LONG ISLAND SOUND STUDY HABITAT RESTORATION INITIATIVE

ANNUAL SUMMARY FOR THE YEAR 2005

Technical Support for Coastal Habitat Restoration

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LONG ISLAND SOUND STUDY HABITAT RESTORATION INITIATIVE -- Annual Summary for the Year 2005

BACKGROUND

This report summarizes the accomplishments of the Long Island Sound Study's (LISS) Habitat Restoration Initiative (HRI) for year 2005, the eighth year of implementation. The HRI is a bi-state, multi-organizational effort to restore estuarine coastal habitats in Connecticut and New York. The HRI members meet several times a year to discuss progress, share new technologies, and identify emerging issues. In 1997, the LISS HRI established the following goals:

- Restore the ecological functions of degraded and lost habitats;
- Restore at least 2000 acres of coastal habitats and 100 miles of riverine migratory corridor habitat over the next 10 years; and
- Use partnerships to accomplish the restoration objectives and to leverage limited state, local, and federal funds.

Potential restoration sites were identified through interviews with individuals knowledgeable with the states' ecosystems, and the public was provided an opportunity to nominate sites as well. These data have been compiled into a Habitat Restoration Geographic Information System, an Access database and were published in a brochure called "Restoring Long Island Sound's Habitats." Implementation of restoration projects began in 1998. Twelve priority coastal habitat types have been identified by the HRI members as particularly important to sustaining the living resources of the Long Island Sound ecosystem. These habitat types are Tidal Wetlands, Freshwater (non-tidal) Wetlands, Riverine Migratory Corridors, Submerged Aquatic Vegetation, Coastal Grasslands, Intertidal Flats, Estuarine Embayments, Coastal and Island Forests, Shellfish Reefs, Cliffs and Bluffs, Rocky Intertidal Zones, and Coastal Barriers, Beaches, and Dunes.

In 2000, eleven state, federal, municipal and non-governmental organizations signed a Memorandum of Understanding (MOU) that codified their commitment to work cooperatively on the LISS HRI goals. To view the MOU, please visit the LISS website: www.longislandsoundstudy.net/archive/misc/mou.pdf. For more information on the habitat restoration initiative, go to: www.longislandsoundstudy.net/habitatteam.htm.

The Long Island Sound Study plays a major role in habitat restoration by providing annual funding to the New York Department of Environmental Conservation's Bureau of Marine Resources and to the Connecticut Department of Environmental Protection's Office of Long Island Sound Programs (OLISP).

In New York, due to limited in-house capacity for construction projects, most restoration projects are being carried out by local governments who have received funding under the 1996 New York State Clean Air / Clean Water Bond Act, Environmental Protection Fund and other state, federal, and private grants. Projects receive technical and planning assistance from state staff, and other members of the Habitat Restoration Workgroup.

The OLISP provides a coordination function for habitat restoration efforts in Connecticut. To that end, four habitat teams have been formed which meet several times a year. These are Tidal Wetlands, Riverine Migratory Corridors, Coastal Barriers/Beaches/Dunes, and Eelgrass (Submerged Aquatic Vegetation). The teams, composed of representatives from federal and state agencies, scientists, and non-governmental organizations, establish annual work plans. The lead agency or organization varies from project to project.

2005 PROGRESS REPORT

Although the ultimate goal of habitat restoration is the implementation of projects, it can take several years of planning, design, obtaining permits and applying for grant funds before a project is ready for construction. For this reason, restoration acreages can vary considerably from year to year, and acreage alone is not a true measure of progress in the field of habitat restoration. Progress is reported by major habitat types with emphasis placed on completed projects. An introduction to each section is provided to summarize the overall work effort.

In calendar year 2005, significant progress was made toward the restoration goals. Four tidal wetland projects were completed, resulting in 43.4 acres restored. Four riverine migratory corridor projects were completed which now provide access to an additional 24.9 miles of migratory passageways for fish. Progress on other habitat types includes restoration of 8.1 acres of estuarine embayment habitat, 5 acres of coastal forest habitat, and 4 acres of dune habitat. Additional progress was made in other areas such as securing funding, initiating engineering design, and conducting preliminary tidal studies, on more than 80 other on-going projects.

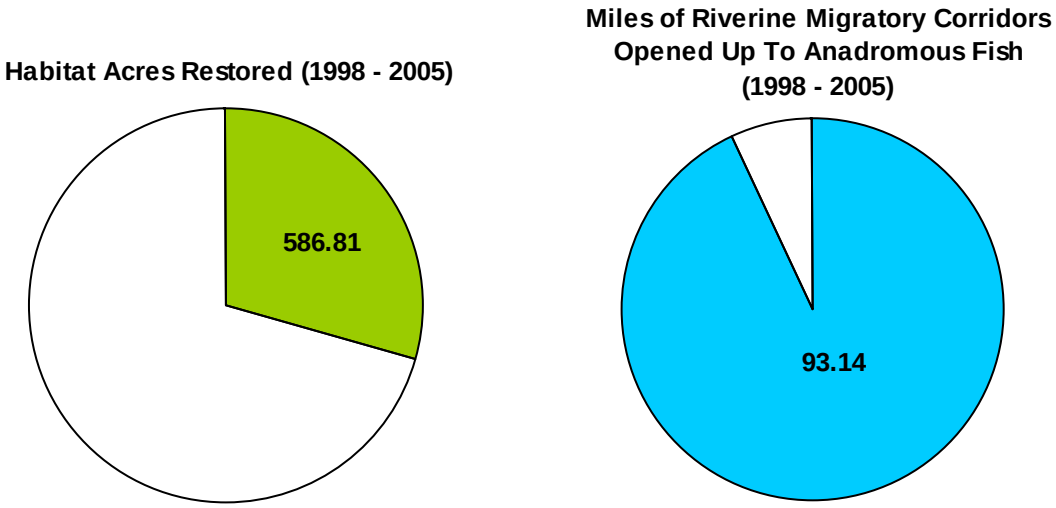


FIGURE 1. Acres and miles restored relative to HRI goals – we are currently at 29.3% and 93.1% of the goals of 2000 acres of coastal habitats and 100 river miles, respectively.

Other miscellaneous highlights include:

- The first awards from the Long Island Sound Futures Fund were made in 2005 and included funding for tidal wetland restoration, eelgrass planting, and migratory fish passage projects.
- New tidal wetland imagery was acquired for New York's portion of Long Island Sound and will be used to analyze wetland loss rates.

The following sections summarize restoration projects completed in 2005 by the states of Connecticut and New York. The habitat types included are tidal wetlands, riverine migratory corridors, estuarine embayments, coastal forest, coastal barriers, beaches and dunes, and submerged aquatic vegetation.

TIDAL WETLAND RESTORATION

Four tidal wetland restoration projects were completed in 2005 for a total of 43.4 acres restored:

- Bluff Point Coastal Reserve Tidal Marshes, Groton, CT 1.9 acres
- Great Meadows Marsh system, Stratford, CT 27.1 acres
  - parcel 2 at 21.32 acres of tidal marsh
  - parcel 3 at 5.77 acres of tidal marsh
- Indian Pond Tidal Marsh System, East Lyme, CT 0.5 acres
  - plus 8.1 acres of estuarine embayment restored
- Lynde Point Marsh, Old Saybrook, CT 13.9 acres

43.4 acres of tidal marsh restored

Project summary pages follow.

Completed tidal wetland project acreage for 1998–2005 are presented in **Figure 2**.

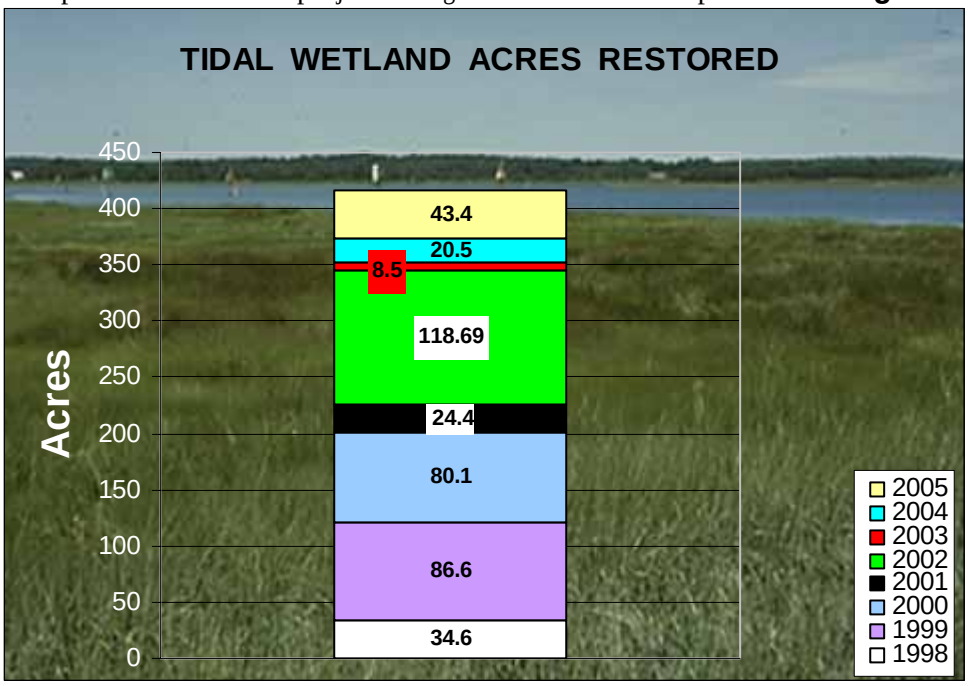


FIGURE 2. Acres of tidal wetlands restored (416.78 acres) between 1998 and 2005.

Many other projects were in various stages of development. Connecticut's 2005 habitat restoration workplan contained 31 tidal wetland projects, including *Phragmites australis* control efforts (see discussion on the following page). Some of the highlights include:

- Lower Connecticut River Marshes: Post-construction monitoring continued in 2005 at the Lower Connecticut River marshes (Great Island, Upper Island, and Lieutenant River near the confluence with the Connecticut River). Fourth-year monitoring was undertaken by researchers from Connecticut College; funding was provided by the Long Island Sound License Plate Fund as administered by the CTDEP and by EPA Long Island Sound Study.
- Great Meadows: Construction began at Parcels 1 and 2 of the Stratford Land Development Corporation's mandated fill-removal project in the Great Meadows tidal marsh complex, Stratford, CT.
- Old Field Creek: A Certificate of Permission was issued by CTDEP's Office of Long Island Sound Programs authorizing the construction of a tidal wetland restoration project at Old Field Creek, West Haven, CT.

