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On the Cover: An Eastern Wild Turkey, *Meleagris gallopavo*, looks as regal as an emperor as he goes into his wing-dragging, tail spreading, full strut display to impress nearby hens and intimidate potential rivals. The full tail fan and extended (6+ inches) beard mark him as an adult male at least 2 years old. The black-edged breast feathers and the wattle/head display readily distinguish him from a hen, which would have brown-edged breast feathers and lack the head coloration. Photo was taken in March from a car blind with Nikon 300mm lens and fill flash. Photo © Bill Byrne

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An Eco-Transformation in Plymouth

The Eel River Headwaters Restoration Project

by Alex Hackman and Jeremy Bell

“The restoration of the headwaters of the Eel River in Plymouth is one of the most ambitious coastal restoration projects completed to date in New England.”

With construction complete and after several months of vigorous plant growth, the former cranberry farm that once occupied the headwaters of the Eel River in Plymouth is hardly recognizable. The straightened main stream channel, the lateral and perimeter ditches, the earthen berms and water control structures, the monoculture plant cover – these are all gone. The area now is exploding with lush, diverse vegetation and wildlife – birds, fish, dragonflies, and amphibians – all taking advantage of the restored stream and vibrant wetlands.

“I just can’t believe it,” said Tim Simons, Restoration Ecologist for the Division of Fisheries & Wildlife (DFW). “The nearly instantaneous progress that has happened here is remarkable.”

When the Riverways Program (Department of Fish and Game [DFG]) merged in 2009 with the Wetlands Restoration Program (WRP; formerly part of the Office of Coastal Zone Management [CZM]), it solidified a relationship that was already flourishing as a result of prior collaboration between the two programs on the Eel River Headwaters Restoration Project.



Photo © Alex Hackman

Turning a commercial cranberry operation into a restored wetland involved moving nearly 40,000 cubic yards of sand that had been brought in over the centuries to cover the natural peat. The results, following page, are spectacular.

The newly formed Division of Ecological Restoration (DER) within DFG seeks to help partners plan and construct ecological restoration projects exactly like this: holistic approaches that integrate both river and wetland elements into thoughtful aquatic habitat restoration. By merging two of the Commonwealth's restoration programs together – and enhancing coordination with sister agencies such as DFW, the Division of Marine Fisheries (DMF) and CZM – Massachusetts is emerging as a national leader in restoring degraded rivers, wetlands, and adjacent lands.

The restoration of the headwaters of the Eel River in Plymouth is one of the most ambitious coastal restoration projects completed to date in New England. It is the largest Atlantic white cedar (*Chamaecyparis thyoides*) swamp restoration in the Commonwealth and includes a variety of restoration techniques in a single project area, including: complete stream channel and wetland floodplain re-construction, fill removal, extensive plantings, rare-species habitat creation/enhancement, dam removals, and culvert replacements. It exemplifies comprehensive restoration of an entire coastal headwaters area,

encompassing both wetland and riverine elements. The restoration effort was a product of innovative design, years of partner collaboration, multiple funding sources, and extensive input and technical assistance from a well coordinated team. Total project cost was \$2 million.

The vision for the project came from the Town of Plymouth – well known for leading other ambitious river and wetland restoration projects.

"When we first considered the site," said David Gould, the Town's Environmental Manager, "we immediately imagined the possibility of a large restored area linked with other publicly-owned conservation land. We didn't settle for the easy route – we had an ambitious vision and went for it." With leadership from Mr. Gould and assistance from a large group of partners, the vision has now become a reality. What follows is the story of the site and the actions that have restored ecological conditions and protected the Eel River headwaters in perpetuity for public use and enjoyment.

The Eel River drains an approximately 15-square-mile coastal watershed to



Photo © Alex Hackman



Complete wetland restoration (inset shows construction phase) was a very lofty goal at the time, but the results prove it can be done and done well.

Plymouth Harbor. As the name implies, it was once an important waterway for diadromous fish – those species that split their time between the ocean and freshwater. So abundant was life in the Eel River that the Pilgrims founded Plimoth Plantation on its banks in part to take advantage of the food supply. Stories of the early fish abundance – literally being able to walk across a river teeming with fish – are still being told by historical reenactors at the Plantation.

What transpired over the next several centuries within and along the Eel River exemplifies the history of human influence upon many of New England's coastal watersheds. The construction of numerous dams blocked historic fish runs and interrupted natural river processes, overfishing diminished stocks, and industry and agriculture polluted the river. In the 1800s, the Eel River was considered too polluted for fishing. This, despite the substantial herring run that once followed a colonial-era hand-dug ditch all the way

to Great South Pond (located upstream from the restored headwaters).

The headwaters is the place in a watershed where a river springs to life. Geological research suggests that the Eel River headwaters area is a depression (or kettle) that formed during the last ice age and filled over thousands of years with peat (i.e., a "kettle hole bog"); it likely once contained a mosaic of wetland ecosystems. Historical maps show this area as 'Finney's Meadow' with a small stream running through it as early as 1857. The numerous dams and mills that occupied the headwaters area at Eel River give further indication of prior resource abundance (e.g., a mill that produced staves for barrels undoubtedly used local lumber). Once trees were cleared, the area transitioned to agricultural use, and cranberry farming has been documented on site as early as 1880. From that point forward, the stream channel was straightened and diverted for irrigation, all native vegetation was removed, berms and dikes were built

genetic integrity of the site,” says DER wetland scientist and co-author, Jeremy Bell. “The project had very high standards for all of its elements.”

