I. Research Projects

Assessment of Beach Erosion and Coastal Storm Damage Vulnerability at East Haven and West Haven, CT

Faculty Dr. James Tait
Science Education and Environmental Studies

Student Participants

Summer 2014; Fall 2014; Spring 2015

Catherine Cota, Undergraduate Student, Honors College
Kaitlyn Stobierski, Undergraduate Student, Honors College

Summer 2014; Fall 2014; Spring 2015

Michelle Ritchie, Undergraduate Student, Geography Department
Fatima Cecunjanin, Undergraduate Student, Geography Department

Project Description

Several research initiatives have been initiated in response to the coastal impacts of hurricanes Irene and Sandy. The cities of East Haven and West Haven suffered severe damages to coastal properties are a result of these storms. Research activities include surveying beach profiles in order to assess beach stability (wide beaches were the most common source of protection against storm wave damage), mapping flood plains from the two storms and potential future storms, and

creating coastal vulnerability maps and assessments. This research is being conducted in close liaison with city engineering and public works department to assure maximum usefulness of the data.

Results to Date/Significance

Pre- and post-Sandy profiles and observations pointed out the critical role of beaches in protecting shorelines from storm wave damage. The critical point of impact for Irene in CT was the Cosey Beach area of East Haven. The principle reason for this is that residents of the area had allowed their fronting beach to erode to the point or having no beach at high tide. The presence of a beach, even a relatively small one as it turns out, allows wave energy to be dissipated before interacting with structures such as coastal homes. This research also led to the discovery that Connecticut's beaches are chronically eroding because of a process we has termed *wave energy asymmetry*. Storm waves generated within Long Island Sound have the power to severely erode the beaches on which they break. According to well-accepted models of beach behavior, fair weather swell waves push the eroded sand back onshore and restore the beach. A seasonal pattern of erosion and accretion occurs. In Long Island Sound, there winds lack a sufficient fetch to generate swell waves capable of moving sand back on shore. The progressively eroding beaches eventually leave shoreline structures without the protection of a buffering beach. This research led the publication of a chapter, *Observations of the Influence of Regional Beach Dynamics on the Impacts of Storms Waves on the Connecticut Coast During Hurricanes Irene and Sandy*, in the book Learning from the Impacts of Superstorm Sandy published by Elsevier in November of 2014. The New England District of the U.S. Army Corps of Engineers used our findings to help define a potential coastal resilience project for the Cosey Beach area of East Haven, Connecticut.

Potential Effects of Phytoplankton Abundance and Diversity on the Eastern Oyster, *Crassostrea Virginica*, in Long Island Sound

Faculty Dr. Sean Grace
Biology, SCSU

Student Participant(s)

Summer 2009; Spring 2015

Melissa Krisak, M.S. Biology Thesis Graduate Student

The purpose of this study was to examine factors that relate to abundance and diversity of phytoplankton, including the effects of site, season, temperature, turbidity and salinity and how they relate to phytoplankton abundance throughout Long Island Sound. Abundance and diversity was determined from plankton tow samples, which was examined via microscopy in order to characterize phytoplankton. Other instruments utilized on site were Hobo temperature recorders, a refractometer, and secchi disk. Further phytoplankton abundance analysis took place through the use of flow cytometry from niskin sample collections at the National Marine Fisheries Lab in

Milford, CT. Glycogen analysis of oyster tissue was carried out to determine the effect of phytoplankton abundance as an available energy source. The effects of season and site will be examined with a 2-factor ANOVA, where independent variables equal season and site and the dependent variable is abundance of phytoplankton. The effects of temperature, turbidity and salinity on phytoplankton abundance were also examined with Pearson and/or Spearman correlations.

Results to Date/Significance

Temperature and salinity were found to be well within the oysters' range of tolerance and thus the physical aspects of sites measured could support a re-introduction of oysters. Biologically, the proper phytoplankton species were present in LIS to support a re-introduction of oysters. Though seasonal community changes were observed at each station examined, and variability between stations was influenced by sampling schedule, changing light irradiance, and location each station did have phytoplankton present. However, in terms of food availability this part of the study shows that appropriate plankton were available for oysters during fall 2009 and spring 2010. But, was plankton abundance great enough for oyster survival? At 2 sites examined, (Housatonic and New Haven stations) results of glycogen content were not identical, but were able to support oysters similarly and comparable enough between stations to support oyster populations. In conclusion, support from aquaculture efforts is necessary in order to sustain a harvestable population in an environment with a plentiful food source.