- Fivemile River: A Structures, Dredging, Fill, and Tidal Wetlands permit was issued to Save the Sound by CTDEP's Office of Long Island Sound Programs authorizing the application of an experimental wetland restoration technique on a section of drowned marsh on the Fivemile River in Darien.
- Marsh Dieback: Several of the Long Island Sound Study's habitat restoration initiative partners participated in the first New England regional Sudden Wetland Dieback Workshop at the Parker River Wildlife Refuge, Newburyport, MA, in April 2005.
- Marsh Dieback: Staff from CTDEP's Office of Long Island Sound Programs have provided technical support to the New England Estuarine Research Society in the development of a website for scientists and managers to share information about wetland dieback. The website can now be accessed at http://wetland.neers.org/
- SETs: A Certificate of Permission was issued by CTDEP's Office of Long Island Sound Programs authorizing the installation of Surface Elevation Tables (SETs) in the tidal marshes along the Quinnipiac River in Hamden and North Haven. Please see the section devoted to Long Island Sound area SETs for additional information.

Phragmites australis *Control and Evaluation of Restoration Techniques*

In marshes that are diked and drained, the non-native genetic strain (haplotype) of common reed (*Phragmites australis*) can become the dominant plant, in large part due to the reduced concentrations of salt and sulfides that are otherwise toxic for this grass. Phragmites invades these otherwise healthy, natural tidal marshes where the salinity is less than 18 parts per thousand (this includes brackish and tidal fresh marshes). The Connecticut Department of Environmental Protection (CTDEP) is conducting a series of experiments to control Phragmites, including manipulation of the hydromodifications caused by mosquito ditches.

One Phragmites control technique is application of the same herbicide that is used in an over-the-counter backyard weed herbicide. To date, CTDEP has found that single treatments of glyphosate only are effective for a period of 5 years or so, after which additional treatment is required. Many of the wetlands in the Connecticut River that are being invaded are designated as Wetlands of International Importance. Given the wetlands' ecological significance, CTDEP is making a long-term commitment to Phragmites control there. Because these treatments are not long lasting, the restoration effort is reported here, but the acreage of wetland treated with herbicide is not reported in the cumulative wetland restoration statistics.

In contrast to strictly spraying and mowing operations, projects that include significant modifications to marsh hydrology that result in long-term improvements in fish and wildlife habitat and Phragmites reduction are classified as restoration projects. For example, the construction phase of a large-scale marsh restoration project on a 96.5-acre section of Great Island and Upper Island (part of the Lower Connecticut River tidal marsh complex) was completed in June of 2002. The project consisted of testing different combinations of treatments (creating ponds, plugging ditches, filling ditches, and herbiciding and mulching Phragmites) to determine the most effective method(s) for reducing the amount of Phragmites and enhancing fish and wildlife habitat. The ultimate goal of this project is to restore and enhance nearly 300 acres of degraded marsh habitat to a mixture of brackish meadows interspersed with shallow, open water areas–a condition that approximates the pre-ditched marsh environment. Some of the individual objectives of this work are to:

- stop the spread and significantly reduce the aerial extent of Phragmites;
- restore the vegetation mosaic that characterized these brackish tidelands prior to their invasion by Phragmites; and
- enhance the habitat value of the marsh system for birds, fish, and other wildlife.

Post-construction monitoring began immediately after project completion in 2002 and has continued through 2005. Additional monitoring is expected over the next several years with funding awarded by CTDEP's Long Island Sound License Plate program and the US EPA's Long Island Sound Study.

Researchers at Connecticut College in New London, CT, were awarded a grant through the Long Island Sound License Plate Program and used those funds to begin their monitoring of the Great Island and Upper Island marsh system in 2003. The Long Island Sound Study made funds available to CTDEP – Office of Long Island Sound Programs to continue the monitoring effort, and these funds were used to hire the same Connecticut College researchers as private contractors.

Preliminary results of this study (through the end of the 2004 monitoring season) indicate that Phragmites cover was significantly lower in Pond & Plug sites than in Meadow sites (Pond & Plug sites are those which were sprayed and mowed, and treated with hydrologic modification; meadow sites were sprayed and mowed, but received no hydrologic modification beyond the filling of mosquito ditches). Mean water table depths were not significantly different between treatments, but were significantly and consistently more variable in meadow sites. Consistently more negative redox was found in Pond & Plug sites, although these were only significant for one of the three study areas. There were no significant differences between treatments for the seven dominant invertebrate species captured in litter bags; nor were there any significant differences detected between treatments for fish captures per trap set. Gut fullness, however, was significantly greater in fish captured leaving meadow sites.

No new preliminary results were available at the end of 2005. The data analyses continue, however. The sampling effort and data analyses also have changed to a certain degree: litter bag sampling for macro-invertebrates now includes counts of microinvertebrates as well; and results from a similar study being conducted in the middle stretch of the Lieutenant River (also Old Lyme) will be compared to results from this study.

Surface Elevation Tables Installation and Monitoring in Long Island Sound

Coastal ecosystems are strongly influenced by many factors, including waves, wind, tides, and changes in sea level. Sediment core analyses have demonstrated that both highly dynamic sand dunes, as well as very stable tidal marshes, migrate landward or seaward over geological time scales to keep pace with rising or falling sea level. With sand dunes, one can observe changes to a dune system's height or position annually, seasonally, or even overnight after a major storm. Projections for dune accretion or erosion can be made simply by determining the trends seen in these observations. In the case of tidal marshes, however, projections and trends are much more difficult to resolve, as the annual and seasonal changes are much more subtle. Scientists can look at core samples to see the position of layers and sediment types and thereby deduce changes that have taken place over geologic time, but scientists do not have geologic time on their side. And the temporal resolution of core samples does not allow us to determine the most current trends in tidal marsh elevation changes.

A device developed in the early 1980s, known today as a Surface Elevation Table (SET, Figure 3), allows scientists to measure changes in marsh surface elevation with sub-millimeter accuracy. These tools help researchers to determine the most current trends (gains/losses) in marsh surface elevation relative not only to current sea level, but to the bedrock below. With this kind of data at their finger tips, researchers and managers are better equipped to determine the fate of marshes, or make science-based decisions when faced with issues or conditions that may cause harm to these systems. Accelerated sea level rise, marsh submergence or subsidence, and more recent phenomena, such as sudden vegetation dieback and landward migration of marsh grasses, are just a few of the issues for which having the most current marsh elevation trends data would be beneficial to coastal ecologists.

A goal of the Long Island Sound Study is to establish a network of SETs in tidal marshes along the entire shoreline of Long Island Sound (please see Table 1 and Figure 4 for a complete list of current SET locations

within the Long Island Sound National Estuary Program area). Data are collected at least once per year and each array of SETs has its own lead affiliate partner in charge of monitoring.

Table 1. List of all installed SET locations in Connecticut through December 2005. New York State DEC is evaluating potential SET sites for future installation.

LOCATION	TOWN	STATE	INSTALLED	PARTNER
Sherwood Island State Park	Westport	CT	Oct-2004	Yale University
Great Meadows	Stratford	CT	Aug-2005	CTDEP/USGS
Jarvis Creek Tidal Marsh	Branford	CT	Oct-2004	Yale University
Hoadley Creek Tidal Marsh	Guilford	CT	Oct-2004	Yale University
Mamacoke Island Tidal Marsh	Waterford	CT	2002	Connecticut College
Barn Island Tidal Marshes	Stonington	CT	2002	Connecticut College

Background

A pair of Dutch researchers (P.M. Schoot and J.E.A. de Jong) first developed the concept of the SET in 1982, to measure the elevation of intertidal mud flats in the Netherlands. They named their invention the Sedi-Eros-Tafel and, although the name and the design have both been modified several times since then by other researchers to better suit their needs, the basic principle of the devices, as well as the acronym 'SET' have remained unchanged.

Louisiana State University researchers Roelof Boumans and John W. Day Jr., who named their modified SET the Sedimentation-Erosion Table, modified the original apparatus of Schoot and De Jong in 1993 to sample shallow water bottoms in Louisiana. The design of the SET has been remodeled and upgraded several times since then, and the most current SET device used for measuring changes in elevation of marsh surfaces is now most widely known as the Surface Elevation Table. For a more comprehensive account of the history of the SET, please visit http://www.pwrc.usgs.gov/set/SET/original.html.

Methods

SETs are installed in groups of three for the purposes of statistical analysis. Three SETs constitute one SET Array. Installation begins by removing a 2' deep x 6" diameter section of peat. A 9/16" stainless steel rod is driven to refusal (by hand) through the center of the core and is cut off below the marsh surface. A custom-built 9/16" diameter receiver is then attached to the rod. A 2' long x 6" diameter PVC collar is centered over the rod and driven into the marsh so that the top is level with the marsh surface. It is then filled with quick-drying cement in order to secure the rod and receiver in place, and a brass USGS elevation marker (benchmark) is set into the top of the concrete base. The entire footprint of the permanent SET benchmark consists of the 6" diameter area of cement, with the receiver protruding 3-6" above the marsh surface. When data are to be recorded (Figure 5), the actual SET measuring device is temporarily mounted to the top of the receiver.

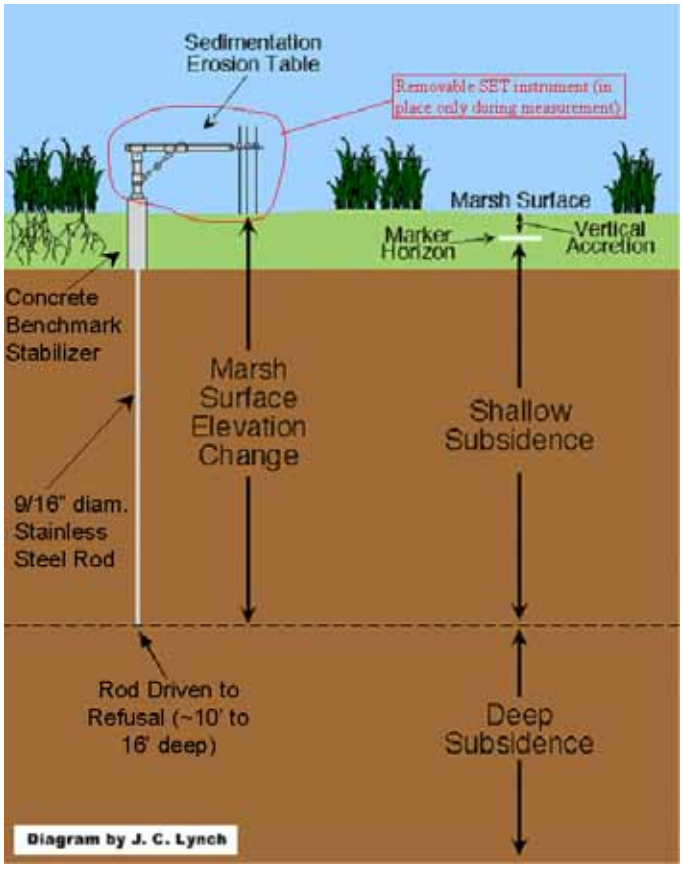


Figure 3. Typical cross-section profile view of a SET installation. From www.pwrc.usgs.gov/set/theory.html Modified by CTDEP

Installation of each SET involves 4 to 6 people and takes roughly 1 hour.

