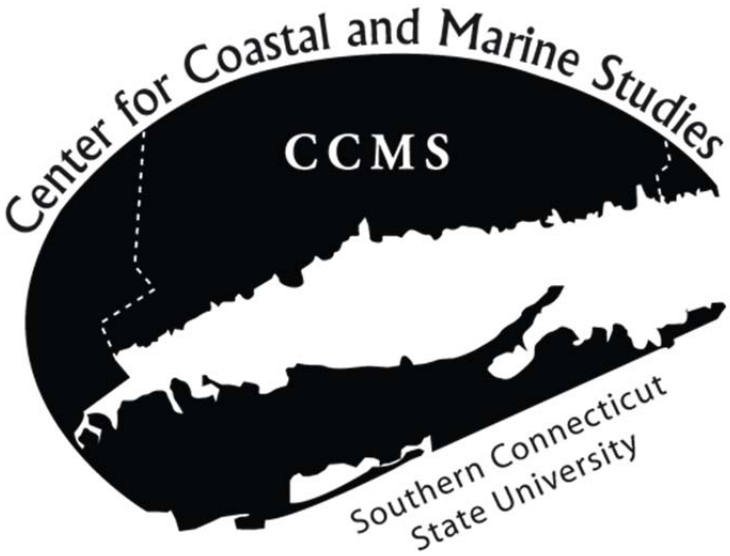
Southern Connecticut State University

Center for Coastal and Marine Studies



CCMS Annual Report 2010-2011

Prepared by:

Vincent T. Breslin, Professor
Science Education and Environmental Studies

Dwight Smith, Professor
Biology

James Tait, Associate Professor
Science Education and Environmental Studies

Sean Grace, Associate Professor
Biology

Prepared for:

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CCMS Annual Benchmark/Evaluation Report 2010-2011

Each year the participating faculty of the CCMS 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 CCMS Annual Report will be completed and submitted to the Werth Family Foundation during February of each year. Contents of the CCMS 2010-2011 Annual Report are described below.

I. Research Projects

Student and faculty research projects conducted each year are a central focus of the center. This year (2010-2011), CCMS participating faculty were involved in laboratory and field research programs involving ten undergraduate and graduate SCSU students. A complete description of 2010 initiated and ongoing research projects are described below.

US Department of Agriculture Grant 2011-2013

The Connecticut Oyster Fishery: A Research and Education Collaboration

Principal Investigators:

Vincent Breslin, SCSU
Scott Graves, SCSU
James Tait, SCSU
Susan Cusato, SCSU
Dwight Smith, SCSU
John Roy, Sound School, New Haven
Joseph Schnierlein, Norwalk Maritime Aquarium

The SCSU Center for Coastal and Marine Studies (CCMS) initiated a study in 2008 (termed September 2010) to examine the changes occurring in LIS which may affect the reestablishment and long-term viability of the Connecticut oyster industry. The initial federal USDA research grant established collaborative relationships with faculty and personnel from The Sound School Aquaculture Vocational School in New Haven, the Maritime Aquarium in Norwalk, CCSU, WCSU, Wesleyan University, the CT Bureau of Agriculture, Dept. of Aquaculture and the Milford Shellfish Laboratory. Important outcomes of the initial grant include: (1) The chemical (sediment metals, water quality), physical (sediment grain size, loss on ignition) and biological characterization (oyster condition, oyster pathology, nutrition, and phytoplankton composition) of thirteen separate commercial and recreational oyster beds from Norwalk in western CT to New London in eastern CT was completed. (2) The oyster research project supported four graduate MS theses, three undergraduate Honors theses, and five undergraduate student research projects (Directed Studies). (3) Results of the study have been disseminated via conference participation and proceedings (Milford Shellfish Meetings, CSU Research Conferences and the Long Island Sound Research Conference) and publications (Theses, and outreach efforts; i.e. a special issue of The Dredge, a publication specifically targeted to the oyster industry).

During 2010, CCMS researchers developed a second collaborative effort involving the Maritime Aquarium at Norwalk and the Sound School Aquaculture Vocational School to further study issues of importance to the Connecticut oyster industry. The proposed two-year (2011-2013) $360,000 collaborative project will be submitted this year to the US Department of Agriculture for consideration for funding.

Project Goals

A primary objective of this research is to continue to assess the extent and quality of current oyster habitat (particular emphasis on New Haven and Norwalk harbors, public and private leased beds) and to identify new (underutilized) areas along the CT coast that may also provide suitable oyster habitat. It is also clear that further analyses of oyster tissue mercury and cadmium concentrations are necessary, particularly in estuarine environments, to assure consumers of the low risk of oyster consumption. Results of this task will more clearly elucidate the relationship between ambient salinity and cadmium, copper and zinc oyster tissue contents for LIS oysters

CCMS studies regarding pathological conditions and the presence of heavy metals in Long Island Sound oysters revealed several cosmopolitan pathological changes including edema, ceroidosis, circulatory system disorders and granulomas in heart tissue. The evidence that the presence of metals in the environment at each site or in the tissues of the oysters sampled was the causative agent of the pathological responses is still unclear and more investigation will be necessary to answer this question with any certainty. Anticipated outcomes from this effort include a clearer understanding of the relationships between contaminated sites and specific pathological changes related to contaminants at those sites and the establishment of a pathobiology laboratory at the Sound School to support a cooperative learning partnership with SCSU students through ongoing research regarding environmental contaminates and their associated biological effects.

