Action Plan 8. Restoring Migratory Fish Passageways

Problem[59]

River herring and other diadromous fish have declined dramatically during the past 100 years. While there were some improvements in certain populations toward the end of the twentieth century, offshore fishing pressures and bycatch takings, coupled with continued river and pond habitat degradation, have resulted in dramatic declines in anadromous fish populations. Water diversion and pumping for agricultural purposes is one of the most significant causes of juvenile herring fatalities. Restoration of these fish populations will require rigorous controls of offshore catch of these species, continued efforts to improve water quality and anadromous fish spawning habitat, elimination of obstructions to migration, and improved water management practices to avoid placing adult and juvenile populations at risk.

In the Buzzards Bay watershed, more than 1,000 acres of pond habitat remains inaccessible due to dams without fish ladders, or other obstructions. In some cases, new fish ladder installations may be appropriate, in some cases dam removal may be the best option to restore smelt, bluebacks, and sea run brook trout.

Goals

Goal 8.1. Ensure that the migration of fish species between salt and fresh water is unimpeded.

Goal 8.2. To restore degraded stream habitat and stream functions to ensure the diversity and abundance of fish in Buzzards Bay streams.

Goal 8.3. To manage fishing pressures on anadromous fish to ensure the fish harvest and bycatch are sustainable.

Goal 8.4. Restore and improve access to spawning habitat.

Objectives

Objective 8.1. Ensure adequate funding of state fisheries restoration programs.

Objective 8.2. Ensure that local, state, and federal fisheries regulators better manage the catch and bycatch of river herring and other diadromous fish to promote their recovery and population sustainability.

Objective 8.3. Improve passageways and remove impediments and obstructions to fish migration.

Objective 8.4. Ensure adequate stream flow for fish migration.

Solutions

The National Marine Fisheries Service should take action to limit the catch and bycatch of river herring in offshore waters. At the same time, state and local managers must identify and restore priority fish habitat sites and remove obstructions to fish migration. Many smaller herring runs need to be elevated as a priority for restoration because of their cumulative benefits. A special focus of the state and towns should be a coordinated restoration of fish habitat on the Weweantic River.

DEP could require as a condition in all state water withdrawal permits that there is adequate flow in rivers during juvenile fall downstream migrations. Permittees should always be required to use appropriate screening of water withdrawal intakes to prevent stranding, mutilation, entrainment or impingement of young herring.

Costs and Financing

Regulatory solutions have negligible costs to government. The installation of a fish counter on a particular stream may cost up to $40,000. Developing and implementing designs to eliminate or repair fish passageway structures and obstacles and dam removal can cost millions for the watershed. Federal grants can cover some of these costs but state and local government may need to provide additional funding for natural resource staff.

Measuring Success

The success of measures untaken under this action plan can be assessed by tracking the installation of ladders or removal of obstructions. Ultimately the abundance of anadromous fish traveling upstream will be the best measure. This count can be determined through automated fish counters and by volunteers to undertake field counts on representative dates and times.

[59] In the 1991 Buzzards Bay CCMP, objectives and recommendations relating to fish migration were found in the "Protecting Wetlands" Action Plan.

Background

For centuries, fish species that migrate between freshwater and saltwater habitat were historically important to the coastal economy and ecosystem of Buzzards Bay. Some of these species, like alewives (*Alosa pseudoharengus*), blueback herring (*Alosa aestivates*, Figure 66, collectively called "river herring"), and rainbow smelt are defined as anadromous species because adults come from the sea lay their eggs in fresh or brackish water. Other species like sea run brook trout, eels, tomcod, and shad were defined as catadromous because the adults lay eggs in salt water and the young travel to or mature in freshwater streams and ponds.