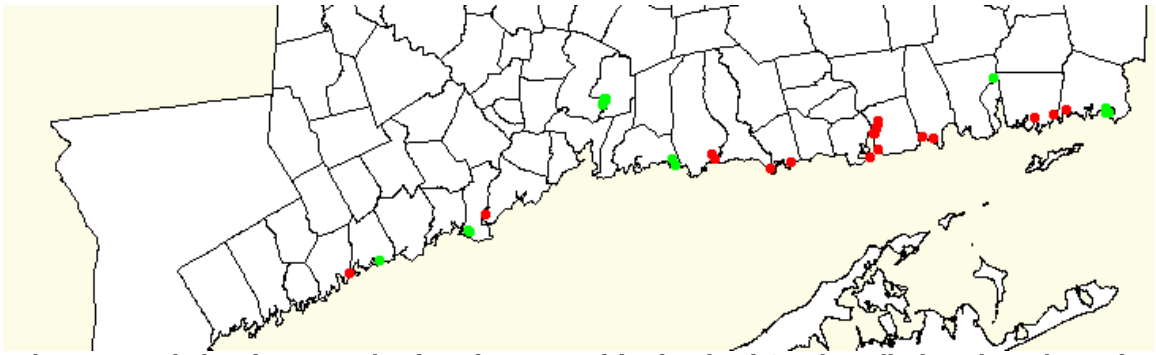


Figure 4. Existing (green points) and proposed (red points) SET installation sites along the Connecticut shoreline. New York State DEC is evaluating potential SET sites for future installation.

Figure 5. SET measuring device. The visible hardware used for recording elevation is in place only while taking measurements. The entire measuring device is removed once all the elevation data have been collected. Note the wooden platforms surrounding the SET - these are in place temporarily to allow researchers to record elevation data without actually stepping in the area being measured. Stepping on marsh peat would compress the soils and that compression would be reflected in the recorded elevation data.

BLUFF POINT COASTAL RESERVE TIDAL WETLAND RESTORATION

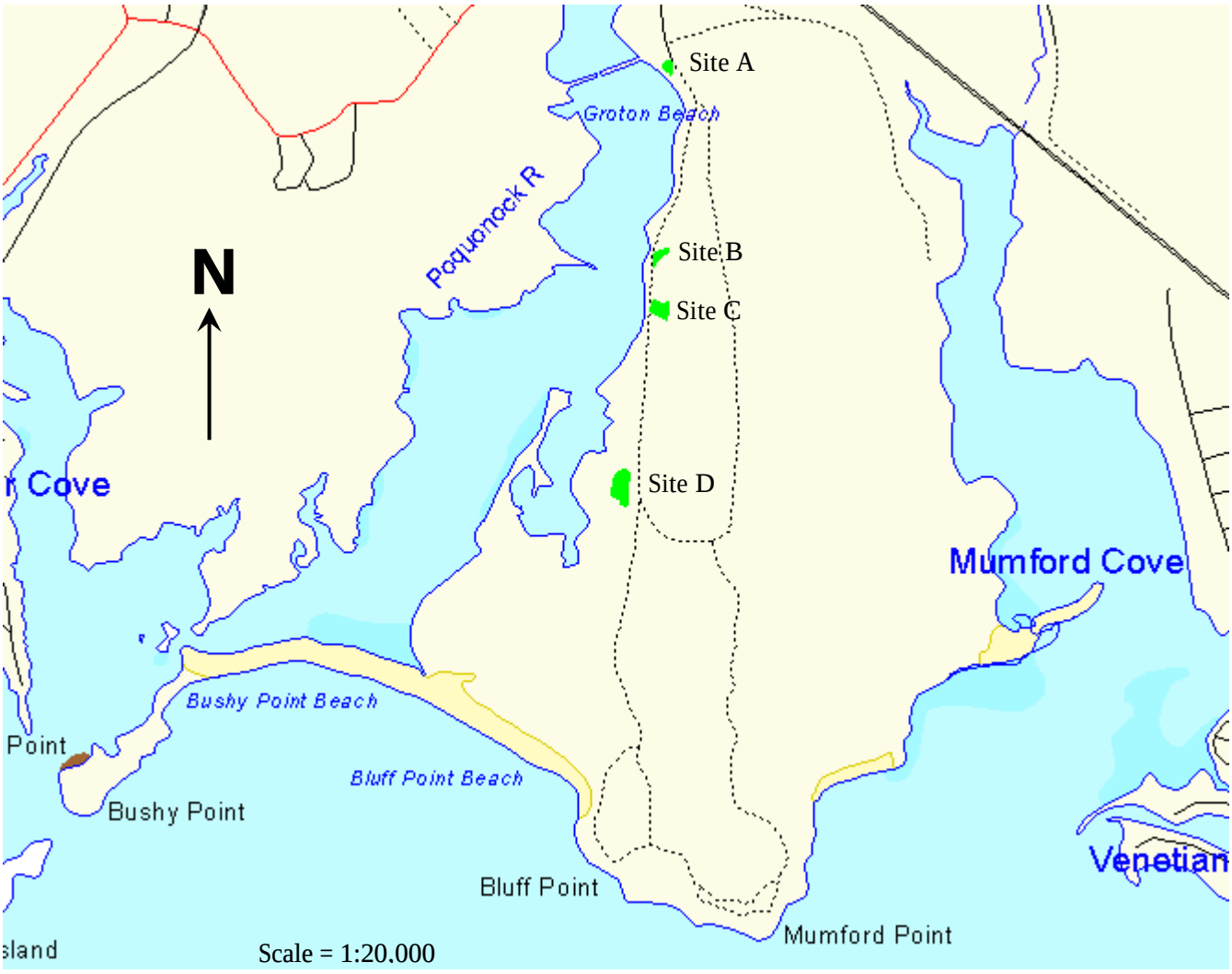
State: Connecticut
Town: Groton
Habitat Type: Tidal Wetland
Acres Restored: 1.9

Cause of Degradation: Four small parcels of tidal marsh within the Bluff Point Coastal Reserve each were tidally connected to the Poquonock River by underground metal culverts. Over time, these culverts had weakened and collapsed, greatly restricting tidal exchange and degrading the quality of the marshes.

Project Description: All four of the crushed metal culverts were removed. The culverts at sites A, B, and C were replaced with corrugated plastic pipes, each about 20 feet long. Rather than install 350 feet of new pipe at site D, the original culvert was replaced with an open channel to allow tidal exchange.

Implementation Partners: Connecticut Department of Environmental Protection - Wildlife Division (lead); Natural Resources Conservation Service; NOAA Restoration Center/Restore America's Estuaries.

Funding Provided By: Connecticut Department of Environmental Protection - Wildlife Division; United States Fish and Wildlife Service - Partners for Fish and Wildlife; CT Duck Stamp; Natural Resources Conservation Service - Wetlands Reserve Program; Save the Sound, Inc.



New culvert at Site A: west side (above); looking east (right); and looking south (below).

New culvert at Site B, looking east from Poquonock River (above) and looking northeast from unpaved access road (below).

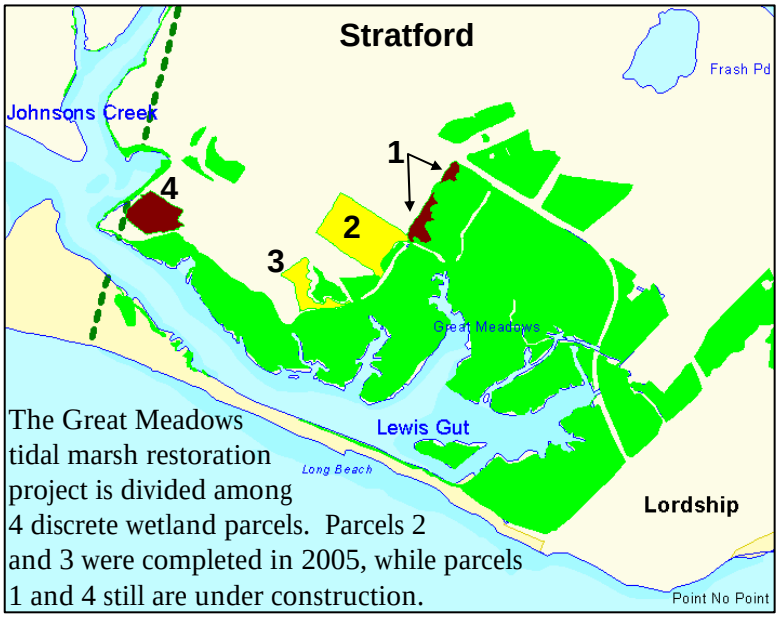
New culvert at Site C looking west (above), and looking east (below).

New open tidal channel at Site D looking west (above), and looking east (below).

GREAT MEADOWS TIDAL MARSH RESTORATION – Parcels 2 and 3

State: Connecticut
Town: Stratford
Habitat Type: Tidal Wetland
Acres Restored: 27.1

- Parcel 2 at 21.32 acres of tidal marsh
- Parcel 3 at 5.77 acres of tidal marsh



The Great Meadows tidal marsh restoration project is divided among 4 discrete wetland parcels. Parcels 2 and 3 were completed in 2005, while parcels 1 and 4 still are under construction.

Cause of Degradation: After a series of dikes were built throughout the marsh system in the 1950s, a large area of tidal marsh was filled when dredged sediments from Bridgeport Harbor were hydraulically discharged behind the dikes and onto the marsh. After having lost nearly all of its functions and values, the tidal marsh system became a dense monoculture of the tall invasive grass known as common reed (*Phragmites australis*). Prior to restoration, these wetlands were classified as formerly connected tidal wetlands as well as degraded inland wetlands.