The American Oystercatcher is a bird of coastal beaches and tidal flats where it alternates between resting and searching for shellfish such as oysters, clams, and scallops. The potential impact of this oyster predator has been much debated. However, data of any kind regarding the effect of oystercatchers on local oyster populations is lacking. This proposed study will: (1) document both breeding and migratory distribution of Oystercatchers in the Long Island Sound area, (2) document their nesting ecology and productivity and (3) determine their diet and foraging activity with respect to oysters and other shellfish.

Finally, CCMS faculty and students will design and develop a series of three 15 minute videos as well as at least one longer documentary developed around the Connecticut oyster, its habitat, and changes over time. The video series will provide a unique set of multimedia including short (15 min.) to long (40-50 min.) documentary-style films, deliverable over the web as well as in DVD format, that cover a variety of oyster research topics. Cast and crew for these documentaries will be those involved in the research, commerce, as well as in the teaching professions associated with LIS oyster ecology.

Quantifying the Relationship between Metal Concentration, Grain Size, and Sediment Organic Content

Faculty Dr. James Tait
Science Education and Environmental Studies, SCSU

Student Participants

Summer/Fall 2010; Spring 2011

Nikita Peperni, Undergraduate Student, Marine and Environmental Studies
Charles Nixon, Undergraduate Student, Honors College
Karen Thomas, Undergraduate Student, Biology and Marine Studies

Project Description

Previous research has shown a direct correlation between heavy metal concentration and loss-on-ignition (LOI), a proxy for organic content, in sediment samples. It has also shown an inverse correlation to sediment grain size. Using sediment copper concentrations, grain size data, and loss-on-ignition (organics content) data, a multivariate linear model was created that allowed prediction of copper concentration at sample stations from grain size and loss-on-ignition data alone.

The importance of other possible controlling factors, such as proximity to a current or historical source for copper, can be examined using the *residuals* of the model, i.e., the difference between the model predictions and the actual observed copper concentration values. In this study, samples in which the observed value is significantly larger than the value predicted value are defined as *hot spots*. A hot spot indicates that grain size and organic content are insufficient to explain the copper concentration. Such a hot spot might indicate a nearby source of copper.

Results to Date/Significance

The application of a simple model to copper concentrations sampled from Norwalk harbor produced promising results. The observed copper concentrations and the copper concentrations predicted by the model were mapped using spherical interpolation techniques. The similarity between the two maps is visually striking. Statistically speaking, correlation between model and observations of copper concentrations had a correlation coefficient ("r") of 0.812, indicating "strong" correlation.

This research is still in the data gathering and early analysis stage. A proposal has been submitted for a CSU research grant to gather additional data and to refine the simple model that has been created. Dr. Raymond Mugno, a statistician in Southern's Mathematics Department is a co-PI on the proposal. Dr. Mugno has done applied mathematics for the Brookhaven National Laboratory and received his PhD from Stony Brook. We hope to have publishable results by 2012. We have also applied for additional support for undergraduate students. The results will increase the scientific understanding of the spatial controls on sediment metal contamination.

Initial results were presented in a talk at the Long Island Sound Research Conference, UCONN Stamford, Fall 2010.

Characterization of Nearshore Benthic Habitats

Faculty Dr. James Tait
Science Education and Environmental Studies, SCSU

Student Participant(s)

Summer/Fall 2010; Spring 2011

Nikita Peperni, Undergraduate Student, Marine and Environmental Studies
Charles Nixon, Undergraduate Student, Honors College
Karen Thomas, Undergraduate Student, Biology and Marine Studies

Project Description

Two primary goals in this habitat characterization study. Identifying the sedimentary environment conducive to oyster aquaculture in terms of sediment grain size, and current strength is one of them. Another is determining whether sediments have the potential for sequestering high concentrations of heavy metals that could enter the food chain via oyster bioaccumulation. Generally speaking, oysters prefer sandy bottoms (or accumulations of oyster shells) and heavy metals are preferentially sequestered in muds. Two methods are used in conducting benthic habitat surveys. One is grab sampling from a ship or boat and subsequent grain size analysis using laser diffraction which allows for rapid analysis of numerous samples. The other is the use of side-scanning sonar and correlation of sonogram reflectivity with physical sediment samples obtained from the same area. Coarse-grained sediments are much more reflective and fine-grained sediments are more absorbent of the energy produced by the sonar. This difference is visually portrayed in the side scan record as variations in gray-scale.

Results to Date/Significance

Cruises were conducted in the summer of 2009 at Norwalk, Bridgeport, the Housatonic Estuary, and New Haven. Side-scanning sonar data and sediment samples were obtained at each location. Sediment grain size analysis is being performed by students at Southern. The analysis is being performed using a Horiba LA-950 particle size analyzer. Results of the grain size analysis are being combined with data collected by Breslin and others on sediment metal concentrations and with data on the organic content of the sediments. These combined data sets are beginning to be spatially referenced using GIS maps. A very large set of samples have been collected for Norwalk, Bridgeport and the Housatonic Estuary, New Haven Harbor, and East Haven. Completion of this project will most likely require another two years of effort but will produce some valuable benthic environment maps. These maps will be carefully compared with side scan sonar data to determine how effective side scan might be in mapping grain size based on differences in sediment reflectivity. Results to date were presented in a talk at the CSU Research Conference at the CCSU Campus, New Britain, Spring 2010.

Causes and Remediation of Chronic Beach Erosion at Hammonasset Beach State Park

Faculty Dr. James Tait
Science Education and Environmental Studies, SCSU

Student Participant(s)

Fall 2010; Spring 2011

Mary LaVallee, Undergraduate Student, Chemistry and Marine Studies

Project Description

Beach and dune erosion has been an issue at Hammonasset since the 1920's. Erosion is particularly intense along the west end of the park. Current thinking is that beach sand is being carried to the east end of the 2-mile beach from the west end of the beach by tidal currents. Based on preliminary studies, we believe this is incorrect and that most of the eroded beach sand has been carried offshore and deposited in low, broad underwater bars. We intend to test this hypothesis by surveying beach and nearshore topography using a total station (laser-based surveying instrument).

