Eelgrass Habitats Get a Boost from GIS

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The eelgrass restoration project is repopulating Narragansett Bay with eelgrass. GIS and a statewide mapping effort are important to the success of this effort. Shown here is an example of a healthy eelgrass (*Zostera marina*) bed. Photo courtesy of Randy Shuman.

Eelgrass (*Zostera marina*) is the primary seagrass in Rhode Island and was once widespread throughout Narragansett Bay and Rhode Island's coastal ponds. Highly valued as a refuge, nursery ground, and food resource for a number of commercially important fin and shellfish, eelgrass also stabilizes sediments from the erosive force of waves and currents. In the late nineteenth century and again in the 1930s, eelgrass declined by more than 90 percent throughout its North Atlantic range due to wasting disease, which is caused by a marine slime mold that increases the susceptibility of eelgrass to wave action and environmental stressors. Although wasting disease remains a primary cause for the decline of eelgrass, additional threats have surfaced during the last two decades. Increased development and related population pressure along the coastal zone have led to increased nutrient and sediment inputs into coastal waters. These excess inputs increase plankton production and turbidity in the water column and consequently reduce the grasses' ability to photosynthesize and threaten its survival. Today, eelgrass beds cover less than 100 of Narragansett Bay's 96,000 acres. The loss of eelgrass prompted the development of an aggressive restoration program.

The water quality and clarity of Narragansett Bay have improved in recent years because of stringent wastewater treatment regulations and other environmental management policies. Areas of the bay that once were polluted are much cleaner now and may again support eelgrass populations. During the last several years, eelgrass restoration has been attempted in Narragansett Bay and in other coastal estuaries with varying degrees of suc-

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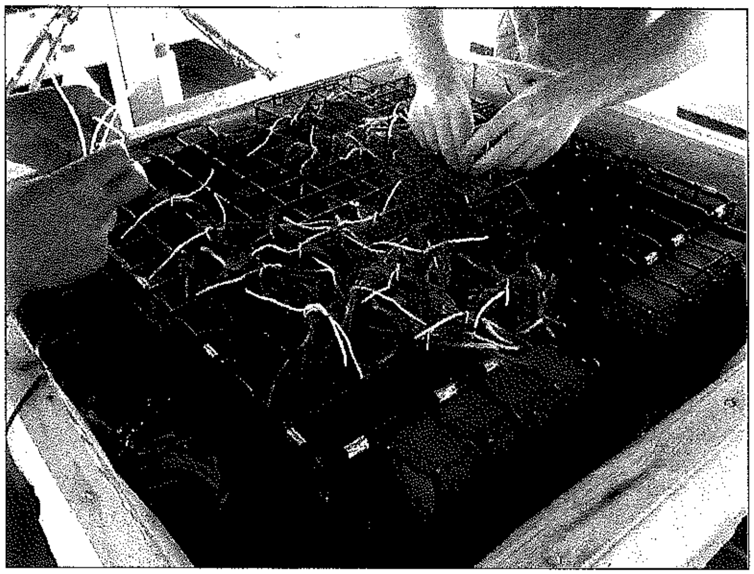
cess. Restoration efforts have typically failed 80 percent to 90 percent of the time. The reasons for failure are varied and scientists and managers are still learning about the important factors that contribute to successful restoration. However, scientists agree that site selection and water quality and clarity are among the most important.

GIS has been used to improve eelgrass restoration site selection in two ways: data management and modeling. The Rhode Island Coastal Resources Management Council (CRMC) and URI's Environmental Data Center (EDC) developed the Coastal Eelgrass Habitats of Rhode Island Web site (www.edc.uri.edu/eelgrass) in the spring of 2001 to provide access to GIS data that is pertinent to the management of eelgrass in Rhode Island waters. In addition, the site contains information about eelgrass policies and regulations and an Internet Mapping Server (IMS), which gives resource managers and the public access to past and present eelgrass data and provides the opportunity for better coordination of restoration efforts. Before the inception of this Web site, relevant eelgrass datasets were held by several organizations, in different data formats, and with varying degrees of documentation. Any attempt to examine, locate, or model potential restoration sites would have been difficult at best. The availability of high quality eelgrass data has made it possible to develop GIS-based models of eelgrass restoration sites. In spring 2001, scientists from Save the Bay, the Narragansett Bay Estuary Program, CRMC, and the EDC worked together to



Volunteers tie eelgrass onto a structure called the Transplanting Eelgrass Remotely with Frames, aboard the R/V *Alletta Morriss*, Save the Bay's educational vessel. The eelgrass was then planted at a predetermined site for optimum growth and survival.
Photo by Steve Cooper, Save the Bay.

cations in Narragansett Bay. Mike Traber, a specialist in restoration ecology at GSO, Andy Lipsky, restoration coordinator at Save the Bay, and Jill Bodnar, a specialist in web-based GIS applications in URI's Department of Natural Resources Science, each gave considerable time and expertise to develop the mapping, implement subsequent restoration efforts and to prepare this article.

The site selection model used for Narragansett Bay is based on a model developed by GSO alumnus, Fred Short, and his colleagues at the University of New Hampshire. Several GIS data layers, notably bathymetry, and current and historic eelgrass distribution were acquired through the CRMC/EDC eelgrass Web site. A light attenuation dataset for Narragansett Bay was created from several long-

a composite picture of potential eelgrass restoration sites within Narragansett Bay. Using this map as a guide, Save the Bay is utilizing the Transplanting Eelgrass Remotely with Frames (TERF™) method to test and rank each high-potential site based on its ability to support eelgrass. These high-ranking sites will then be targeted for more aggressive restoration efforts (http://marine.unh.edu/jel/fred/siteselection01.html).

Since declines in water quality have been one of the most significant causes of eelgrass loss, limiting nutrient loading from combined sewer overflows and nonpoint sources of nutrients is key to successful eelgrass restoration. To mitigate nutrient loading into coastal waters and improve water quality levels, an understanding of the hydrologic connections betypes and important water bodies is needed. GIS provides the tools to visualize and analyze hydrology, topography, and land-use/land-cover patterns and to examine the relationships between these diverse entities.

The link between water quality and eelgrass is well founded. But few eelgrass restoration projects are sufficiently funded to include watershed management. Fortunately, the benefits of watershed management are varied and many projects are underway in Rhode Island. Save the Bay, in conjunction with URI Cooperative Extension, is using GIS and the MANAGE watershed assessment tool (www.uri.edu/ce/wq) to identify pollution threats, or "hot spots," to the waters of the Wickford Harbor watershed. Combining information on water resources, drainage basins, soils, land use/land cover, and open space helps to translate complex land-water relationships into terms that can be used by informed resource managers to benefit water quality.

We are relying more and more on GIS in our attempts to restore eelgrass into the waters of Rhode Island, but the success of these efforts will be determined by the accuracy of our data. Although our statewide databases are good, the water quality and distribution of eelgrass in Narragansett Bay changes every year. As changes occur, the spatial and temporal accuracy of our data decreases, the overall effectiveness of spatial technologies is lessened, and our ability to locate potential restoration sites is diminished. Our challenge now is to monitor the environment and to maintain the database. We need to track the success of our restoration experiments, monitor the extent and condition of existing eelgrass beds, and ensure that the data are included in publicly accessible GIS datasets. ■