FALL 2013

SOUND UPDATE

NEWSLETTER OF THE LONG ISLAND SOUND STUDY

The Importance of Seafloor Mapping and Spatial Ecology in Long Island Sound

Looking out over Long Island Sound (LIS) we can easily see coastal habitats such as salt marshes and intertidal flats, areas dominated by human development, and the many recreational and commercial activities that are evident near and on its waters. But under the waters, hidden from view, are a diversity of underwater habitats that comprise the LIS seafloor. The seafloor is an integral component of a larger LIS ecosystem, providing invaluable ecological goods and services. These include habitats for fish, crustaceans, and many other organisms that comprise food webs critical to the overall functioning of the Sound. In addition, the bottom sediments serve as a repository for nutrients and pollutants that affect water quality. However, many human activities such as dredge material disposal and energy infrastructure development can disturb the benthic ecology. Thus in order to support effective management, conservation, and environmental planning it is necessary to understand the structure and dynamics of the physical, chemical, and biological components of the LIS seafloor and the interactions among them.

Just as in terrestrial systems, the framework used to build an understanding is based on the spatial structure and characteristics of the environment provided by high resolution mapping and related analyses. For seafloor environments, mapping entails using a combination of technologies including acoustic based systems such as multibeam and side scan sonar, videography and photography, and sediment sampling to collect data. These data are then combined to create maps of seafloor structure, habitat composition, and ecological characteristics that can provide insights into ecological dynamics across different habitats. We refer to this analysis as spatial ecology, as it considers how ecological characteristics and dynamics change over different spatial scales, from within a patch of boulders that may be tens of meters square to large expanses of mud or sand that may be kilometers square.

THE SEABed OBSERVATION AND SAMPLING SYSTEM (SEABOSS) being recovered by graduate students.

Dann Blackwood, USGS

Early depictions of the LIS seafloor based on sediment sampling provided a very coarse and potentially inaccurate depiction of seafloor structure and composition. Subsequent mapping efforts using side scan sonar, photography, and grab sampling during the 1990s provided a much more accurate and spatially explicit depiction of seafloor structure across much of the Sound, laying the groundwork for the current effort, which seeks to create a more updated and detailed view of benthic habitats and ecological processes.

Preliminary results from mapping and related analyses conducted in the vicinity of Stratford Shoal are revealing a greater diversity of habitats and biota than previously recorded. The maps are allowing scientists to conduct detailed spatial ecological analyses to greatly enhance our understanding of the Sound, which in turn will help balance resource conservation with supporting commercial, recreational, and aesthetic uses. Seafloor maps will also be a great educational resource, informing stakeholders of all ages about the many benthic wonders that lie below LIS waters.

—Roman Zajac, PhD, is a Professor at the University of New Haven

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Sound Update provides readers with news about the Sound and the Long Island Sound Study.

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The Long Island Sound Seafloor Mapping Program: Background and Organization

Often, making the best possible decisions can be difficult. In 2002, a Connecticut legislative task force found there was a lack of substantial scientific information regarding the seafloor habitats of Long Island Sound (LIS), which hampered the ability to properly respond to and address topics such as the placement of large scale in-water utility infrastructure. A subsequent review by the Connecticut Academy of Science and Engineering identified similar data gaps and deficiencies.

In 2004, the Connecticut Department of Energy and Environmental Protection (DEEP) resolved two non-compliance issues with LIS electric cable projects involving both Connecticut and New York utility companies. As part of the settlement, a fund seeded with $6 million for research and restoration was created. The Long Island Sound Study signed an agreement among members of its policy committee and determined the fund should support new projects that enhance Long Island Sound, promote improved scientific understanding of the potential effects of energy infrastructure and how to mitigate their impacts, and emphasize benthic mapping as a priority need for improved management decisions.

To manage this effort, a Steering Committee was formed consisting of representatives from CT DEEP, US EPA Regions 1 and 2, New York State Department of Environmental Conservation, New York State Department of State, and the Sea Grant programs of Connecticut and New York. While the committee works in a joint administrative capacity, management of the fund is the sole responsibility of DEEP staff. By 2007, the Steering Committee, DEEP, and the University of Connecticut (UConn) hosted a workshop that tasked regional state, federal, and non-governmental groups to further identify the specific management needs of LIS and how a mapping program could address them.

