Photo Credit: Chris Pickerell

HABITAT PROTECTION & RESTORATION

NATIONAL ESTUARY PROGRAM

SOME OF THE HABITATS FOUND IN OUR NATIONAL ESTUARIES

Photo Credit: New Hampshire Estuaries Project

Photo Credit: Donna Bollenbach

Photo Credit: Center for the Inland Bays

Photo Credit: Center for the Inland Bays

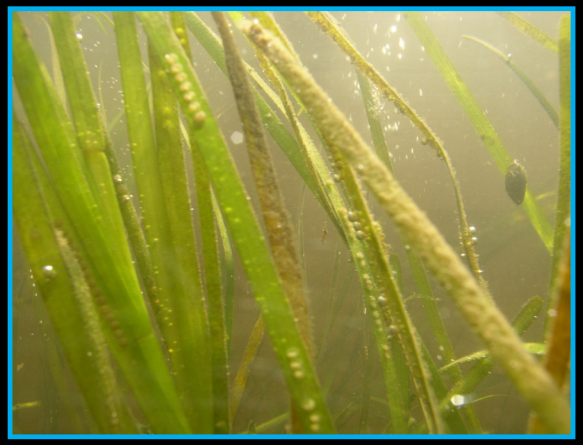

Photo Credit: New Hampshire Estuaries Project

Photo Credit: Stephan Gersh

Photo Credit: Oregon Department of Fish and Wildlife

Photo Credit: Stephan Gersh

Photo Credit: Nancy Laurson

Photo Credit: Kristie Gianopolus

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NATIONAL ESTUARY PROGRAM: A NETWORK PROTECTING AND RESTORING COASTAL ECOSYSTEMS

INTRODUCTION

Estuaries are transitional zones between fresh water from rivers and salt water from the ocean. They are the most biologically productive, economically valuable, and densely populated places on earth. Estuaries and their nearby habitats provide essential breeding/nursery areas, food and cover, and critical migratory corridors for many coastal and marine organisms.

The EPA has designated 28 of these special places along the coastal United States as estuaries of national significance or National Estuary Programs (NEPs). The NEP, EPA's flagship national watershed program, was established under the Clean Water Act to maintain and improve water quality, and to protect and restore habitat, native fish, shellfish, and wildlife populations that inhabit those areas.

Each NEP is unique in many ways. Their geographical locations and habitats they contain vary widely. Their program boundaries, or area in which they conduct their efforts and focus their work, range from very large approximate 23,000 square miles down to roughly 90 square miles. NEPs encompass a variety of habitat types throughout their coastal watersheds, from forested uplands, down to barrier beaches, and everything in between (such as seagrass beds, mudflats, and salt marshes). Some NEPs are urban and densely populated, while others belong to rural watersheds with small populations.

However, habitat loss and degradation—the disruption of an environment's normal ecological functions—is a common problem among all the NEPs and likewise, watersheds all across the country.

NEPs have already documented losses in the quantity and quality of estuarine habitats. Like other coastal areas, impacts to habitat are a result of historic and continuing human uses and increasing population growth. NEPs and other coastal areas are also vulnerable to the effects of climate change, including sea level rise and its resulting impacts on habitat. Invasive species are an added and particularly complex problem as they crowd out native plant and animal populations, especially where habitat has been disturbed.

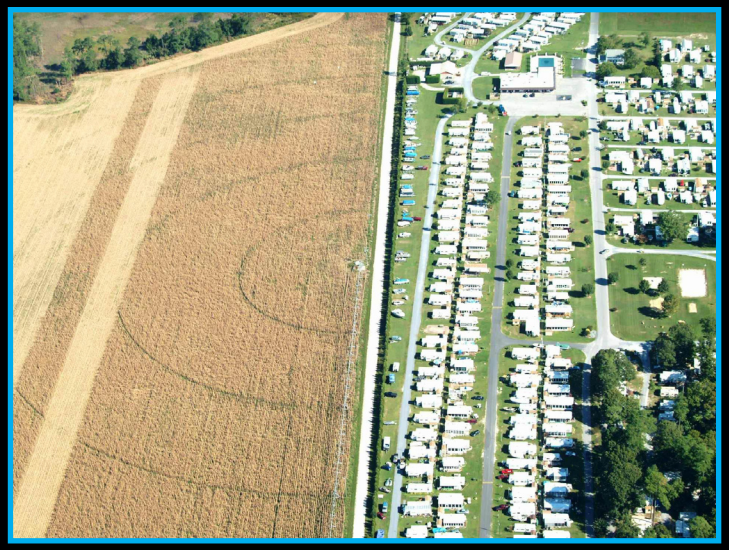


Photo Credit: Center for the Inland Bays

Photo Credit: Stephan Gersh

Photo Credit: Costal Bend Bays and Estuaries Program

Photo Credit: Mobile Bay National Estuary Program

Photo Credit: Maryland Coastal Bays Program

HABITAT LOSS & DEGRADATION

COMMUNITY DRIVEN, PARTNERSHIP BASED

Addressing these kinds of problems requires thoughtful responses based on sound scientific study, strong partnerships, community involvement, and effective action. A community based program from the very beginning, the NEP works exclusively through partnerships made within all levels of government, environmental agencies and non-profit organizations, business, academia, and citizens to provide a healthier environment for the plants and animals that live, feed, rest, and reproduce within their estuary's habitats. This collaboration is also fundamental to the many public outreach programs NEPs need to inform and educate communities about the living resources in their communities and how to protect them—an essential module in every NEP plan that helps ensure widespread, long-term support of this important work.

Each NEP works with their many stakeholders, and uses their expertise to collectively develop a Comprehensive Conservation Management Plan (CCMP) with specific tailored actions designed to protect the estuary and its resources. The object is to create and implement a plan that addresses the whole range of environmental problems facing the estuary—including those that address habitat loss and degradation.

There is a wide range of NEP habitat efforts contained in each CCMP and level of NEP involvement implementing those actions. NEP habitat efforts generally fall into two categories: restoration, which involves returning damaged or lost habitats to a preexisting historic or natural condition; and protection, which preserves existing habitat and prevents further degradation. Habitat projects often involve working with multiple habitat types on a single site and may require a variety of techniques and efforts to protect and restore them. Further, both protection and restoration can take place on the same habitat site. Key to these efforts is taking steps to improve water quality as well. Lowering temperature, reducing sediments, nutrients and bacteria, and increasing dissolved oxygen all benefit the health of fish and wildlife.

Some NEPs take an active role by hiring contractors to conduct the site modification work. (e.g., restoring tidal flow to a wetland), purchasing lands for open space, or facilitating easements from a willing landowner. Many NEPs provide funding and/or technical assistance to partners to implement projects such as replacing culverts, or installing fish ladders. Yet other NEPs are involved long before the

Photo Credit: Sarasota Bay Estuary Program

Photo Credit: Barataria-Terrebonne National Estuary Program

Photo Credit: Casco Bay Estuary Partnership

Photo Credit: Gary Raulerson

Photo Credit: Salem Sound Coastwatch

HABITAT RESTORATION AND PROTECTION

"earth-moving" even begins, by collaborating on engineering designs, assisting in obtaining appraisals, and helping to move through the permitting process. Frequently, NEPs work with volunteers and community members, whether planting native vegetation, removing invasive plants or growing oyster reefs. Whatever the level of NEP engagement is on a particular project, one thing remains unchanged from coast to coast, restoration and protection efforts require extensive coordination with partners from many areas. The NEP is uniquely positioned to do just that.

ESTUARIES PROVIDE UNMATCHED ECONOMIC VALUE

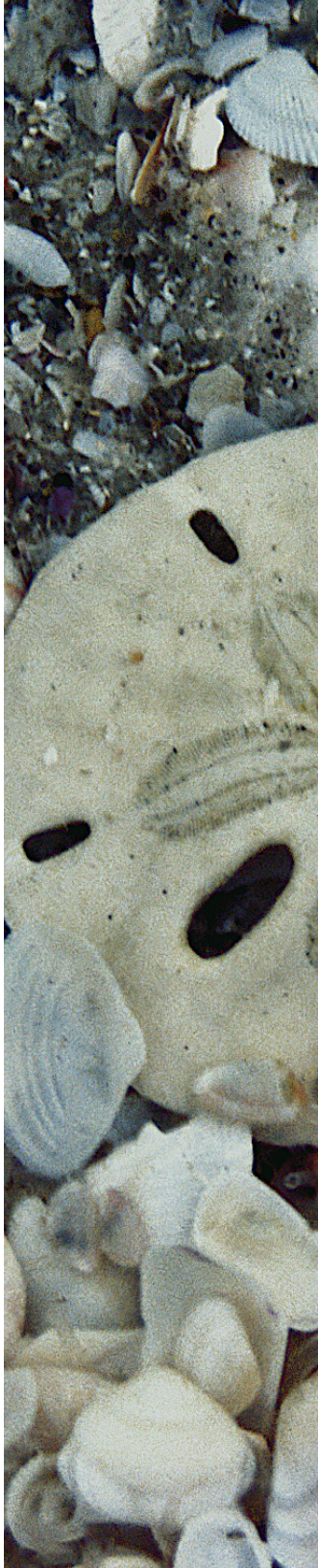
NEP projects produce far-reaching results for plants and animals, they also lend important benefits to people. Strong, functioning and thriving estuary habitats are critical to sustaining billions of dollars through employment, tourism, commercial and recreational fishing, shipping, transportation, science, foodstuffs, and more.

Estuaries provide essential habitat for 80-90 percent of the country's recreational fish catch and more than 75 percent of our commercial catch (The National Estuary Program Coastal Condition Report 2005, U.S. EPA, June 2007; NOAA; NRC)

Coastal tourism—boating, swimming, surfing, fishing and bird watching—attracts some 70 percent of the U.S. population every year, pulling in as much as $12 billion annually; and boat products and services generate another $10 billion. (The National Estuary Program Coastal Condition Report 2005, U.S. EPA, June 2007; NOAA; NRC)

Estuary regions comprise only 13 percent of the land area of the continental US, yet contain 43 percent of the US population, and produce 49 percent of the nation's output (The Economic and Market Value of Coasts and Estuaries: What's at Stake? Ed. By Linwood H. Pendleton. Arlington VA: Restore America's Estuaries 2008)

NEP study areas encompass coastal areas that support over $4 trillion in economic activity



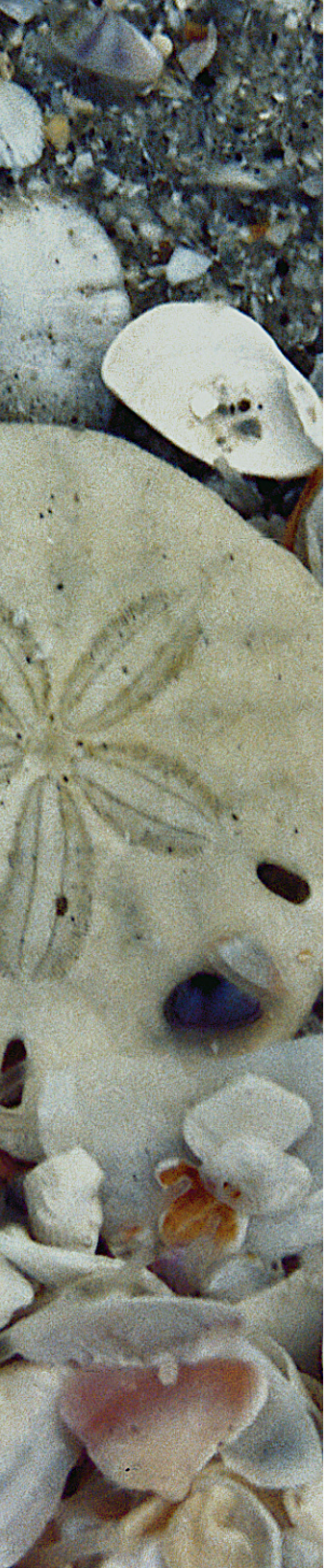


Photo Credit: Misty Nabers Nichols

and 39 million jobs (Economic Profiles for EPA's National Estuary Program, U.S. EPA, National Center for Environmental Economics 2003)

SUCCESSFUL OUTCOMES DEPEND ON SOUND PLANNING

The CCMP addresses the entire range of environmental problems facing the estuary, and provides a blueprint to identify, prioritize, and tackle habitat loss and degradation.

Some universal CCMP objectives for NEP habitat restoration and protection work include:

- Assessing habitat conditions: monitoring and sampling the habitat's physical, biological, and chemical characteristics and documenting changes to determine status and trends.

- Setting habitat goals: identifying and evaluating habitat sites to target the number of acres and species of concern, and prioritizing efforts. An inventory is often developed and sites are mapped.

- Funding and implementing projects: habitat protection and restoration: Providing the funds and technical assistance to conduct on-the-ground restoration and acquire land for protection. Projects are designed to improve habitat structure and functioning so species have the necessary conditions to live and thrive.

- Evaluating outcomes: monitoring efforts and tracking progress to determine the effectiveness of its habitat efforts is a central component of every NEP plan.

Photo Credit: Jim Young

Photo Credit: Charlie Spiekerman

Photo: Oregon Department of Fish and Wildlife

Photo Credit: Tampa Bay Estuary Program

SOME OF THE SPECIES FOUND IN OUR NATIONAL ESTUARIES

Photo Credit: Margherita Pryor

Photo Credit: Tampa Bay Estuary Program

Photo Credit: Jarrett Woodrow

Photo Credit: Missy L. Christie

ACHIEVING ENVIRONMENTAL RESULTS

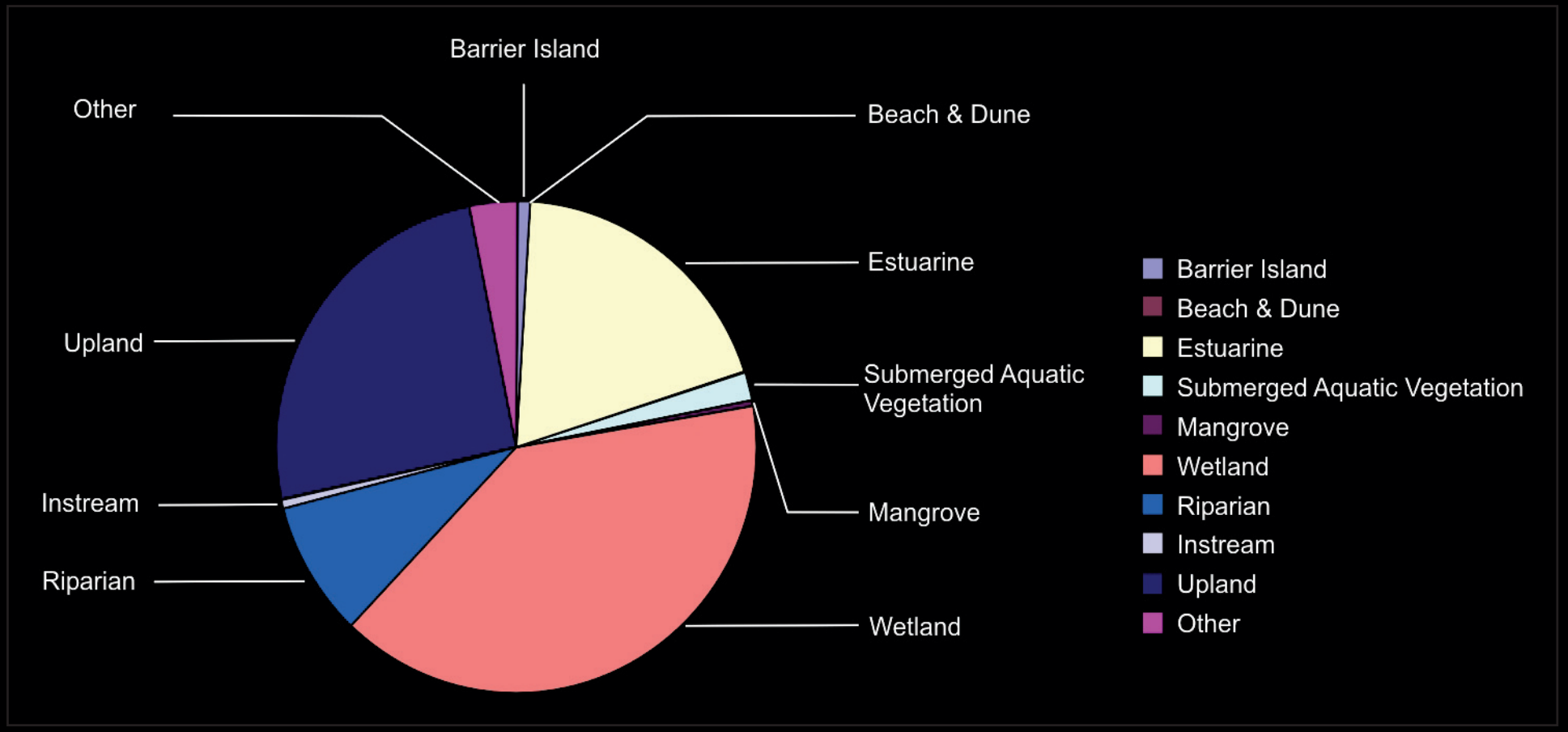
NEP habitat efforts produce tangible results. NEPs have restored and protected over 1.2 million acres of estuarine habitat since 2000. Wetlands (salt marsh, forested wetland, freshwater wetland, shrub swamp) have constituted the largest portion of acres.

LOOKING AHEAD

These results are an important achievement that will go a long way in protecting the integrity of NEP coastal ecosystems and their natural resources. As the NEP moves forward in its work, continued success requires NEPs keep studying current and emerging impacts to habitats, increase their scientific understanding of restoration techniques, reassess actions they have taken, and implement new restoration and protection efforts to enhance these very valuable and critical estuarine habitats.

What follows are a number of significant NEP habitat efforts that have taken place across the country. The work illustrated here provides a good cross-section of the different types of NEP protection and restoration projects that showcase how NEPs are "Effective" in producing environmental results.

National Estuary Programs have protected and restored over 1.2 million acres of habitat since 2000.



