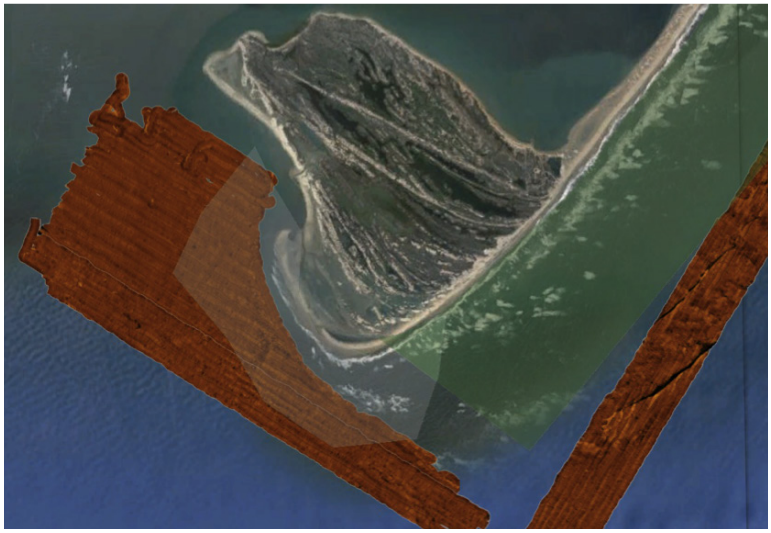
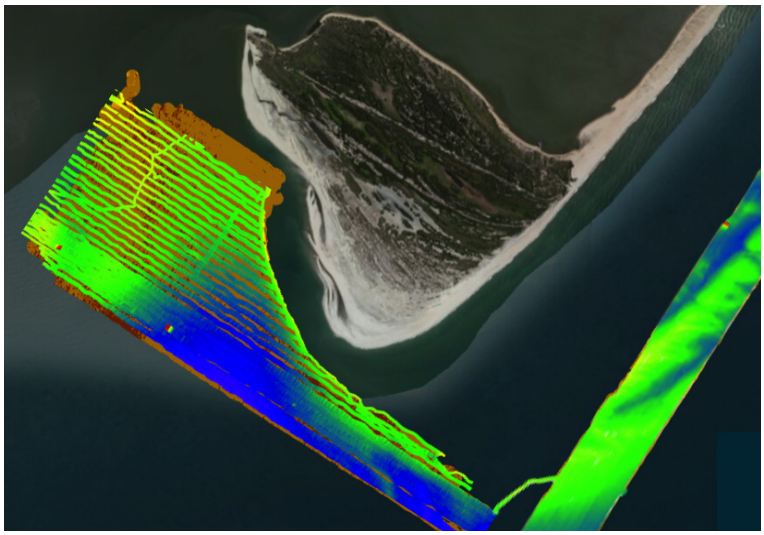
National Park Service
U.S. Department of the Interior

Submerged Habitat Mapping

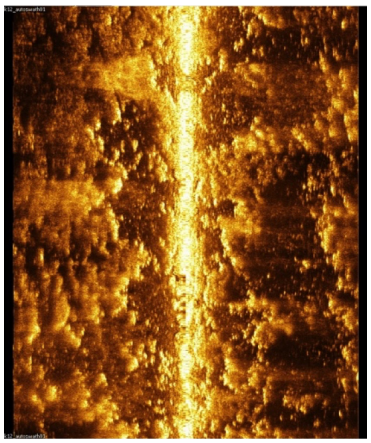
Filling a Data Gap and Facilitating Resource Stewardship Following Hurricane Sandy

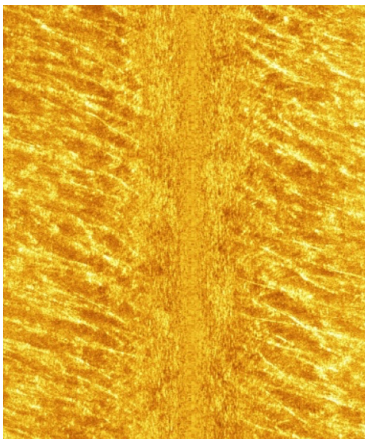


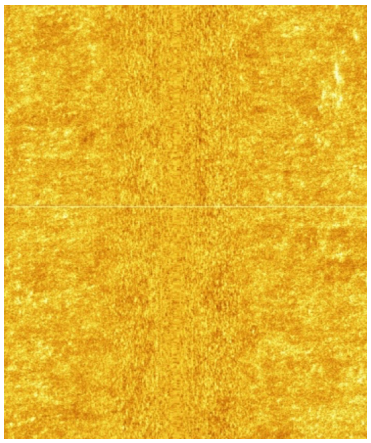


Images of the southern tip of Assateague Island National Seashore show two types of preliminary data used in developing habitat maps. In the sidescan sonar map (left), a range of gold colored tones represent various seafloor types. In the bathymetry map (right), the color scale ranges from green to blue, representing shallower to deeper water depths, respectively. Together, these maps provide a rich picture of the various habitats and their characteristics present off the coast of our parks. Credit: Art Trembanis and Doug Miller, University of Delaware.

