

Anadromous Fish Restoration Project Update

6/30/06

Anadromous fishes are an important part of the near-shore fauna along the Massachusetts coast. Seventeen species of anadromous fish reside in our marine and inland waters at various times of year. The potential impact to anadromous fish populations from disruption of the near-shore environment during spawning and migration periods can be high. Siltation resulting from construction activities can smother eggs of anadromous fish that spawn in the upper portion of estuaries (e.g., blueback herring, rainbow smelt, white perch, tomcod) or can block the spawning migration of other anadromous species that are trying to reach the headwaters of rivers draining into the estuaries (e.g., alewives and American shad). The effect of perceived minor insults to the populations can be significant because the anadromous fish resources have already suffered the cumulative effects of years of habitat alteration and disturbance.

Marine Fisheries is implementing a three-year Anadromous Fish Action Plan to enhance the anadromous fish resources in the embayments and associated watersheds adjacent to the HubLine Project. These are resources that were potentially impacted by the HubLine construction. Sportfish Program Manager Michael P. Armstrong has proposed a 3-part project which will consist of propagation/stocking, monitoring, construction and repair of anadromous fish passage, and improvements to habitat.

Part 1. Anadromous Fish Passage Enhancements

Contact: Kristen Ferry

Project Goals

The objectives of this project are to enhance and increase spawning habitat for all anadromous species, but primarily for alosid fishes (alewives, *Alosa pseudoharengus*; blueback herring, *Alosa aestivalis*; American shad, *Alosa sapidissima*). The *Marine Fisheries* Anadromous Fish Project completed a survey of fish passage along the Massachusetts coast, which identified sites where anadromous fish are impeded or blocked from reaching their spawning grounds (Reback et al. 2004). These data were used to create a prioritized list of construction/repair projects for new and existing fish passage structures. Needs for biological monitoring and habitat improvements were also identified. Many of these projects are located in watersheds associated with the Hubline construction area. Based on this prioritized list, *Marine Fisheries* is selecting several key construction/repair projects in the vicinity of the Hubline project that can be completed over the next few years and that will restore or enhance hundreds of acres of anadromous fish spawning habitat. The projects range in magnitude from large fishway construction costing hundreds of thousands of dollars to small repairs costing hundreds of dollars. Where runs have been severely depleted or extirpated because of passage problems, *Marine Fisheries* will transfer spawning adult fish of the appropriate species from a healthy donor run to the depleted run after the fishway repair/construction is completed.

Completed projects for the time period June 2005 – June 2006 are described below, along with projects pending action in the upcoming year.

Prioritization and Project Selection:

The prioritized list of fish passage improvement projects has been completed and relevant meetings conducted. In addition to the finished Hubline projects described below, Table IVC.1 specifies the numerous other jobs under consideration for action in 2006-2007. Site visits have been conducted at all of these locations (Table 1). *Marine Fisheries* will proceed with selected projects based on the costs of construction and/or repair versus the combined benefits of acreage of habitat restored, historical presence of a fish run, community support, water quality, and the reliability of adequate water supply. Several projects may require feasibility studies for engineering and hydrology prior to construction. Remaining Hubline funds will cover some, but not all of the projects listed

in Table 1. *Marine Fisheries* is pursuing partnerships with the National Oceanic and Atmospheric Administration Fisheries Restoration program and the U.S. Fish and Wildlife Service Fish Habitat Initiative for as many projects as possible.

Completed Projects (June 2005- June 2006):

Back River, Weymouth

In the fall of 2005, *Marine Fisheries* installed grating over the Iron Hill fishway to prevent poaching of river herring as they migrate to their spawning habitat. Given the severe decline in river herring and the current *Marine Fisheries* ban on harvest until 2009, preventing poaching is critical for the protection of this resource. The Iron Hill Dam is the sixth obstruction in this system. After herring ascend the Iron Hill fishway, they must only traverse one additional obstruction before entering their spawning habitat in Whitman's Pond. A viewing platform was also constructed near the fishway to enhance accessibility for biological monitoring and to promote public advocacy. *Marine Fisheries* sponsored and assisted a local Eagle Scout working through Senator Robert Hedlund's office to carry out this project.