Project Description: As a condition of their permit to conduct regulated activities in areas under Connecticut Department of Environmental Protection's (CTDEP) jurisdiction, the Stratford Development Corporation (SDC) agreed to restore approximately 42 acres of tidal wetlands. The SDC sold some of its property, which contained filled tidal wetlands, to the US Fish and Wildlife Service and agreed to restore the ecological value of the federal lands. The restoration site is composed of four discrete parcels, each ranging in size from approximately 5 acres to 20 acres, and divided by other upland parcels, as well as by a series of dikes designed to keep tidal waters out of this system. Beginning in 2003, the Stratford Development Corporation hired a private contractor and the CTDEP Wildlife Division to excavate the fill material to an elevation that would support a more natural assemblage of tidal wetland vegetation. A series of tidal creeks and ponds were excavated to help restore a more natural tidal flow and to support species of birds and fish that depend on the marsh as habitat or as a source of food. As noted from the photograph on the following page, no planting of marsh vegetation was done after excavation was completed. Restoration of tidal flow will result in a more natural distribution of plants, as seeds are deposited by the tides, and the sprouting plants spread out on their own.

Parcels 2 and 3 were completed in 2005, while parcels 1 and 4 are still undergoing excavation. By the end of 2006, the construction phase for the restoration of over 42 acres of tidal wetlands will be completed, and it is estimated that over 140,000 cubic yards of fill will have been removed from this site.

Implementation Partners: Stratford Development Corporation (lead); Connecticut Department of Environmental Protection - Wildlife Division; U.S. Fish and Wildlife Service - Stewart B. McKinney National Wildlife Refuge.

Funding Provided By: Stratford Development Corporation.

Vertical aerial photo of the Great Meadows marsh complex, taken approximately 1 month before the construction phase at parcel 2 was completed (above). Below, oblique aerial photo of parcel 2 before restoration. Note the nearly 100% cover by the aggressive common reed (*Phragmites australis*).

INDIAN POND ESTUARINE EMBAYMENT - TIDAL MARSH SYSTEM RESTORATION

State: Connecticut
Town: East Lyme
Habitat Type: Tidal Wetland and Estuarine Embayment
Acres Restored: 0.5 acres of tidal wetlands and 8.1 acres of estuarine embayment habitat

Cause of Degradation: The tidal pond and surrounding tidal wetlands had become blocked off by a recently formed sand dune. As a result, the pond and wetlands had become a predominantly freshwater, non-tidal system with only a small amount of salt water influence occurring during storms. In the summer, the water would warm up and become stagnant, which created prime conditions for algal blooms. A thick algal mat covered this pond during much of the growing season, and was surrounded by a tall, dense belt of common reed (*Phragmites australis*).

Project Description: Tidal flow was restored by reconnecting the system to Niantic Bay. A pair of 18-inch diameter culverts were installed at –1 foot National Geodetic Vertical Datum (NGVD), along with a water control structure. The purpose of the water control structure is to help keep out excessive tidal flooding through the placement of weir boards. Without the control structure, the full natural range of the Niantic Bay tides could potentially flood adjacent properties. The reintroduced salty tidal waters will prevent the algal mat from forming and will greatly reduce the vigor of the Phragmites.

Implementation Partners: Connecticut Department of Environmental Protection - Wildlife Division (lead and construction); U.S. Fish and Wildlife Service; local homeowners association.

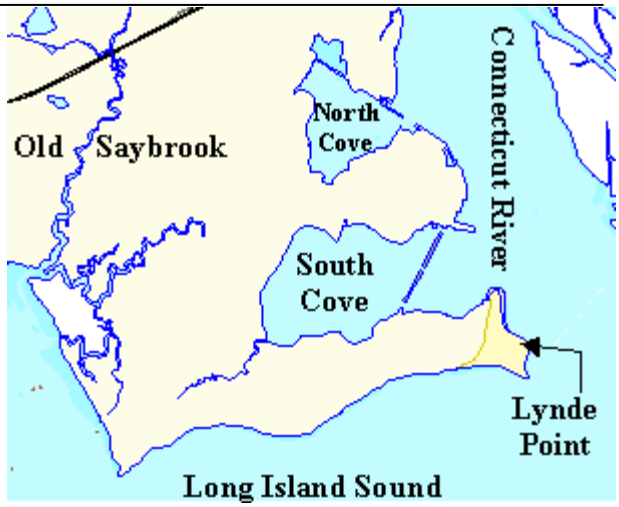
Funding Provided By: U.S. Fish and Wildlife Service; Connecticut Department of Environmental Protection - Wildlife Division (in-kind services).

View of the water control structures and pond, facing northwest. The culverts are buried at an elevation of –1.0 feet NGVD. Note the algal mat on the surface of the pond.

The downstream section of paired 18-inch diameter culverts during installation (view to southeast toward Niantic Bay). The culverts are secured by stainless steel cable and stainless steel clamps.

View down inside one of the water control structure, during a full moon tide coming into the pond on 07/21/05 at 10:00 am.

LYNDE POINT TIDAL MARSH RESTORATION



State: Connecticut
Town: Old Saybrook
Habitat Type: Tidal Wetland
Acres Restored: 13.9

Cause of Degradation: The Lynde Point tidal marsh, which was filled with sandy dredged sediment during the 1940s, had lost all of its natural tidal wetland functions and values. The marsh was used as a disposal site for the hundreds of thousands of cubic yards of material dredged out of the federal navigational channel in the Connecticut River. Over the years, the site had become recolonized with plant species regarded as weeds, which provided poor–quality habitat for the local wildlife as well as for migratory birds. As the marsh below the filled area began to compress and subside, some sections became wetter once again, a result of infrequent tidal flooding and poor drainage. With only the slightest tidal influence, the site began to show the characteristics of a typical degraded New England tidal marsh. By the 1980s, the degraded and filled wetland had become dominated by common reed (*Phragmites australis*) in the wetter areas; several other species of non-native upland plants were invading at slightly higher elevations.

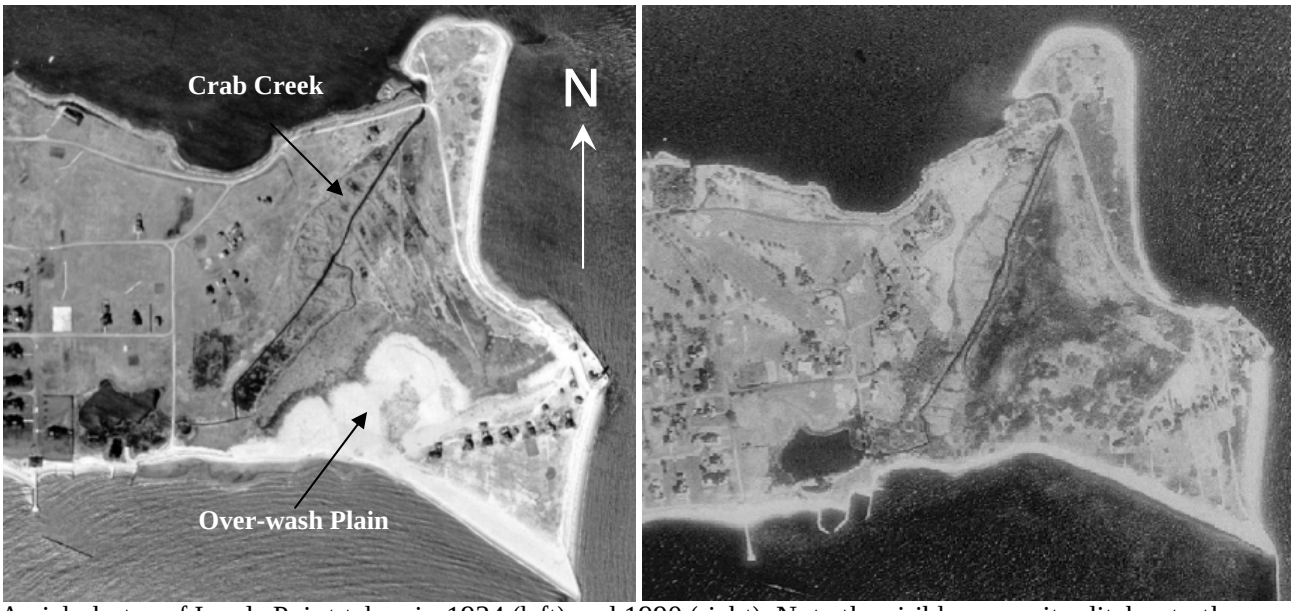
Project Description: Before tidal flow restoration could begin, the area was cleared of Phragmites and other upland invasive weeds using a combination of herbicide and cutting. Phragmites-dominated areas were mowed, using modified, low-ground pressure equipment, while the woody/shrubby weeds were mulched using a hydro-ax brush cutter. Tidal flow then was restored through the removal of sandy fill material. Tidal flow into and out of the marsh was aided by the creation of tidal creeks. Three tidal ponds also were created.

The re-establishment of the Lynde Point tidal marsh adds to the already numerous acres of fresh and brackish tidal marshes of the lower Connecticut River classified as “Wetlands of International Importance” by the Ramsar Convention on Wetlands. This classification was granted to these wetlands, among other reasons, for their importance to migratory birds as a feeding and resting area. For the same reasons, The Nature Conservancy has declared the lower Connecticut River area as among the 200 “Last Great Places” on earth.

Coastal grassland and remnants of historic maritime shrubland and forest, which were cleared for farmland in the 1800s, are also associated with the wetland restoration site. The widespread distribution and aggressive nature of non-native invasive plants, such as bittersweet, multiflora rose, and bush honeysuckle, threatened these habitats. These species were removed and a healthy native plant community was created in its place, which included such native coastal grassland species as little bluestem (*Schizachyrium scoparium*), switch-grass (*Panicum virgatum*), and broomsedge (*Andropogon virginicus*). This phase of the project is still under construction and will be further discussed in a future report.

Implementation Partners: Connecticut Department of Environmental Protection - Wildlife Division (lead and construction), and Office of Long Island Sound Programs; Lynde Point Land Trust; Borough of Fenwick; Ducks Unlimited; Corporate Wetland Restoration Partnership; United States Fish and Wildlife Service; National Oceanic and Atmospheric Administration; Natural Resources Conservation Service.