Research teams from four institutions have been mapping the underwater habitats of four coastal National Parks in the northeast. This submerged habitat mapping effort provides researchers and National Park Service (NPS) staff with a unique view of seafloor features and habitats. The NPS is charged with protecting vast submerged areas, yet the current information base about those areas is limited. Managers need to better understand the ecosystem structure and function within National Parks - including submerged areas - and how these habitats are changing in response to storms like Hurricane Sandy, sea-level rise, ocean warming, pollution, and other factors in order to initiate effective protection and management strategies.







Sidescan sonar images of the ocean bottom, showing areas of dense seagrass (top left), flat sand (bottom left), and sand waves (top right). As the name implies, sidescan sonar emits sound at an angle. As a result, the area directly under the vessel, referred to as the nadir, is not ensonified, which causes the distortion that is visible along the center of each image. Credit Monique LaFrance Bartley, Graduate School of Oceanography, University of Rhode Island.

Submerged Habitats and Features Being Mapped and Inventoried

Like the terrestrial environment, the submerged landscape of northeast coastal parks is complex. Habitat types and features may include broad relatively flat plains, areas of sand waves, mud flats, natural and dredged channels, and shelfs. Sediment types are also variable (e.g., mud, sand, cobble, boulders). Biologically, submerged habitats include seagrass beds, algae-dominated areas, and diverse benthic communities comprised of numerous invertebrate species. Historical and archeological features are also important

components to submerged mapping. This submerged mapping effort being conducted at northeast coastal parks will encompass all of these features and more.

How will the Habitat Maps and Inventory Information be Used?

Submerged habitat maps will illustrate the distribution and extent of seafloor habitats and resources present within the parks. This solid understanding of the park will support ongoing NPS efforts to identify and implement **ecosystem-based management**, conservation, and climate change-adaptation strategies. For example, this research may inform NPS staff of park areas that may be considered for recreational and educational use or conservation.

These mapping efforts will contribute to **coastal resilience**, helping to understand the potential effects of major storms and the impacts of various climate change occurrences, such as sea-level rise and ocean warming. The mapping and inventory may reveal submerged resources that are degraded and require restoration actions that will enhance their resilience to climate and other stressors.

Mapping projects will develop **baseline datasets**. There is limited information on the marine portions of these coastal parks – both the habitats and physical features that are present and the species that inhabit these areas. Mapping and inventory of habitats and species will provide baseline information to serve as a point of comparison for future data collection to evaluate changes in response to storms, ocean warming, contaminant spills, and other influences. These baseline datasets can also support other research, including hydrodynamic and sediment transport modeling, and guide the design of submerged resource monitoring programs.

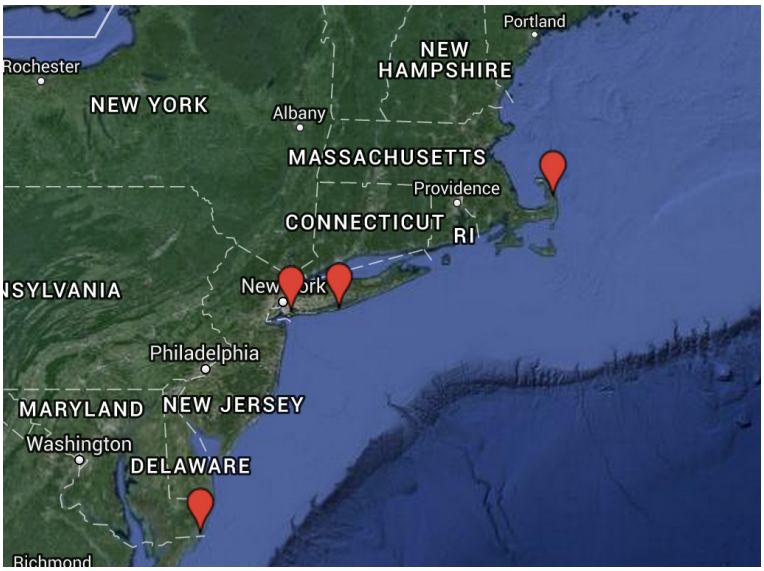
This post-Hurricane Sandy project will **advance the NPS mapping program** within the coastal parks in the northeast and throughout the nation, as well as enhance working relationships and collaborations between the NPS and research partners. These efforts will provide valuable guidance to others that are confronted with the challenges of submerged mapping in shallow and turbid waters, common characteristics of northeast coastal parks.