Beach Stability and Maintenance Options for the Town of West Haven

Faculty Dr. James Tait
Science Education and Environmental Studies

Student Participants

Summer 2014; Fall 2014; Spring 2015

Kaitlyn Stobierski, Undergraduate Student, Honors College
Catherine Cota, Undergraduate Student, Honors College
Steve Krozer, Undergraduate Student, Honors College

Project Description

The town of West Haven, CT, has approximately 3.5 miles of public beaches, the largest public beach in the state. The beaches were developed in the 1950's to attract economic development. This development included a U.S. Army Corps of Engineers beach nourishment project. The coast per linear foot at the time was $55.41. The Corps has replenished the beach sand several times. The most recent project was a replenishment of the western beaches in fall of 2014. The cost of the project was $842.22 per linear foot. The cost of future replenishment will only rise and the town is faced with a beach maintenance obligation that has become unsustainable.

In an effort to provide some sustainable options to the town of West Haven, students have measured 22 beach profiles along 3 of the 3.5 miles of town beaches. Profiles were measured in the summer of and in the summer of 2013 and the summer of 2014. Profile data will be analyzed

for changes in beach volume and changes in beach width at various locations along the shoreline. This data will be used to assess the stability of the beaches in various locations.

This assessment will then be used to generate a cost/benefit analysis for beach maintenance. Several options will be presented to the city with difference financial obligations and different levels of benefits. The basic strategy is counter-intuitive. Instead of focusing on beach replenishment for the most erosive and *unstable* beaches, beach maintenance would be focused on the most *stable* beaches. Highly unstable beaches could be allowed to revert to nature. Stable beaches would be the most cost effective to maintain. The other class of beaches that would be important to maintain, even if unstable, are the ones protecting important infrastructure from wave damage.

Student researchers are working in conjunction with the assistant commissioner for public works for the town of West Haven.

Results to Date/Significance

Profile data has been entered into a computer database and is in the process of being analyzed. One of the students, Kaitlyn Stobierski, is doing the cost/benefit analysis and developing the various sustainable beaches options for the town. She is conferencing with the assistant commissioner of public works regularly. Information about the monetary value of infrastructure such as gas lines, sewers, water lines and other infrastructure is currently being gathered.

Water Quality Monitoring in New Haven Harbor

Faculty

Dr. Vincent T. Breslin
Science Education and Environmental Studies
Dr. James Tait
Science Education and Environmental Studies
Dr. Elizabeth Roberts
Biology

Student Participants

Summer 2014; Fall 2014; Spring 2015

Hollie Brandstatter, Undergraduate Student, Marine Studies
Dylan Steinberg, Undergraduate Student, Marine and Environmental Studies
Aubrey Tigno, 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 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.

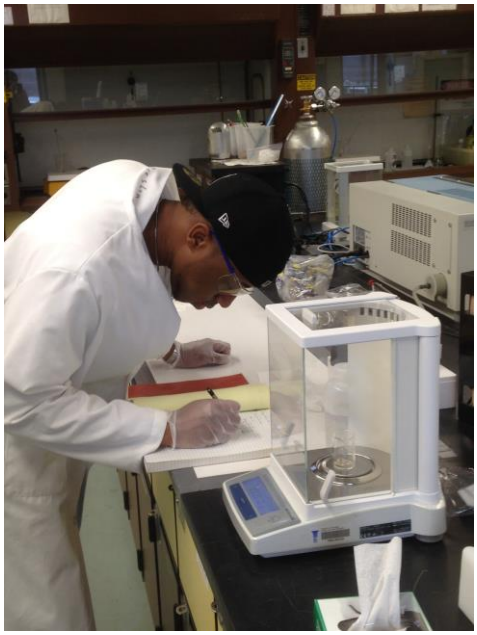
Results to Date/Significance

To date, we have completed three 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 25.2°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 two instances (8/16/12 and 7/24/13) 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 27.2 ppt). Water clarity, as measured using a secchi disk, varies from 0.05 to 2.5 meters. As of March 2015, we have managed to capture this year's spring phytoplankton bloom using chlorophyll-a concentration measurements through UV/Vis spectrophotometry and fluorescence measurements. Currently, our chlorophyll-a concentrations range from 0.62 to 32.2 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 Aubrey Tigno is working with Biology Professor Elizabeth Roberts on determining fecal coliform bacteria concentrations at the Long Wharf pier. The Werth Center recently purchased an IDEXX Quanti-Tray Sealer ($3,938). The Sealer is a motor-driven, heated roller instrument designed to seal IDEXX Quanti-Trays. This Sealer, used with Quanti-Trays and any IDEXX Defined Substrate Technology reagent, automates the sample handling of coliform bacterial enumeration. 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.