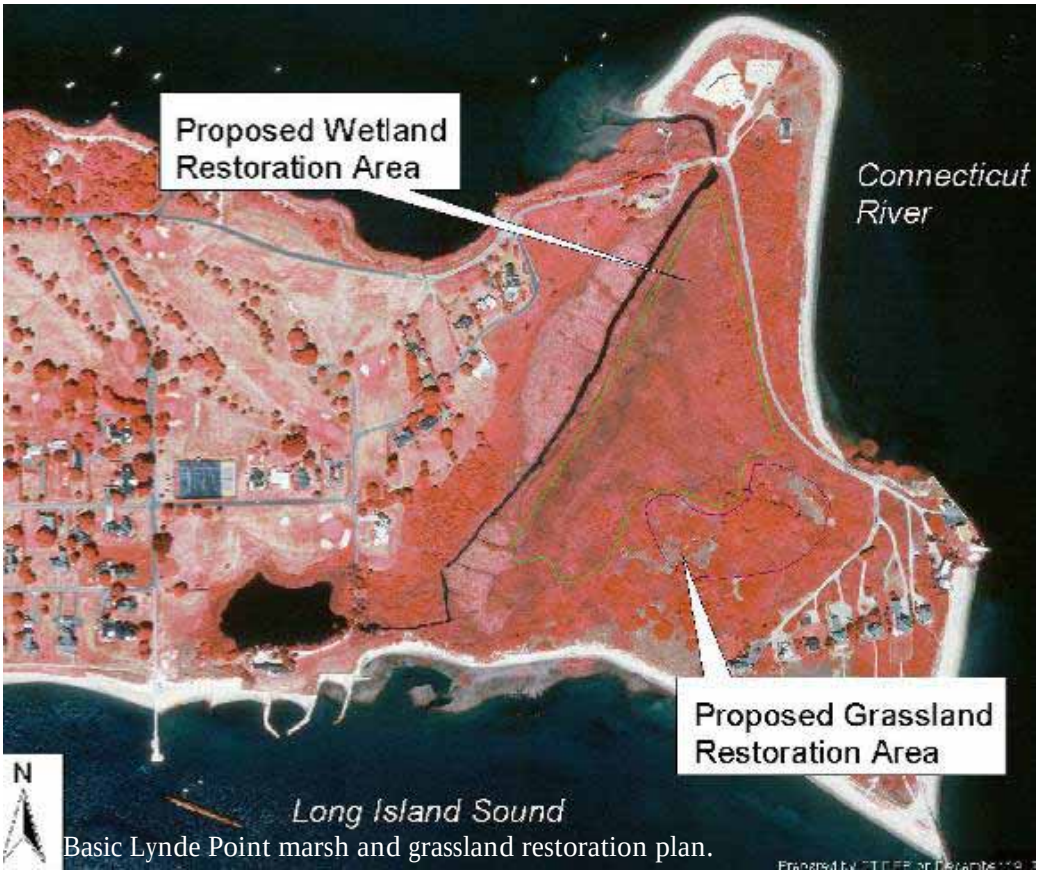
Funding Provided By: Lynde Point Land Trust; Borough of Fenwick; U.S. Fish and Wildlife Service - National Coastal Wetlands Conservation Grant Program, and Partners for Fish and Wildlife Program; Ducks Unlimited / National Oceanic and Atmospheric Administration partnership; Connecticut Corporate Wetlands Restoration Partnership; Natural Resources Conservation Service; Connecticut Department of Environmental Protection - Wildlife Division (in-kind), and Office of Long Island Sound Programs (in-kind).



Aerial photos of Lynde Point taken in 1934 (left) and 1990 (right). Note the visible mosquito ditches to the southeast of Crab Creek and the sandy over-wash plain on the south shore in 1934. By 1990, the marsh area southeast of the creek had been buried under several feet of fill, with only a few wet areas remaining. The over-wash plain, buried under a much deeper layer of fill, is being transformed into a native coastal grassland habitat.

A recently sprayed and mulched Phragmites-dominated section of Lynde Point marsh.

Aerial photo taken early during the construction phase of the project.



Basic Lynde Point marsh and grassland restoration plan.

RIVERINE MIGRATORY CORRIDOR RESTORATION

The Connecticut Riverine Migratory Corridor (RMC) team, led by the Connecticut Department of Environmental Protection (CTDEP) Inland Fisheries Division, completed four migratory fish passage projects, resulting in 24.9 additional river miles now accessible to anadromous finfish. Fishways were built at Branford Water Supply Dam and Occum Dam; the Pizzini Dam was completely removed. A fish bypass channel was constructed at Cannondale Dam, and a temporary eelpass was installed at Stevenson Dam. Project summary pages follow.

New York completed a number of riparian buffer restoration projects that involved plantings for bank stabilization. New York's portion of the Long Island Sound shoreline presents significantly fewer opportunities for migratory riverine migratory corridor restoration. However, those opportunities that do arise are very important to the overall health of riverine species and in the reduction of sediment and nutrients reaching Long Island Sound. Because the projects described are riparian or streambank enhancements, and not migratory fish restoration projects that consist of dam removals or fishway installations, the miles for New York's projects are not included in the totals for riverine migratory corridors.

The 10-year goal (1998 - 2007) for this habitat type is to open up 100 currently inaccessible river miles to diadromous fish. To date, 93.1 river miles have been restored through such fish passage projects as dam modifications or dam removal. River mileage for projects completed in 1998–2005 is presented in **Figure 6**.

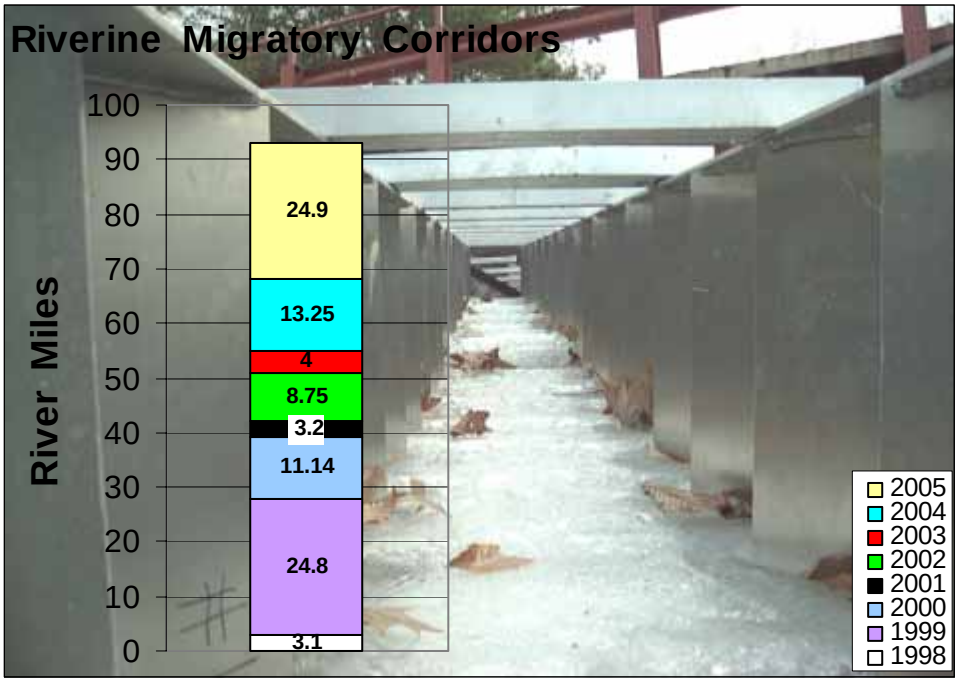


FIGURE 6. Cumulative river mileage (93.1 miles) for RMC projects completed between 1998–2005. Three miles that were not counted before were added to a previously reported project, which was completed in 2000.

The RMC team also worked on 49 other projects that were in various stages of development. Highlights of progress include:

- Goodwives River: Dam repair permits were issued by CTDEP for Rings End Dam in Darien, CT; a condition of the permit is the construction of a new steep-pass fishway.
- Vargas Ice Pond Brook: As a condition of a coastal permit issued by CTDEP's Office of Long Island Sound Programs to extend the Town Pier, the Town of Stonington has agreed to modify a dam in Vargas Pond Brook to allow the passage of anadromous fish. This project was put on hold, pending availability of funds.
- Eightmile River: Approximately 40 eastern pearl shell mussels, classified as "special concern" in Connecticut, were located near the Pizzini Dam in East Haddam; they were relocated upstream of the project site before construction began.

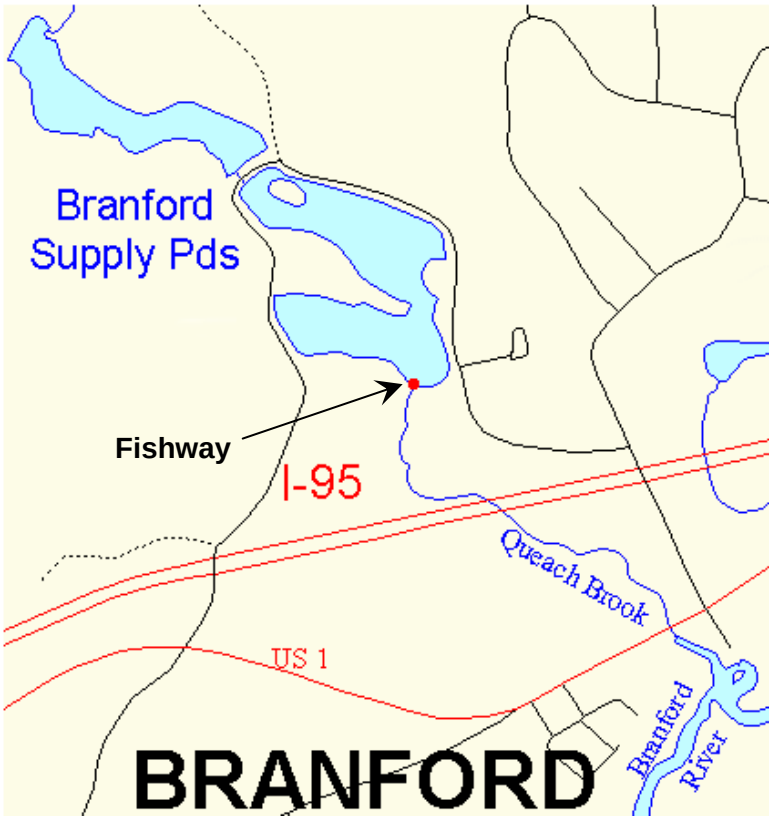
BRANFORD WATER SUPPLY POND DAM FISHWAY

State: Connecticut
Town: Branford
Habitat Type: Riverine Migratory Corridor
Stream Name: Queach Brook
Miles Restored: 5.6 miles

Cause of Degradation: A 16-foot-high dam was constructed in Queach Brook (a.k.a. Pisgah Brook) during the late 19th century to provide the Town of Branford a public water supply. Unfortunately, the dam blocks an important migratory corridor for several species of anadromous fish.

Project Description: A steep-pass fishway was designed and built on the dam to allow the safe passage of migratory fish. The project included a special lock box where an electronic fish counter is housed.

Targeted Fish Species: Alewife, blueback herring, sea-run brown trout.