Fore River/Monaticquot River, Braintree

The Fore River is a major tributary to Boston Harbor and is known to have one of the largest smelt spawning populations in the state. In addition, in recent years thousands of river herring have been observed below natural waterfalls in Braintree, unable to pass upriver to spawning habitat. To better understand the hydrology of this key tributary and in preparation for potential fish passage improvements, *Marine Fisheries* entered into a cooperative agreement with the U.S. Geological Survey (USGS) to install a staff gage and develop a rating curve for the Fore River. The gage was installed in August 2005 and the rating curve completed over the late summer low flow period. Based on this initial Hubline funded work and due to the demonstrated importance of this site, the Fore River was subsequently selected by the Massachusetts Executive Office of Environmental Affairs Streamgaging Initiative for installation of a state of the art real-time stream gage. This new gage is one of approximately 30 new gages installed across the state in systems where the growing demand for water is competing with the need to maintain adequate streamflow for aquatic habitat protection. Real-time data from this site can be viewed on the USGS website.

Neponset River, Milton and Mattapan

Marine Fisheries has been actively working with other agencies to establish fish passage in the Neponset River and to contribute to the overall river restoration efforts led by the Massachusetts Riverways Program. In February 2006, a final feasibility study financed in part by Hubline funds was initiated to determine the best alternatives for fish passage and river restoration in the area from the Walter Baker Dam in Milton to the Tileston and Hollingsworth Dam in Milton/Mattapan. Passage at these dams would provide access to more than 17 miles of spawning habitat for American shad. Study results will account for the suite of limiting factors in the Neponset including river hydrology, fish biology, PCB (polychlorinated biphenyls) contamination (Breault et al. 2004), social attitudes, and economic feasibility. Recommended alternatives will be announced on June 15, 2006 by Milone and MacBroom, Inc., the firm contracted to complete the study. In addition, *Marine Fisheries* Hubline-funded employees have been participating on the Neponset River Restoration Technical Advisory Committee, which will select and move forward with the best restoration alternative in July 2006.

Charles River, Watertown to Wellesley/Newton

Evaluation and improvement of fish passage in the Charles River has been a continued focus of the Anadromous Fish Passage Enhancement Project, as the success of the concurrent Hubline-funded American Shad Propagation project depends on adequate passage for shad. In the summer and fall of 2005, all functional repairs and modifications to fishways from Watertown to Wellesley/Newton were completed. Most notably, the breaching of the Bleachery Dam (Waltham) on the north side of the river was completed on September 13, 2005. This breach, which has been under consideration for a number of years, has created an additional avenue for anadromous fish passage that complements a breach completed on the south side of the river decades ago. Fish migrating along the north side of the river will no longer be impeded by the 3.5 ft dam. In addition, to highlight improved passage structures and anadromous fish species in the Charles River, *Marine Fisheries* Hubline staff participated in the development of a multi-panel educational kiosk that will be installed near the Watertown Dam fishway in summer 2006. Kiosk project partners include *Marine Fisheries*, the Department of Conservation and Recreation, the Corporate Wetlands Restoration Partnership, the Charles River Watershed Association, and Sasaki Associates.

Table IVC.1. Potential HubLine anadromous fish passage enhancement projects, 2006 - 2007

System	Town	Obstruction	Work Description
Bound Brook	Cohasset	Hunters Pond Dam	Repair and reinforce fishway; monitor herring and smelt population
Weir River	Hingham	Foundry Pond Dam	Recreate smelt spawning habitat below dam (destroyed during dam repair)
Weir River	Hingham	Foundry Pond Dam	Notch dam to provide non-lethal passage for outmigrating juvenile herring
Weir River	Hingham	Foundry Pond Dam	Repair weirs at base of fishway for herring
Back River	Weymouth	Jackson Square Dam	Restore streambed below fishway to accommodate smelt spawning
Back River	Weymouth	Jackson Square Dam	Replace scoured cobble below first fishway weir to enhance herring passage
Fore River	Braintree	natural falls	Conduct system-wide feasibility study; install herring passage structure
Fore River	Braintree	Hollingsworth Dam	Conduct system-wide feasibility study; install herring passage structure
Fore River	Braintree	Sunset Lake Dam	Conduct system-wide feasibility study; work with town for pond management; modify flashboards for herring passage
Fore River	Braintree	Great Pond Reservoir Dam	Conduct system-wide feasibility study; consult with Tri-Town water management for herring passage potential
Town Brook	Quincy	NA	Remove sediment to address flow alterations; investigate instream sediment pump
Saugus River	Saugus	Lynn Waterways Dam	Install eel ramp
North River	Salem	NA	Improve smelt spawning habitat with cobble and flow modification
Crane River	Danvers	Mill Pond Dam	Install herring passage structure; work with town for pond management

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- Reback, K., P. Brady, K. McLaughlin, and C. Milliken. 2004. A survey of fish passage in coastal Massachusetts, Parts 1-4. Massachusetts Division of Marine Fisheries Technical Report TR-15, 16, 17 and 18.