Collectively, anadromous and catadromous species are also called "diadromous" species, and their habitat is shown in Figure 68. These diadromous species not only were important as a fishery, but juveniles and adults of these species are an important food species for many commercially and recreationally important fish, some whales, and many coastal birds, including the roseate tern (*Sterna dougallii*), a U.S. endangered species with 60% of the North American breeding population found in Buzzards Bay.

Some diadromous species, like sea run brook trout, are virtually absent from all Buzzards Bay rivers today. Other, like shad are now found in abundance in only one Buzzards Bay River (the Weweantic). In some instances, as is the case of shad and blueback herring, streams, rather than ponds, are the principal egg laying and nursery areas. This can create a conflict because of differing restoration goals and solutions.

Throughout the twentieth century river herring populations in the Buzzards Bay watershed showed dramatic declines. These declines were believed to be caused by many factors including physical obstructions to migration, overfishing, poor water quality, or inadequate spawning habitat. Of these, physical obstructions in the form of dams, constraints associated with roadway construction (e.g. collapsing or obstructed culverts), failing fish bypass structures, and other obstructions were identified in the 1991 Buzzards Bay CCMP as among the greatest impediments to herring migration in Buzzards Bay herring runs.

Because of these concerns, during the 1990s and into the 21st century, the Buzzards Bay NEP provided

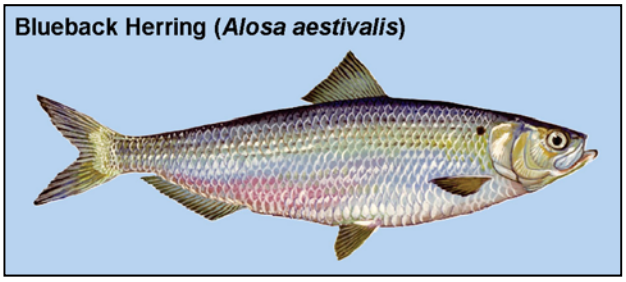
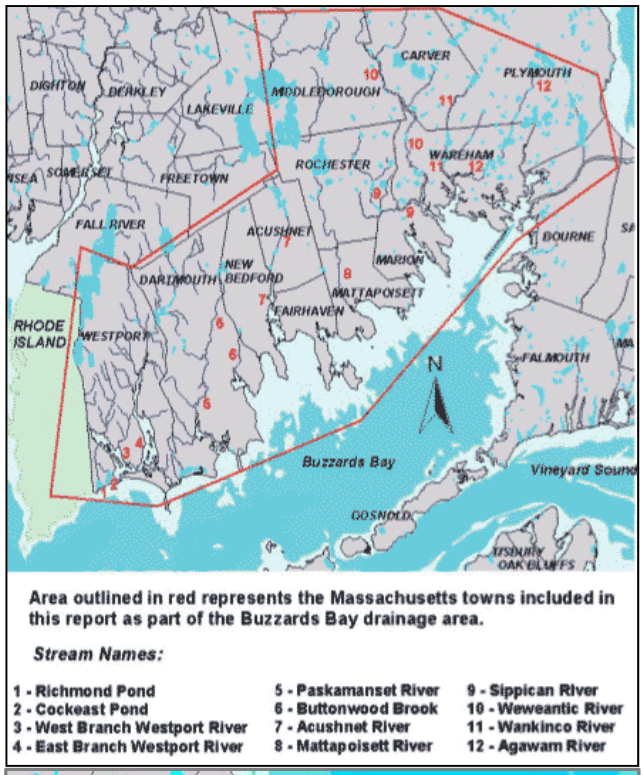
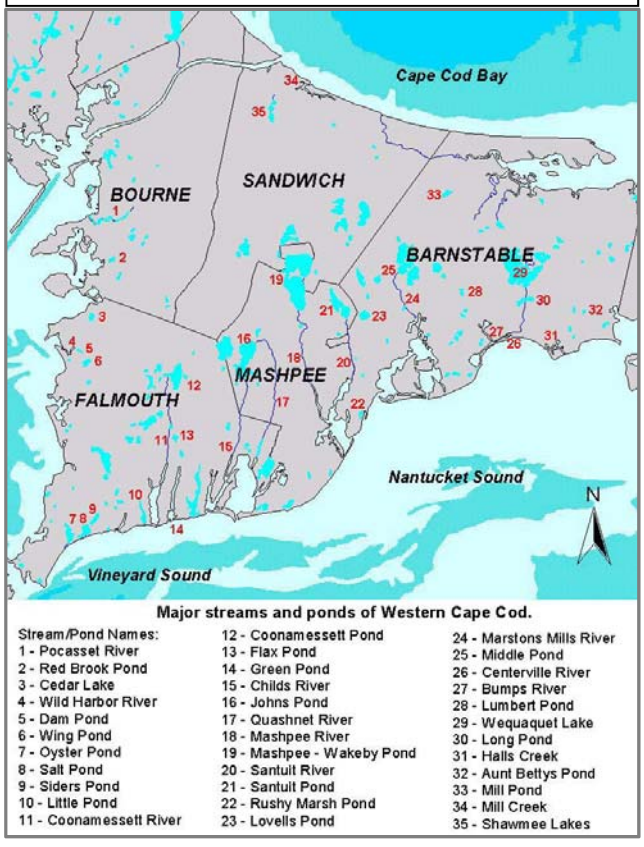