With additional funding from the town, Riverways, WRP, and Mass. Department of Environmental Protection (DEP), project partners moved into final engineering design, permitting, and public hearings. Permitting for this complex project that involved contaminated sediment, dam removal, etc., took approximately 18 months. Successful grant applications secured funding from the U.S. Fish and Wildlife Service’s National Coastal Wetlands Conservation Grant program (\$1 million) and Mass DEP’s section 319 grant program (\$400,000 via U.S. Environmental Protection Agency). NRCS provided approximately \$350,000 for bog restoration. The Massachusetts Corporate Wetlands Restoration Program (CWRP) arranged approximately \$15,000 in donated permitting services from the consulting firm Horsley Witten. Additional funding from Mass DEP, WRP, Riverways, TNC, A.D. Makepeace, and the Town of Plymouth rounded out restoration finances.

In 2009, with funding secured and permitting complete, the Town of Plymouth, with the help of project partners, selected SumCoEco-Contracting through a competitive bid process to perform site work. Excavators broke ground in the old cranberry bogs in October 2009. Old Finney’s Meadow was about to come back to life!

DER Project Manager and co-author Alex Hackman vividly recalls a moment during work in the former dam impoundment: “After most of the dam and upstream sediment were removed, we were in the former pond, placing boulders and trees with an excavator to give structure to what would be the new stream channel. A splash in the water caught my eye – it was a brook trout (*Salvelinus fontinalis*) swimming upstream through the shallow water. On that first day, we personally witnessed fish swimming upstream – past the former dam – for the first time in almost two hundred years! It was just magical.” Hackman further recounts seeing American Eels (*Anguilla rostrata*) swimming upstream on that same day. By the end of that day, DFW’s Steve Hur-



Photo © Jeremy Bell

Local nurseries, using seeds from local trees, produced thousands of Atlantic white cedars to plant a cedar swamp in the highest headwaters section.

ley was on site with Trout Unlimited’s Warren Winders catching and relocating a stranded pool of fish from the work zone into the restored headwaters.

So went construction at the Eel River project; every week produced impressive changes as evidence of the old cranberry farm faded away, and the restored wetland and river system emerged from the landscape. Excavators worked through the fall, winter, and spring to move over 40,000 thousand cubic yards of sand, build almost 2 miles of restored stream channel, place 1,000 pieces of large-sized woody debris into the stream and on the bog surface, haul excess sediment, expose original portions of the river, remove most of the old stone dam, and replace two undersized culverts with new wildlife-friendly structures. Working closely with SumCo, Inter-fluve, and the project technical team (Town of Plymouth, DER, U.S. Fish and Wildlife Service, American Rivers, and TNC) held biweekly meetings

to keep the project on track and address unforeseen circumstances.

Earthwork and infrastructure removal/replacement was only the start. Next came the enormous task of planting over 17,000 trees and approximately 8,000 other wetland plants. Local scout troops chipped in to help plant several hundred trees one summer weekend. Erosion control blankets, native wetland seeds, protective material against deer browsing, installation of an approximately mile-long fence around the trees, and other finishing touches continued into late summer 2010.

All the while, the site was coming back to life. A red-tailed hawk perched on an excavator during construction, enjoying the field mouse banquet that was exposed. New areas of standing water on the bog surface were heavily used by birds during the winter. Almost immediately after the new stream channel was built, natural algae started appearing, followed by insects and then fish. As the bog surface turned green with the start of the growing season, the site became abuzz with dragonflies and other insects, frogs, and birds. By the end of the summer, the bog surface that was nearly devoid of vegetation just a few months earlier had become a tangle of wetland vegetation. "If every frog was worth a dollar, then we'd have

paid all the grant money back several times over," mused Hackman, observing a newly constructed vernal pool literally brimming with tadpoles.

The project team will collect monitoring data to confirm and quantify the observations of a quickly recovering ecosystem. "The purpose of this work is to start a restoration trajectory at the site," says Eric Derleth of the USFWS. "We think the initial signs of healing are very positive." The latest benthic macroinvertebrate (insects that live on the stream bottom) data suggest that new inhabitants are starting to colonize the newly restored stream. Additional sampling is in progress and will continue for several more years to document changes to fish, insect, and plant communities on the site.

In August 2010, the final piece of construction was completed – placing a pedestrian footbridge over the site of the former dam. The Eel River now flows unobstructed beneath the footbridge, which residents and visitors can cross to connect with acres of town-owned and -managed conservation land. The clean, cold water below the footbridge represents a dramatic change from just under a year ago, when over 10 feet of mucky sediment was present, the water was slow-moving and warm, and fish were blocked at the base of the dam, unable to access their historic headwaters habitats.

All of the many partners involved in the Eel River Headwaters Restoration Project hope that it may serve as an example for future cranberry bog and other ecological restoration efforts. Based on the initial success of the Eel River restoration, DER and DFW staff are already working with NRCS and others on two more large-scale cranberry bog naturalization projects.



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Jeremy Bell is a wetlands ecologist and project manager for DER. He holds a Master of Environmental Studies degree from Evergreen State College in Olympia, WA, and lives in Watertown with his wife and two children.



Photo © Alex Hackman

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