Results to Date/Significance

A total station was acquired via successful application for a CSU research grant ($5,000). We have examined the study area via aerial photos and have determined the locations for cross-shore transects to be surveyed in order to determine the volume and other dimensions of the offshore sand bars. We have also set up a liaison with Mr. John Hine, superintendent of Hammonasset State Beach.

We will begin our actual surveys in the late spring and summer. They will consist of approximately 30-40 beach and bar profiles. We will calculate volume of the sand in the bars using the end-area method, and then compare this number with beach erosion volumes. Connecticut is fundamentally an erosional coast due to the combination of moderately severe winter storms and a low energy fair-weather wave field. The beaches erode via large storm waves. The very small waves associated with non-storm conditions, however, lack the energy to return the sand to the shore. It is our hypothesis that simple beach-based dredging operations could return eroded sand to the beach at the end of each winter before the park opens at a minimal cost to the taxpayer.

Behaviors and Behavioral Ecology of the Monk Parakeet in Connecticut: Constructing an Ethogram and Ecology for this Species

Distribution and Abundance and Abundance of Monk Parakeet Colonies in Connecticut. Monk Parakeet Nests, Renestings, and Nest Associates

Monk Parakeets: Impact on Urban Habitats and Competition with Urban Species

Faculty Dwight Smith
Biology, SCSU

Student Participant(s) **Summer/Fall 2010**

Jocelyn Hallet, Undergraduate Student, Biology
Bonnie Ponte, Undergraduate Student, Biology

Spring 2011

Beth Patrizzi, Graduate Student, Biology

Project Descriptions

Monk Parakeet research has continued during the year on a variety of subjects. First, we have continued and extended our study of movement behaviors, movement distance, and movement purpose from nest sites to feeding sites at Hammonasset Beach State Park in Madison, Connecticut. This site was chosen because of its openness and ease of following the individual parakeets on their foraging rounds and sometimes over considerable distances. This work is fundamental to our framed goal of understanding biology and ecological dynamics of an invasive species, the monk parakeet in Connecticut and elsewhere in the Northeast. Second, we have continued to analyze the data we have collected over the past 4 years in the preparation of publications. While some have already appeared in print and have been included in previous reports we attach a new manuscript which has been submitted for publication entitled "Nest building of introduced monk parakeets (*Myiopsitta monachus monachus*) in Connecticut, United States."

Results to date/Significance

Data was collected via direct surveillance using snapshot focal sampling regimen to obtain an unbiased estimate of time activity behaviors and the frequency of these behaviors. We also used video photography to photo document both frequency and details of behaviors. By the end of the summer study we accumulated a film library consisting of hundreds of hours of monk parakeet activities filmed at all times of day and under all weather conditions. Our current focus is to digitize these video clips to permit detailed analysis and reconstruction of each behavior. These can then be reviewed and summarized to provide an accurate baseline model of the timing, sequence, and architecture of each behavior in the explicit context (e.g., time of day, biotic and abiotic components) and purpose associated with each behavior. This information is being used to construct the first ethogram (a catalog of behaviors) for this species. It is anticipated that the

completed catalog will serve as the standard reference dictionary for this species and provide the reference base for all future studies of monk parakeets.

Monk Parakeet Study Results II

Monk Parakeet nest site construction activities were observed across their range in southern Connecticut, from Greenwich and Stamford in the Southwest to Old Saybrook and Mystic in the extreme southeastern part of the state. These observations included detailed descriptions of nest construction activities, twigs used, location and types of twigs used, impact, if any, of twig removal for nest construction, and use of nest by other species. Information was obtained from no fewer than 208 nests during the last two years. All information regarding nests and twigs has been and is being entered on Excel files for future reference. Information processing to date has revealed that Monk Parakeets provide both nest substrate materials and also nesting sites for a number of other urban and suburban species including Mourning Dove, Great Horned Owl, Song Sparrow, House Finch, Starling, and Blue Jay. These results suggest that this invasive species is in many ways serves a beneficial function for urban wildlife. Several papers are currently being prepared for publication based on these results.

Oyster Education Outreach: Curricula Development

Faculty Dwight Smith
Biology, SCSU

Student Participant(s) **Summer 2010**

Melissa Krisak, Graduate Student, Biology

Project Description

While most think of oysters as succulent components in delicious seafood meals, the oyster is also extremely important to our ecosystem. Due to their enormous water filtering capabilities, oysters maintain healthier water ecosystems. Oysters provide shelter for marine organisms, enriching the diversity of biota in a given water system. Also, oysters play a vital economic role in the region by providing a fishery and food source for humans. Connecticut's native oyster, *Crassostrea virginica*, often called the Eastern, American, or Atlantic oyster, played an important economic role in Connecticut's history as a lucrative export product. Oysters were once so abundant that millions of bushels of oysters were able to be harvested each year to maintain the market demand. Today, the oyster is less abundant due to overfishing, increased water pollutants, and diseases, some either introduced by human transport or disruption of the oyster's marine habitat. The goal of this project will be to develop curriculum materials, linked to Connecticut education standards and learning outcomes, concerning the environmental, social and economic importance of the eastern oyster.

