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Critical Grass

A vital source of food and shelter for a wide variety of marine life, eelgrass has disappeared from much of the Northeast's shallow inshore waters over the last century. Now scientists and volunteers are hoping to restore these underwater meadows.

by Joe Myerson

My friends and I were entering our teens when we started exploring the waters of Pocasset Harbor, Massachusetts, with masks and snorkels. The breathing tubes were new to us, so we floated face-down on inner-tubes, peering into eelgrass beds at low tide.

As we hovered above, the grass looked like a mysterious swaying jungle of green and brown. Tiny black snails clung to the fronds. Little fish swam among the plants. Crabs scuttled between the waving blades, and scallops lay on the bottom in abundance. Baby flounder darted away from our shadows, burying themselves in the bottom a few feet away. Sandy patches in

Cornell Cooperative Extension Marine Program, www.seagrassli.org

Eelgrass meadows, like this healthy one in Long Island Sound, provide food and shelter for numerous species of fish and shellfish. Many sea grass beds have disappeared during the past 70 years, mostly due to human activity on and near the water.

Botany educator Steve Schott harvests eelgrass from a healthy bed off eastern Long Island, New York.

Cornell Cooperative Extension Marine Program Photos, *www.seagrassli.org*

Eelgrass is a flowering plant, complete with leaves (those long green blades), rhizomes (runners that expand an eelgrass patch) and roots. It spends its entire life underwater, where it blossoms and produces seeds, which can also start new plants.

This juvenile northern puffer is one of many fish species that use healthy meadows of Zostera marina *as nurseries.*

Above: Tiny snails and other small creatures graze on the surface of eelgrass leaves.

Below: A winter flounder finds food and shelter in a Long Island Sound eelgrass meadow.

the midst of the jungle sometimes turned out to be half-buried fluke. As fans of the Lloyd Bridges television show *Sea Hunt*, we could almost imagine that the harmless American eels hiding among the plants were dangerous morays.

Many of Pocasset Harbor's eelgrass meadows have since died off. In fact, scientists think that up to 90 percent of the world's sea-grass habitats have vanished since the early 20th century, due to a variety of factors.

I hadn't thought much about eelgrass until last June, when I joined a group of volunteers on the beach at the Fort Getty Recreation Area in Jamestown, Rhode Island. We were carefully untangling eelgrass plants, counting them into bundles of 50 and storing them in coolers, wrapped in moist cloths. The group, along with volunteer scuba divers who carefully dug the plants from the bottom and kayakers who ferried net bags of eelgrass to the shore, were part of an effort by the Rhode Island environmental group Save The Bay (STB) to help restore the lush underwater environment that I had found so thrilling 50 summers ago. Other divers would eventually take the healthy shoots we harvested and anchor them to the bottom in other parts of Narragansett Bay using U-shaped bamboo skewers. Last summer some 200 volunteers planted approximately 120,000 eelgrass shoots in sites off Prudence Island, Hog Island and Coggeshall Point, according to Marci Cole, coastal ecologist for Save The Bay.

A Flowering Plant

Before we plunged our hands into the tangle of eelgrass plants, known to scientists as *Zostera marina*, STB staff members showed us how to sort and count the shoots. They also explained that eelgrass is a flowering plant, complete with leaves (those long green blades), rhizomes (runners that connect one plant to the next and help expand an eelgrass patch) and roots. It spends its entire life underwater, where it blossoms and produces seeds, which can also start new plants. In the autumn *Zostera* becomes dormant and sheds its leaves, which turn brown and float in clumps on the surface, eventually ending up as matted brown masses on leeward shores.

Eelgrass grows in shallow, intertidal areas in bays, estuaries and other coastal zones. As a green plant, it needs sunlight to survive. In clear water, it can grow in depths up to 40 feet, but most eelgrass beds are found in shallower places. Bathers might find *Zostera* uncomfortable underfoot, especially at low tide, but it's critical to the survival of many sea creatures and to the livelihoods of people who harvest them. Bacteria and microscopic larvae cling to (and often eat) the slender leaves. Numerous species of fish, including tautog, lay their eggs on the leaves. Bay scallops, quahogs, blue crabs and lobster depend on eelgrass beds for shelter, nourishment and as nurseries for their tiny young. Certain types of waterfowl graze on the tender shoots and leaves, relying on eelgrass during seasonal migrations. Decomposing leaves on the shore serve as a habitat for tiny crustacea and insects—and they, in turn, provide a feast for shore birds.