Part 2. Rainbow Smelt Propagation and Habitat Enhancement

Contact: Brad Chase

Introduction:

Concern over declining rainbow smelt (*Osmerus mordax*) populations in Massachusetts prompted *Marine Fisheries* to seek improved population assessment capabilities and management measures for restoring populations. A two-year pilot project began in 2004 using Hubline funds to develop smelt culture and early life-stage marking techniques. This effort was linked to a NOAA Protected Species Program grant to develop population indices for smelt. The population index project developed fyke net sampling stations in 2004 and 2005 that also serve as a source for mature smelt for laboratory culture and hopefully will capture marked smelt that were stocked in specific rivers.

FY 2005 Activities:

Efforts prior to FY 2006 focused on developing techniques to achieve high survival of smelt eggs fertilized at the Gloucester Laboratory, marking eggs with oxytetracycline (OTC), rearing juvenile smelt to confirm the persistence of the OTC mark, and stocking marked larvae in the Crane River, Danvers. A total of 55 females were strip-spawned in seven batches during 2005, resulting in approximately 1.1 million larvae stocked in the Crane River. All larvae were marked with 500 mg/l OTC and average survival of incubated larvae was approximately 83%.

The laboratory rearing experiments were not long-lasting as nutrient removal in our culture systems did not function well. All marked larvae reared in the laboratory died within a month of hatch.

During 27 hauls in 2005, the Crane River fyke net caught a total of eight smelt and the nearby North River (Salem) fyke net caught six smelt. The North River caught no smelt with similar methods in 2004 and the Crane River station debuted in 2005.

FY 2006 Activities:

The six fyke net stations monitored in 2005 were continued in 2006 (Jones River, Kingston; Fore River, Braintree; Saugus River, Saugus; North River, Salem; Crane River, Danvers; and Parker River, Newbury). These locations will be annual population monitoring stations maintained by *Marine Fisheries*, with the exceptions of the North and Crane rivers. These two stations will be monitored for a limited-duration smelt stocking project. The fyke nets were hauled three times per week for an 11 week season starting on March 8th. Most hauls were completed as targeted until the May 13th rain event that brought enough rain to prevent the setting of nets for the last week of the season.

Catch data for the 2006 season are not processed at this point. Smelt catches for the two restoration stations improved to between 30 and 40 smelt in the North and Crane rivers; however, sampling methods changed for these two stations as a larger standardized net used at the other four stations was deployed in 2006. We increased the number of egg batches that were incubated and marked in 2006. Nine batches of eggs from 97 females were processed, but egg survival data have not been analyzed yet. A preliminary assessment indicates that egg survival declined in 2006. Therefore, the large increase in female numbers will translate to a modest increase in larval production (roughly 1.5 million stocked.).

In addition, an experiment was conducted on egg survival with two concentrations of OTC. Replicates (N=6) of 500 mg/l, 1000 mg/l, and a 0 mg/l control were run to test the hypothesis of no difference in egg survival when incubated and marked with no OTC, a moderate dose, and a high dose of OTC. These data have not been processed, but even without a formal analysis, it appears that survival was the same for all three treatments. These larvae are being reared now (1 month old) and will also serve as specimens to confirm the persistence of the OTC mark as they grow.

Outlook for FY 2007:

Next season will be the last under Hubline funding. We intend to continue marking and stocking smelt larvae with the goal of reaching two million larvae. We will conduct another OTC treatment experiment with the interest of isolating the preferred concentration. Prior to the 2007 spawning season we will be checking otoliths for the OTC mark from the saved age-1 smelt from the North and Crane Rivers. In 2007 we will save most smelt caught in both rivers to check for the OTC mark. We may attempt to deploy the stream-side incubator that was used in 2005, but was troubled by filtration problems with the slightest stormwater pulse. We may also experiment with double-

marking and release larvae in the North River, Salem. These efforts will culminate in summary recommendations for smelt restoration efforts in the future.

