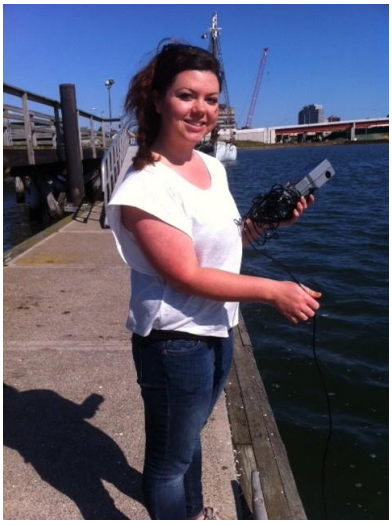
I. Research Projects

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 to19.18 mg/L) at this location also vary with temperature as oxygen solubility in water is a function of water temperature (greater solubility at lower water temperature). Additionally, there have only been three instances (8/16/12; 7/24/13 and 9/11/15) when the dissolved oxygen level measured below the threshold suitable to sustain marine life (3 mg/L). Salinity at this location at high tide varies within a narrow range (9.8 to 30.5 ppt). Water clarity, as measured using a secchi disk, varies from 0.30 to 2.5 meters. Chlorophyll-a concentration measured using UV/Vis spectrophotometry and fluorescence range from 0.13 to 80.6 µg/L. The ranges of these values for these water quality parameters are typical for similar parameters reported for 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

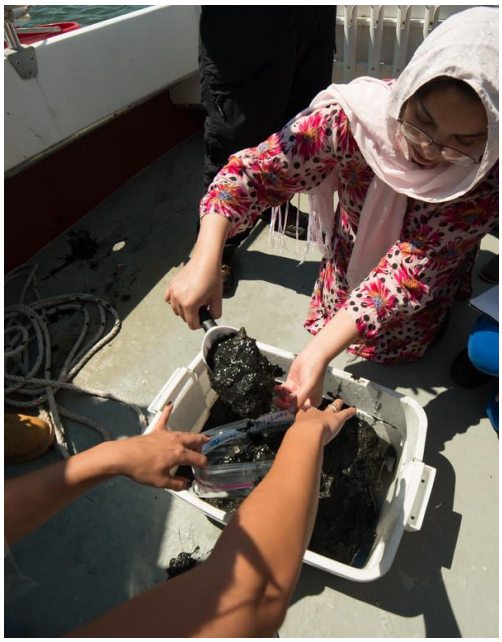
Plastic microbeads (< 5mm) in consumer cosmetic and skin care products bypassing municipal wastewater treatment systems may cause harm to marine ecosystems yet no systematic study has been conducted to confirm their presence in Long Island Sound. New Haven harbor, with two municipal wastewater treatment 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 Orlowski, Undergraduate (Honors College/ Earth Science)
Dylan Steinberg, Undergraduate Student (Earth Science)
Kaelyn Phillps, 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 Phillps, 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.

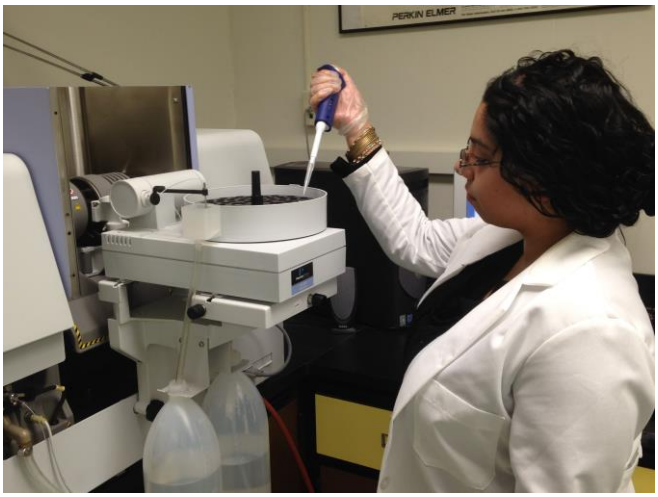
The current research involves testing the scenario above by measuring beach profiles at five Connecticut beaches on a seasonal (four times per year) basis in order to establish the presence or lack of seasonal beach profiles (i.e., does the beach ever accrete and, if so, is there ever full recovery after 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.