaling \$29,800.

Permanent Equipment and Service Contracts (\$19,814 expended)

The Werth Center recently purchased a Total Station (\$5,144). A total station is an electronic/optical instrument used in modern surveying. The total station is an electronic theodolite (transit) integrated with an electronic distance meter to read slope distances from the instrument to a particular point. Dr. Tait and his students use this instrument in support of the studies examining beach erosion along the Connecticut coastline. Werth funds (\$1,886) were used to purchase a washer and dryer for use in the field support lab (room 109) and a refrigerator for the aquarium support room (room 111A) in the new science building. Werth Center funds were also

used to purchase an Omano 6x – 45x Trinocular Stereo Microscope equipped with a SK2-10x Digital Microscope Camera. The microscope and camera will be used in support of the microbead studies.

Funds in the service contract budget category (\$11,766) were used to purchase a service contract for fiscal year 2015-2016 for the PerkinElmer AAnalyst 800 Atomic Absorption Spectrophotometer (\$7,416). Werth funds were also used to purchase a one year service contract (2015-2016) for the Milestone DMA 80 Direct Mercury Analyzer (\$4,350).

Ship Time (\$3,000 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 (\$600) were used to charter the R/V *Island Rover*, Sound School, New Haven, CT on 8/28/2015 to collect sediment in New Haven harbor. 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 on October 29 and 30 in support of education cruises for students in MAR 210 Coastal Marine Studies. The R/V *Island Rover* was also chartered on November 6, 2015 in support of a charter for the students of HON 270 Science along the Connecticut Coastline. Sediment samples acquired during this cruise were also analyzed for contaminant metals.

Travel Funds (\$1,991 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. James Tait travel to the Association of American Geographers national meeting in San Francisco in March 2016. Dr. Tait will be presenting a paper entitled Wave Energy Asymmetry, Seawalls and Beach Erosion on a Fetch-Limited Shoreline. Travel costs for this conference will also be supported by an SCSU AAUP contribution of \$1,200. Travel funds were also used in support of Dr. Breslin's participation in the 36th Milford Aquaculture Seminar, Shelton, CT in January 2016.

Publication Costs (\$261 expended)

A total of \$600 was budgeted for publication costs for FY 2015-2016. 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 Long Island Sound Research Conference in May, 2016. Additional funds (\$261.09) were used for printing CCMS student research reports and theses.

Expendable Supplies (\$6,469 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 (\$4,388.49). Additional funds were used for the purchase of chemicals, supplies and reagents for chlorophyll *a* determinations and general office supplies. Supply purchases exceeded the budgeted amount as supply needs were increased due to the move to the new science building.

Balance of Funds

To date, CCMS has expended \$69,115 of the \$75,000 funds budgeted for FY 2015-2016. The majority of the remaining funds will be used to purchase equipment for WCCMS laboratories and field studies. An analytical balance (\$1,900) will be purchased this Spring in support of the sediment metal analyses. Additional funds will be used to support technical assistance with updating the WCCMS website.

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 2015

Tait, J., 2015. Causation of Chronic Beach Erosion in Connecticut with Implications for Vulnerability to Large Coastal Storms in a Time of Changing Climate, Faculty Creative Activity Research Grant (\$2,500).

Heidkamp, P. and Tait, J., 2015. Masters of Science Program in *Coastal Resilience Assessment and Planning*: A Collaboration between Southern Connecticut State University and Liverpool John Moores University (\$5,000).

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Twelfth Annual Seminar Series on Environmental Issues in Long Island Sound. Southern Connecticut State University Faculty Development Grant, Spring 2015. PIs – J. Tait, V. Breslin, and S. Grace. Total Funds: \$2,500.00