Part 3. American Shad Propagation

Contact: Kristen Ferry

Introduction

American shad (*Alosa sapidissima*), the largest members of the Clupeidae (Herring) family, were once an important component of the anadromous fish fauna in Massachusetts, especially in larger systems such as the Connecticut, Merrimack, Neponset, and Charles Rivers. Over the last century, shad were extirpated or reduced to unsustainable populations in all Massachusetts rivers where they occurred, due to the construction of dams, water pollution at the spawning grounds, and over-fishing.

The objectives of the of the American Shad Propagation project are to restore viable populations of American shad to the Charles River and secondarily the Neponset River, and to create local sportfisheries. The project is a long term collaborative effort between *Marine Fisheries* and the U.S. Fish and Wildlife Service (USFWS) and includes the development of a shad fry stocking program in conjunction with fish passage improvements. The fry stocking program will be modeled after the successful programs implemented by Virginia, Maryland, and Pennsylvania for restoring shad to the tributaries of the Chesapeake Bay (Hendricks 1995). Brood stock shad for this effort will be obtained from the Merrimack River, where the shad population has rebounded in recent years because of good recruitment resulting from water quality improvements and the construction of efficient fish passage structures on dams.

The Charles River is the primary target for restoration due to (a) the availability of spawning/rearing habitat, (b) the availability of functioning fishways suitable for shad, and (c) the historical significance of shad in this system. The secondary target, the Neponset River, was likely home to a once thriving shad population, but dams have impounded this system for 350 years. In addition to the dams, the Neponset River's industrial past and continued urbanization has resulted in contaminated water and bottom sediments. The first two obstructions on the Neponset, the Walter Baker Dam and the Tileston and Hollingsworth Dam do not have fish passage structures. Passage at these dams would open up approximately 17 miles of spawning/rearing habitat for shad. Efforts are currently underway to remove these dams or install fishways; however, the issue of PCB contaminated sediments above each obstruction will need to be addressed. *Marine Fisheries* plans to initiate shad restoration in the Neponset, as strategies for dam removal/fishway installation develop (see Ferry 2006).

Progress Update (June 2005 – June 2006)

In June 2005, limited pilot production was conducted at the Essex Dam on the Merrimack River and at the North Attleboro National Fish Hatchery. The goals of the pilot project were to (a) construct test facilities, (b) evaluate reproductive condition of broodstock, (c) test and evaluate tank spawning and rearing techniques to promote high fry survival, and (d) adjust water quality and flows in the hatchery to suit shad production. To address these goals, 50 adult shad were collected from the Essex Dam fish lift, injected with a Luteinizing-Releasing Hormone analogue and Salmon Gonadotropin Releasing Hormone, and held in spawning tanks on the dam. The shad began spawning within 24 h. Eggs were collected over the next 7 days and transported to the North Attleboro National Fish Hatchery. Using these eggs, hatchery staff tested rearing procedures and the production setup constructed exclusively for shad (i.e., hatch battery/rearing tank system). At the end of the trials, broodstock shad and eggs/larvae were sacrificed. The pilot production goals were met, and relevant modifications were made in preparation for future production. Unfortunately, persistent high water levels in the Merrimack River resulting from significant rain events in June 2005, forced the closure of the Essex Dam fish lift at the time of peak shad passage. Only 6,500 American shad were passed upriver, which is roughly 10% of the previous five year average. Consequently, full shad fry production was not feasible in 2005, due to a lack of available broodstock.

In April 2006, *Marine Fisheries* and the USFWS Central New England Fisheries Resource Office (CNEFRO) entered into a formal five year Cooperative Agreement for shad propagation. In addition to Hubline funding, the CNEFRO received internal USFWS funds to help retrofit the Nashua and North Attleboro National Fish Hatcheries for shad production, as well as to hire additional permanent hatchery staff dedicated to the project. *Marine Fisheries*

has also successfully secured match funding for the Shad Propagation Project for current and future years through the federal Wallop-Breaux Sport Fish Restoration Program (F-57R-Job 18).