Casco Bay Estuary Partnership

REOPENING SHELLFISH BEDS

www.cascobay.usm.maine.edu

The Casco Bay region is the most densely populated area in Maine. While the watershed represents only three percent of Maine's land area, its 41 municipalities include a quarter of the state's population. Composed of 578 miles of shoreline, including 785 islands, islets, and exposed ledges in Casco Bay, the water surface covers nearly 200 square miles.

The bay supports a wealth of industries including shipping and petroleum transport, commercial fishing, tourism, and recreation, and shellfish harvesting. Fishing, recreation, and tourism in Casco Bay generate hundreds of millions of dollars annually.

Despite increasing population, much of the area still contains high value habitat, including rocky and sandy beaches, eelgrass beds, saltmarsh, and riparian habitat, which provides nursing, refuge, and feeding grounds to 850 species of marine life, including clams, quahogs, mussels, and other mollusks, lobsters, fish, seals, and tens of thousands of water birds.

The Casco Bay Estuary Partnership (CBEP), one of 28 National Estuary Programs across the country, has been working with its partners to successfully attain and maintain a functioning, healthy ecosystem which supports endangered and threatened species, fisheries, commerce, and recreation.

CHALLENGES

Clamming and other shellfishing represent an important tradition and provide a considerable livelihood and economic value to Casco Bay residents and commercial harvesters alike. Yet in recent decades, increased bacterial pollution from sources such as stormwater runoff, malfunctioning septic systems, combined sewer overflows, and overboard discharges have led to a decline in water quality, causing consistent and extended closures of portions of harvestable areas across the bay.

To address bacterial pollution that results in shellfish bed closures, CBEP and its partners have launched several programs to improve water quality and facilitate the reopening of high productivity clam-flats. They've taken active roles in getting local plumbing codes and

Photo Credit: Steve Karpiak

regulations revised, removed faulty sewage structures, fostered improvements in wastewater treatment facilities, and undertaken other important activities that have resulted in better water quality and shellfish habitat.

Unfortunately, shellfish bed closings are still a common problem throughout Casco Bay and other parts of New England. Of particular concern are the intense and prolonged outbreaks of red tide, a harmful Algal Bloom (HAB) of Alexandrium, which produces a biotoxin that infects filter-feeding shellfish and causes paralytic shellfish poisoning (PSP).

The routine procedure for monitoring red tide contamination in Casco Bay has entailed low-tide sampling, a time-consuming and restrictive process that often resulted in a limited number of sample collections. Subsequently, public health managers were often required to close shellfish beds based on incomplete data or complete absence of data. This caused large-scale closures all across Casco Bay, bringing shellfish harvesting to a halt until the HAB passed, typically in late summer. With indications that a red tide outbreak could recur for several years or more, it became imperative for resource managers to improve their ability to make localized decisions on closing and reopening shellfish harvesting areas in order to still protect human health but have less of a negative impact on the shellfishing industry.

DEVELOPING STRATEGIES AND TAKING ACTION

In an effort to better understand harmful algal blooms and keep more shellfish flats open during a red tide event, the Casco Bay Clam Team, a multi-stakeholder collaborative group that addresses shellfish issues (facilitated and funded by CBEP), and the Maine Department of Marine Resources (DMR), worked together to step up red tide monitoring efforts in Casco Bay with an experimental PSP monitoring initiative.

The monitoring crew created 28 sampling stations across western Casco Bay and 15 stations in eastern Casco Bay. They also included in the study three existing stations routinely sampled by DMR to compare boat-based and

Checking a phytoplankton net tow in Casco Bay
Photo: Karen Young, Casco Bay Estuary Partnership.

land-based sampling results. The 43 new stations consisted of anchored buoys with sentinel mussel bags attached. Over the course of several weeks, the crew collected nutrient data, phytoplankton, water profile data, PCP toxicity in mussel meat, and other bloom dynamics in Casco Bay.

This proved extremely efficient and benefits were immediate. Since they conducted the sampling by boat instead of by land, crews had the freedom to conduct activities across a broader territory while increasing the frequency in which sampling could be performed, regardless of tide stage. Having the sampling crew out visiting a variety of locations around the bay also afforded them an opportunity to collect additional data to correlate with the incidence and levels of biotoxin found.

To improve management of shellfish beds, CBEP funded the purchase of 10 new automated weather-monitoring stations and located them throughout the bay in areas adjacent to highly productive clam flats. The additional climatic data, instantly available online, allow shellfish resource managers to better understand the impact of precipitation on shellfish beds and avoid unnecessary closures that were previously made due to a lack of local climate data. The data also gives shellfishers immediate access to localized climate conditions and the assurance that any closures are in fact based on the best available information.

The Clam Team also identified the need to increase the capacity of local communities to conduct and assist with shoreline surveys, a required component of the National Shellfish

Softshell Clams from Casco Bay in Maine. Photo: Matt Craig, technical program coordinator, Casco Bay Estuary Partnership

Sanitation Program (NSSP) that helps identify potential or existing bacterial pollution sources and ensures shellfish are fit for human consumption.

CBEP sponsored a two-day training workshop for municipal staff and shellfish industry workers, representing nearly all of Casco Bay's coastal communities. Regulatory staff from DMR, the U.S. Food and Drug Administration, and the Maine Department of Environmental Protection provided classroom training. DMR staff followed up with field training, resulting in the identification of new pollution sources while allowing productive flats in the Mid-Coast Maine region to remain open rather than face imminent administrative closures. Participants expressed appreciation for the thorough explanation of the complex NSSP, the detailed case studies provided by workshop leaders, and the workshop's discussion-rich format, which served as a unique forum to foster new and improved communication channels among the various stakeholder groups. Based on the success of the shoreline survey training initiative, Maine DMR duplicated the program further up

Maine's coast. CBEP is also involved in several stewardship initiatives to help bolster efforts to improve shellfish habitat, including:

• A regional voluntary property transfer septic inspection program in which CBEP promotes the distribution of septic system fact sheets and other educational materials to realtors, homeowners, and other key audiences to encourage septic system replacement and to recommend septic testing at property transfer.

• Following a CBEP-funded study in Brunswick to assess methods for providing regular septic system inspections and maintenance, the Town partnered with pumping contractors to automatically notify septic owners of maintenance and pumping needs. The Brunswick model is also available for other municipalities.

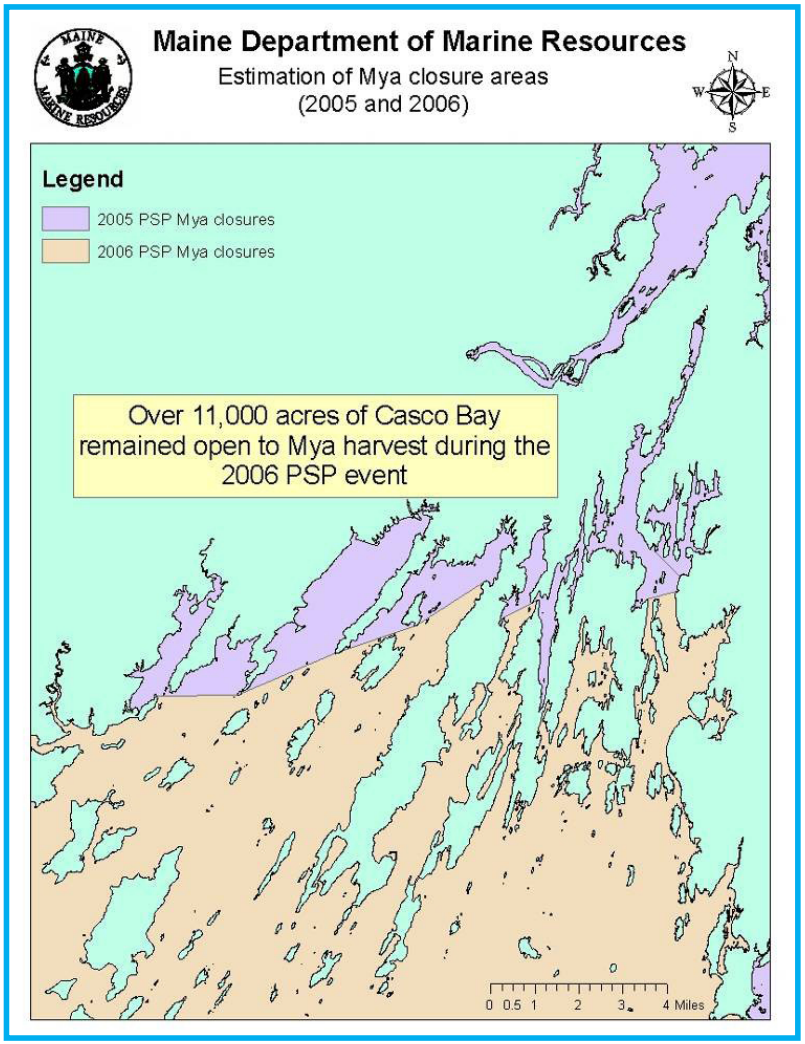
• CBEP supports Friends of Casco Bay's mobile pump-out boat program (Casco Bay was declared a No Discharge Zone in 2006), serving hundreds of Casco Bay boaters each year—an especially important program that has helped replace shoreside pump-outs that incurred damage during storms.

• CBEP participates in the Healthy Coastal Beaches Committee, which promotes public education activities and products, a program to recruit new towns into the monitoring program, training for town and state park beach personnel, lab personnel, GIS maps of participating beaches and monitoring sites, an on-line database for monitoring data, and educational brochures, posters, and signs.

MEASURABLE RESULTS AND OUTCOMES

Increasing the number of monitoring stations, improving the proximity of stations to specific harvest areas, and increasing sampling frequency proved extremely successful. Some 11,000 shellfish acres ordered closed the previous year remained open during the entire red tide outbreak. Among areas that did close, the closures were of shorter duration than during previous PSP events. Increasing the frequency and spatial scale of testing also proved to be more protective of human health than the old sample monitoring method.

Comparison of 2005 and 2006 soft shell clam (Mya) closures in eastern Casco Bay. The tan area was closed in 2005 and 2006. The purple are remained open throughout the 2006 red tide.



While questions about bloom dynamics and their origin remain unanswered, the program's overwhelming success in other areas as well as the promise it shows for providing more opportunities for study, enabled DMR to obtain additional funding to implement it again. Based on the success of the Casco Bay pilot program, the new monitoring protocol was expanded state-wide in subsequent years by the Maine DMR. CBEP is also supporting a nutrient analysis to help determine whether excess nutrients prolong red tide blooms in Casco Bay.

LESSONS LEARNED

Maine shellfish resource managers have to cover nearly 1,000 miles of coastline per person, the highest ratio in New England, making matters of efficiency a top priority. Developing and implementing the shellfish monitoring program by boat rather than by land, which has been the general practice by Maine's resource managers, substantially increases the efficiency of monitoring, allowing for more stations to be sampled over a broader range in a shorter period of time. The realization of efficiency of scale—the most valuable lesson learned—has led to increased discussion about applying a similar approach to other efforts.

Also, when designing the first monitoring program, resource managers quickly realized it was difficult to locate PSP-free mussels to use at buoy stations once a red tide bloom had already begun. To simplify the process of preparing stations during subsequent monitoring years, crews learned to obtain "clean" mussels well in advance of the anticipated red tide outbreak (usually in the spring) in order to ensure that mussel availability would not restrict the geographic or temporal span of a given season's monitoring.

Intensive monitoring of red tide also provided clues and raised important questions about the impact of harmful algal blooms at smaller spatial scales within Casco Bay. On several occasions, crews collected samples simultaneously from buoy stations and nearby intertidal mussel beds when low tide permitted. They discovered the mussels collected at buoy stations generally contained higher toxicity levels than those collected intertidally, suggesting that buoyed mussels provide equally or perhaps even more protective indicators of toxicity for protecting public health. One possibility, hypothesized by the project scientists, is that buoyed mussels are continually submerged compared to intertidal mussels, which are under water only part of the time. Tide cycles might also create an uneven distribution of exposure to Alexandrium cells among intertidal mussels. More studies would help to clarify the difference between the toxicity levels found using the two methods, and determine the possibility of developing a new buoy-specific method of monitoring red tide.

Photo Credit: Karen Young

"A traditional sampler usually can cover a maximum of 8 to 10 stations in a single day…assuming a 3 to 4 hr window of opportunity around low tide. By contrast, 30-plus sampling stations can be covered during an 8- to 9-hour boat-based sampling day…including the collection of associated data such as water column profiling, nutrient sampling, etc. at each station."

– Casco Bay Red Tide 2006: Intensified Paralytic Shellfish

The Center for Inland Bays

OYSTER GARDENING

www.inlandbays.org

Delaware's three Inland Bays—Rehoboth Bay, Indian River Bay, and Little Assawoman Bay—cover 32 square miles and are separated by a barrier beach from the Atlantic Ocean.

The Inland Bays are drowned river valleys with fresh water inflows and shallow coastal lagoons bearing an average depth of three to eight feet—essential habitat for many aquatic plants, shellfish, crabs, and worms. This depth also makes the bays more vulnerable to impacts from rapid development and agricultural runoff (eutrophication).

The Center for Inland Bays (CIB), one of 28 National Estuary Programs across the country, works to promote the responsible use, health, and protection of the Inland Bays and their watershed through research, restoration, education, and public policy.

CHALLENGES

Persistent eutrophication and sediment erosion from decades of sustained nutrient input and development from within the surrounding watershed have degraded water quality and altered the diversity and abundance of various species of fishes, invertebrates, submerged aquatic vegetation (SAV), and other habitat. Excessive nutrient levels, namely nitrogen and phosphorous, are the most serious environmental problems facing the Inland Bays habitat.

Looking at historical reports of water quality and ecological conditions in estuaries throughout the mid-Atlantic, the CIB assessed that most of the great water quality reported was likely due in part to their having healthy oyster populations, as oysters are naturally equipped to filter water, maintain its clarity and quality, and recycle nitrogen and phosphorous.

Despite strong evidence in some parts of the Inland Bays that native oyster populations had previously existed, no quantifiable population had existed for several decades. Many geological transformations had taken place in the bay waters—in years past, the bays had changed back and forth several times from an estuarine setting to a fresh water setting, which would have challenged oyster survival.

This was a troubling discovery since a single healthy oyster has the ability to filter as many as 50 gallons of nutrient-dense water per day—something the Inland Bays needed. In addition, having oyster reefs in the bays would provide important habitat and refuge for grass shrimp, worms, barnacles, plankton, and other small organisms which support larger fish and crabs.

Although the estuarine waters of the Inland Bays can support naturally-occurring oysters today, they still face some challenges. Oyster spat are about the size of a pinkie fingernail before they reach maturation, making them easy prey for crabs and sea birds. Oysters are also vulnerable to different species of macro algae found in the bays, which can readily attach to the oysters and if abundant, biofoul and kill whatever is on the reef.

With a strong focus on improving water quality and restoring habitat for other aquatic life, the CIB and its partners decided to develop a plan to try to circumvent those obstacles so they could restore the American oyster population in the bays.

Little Assawoman Bay, Photo: Center for Inland Bays

DEVELOPING STRATEGIES AND TAKING ACTION

Pointing to a successful oyster restoration program implemented in the Chesapeake Bay region, the CIB felt encouraged to start a similar effort in the Inland Bays. During the late 1990s, the CIB had been funding and participating in a demonstration project with aquatic researchers from the University of Delaware at the James Farm Ecological Preserve, a study area managed by the CIB.

Placing cultured native oyster spat in off-bottom gear, the University of Delaware's Marine Advisory Service found that oysters could grow quite well, have little to no mortality rates and they even developed faster than if they were to grow naturally in deeper water. Keeping the oyster spat away from the bay floor allowed for increased water flow, greater access to particulate food, and protection from bottom predators.

With such encouraging results, the CIB decided to keep going by building an artificial reef made of dead oyster and clam shells, use the new seed stock to plant juvenile oysters on it, and place it in a small area in the Indian River Bay. A $40,000 grant from EPA's regional geographic initiative supported the effort. The work continued to show promising results. They found that oysters grew best in areas of Little Assawoman Bay that had moderate tidal flow but would also do well in other areas when gardened. With that information, CIB thought it logical to move beyond the demonstration site and try to grow oysters at different locations throughout the Inland Bays. Since the task would require more manpower and resources, the CIB cam-

E.J. Chalabala, wildlife coordinator at the, Center for Inland Bays pulls an oyster basket from a Taylor float. Photo: CIB

paigned for citizen volunteers—residents who lived along the waterfronts of Rehoboth, Indian River, and Little Assawoman Bays who would be willing to train to become oyster gardeners. A few years later, the CIB applied for and received a National Oceanic and Atmospheric Administration five-star restoration challenge grant for $11,000, which supplied the seed money to buy the gear and the oyster spat and begin the work of enlisting and training some local volunteer oyster gardeners.

The CIB Oyster Gardening Program had officially begun. The CIB recruited 16 volunteers from all three bays the first year, which proved a fruitful endeavor from the very start.

The CIB provided the training and the gear (Taylor floats, which CIB built themselves with raw materials they purchased at cost from a local vendor; shellfish baskets, and two bags of spat at $125 each). The spat was donated by the University Of Maryland and tested and cleared free of disease at a lab in Virginia. The CIB then delivered the oyster spat to the volunteers and attached the new floats to their docks. The growers kept the spat clean and safe from predators during the summer and fall growing seasons. Staff from the CIB and the University kept a close eye on the oyster count, growth, water quality readings, and sampled tissues to determine how well the oysters were thriving.

Having the system-wide gardening locations—today there are more than 100 sites—also put the CIB in a more favorable position to increase monitoring of the Inland Bays' water quality for the occurrence of shellfish pathogens. Plus, a separate program, the Citizens' Monitoring Program, trained residents to be water quality monitors and identify alga blooms. Serving as "the eyes and the ears of the Inland Bays," the CIB has found the program very helpful when used in concert with the oyster gardening effort. The CIB is pleased to see that as people get involved in recording water quality and caring for the oysters, many have become interested in a variety of other environmental issues affecting the bays since they now have a stake in what happens and have established some ownership. Even residents without docks are joining the effort by helping other growers keep the oysters and equipment clean. By the end of the first year, the volunteer gardeners raised more

> "Getting people to volunteer to do this is not that hard. People see these floats in their neighbors' yards and they say, 'What's that, what are you doing?' When they find out they're growing oysters to help clean water, it's pretty much a domino effect. We often get a call from the neighbor the same day asking how they can get involved."
>
> – E.J. Chalabala, Wildlife Coordinator, Center for Inland Bays

than 100,000 oysters and another 400,000 juveniles were transported directly to the artificial reef from the culturing facility in Maryland. From the onset, each site has yielded anywhere from 400 to 500 oysters per season.