Beginning in 2009, the Steering Committee began to develop a benthic mapping program for LIS and formed a collaborative partnership combining national and local expertise and resources. The partners include the National Oceanic and Atmospheric Administration (NOAA) Biogeography Branch and two regional academic consortiums led by UConn and Columbia University's Lamont-Doherty Earth Observatory (LDEO).

By 2011, the Steering Committee and partners developed a plan to prioritize areas of LIS by evaluating areas of interest identified by stakeholders based on issues including ecological value, multiple use conflicts, compliance, resource management, and potential for further development. Using these high priority areas as a guide, a technical scope of work was co-developed to implement a pilot effort. Once the contracting mechanisms were completed, the pilot began in the fall of 2012 within a corridor from Bridgeport, CT to Port Jefferson, NY (see map at left). Program teams are producing mapping and data products focused on acoustic intensity; seafloor topography; benthic habitat and ecological processes; sediment texture and grain size distribution; sedimentary environments; physical and chemical environments; and a data management system.

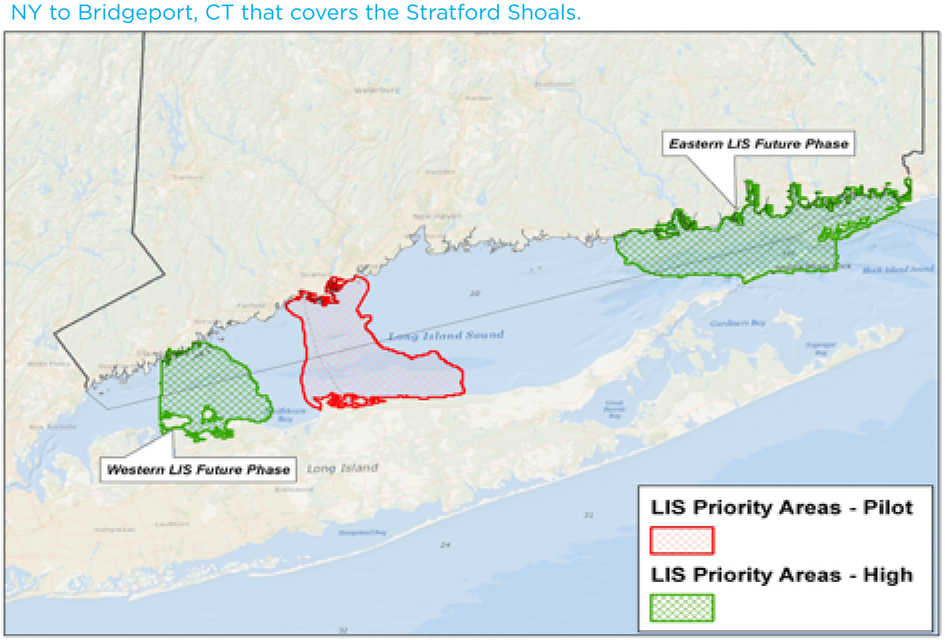
The results of the pilot will be delivered in the spring of 2014 and, following a review, full-scale implementation will commence in additional high-priority areas, beginning with an area in Eastern LIS and continuing to an area in Western LIS and beyond as funding allows.

—Kevin O'Brien is an Environmental Analyst with the Connecticut Department of Energy and Environmental Protection's Office of Long Island Sound Programs

Learn More

The Long Island Sound Study website has a webpage devoted to the Long Island Sound Seafloor Mapping Program: *http://longislandsoundstudy.net/research-monitoring/seafloor-mapping/*
At this page, you will find information on the program and additional reading materials and resources.

AREAS PRIORITIZED FOR DATA COLLECTION and processing as part of the LIS Seafloor Mapping Program. Additional areas may be collected as funds permit. The red pilot area is the focus for work thus far and incorporates a swath from Port Jefferson, NY to Bridgeport, CT that covers the Stratford Shoals.