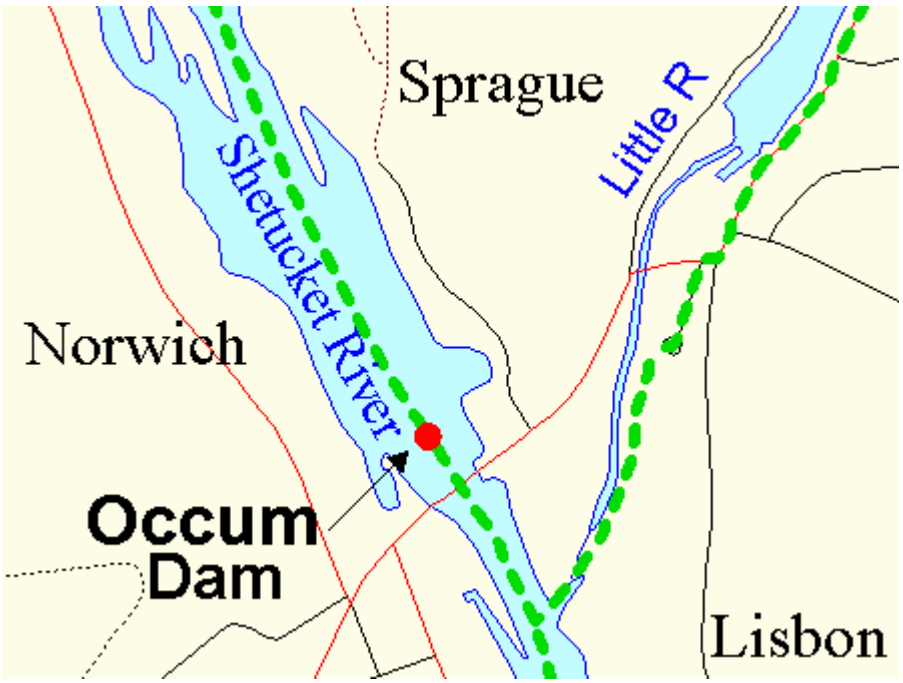
Implementation Partners: Branford River Project (lead) - a joint effort of the Branford Land Trust and the Branford Rotary Club; Town of Branford; U.S. Fish and Wildlife Service - Engineering and Southern New England–New York Bight Coastal Ecosystems Program; National Fish and Wildlife Foundation; Connecticut Corporate Wetlands Restoration Partnership; Connecticut Department of Environmental Protection - Inland Fisheries Division, and Office of Long Island Sound Programs; National Oceanic and Atmospheric Administration - Fisheries Restoration Center; Natural Resources Conservation Service.

Funding Provided By: Branford Land Trust; Connecticut Department of Environmental Protection - Long Island Sound License Plate Fund, and Diadromous Fish Program (in-kind); Town of Branford - Parks and Open Space Authority; Natural Resources Conservation Service - Wildlife Habitat Incentives Program grant; U.S. Fish and Wildlife Service - Southern New England–New York Bight Coastal Ecosystems Program; Long Island Sound Study – Long Island Sound Futures Funds grant (made up of contributions from NOAA, National Fish and Wildlife Foundation's Striped Bass Fund, and US FWS); National Oceanic and Atmospheric Administration - Restoration Center; Connecticut Fund for the Environment - Save the Sound program through National Oceanic and Atmospheric Administration/Restore America's Estuaries partnership; Connecticut Corporate Wetlands Restoration Partnership; Additional in-kind grants provided by Richard Pinder Construction Company, and Nathan L. Jacobson & Associates, Inc.

Branford Water Supply Dam fishway viewed from the bottom (above) and from the top (below). Photos taken by Tom Cleveland.

OCCUM DAM FISHWAY and EELPASS

State: Connecticut
Town: Norwich
Habitat Type: Riverine Migratory Corridor
Stream Name: Shetucket River
Miles Restored: 11.5 (including 4.5 miles in Merrick Brook)



Cause of Degradation: A 13-foot tall hydroelectric dam in the Shetucket River blocks the passage of migratory fish.

Project Description: The restoration of diadromous fishes to the Shetucket River watershed has been a high priority of the Connecticut Department of Environmental Protection (CTDEP) for many years. The Occum Dam is used by the City of Norwich to generate hydroelectricity and was licensed by the Federal Energy Regulatory Commission (FERC) in 1999 [FERC No. 11574]. Based on input from the CTDEP and the U.S. Fish and Wildlife Service, FERC required the City to provide fish passage at the dam as soon as fish passage was provided at the Taftville Dam, the first dam downstream of Occum Dam. An agreement between the City and the CTDEP accelerated the schedule for the construction. A Denil fishway and an accompanying eelpass were built during late 2004 and early 2005, at the same time as the Taftville Fishway.

The Occum Fishway opened in May of 2005. The fishway is located adjacent to the powerhouse and extends along the western shore for approximately 225 feet. The fish passage structure consists of a 4-foot-wide concrete rectangular flume. A series of baffles, placed at an angle to the water flow, allow the fish to swim through the flume. A downstream fish passage was constructed adjacent to the project's powerhouse and intake structure to promote the passage of the targeted fish species. The main eelpass is located in a small space between the Denil and the dam abutment. There are two entrances: at the spillway's apron and below the apron. The Occum Dam Fishway allows fish to swim an additional seven miles upstream before reaching the Scotland Dam, which is expected to have fish passage provided in the near future.

Targeted Fish Species: American shad, alewife, blueback herring, sea-run brown trout, gizzard shad, and sea lamprey.

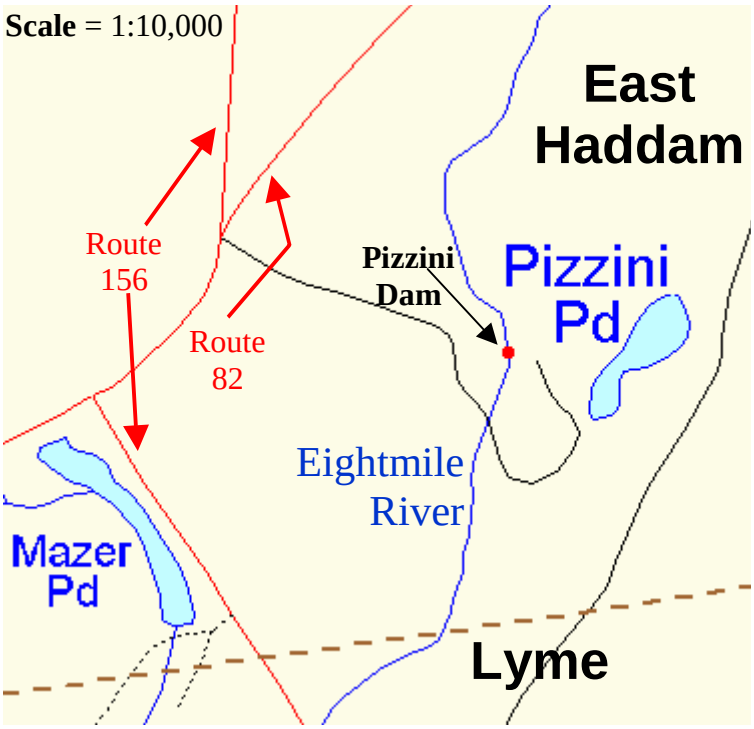
Implementation Partners: City of Norwich (lead); Connecticut Department of Environmental Protection - Inland Fisheries Division; U.S. Fish and Wildlife Service – Ecological Services.

Funding Provided By: City of Norwich – Norwich Public Utilities.

(Some project information obtained from http://www.norwichpublicutilities.com/fish-lift.html)

Aerial views of the Denil fishway constructed on the Occum Hydroelectric Dam. (screen captures from maps.live.com)

PIZZINI DAM REMOVAL



State: Connecticut
Town: East Haddam
Habitat Type: Riverine Migratory Corridor
Stream Name: Eightmile River
Miles Restored: 4.5

Cause of Degradation: A 2.5-foot-high, privately owned masonry dam, built for recreational purposes in the 1940s, blocked the migrations of fish. Anadromous fish did not have access to the site because of a downstream dam; when that dam had a fishway installed, however, migratory fish then were blocked by this dam.

Project Description: Completely remove the dam and some appurtenances, such as remnant water pipes. Permission was needed from two landowners (each owned half of the dam). Eastern pearlshell mussels were relocated from immediately downstream of the dam to get them out of harm's way. Less than 5 yards of sediment was removed from behind the dam. The dam was demolished and the pieces removed with a backhoe in one day. The demolition debris and sediment were buried on site, capped, and seeded. This was the last anthropogenic barrier to fish passage on the Eightmile River, downstream of Hopyard Falls (also in East Haddam).

Targeted Fish Species: Atlantic salmon, alewife, blueback herring, sea-run trout, sea lamprey, American eel.

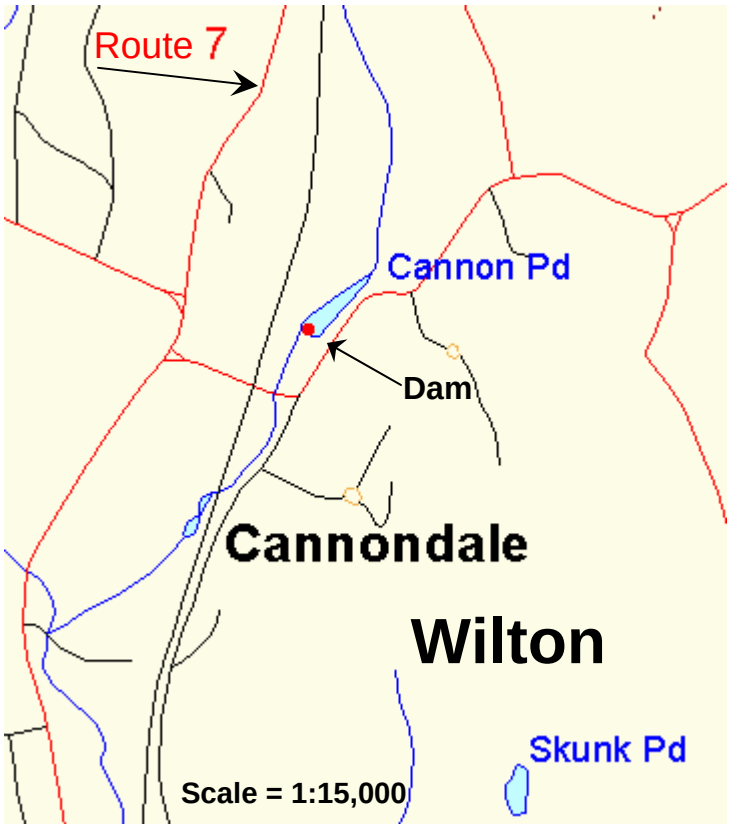
Implementation Partners: Connecticut River Watershed Council (co-lead); Connecticut Department of Environmental Protection - Inland Fisheries Division; American Rivers (co-lead); National Oceanic and Atmospheric Administration; Bettina Lyons (land owner).