Today at orientation meetings, many gardeners now volunteer to pay the initial costs of getting started and many agree to pick up their own floats and spat, saving the CIB additional time and resources. Financial support for the oyster gardening program also began to arrive in from unexpected places, such as the Town of Fenwick Island—a municipal contribution the CIB wouldn't ordinarily expect to receive—and local businesses are also intrigued by the program and eager to assist. A local plumbing supplier donated 28 floats worth of PVC pipe one year and continues to supply the material at cost to the CIB, saving them several hundred dollars every season—a figure that is certain to increase with rising material costs and the always-increasing number of new volunteers signing up. In addition, Sussex County contributed a $10,000 assistance award to support the shellfish gardening program. By 2007, the CIB also began to harvest its own spat, using larvae from Rutgers University, which are stored in a 10,000 gallon tank in Sussex County at the College of Marine Studies. By culturing its own oysters, the CIB can deliver oysters at a much larger size to its growers.

Taylor float and oysters, Photo: Center for Inland Bays

MEASURABLE RESULTS AND OUTCOMES

Since the project's inception, the CIB has deployed more than 1.5 million oysters on the reef. The number of volunteer oyster gardeners doubled in the second year and continues to double each year. By 2007, the CIB had recruited 175 volunteers to grow oysters at 105 sites across the Inland Bays.

In one area where growers have two- and three-year-old oysters, anecdotal evidence shows they are beginning to reproduce and form their own spat. The CIB anticipates that in time oyster clusters will be able to attach to nearby bulkheads and continue to proliferate. In Assawoman Bay, the CIB is creating mini oyster reefs and seeding them near existing erosion control structures made from rip-rap. Oysters that cluster into three-dimensional structures will also provide rich new habitat filled with nooks and crannies for small fish and crabs to slip into and hide from predators.

In South Bethany, oysters are growing rapidly in just four months; Photo: Center for Inland Bays

Even dead-end lagoons, where little to no growth was anticipated, turned out to be productive areas. The CIB attributes this to the great quantities of food these lagoons contain.

In addition to improving water quality and creating new habitat, as the program continues to evolve it's likely that new oyster colonies will perform other important functions. Instead of having to install bulkheads, seawalls, and other man-made structures, burgeoning oyster clusters, natural vegetation, and other shellfish will start to serve as living shorelines—natural barriers that help control flooding, erosion, and improve the local ecology.

"The shellfish gardening program has demonstrated that our Inland Bays can support a viable oyster population. The recruitment of over a hundred volunteers to assist in this effort has also shown us the value of community-based restoration activities. If we are able to secure additional financial support, I have no doubts that this program can be expanded to help us reach a "tipping point" for oyster recovery in our Inland Bays."

– Ed Lewandowski, Executive Director, Center for Inland Bays

Today the CIB has developed strong partnerships with area colleges and universities. The partnerships are paying off in several ways. Working to develop a stronger research department, Delaware State University has been successful in securing significant funding to help CIB enhance its restoration efforts. The school is also supplying interns to help with field work while increasing its own recruitment of students seeking doctorate degrees in marine-related fields. The oyster gardening program is also giving geneticists from the University of Delaware opportunities to study oyster disease such as MSX and Dermo. Currently, they are trying to determine its prevalence in the Inland Bays system and have started to do some genetic marking to try to pinpoint disease origin and identify different disease strains.

Photo Credit: Center for Inland Bays

LESSONS LEARNED

Oysters have grown well in all locations throughout the Inland Bays suggesting that restoring oysters to the Inland Bays on a large scale would be a success. Their success encourages other coastal managers to borrow from the lessons learned there. Oysters provide tremendous habitat for all sorts of marine life, such as eels, grass shrimp, angelfish, crabs, and plenty more, including the much larger fish that are attracted by the smorgasbord of new food available.

The oyster flourished when raised on the water column, however because many volunteers are summer vacationers who leave in the winter, CIB realized oysters left at that height would freeze and die. After having lost a few bushels, CIB and the volunteers lowered the baskets to rest about four inches above the bay bottom during the winter, which has worked out very well.

After the CIB started growing their own spat, they began growing them out a little longer and distributing a mix of spat and larger oysters to the growers, which is having a positive influence on growth numbers. Also, since CIB uses disease resistant strains of spat, they've been able to grow oysters virtually disease-free in the bays the entire time.

Charlotte Harbor National Estuary Program

EXOTIC PLANT CONTROL AND MANAGEMENT

www.chnep.org

Unlike other estuaries in southwest Florida that are mostly influenced by the Gulf of Mexico, large rivers of the Peace, Myakka and Caloosahatchee give Charlotte Harbor its unique freshwater characteristics. These three watersheds are also a major source of surface freshwater supplies. The Charlotte Harbor estuary and its adjoining waters also provide essential refuge, feeding ground, and nursery areas for hundreds of fish and wildlife species including manatees, dolphins, sea turtles, storks, American alligators, frogs, osprey, belted kingfishers, and a variety of others that depend on Charlotte Harbor habitat for all or part of its lifecycle.

Defined by its subtle topography, subtropical climate, and subtropical plant communities, the Charlotte Harbor study area spans seven counties and 4,700 square miles and is a fundamental support to agriculture, fishing, mining, and recreation/tourism uses that are valued annually in billions of dollars.

The Charlotte Harbor National Estuary Program (CHNEP), one of 28 National Estuary Programs across the country, has been working with its many partners to successfully attain and maintain a functioning, healthy ecosystem which supports endangered and threatened species, fisheries, commerce, and recreation.

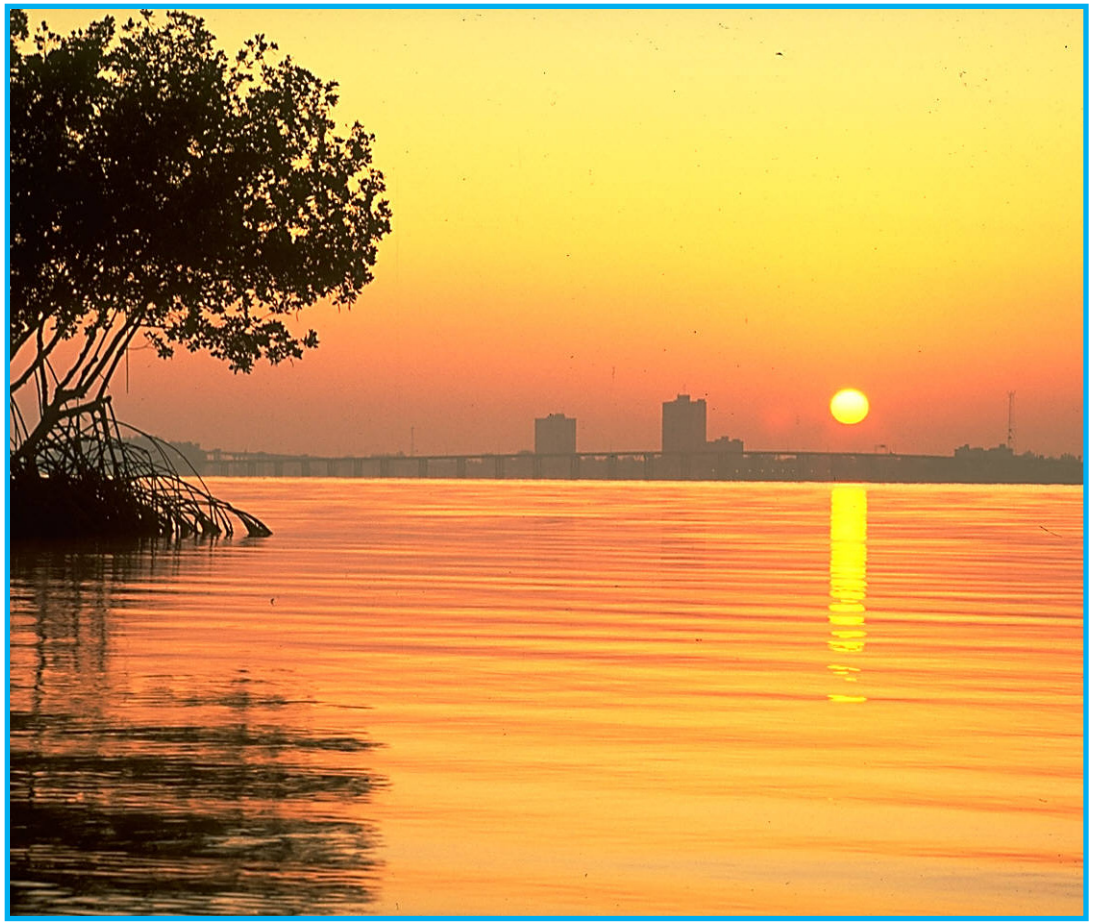


Photo: Lee County, Florida

CHALLENGES

Once valued as a fast-growing tree with seeds that spread easily and rapidly, melaleuca (melaleuca quinquenervia), native to Australia (and in endangered there), was introduced to the United States during late 1800s.

With its prolific seed production, tolerance of brackish water, flooding, and fire, melaleuca, also known as punk tree, has become a serious threat to estuarine habitats in southwest Florida and the Everglades where, according to scientific research, invasion has resulted in 60 to 80 percent losses of biodiversity in freshwater her baceous marsh communities. A slight change of hydrology and land disturbance—even that of automobile tires pressing into the soil—can spur rapid melaleuca growth.

In addition to displacing native vegetation and degrading wildlife habitat, melaleuca trees flower several times a year producing large amounts of pollen that can cause human health problems, such as respiratory allergies, which a purported 20 percent of the population suffers in areas where it is prevalent. Melaleuca monocultures also block access to boaters, hikers, birdwatchers, and other outdoor enthusiasts, posing an economic threat to communities that depend on parks and tourism.

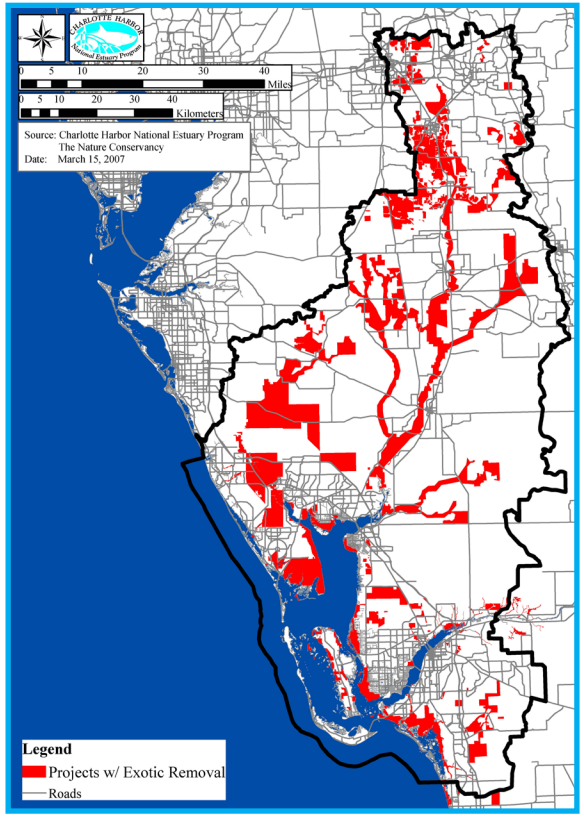
Without a steady and concerted effort to control infestation, some researchers suggest many of the remaining natural areas in southern Florida will be lost to an overgrowth of melaleuca within the next few decades.

"In the high marsh, melaleuca is taking over small plants and grasses and displacing where the invertebrates grow, reducing the food source for the birds that fly over. In the pine flat woods, it displaces grasses, palmetto, and the ability of the forest to replace its pine trees. The growth rate is enormous…by the time you get to a 10-year-old-forest, it might be nearly 100 percent melaleuca."

– Lisa Beever, Director, Charlotte Harbor Estuary Program

DEVELOPING STRATEGIES AND TAKING ACTION

At the 307-acre Pop Ash Creek Preserve, past land uses and hydrologic modifications have disturbed about 90 percent of the area; melaleuca is the most widespread of the non-indigenous species.



Although the preserve had been highly altered, there remains much habitat and foraging ground for many species. In August 2003, Lee County acquired the first land parcel of the Pop Ash Creek Preserve as a conservation 20/20 project, a local land acquisition program. The project had several aims: restore native plant communities, provide more habitat and opportunities for additional species, boost tourism and improve the integrity of coastal habitat in southern Florida.

The objectives were also part of the Lee County Master Mitigation Plan in which the CHNEP had designed a method to identify priority land for habitat restoration, such as melaleuca removal, on a Graphic Information System (GIS) map. To complete the task, CHNEP brought together a number of agencies, private, public, and not-for-profit groups, and local state and federal governments that worked in the area in order to identify parcels to acquire and restore.

Some of the previous methods used to control melaleuca growth at the preserve included cutting and applying chemicals (the hack and squirt method) and prescribed fire, but the applications were not effective enough. The trees continued to grow and

"Pop Ash Creek looks pretty incredible now. Our melaleuca do not look as healthy as they used to…. Look at the post treatment in the wet season and you see the hydric pine flatwoods with native vegetation there. That dog hair melaleuca is all gone. It is just beautiful, it really is. "

– Lisa Beever, Director, Charlotte Harbor Estuary Program

spread faster than conservation crews could manage. Recognizing the value in restoring native vegetation and protecting the preserve from continued infestation, the CHNEP granted some of the funding the county needed to implement an experimental program consisting of introducing some newly approved bio-controls, reworking a variety of past removal efforts, and following up with a maintenance plan.

Depending on the size and density of the melaleuca and the type and structure of the underlying natural community, the team tried new applications of old methodologies, such as prescribed fires, and introduced some newer procedures, including the release of two insects from Australia that can weaken and eventually devastate melaleuca without affecting native vegetation. Lee County Parks and Recreation Conservation's 20/20 program staff conducted much of the work and some they contracted out to private firms.

The main goal of the experiment was to kill invasive melaleuca seedlings, also known as "dog hair" because of their tiny tightly packed stems growing up against each other, before they reach maturity. Intercepting growth at the juvenile stage would help reduce the costs and effort they would have to put into future restoration. Furthermore, by eradicating as many seedlings as possible, in case of a wildfire, public use or some other disturbance that typically encourages melaleuca growth, a widespread invasion is less likely.

Pine flatwoods before treatment (with melaleuca)
Photo: Lee County

Pine flatwoods after treatment

Pine flatwoods after treatment during wet season
Photo: Lee County

MEASURABLE RESULTS AND OUTCOMES

CHNEP contributions have allowed the removal of non-indigenous invasive melaleuca from approximately 63.5 acres of the northern portion of the preserve. Funding provided by CHNEP has also allowed a "jump start" on stewardship activities in the northern 20 percent of the preserve.

Lee County Parks and Recreation has been able to treat the invasive trees much earlier than originally planned in its Land Stewardship Plan, especially the very thick stands of melaleuca, which were a main seed source for the rest of the reserve. Removing the trees also helped pave the way for Lee County Natural Resources and the Conservation 20/20 program to begin a design to fix hydrological alterations on the site.

The experiment was presented and well received at the Florida Academy of Science annual meeting.

LESSONS LEARNED

In the past, it was customary to wait until the melaleuca was treated and controlled with chemicals before reintroducing fire to the site. However, this experiment shows that seedlings and saplings do not need those initial controls but that using fire alone can eradicate as much as 50 percent of the seedlings and saplings. This resulted in the need for less herbicide, which has shown to be less effective and damaging to native plants anyway.

Before starting the groundwork, particularly when using prescribed fire, CHNEP also found it necessary to communicate with neighboring property owners to explain why they were destroying trees that live in a preserve. The team sent out notices and set up meetings with neighborhood organizations to involve the public and give them an opportunity to learn about what's going on and what to expect.

While many areas of the preserve had been used for cattle grazing, they learned that once the cattle are removed the melaleuca would start to habitat the area. As a result, a technique now is to leave the cattle on the land until the appropriate management strategies begin, and then transfer the cattle to an area where they are safe from chemical, fire, and other treatments.

> "These results really have changed the way we look at fire. In the past we always treated all melaleuca before burning, which meant a much higher—often prohibitive—cost. With fire we can be on the ground much faster…we're seeing a lot more plant diversity now in the areas that we burned. "
>
> – Cathy Olson, Conservation 20/20 Senior Supervisor, Lee County Parks and Recreation

Galveston Bay Estuary Program

WETLAND RESTORATION & PROTECTION

www.gbep.state.tx.us

Galveston Bay is the defining geographic feature for the Houston metropolitan region, and serves as the foundation for its economy. Galveston Bay and its many waterways and diverse natural features afford an array of recreational opportunities for residents and visitors, and play an essential role in maintaining quality of life.

The Galveston Bay watershed features an amazing diversity of habitats. Two major rivers, countless bayous, oxbows, cypress swamps, tallgrass prairies, seagrass meadows, oyster reefs, and tidal marshes make this one of America's most productive estuaries.

The Galveston Bay Estuary Program (Estuary Program), one of 28 National Estuary Programs across the country, has been working with its many partners to successfully attain and maintain a functioning, healthy ecosystem which supports endangered and threatened species, fisheries, commerce, and recreation.

Photo: Galveston Bay Estuary Program

CHALLENGES

Habitat loss poses the greatest threat to the Galveston Bay watershed. Since the mid-1950s, the system lost more than 45,000 acres of its wetlands and nearly all of its seagrasses due to subsidence, erosion, and land-use conversion. The watershed also lost vast expanses of coastal prairie, forests, and other important habitats. Habitat loss continues at a rapid pace, and the impact of this loss is exacerbated by fragmentation.

East Bay, one of four major secondary bays within the Galveston Bay system, provides an excellent example of rapid wetland loss due to erosion. This 20-mile shoreline of a relatively pristine bay has experienced erosion of up to 10 feet per year – destroying fringing marshes along the shoreline.