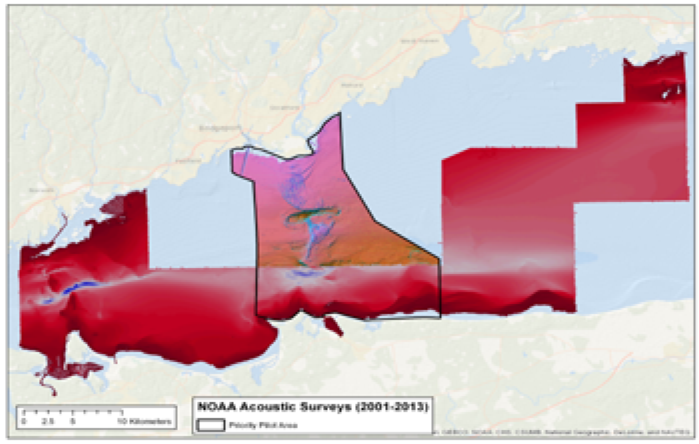
CT DEEP

Acoustic Mapping

NOAA is an important collaborator with the LIS Seafloor Mapping Program. NOAA's Office of Coast Survey (OCS) and National Centers for Coastal Ocean Science (NCCOS) are providing management and technical expertise, acquiring data, and developing products for the seafloor mapping program. As a leading Federal agency in national seafloor mapping, NOAA has filled critical data gaps by collecting new data and interpreting those data to provide informative products. The LIS Seafloor Mapping Program needed bathymetry and backscatter, and biological and physical observational and sampling data, to produce all the products needed by governments, industry, academia, and the public.

In 2012 and 2013, NOAA Ship *Thomas Jefferson* conducted extensive hydrographic surveys in LIS. Coast Survey, the nation's nautical chartmaker, needed new bathymetry to update charts for ships traveling through the increasingly crowded Sound (see figure top right). To meet the needs of LIS partners, Coast Survey made some adjustments to survey areas and parameters to support both nautical charting and the seafloor mapping of Long Island Sound over the next several years. *Thomas Jefferson* conducted hydrographic surveys collecting high resolution acoustic data for approximately 900 km^2 of LIS in water depths ranging from approximately three to 60 meters using state-of-the-art acoustic multibeam sonar systems. These surveys also included the collection of data within the southern third of the pilot area, the focus of the LIS Seafloor Mapping Program's initial efforts. Products from these surveys include high resolution bathymetric and backscatter maps. Bathymetry information can identify areas of important topographic change or complexity, such as undulating sand waves (see figures below). Coincident backscatter data provides a measure of the roughness, hardness, and habitat composition of seafloor features, which is useful for distinguishing different habitat types. NOAA's partners in this mapping effort, two academic consortia led by LDEO and UConn, have assisted in the collection of nearshore (less than five meters) data along the Connecticut and New York coastlines. In addition, researchers from LDEO have also collected an extensive set of sub-bottom profiles by using low-frequency sonar devices to "see" the geologic structure beneath the seafloor itself.

In addition to collecting new data, NOAA was able to use data previously collected within the pilot area in 2001 and 2003. At the time, these data were gathered explicitly for nautical charting purposes, but this provided an opportunity to reuse existing data for new purposes. Reprocessing of these existing data using new techniques developed by NOAA provided valuable planning insight for the other ecological, geological, and oceanographic components by bringing to bear increased clarity and resolution on these efforts.