"Juvenile predator species and forage fish come from estuaries, and eelgrass beds are important for producing and protecting the young of these species," explains Fred Short, research professor in the Department of Natural Resources and Environment at the University of New Hampshire, who has been studying sea grasses for more than 20 years. *Zostera*'s indirect impact on fisheries is also important, he adds. "Juvenile lobsters burrow in eelgrass beds during the day and go out to feed at night. Many migratory fish hop from grass bed to grass bed as they move up and down the coast. Radio-tagged striped bass, for example, have been tracked going from bed to bed. And eelgrass beds are a nursery for juvenile winter flounder."

Beds of *Zostera marina* grow in shallows on the East Coast as far south as the Carolinas, as well as along the Pacific coast, the south coast of Greenland and Europe's North Sea and the Mediterranean. The first great shock to this productive habitat came

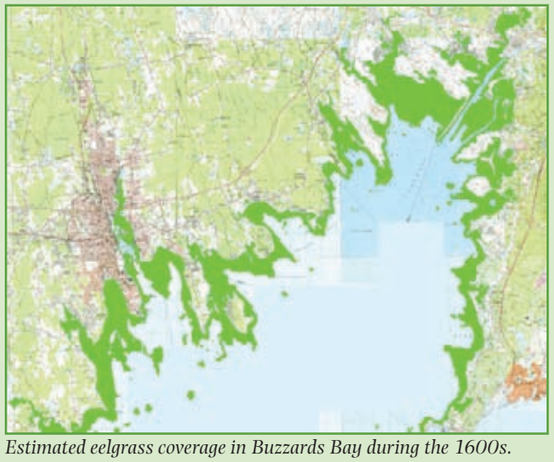
Save The Bay Photos, www.savethebay.org

Opposite page: A Save The Bay volunteer loads harvested eelgrass shoots into baskets so they can be planted by divers.

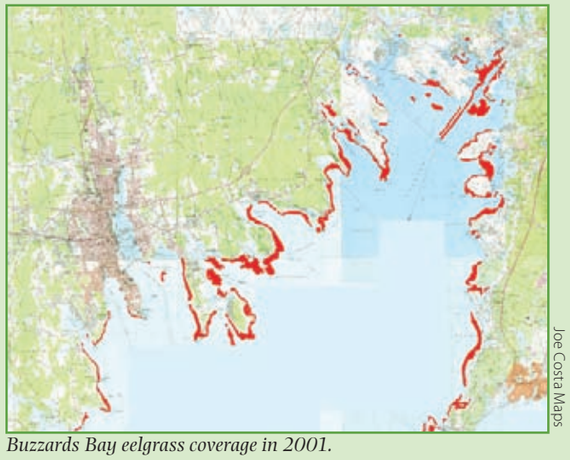
Left: Volunteers sort the harvested plants into bundles of 50.

Below: Divers donate their time to harvest eelgrass from healthy beds and replant them in restoration sites.

then and now



Estimated eelgrass coverage in Buzzards Bay during the 1600s.



Buzzards Bay eelgrass coverage in 2001.

Joe Costa Maps

These two maps of Buzzards Bay, Massachusetts, show the effects of modern human activity on the distribution of eelgrass beds. Although the maps were prepared for a 2003 conference on the state of Buzzards Bay, similar maps could probably be assembled for any of the Northeast's major bays and estuaries. For the map at left, Joe Costa of the Buzzards Bay National Estuary Program (*www.buzzardsbay.org*) estimated the extent of eelgrass coverage that probably existed in the bay around 1600, before the arrival of European settlers. He based this estimate on assumptions of water quality and transparency and on the likelihood that eelgrass grew to depths of 12 feet MLW (mean low water) in the upper bay and down to 20 feet MLW in lower Buzzards Bay. Since Costa and other researchers have found the remains of eelgrass seed husks in sediment cores, it would be possible to verify the historical presence of eelgrass.

The second map is based on aerial surveys of eelgrass cover in Buzzards Bay taken in 1996 by the Massachusetts Department of Environmental Protection. When compared, these maps illustrate that human activity has decreased the clarity of the water and severely reduced the area covered by eelgrass.

—J. M.

in the 1930s, when a blight known as wasting disease (caused by *Labyrinthula zosterae*, a slime-mold-like organism) wiped out 90 percent of the eelgrass beds along the East Coast and in Europe. The disease, spread by contact from plant to plant, turned the eelgrass leaves dark brown and deprived them of the ability to turn sunlight into food. Violent storms, including the Great 1938 Hurricane, scoured away many of the remaining eelgrass beds.