Funding Provided By: Connecticut River Watershed Council; National Oceanic and Atmospheric Administration – Partnership Funds.

Upstream view of Pizzini Dam before removal (above) and after (below). The source for both photos is: http://www.aswm.org/calendar/integratingrest/wildman.pdf

CANNONDALE DAM FISH BY-PASS CHANNEL

State: Connecticut
Town: Wilton
Habitat Type: Riverine Migratory Corridor
Stream Name: Norwalk River
Miles Restored: 3.3



Cause of Degradation: A 5-foot-high dam in the Norwalk River in Wilton, CT blocked fish passage. Dams such as this one not only act as a barrier to fish, they alter the habitat by increasing water temperature, reducing dissolved oxygen, and providing refuge for warm water fish (such as chain pickerel and large mouth bass) that out-compete cold water fish (such as trout) 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.

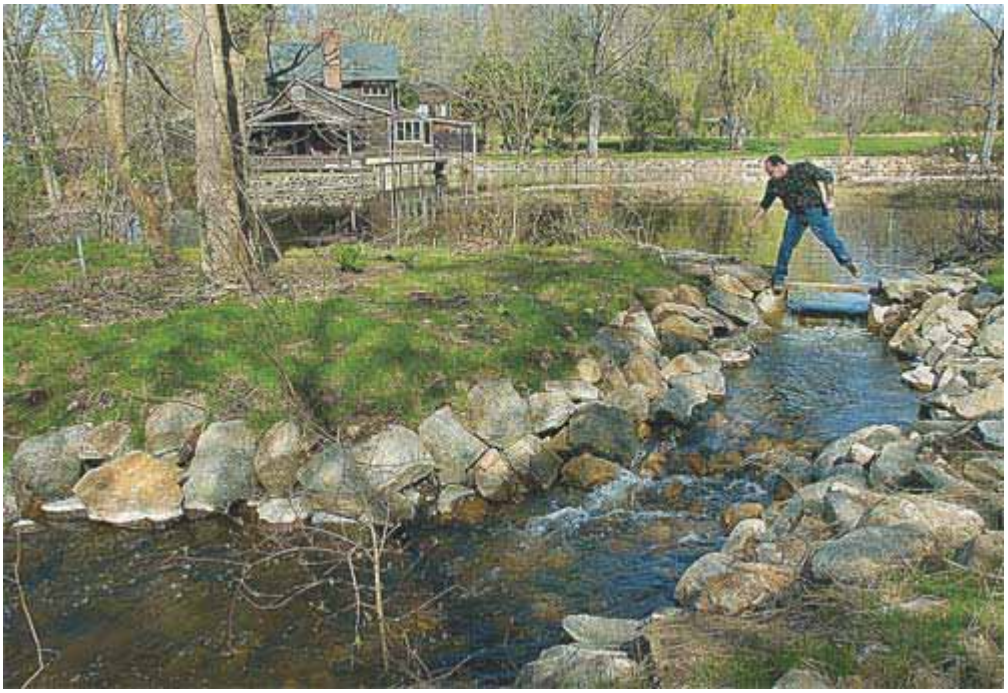
Project Description: Construction of a 1:30 bypass channel around the dam was completed in October 2005, allowing migratory fish access to their historic spawning grounds upstream. The bypass is a boulder-lined, horseshoe-shaped trench that diverts water from the river above the dam, and returns the water to the river below the dam. The bypass channel is sloped in such a way that it creates a current strong enough to attract the fish, but not so steep as to create currents too powerful for the successful passage of fish. During the summer when water levels are low, the bypass channel is closed off by placing a board at the upstream end of the channel. The Cannondale Dam is the 3rd dam on the Norwalk River. Until fish passage can be provided at the two dams downstream – Strong Pond Dam, also in Wilton, and Flock Process Dam in Norwalk – only riverine species of fish (non-anadromous species) can utilize the bypass channel.

Targeted Fish Species: Alewife, blueback herring, sea-run brown trout, and American eel, in addition to riverine species.

Implementation Partners: Natural Resources Conservation Service (lead); Trout Unlimited - Mianus Chapter; Town of Wilton - Conservation Commission.

Funding Provided By: U.S. Environmental Protection Agency 319 (Clean Water Act) Funds; Natural Resources Conservation Service - Wildlife Habitat Incentives Program; Trout Unlimited.

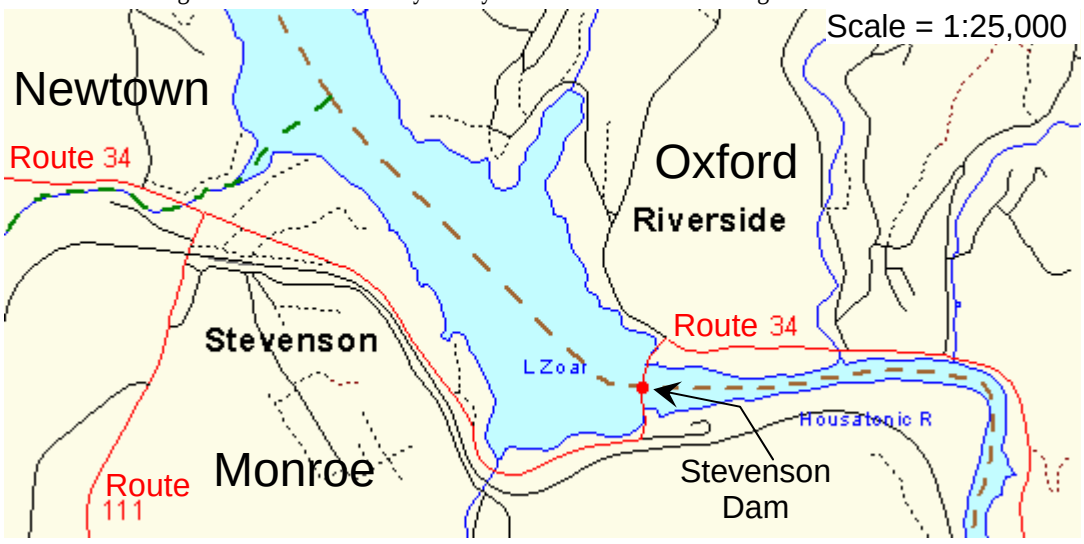
(Sources: http://www.mianustu.org/nwri2.htm - Jessica A. Kaplan, Watershed Coordinator, Norwalk River Watershed Initiative; and Ryan Jockers, Stamford Advocate, Bypass built at Cannondale Dam to aid passing trout, April 26, 2006 - www.tu.org/site/c.kkLRJ7MSKtH/b.3205851/apps/s/content.asp?ct=4356817).



Upstream end of the bypass channel constructed around the Cannondale Dam.
Photo source: http://photos1.blogger.com/blogger/5728/158/1600/cannondale%20dam.0.jpg

STEVENSON DAM INTERIM EELPASS

State: Connecticut
Town: Monroe
Habitat Type: Riverine Migratory Corridor
Stream Name: Housatonic River
Miles Restored: 10.6 miles of passage strictly for American eels; projects intended to pass only eels cannot be applied toward the Long Island Sound Study's 10-year habitat restoration goal.



Cause of Degradation: Built in 1919 to generate hydroelectric power, the Stevenson Dam, bordering Monroe and Oxford, is the largest of the five hydroelectric dams on the Housatonic River. Built and formerly owned by the Connecticut Light & Power Company, this project was owned and operated by the Northeast Generation Services (NGS) when this project was initiated. Most dams block the passage of most fish species but American eel are able to wiggle over in some limited numbers. This dam is 84 feet tall and spills no water so even eels cannot get past it. Lake Zoar was formed by the construction of the Stevenson Dam.

Project Description: A temporary eel passage structure was constructed at Stevenson Dam, as required by the Federal Energy Regulatory Commission (FERC) for re-licensing of the hydroelectric dam. The eelpass is a steeply sloped ramp that has a roughened floor with small amounts of water passing down it. The bottom is a short distance under the water's surface below the powerhouse. Eels are attracted by the flow, climb up the ramp and are trapped. The eels are removed, counted, and manually transported above the dam where they are released. A permanent fish passage device that will include eels as well as anadromous species of fish will be installed by 2014 as required by FERC.

Targeted Fish Species: American eel.

Implementation Partners: Connecticut Department of Environmental Protection - Inland Fisheries Division; US Geological Survey - Conte Anadromous Fish Research Center.

Funding Provided By: private [Northeast Generation Services].

No photos of the eelpass device used at Stevenson Dam are available at this time

COASTAL FOREST RESTORATION

At this time, the *Technical Support for Coastal Habitat Restoration* manual does not include a finalized chapter to summarize the key elements of coastal forest restoration. A draft chapter, however, is in the early stages of development.

In New York, one coastal forest restoration project was completed during 2005, for a total of 5 acres restored. Several other projects were in various stages of development.

No coastal forest restoration projects were completed in Connecticut. The State of Connecticut currently has no program dedicated specifically to the restoration of coastal forest habitat.

The following freshwater wetland restoration project was completed in 2005:

- Cunningham Park coastal forest restoration, Queens, NY 5.0 acres of coastal forest

CUNNINGHAM PARK COASTAL FOREST RESTORATION

State: New York
Town: Queens
Habitat Type: Coastal Forest
Acres Restored: 5

Cause of Degradation: Forest habitat was being encroached by non-native species.

Project Description: The restoration area is located in Cunningham Park's Southern Forest, one of the most undisturbed natural areas in New York City. The forest is a mature growth forest comprised of red oak, black oak, tulip and hickory trees with a healthy understory. The encroaching non-native species, including Norway maple, multiflora rose, and Asiatic bittersweet were removed. After removal of nuisance species, over 1000 native trees and shrubs and 2000 herbaceous plants were planted. After removal of the Norway maples, the increased sunlight penetration to the understory stimulated native seedbanks. Native plantings included tulip trees, spicebush, sweetgum, red maple, and various oak species.

Implementation Partners: New York City Department of Parks & Recreation-Natural Resources Group; Partnerships for Parks; Boy Scouts of America; Queens College; AmeriCorps; Friends of Cunningham Park; various church groups.

Funding Provided By: New York City Environmental Fund; New York City Department of Parks & Recreation-Natural Resources Group.