Results to date/Significance

The developed oyster curriculum allows students to explore the economic and environmental importance of the Eastern oyster to Connecticut and Long Island Sound. The Curriculum is aligned with National and Connecticut Standards and includes the following topics:

What are Oysters?
Oyster Kin
Oyster Environments
Ecological Role of Oysters
Oyster Predators and Competitors
Local and Global History of Oyster Consumption
Celebrating the Oyster: Oyster Festivals around the World
Harvesting and Over-Harvesting the Oyster Fishery
Oyster Farming
Future Oyster Management Strategies

The curriculum was presented at the South Eastern New England Marine Educators Conference in October of 2010. This was to create awareness of the curriculums upcoming availability amongst educators and to gather feedback from educators' view points. An excerpt of the curriculum was published in the Connecticut Journal of Science Education, Volume 48, No. 1. The final product will be made available to educators in the form of a PDF. It is projected that further excerpts of the curriculum will be appropriately developed for future publications.

Mercury and Cadmium in the Sediment and Oysters in the Housatonic River Estuary

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

Student Participant(s)

Summer 2010

Karen Thomas, Undergraduate Student, Biology and Marine Studies

Fall 2010; Spring 2011

Karen Thomas, Undergraduate Student, Biology and Marine Studies
Mary LaVallee, Undergraduate Student, Chemistry and Marine Studies

Project Description

Bivalve mollusks (mussels and oysters) are used worldwide as indicators of metal pollution and are known to accumulate mercury and cadmium in their tissues. The Housatonic River generates more than one-third of CT's seed oysters from its public oyster beds. Mercury contaminated sediment in the Housatonic River estuary poses a threat to the commercial oyster industry and quantifying the relationship between sediment and oyster tissue mercury contents is necessary

for oyster habitat restoration efforts. Cadmium can be harmful to humans if accumulated in oyster tissue and consumed. Ambient salinity may also influence cadmium contents of oyster tissues in estuaries. This study examines the mercury and cadmium concentration in surface sediment and corresponding oyster tissues in the Housatonic River estuary. The goal of this study will be to test the following hypotheses: (1) sediment mercury and cadmium content will vary in proportion to sediment grain size and organic carbon content (Loss on Ignition); (2) the mercury content in oyster tissue will vary in direct proportion to the sediment mercury content at that location; (3) oyster tissue cadmium contents will vary inversely with ambient salinity in the Housatonic river estuary; and (4) oyster tissue mercury and cadmium contents in lower Housatonic river will, on average, be higher than other regional coastal estuaries.

Results to Date/Significance

Two pieces of equipment acquired during 2008, the Labconco Freeze Dryer and the Milstone DMA-80 Direct Mercury Analyzer, provided the analytical capabilities to conduct this study. Our laboratory has now developed the expertise to accurately and precisely measure mercury concentrations in marine sediment and biological tissues. Using the Milestone DMA-80 direct mercury analyzer and EPA Method 7473 we have achieved mercury measurements for National Institute of Standards and Technology standard reference materials that show excellent agreement with certified mercury values. We have also achieved success in developing analytical methods for cadmium determinations on oyster tissue digests using graphite furnace atomic absorption spectrophotometry. To date, we have completed the mercury and cadmium analysis for oyster tissues collected from three locations (Sites 1, 2 and 3) in the lower Housatonic River on three separate occasions (November 2008, June 2009 and October 2009). Oyster tissue mercury was also determined for oysters sampled from New Haven harbor and Westbrook harbor in November 2008. Oyster tissue mercury concentrations have ranged from (0.11 ± 0.01 to 0.17 ± 0.03 mg/kg dry weight for New Haven lot 72S and Westbrook Town Lease #1 oyster tissues, respectively). Results of this study were presented as a poster at the Milford Aquaculture Seminar, Shelton, CT during February 2011.

Mercury Accumulation in Bluefish (*Pomatomus saltatrix*) in Long Island Sound

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

Student Participant(s)

Summer/Fall 2010; Spring 2011

Karen Thomas, Undergraduate Student, Biology and Marine Studies
Mary LaVallee, Undergraduate Student, Chemistry and Marine Studies

Project Description

Bluefish are a schooling, migratory pelagic species common in Long Island Sound. Bluefish were the third most frequently caught species in Connecticut coastal waters in 2008 and

represent an important recreational fishery. Bluefish are apex predators and bioaccumulate mercury through dietary transfer through the food chain. Mercury is a neurotoxin and is passed to humans primarily via consumption of fish. I propose a study to measure tissue mercury concentrations in juvenile and adult bluefish (*Pomatomus saltatrix*) in Long Island Sound. As a recreational fisherman and consumer of LIS bluefish, I am concerned with the seasonal and long-term trends in tissue mercury concentrations and their associated human health impacts. The goal of this study will be to determine the current concentrations of mercury in LIS bluefish and test the following hypotheses: (1) LIS bluefish tissue mercury concentrations will positively correlate with weight, age and length and (2) LIS bluefish tissue mercury concentrations will be less than mercury tissue contents measured in previous studies. Knowledge of bluefish tissue mercury contents, and its relationship with length and weight, is essential for establishing effective fish consumption advisories and protecting human health.

Results to Date/Significance

Bluefish were collected during September-November 2010 during the annual Fall migration through Long Island Sound. Many bluefish were collected by personnel at the CT Department of Environmental Protection, Marine Fisheries Division, Old Lyme, CT. A wide range of bluefish sizes and weights were collected. Samples of skinless (skin and scales removed) axial muscle (approx 2.5 grams wet weight) are being removed from the dorsal region above the operculum on each side of the fish using a stainless-steel scalpel. Dissected fish tissue is being freeze-dried in preparation for mercury analysis thermal decomposition amalgamation and atomic absorption spectrophotometry using a Milestone DMA-80 direct mercury analyzer according to EPA Method 7473.