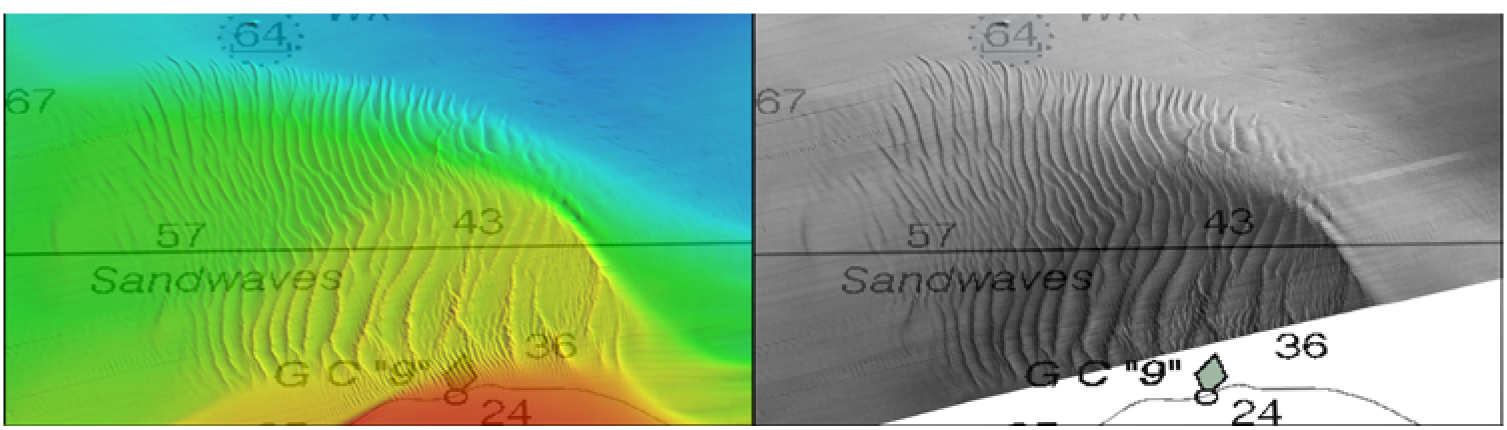


NOAA, 2013

HYDROGRAPHIC DATA indicates the depth to the seafloor. Red indicates a shallow area, while blue indicates a deeper area.

Products from the LIS Seafloor Mapping Program will give state and federal governments valuable information for their coastal management and planning efforts, as well as produce the hydrographic data necessary to update nautical charts of the Sound. The program synergies demonstrate how integrating various technologies, sciences, capabilities, and needs can exponentially increase the value of data. It is a practical example of NOAA's commitment to the concept of integrated ocean and coastal mapping, where the goal is to map once, use many times. The integrated "whole ocean" philosophy leverages limited resources by identifying common mapping requirements, ensuring proper stewardship of mapping data, and, where possible, re-using these data to derive additional products for ocean and coastal needs.

—Tim Battista is an Oceanographer with the NOAA Center for Coastal Monitoring and Assessment's Biogeography Branch



NOAA, 2013

ACOUSTIC PRODUCTS collected by the NOAA Ship *Thomas Jefferson* depicting a sand wave field. Color shaded bathymetry (left) and backscatter intensity (right).

Benthic Habitats and Ecological Characterization

University of Connecticut

CHANGES IN SEAFLOOR HABITAT over time. From 1991-2010, *Haliclona oculata*, *Astrangia poculata*, *Mytilus edulis*, and branching bryozoa were reef dominants. In 2012-2013, *Haliclona* (the long, finger-like organisms) is absent from reef fauna.

Mapping seafloor habitats and ecological processes requires combining and visualizing the geologic and biologic elements of the seafloor environment. Another challenge is to incorporate their dynamics over time, since, as we know, things change over time. If maps are to be more than a simple snapshot in time, we need to capture the changes that occur over time in a way that will be useful to stakeholders and managers who are the target audience for these maps. The LIS Seafloor Mapping Program involves a close collaboration of oceanographers, geologists and ecologists each using a diversity of approaches for data collection, processing, and interpretation. The pilot area features Stratford Shoal, a feature that based on previous experience has a diversity of habitats including boulder reefs along the spine of the shoal, sand waves with gravel troughs in shallower areas, and mud-clay in the basins to the east and west. Multiple sampling tools were used to sample and quantify the geological and ecological variability, and the process of testing different approaches to map this variation in both space and time is underway. Maps of sediment type and texture, species distributions, biological diversity, community type, community dynamics-stability, and more are being developed.

Sampling Tools

Grab samples of the seafloor sediment are useful for grain size analysis and quantifying the animals that live beneath the sediment surface, while video and still photography allow us to rapidly survey those animals that live on the sediment surface, especially in areas of coarse sand and gravel. A grab sampler with video and digital still camera capability named SEABed Observation and Sampling System (SEABOSS) and operated by the US Geological Survey (USGS), is the backbone of our sampling program. This technology allows us to both see and sample the seafloor from the deck of the ship. UConn operates the Instrumented Seafloor Imaging System (ISIS) camera platform, similar to SEABOSS but without the grab. Both vehicles are essentially flown over the seafloor, with the winch operator controlling altitude and the ship controlling speed and direction. While these systems can operate from multiple research vessels, the *Research Vessel (RV) Connecticut* has dynamic positioning, a computer system that allows the ship to hold position and make small controlled changes in its position using GPS without anchoring. The *Kraken2* Remotely Operated Vehicle (ROV), also operated by UConn, allows us to fly over complex seafloor terrain to collect video and still images from multiple angles. Our strategy has been to focus efforts at 31 sampling sites, chosen using the initial multibeam sonar maps developed by NOAA to represent unique areas based on sediment, texture, and depth or in areas of unique transitions.