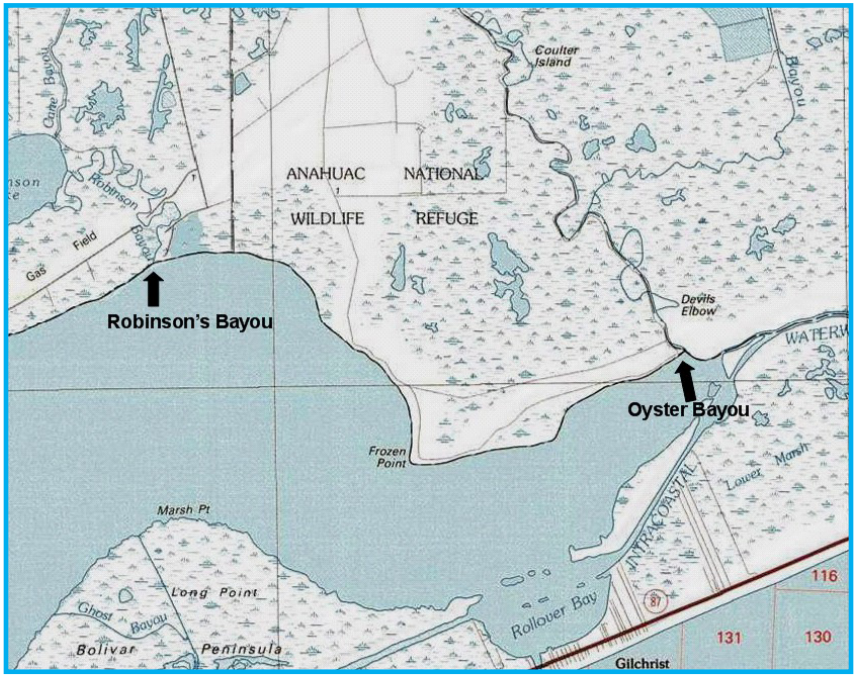
DEVELOPING STRATEGIES AND TAKING ACTION

The Estuary Program supported shoreline-wetland protection and restoration of East Bay at the Anahuac National Wildlife Refuge because of its rich diversity of habitats. Additionally, rapidly eroding shoreline threatened to expose fresh and brackish marshes with saltwater intrusion, reducing habitat diversity and value to wildlife, particularly neotropical migratory birds and overwintering waterfowl.

The Estuary Program convened a steering committee and began working with the refuge staff, involved local stakeholders and the public, and secured funding for the project.

Since East Bay is very shallow, the original designs called for dredging an access channel to transport the crushed concrete that was needed to protect more than three miles of shoreline—but the process was expensive. Although typically cheaper to work from water, dredging from a barge would raise costs dramatically.

Coincidentally, because the site is an active hunting area, the refuge staff had already planned to build a road along the shoreline



The East Bay project site stretches along approximately 7 miles of shoreline at the Anahuac National Wildlife Refuge, from Robinson Bayou on the West to Oyster

for access and maintenance; the restoration team was able to revise its logistics plan so they could share the road and work from the land. The refuge staff became a key player in other important ways. For example, by applying innovative field design, a large amount of the work was conducted by the refuge staff, which saved money and increased efficiency. They even created and built a unique sled design to pull materials over the land and through the marsh without causing long-term damage to the surrounding vegetation—a small innovation that delivered big results.

More than a dozen additional state, local, and business partners contributed expertise and funding to the project, which entailed installing offshore erosion control structures —18 inches of crushed concrete riprap and some reef balls—to reduce wave energy, promote shoreline stabilization, and protect the remaining intertidal marsh within the project area.

The Estuary Program and its project partners closely monitored the installation of the erosion control structures, and accretion of marshes behind them during construction.

At a volunteer planting event, 50 boy scouts and dozens of residents spent hundreds of hours further stabilizing the water's edge by transplanting large clumps of smooth cordgrass, the predominant intertidal marsh in the area, behind 1,500 linear feet of the breakwater.

MEASURABLE RESULTS AND OUTCOMES

After two-years of work, the $430,050 East Bay Wetland Habitat and Water Quality Protection Project was an overwhelming success that enabled the Estuary Program to reach some of its habitat goals by addressing several action items in the Galveston Bay Plan: restoring, creating and protecting wetlands (HP-1), reducing habitat erosion (HP-9), and developing volunteer opportunities (PPE-5).

This work armored more than 17,000 feet of the shoreline, and protected more than 300 acres of brackish marsh and 5,675 acres of intermediate marsh. In addition, hundreds of acres of coastal prairie are now protected from saltwater intrusion and habitat conversion.

The marshes behind the rock breakwater structures are thriving and accreting rapidly. In some areas, the smooth coordgrass is expanding beyond the rock–accreting naturally behind the breakwater. This healthy and protected new marsh traps sediments and pollutants and prevents them from entering the bay. The project design not only helps to improve water quality in the marshes, but it also reduces the impacts of flooding and provides refuge for shrimp, crabs, fish, and birds. Monitoring stations are currently evaluating the exact rate of marsh accretion and vegetation spread.

This project earned the Estuary Program and partners two awards, including the EPA Gulf Guardian Partnership Award for environmental excellence and the esteemed Cooperative Conservation Award from the Secretary of the US Department of Interior. The following partners helped make it happen:

"Acting through a diverse partnership, we were able to achieve a phenomenal amount of critical habitat protection at a very low cost, representing an outstanding conservation value. Innovations applied by the Wildlife Refuge staff were key to the project's success."

– Jeff DallaRosa, Habitat Conservation Specialist

Cordgrass moved beyond the breakwater along the Anahuac National Wildlife Refuge's shoreline in East Bay.

Anahuac National Wildlife Refuge, USDA Natural Resources Conservation Service, US Fish and Wildlife Service, US EPA-Region 6, Texas Coastal Program, NOAA Restoration Center, NOAA Fisheries, TCEQ Galveston Bay Estuary Program, National Fish and Wildlife Foundation, US EPA Gulf of Mexico Program, Restore America's Estuaries, Galveston Bay Foundation, Shell Oil Company, NRG Energy, Inc.

LESSONS LEARNED

The Anahuac National Wildlife Refuge team learned from previous shoreline protection work at the refuge, and applied those lessons learned to the East Bay project. One important lesson included determining the best distance from the shoreline to construct the breakwater. By placing the breakwater closer to shore, sediment accumulation rates were much higher, which allowed cordgrass to establish quickly and expand at a faster pace than it had during previous projects.

The Estuary Program is currently considering the application of this model for future shoreline protection.

East Bay shoreline after restoration, Photo: Galveston Bay Estuary Program

Indian River Lagoon National Estuary Program

RECONNECTING IMPOUNDED WETLANDS

www.sjrwmd.com/indianriverlagoon/index.html

The Indian River Lagoon (IRL) stretches 156 miles along Florida's east coast and is considered the country's most biologically rich and diverse estuary. The IRL's coastal wetlands are extremely productive, providing critical habitat to myriad species of fish, wading birds, and waterfowl. The wetlands also provide water quality protection and improvement, flood storage, and serve as a buffer from adjacent uplands.

Recreation and commercial fishing in the IRL are a major source of enjoyment and contribute significantly to the region's economy. The IRL National Estuary Program (IRL NEP) recently completed an economic valuation assessment of the estuary and discovered that the Indian River Lagoon provides over $3.7 billion in annual economic benefits to the State of Florida.

The Indian River Lagoon National Estuary Program (IRL NEP), one of 28 National Estuary Programs across the country, has been working with its many partners to successfully attain and maintain a functioning, healthy ecosystem which supports endangered and threatened species, fisheries, commerce, and recreation.

Photo: Indian River Lagoon wetlands; Ralph Brown, SJRWMD

CHALLENGES

In an effort to control the mosquito population during the 1950s and 1960s, more than 40,000 acres of coastal wetlands were diked or impounded. Approximately 75% of the Indian River Lagoon's wetlands were impounded during this timeframe for mosquito control purposes.

Isolating the marshes from the lagoon and flooding them with artisan wells or pumps during the spring and summer months halted salt marsh mosquito production by inundating the muddy wetland soils the mosquitoes need to successfully breed. The impoundments worked well at controlling mosquitoes, but the relief came with a high cost. Unfortunately, the practice has had a devastating impact on native vegetation and wetland functions in the estuary.

Lagoon scientists have documented that isolated, impounded marshes only harbor around six to 10 species of fish - a far cry from the many species that normally inhabit wetlands when unobstructed. Fish such as snook, tarpon, and mullet and many other species had either decreased or disappeared altogether from the impounded wetlands. The number of wading birds, migratory birds, and waterfowl that forage and refuge in lagoon wetlands decreased by impounding these marshes because of the reduced quantity and diversity of prey caused by being isolated from the lagoon's waters.

It was clear then that thousands of acres of wetlands in and around the Indian River Lagoon - essential habitat to a dozen federally-endangered or threatened species - required immediate and lasting restoration solutions.

DEVELOPING STRATEGIES AND TAKING ACTION

Restoring or enhancing impounded marshes can be a complex task. For example, restoring impounded wetland in Mosquito Lagoon, the northern lagoon in the IRL estuary, required a partnership involving time, money, and skill from the county mosquito control district, Federal Fish and Wildlife staff and National Park Service employees and plenty of concerned stakeholders. A major component of the plan was to completely remove impoundment dikes from certain wetlands and rehabilitate others by reconnecting them to the lagoon with large

Photo Credit: Florida Fish and Wildlife Research Institute

gated metal culverts. Strategic planning on that front ensured the right management measure would be used in the right location to restore the function of the wetlands while still maintaining the ability to control mosquito populations.

CCMP HIGHLIGHT: FISHERIES ACTION PLAN

The Florida Fish and Wildlife Research Institute (FFWRI) is implementing a Fisheries Independent Monitoring Program to conserve, protect, and restore the fin and shellfish resources of the Indian River Lagoon.

The FFWRI is a key member of the IRL Technical Committee and the NEP management conference.

FFWRI's monitoring program is conducted in several regions of the state in order to provide estimates of the relative abundance of many economically and recreationally important species. The data obtained will allow the development of annual abundance models of juvenile fishes—models that may be used to predict the future availability of a species and provide the numbers and information needed to determine necessary fisheries management measures and assess their effectiveness after they are enacted.

Academic and research institutions active in the IRL region are also conducting research projects to inventory and assess the ecological requirements of various species, as well as other fisheries-related studies. Several species of shellfish are also important components of fishery landings, including blue crabs, hard clams, and oysters, which are harvested from the lagoon by commercial and recreational anglers.

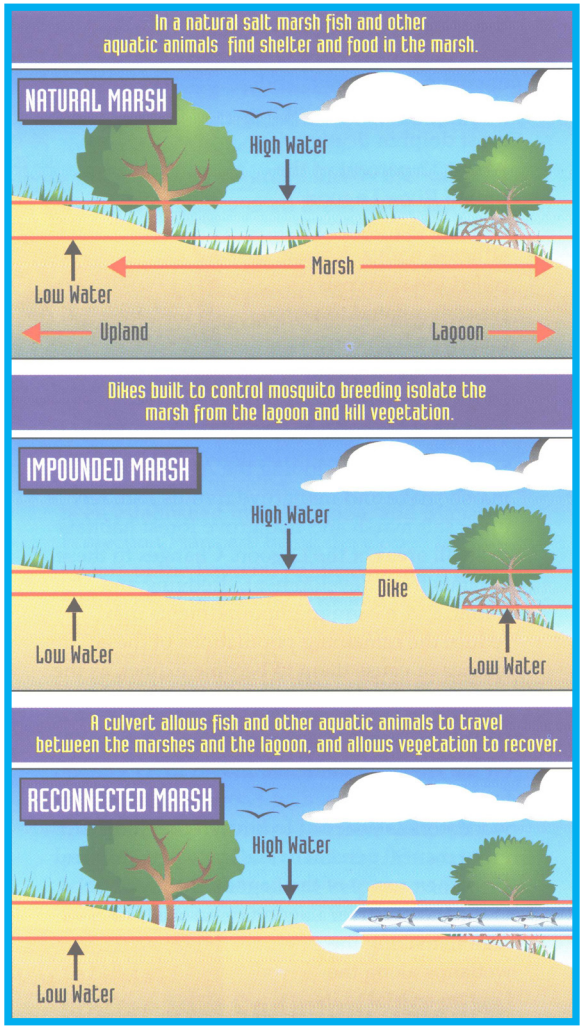
– Indian River Lagoon National Estuary Program, CCMP Update, 2008

In order to enhance function and maintain mosquito control, the mosquito control districts often employ a method known as rotational impoundment management (RIM). This best management practice allows water levels to be

managed during the summer mosquito breeding season in wetlands where impoundments were reconnected by gated culverts. In the fall and spring, during non-breeding mosquito season, the gates would be left open to allow fish, shrimp, crabs, and aquatic fauna access to feeding and nursery wetlands.

To install the culverts, tear down the dikes, and perform other restoration work, the IRL program contracted with Volusia, Brevard, Indian River, St. Lucie, and Martin County mosquito control districts since they were already familiar with and responsible for maintaining most of the mosquito impoundments. Working in these districts, several hundred culverts have been installed, placing them in the most productive locations, including areas where old tidal creeks used to flow out of the marsh, and pumps have been installed so the areas could be flooded during the breeding season.

IRL wetlands have also been impacted by another historic practice known as dragline ditching – a mosquito control technique that criss-crosses wetlands with ditches to always keep them flooded. This practice was primarily used in Mosquito Lagoon basin. With assistance from



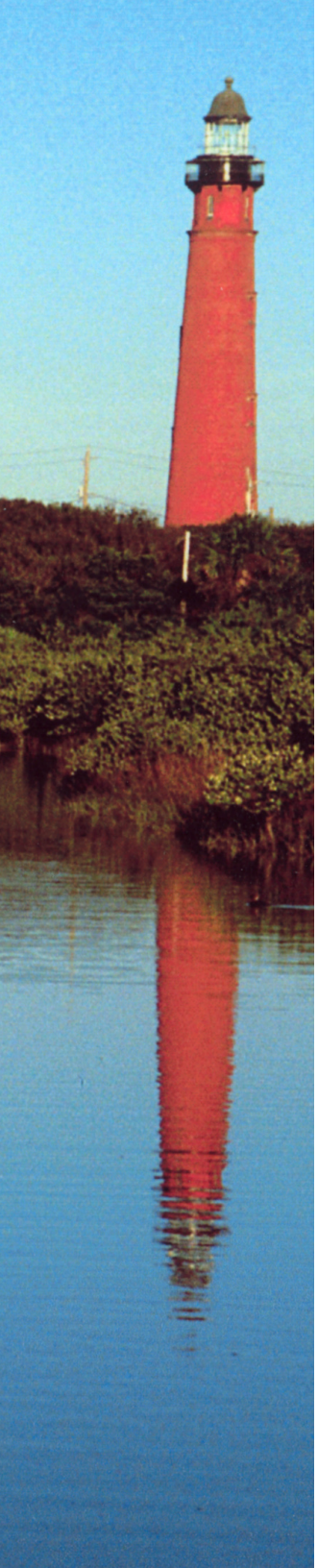


Photo Credit: Joseph Schofield

St. Johns River Water Management District, Volusia County Mosquito Control District purchased two amphibious trackhoes to refill the ditches and restore a natural elevation to the impacted wetlands. These amphibious trackhoes are well suited for use in environmentally sensitive wetland areas as they are able to float on the lagoon and access remote areas with minimal environmental impacts.

Using conventional excavating machinery would have been cost prohibitive and would likely have resulted in substantial impacts. Principal support for the project, which averaged an estimated $6,000 per acre came from St. Johns River Water Management District and the mosquito control districts, with additional assistance from the Subcommittee on Managed Marshes, Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission, and the National Marine Fisheries Service.

"As many as 90 species of fish often occur after an impoundment is reconnected to the lagoon… this project shows what can happen when we restore these impounded wetlands—it's like a 'build it and they will come' kind of thing….."

– Troy Rice, Program Director,
Indian River Lagoon National Estuary Program

MEASURABLE RESULTS AND OUTCOMES

The IRL NEP has reconnected or restored more than 29,000 acres of previously impounded marshes to their natural function with more than 700 culvert installations, dozens of dike removals, and additional restoration work such as dragline ditch restoration.

After years of isolation and limited activity, the reconnection and rehabilitation of these impounded wetlands have produced encouraging results for increased diversity and productivity in plants, fish, and wildlife. The areas are once again a rich feeding ground for numerous species and are providing healthy, new habitat so that juveniles have a fighting chance to mature.

Monitoring reports show a remarkable number of fish, macrocrustaceans, birds, and mammals have returned to live and breed across the rehabilitated wetlands in Indian River Lagoon.

Having already reached a significant percentage of its 37,943-acre goal for wetland rehabilitation through continuing established partnerships and renewed dedication to this important priority, the IRL NEP is confident that with sustained efforts and funding, they will be able to rehabilitate all of the targeted damaged wetlands in the coming years.

LESSONS LEARNED

The increases in fisheries and faunas that now migrate to the restored wetlands of the Indian River Lagoon provide living proof of the truth in the adage "build it (or in this case reconnect it or knock it down) and they will come". While ideally complete removal of the impoundment levees is desirable from a habitat/fisheries perspective, the IRL NEP recognizes that some marshes must be managed for mosquito control in order to protect the public health. Culvert reconnections within the levees offer a good second option that allow access to the wetlands while still enabling mosquito control when needed.

Building partnerships was instrumental to IRL wetland restoration. The work wouldn't have been possible without the assistance of local mosquito control districts, the USFWS, the National Park Service, and the St. Johns River and South Florida Water Management District.