Lipofuscin concentrations at varying temperatures in the American Lobster

Faculty Dr. Sean Grace
Biology, SCSU

Student Participant(s)

Fall 2010

Joseph Direnzo, Biology, Undergraduate Student

Spring 2011

Mary Alice Page

Project Description

Research was completed to determine the age of American lobster (*Homarus americanus*) in the Gulf of Maine (GOM) from multiple orbital carapace lengths (mm). The purpose was to document the age and levels of the aging pigment lipofuscin in lobsters from the GOM. It also will aid in the management of this resource. Recent studies on western rock lobster (*Panulirus*

cygnus) indicate that the aging technique proposed in this research would allow independent assessment of population parameter estimates and has shown that most juvenile lobsters are 3-5 years old immediately prior to recruitment (Sheehy 1998). Another study on the European lobster (*Homarus gammarus*) yielded reproducible catch age structures with year-class resolution. In addition, a recent study performed on the European Lobster demonstrated that lipofuscin quantification produced more accurate estimates of age in the species than carapace length (Huglem *et. al.* 2005). This finding has important implications for stock assessments that employ traditional models which include age as an input parameter (Sheehy 1996). We are on our second year of data collection to determine if lipofuscin concentrations change with season and between years.

Results to date/Significance

We have completed our analysis of the complete data set. This is a 3 year grant funded by the State of Maine, Department of Marine Resources. Results thus far demonstrate no difference in lipofuscin concentrations between sexes within a size class of lobsters and more importantly no effect of area on concentration.

An Examination of Phytoplankton Abundance and Diversity with Relation to Physical Factors in Long Island Sound

Faculty Dr. Sean Grace
Biology, SCSU

Student Participant(s)

Summer 2010

Melissa Krisak, Graduate Student, Biology

Project Description

Historically the oyster fishery of Long Island Sound has been economically important to Connecticut, as it still is today. Throughout history the oyster population has diminished and rebounded. The most recent decline was in the 1990s. Oysters are selective in their feeding, preferring particles, including phytoplankton, between 3 and 20 micrometers. One purpose of this study was to examine factors that relate to abundance and diversity of phytoplankton, including the effects of site, season, temperature and salinity. Another purpose of this study was to identify the amount of glycogen in oyster tissue in order to determine the effect of phytoplankton abundance as an available energy source. Abundance and diversity was determined from plankton tow samples, which were examined via microscopy in order to characterize phytoplankton communities. 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 at the National Marine Fisheries Lab in Milford, CT. These samples were collected in a van Dorn bottle. The plankton tow and van

Dorn samples and analysis illustrate diversity and abundance of phytoplankton available for oysters in Long Island Sound throughout the year.

Results to date/Significance

Plankton tow collections have been completed for each site, and salinity and temperature were recorded during each station visit. Plankton samples have been analyzed for diversity and abundance via microscopy. Cement blocks with hobo temperature loggers have been collected from the sampling sites and data has been downloaded and appropriately graphed. Fall 2009 and spring 2010 van Dorn samples have been analyzed with the flow cytometer for particle size and abundance. Temperature and salinity data were also collected during the van Dorn sample collections. Oyster tissue was processed for glycogen analysis. The fall glycogen analyses show the amount of energy present after the fall bloom, which is an indication of the stored energy available for oyster through the winter. The spring glycogen analyses show the amount of glycogen used over the course of the winter. Statistical analysis has indicated that the stations located in the Housatonic River are indicative of a riverine system, while the stations located in the Quinnipiac River area are indicative of a harbor system, and the stations in Clinton and Groton are indicative of an open water system. The defining parameters used to categorize these sites were temperature, salinity, and planktonic communities. Plankton presence or absence was qualitatively compared to previous studies. This research has been discussed at the 2009 Benthic Ecology Meeting, the 30th Annual Bivalve Conference, the 2010 Connecticut State University Research Conference, the 2010 Graduate Research Symposium at SCSU, and the Long Island Sound Research Conference.

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 2010 to discuss topics concerning the health and quality of Long Island Sound and its environs as part of the **Seventh Annual Seminar Series on Environmental Issues of Long Island Sound 2010**. Partial support for the seminar series was provided by a $1,600 SCSU Faculty Development Grant awarded to Drs. Breslin, Tait and Smith.

The seminar series was consisted of four separate one-hour seminars by invited experts on Long Island Sound environmental issues during the Spring 2010 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 2010 semester attended and encouraged their students to attend the seminar series. A primary goal of the seminar series is to distribute information about Long Island Sound research among faculty and to encourage interdisciplinary collaborative research at SCSU.

Date	Seminar	Attendance
3/3/10	Storms to Sewers: Initiatives that will Clean Rivers, Open Beaches, and Promote a Healthy Long Island Sound **Leah L. Schmalz, Director of Legislative and Legal Affairs, Save the Sound, New Haven, CT**	23

Stormwater runoff is one of the most serious water quality problems facing Long Island Sound. With each rainfall, water cascades off of houses roofed in petroleum products and washes over chemical-slicked asphalt roadways and concrete sidewalks, ultimately flowing into storm drains or waterways that lead to Long Island Sound. Water running off of hard surfaces accumulates greases, salts, fertilizers and pesticides that can kill fish and damage shellfish beds and aquatic plants. In older cities, stormwater and sewer systems are often combined; the pipes that carry sewage to treatment plants are the same pipes that receive storm drain outflow. In heavy rains, the system gets overwhelmed, which can lead to untreated sewage flowing directly into the Sound. With appropriate management, polluted runoff and outdated sewage infrastructure don't have to be so destructive to our environment or our wildlife. State, regional, and local solutions can include; (1) stormwater assistance funds; (2) working with municipalities to find and address illicit discharges, (3) implementing green infrastructure techniques like vegetated swales, green roofs, and permeable pavement in new construction; and (4) citizen education to create incentives for stormwater control at the household level.