Preliminary Results

We already have some interesting results during the pilot period. Previous studies along the boulder reef on the southern spine of the Shoal showed a coral-dominated community that was relatively stable for over 20 years. Our first survey in this area using SEABOSS showed that the "dead man's finger" sponges (i.e., *Haliclona oculata*) were gone at a couple of our stations. A subsequent survey with ISIS, focused solely on the reef, revealed these sponges were gone from a large area. What happened? Predation, disease, disturbance from storms, climate change, or freshwater runoff? The answer remains unclear. Quantitative analysis of image samples is ongoing, assessing abundance of habitat forming species like the sponge and other species and seafloor features. Grab sampling approaches also have produced some new and interesting results. One might expect that samples of organisms living in similar types of sediment, like mud, would be very similar across the study area. However, results to date indicate a high degree of variation in community composition across small spatial scales. Noting that sample sorting and species identification is ongoing, interim results indicate that, even in areas with similar sediments the biological community comprises less than 50 percent similarity between sample sites. Further, when compared to sampling conducted in the same area in 1996, the samples in 2012 had significantly greater diversity.

—Lauren Stefaniak, PhD, is a post-doctoral researcher at the University of Connecticut; Peter Auster, PhD, is a Research Professor Emeritus at the University of Connecticut and is a Senior Research Scientist at the Sea Research Foundation-Mystic Aquarium; and Roman Zajac, PhD, is a Professor at the University of New Haven

"One might expect that samples of organisms living in similar types of sediment, like mud, would be very similar across the study area. However, results to date indicate a high degree of variation in community composition across small spatial scales."

Sediment Sampling Program

The LIS Seafloor Mapping Program was created for the purpose of mapping the benthic environment of Long Island Sound. The type and distribution of seafloor substrates (i.e. boulders, gravel, sand, or mud) is a key factor for benthic habitat determination. In addition, sediment samples provide a scientific documentation of long- and short-term environmental changes that will facilitate decision making for conservation and remediation. The main sediment sampling program was conducted in June 2013 from Stony Brook University's *RV Seawolf* and *RV Pritchard*, and was a collaborative effort between LDEO and Queens College (QC), City University of New York.

Sediment Grabs

Sediment grabs are an efficient way to obtain a surface sediment sample. Analysis of these samples will provide a detailed baseline and better understanding of the spatial variability of the sediment type (gravel, sand, mud). Analysis will focus on describing the texture of the sediment, characterizing it as erosional or not, and determining the distribution of metals and organic material. Guided by the acoustic data, we collected 200 grab samples using the *RV Seawolf* and *RV Pritchard.* An additional 100 grab samples were collected by USGS with their SEABOSS system using the *RV Connecticut* from UConn. Detailed analyses are ongoing, but preliminary results indicate a high variability of the sediment distribution in the study area.

Elissa Olivera

McHUGH, LEFT, AND STUDENTS are ready for the next sediment sample.

Sediment Coring

To better understand the long-term history of sedimentation in LIS, sediment coring is essential. Analysis of sediment cores will provide information on various geologic processes through time. The results will significantly improve our understanding of the present sedimentation pattern and will help make future decisions for the health of ecosystems. For collecting the sediment cores, we used two systems. One is a gravity corer, consisting of a core head and a two-meter long PVC pipe. The core head is equipped with a check valve that maintains a vacuum above the collected sediment. As the name implies, the system descends through the water column and penetrates the sediment by the force of its weight. The other system was a hydraulic damped gravity corer, provided by the USGS in Woods Hole, MA, which allows for the recovery of sandy sediments that are difficult to retain in a normal gravity coring system. Again, using acoustic data as guidance for site selection, we collected 46 sediment cores of varying length. The sediment cores are currently being analyzed and we expect that some will provide details of recent environmental changes including erosion and deposition while others will contain records of long-term changes since the last glaciation.

