I. Research Projects

<u>Water Quality Monitoring in New Haven Harbor</u>

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

Student Participants

Summer 2019; Fall 2019; Spring 2020

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

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

Results to Date/Significance

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

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

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

Student Participants

Summer 2019; Fall 2019; Spring 2020

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

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

Volunteers

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

Project Description

Ongoing multi-year research focused on testing for seasonal beach profiles on the Connecticut coast has been concluded with documentation of the lack of any significant seasonal beach profiles on five beaches that span the length of the Connecticut shoreline. The beaches include Sherwood Island State Park, Bayview Beach in Milford, Hammonasset Beach State Park, Rocky Neck State Park, and Ocean Beach in New London. Previous studies by Werth Center researchers have pointed to lack of energy in the fair-weather wave field as being responsible for chronic erosion of Connecticut beaches and exposing coastal structures and infrastructure to damages. Geomorphic evidence for such a hypothesis is the absence of shoreward transport of sediment resulting in beach profile rebuilding. In other words, there is a lack of seasonal beach profiles. This non-textbook behavior of Connecticut beaches calls for commensurate adjustments in Connecticut's coastal management policies. Current policies have been examined and recommendations for policy changes that enhance adaptive capacity have been articulated by Ms. Mercaldi.

Results to Date/Significance

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

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

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

More specific recommendations include:

- Increasing the importance of beach maintenance as an integral part of building coastal resilience,
- Passing legislation in the Connecticut General Assembly to incentivize the regular maintenance of beaches by coastal communities,
- Creating 5-year permits allowing coastal communities to manage their sediments with expedited approval from the DEEP,
- Focusing beach monitoring around periods associated with large storms because the current research suggests that profile change (e.g., beach width and volume) under other conditions is largely static.

WCCMS Aquarium Operations and Animal Husbandry

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

Student Participants

Summer 2019; Fall 2019; Spring 2020

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

Fall 2019; Spring 2020

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

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

Results to date/Significance

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

We renewed our Institutional Animal Care and Use Committee (IACUC) certification during the spring 2019. The IACUC certification is required for the use of mummichog fish in our coastal marine studies courses (MAR 210). The IACUC certification also informs our oversight of the water quality and the health of the fish in the display tanks. We have also added four of the students working in the aquarium lab to the protocol. The students had to pass several exams on fish handling and laboratory regulations and oversight to qualify for listing on the protocol. We have added a 270-gallon aquarium to the aquarium lab 11lA to house approximately 100 mummichogs for use in our marine studies courses. We also renewed our CT DEEP Specimen Collection Permit (6/1/2019-5/31/2022) allowing our students to continue to collect invertebrates and fish from local habitats.

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

Macroalgae as Bioindicators for Mercury Contamination in Long Island Sound

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

Student Participants

Summer 2019; Fall 2019; Spring 2020

Cassandra Bhageloo, Undergraduate Student (Chemistry)

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

This study focused on determining the mercury content of seven species of macroalgae including green *(Viva lactuca, Codium fragile),* brown *(Fucus vesiculosus, Fucus distichus)* and red *(Chondrus crispus, Grateloupia turutura, Graci/aria tikvahiae)* algae sampled from seven locations (Stamford to Westbrook) in fall 2017 along the Connecticut shoreline. Freeze-dried algae tissue samples (0.100-0.250 g) were analyzed directly for mercury by thermal decomposition amalgamation and atomic absorption spectrophotometry using a Milestone DMA-80 direct mercury analyzer.