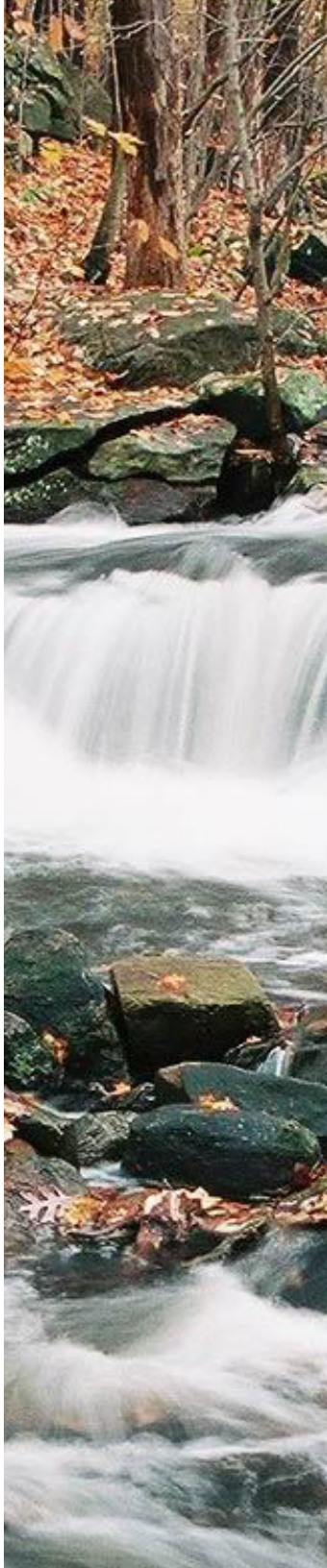


Photo Credit: John McShane

Long Island Sound Study

RESTORING ANADROMOUS FISH PASSAGES

www.longislandsoundstudy.net

Long Island Sound, which spans Long Island and other parts of New York and coastal Connecticut, is one of the country's most unique watershed regions. The Sound's very diverse habitat, which includes beaches, dunes, forests, rocky shorelines, wetlands, and more, supports more than 1,200 species of invertebrates, 170 species of fish, and dozens of species of migratory birds.

The Sound is one of the largest urban estuaries in the United States and provides numerous economic and recreational benefits. It generates some $5.5 billion annually to the regional economy with more than 8 million residents and millions more visiting every year.

The Long Island Sound Study (LISS), one of 28 National Estuary Programs across the country, has been working with its many partners to successfully attain and maintain a functioning, healthy ecosystem which supports endangered and threatened species, fisheries, commerce, and recreation.

CHALLENGES

Physical barriers in Long Island Sound that block access to spawning areas have limited the migration from salt to fresh water of anadromous fish such as alewives, blueback herring, American shad, and Atlantic salmon. These obstacles include dams, culverts, tide gates, and sections of river with inadequate water volume.

Some of these structures not only act as a barrier to fish but can alter the habitat by increasing water temperature, reducing dissolved oxygen, and providing refuge for warm water fish that out-compete cold water fish where their ranges overlap. Dams also provide detention time for the uptake of nutrients, which in turn promotes growth of plants and algae and results in eutrophication. In addition, aging fishway structures also pose problems, because they no longer may safely passing fish.

The loss of access to upstream spawning habitat not only has adversely affected the local populations of herring and their fisheries, but has a secondary impact on other fish species and wildlife, such as osprey, which readily feed on herring.

Riverine Migratory Corridors are river systems that drain to the Sound and are often bordered by flood plain trees and wetlands. Migratory species such as salmon, shad, and herring use these rivers to travel to spawn in fresh waters miles away from Long Island Sound. Recreational and commercial fisheries benefit when river corridors remain healthy and passable to migratory fish.

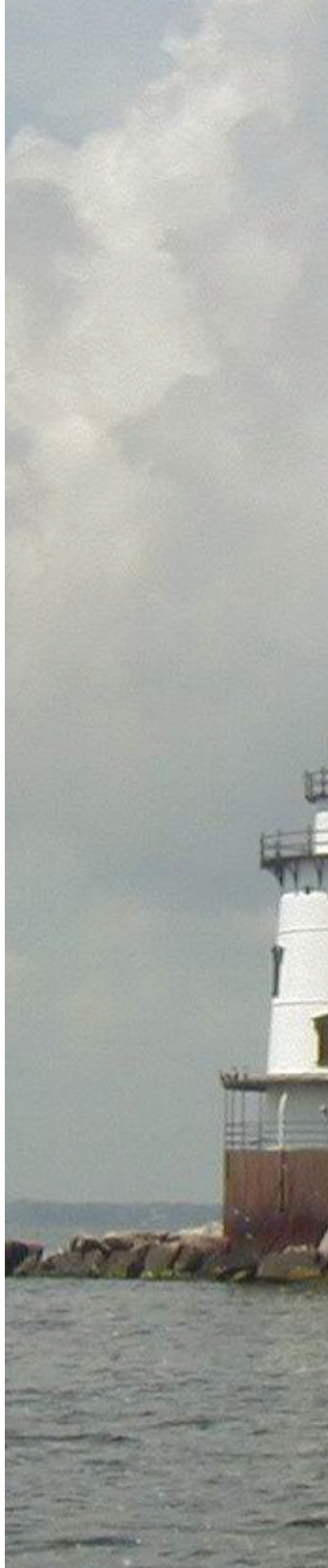
Anadromous Fish spend the adult phase of their lives in salt waters but move up streams and rivers to spawn in fresh water. A barrier on coastal streams and rivers prevents these fish species from reaching their natural spawning habitat and reduces their reproductive success. Source: Long Island Sound Study

DEVELOPING STRATEGIES AND TAKING ACTION

To begin addressing the problems, the Connecticut Department of Environmental Protection (CT DEP) Inland Fisheries Division had established a Riverine Migratory Corridor team. However, it was not until LISS joined the collaboration—bringing with it a goal to restore 100 miles of riverine migratory corridors for anadromous fish by the year 2008—that restoration projects for anadromous fish really began to take off.

Having Connecticut's program in place provided a significant springboard from which a large collaborative working group comprising federal and non-profit partners could plan and implement projects to help LISS achieve the 100-mile goal presented in its comprehensive conservation management plan.

To begin, LISS enlisted the help and expertise of fisheries biologists to investigate dozens of streams between the dams and tributaries in order to determine which sites in the watershed to target, particularly areas that are most suitable for passing fish and would provide optimal spawning habitat.



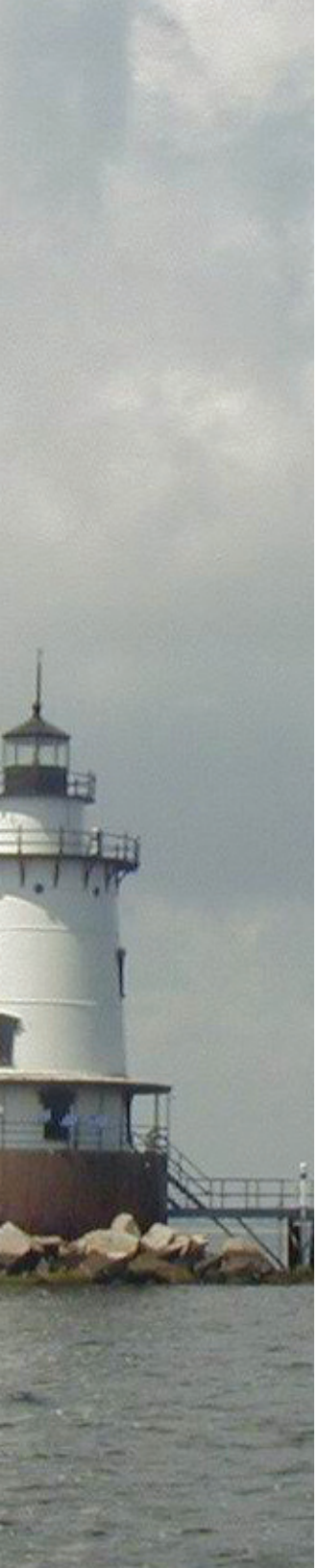


Photo Credit: Long Island Sound Study

NOTEWORTHY NEWS IN NEW YORK

LISS partner New York State Department of Environmental Conservation (NYSDEC) succeeding in bringing together agencies and organizations that have long worked separately and often unknowingly against each other. Issues involving public safety regulations, jurisdictional matters, and in many cases, a lack of understanding between stakeholders have stalled fish passage restoration in LISS NY territory.

For example, during a recent first meeting between dam safety engineers, administrators, scientists, EPA, and other environmental agencies, some of the engineers in attendance acknowledged being unaware of the problems dams were causing fish species. "The subject just hadn't been part of the focus of their work," said LISS partner, Heather Young, a habitat restoration coordinator for the NYSDEC who spearheaded the collaboration and organized field visits to several dam locations for a visual, hands-on experience.

As a result, NYSDEC and others are now working alongside the safety unit in an effort to help guide their thinking in the revision of their regulations, an effort they hope will place fish passage projects higher on the state's agenda.

The Jordan Millpond Dam Fishway project was one of CT DEP's efforts to help LISS re-establish riverine migratory corridors. The Jordan Millpond Dam, built over 150 years ago and listed on the National Register of Historic Places, included an eight-foot-high stone masonry dam and retaining wall. The barrier prevented anadromous fish from migrating from Long Island Sound to the upper reaches of Jordan Brook as well as the entire Nevins Brook in Waterford, CT. However, the team saw that anadromous species still gathered in the tidal waters at the base of the dam each spring, indicating that a historic riverine migratory corridor existed; surveys of the upstream watershed revealed suitable spawning and nursery habitat for the fish.

The privately owned dam was located at Jordan Mill Park, a 7-acre parcel of waterfront property donated to the town in 1961 with a right-of-way easement to allow public to access the park from a nearby street via a footbridge over the Jordan Brook. Also, a 27,000-gallon oil spill in Long Island Sound led to contamination, despite efforts to clean it up, from Fishers Island Sound to the Connecticut River, a shoreline distance of approximately 18

"We have a general boundary for our restoration projects, but our fish projects extend as far up into the state of Connecticut as possible. Some kid fishing in a stream way upstate in Connecticut ultimately benefits from a LISS habitat project like improved fish passage because the fish that he or she catches might be a species that never could have reached that point in the last 50 or 100 years."

– Louise Harrison,
U.S. Fish and Wildlife Service Biologist
and EPA Liaison

miles. This spill adversely affected anadromous fish species, causing mortality from direct contact with contaminants and reduced forage base and degradation of physical habitat. In addition, scientific research suggests that petroleum products also may have interfered with the imprinting/homing mechanisms that are crucial to an anadromous species' ability to migrate to and from freshwater streams. As a result, a majority of the $100,000 settlement, secured through NOAA's Damage Assessment and Remediation and Restoration Program, helped pay for the construction of the Jordan Millpond Dam project. The CT DEP, as spill-case co-trustee with NOAA, matched grant monies through NOAA's Community-based Restoration Program (CRP). Save the Sound (a program of the Connecticut Fund for the Environment), the Connecticut Corporate Wetlands Restoration Partnership (CWRP), and the Town of Waterford contributed additional funding and resources to the project.

Photo: R. Jacobs

Jordan Millpond Dam and Fishway looking upstream
Photo: NOAA

LISS helped plan meetings, site visits, and budgeting, and assisted with the planning details, including support through permitting hurdles, before construction of the fishway began. Contractors then installed a 65-foot long Alaskan Steeppass fishway on the southern bank of Jordan Brook leading up to the spillway to safely pass two targeted species of anadromous fish—the alewife and sea-run brown trout–and potentially other species. Construction involved cutting a notch into the southern end of the spillway, removal of bedrock from the southern bank, and the installation of four prefabricated aluminum steep-pass units. They also built entrance and exit structures and constructed a concrete resting pool approximately halfway up in order to slow water velocity. A stone weir located below the entrance structure directs fish into the passage.

MEASURABLE RESULTS AND OUTCOMES

The Jordan Millpond work has restored access to 4.25 miles of Jordan Brook and its tributaries as well as to approximately 8 acres of high-quality spawning habitat behind the dam. This project is one of many LISS-sponsored initiatives that collectively can benefit at least 13 fish species in the Long Island Sound Study area, such as shad, salmon, alewife, herring, and trout.

In fact, by 2006, the working group had already helped LISS surpass its goal to restore 100 miles of river passage by 2008. The achievement moved the LISS Policy Committee to set a second goal of restoring 50 additional miles by 2011. With 44 fish passage projects completed and 142.8 river miles restored, it is clear that LISS once again will fulfill its new restoration goal ahead of schedule.

Volunteers are assisting LISS and partners at various locations by tallying total fish population and tracking new fish species that enter the enhanced and restored habitat areas with information gleaned from installed fish counting mechanisms.

LESSONS LEARNED

Through careful study and deliberate planning with its partners, LISS discovered that removing or modifying specific dams allowed them to achieve more miles and open more waterways than they originally had planned. For example, opening a dam one-quarter mile upstream freed additional waterways and tributaries existing between the project site and another dam. Taking into account the length of those tributaries, LISS was able to achieve a lot more mileage and many more places for fish to spawn once they passed through the dam. This realization underscores an effective, efficient, and cost-effective approach that LISS can apply to all passage restoration plans.

> "You can get a lot of bang for the buck if you take out a certain dam because you're not just opening passage through a dam site to the next dam--you're also allowing fish potential access to all the tributaries of that reach…even small projects can make a big difference."
>
> – Louise Harrison, U.S. Fish and Wildlife

Lower Columbia River Estuary Partnership

RECONNECTING TIDAL FLOODPLAINS

www.lcrep.org

The Columbia River originates in Canada and flows south 1,214 miles to the Pacific Ocean, receiving waters from seven states and one province. It is the fourth largest watershed in the United States, draining a total of 259,000 square miles, and has the second largest volume of flow of any river in the United States.

Hundreds of species of fish and wildlife use portions of the lower Columbia River and estuary during a portion of their life. They swim in its waters, dwell along its banks, and fly and nest in the surrounding heights. Columbia River salmon and steelhead runs were once the largest runs in the world. Thirteen Columbia River salmonid species are listed as threatened or endangered, as are some birds, mammals, and plants.

The Columbia River generates electric power for residents and businesses, provides irrigation for crops, and harbors deep-water ships that come and go across the Pacific. Millions of people depend on the river for employment in water-related industries, for commerce, and for transportation.

The Lower Columbia River Estuary Partnership (Estuary Partnership), one of 28 National Estuary Programs across the country, has been working with its many partners to protect the lower Columbia River ecosystem and its species, to reduce toxic and conventional pollution and to provide information about the river to a range of audiences. The Estuary Partnership's mission is to preserve and enhance the water quality of the estuary to support its human and biological communities.

Harrington Point, Oregon Photo: Ed Deery

The Estuary Partnership's Habitat Restoration Program incorporates a wide variety of activities ranging from funding on-the-ground habitat restoration, to effectiveness monitoring at restoration sites, reference site studies, and developing a regional habitat prioritization tool. The Estuary Partnership has secured funding from the Bonneville Power Administration, NOAA, and EPA to implement the program. Profiled below is one of more than 30 projects the Estuary Partnership has funded.

CHALLENGES

Many sites in the Columbia River Estuary are no longer available for habitat restoration because of urban, agricultural, industrial, or residential uses. In the Grays River region, however, many areas remain relatively free of urban impacts. Some sites contain remnant old-growth Sitka spruce forests, intact wetland swamps, and backwater channels—prime habitat and foraging ground for fish, bald eagles, which nest along the tributaries, and potential nesting habitat for the threatened marbled murrelet seabird.

However, several tidally-influenced tributaries within the Gray's River Watershed had been cut off from the river's twice daily tidal cycle–diked for farming and logging purposes. Reconnecting these channels to tidal influence would provide high-quality rearing habitat for cutthroat trout, steelhead, Coho, Chinook, and some chum salmon, which were already using other Gray's River tributaries for spawning and rearing. In fact, the Grays River watershed supports the largest population of chum in the Columbia River Estuary. Connecting previously diked areas back to the tidal prism would also trigger vegetation and other ecological changes associated with the historic habitats and habitat functions important in the Columbia River Estuary.

DEVELOPING STRATEGIES AND TAKING ACTION

The Columbia Land Trust (CLT) applied for funding through the Estuary Partnership's Habitat Restoration Program for a project to protect and restore several hundred acres of habitat in the Grays River Watershed. The project scored well in the Estuary Partnership's ranking crite-

Photo Credit: Lower Columbia River Estuary Partnership

ria, in part because of the opportunity to implement a large scale ecosystem project over time and because of the landowner's willingness to sell such sizeable parcels of land with valuable estuarine habitat and varying degrees of function. Connecting the river with several hundred acres of floodplain (across multiple individual sites) would produce far-reaching results and could be a significant achievement in the Estuary Partnership's effort to protect, and restore, the Lower Columbia River watershed system. Specifically, the project aimed to accomplish the following goals:

- Permanently protect 850 acres of habitat, including spruce-swamp forested wetlands, inter-tidal channels, and emergent/scrub-shrub wetlands.

- Restore floodplain connectivity to 500 acres of tidal backwater, riparian, and wetland-forested habitat.

- Restore over 300 acres of potential salmonid-rearing habitat.

- Enhance approximately 3.0 miles of riparian shoreline.

"Multiple ownerships can make large-scale restoration difficult…but I think the reason the Grays River project was successful is because we showed that we were able to implement these ecosystem-scale actions."

– Evan Haas, Habitat Restoration Coordinator, Estuary Partnership

• Protect three bald eagle nests and over 100 acres of potential marbled murrelet nesting habitat.

Through its Habitat Restoration Program the Estuary Partnership provided a good deal of the funding for the project, including land acquisition, design, permitting, restoration, and monitoring activities. Estuary Partnership funds came from awards through the Bonneville Power Administration's Fish and Wildlife Program (BPA) and the U.S. Environmental Protection Agency's Targeted Watersheds Program.

The project's primary goal was to increase watershed function and provide an anchor point for stabilizing the Grays River system, with a focus on restoring or enhancing estuarine and riparian wetlands, which provide important juvenile salmon rearing habitat, for both Grays River species and other Columbia River basin salmonids. Through the project, the Columbia Land Trust and the Nature Conservancy acquired 11 properties which varied in size from 20 to 226 acres and included a wide range of habitats, from spruce swamps and other intact wetland habitats to diked farm and forestland areas, to disconnected backwhater channels and small roads – all within roughly two miles of each other.