—Cecilia McHugh, PhD, is a professor at Queens College, City University of New York; Frank O. Nitsche, PhD, is a research scientist at Lamont-Doherty Earth Observatory of Columbia University; and Timothy Kenna, PhD, is a Lamont Associate Research Professor at Lamont-Doherty Earth Observatory of Columbia University

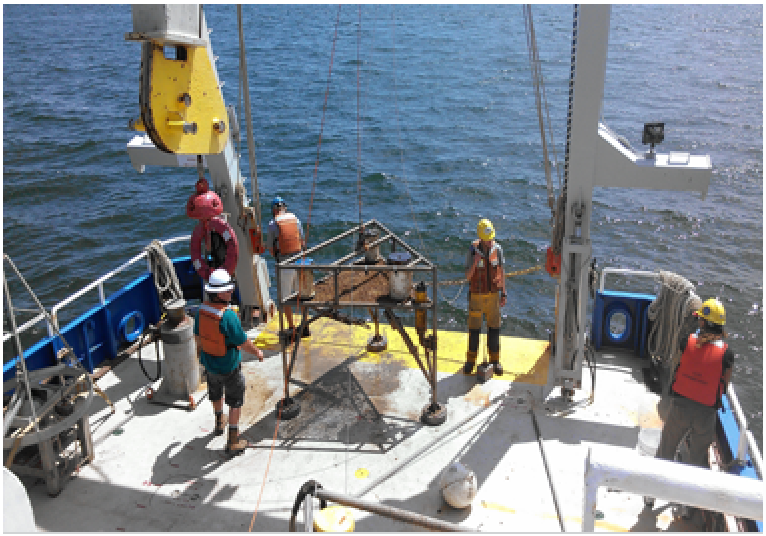
Education

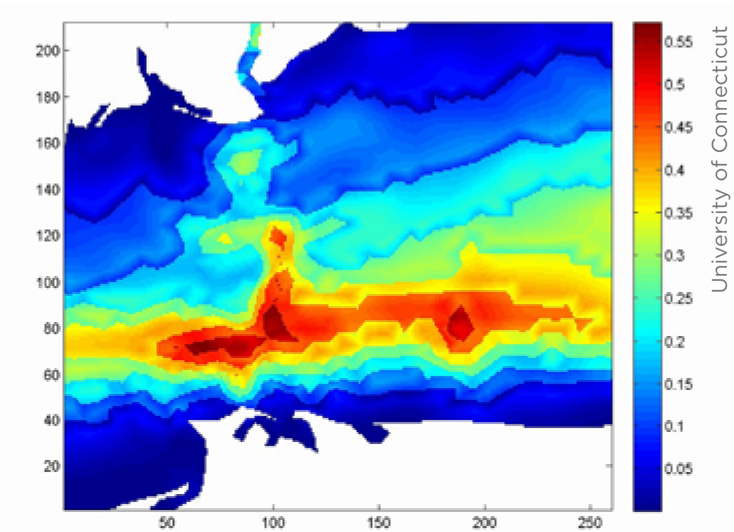
THE SEDIMENT SAMPLING INVOLVED the participation of seven undergraduate and graduate students from Barnard College, Queens College, Hunter College, and a summer internship program at LDEO. The students participated in all the different acquisition methods: sediment coring, grabs, and navigation that required understanding of the latitude, longitude, and water depths. We formed teams and rotated them so that the students would learn about the different instruments. In this way, the students learn not only about science but also about collaboration and pledged to each other that they will continue to collaborate beyond the scope of this program. This was an invaluable experience for the students.

F. Nitsche (LDEO)

STUDENTS SAMPLING a sediment grab.

University of Connecticut





University of Connecticut

(Left) INSTRUMENT RECOVERY from the *Research Vessel Connecticut*. The data collected will help researchers determine the bottom stress on the seafloor. (Right) MAP OF ESTIMATED maximum bottom stress in the Stratford Shoals region. Red areas show very high bottom stress, while blue areas indicate low bottom stress as measured in Newtons/square meter.

Characterizing the Physical Environment of Long Island Sound

Understanding and predicting the impacts of management actions on ecosystems requires an appreciation of the environment. Characterization of the benthic habitat is particularly important, since temperature, dissolved oxygen (DO), salinity, acidity, nutrient concentrations, turbidity, and light levels can affect how some species live and reproduce. Some of these parameters, and their correlation scales, have structure that varies with seasons. Bottom temperature and DO, for example, have annual cycles that are well established in the deeper areas of the Sound.

The physical stability of the seabed and the processes that control the exchange of materials into and out of the seafloor are also important to inform and understand habitat dynamics, so parameters like wave and current-induced bed stress, bottom roughness, and critical erosion shear stress are necessary complements to the sediment size and density maps. Bottom stress and the fate of materials, both suspended and dissolved, introduced to the Sound by riverine discharge and construction activities, are largely controlled by water movement (i.e., circulation and waves).