3/31/10	Water Quality and Hypoxia in Long Island Sound **Hans G. Dam, Professor, Dept. of Marine Sciences, UCONN, Avery Point, Groton, CT**	49

Water quality parameters have been systematically monitored in Long Island Sound since 1988, starting with the Long Island Sound Study (1988-89) and later with the CT DEP Water quality Monitoring Program (1991present). In these monitoring programs, data have been collected monthly or biweekly throughout the year at numerous stations through the Sound. Hypoxia (dissolved oxygen concentration < 3 mg 0_2 L^{-1}) is a pervasive summertime feature in bottom waters of western Long Island Sound, LIS. Using data from the water quality monitoring programs in the Sound (1988-2005), this study examined the relative importance of temperature, nutrients and vertical stratification in determining both the concentrations and rates of change of dissolved oxygen in western LIS. Multiple regression analysis indicates that temperature is the dominant factor for oxygen concentration. Similarly, the temporal oxygen depletion rate is significantly correlated to the temporal rate of change of the vertical density gradient and temperature. In addition, high frequency studies as part of the Long Island Sound Integrated Coastal Observing System (LISICOS) reveal short-term (3-7 days) ventilation events driven by vertical mixing. Hence, hypoxia appears to be mostly controlled by physical factors. An implication is that despite aggressive efforts to reduce nutrient loadings, future climatic scenarios must be considered in the management of hypoxia in the Sound.

Date	Seminar	Attendance
4/9/10	Pharmaceutically Active Contaminants in the Greater New York/New Jersey Harbor Complex **Bruce J. Brownawell, Associate Professor, School of Marine and Atmospheric Sciences, SUNY Stony Brook, NY**	60

There has been much recent interest in the detection and widespread occurrence in the environment of wastewater derived chemicals. Contaminants of emerging concern include prescription and nonprescription pharmaceuticals; naturally occurring steroid hormones; disinfectants; other personal care products (e.g., fragrances and shampoo ingredients); detergents; modern use household pesticides (e.g., DEET); and metabolites of these and more traditionally studied organic contaminants. Many of these chemicals are potentially pharmacologically active and little is known about sublethal effects of complex mixtures of such chemicals. This seminar focused on recent results from studies of pharmaceutical and personal care product occurrences and fate in derived chemicals as tracers of sources and transport of nutrients, potentially toxic chemicals, and microbial pathogens in receiving waters. Sampling of surfacial sediments was conducted in 2008 along a 45 mile transect between more sewage impacted sites near the Throgs Neck Bridge to a site north of Mt. Sinai harbor, NY. A unique aspect of this study was the measurement of a suite of waste-water derived quartenary ammonium compounds (QACs). Quaternary ammonium salts are used as disinfectants, surfactants, fabric softeners, and as antistatic agents. Results show that QACs are excellent particle tracers of sewage affected sediments.

4/21/10	The Ecology of the Non-Native Asian Shore Crab (*Hemigrapsus sanguineus*): A View from Western Long Island Sound. **George P. Kraemer, Professor and Associate Dean, School of Natural and Social Sciences, Purchase College, Purchase, NY**	31

Hemigrapsus sanguineus (Asian shore crab) first arrived at Rye, NY in 1994. The intertidal abundances of *H. sanguineus*, *Carcinus maenas* (green crab), and the native crabs *Eurypanopeus depressus* (flatback mud crab), *Cancer irroratus* (Atlantic rock crab), and *Libinia emarginata* (spider crab) were censured from 1998–2005. The study was conducted at Edith Read Wildlife Sanctuary in Rye, NY, near the western end of the LIS estuary. Asian shore crab densities (estimated in June) increased from 1998–2001 to ca. 120 crabs m^{-2}, and then declined to 80 crabs m^{-2} from 2002–2005. The flatback mud crab declined in abundance by about 95%. Decreases in the abundances of Atlantic rock crabs, green crabs, and spider crabs may also have occurred, though these species were uncommon at the outset of the study. The lower intertidal density of the gastropod *Littorina littorea* (common periwinkle) decreased by about 80%, and the decline was coincident with the expansion of the Asian shore crab population. In June, small Asian shore crabs were disproportionately more abundant in the upper intertidal zone compared with lower zones, where large crabs were more abundant. January intertidal populations were dominated by small Asian shore crabs, and these were restricted to the lower half of the intertidal zone. The Asian shore crab appears here to stay. The drastic (50-95%) declines that we have observed in

the populations of resident crabs and common periwinkles, temporally coincident with increase of the Asian shore crab population, strongly suggest that the invader has had significant ecological impacts.

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 on-going Center partnerships include:

The CSU Oyster Research Project: U.S.D.A. funding received by Drs. Breslin, Tait, Grace and Smith for oyster research has allowed us to: (1) initiate a collaborative, multidisciplinary laboratory and field-based research program with faculty from CCSU, WCSU, and Wesleyan University, as well as drawing upon the expertise of community stakeholders; (2) create sustainable education, research and outreach projects at the participating CSU campuses, the Sound School, Schooner Inc., and the Maritime Aquarium at Norwalk; and (3) produce data and analyses that will provide the foundation for a recovery plan the Connecticut oyster fishery.

Department of Environmental Protection Marine Fisheries Division, **Old Lyme, CT**: Kurt Gottschall, CT DEP, has agreed to assist Dr. Breslin with the collection of bluefish from Long Island Sound in support of the bluefish tissue analyses for mercury. The bluefish collection will occur during the annual Fall trawl survey of fish and invertebrates conducted each year for the past 20 years by the CT DEP.