By the 1950s eelgrass began to reappear in many of its old sites, apparently sprouting from the drifting seeds of plants that survived the blight. The impact of the die-off on commercial fisheries was difficult to measure, since so much seafood harvesting takes place offshore. Most species seemed to rebound along with the grass beds, but not all: "The bay scallop was devastated in the 1930s and has never recovered fully," explains Short. "It was wiped out completely in New Jersey, Maryland and Virginia." The scalloping industry in those states remains a dim memory today.

Continuing Threats

"Wasting disease caused the initial decline in eelgrass, and it's never recovered fully," says Steve Schott, marine botany educator with the marine program of the Cornell University Cooperative Extension Service in Suffolk County (Long Island), New York. By the 1960s, after a brief rebound, eelgrass habitat in the Northeast was in retreat again, falling prey to declining water quality—almost all of it triggered by human activity.

Expanding shoreline development has increased the level of sewage discharge, which has elevated the levels of nitrogen and other nutrients in bays and estuaries. Runoff from chemical fertilizers, used in increasing quantities both for agricultural purposes and to keep newly constructed lawns and golf courses green, contributes even more nitrogen and organic materials to the water. Known as nutrient loading, the excess nitrogen feeds enormous blooms of algae, which cloud the water, blocking sunlight from the eelgrass. Epiphytes, algae species that normally coexist with *Zostera* and grow on its leaves, also respond to the extra nitrogen and nutrients with explosive growth, smothering the eelgrass in a light-blocking coat of brown fuzz.

Coastal development also means more runoff from paved roads and parking lots, as well as increased seawall construction, especially in areas like New Jersey's Barnegat Bay. The runoff clouds coastal waters, while waves rebounding from hardened shorelines uproot existing eelgrass beds and prevent seeds and rhizomes from taking root. Another factor, which is more difficult to quantify, has been global climate change; elevated water temperatures promote algae growth while stressing the eelgrass plants, which prefer cold water.

Recreational boating activity has also grown since the 1960s, placing additional pressure on eelgrass beds. Channel dredging, anchors and propellers can all uproot undersea grasses. Increasing numbers of floating docks and slips, as well

Cornell Cooperative Extension Marine Program Photos, *www.seagrassli.org*

UNH Seagrass Ecology Lab

Opposite page: A scup cruises above a restored eelgrass meadow in Long Island Sound.

Top: Bay scallops are one of many species that require healthy beds of eelgrass to survive.

Above: Disappearing eelgrass means fewer blue crabs.

as expanded mooring fields, have meant more blocked sunlight—and fewer healthy eelgrass beds.

Successes and Failures

Save The Bay's Marci Cole estimates that Narragansett Bay's eelgrass beds may once have covered some 10,000 acres. "Now, we have a couple of hundred acres," she says. Restoration projects, some under the auspices of the University of Rhode Island, started in the 1990s. Though success was limited, they led to the development of a number of techniques in use today. STB started replanting eelgrass in 2001. Careful monitoring of various sites indicates an overall success rate of between 50 and 60 percent, with some years and locations doing better than others. "We had a terrible year for water quality in 2003, so we lost that season's transplant at Prudence Island," Cole recalls. "But other sites have a success rate of 105 percent, with the grass expanding on its own."

The Cornell Cooperative Extension has been restoring eelgrass beds on eastern Long Island for approximately 15 years. Botanist Steve Schott puts the area's eelgrass loss since the 1930s at approximately 80 percent, based on surveys of the Peconic estuary that showed almost 9,000 acres in 1930 and only about 1,500 in 2000. He says two restored meadows in Long Island Sound, both on the north shore of the North Fork, have been "doing extremely well, showing signs of expansion." Other sites, in shallower bays with less tidal flush, have shown mixed results. "The eelgrass is pretty healthy in Long Island Sound," Schott adds. "It's a cooler body of water; deeper, with more tidal flush. The eelgrass in the Sound is limited to the eastern part."

Massachusetts has seen two particularly effective eelgrass restoration projects: one in Boston Harbor and the other in outer New Bedford Harbor. Alison Leschen, a biologist with the state's Division of Marine Fisheries (DMF), credits the cleanup of Boston Harbor for the success of the replanting program there, which started in 2004. "Despite the fact that the harbor had been polluted for so many years, the water quality was so much better after the well-documented cleanup [including construction of a tertiary sewage-treatment plant on Deer Island and an outfall pipe that carried treated sewage nine miles into Massachusetts Bay]," she says. After extensive research and volunteer-assisted test plantings, the DMF chose four restoration sites around Long and Peddocks Islands. "They've all done really well," she says. The planting stopped in 2007, and the grass "is growing and spreading like crazy on its own. It doesn't need us anymore." The project was paid for with remediation funds from the construction of a natural-gas pipeline that crossed the harbor.