By early May 2006, all infrastructure for spawning and rearing was setup and fully operational at the Nashua and North Attleboro National Fish Hatcheries and at Essex Dam. Significant modifications for 2006 included (a) the installation of heaters at the Nashua hatchery to address the cold well water temperatures, (b) the installation of large fiberglass spawning tanks in all three locations, and (c) the construction of an above-ground frame and plumbing system for the spawning and egg collection tanks at Essex Dam. The production goal for 2006 is three million fry for distribution in the Charles River.

2006 Plans

During May-July 2006, approximately 500 brood stock shad will be obtained from the Merrimack River at the Essex Dam fish lift in Lawrence, MA. Most shad will be transported to and spawned at the USFWS hatchery Nashua, NH; however, a small number will be retained and spawned at the Essex Dam in a temporary spawning facility. The propagation program will include both volitional and hormone-induced tank spawning. Egg incubation and rearing of larvae will take place at the USFWS hatcheries in Nashua and North Attleboro. Eggs produced at the temporary spawning facility in Lawrence will be transferred to the hatcheries. The larvae will be raised for about 7-10 days before release as fry into the upper Charles River. All fry will be immersed in an oxytetracycline bath in order to mark their otoliths prior to release. Marking in this way will enable *Marine Fisheries* to quantify hatchery returns in 3-4 years. Fry that have been released in this manner have shown high fidelity to their natal rivers (Hendricks et al. 2002). Therefore, we expect that when surviving fry reach maturity, they will return to the Charles River. To estimate juvenile survival and to help establish recruitment indices, juvenile sampling will begin in the weeks following stocking and continue through fall. Sampling will occur throughout the river below the stocking site and will include several methods, including seining, drop nets (e.g., in dam bays), and incline plane traps. Water quality data including temperature, pH, and dissolved oxygen will be recorded by stationary and portable monitoring systems in several locations from stocking site to harbor. Beginning in 2009, returning adults will be sampled and examined for marked otoliths. A successful restoration will be indicated by the presence of a greater number of naturally spawned individuals as compared to hatchery spawned individuals.

Update June 2006

For the second year in a row, heavy and concentrated spring rains have resulted in extraordinary flows in the Merrimack River, delaying shad propagation activities. Shad Propagation Project personnel had planned to begin taking broodstock fish into the spawning tanks on Essex Dam during the week of May 15, as small numbers of shad were observed in the fish lift during the previous week. However, on Sunday May 14, heavy rains (approx. 15 inches in 48 hours) brought the Merrimack River to historic levels—within a few feet of the 1936 flood and to flows of 106,000 cfs. For comparison, the average flow during May and June ranges between 4,500 and 10,000 cfs. Both Lawrence and Lowell were flooded in this “Mother’s Day Flood” and declared federal disaster areas by the Federal Emergency Management Agency. Raw sewage was discharged into the river by multiple towns over several days. For safety reasons, the fish lift, which is not designed to operate above 25,000 cfs, was closed on May 13.

Persistent rains in late May and June have prevented the river from receding to levels that would allow the fish lift at Essex Dam to be cleaned of debris, fully inspected, and returned to operation. Thus, the lift remains closed, and will likely remain closed through June. Shad Propagation project staff evaluated contingency plans for obtaining broodstock shad. Alternatives include actively sampling for shad downriver of Essex Dam via electrofishing and/or gillnetting and obtaining fish from another system (e.g., the Connecticut River). Each alternative has constraints and implications for shad mortality and health certification. Active sampling in the Merrimack River cannot occur until the river has returned to safe flow levels.

As of 19 June 2006 about 380,000 live eggs had been transported to the USFWS hatchery in Nashua. These were obtained from Merrimack River broodstock via electrofishing below the Essex Dam in Lawrence. Hatching has occurred and larvae are available. We are continuing to augment broodstock by this method.

Fish have been sent to the USFWS Lamar facility for health testing from both the Connecticut River and the Merrimack and fish health certification was obtained. However, if enough shad are captured from the Merrimack

via electrofishing, we may not need to resort to obtaining fish from the Connecticut River (which is nearing the end of its shad run).

The fish lifts at both Lawrence and Lowell are still inoperable. Water flow in the Merrimack River flow is finally coming down (14,000 cfs on 19 June 2006), so it may be possible for the power company to start cleaning and inspecting the lifts in the near future. However, it is not yet known what the extent of the damage is from the May 13th flood.

Literature Cited:

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