Department of Earth and Environmental Sciences, Wesleyan University: Dr. Tait has established research collaborations with Dr. Suzanne O'Connell and Dr. Johan Varekamp focused on salt marsh dynamics, coastal erosion, and marine sedimentation. He has also served as a thesis advisor to Tracy Krueger, a master's student, who studied erosional processes at Griswold Point in Old Lyme.

Department of Natural Resources, State of Maine, Boothbay Harbor: Dr. Grace has had an ongoing relationship with this marine center for the lobster aging study for the past 4 years. This center provides the laboratory space and equipment needed for the dissection of lobster brains in support of the grant awarded to Dr. Grace. See for reference:
http://www.maine.gov/dmr/index.htm.

Department of Biology, University of Maine, Machias: Dr. Grace has recently collaborated with Dr. Brian Beals, professor in the biology department at the University of Maine at Machias. Specifically, Dr. Beals has provided Dr. Grace and the center with known age lobsters that have been held in cages along the coast of Maine representing varying temperature regimes. These lobsters will be used to examine the question of how do lipofuscin concentrations differ in known age animals raised at different temperatures. See for reference:
http://www.umm.maine.edu/.

State of Connecticut Department of Agriculture, Bureau of Aquaculture, Milford, CT
Dr. Inke Sunila is a Shellfish Pathologist employed by the Bureau of Aquaculture at the Milford Fisheries Laboratory, Milford, CT. Dr. Sunila has extensive research experience and is recognized as an expert identifying and diagnosing Eastern oyster pathologies in Long Island Sound.

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 2010-2011 research presentations is listed below:

Presentations

Breslin, V.T. 2010. Nuts and Bolts: Designing a SENCER Course. Mandel Center for Humanities, Brandeis University, November 13, 2010.

Geist, N. G., Oshana, D., Sunila, I. and Breslin, V.T. 2010. Pathological Changes, Disease, and Tissue Metals in Eastern Oysters from Five Sites Along the Connecticut Coast. Long Island Sound Research Conference, UCONN Stamford. October 29-30, 2010

Breslin, V.T., D. Oshana, N. Geist. 2010. Habitat Quality, Prevalence of Disease and Tissue Metals in Eastern Oysters along the Connecticut Coastline. *Connecticut State University Faculty Research Conference*, Central Connecticut State University, New Britain, CT. April 17, 2010.

Breslin, V.T. 2010. Preparing Public Problem Solvers in STEM (Science Technology, Engineering and Mathematics). *New England Regional Campus Compact Conference*, University of Vermont, Burlington, VT. April 13, 2010.

Geist, G. N., D. Oshana, I. Sunila and V.T. Breslin. 2010. (Poster). Prevalence of Disease, Growth Abnormalities and Tissue Metal Contents in Eastern Oysters Along the Connecticut Coastline. *30th Milford Aquaculture Seminar*, Courtyard by Marriott, Shelton, CT. February, 8-10, 2010.

Conklin, J and V.T. Breslin. 2010. (Poster) Metal Concentrations in the Sediment of the Lower Housatonic River. *30th Milford Aquaculture Seminar*, Courtyard by Marriott, Shelton, CT. February, 8-10, 2010.

Krisak, M. and S. Grace. 2010. An Examination of Phytoplankton Abundance and Diversity with Relation to Physical Factors in Long Island Sound. Book of Abstracts, *13th Annual Connecticut State University Faculty Research Conference*, Central Connecticut State University, New Britain, CT. April 17, 2010. pg. 19.

Krisak, M. and Grace S. 2010. Potential Effects of Phytoplankton Abundance and Diversity on the Eastern oyster, *Crassostrea virginica*, in Long Island Sound. Program and Abstracts, Tenth Biennial Long Island Sound Research Conference, University of Connecticut, Stamford, CT. October 29-30, 2010.

Stevens, J., J. Tait, N. Peperni, K. Thomas, and C. Nixon. Estimating sediment metal concentrations in Norwalk Harbor using mean grain size and loss-on-ignition data. Long Island Sound Research Conference, University of Connecticut, Stamford, Connecticut, October 29-30, 2010.

Tait, J. Science and the Connecticut Coast: A SENCER Model Course. SENCER Conference, Brandeis University, November 13, 2010.

Tait, J., J. Stevens, S. O'Connell, and R. Ostfeld. Synoptic reconnaissance of oyster habitat in Connecticut harbors. Thirteenth CSU Faculty Research Conference, Central Connecticut State University, New Britain, CT, April 17, 2010.

Publications

Krisak, M., Allen, M. and D.G. Smith. The great debate: What's good for oysters, oysterman and us? *Connecticut Journal of Science Education.* In press.

Allen, M. and D.G. Smith. 2010. Long Island Sound Curricula. *Connecticut Journal of Science Education*, 47 (2): 27-33.

Participation

Breslin, V.T. Participant. (Invited). Long Island Sound Science and Technical Advisory Committee Meeting. SUNY at Stony Brook, November, 2010.

Breslin, V.T. Keynote Speaker (Invited). Southeastern New England Marine Educators, Fall 2010 Conference and Annual Meeting, October 16, 2010. Oil Spills in our Coastal Waters: Who's to Blame?"

Student Theses and Reports/Advisors

Amanda Lee, Honors Thesis, Marine Studies (Advisor: Breslin)

Sediment Metal Contamination in the Thames River and New London Harbor. May 2010

David Oshana, Masters Thesis, Environmental Education. (Advisor: Breslin)

Spatial Trends in Eastern Oyster (*Crassostrea virginica*) Tissue Metal Concentrations in Long Island Sound. May 2010.