Image of acoustic sonar being used at the four coastal parks. The sonar is capable of collecting sidescan and bathymetry data simultaneously. Credit Monique LaFrance Bartley, Graduate School of Oceanography, University of Rhode Island.

The University of Delaware's mapping team on board the University's Research Vessel, R/V Joanne Daiber. Credit Art Trembanis and Doug Miller, University of Delaware.

Three of the bottom types represented in the Northeast Coastal and Barrier Network parks: sandy bottom (left), some seagrass (right), and dense seagrass (far right). Credit Monique LaFrance Bartley, Graduate School of Oceanography, University of Rhode Island.

A sediment sample from the seafloor collected by the grab sampler. Credit Monique LaFrance Bartley, Graduate School of Oceanography, University of Rhode Island.



Location of submerged mapping projects at Assateague Island National Seashore, Gateway National Recreation Area, Fire Island National Seashore, and Cape Cod National Seashore.

The Mapping and Inventory Process

Habitat Data Overview: Habitat mapping is accomplished through the collection of high-resolution acoustic data and sediment and biological samples of the seafloor. To define habitats, researchers look primarily at geological and biological data. Geological data includes sediment composition, as well as structural features such as sand waves, mud flats, and boulder fields. Biological data involves examining the plant and animal species that live within the area. Chemical and physical data can also play a role in habitat determination. Chemical features may include salinity (or salt content) and other chemical constituents of the water column. Physical features may include currents and waves. For this coastal park mapping effort, all data will follow the Coastal Marine and Ecological Classification Standard (CMECS), a framework designed to allow users to classify, share, and examine data on the marine environment in a consistent manner.

Site Selection: NPS selected priority areas to be mapped for each coastal park. At Assateague Island National Seashore, researchers will map the entire 58km ocean shoreline, repeating a mapping effort completed in 2011 and providing an opportunity to compare pre- and post-Hurricane Sandy conditions. At Gateway National Recreation Area, researchers are studying both the ocean and bay portions of the Sandy Hook Unit, providing a complete assessment of this barrier spit ecosystem that sustained significant flood inundation from Hurricane Sandy. At Fire Island National Seashore, researchers are mapping the bayside shore of the federal-designated Wilderness Area and the location of a breach through the barrier island created by Hurricane Sandy, as well as other natural bay shoreline areas. At the most northern park included in this mapping study, Cape Cod National

Sun reflecting on the calm surface at Fire Island National Seashore masks the complexity of habitats below. Credit Monique LaFrance Bartley, Graduate School of Oceanography, University of Rhode Island.

Seashore, researchers are studying a diversity of priority areas with management implications, including enclosed coastal embayments and portions of the ocean and Cape Cod Bay shoreline.

High-resolution Acoustic Data Gathering

Bathymetry, or bottom topography, data are collected using an acoustic sonar. The sonar determines water depth by sending sound from the sonar to the seafloor and measuring the time it takes for the sound to return to the sonar. These bathymetric data collected at the coastal parks will be of much greater resolution, or detail, than currently available data.

Sidescan sonar produces an image of the seafloor similar to a photograph, but based on sound. Sidescan data are used to identify seafloor features and habitats. Like bathymetry, sidescan data are collected by an acoustic sonar, though different parameters are measured. The sonar sends sound towards the seafloor and then measures the return signal (i.e. the amount of sound that is reflected back to the sonar and its intensity). The return signal varies based on characteristics of the seafloor. For example, much of the sound signal is absorbed in muddy sediments so the return signal is weak. In contrast, for hard sandy bottoms, much of the sound is reflected off the bottom and the return signal is strong. The sidescan imagery is a representation of the return signal and provides scientists with information about sediment type and geological and biological features of the seafloor.

Researchers prepare to deploy a grab sampler (above), which will collect samples of seafloor material to be analyzed for sediment type and biology. The samples are processed through a metal mesh screen, or sieve (right). Credit Art Trembanis and Doug Miller, University of Delaware (above). Credit Mark Borrelli, Center for Coastal Studies (right).

Organisms captured using a grab sampler include this brittle star (left), amphipod (middle), and worm (right). Credit Mark Borrelli, Center for Coastal Studies.

Ground-Truthing and Species Inventories

Ground-Truthing is the collection of physical data or images to verify the interpretations of the acoustic data and to develop a quantitative species and sediment inventory. Samples of the sediment and biota on and within the sediment are collected with a grab sampler. The sediment is classified by grain size (e.g., clay, silt, sand, etc.), organic content, and other properties that are important to defining different habitats and organism preferences. The organisms within the grab sample are identified to particular species and counted. For a more expansive view of an area, underwater cameras collect images or videos of the seafloor. To view a cross-section of the water-sediment interface on the seafloor, researchers use a specialized camera known as a Sediment Profile Imagery (SPI) camera.

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