The central challenge of the Physical Environment component of the LIS Seafloor Mapping Program is to combine existing data with new observations to create user-friendly maps of these critical variables that can be easily used by planners, managers, and scientists.

Since we can't make measurements everywhere or hope to observe all possible conditions at a site over a short-term instrument deployment, we have developed a strategy that combines theoretical predictions with actual observations. We have developed a mathematical model that we are refining so that it is consistent with the observations we do have. We will then use it to predict distributions of the physical seabed stress in areas for where we don't have data. Our maps will then be consistent with our theoretical understanding of the processes that are operating and actual measured values.

The model, called FVCOM (Finite Volume Coastal Ocean Model), is a sophisticated three dimensional representation of the density, flow, and waves throughout the Sound and inner continental shelf off the east coast. For the pilot, we have determined preliminary estimates of the stress on the seafloor in the vicinity of Stratford Shoal. To put this into a common context, there are areas where bottom currents are moving at 50 centimeters per second (or just over 1 mile per hour). Even at this relatively low speed, the pressure these currents exert on sediments and organisms is roughly equivalent to what if feels like to put your hand outside the window of a car moving at 30 miles per hour.

INITIAL RESULTS show a reasonably robust fit between observations collected and modeled data used to characterize surface currents and maximum ebb and flow values. However, subsurface current models depicting stress near the seafloor itself have thus far shown greater variability between observed and predicted values.

Having this new understanding of the seafloor physical dynamics of the Sound and this evolving predictive capability, when combined with the new knowledge of the sediment and organism distribution, will provide new insights into how the Sound changes and reacts over time in the face of increasing physical disturbance.

Initial results show a reasonably robust fit between observations collected and modeled data used to characterize surface currents and maximum ebb and flow values. However, subsurface current models depicting stress near the seafloor itself have thus far shown greater variability between observed and predicted values.

—James O'Donnell, PhD, is a Professor at the University of Connecticut

Data Management

The LIS Seafloor Mapping Program brings together multiple investigators from within the region and beyond who have complementary expertise and perspectives. While each investigator plays a unique role and is responsible for producing specific data products, it is important that we work together to coordinate data acquisition, processing, and exchange of information. The intensive observation and field sampling program is yielding an invaluable set of data that can be used for a wide variety of other applications in the future. Documenting, sharing, and preserving these data helps us not only collectively meet our goals, but also ensures that the data will be broadly available for use in the future.

Organizing, distributing, and documenting specific details about data is often very labor intensive. However, the benefits of proper data management are far-reaching to a broad community of stakeholders including researchers, educators, policy makers, and the public. Not only can open access to data empower citizen scientists who want to learn more about their environment, but it can also be transformative for researchers of the future seeking to ask new questions.

Data management efforts for the LIS Seafloor Mapping Program include a data sharing policy among partners, the adoption and use of common formats and standards, and of course, sharing and preserving data. To facilitate these, we are developing a comprehensive system that provides access to all levels of the data and products to support cross-collaboration. Eventually, this system will interface with the appropriate permanent archive/data centers (e.g., the National Geophysical Data Center, etc.) to secure the legacy of all the information collected, processed, and delivered.

Central to the aspect of data sharing are two parallel data portals that provide user interfaces for search and discovery and can be used to link to distributed data resources. The range of data supported span all topical areas within the overall seafloor mapping investigation and include direct observations, derived or interpretive geospatial products, underwater photos and videos, cruise tracks, sampling locations and navigation files, as well as additional maps, reports, and assorted analyses. Over the course of the last two decades, great advances have been made in the technical infrastructure and tools necessary for handling the diverse types of marine science data. The development of robust internet mapping applications is a notable one; the Network Common Data Form (NETCDF), an efficient binary format transportable to almost any type of computer, and Thematic Real-time Environmental Distributed Data Services (THREDDS), an infrastructure for conveniently publishing and accessing scientific data, are lesser known, but equally relevant examples.

During our pilot phase, we were able to build upon existing technologies and are now working to fine-tune the process to ensure that the Data Management infrastructure can effectively support the LIS Seafloor Mapping Program and provide useful benthic habitat map products and analyses for better planning and management of the Sound.