Other project aspects included removing tide gates, upgrading culverts and cross dikes, removing interior roads and channel crossings, filling agricultural drainage ditches, planting native vegetation, reestablishing tidal connection to the floodplain, and establishing weed management and monitoring programs. For example, at one site, the main objective was to restore tidal influence to a 163-acre parcel of formerly agricultural land. In addition to the habitat benefits, most work had the potential to provide significant other long term benefits, including increased flood storage capacity, improved sediment dynamics, improved water quantity, and improved habitat conditions for salmonids (particularly temperature, dissolved oxygen, and stream flows).

In addition to funding assistance from the Estuary Partnership, the multi-year Gray's River

project required a variety of other assistance from Federal, State, and local entities. Partners such as the Columbia River Estuary Study Taskforce, Ducks Unlimited, Washington Salmon Recovery Funding Board, Lower Columbia Fish Recovery Board, Washington Department of Fish and Wildlife, Pacific Coast Joint Venture, and several others helped fund, monitor, and perform on-the-ground restoration activities in the Grays River region. The Estuary Partnership tracked and received information on the restoration work, baseline documentation, monitoring data, site surveys, permits, and construction plans during the course of the project.

One site within the Grays River project area is serving as a reference site. The Secret River site is a 226-acre parcel hydrologically connected to the Columbia River with intact upland forests, high-quality wetlands, intertidal areas, and excellent rearing habitat for salmonid species. The near pristine nature of the Secret River site will be a gauge against which restoration efforts on the other parcels, and at other lower Columbia River restoration sites, can be measured against and compared to.

"The Estuary Partnership's Habitat Restoration Program provides a framework - and funding -- to ensure projects fit into a regional strategy and that investments are effective and efficient. The Grays River Project is a great example of a collaborative project that used multiple funders to get us further than any partner could have done alone."

– Debrah Marriott, Executive Director, Estuary Partnership.

MEASURABLE RESULTS AND OUTCOMES

Restoration in the Grays River region has met or exceeded all goals, including:

• Permanent protection of 986 acres, which are now managed by the CLT (original goal was 850 acres).

• Restoration of tidal activity to 589 acres of floodplain (original goal was 520 acres).

• Juvenile salmonids are able to access well over 300 acres of rearing habitat during different times of the year and water events (original goal was 300 acres).

• Protection of three bald eagle nests and over 100 acres of potential marbled murrelet nesting habitat.

• Enhancement of approximately three miles of riparian shoreline through planting and weed management.

At the Grays River restoration sites, the emergent marshes and much of the forested areas are now inundated at least once per day, affording juvenile fish access to a variety of food sources and abundant cover. Sampling at a Grays River site showed hundreds of Coho Salmon (age 0+) are using the tidal channels during falling tides in the spring. The habitat protection and restoration projects provide excellent foraging opportunities for chum and are prime rearing habitat and productive foraging areas for steelhead, searun cutthroat, and Chinook. Restoring the natural function of the floodplains and wetlands and reconnecting riparian areas have also increased flood storage capacity and more natural sediment and organic transport systems, which will improve water quantity through subsurface recharge. This also helps cool water temperatures and augment low flows, improving juvenile salmon-migration conditions.

Seal Slough; Grays River restoration site Photo: Lower Columbia Estuary Partnership

LESSONS LEARNED

Recognize the complexity of large-scale projects. Projects with as many components as this one require organization, flexibility, and persistence. Many factors need to be orchestrated, and a delay in one area can affect other components.

Respect timelines. In every project, much needs to be accomplished during the contract period, so it is important to prepare well, track progress, and keep everything in order during the inevitable changes in the project.

Work together and have a plan. A coordinated effort by all parties helps ensure timely completion of the work and high-quality results.

Stewardship ethics matter. Stewardship of the land extends beyond the project boundaries to neighboring properties and the surrounding community. Community involvement needs to be ongoing.

"The success of the projects in the Grays River watershed illustrate the many habitat benefits that can result when restoration actions are implemented on a large scale."

– Evan Haas, Habitat Restoration Coordinator, Estuary Partnership

Morro Bay National Estuary Program

RIPARIAN, FLOODPLAIN AND WETLAND RESTORATION

www.mbnep.org

Morro Bay, a small estuary of 2,300 acres, is fed by Chorro and Los Osos Creeks and is protected from the Pacific Ocean by a lengthy sand spit. The 48,000-acre Morro Bay estuary watershed includes the town of Los Osos, portions of Morro Bay, farms and ranches, parks, national forest, highways, and more.

Morro Bay is an important stopover on the Pacific Flyway and a critical winter home to numerous bird species. The bay and its 48,000-acre watershed rank perennially among the top sites in the nation during the Audubon Christmas Bird Count. The habitats of Morro Bay, wetlands, creeks, rivers, lagoons, and forests, offer essential nesting and feeding grounds to many species, including the federally-listed steelhead trout and other species that make up the more than two-dozen endangered species in Morro Bay.

The Morro Bay National Estuary Program (MBNEP), one of 28 National Estuary Programs across the country, has been working with its many partners to successfully attain and maintain a functioning, healthy ecosystem which supports endangered and threatened species, fisheries, commerce, and recreation.

Photo Credit: Morro Bay National Estuary Program

CHALLENGES

On the central coast of California, steelhead trout, once abundant in the streams that drain into the Morro Bay Estuary, are a federally-listed threatened species. Numerous migratory fish passages previously dammed to produce electricity and roads and lands cleared for logging have increased erosion and widespread sedimentation throughout the watershed.

Walters Creek, owned and managed by the California Department of Fish and Game, meanders through property that was formerly used as a military training ground and now as a gun club. Once a thriving migratory fishway for steelhead trout, the creek was severed with several culverts, now eroded and failed; and the channel was so insized and narrow in some places that it looked more like a ditch than a stream. The creek's lack of mature riparian vegetation also accelerated sedimentation in the channel, clogging spawning gravel and smothering fish eggs, insects, and other natural resources that juveniles need to survive. The lack of vegetation also destabilized the channel, adversely impacted water temperature and dissolved oxygen levels. This once-healthy fish-rearing habitat has been greatly diminished by clogs and obstructions throughout the channel as well as by the dearth of complexity in instream cover for young steelhead to escape predators and feed.

A dysfunctional culvert and retaining wall carry a tributary to Walters Creek.
Photo: Jon Hall, MBNEP

DEVELOPING STRATEGIES AND TAKING ACTION

While working on another upstream restoration project on adjoining land owned by California Polytechnic State University, MBNEP and the Department of Fish and Game discovered the damage at Walters Creek. Sandwiched between the restoration and erosion control project they were conducting upstream and noting another restoration that was planned at the Chorro Creek Ecological Reserve immediately downstream, it was evident they would need to address the gap in the middle. It would also fulfill MBNEP's Comprehensive Conservation and Management Plan by benefiting significant habitat for endangered species and improving water quality, both on site and ultimately in the Morro Bay Estuary downstream.

The Dept. of Fish and Game funded a grant and MBNEP hired an engineer to develop a concept plan, which addressed several of the erosion points with various drop structures designed to stabilize the creek; MBNEP would create the revegetation plans for the riparian work. During the development stage, however, MBNEP quickly realized they were dealing with a much bigger hydrology issue—one that demanded a larger, more expensive approach than they had originally thought. Engineers suggested a better alternative would be to remove the defunct culverts, bury the old channel entirely, and build in a whole new creek. The plan also called for adding a new floodplain to lower channel velocities during high flow events, reduce erosion potential in the channel, and create stable sites for an intensive instream, floodplain, and streambank revegetation.

A large adult California Red-Legged Frog, an endangered species, is captured and safely transferred prior to construction.
Photo: MBNEP

Having enough money to support such an ambitious project was of immediate concern. The Dept. of Fish and Game suggested MBNEP turn to the Wildlife Conservation Board, a close partner that generally supported projects that were affiliated with the department. The organization also worked with MBNEP on some previous land acquisitions, which made the prospect of garnering support for this project promising. After meeting with the Conservation Board, MBNEP was encouraged to apply for the funds. They also attended some grant board hearings in Sacramento to answer questions about the project, and in time MBNEP received the help they needed to fund and implement the near million-dollar project. A couple of other organizations also joined the effort with smaller grant contributions. To keep the costs as low as possible, MBNEP hired contractors to do the groundwork on an hourly basis. MBNEP would also handle the permitting process itself, which at times proved tricky. Since the project had amassed into quite a large construction site, the water quality control board required a Stormwater Pollution Prevention Plan. Unprepared for the task, MBNEP was able to seek help from a former staff member who also worked for the water board. Also helpful, one of MBNEP's board members raised the point early that because the restoration site was located on property where ammunition is used, they would need additional permits and other

"When we needed help during the permitting process, we could always reach out to one our committees. It's one of the benefits of being an NEP—there was always someone on our board or one of our partners who had either been through this before or who actually knew the permitting people; that really helped us keep the project on schedule."

– Jon Hall, Restoration Coordinator, Morro Bay National Estuary Project

A view of the living channel liner installed. Photo: Jon Hall, MBNEP

implements to meet the requirements of an unexploded ordinance, including training for the construction crew. Environmental training and onsite endangered species experts were also necessary in case they encountered any steelhead or the federally-listed red-legged frog during construction. This came in handy when later they did come upon two frogs, which they had to relocate to a deep pool habitat with lots of woody debris in Chorro Creek. For two years, MBNEP, construction crews, scientists, monitors, and engineers moved across five different sites removing berms, eroded culverts, and other obstructions, including a 75' wide by 6' tall concrete barrier to salmonids. They installed numerous grade control structures to allow passage of juvenile steelhead and help stabilize the channel, installed a free-span bridge to

increase hydraulic function, and prepared the land for a large-scale revegetation effort. However, unlike most creeks, which contain lots of stabilizing bottom rocks, Walters Creek consisted entirely of highly erodable clay. In deciding how to protect and stabilize the new creek and habitat during heavy rains, MBNEP's vegetation expert investigated conditions further upstream and discovered many native wetland grass species that acted as natural stabilizers in that part of the creek. Instead of sticking to the original blueprint, which was to plant plugs and hope they grow and spread quickly, the team came up with another idea. They created a "living channel liner". MBNEP found a vendor willing to take on the large experimental project, which entailed cultivating 33,000 square feet of sod with the seeds of same or similar native plants living further up the creek and placing it across the bottom of the creek. This enormous vegetative mat, nearly an acre in size, would help stabilize the creek and simultaneously filter bacteria and trap excess sediment coming down through the channel. For the riparian work, MBNEP developed a "plant pallet" based on field observations. They planted more than 8,000 plants and trees with appropriate tolerances for varying conditions across the five separate stream bank zones. The California Conservation Corps, with direction from the MBNEP, is currently managing the vegetated areas until they are fully reestablished. Management activities include monitoring native vegetation growth and taking corrective actions as required, controlling weeds, and irrigation maintenance. Volunteers are monitoring water and a new bird-monitoring program is also in

A new free-span bridge, plantings, and boulder grade control at a Walters Creek restoration site. Photo: Jon Hall, MBNEP

progress, which will help assess the ability of the habitat to supply necessary resources for feeding and nesting.

MEASURABLE RESULTS AND OUTCOMES

MBNEP and its partners provided access to 9,232 linear feet of stream for steelhead trout and other species. The water in Walters Creek is exceptionally clear today, with no reports of new erosion in the new channel. The 1,200 feet of linear channel they cut have slowed water velocity and decreased erosion and the 1.44 acres of floodplain surfaces are helping decrease water velocity and trap sediment. The re-establishment of healthy riparian corridors will protect eroding creek banks, increase shading, and help reduce water temperature so this historic spawning ground can resume its former healthy state. MBNEP also installed 7,568 feet of cattle exclusionary fencing to decrease sediment source from cattle-caused erosion and will continue to work on creating a mature riparian plant community.

LESSONS LEARNED

MBNEP found that doing much of the planning and strategizing in-house significantly reduced the cost of the project. When out in the field, instead of distributing the design and calling for bids, MBNEP kept costs low by hiring subcontractors who worked by the hour, under their direction. Instead of using conventional planting methods, the living channel liner proved a smarter choice for this project. It eliminated the need to schedule planting time and seed irrigation to try to ensure a percentage of germination and cover would be established before the onset of storms and winter weather. In addition, installing the sod in concert with the gravel riffles also removed any soil that would otherwise erode.

New Hampshire Estuaries Project

LAND PROTECTION

www.nhep.unh.edu

There are two major estuarine systems in the State of New Hampshire —the Great Bay Estuary (most of which is located about five miles inland from the Atlantic shoreline), and the Hampton-Seabrook Estuary, which is situated on the coast. The state's largest estuary, the Great Bay, is a tidally-dominated system characterized by steep wooded banks and rock outcroppings, cobble and shale beaches, and fringing saltmarsh. The Hampton-Seabrook Estuary, a busy tourist attraction and popular clamming destination, contains extensive saltmarshes and some of the last remaining sand dunes in coastal New Hampshire.

The phytoplankton, saltmarsh plants, algae, and eelgrass found in these delicate estuarine ecosystems provide essential habitat and nursing areas for bivalves, crustaceans, fish, and large populations of filter-feeding invertebrates. Numerous diadromous fish species spawn in the freshwater portions of the rivers and streams; and as many as 110 bird species have been identified in the estuaries, including several that are endangered and threatened.

The New Hampshire Estuaries Project (NHEP), one of 28 National Estuary Programs across the country, places a strong emphasis on water resources by supporting projects that protect streams, shorelands and wetlands.

Little Harbor, New Castle, NH
Photo: The New Hampshire Estuaries Project

CHALLENGES

While a significant portion of New Hampshire's coastal watershed is still relatively intact and able to carry out many important ecological functions, clear signs of degradation and alteration are also evident. A 2006 report from the NHEP reveals that New Hampshire's estuaries are under threat largely due to increased development and increasing nitrogen loads.

For the past 40 years and counting, New Hampshire has been the fastest growing state in New England – with much of its growth focused in the coastal watershed. While only about 10 percent of the state's land area is in the coastal watershed, one-third of the state's population and businesses are located there. Further, New Hampshire expects to see its human population grow 28 percent between 2000 and 2025. Population growth has thus far been accompanied by rapid land development, sprawl, and conversion of natural land cover to impervious surfaces (roofs, parking lots, driveways, etc.) Increases in impervious surface cover in a watershed are tightly correlated with associated degradation of water quality in rivers, lakes, and streams. Eight to ten percent impervious cover in a coastal New England watershed appears to be the threshold beyond which serious water quality problems become clearly evident and persistent. Some of New Hampshire's coastal subwatersheds are beyond this threshold, and some are rapidly approaching it. As of 2005, 10 of the 37 subwatersheds in the NHEP's focus area had greater than 10 percent impervious surface cover. Beyond conversion of land and degraded water quality, other negative impacts include loss of plant and wildlife habitat, fragmentation of wildlife migration corridors, increased severity of flooding impacts, decreases in summer stream flows, and a decrease in the relatively rural quality of life valued by NH seacoast region residents.

As coastal land costs rise and developers succeed in making indelible marks across larger areas of coastal habitat it is becoming increasingly difficult to afford to buy land for conservation. Even when landowners are willing to donate land for conservation, there remain significant real estate transaction costs, which buyers must often pay early in a land protection project. Yet land acquisition grant funds usually won't cover those kinds of expenses, making it difficult for conservation groups to move forward.

"Because our area is developing so rapidly, permanent land protection is a top priority. When you're protecting land, you're protecting stream buffers, wetlands, diverse wildlife habitat, and water quality—all of which helps to implement central goals of our Management Plan."

– Derek Sowers, Program Coordinator, New Hampshire Estuaries Project

DEVELOPING A STRATEGY

The NHEP has a goal of permanently protecting 15 percent of the watershed land area by 2010. As of 2005, there were 54,622 acres of protected land, representing 10.7% of the watershed. To meet the 2010 interim goal, the NHEP needed to find a way to increase the pace of land protection and address the challenge of widespread land fragmentation and development.

To support the critical work of land protection experts in the region, the NHEP launched the Land Protection Transaction Grants Program to help its land protection partners offset some of the costs associated with permanent land protection projects located within the boundary of the New Hampshire coastal watershed. This would provide targeted financial assistance in areas where buyers need it the most.

Using National Estuary Program funding awarded by EPA, the NHEP provides matching grants of up to $3,000 to assist qualifying partner groups with the costs associated with land surveys, attorney fees, appraisal fees, conservation staff time, recording fees, title expenses, stewardship, and other relevant activities—expenses that are often the most difficult to offset with fundraising.

The NHEP decided all grants would be non-competitive, open to public and private entities, (including local government) and on a first-come, first-serve basis, as long as applicants' projects met certain environmental criteria, including at least one of the following:

- Be located at least in part in a Priority Conservation Focus Area identified in the Land Conservation Plan for New Hampshire's Coastal Watersheds.

- Contain shoreline on streams, tidal waters, or lakes.

• Be composed of at least 50 percent undisturbed wetlands or contain wetlands with a "prime" legal designation.

• Support exemplary natural communities or habitat for plants or animals that are listed by the state as being rare, threatened, or endangered.

The NHEP assembled and coordinated a review team that consists of NHEP staff and land and water conservation specialists from the University of New Hampshire and the Society for the Protection of New Hampshire Forests. Development of a grant application was followed by a publicity effort to attract qualifying applicants.

The program was popular from the onset, attracting dozens of interested applicants from communities throughout the coastal watershed. The awarded amounts ranged from as little as a few hundred dollars to the maximum $3,000 allotment and many figures in between that went toward protecting as few as nine acres up to several hundred acres of watershed habitat.

Conservation Easements: Landowners give up specific development rights to the land and grant an organization (typically a land trust, conservation group, or government agency) rights to enforce the terms of the easement. Easements are very popular because they allow landowners to retain ownership of their property while ensuring the land is permanently protected from future development, often with significant tax benefits to the landowner. Because development restrictions reduce the fair market value of the land, easements are often purchased to compensate the landowner for the difference in the pre and post-easement value of the land.

Acquisitions: Ownership (full fee title) of the land is transferred to a conservation buyer. Acquisitions are sometimes combined with easements to ensure permanent protection of the land regardless of ownership.

Donations: A landowner can donate either a conservation easement or full fee ownership of their property in order to protect the property from development. Donations are important in securing "matching" funds for acquisition grants, and often provide the landowner with significant tax benefits.