New Bedford faced a similar situation. The inner harbor was heavily polluted with industrial waste and by an antiquated sewer system. Remediation funds from the industrial cleanup paid for a new sewage-treatment plant. This cleaned the water in Buzzards Bay, just outside the harbor entrance, sufficiently for the National Oceanic and Atmospheric Administration (NOAA) to fund a replanting effort. Fred Short of UNH, who directed the

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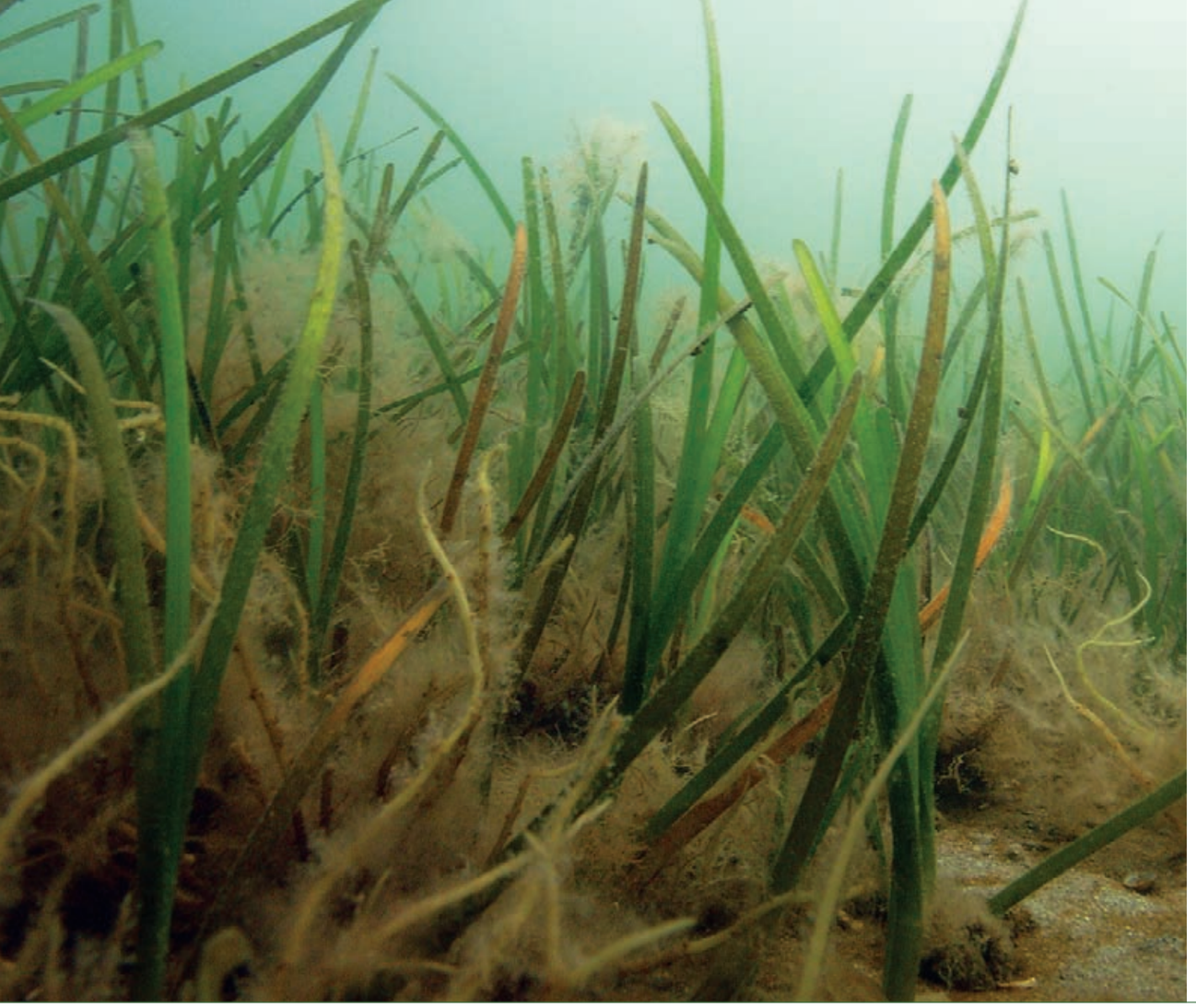
—Fred Short, UNH Scientist