—Vicki Ferrini, PhD, is a Research Scientist with Columbia University's Lamont-Doherty Earth Observatory and James O'Donnell, PhD, is a Professor at the University of Connecticut

Protection and Progress

THE 2011-2012 LONG ISLAND SOUND STUDY BIENNIAL REPORT is available for download at ***www.longislandsoundstudy.net***. The 24-page report highlights the programs and projects undertaken in 2011 and 2012 to improve water quality, restore and protect natural areas, better understand the Sound's environmental issues through scientific research, and increase the public's awareness of the Sound. It also highlights the Long Island Sound Futures Fund, which distributed more than $3.2 million in grants in 2011 and 2012 to groups involved in Long Island Sound activities.

The projects involve the cooperation of a wide range of partners that are dedicated to improving the 110-mile long waterway through the Long Island Sound Study, a cooperative effort sponsored by the Environmental Protection Agency and the states of Connecticut and New York.

The Long Island Sound Study is sponsored by the States of New York and Connecticut and the USEPA. The LISS Management Committee consists of representatives from the USEPA, NYSDEC, NYSDOS, CTDEEP, NYCDEP, USDOI, IEC, NEIWPCC, NY and CT Sea Grant Programs, co-chairs of the Technical Advisory Committee and Citizens Advisory Committee.

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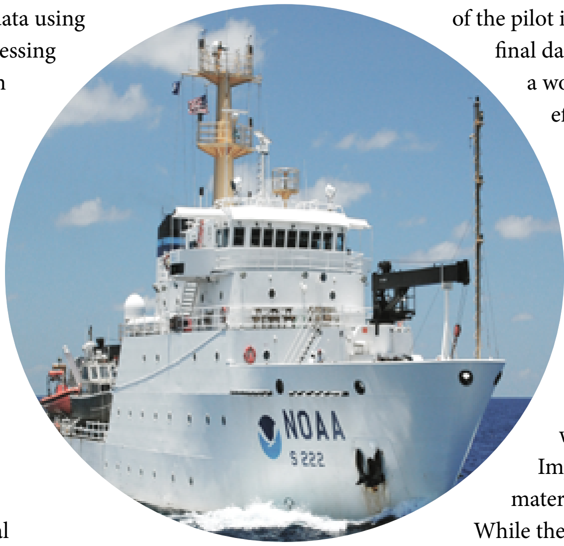
Preliminary Results and Next Steps for the LIS Seafloor Mapping Program

Preliminary Results

Acoustic mapping was the foundational component of this program, upon which the other elements relied. The program was able to combine previous surveys with new data collections by analyzing the older data using advanced sonar processing to increase resolution and improve data quality. These enabled the creation of a variety of detailed derivative acoustic products that helped guide subsequent sampling plans and analyses.

The benthic habitat and ecological characterization has revealed a complex story. Areas once thought relatively stable in terms of community composition have experienced a decline in certain populations. While in other areas, organisms living in similar habitats show highly variable communities and significantly greater diversity when compared to historic sampling.



Next Steps

In October 2013, the Steering Committee will provide a preliminary review of draft data products and give feedback to the research teams; the final review process will begin upon completion of the pilot in Spring 2014. As the final data is delivered and vetted, a workplan to guide future efforts in LIS will begin.

The next phase of data collection and analysis will concentrate on the Eastern LIS high priority area due to potential tidal and wind energy projects in the vicinity as well as its proximity to comparable work on an Environmental Impact Statement for dredged material disposal sites nearby. While there is no official start date as yet, the next phase will try to leverage potential bathymetric and other data collection efforts planned by NOAA, USGS, and UConn.

—Kevin O'Brien is an Environmental Analyst at the Connecticut Department of Energy and Environmental Protection

Photo credit: NOAA, 2013

Updating the LISS Comprehensive Conservation and Management Plan

THE LONG ISLAND SOUND STUDY is updating its Comprehensive Conservation and Management Plan (CCMP). In 1994, the states of Connecticut and New York and the EPA approved the first CCMP for LISS. This plan has served as the blueprint for improving or maintaining the health and vibrancy of the Sound for the past 19 years. Since then, our understanding of how the Sound functions has improved greatly, thanks to extensive monitoring and other scientific discoveries. Many new issues, including climate change, have come to the forefront of environmental issues in the Sound. Furthermore, the theory behind managing large ecosystems has evolved. Now the CCMP is being updated in order to incorporate this new knowledge and to make the CCMP effective over the next 20 years.

We invite you to learn and explore the work that has been done on the CCMP update so far: ***http://longislandsoundstudy.net/Plan-update***

SOUND UPDATE LISS NEWSLETTER

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