OUTCOMES AND MEASURABLE RESULTS

Since the program's inception in 2002, more than 25 communities have benefited from 50-plus land transaction grants distributed by the NHEP so far, enabling them to protect 3,378 acres of coastal land (0.6% of NHEP study area) valued at more than $23.6 million; and with the program now in its third cycle, those numbers and figures continue to climb.

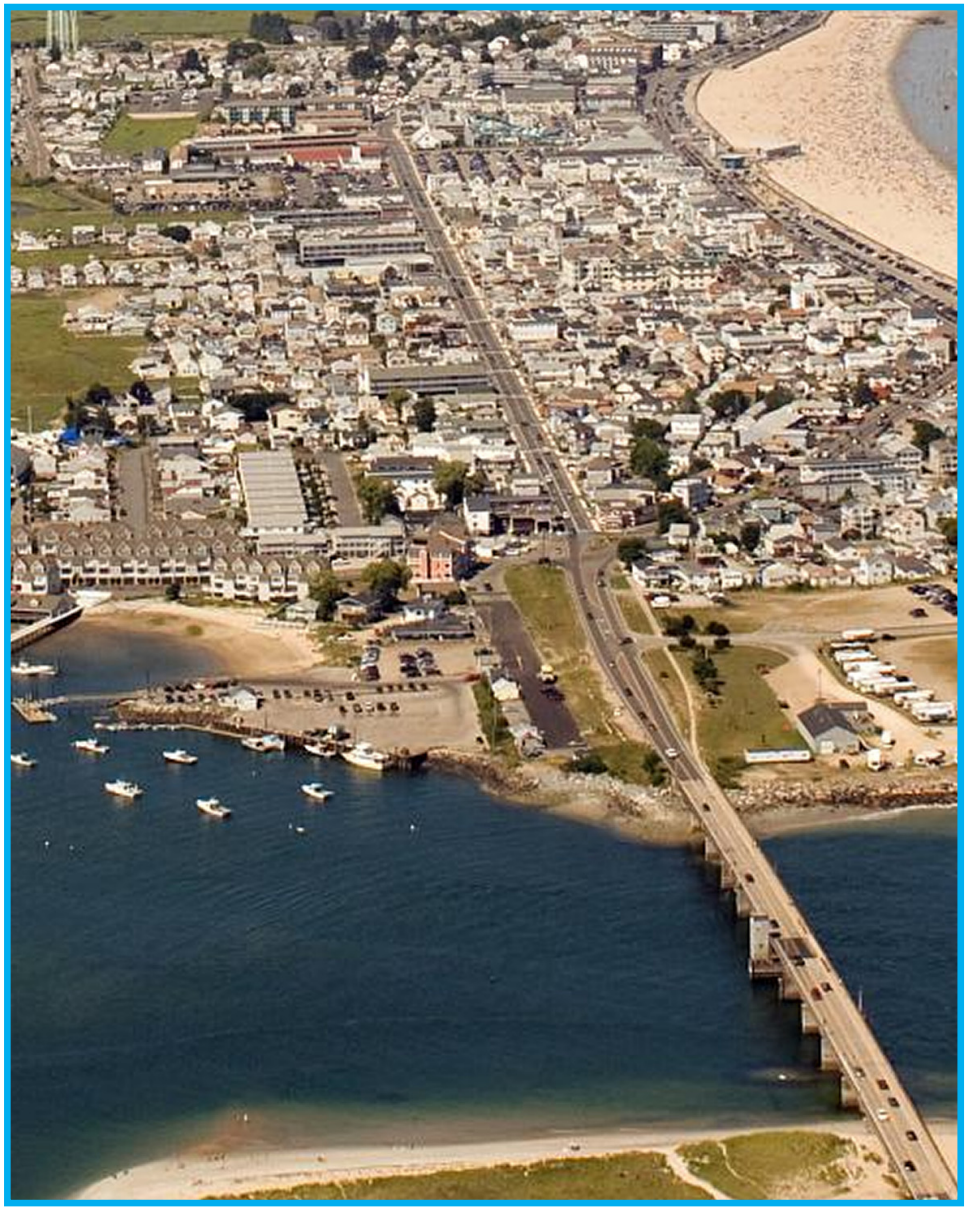
Newly protected section of the Isinglass River corridor. Photo: Derek Sowers

One of the more recent and notable achievements is the completion of an effort to permanently protect three separately owned land parcels within the Isinglass River Corridor Conservation Project area. This successful effort was made possible by a diverse partnership of organizations including the Trust for Public Land, Bear-Paw Regional Greenways, the NH Coastal Program, the Town of Strafford, and private landowners. The effort put an end to a previously-approved 58-unit housing development scheduled for construction and has permanently protected 270 acres of land and 6,063 feet of stream habitat, including 2,700 feet along the main stem of the Isinglass River—property located in one of NHEP's priority Conservation Focus Areas.

Landowners generously donated the easements, which together have an estimated value of $800,000.00. The Town of Strafford, NH Coastal Program, and the NHEP provided additional financial support to help cover project costs.

To maintain healthy coastal ecosystems, ecologically valuable land needs to be protected from development. The Land Conservation Plan for New Hampshire's Coastal Watersheds identifies 75 conservation focus areas totaling over 230,000 acres that are key targets for land protection activities. The conservation focus areas were selected for their importance in protecting water quality and aquatic resources, promoting large forested habitat blocks, and supporting critical habitats and species that are valued in the seacoast region. The plan is intended to serve as a scientifically defensible guide to support habitat protection activities – both through traditional conservation approaches (e.g., fee ownership and conservation easements) and regulatory approaches that limit development in high priority areas and encourage conservation practices.

Photo: Sagamore Creek salt marsh;
New Hampshire Estuaries Project



Entrance to the Hampton/Seabrook Estuary. Photo: Chris M. Nevins

LESSONS LEARNED

In the course of implementing the Land Protection Transaction Grants Program, the NHEP has learned several valuable lessons about how to effectively promote high quality permanent land protection projects in the coastal watershed:

• Work with partners to develop a scientifically based regional land conservation plan to identify the highest priority areas for protection. This plan is a key resource for many conservation partners and helps target scarce time and resources on the most ecologically important areas.

• Structure the grant program to try to provide "start-up" funds to facilitate land protection projects, but include provisions to only invest National Estuary Program funds in projects with a high likelihood of ultimate project success ("closed" real estate transactions).

• Strive to provide equitable opportunities for financial assistance among different applicant organizations and geographic areas – but also support coordinated efforts that link conservation lands together.

Sarasota Bay Estuary Program

LAND ACQUISITION AND WETLAND RESTORATION

www.sarasotabay.org

Sarasota Bay is part of a 250 square mile watershed with a coastal lagoon approximately 56 miles long. It is located on the southwest coast of Florida between the mainland and a chain of barrier island communities, called keys, which receive waters from the Gulf of Mexico.

Saltwater wetlands, primarily mangroves across the Bay, and other habitats provide essential nursery areas for many aquatic species, including dolphins, manatees, black mullet, red drum, spotted sea trout, snook, shellfish, and crustaceans as well as the endangered loggerhead sea turtle. Common birds include the great blue heron, egrets, brown pelican, osprey, wood stork, bald eagle, and the endangered Florida scrub jay.

The Sarasota Bay Estuary Program (SBEP), one of 28 National Estuary Programs across the country, has been working with its many partners to successfully attain and maintain a functioning, healthy ecosystem which supports endangered and threatened species, fisheries, commerce, and recreation.

Photo: Sarasota Bay Estuary Program

CHALLENGES

Wetlands, primarily mangroves, have decreased in Sarasota Bay 38 percent between 1950 and 1990. Once used as farmland for crop rotation, most of the area had remained fallow for decades, whereby invasive vegetation and trees, including Brazilian pepper tree and Australian pine, quickly overtook the native plants and wildlife that existed across many parts of the area.

An important mangrove restoration target and one of the largest coastal properties in Manatee County is the Robinson Preserve, a 487-acre parcel near the confluence of Tampa Bay and Sarasota Bay in Manatee County.

The Robinson family, the landowners who purchased the space as agricultural land, was preparing to divert most of the property into a massive, waterfront PGA-level golf course resort and residential community—an effort that would destroy or further denigrate the land's natural ponds, high marshes, lagoons, and other habitat essential to the survival of fish and wildlife.

DEVELOPING STRATEGIES AND TAKING ACTION

As the Robinson property owner faced delays and obstacles getting parts of his plan approved, SBEP partners were busy working on a restoration project nearby to reestablish a historic intertidal connection between the Perico Bayou and Sarasota Bay, which would improve water flow. Incidentally, this led to conversations with Manatee County about SBEP and some other partners acquiring the neighboring land and doing a large habitat protection and restoration project.

Mindful of the habitat strategy fundamentals of its comprehensive plan, if the county stepped in, SBEP would have a prime opportunity to build on its current goal to restore a mosaic of wetland habitat for juvenile fish and other wildlife. The work would also increase public access to natural areas, provide opportunities for environmental education, and increase awareness of the preserve's beauty and ecological value.

The SBEP prepared a conceptual design for the county commission, which endorsed the plan. The plan suggested a number of restoration ef-

forts to recreate tidal connections and wetland areas as well as new trails and access areas for people.

Manatee County liked the plan and decided to offer to purchase the land and obtain the development rights from the landowner. What followed became a true cooperative effort with SBEP, US Fish and Wildlife, and EPA playing important roles during negotiations between Manatee County and the Robinson family. The groups settled on a purchase price agreement of $10 million, which was much lower than the property's actual value of $17 million. Florida Community Trust provided a $6 million state grant toward the county's purchase—the maximum dollar amount allowed for land acquisition projects per grant cycle.

Manatee County hired a firm to create the engineering plans based on SBEP's original design. Continued SBEP support proved invaluable as it was in a unique position to handle virtually all of the permitting processes, which included working through the tangle of state and federal building codes, zoning and environmental laws, and other issues. Soon after, the restoration

Inlet restoration at Robinson's Preserve,
Photo: Sarasota Bay Estuary Program

"A recent fishery assessment shows approximately 68,000 fish inhabit each acre of restored lagoons whereas approximately 109,000 fish per acre live in a natural lagoon. So our lagoons are providing about 67 percent of what a natural lagoon would do—and that's just after construction. Wait a while until the full productivity of the system comes back."

– Mark Alderson, Director,
Sarasota Bay Estuary Program

work began. The EPA contributed $500,000 to create and improve wetlands and SBEP committed approximately $70,000 for part of the planning and permitting expenses, general outreach, and volunteer support. Additional support for the $5-million effort came from the Fish & Wildlife, Southwest Florida Water Management District, and others, including private entities that helped create a 53-foot observation tower where visitors can see approximately eight miles to the north at Tampa Bay. A historic Florida dwelling was relocated down the Manatee River on a barge from Palmetto to serve as a visitor's center and nature center.

Meanwhile, the seller still had plans to build a PGA golf course, albeit with a less ambitious plan than the original, on 250 acres of land adjacent to the Robinson Preserve. Interestingly, the arrangement actually worked to the restoration team's advantage by providing a unique, money-saving opportunity. The county invited the landowner to bid on and "buy back" all the soil that it was removing from Robinson Preserve, which was necessary for implementing the plan's design to recreate the tidal creek connections and wetland communities. The

Visitors enjoy the new "daisy trail" at Robinson Preserve
Photo: Sarasota Bay Estuary Program

owner agreed, won the bid, and construction workers at the preserve were able to transport the material to the neighboring golf course site where it is now being recycled to develop greens, tee-off areas, and other necessary golf course components. This saved the county a lot of money since they didn't have to pay to have all the dirt hauled off the site or bear the burden of contributing to greenhouse gases attributed to trucking and hauling millions of dollars worth of material to another site. The money they received for the soil was reinvested into the project.

Another creative move involved fashioning upside down Australian pine trunks into artificial reefs and installing them throughout several interconnected fishing lakes to provide additional habitat for aquatic species—a unique experimental initiative. All adjoining areas between

the preserve and the golf course, which will include more than a dozen residential buildings, now feature natural barriers built from native vegetation. Sarasota Bay Buddies, a successful SBEP-sponsored volunteer program of high school students across the region, engaged in several planting and clean-up efforts on the preserve.

MEASURABLE RESULTS AND OUTCOMES

Robinson Preserve is SBEP's largest land acquisition/habitat restoration project to date—a monumental achievement and significant addition to the necklace of SBEP projects that will encircle the sea and improve the ecological integrity of the Manatee County coastal watershed.

The removal of the excess fill allowed SBEP to build tidal creeks that connect the Manatee River, Palma Sola Bay, and Robert's Bay together. Prior to the work, these water bodies were only intermittently connected through the mangrove forest during high tide events. Now fish, wild-

"We had a lot of volunteer work at Robinson. Thousands of volunteer hours were spent removing exotic plants, building benches and towers, and planting native plants. The great thing about this is that we now have kids who know what Australian pine is, they know what Brazilian pepper is, they know how to remove them and they know about the native plants—what to pull, what to plant, where they need to go—they really know what to do. They bring their parents, too. So we have plenty of adults who are learning about this work as well."

– Julia Burch, Public Outreach Coordinator, Sarasota Bay Estuary Program

life, and the public are able to enjoy permanent pool connections. This multi-recreational park went from a fallow, low-functioning wilderness to lush, multi-recreational complex with a diversity of healthy habitat for fish and wildlife, canoe and kayak launches, campsites, and trails for biking, rollerblading, and hiking.

Kayakers prepare to launch
at the new Robinson Preserve
Photo: Sarasota Bay Estuary Program

Before and after baseline monitoring of vegetation and wildlife will provide additional information on the project's success. Anecdotal evidence shows avifaunal and fishers use have increased dramatically. The saltern areas that were restored are naturally colonizing with native species; this is considered rare for the area and demonstrates that the project is already functioning as designed.

LESSONS LEARNED

There were many lessons learned from such a large project, many of which will be considered and carried over to future restoration projects.

One of the principal lessons SBEP has learned is the importance and value of working with a streamlined permitting process. The cooperation of Florida's permitting agencies and the relationships SBEP have developed with them were essential to making the project happen. Constant and early coordination with funding partners was also imperative. In one instance, a funding partner had decided to bid the construction funds out themselves rather than the

Photo: Sarasota Bay Estuary Program

county, a move that required modifying the plans prior to construction and separating some components. Staying in close contact ensured there were no surprises.

The heavy equipment used during construction inadvertently distributed salinity rich soils throughout the site, making installation of the freshwater and upland plants somewhat difficult. For future projects, it may be best to restrict it to areas intended for estuarine plantings and to leave other areas intact. Preserving existing topsoil would give native plants a better chance to adapt to their new environment. Also, instead of planting immediately following the completion of grading work, which is typical of most projects, future projects could schedule time for the site to equilibrate, especially in estuarine areas. This would also allow newly groomed areas to be observed through a couple of tidal cycles so that planting plans can be matched to conditions.

Because sediment transport has the potential to continue through the full lunar cycles, the team left erosion control devices in place for two cycles, even after the excavation was completed. This was a good preventive measure that helped reduce sediment transport associated with high and low tidal events.

Tampa Bay Estuary Program

SEAGRASS RECOVERY

www.tbep.org

Tampa Bay, located on the west central coast of Florida, is the state's largest open-water estuary with four major rivers and a watershed covering 2,200 square miles.

Seagrass habitats are one of the most dominant and pervasive natural resources in Tampa Bay and have served as the primary indicator for estuarine health for bay managers. Other important habitats in Tampa Bay include emergent wetland vegetation such as salt marsh and mangrove forests. These emergent habitats provide barriers to pollutants and protect uplands from waves, storms, and floods. Collectively, these habitats provide shelter and nursery areas for more than 200 species of fish, crustaceans, and shellfish.

The Tampa Bay Estuary Program (TBEP), one of 28 National Estuary Programs across the country, has been working with its many partners to successfully attain and maintain a functioning, healthy ecosystem that supports endangered and threatened species, fisheries, commerce, and recreation.

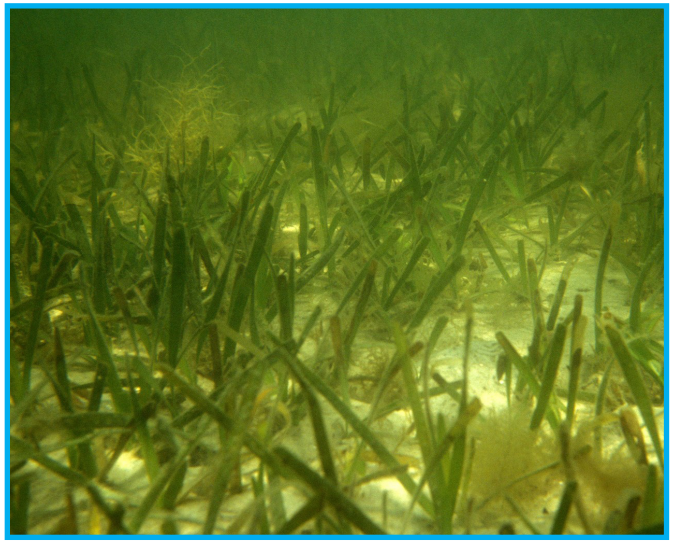
Roseate spoonbill, Photo: Gerold Morrison

CHALLENGES

Tampa Bay has a variety of seagrasses, including turtle grass (Thalassia testudinum), manatee grass (Syringodium filiforme), shoal grass (Halodule wrightii), widgeon grass (Ruppia maritime), and star grass (Halophila engelmannii). Of this group, turtle, manatee, and shoal grasses are most common. The grasses declined steadily throughout Tampa Bay from the 1950s until the early 1980s.

Fortunately, recent improvements in water quality, primarily due to sewage treatment upgrades in the 1980s and TBEP's recent efforts to reduce nitrogen have reversed this trend and seagrass habitats have been expanding. In the past two decades, more than 6,000 acres of seagrass have returned to Tampa Bay, however, there are still nearly 10,000 acres of seagrass that were present in the mid-1900s that are not present today. While water quality and clarity are now sufficient for seagrass growth and maintenance, other factors may limit the complete recovery of seagrass.