Neil Geist, Masters Thesis, Environmental Education. (Advisor: Breslin)

Incidence of Disease and Growth Abnormalities in Easter Oysters (*Crassostrea virginica*) vs. Incidence of Heavy Metal Tissue Content from Three Sites in Long Island Sound. May 2011.

Melissa Krisak, Masters Thesis, Biology. (Advisor: Grace)

An Examination of Phytoplankton Abundance and Diversity with Relation to Physical Factors in Long Island Sound. May 2011

Grants

Mercury Accumulation in Bluefish (*Pomatomus saltatrix*) in Long Island Sound. Connecticut State University 2010 Research Grant. Project Duration: June 1, 2010– May 30, 2011. PI – V.T. Breslin. Total Funds $4,875.

Seventh Annual Seminar Series on Environmental Issues in Long Island Sound. Southern Connecticut State University Faculty Development Grant. Spring 2010. PIs – D. Smith, V.T. Breslin and J. Tait. Total Funds $1,600.00.

Causes and Remediation of Chronic Beach Erosion at Hammonasset Beach State Park. Connecticut State University 2010 Research Grant. Project Duration: June 1, 2010– May 30, 2011. PI – James Tait. Total Funds $5,000.

VI. Accounting, Budget Expenditures and Grant Writing

Academic Year 2010-2011 Itemized Budget Justification

Funds totaling $30,150 were requested for Year 5 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

Werth Foundation funds were not used in support of salaries for faculty mentoring students during the Summer and Fall 2010. CCMS will contract a web designer ($1,000; Janet Colandrea) to update and maintain the CCMS website during Spring 2011. The website is an important component of our education and outreach activities. The SCSU Dean of Arts & Sciences provided faculty reassigned time (3 credits time each for Breslin and Tait) in support of managing the CCMS activities and programs. The reassigned time allow faculty a lesser teaching credit load and the 6 credits time are valued at $10,903.

Student Research Fellowships

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 2010 (6 students; $11,500), Fall 2010 (6 students; $3,750) and Spring 2011 (6 students; $4,500). Fellowship amounts per student ranged from $250-$2,000 per semester (25-200 hours @ $10/hour). The CCMS has a system-wide mission to support student research. This past year, the CCMS supported 12 different students in five different academic fields (Biology, Chemistry, Marine Studies, Geography, and Honors) in support of faculty-directed research projects during this past year totaling $19,450.

Travel Funds

Travel funds totaling $2,500 were budgeted to reimburse costs associated with travel in support of field sampling activities and attendance at local, regional and national scientific meetings. Students and faculty completing their research projects are expected to give talks or poster presentations at scientific meetings. This past academic year CCMS supported student and faculty travel ($790) to the Long Island Sound Research Conference, Stamford, CT; the Milford Aquaculture Seminar, Shelton, CT; the Southeastern New England Marine Educators Annual Meeting, Groton, CT and the Connecticut State University Faculty Research Conference, New Britain, CT. Travel funds ($580) were used in support of student and faculty travel to field sites in support of their respective research projects. Remaining travel funds will be used in support of students and faculty traveling to field sites and to support participation in regional meetings.

Permanent Equipment

Werth Foundation funds were not budgeted for this past year for permanent equipment in support of faculty and student research projects. No major permanent equipment purchases were made using Werth Family Foundation funds allocated in 2010-2011.

Ship Time

Funds for chartering ship time were budgeted ($6,250) to provide access to field sample sites for research and education along the Connecticut shoreline and in Long Island Sound. Werth Foundation funds have not been expended to date for ship time. Sufficient funds for ship time were available from the USDA Oyster grant during the 2010 sampling season (grant termed August 2010.

Publication Costs

A total of $1,000 was budgeted for publication costs for FY 2010-2011. Funds ($123) were used to support the printing of large format posters for presentation at regional meetings. Additional funds will be used in Spring 2011 to photocopy and bind student theses and reports for distribution.

Expendable Supplies

Funds for laboratory and office supplies ($1,000) 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 and supplies for the sediment metals research and laboratory supplies and field supplies for the sediment grain size research ($424). Additional supply funds will be used in support of student-facutly research projects during Spring 2011.

Balance of Funds

To date, CCMS has a balance of $8,608. The majority of the unencumbered funds are earmarked for ship time ($6,250). The US Dept. of Agriculture Oyster study funds were sufficient to cover the costs associated with ship charters during the Summer 2010 sampling season. As the USDA grant termed August 31, 2010, these funds needed to be expended prior to the grant terming. Also, the cooperative agreement with the CT DEP Marine Fisheries Division to collect bluefish in support of Dr. Breslin's CSU research grant eliminated the need to charter ship time in support of that activity. The remaining Werth Foundation funds for chartering ships ($6,250) will be used in support of educational and research activities during the Spring and Summer 2011.

Matching Funds

Each of the grant awards listed have been used in support of CCMS research and education activities.

Connecticut State University Research Grant Award 2010

Principal Investigator: Vincent Breslin
Project Title: Mercury Accumulation in Bluefish (*Pomatomus saltatrix*) in Long Island Sound.
Award Amount: $4,875.

Connecticut State University Research Grant Award 2010

Principal Investigator: James Tait
Project Title: Causes and Remediation of Chronic Beach Erosion at Hammonasset Beach State Park Award Amount: $5,000

SCSU Faculty Development Grant 2010

Co-Authors: James Tait, Vincent Breslin, Dwight Smith
Title: Seventh Annual Seminar Series on Environmental Issues in Long Island Sound
Award Amount: $ 1,600