Results to Date/Significance

Results showed that macroalgal tissue mercury concentrations varied by species but no significant west to east trends in algal tissue mercury were observed. Mercury concentrations were typically lowest in green algae species, intermediate in red algae species and highest in brown algae species. Graduate student Cassandra Bhageloo recently completed her MS thesis proposal and will expand her studies to include sugar kelp *(Saccharina latissima),* an important algae in the emerging aquaculture industry in LIS. This study is designed to address the following research questions: (1) Are there differences in mercury concentrations in kelp sampled from native New England kelp beds and kelp aquacultured from regional LIS aquaculture farms? (2) Does kelp mercury concentration vary during the growing season? (3) Are aquaculture kelp mercury concentrations lower than the pending CT safe consumption level of0.l mg/kg? and (4) Are temporal variations noted in mercury concentrations ofrepresentative species of algae sampled from the same LIS locations as 20177 Addressing these questions will aid in understanding how water quality in LIS may affect the regional algal aquaculture industry.

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

Faculty Dr. Meghan Barboza
Biology

Student Participant(s)

Summer2019

Gabriella Restrepo, Undergraduate, Biology

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

Results to date/Significance

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

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

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

Student Participant

Summer 2019; Fall 2019; Spring 2020

Renee Chabot, Undergraduate, Chemistry

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

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

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

Results to Date/Significance

Sediment metal contamination (copper, zinc, and mercury) for the Norwalk river area is particularly high around the Walk bridge. Contaminant point sources include the sewage treatment plant, the highway (195), the marinas, and the abandoned landfill. Furthermore, contaminated metals in sediment tended to co-vary. Where copper concentration was high, zinc and mercury concentration were also high. Mercury is extremely high, ranging from 0.248-1.17 mg/kg, while copper exceeds 100 mg/kg. In comparison, sediment metals in the outer harbor are presently at or slightly above their crustal (natural) abundance, which is 0.06 mg/kg for mercury and 25 mg/kg copper. These high metal concentrations in the river directly correlate to the presence of silt-to-clay grain-size of the sediment. This is important because once construction on the bridge starts, these fine sediment grains may be resuspended into the river water and may be transported downstream. The river is tidal influenced, so sediment can flow both north and south in the river away from the construction site, affecting marine life and estuary habitats.

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

Subtidal Recruitment and Settlement of the Temperate Scleractinian Coral *Astrangia pocu/ata*

Faculty Dr. Sean Grace
Biology

Student Participant(s)

Academic Year 2015, 2016, 2017, 2018, 2019

Gabriella DiPreta, Biology, Graduate Student

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

Results to Date/Significance

In summer 2017, terra-cota tiles have been placed in situ at 12 m depth at Fort Wetherill. Tiles have been secured to the horizontal and vertical substrate with z-spar (splash zone compound). At monthly intervals, the tiles have been photographed and all species settling on the tiles identified to species. Additionally, temperature measurements have been made in situ using Onset Hobo-temp recorders set to record temperature at 5 minute intervals from the initiation of the study till the end of the student (December 2018). Gabriella has collected all data and is currently writing her MS thesis. She has analyzed all videos and pictures and developed an underwater lighting system (that she wrote code for) to investigate coral behaviors and is currently writing. Gabriella's research resulted in the first ever examination of community development on the northern range of the mid-Atlantic bight. Fine macroalgae settle first, then bryozoans, tunicates, and sponges make up a majority of the successional community structure. Gabriella defended her MS thesis in April 2019 and is currently writing up the results for publication in the Journal of Experimental Marine Biology and Ecology.

GIS Maps of Connecticut Coastal Harbor Sediment Metal Contamination

Faculty

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

Student Participant

Summer 2019; Fall 2019; Spring 2020

Ethan Mehlin, Undergraduate, Geography

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

sample in a harbor and the use of GIS software to prepare contour maps showing the trends of sediment physical and chemical properties within each harbor.

Results to Date/Significance

Sediment metal concentrations and physical properties (grain-size and loss on ignition) were mapped in ArcMap 10.5.1 according to categories defined using sediment quality guidelines and known sediment grain-size categories. These points were analyzed using inverse distance weighting, resulting in maps that were then edited in Arcmap to have the same color scheme and comparable scale categories. Each parameter scale was created with seven or eight categories; the highest range for metals was defined by the Effects Range Median for each respective metal while the lowest category was equal to or less than each metals' respective crustal abundance. These maps can be useful in identifying areas within harbors for shellfish habitat restoration/expansion, identifying areas of concern for dredging projects, inform harbor development activities, and highlight areas of concern for sediment resuspension (storm events).