Cornell Cooperative Extension Marine Program Photos, www.seagrassli.org

restoration from 2001 to 2004, says the beds are now thriving—because of improved water clarity. Eelgrass restoration efforts in New Hampshire's Great Bay have been less successful. "We started in 1993, and they did well until 2004," says Short. "That's when they started to decline because of a continued decline in water clarity. Even in a system as well-flushed as the Piscataqua River, human pressure is degrading the growth conditions. They've virtually disappeared now. It's hard to see the restored beds grow, develop, flourish and slowly disappear."

Looking Ahead

Through a program called SeaGrass Net, Short has been gathering data on the health of eelgrass and other sea grass species at 95 sites in 27 countries. Since the monitoring started in 2001, almost half of those sites have registered a decline. In most of those cases, as in the Northeast, he finds a pretty direct correlation between water quality and the health of sea grasses.

In our region, Short says, the healthiest eelgrass beds are "probably in Maine." Parts of Long Island and the waters off islands like Block Island, Martha's Vineyard and Nantucket also have very healthy *Zostera* beds, as do the shores of the Elizabeth Islands—an area in Massachusetts that has seen almost no development since the early 19th century. "Eelgrass beds are healthiest where they experience clear water and are not impacted by human activities," he says. "It's hard to keep our coastal waters clear, and it's hard to bring them back." ◥

When he isn't getting his hands dirty sorting clumps of Zostera marina, *Joe Myerson,* Northeast Boating*'s senior editor, can be found sailing his Cape Dory sloop well above the eelgrass beds of Buzzards Bay, Massachusetts.*

Save The Bay, www.savethebay.org

how you can help

Nitrogen Reduction

Nitrogen loading poses the single greatest threat to eelgrass, especially in populated watersheds. You can limit the amount of nitrogen leaching into the water by reducing the amount of fertilizer applied to your lawn. Another important step is to upgrade septic systems and lobby for municipal sewer connections, as well as to push for nitrogen-removal systems at sewage-treatment facilities.

Know Where You Are

Propeller scarring and frequent anchoring can tear up delicate eelgrass meadows, digging trenches and holes that become the starting points for further erosion. Boaters should stay in dredged channels, watch their charts and raise their engines if necessary. Anchoring in eelgrass beds should be avoided.

Watch Your Wake

Kicking up a wake, especially at low tide or in shallow areas, can roil the water and make it more difficult for eelgrass plants to get the sunlight they need. Excessive wakes can also accelerate the breakup of *Zostera* meadows that have been scarred by propellers and anchoring.

Manage Your Mooring

The shadows cast by moored boats can block sunlight in one area for a long enough time to impede the growth of *Zostera* plants. Communities can moderate this problem by keeping mooring fields compact.

As mooring chains drag on the bottom, they clear the eelgrass in a circle around the base of the mooring. In regions with a limited tidal range the clearing will not be much larger than that created by the boat's shadow, but in northern New England, where the tides can vary from 15 to 20 feet, some moorings use as much as 100 feet of chain and clear circles almost 200 feet across.

A number of eelgrass-friendly mooring systems are now available. Some replace the chain with a flexible, shock-absorbing cord, while others use floats to keep the chain off the bottom. The flexible system has the additional advantage of allowing moorings to be placed more closely together. Both systems are more expensive than conventional moorings, however.

Harvest Shellfish Sensibly

Clamming can disrupt eelgrass meadows. Commercial harvesters tend to stay away from healthy *Zostera* beds because they're harder to work with bull rakes. Recreational clammers, who work at low tide, should also avoid digging in eelgrass beds.

Build Eelgrass-Friendly Docks

Docks break up the band of eelgrass that normally hugs the shoreline. They also block sunlight. Floating docks are especially damaging in this regard. Narrower fixed docks, built on relatively high pilings, allow more sunlight to reach the bottom.

—J. M.

Opposite page: Eelgrass in a bed on Long Island's Peconic estuary struggles against an overabundance of algal epiphytes.

Top left: Baitfish like these Atlantic silversides often gather over eelgrass meadows, attracting larger predators.

Above: This bed of Zostera marina *in Shinnecock Bay, New York, shows multiple propeller scars.*