Spatial Trends in Sediment Mercury in Connecticut Embayments

Faculty Dr. Vincent T. Breslin
Science Education and Environmental Studies



Student Participants

Summer 2014; Fall 2014; Spring 2015

Jremy Flanders, Undergraduate Student, Chemistry and Marine Studies

Fall 2014; Spring 2015

Jremy Flanders, Undergraduate Student, Chemistry and Marine Studies
Samantha Andrews, Undergraduate Student, Environmental Studies

Harbor sediments, due to the restricted water circulation and the proximity to multiple sources of industrial and municipal wastewater, are often contaminated with metals of environmental concern. Sediment metal contents vary as a function of sediment type and coastal harbors are usually characterized by a variety of sedimentary environments. The presence of contaminated sediment in Connecticut harbors is an issue of concern. WCCMS faculty and students have sampled sediment from 12 Connecticut harbors and embayments over the past decade (2002-2013). Many of the sediment samples collected from these harbors have been analyzed for copper, iron, zinc, loss on ignition and mean grain-size. WCCMS researchers are analyzing these archived sediments for the presence of mercury using the Milestone DMA-80 direct mercury analyzer.

Results to Date/Significance

Sediment mercury concentrations have been determined on archived samples for Black Rock, New Haven, Stamford, Clinton, and Milford harbors (2013). This past year analyses have focused on mercury determinations on sediment samples collected from Mystic and Stonington harbors (2014). Mercury determinations have now been completed for 12 Connecticut harbors and Jremy Flanders is writing the results of these measurements in his Chemistry Department Honors Thesis. Jremy is examining the spatial distribution of mercury in CT harbors and the physical and chemical factors controlling the distribution of mercury in sediment.

Analysis of the Dispersement Pattern of Beach Fill Material on West Haven Beaches

Faculty Dr. James Tait
Science Education and Environmental Studies

Student Participants

Fall 2014; Spring 2015

Ryan Orlowski, Undergraduate Student, Earth Science Student
Dylan Steinberg, Undergraduate Student, Earth Science Student

Project Description

The town of West Haven is faced with the problem of maintaining 3.5 miles of public beaches on a chronically eroding coast with the cost of beach replenishment nearing $1,000 per linear foot. This is clearly unsustainable. Knowledge of sediment transport or dispersal patterns is key for making sound management decisions. In other words, if the beaches are eroding, where is the sand going? And if this is known, would it be possible to reclaim that sand?

In fall of 2014, the U.S. Army Corps of Engineers sponsored a beach replenishment project on 4,500 feet of West Haven's western most beaches. The cost of the project was $3.79 million. Replenishment projects are typically built with the expectation that there will be a period of fairly rapid erosion and the beach attains its equilibrium profile. This research involves measuring beach profiles of the project and in areas adjacent to the project in both the alongshore and offshore direction. Movement of sand will be determined using conservation of mass. Loss of sand in one area shown by profile lowering should be accompanied by profile growth in another area. For the Werth Center for Coastal and Marine Studies, this represents a fortuitous $3.79 million experiment.

Results to Date/Significance

Preliminary profile measurement are being taken.

Spatial Trends in Sediment Metals in Mystic and Stonington Harbors

Faculty Dr. Vincent T. Breslin
Science Education and Environmental Studies

Student Participants

Summer 2014

Jihan Hallawa, Undergraduate Student, Chemistry
Jremy Flanders, Undergraduate Student, Chemistry and Marine Studies

Fall 2014; Spring 2015

Jihan Hallawa, Undergraduate Student, Chemistry
Jremy Flanders, Undergraduate Student, Chemistry and Marine Studies
Samantha Andrews, Undergraduate Student, Environmental Studies

The objective of this study is to conduct a high spatial resolution sampling of Mystic and Stonington harbors in eastern Long Island Sound to determine levels of sediment metal contamination. This study examines the sediment composition and physical characteristics (grain size, and loss on ignition) at predetermined stations throughout each harbor. This study will also analyze the sediment for metals including iron, copper, zinc, mercury and manganese. Results of this study will be compared to the results which have been found in previous studies. Sediment metals will be compared to their respective crustal abundances to determine the extent of contamination due to anthropogenic discharges. The sediment metal concentrations will be compared to previously published sediment quality guidelines to determine if sediment metal concentrations are causing harm to living marine resources.