SUBMERGED AQUATIC VEGETATION (SAV)

Eelgrass

In 2001, Connecticut Department of Environmental Protection (CTDEP) was awarded a grant by the EPA Long Island Sound Study to re-map eelgrass *(Zostera marina)* beds in eastern Long Island and Fishers Island Sounds in New York and Connecticut. The CTDEP used those funds to contract with the National Wetlands Inventory Program of the U.S. Fish and Wildlife Service to (a) acquire low-altitude aerial photography, (b) perform photointerpretation of eelgrass beds, and (c) ground-truth those areas interpreted as possible eelgrass beds. Aerial photography was conducted in mid-June, 2002. The results of this survey were compared with mapping of eelgrass that was done during 1993 and 1994 to identify trends (gains/losses) in Long Island Sound eelgrass beds, and potentially identify future restoration opportunities. A Geographical Information Systems (GIS) project with a final summary report for this survey was created. An additional survey following the same procedure that was used in 2002 was planned for 2004, but was delayed and should be undertaken in 2006. The goal of the Long Island Sound Study and their partners is to make this aerial eelgrass survey a regular event, conducted every 2 to 3 years.

Water Chestnut Removal

Restoration of the Hockanum, Connecticut, and Podunk Rivers

CTDEP completed a seventh year of control efforts for the highly invasive aquatic plant, water chestnut (*Trapa natans*). Water chestnut was first documented in Connecticut in 1999 when it was discovered in Keeney Cove, a freshwater tidal cove of the Connecticut River in Glastonbury. Infestations since have been discovered in the Hockanum River (East Hartford), Vinton's Millpond in the Podunk River (South Windsor), Trout Brook (West Hartford), and in several private ponds in the eastern and western parts of Connecticut.

Water chestnut populations continued to decline this year compared to the 2004 harvest. In all, a 94.8% drop in water chestnut was recorded from 2004 to 2005 at all previously known Connecticut River-area sites. Pounds (wet-weight estimates) of water chestnut harvested dropped at all of these sites with only one exception–Keeney Cove in East Hartford, CT–where 1000% of 2004's population was documented in 2005. Fortunately, CTDEP was able to handle this astronomical increase in water chestnut because the 2004 population consisted only of 1 plant (0.5 pounds). Ten times more, 5 pounds, was removed in 2005. After a huge resurgence from 2003 to 2004, the water chestnut population in Vinton's Millpond in South Windsor, CT, experienced an equally impressive 98.4% reduction in harvested biomass from 2004 to 2005.

Figure 7. Water chestnut distribution in Vinton's Millpond (South Windsor, CT, summer 2004). The red areas represent dense patches, except for the two that lie east of the beaver dam (moderate density). The entire pond also had many plants scattered throughout. There were no dense patches found in 2005, just sparsely-populated patches and solitary plants scattered throughout the pond.

Additional water chestnut population reductions included: a 51.4% reduction at Cromwell Cove; a combined 85.7% reduction at both Hockanum River sites in East Hartford; and a 100% reduction (no plants were found at all) at Trout Brook in West Hartford.

Water Chestnut Expansion

Six new infestations of water chestnut were found during 2005, including three immediately adjacent to, and therefore a potential threat to, the Connecticut River. The first of these three sites is Meadow Brook Pond, a small drainage pond on Connecticut Department of Transportation property in Hartford, next to the exit 34 ramp off of Interstate 91 north-bound, and less than 0.5 miles from the Connecticut River. Two small patches equal to about 25 sq. ft. were found and removed. The second population was discovered at the southern end of Chapman Pond in East Haddam, only 0.25 miles from the Connecticut River. Approximately 50 pounds of water chestnut were found and removed from this site. The third population was found in the North Meadows Pumping Station Storage Pond, which is used primarily to collect storm water, and routinely pumps water into the Connecticut River when the water reaches a specified level. The pond is nearly 15 acres in size and reports indicate that water chestnut covers anywhere from 50% to 90% of its surface. Located only 800 feet from the river, the potential for water chestnut plants to get pumped out of the pond and into the main stem Connecticut River is very high. Uprooted water chestnut plants, including rosettes that have been cut from their stems, can be carried long distances downstream and are still capable of producing seeds. Removal, therefore, is a priority for this site for both the CTDEP and the City of Hartford. This population was discovered too late in the year to justify a large-scale harvesting effort, but plans for herbiciding the pond next year already are under way.

The last three sites are privately owned ponds in northwestern Connecticut, including Beeslick Pond in Salisbury, Strastrom Pond in New Milford, and a small, unnamed pond in Litchfield. Only 30 plants were found and removed from Beeslick Pond, which is on Nature Conservancy property, and a patch covering approximately 0.5 acres was discovered in the small pond in Litchfield. Reports indicate that Strastrom Pond, which is over 20 acres in size (including areas of emergent wetland), has a very large and dense water chestnut population whose fate remains undetermined. Strastrom Pond is just 700 feet south of a small unnamed pond where water chestnut was discovered last year.

There were additional plants were discovered in 2005 as a result of CTDEP's Connecticut River survey. These small patches of water chestnut (each only consisting of a few individual plants) were not included in the six new discoveries mentioned above, as they are not established populations. Small, sporadic patches such as these are found at different locations along the banks of the CT River each year. In 2005, seven 'transitory patches' were discovered at various locations in Glastonbury, Wethersfield, Rocky Hill, Cromwell, and Middletown. A total of seven water chestnut sites (including these transitory patches) are now within the Ramsar boundary, which contain wetlands of international importance, and two of this year's discoveries are within 0.5 miles of Ramsar's northern boundary. It is important to track water chestnut sites and remove the plants from throughout the state, even from these small transitory patches, because individual flowering rosettes can easily break off and float downstream into the LISS project area. If left undiscovered for too long, these can easily form large, dense, and well-established populations with a rich seed bank.

The Chapman Pond population is the third documented water chestnut site within the Long Island Sound National Estuary Program project boundary (Figure 7). The Hamburg Cove site discovered last year is actually the second discovery. The first was a small patch of water chestnut discovered and removed in 2001 by a kayaker, but it not reported to CTDEP until last year. This site was just outside of Chapman Pond in the main stem Connecticut River. Please note that all three of these sites are in the lower Connecticut River area. With this year's discovery of the large population in the North Hartford Flood Pond, which is outfitted with a pumping station, the potential for water chestnut to spread to additional sites is greater than ever.

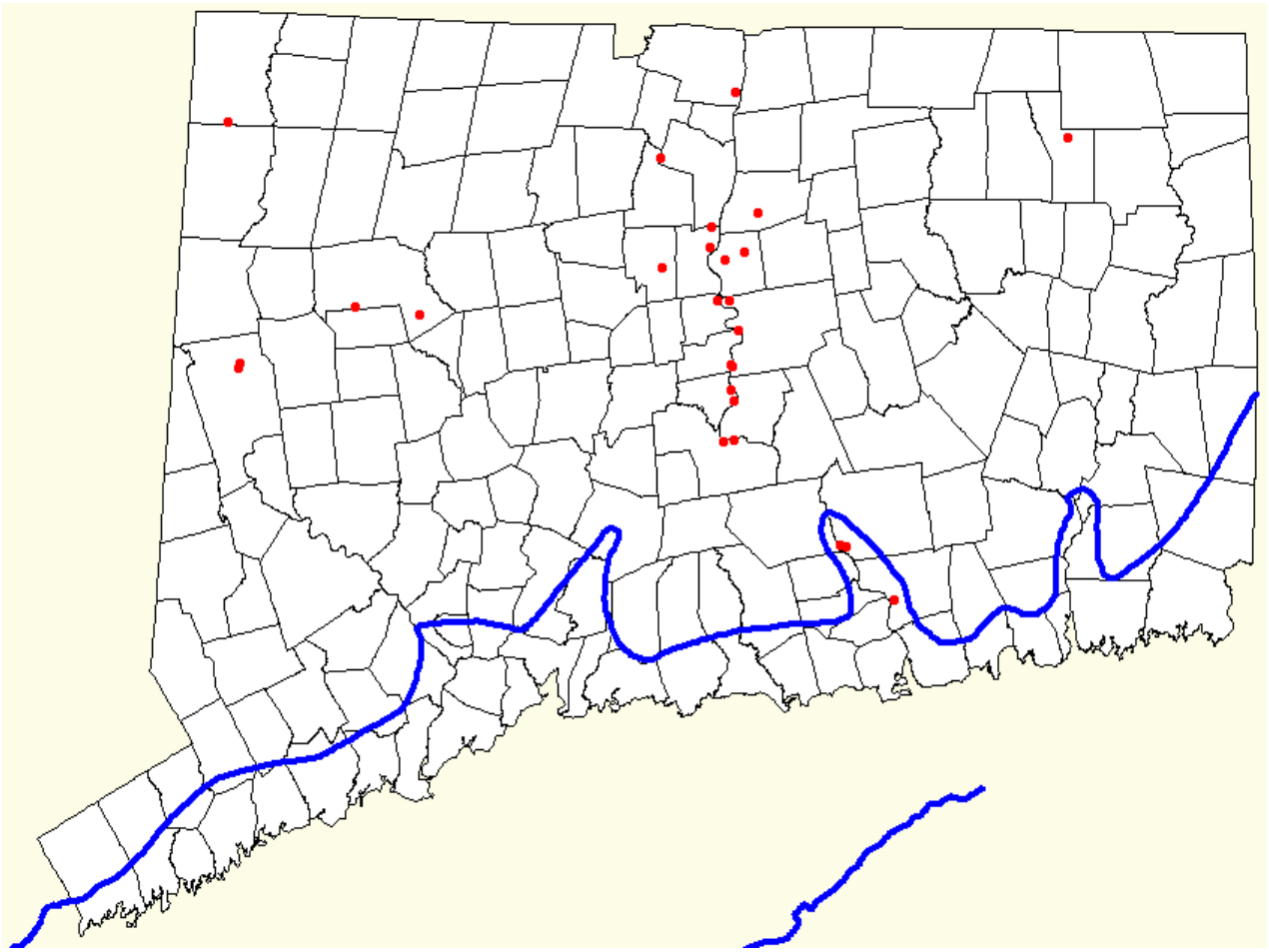


Figure 8. Known distribution of water chestnut in Connecticut as of December 2005. Red dots indicate known water chestnut populations. The Hamburg Cove population is marked by the southern-most red dot. The other red dots within the LISS NEP Project Boundary (blue line) represent water chestnut plants discovered in Chapman Pond in 2005, and in the Connecticut River just outside of Chapman Pond, East Haddam, in 2001, but not reported to CTDEP until 2004.