Coastal Vulncnbility to Storm Wave Impacts and Recommendations for Enhancing Resilience

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

Student Participants

Spring 2020

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

Project Description

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

Results to Date/Significance

This research has just recently begun. At present, we have been examining the impacts that large storms have had on various coastal communities, steps that different coastal communities have taken to improve their resilience, and our assessment of current vulnerabilities including beach dimensions, shoreline urbanization, and coastal infrastructure. We are also looking at steps that organizations such as the Connecticut Institute for Resilience and Climate Adaptation, the CT Department of Energy and Environmental Protection and the Nature Conservancy have taken.

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

Faculty

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

Student Participant

Summer 2019; Fall 2019; Spring 2020

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

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

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

Results to Date/Significance

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

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

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

Faculty

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

Student Participant

Fall 2019; Spring 2020

Maeve Rourke, Undergraduate, Environment, Geography and Marine Sciences

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

Results to Date/Significance

Atlantic herring (30 fish) were obtained from the Maritime Aquarium at Norwalk for use in this study. Maeve Rourke has developed dissection protocols to remove the alimentary canal (esophagus, stomach, intestines and pyloric caeca) from each fish. The dissected fish tissues (gills and digestive tract) are digested separately using 70% nitric acid according to Claessens et al. 2013). The digest solutions are then vacuum filtered through a 0.4 µm nitrocellulose membrane to isolate any microplastic particles. To date, 20 herring have been dissected to remove the gills and digestive tract. Acid digestions of the herring digestive tracts are in progress. Microplastic particles will be counted and categorized (film, fiber, bead) using a dissecting microscope equipped with a digital camera (Troupview software) at 45x magnification. Maeve Rourke has applied for an Undergraduate Summer Research grant ($3,000) for summer 2020 to expand her research to include menhaden. Menhaden are an important species in the food chain in Long Island Sound and also feed on plankton in the water column.

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

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

Student Participants

Summer 2019, Fall 2019 and Spring 2020

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Lead Researcher, Hammonasset Beach State Park

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

Volunteers

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

Project Description

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

The beach replenishment assessment was part of a larger project concerned with developing a beach sediment management plan for Hammonasset Beach State Beach, based in part, on observations of sediment erosion, deposition and transport. The object of this research was to find a sustainable alternative for addressing beach erosion problems at Hammonasset that could ultimately be exported to other state beaches. The basic plan was to use 27 beach profiles distributed along the length of the beach to 1) measure the volumes of sand and the beach width, 2) measure erosion, deposition, and infer transport pathways, and 3) articulate a plan that can be used by the CT DEEP (the agency that manages the park) to address erosion problems. To put it simply, the basic strategy is to monitor beach erosion, determine where the sand goes and to put it back. This is the essence of *sand management* and *reclamation.*

Results to Date/Significance

There were a number of issues with the C.O.E. replenishment. The most salient was cost. For example, *approximately two thirds of the $9 million consisted of the cost of transporting the sand by barge 33 miles from its source at the mouth of the Housatonic to the beach at Hammonasset.* In terms of the larger beach as a whole, there was a mixture of erosion and accretion of individual profiles both in terms of beach width and beach volume. Individual profiles could accrete during some periods between surveys and erode during others. There are two principal mechanisms by which erosion or accretion at an individual profile can occur, cross-shore transport and alongshore transport. If gradients in littoral drift are considered to be the sole driver of accretion and erosion, then gains and losses along the beach, should sum to zero in order to conserve mass. Since there is a net erosion of 347, 180 m3, it is assumed, given that losses to the dunes are minimum, that this volume of eroded sediment is lost offshore.
While this amount appears to be a reasonable estimate of net offshore losses during the period of the study, the timing and exact location of offshore losses is not known.

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