Results to date/Significance

Sediment samples were collected from 19 stations in Mystic harbor and 12 stations in Stonington harbor during July/August 2014. The Mystic harbor sediment samples have been examined for physical characteristics (predominant grain size, LOI) and digested for metal analyses. The Stonington harbor sediment samples are currently archived frozen awaiting analysis. Both Jihan Hallawa and Jremy Flanders are using results from Mystic harbor analyses in support of their respective Chemistry Department Honors Theses in May 2015.

The Effects of Dormancy on Competition Outcomes between Marine Sessile Invertebrates

Faculty Dr. Sean Grace
Biology, SCSU

Student Participant(s)

Summer 2014; Fall 2014; Spring 2015

Gabrielle Corradino, Biology, Graduate Student

Research suggests that the temperate coral *Astrangia poculata* is overgrown during the winter months by other marine invertebrates because this coral species undergoes dormancy (hibernation). The suggestion is being investigated for the first time in situ by tagging (aluminum tree tags) and following the competitive outcomes of 30 *A. poculata* colonies both in the intertidal (Bass Rock, Narragansett, RI) and subtidal (Fort Wetherill, Jamestown, RI) through the winter months (2013-2015). Using SCUBA, bi-monthly examinations of these interactions are taking place.

Results to Date/Significance

Results to date (February 2015) demonstrate that no overgrowth occurred in either intertidal or subtidal studies examining the competitive interactions between corals and 'other encrusting invertebrates'. Results also show that intertidal colonies go into and get out of the diapause state sooner than subtidal colonies. All corals survived and increased in size (based on polyp number). Dormancy was further examined with laboratory studies designed to determine the temperature on which dormancy commenced and when corals became non-dormant. Results show that all corals can survive for up to 5 days in ice (once thawed). Results of this study were presented at *The 51st Annual Conference of the Animal Behavior Society* in August 2014 at Princeton, NJ. Presentation was entitled: Dormancy Behavior in Intertidal and Subtidal Populations of *Astrangia poculata* with Gabrielle Corradino. Also, results are currently being written up as a Master's thesis for Gabrielle Corradino (expected graduation May 2015) and publication in the international journal Coral Reefs.

Effects of water flow on the capture ability of the temperate coral *Astrangia poculata*

Faculty Dr. Sean Grace
Biology, SCSU

Student Participant(s)

Fall 2014, Spring 2015
Sarah Koerner, Biology, Undergraduate Student (Biology Honors Major)

Recent work suggests that water flow is important in explaining many aspects of a sessile organism's ecology and physiology. Small, sessile aquatic organisms like corals, anemones and sponges carry on simple respiration, in which dissolved oxygen diffuses into their cells from the surrounding water and carbon dioxide diffuses out of their cells back into the water, so that no specialized respiratory structures are needed. In addition to renewal of essential gases, water flow and mixing provide a continuous supply of nutrients and prey which allows some animals (for example, anthozoans like anemones, corals and hydroids) to feed as passive suspension feeders. Though this may appear to be an ideal feeding mechanism energetically, it has clear mechanical constraints. When water flow is very high, holding structures such as tentacles into the flow to capture prey may be difficult or impossible and polyps may collapse because of the water strain. Laboratory studies will be designed to determine the relative importance of water flow on the feeding biology of *A. poculata*. Laboratory experiments will be completed in a recirculating flume, (Vogel style racetrack flume) powered by a 3hp trolling motor.

Results to Date/Significance

Sarah has completed all preliminary flume runs to properly characterize the flow in and around coral colonies. She has decided on flow speeds that are similar to those experienced in nature and is currently waiting to collect more corals via SCUBA to initiate the feeding studies. Sarah is expected to complete the study by March 2015 and present this to the department and her Honor's Colloquium during the spring 2015 semester.