During the same period of major seagrass decline, there also was a nearly 50 percent decrease in the length of longshore bars in Tampa Bay, which run parallel to the shoreline. These bars help dampen wave energy and provide suitable habitat for seagrass growing behind the bars. Few early sequential photographs of the bay exist and scientists are unsure which occurred first – the loss of seagrass or bars. Scientists hypothesize that poor water clarity caused seagrass declines; and without the seagrass rhizomes (roots) to hold sediment in place, the bars may have eroded, leading to further losses of seagrass.



Turtle grass in Tampa Bay, Photo: Tampa Bay Estuary Program

DEVELOPING STRATEGIES AND TAKING ACTION

With a multi-partner, collaborative effort, the TBEP is tackling the questions surrounding seagrass loss and recovery by first ensuring they achieve its goals to improve water quality in the bay—the first and most important step. Maintaining light availability to seagrass through the water column is the guiding paradigm of TBEP's Nitrogen Management Strategy. To help maintain, restore, and track progress in recovering the bay's seagrass resources, the TBEP annually assesses water quality conditions in the bay using data from the Environmental Protection Commission of Hillsborough County's long-term ambient water quality monitoring program.

TAMPA BAY WATER QUALITY DECISION MATRIX

Each major bay segment is presented in a simplified "decision matrix" using a stop-light color scheme to determine water quality.

• Green indicates TBEP met both water clarity targets and should "stay the course" and continue with planned projects to implement its Comprehensive Conservation and Management Plan.

• Yellow indicates one water clarity target was not met (caution alert) and the TBEP TAC and Management Boards should review possible causes and suggest management responses.

• Red indicates that no water clarity targets were met (action alert) and prompts the TBEP TAC, Management, and Policy Boards to take appropriate action to get the program back on track.

Photo Credit: Merle Allshouse

"The 'decision matrix' chart has been really helpful. When our Policy Board sees a green year, they know things are on track. Even if it is due to a drier year with less runoff, it's still a good sign that we are meeting water quality standards…this process is actually what led us to intensively study seagrass recovery in Old Tampa Bay, a 'problem area' for several years."

– Lindsay Cross, Environmental Scientist, Tampa Bay Estuary Program

1982	Red	Red	Red	Red
1983	Red	Yellow	Red	Red
1984	Red	Green	Red	Yellow
1985	Red	Red	Red	Yellow
1986	Red	Yellow	Red	Green
1987	Red	Yellow	Red	Green
1988	Yellow	Green	Yellow	Green
1989	Red	Yellow	Red	Yellow
1990	Red	Green	Red	Yellow
1991	Green	Yellow	Yellow	Yellow
1992	Yellow	Green	Yellow	Yellow
1993	Yellow	Green	Yellow	Yellow
1994	Yellow	Yellow	Red	Red
1995	Red	Yellow	Red	Yellow
1996	Yellow	Green	Yellow	Green
1997	Yellow	Green	Red	Yellow
1998	Red	Red	Red	Red
1999	Yellow	Green	Yellow	Yellow
2000	Green	Green	Yellow	Yellow
2001	Yellow	Green	Yellow	Yellow
2002	Yellow	Green	Green	Green
2003	Red	Yellow	Green	Yellow
2004	Red	Green	Green	Yellow
2005	Green	Green	Yellow	Yellow
2006	Green	Green	Green	Green
2007	Green	Green	Green	Green

"Our water quality assessment tells us how well we are doing in stemming nitrogen sources flowing to the bay. That serves as an annual report card on our progress—and it also relates to management of our seagrass resources by determining if enough light is available each year to sustain seagrass recovery in the bay."

– Ed Sherwood, Program Scientist,
Tampa Bay Estuary Program

TBEP's Technical Advisory Committee (TAC), a diverse group of more than 100 scientists, developed the program, which uses two measures of water quality to indicate whether TBEP's nitrogen load reduction strategies are working.

In addition to its bay-wide water quality management efforts, TBEP is simultaneously investigating the role that longshore bars play in the expansion and recovery of seagrass habitats. Using a two-pronged research approach for restoring seagrass and longshore bars, researchers are testing to see if re-planting seagrass into areas that historically had bars will lead to sediment accumulation and the development of a bar feature, and whether re-creating a bar structure will encourage volunteer seagrass recovery behind the bars. To do the work, TBEP has received more than $750,000 in grants from five funding agencies and is working with 10 government, non-profit, and university partners to help answer these questions.

Tasks include mapping current and historical distribution of longshore bars to determine the actual loss of longshore bars bay-wide and characterizing the topography and bathymetry

Volunteers transplant a large plug of manatee grass.
Photo: Holly Greening

of existing bars in relationship to seagrass distribution. TBEP research partners used this information to develop a conceptual model of a restored seagrass longshore bar system and coastal engineering criteria needed to re-construct bars with dredged material.

On the ground, TBEP and its partners transplanted plugs of manatee grass from an area of the bay with good water quality to an area with similar water quality where a longshore bar historically existed. This restoration effort will test how the grass transplants and whether the re-established plants are accumulating sediment to create a bar. Monitoring efforts for this and other project tasks are well underway.

The next task will result in the construction of a 500-foot-long experimental longshore bar, utilizing dredged and other materials. TBEP partners have prepared an Environmental Resource Permit application based on the engineering design criteria and TBEP expects to construct in spring 2009. Partners will monitor the system's integrity over time and track volunteer establishment of seagrasses adjacent to the structure. Scientists will also assess the actual dampening of wave energy, if any, for both natural and experimental bar systems in the bay.

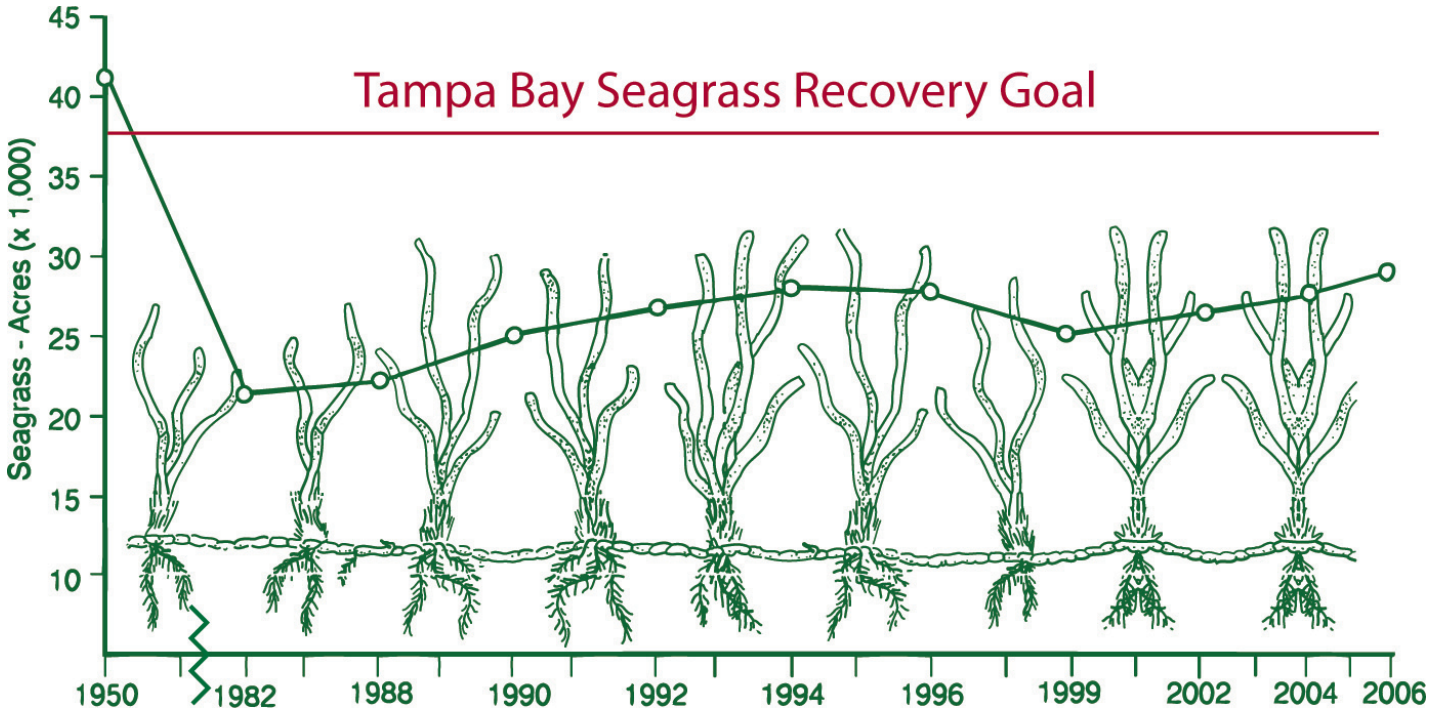
MEASURABLE RESULTS AND OUTCOMES

For the first time since the annual water quality assessment began in the 1970s, all four major bay segments of Tampa Bay achieved a green status in the decision matrix, indicating that water quality conditions bay-wide have been sufficient to foster seagrass recovery. After two years of monitoring, there has been complete recovery of seagrass at the donor location. At the transplant location, seagrass patches are growing and coalescing, forming larger patches. Overall, TBEP is making significant strides toward achieving its 38,000-acre goal for bay-wide seagrass recovery and protection. Aerial photographs of the bay in 2006 already indicate the bay is only 9,679 acres short of this target, setting the stage for additional restoration projects, such as the longshore bar project—a project that is instrumental in obtaining the bay-wide target.

Scientists have documented increases in sediment elevation behind some of the plots and additional monitoring during the next phase will determine if these accumulated sediments will form a complete bar structure. TBEP is also measuring wave energy in locations with and without longshore bars to compare with the results from the seagrass transplantation and longshore bar experiment.

A scientist examines the rhizomes of a manatee grass plug. Photo: Tampa Bay Watch

Photo Credit: Bryon Chamberlin



LESSONS LEARNED

One of the key lessons learned from this project is the importance and necessity of building partnerships. This enabled TBEP to leverage more money from various entities. Without strong partnerships, TBEP feels certain that many of its projects would never have gotten off the ground.

The seagrass transplant technique in this project used large plugs of manatee grass that included the rhizomes (roots) and sediment. It appears that using larger seagrass plugs with the rhizomes and sediment intact may lead to better long-term survival than transplanting only the plant material.

On a much broader front, because of past and continuing development, TBEP understands the unfeasibility of trying to recover all the habitat acreage that has been lost, although the work does aim to protect and restore habitat in a similar ratio to what existed in 1950, TBEP's benchmark year. TBEP is also taking more of a "mosaic habitat" approach to habitat restoration by designing plans that incorporate a diversity of habitat types and functions, as opposed to addressing one habitat type at a time. Work will also include a greater watershed management approach that expands the planning of habitat restoration activities to the landscape level (rather than the parcel level) by acquiring and connecting multiple sites and incorporating hydrologic modifications to create larger contiguous integrated systems. Opportunities exist to create very large adjoining tidal wetland systems with extensive salinity gradients and habitat richness. For example, the Tampa Bypass Canal and Lake Tarpon Outfall Canal—two highly modified freshwater inflows to the bay, each several miles in length—are a significant target for TBEP's plans for large-scale watershed-based habitat restoration. TBEP has proposed conceptual plans to the Southwest Florida Water Management District, one of TBEP's principal partners, which owns a vast majority of the riparian lands, as well as many large adjacent parcels.

"When we're able to pool our resources, it enables agencies to look beyond their traditional boundaries and put the focus on the health of the bay overall….we've seen bay-wide seagrass recovery because we're working on a collective basis."

– Lindsay Cross, Environmental Scientist, Tampa Bay Estuary Program

Tillamook Estuaries Partnership

RIPARIAN & INSTREAM ENHANCEMENT

www.tbnep.org

Tillamook Bay, the second largest estuary in Oregon, is located on the state's northern coast, roughly 60 miles west of Portland and 45 miles south of the Columbia River mouth. The Tillamook Bay watershed—a coastal temperate rainforest ecosystem—possesses an extraordinary natural resource base with extensive upland forests dominating almost 90 percent of the basin's land area and rich, fertile alluvial soils characterizing the lowlands.

Spanning a mere 13 square miles, Tillamook's low shallow waters average only about six feet deep and are a critical support to commercially-valued fish and shellfish, including five salmon species. The area also provides important habitat for seals, which, after years of decline, are beginning to flourish again. The clams and crabs that populate the bay's mudflats are a popular draw for anglers and tourists alike as are the many native and migratory birds and other wildlife that live, breed, and feed in the various habitats of Tillamook Bay.

The Tillamook Estuaries Partnership (TEP), one of 28 National Estuary Programs across the country, has been working with its many partners to successfully attain and maintain a functioning, healthy ecosystem which supports endangered and threatened species, fisheries, commerce, and recreation.

CHALLENGES

Three Cruiser Creek tributaries, part of the upper Trask River Watershed that provide critical spawning grounds for migratory fish, including the federally listed Coho Salmon, were losing its ability to provide a natural functioning habitat. Undersized, perched culverts were completely blocking or severely limiting fish passage. Historic fires, subsequent salvage operations, and a defunct forest road were dumping sediments into the stream. With a scarcity of refuge areas, quality pools, and large wood in the stream, the poorly functioning channel threatened the ability for migratory salmon to thrive.

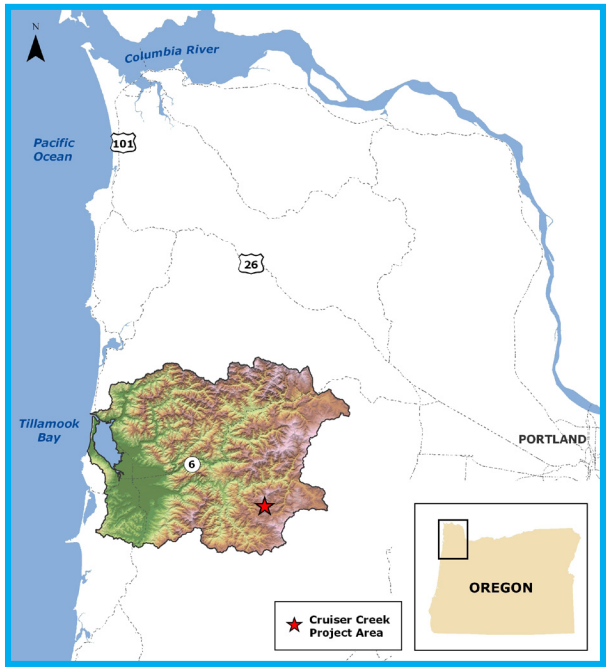
The site, a part of the Elkhorn drainage basin owned jointly by the Oregon Department of Forestry (ODF) and Bureau of Land Management (BLM), was ripe for restoration—and both agencies had the funding to make it happen. However, neither agency had the authority to administer a contract on the other's land. As they began to collaborate, they saw the potential for their logistical and conflicting administrative rules to turn the project into an inefficient managerial hassle.

DEVELOPING STRATEGIES AND TAKING ACTION

Seeking a solution, BLM managers approached TEP, who saw the project as an extraordinary opportunity for them to participate in a promising habitat enhancement project that would measurably improve conditions for the federally listed Coho Salmon and other migratory species, including Fall Chinook Salmon, Winter Steelhead, and Coastal Cutthroat Trout.

The work aligned perfectly with TEP management criteria and TEP was suited to serve as a third party and coordinate all the necessary activities while adhering to the standards and practices of each agency. By working under TEP's project management, the two agencies would be assured their resources were being managed effectively and efficiently, and that the restoration activities of each would enjoy economies of leverage and scale.

To initiate the work, the three entered into a formal Cooperative Agreement in which TEP would administer the necessary contracts while ODF and BLM would oversee the groundwork. Several others joined the effort, including the local watershed counci, native plant cooperative,



school district, and others. Together, the partners embarked on a one-year project— fast by usual standards—to fully restore fish passage and spawning and rearing habitat by installing new culverts, placing log and boulder structures in the stream channel, eliminating a water-polluting road, and planting trees in the riparian area.

"Instead of the agencies implementing the project independent of one another, risking duplication, a third party providing overall management increased efficiencies. Many have talked about that process since then… partners have brought projects to our attention to foster collaboration with us."

– Rachel Hoffman,
Habitat Restoration Manager,
Tillamook Estuaries Partnership

MEASURABLE RESULTS AND OUTCOMES

The Cruiser Creek project was a great success. At the project's end, the partners had installed three fully-functioning fish passable structures, restored 1.5 miles of instream habitat, decommissioned 3.5 miles of forest road, and enhanced five acres of riparian habitat—all of which are going a long way today to provide essential spawning and rearing habitat, reduce road sedimentation, and increase riparian diversity.

Restored fish passage at one of the Cruiser Creek tributaries; Photo: TEP

Surveyors for the Cruiser Creek project site found that over-winter retention of smolts has increased dramatically from 5.0 percent to 17.4 percent over a two-year period since the project was completed.

TEP attributes this major success—a 248 percent increase in retention—to the increased habitat complexity that now exists throughout the Cruiser Creek project area. In fact, in comparison, over-winter retention rates in nearby untreated control reaches remained nearly identical at 5.3 percent and 5.6 percent respectively during the same period.

LESSONS LEARNED

TEP managed to keep costs on a relatively large project lower than usual (planning cost $40,000 and construction cost $150,000) primarily because they were able to conduct the planning and engineering in-house. They also saved money by taking advantage of some donated materials, such as plants and other vegetation needed for the riparian work.

Placing wood and boulder structures in Cruiser Creek; Photo: BLM

This effort also showed that bigger projects don't always require a several-stage process. With the right partnerships, good leveraging skills, and other variables in place, TEP realized it could tackle large projects all at once and still achieve effective outcomes and lasting results.

TEP considers the Cruiser Creek watershed enhancement project the first collaborative endeavor of its kind in the region to offer an opportunity to leverage the efforts of state and federal landowners toward common restoration goals.

This important achievement also marks the first of many habitat enhancement projects as BLM and ODF ownership patterns form a mosaic throughout Northwest Oregon.

Decommissioning a forest road adjacent to Cruiser Creek; Photo: TEP

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Photo Credit: Eva Furner

NATIONAL ESTUARY PROGRAM

EPA

www.epa.gov/nep