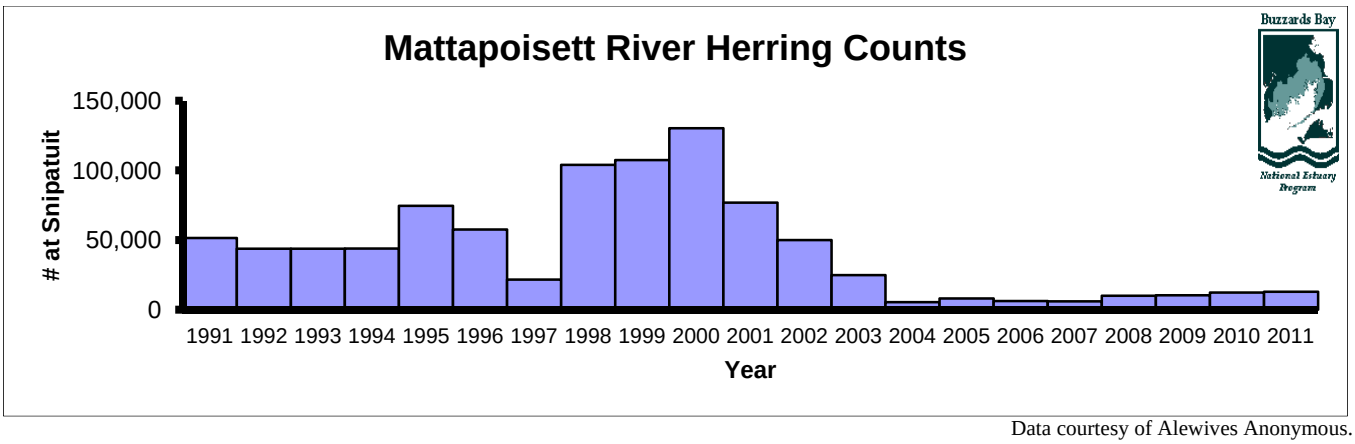
Figure 69. The Blueback herring, *Alosa aestivalis*.





From Division of Marine Fisheries Technical Report TR-15A and TR-16A Survey of Anadromous Fish Passage in Coastal Massachusetts Part 1. Southeastern Massachusetts (Rebeck et al., 2004).

Figure 68. Map of major herring runs in the mainland portion of the Buzzards Bay watershed (top) and on Cape Cod (bottom).



Data courtesy of Alewives Anonymous.

Figure 70. Counts of herring passing upstream as measured by a counter at Snipatuit Pond.

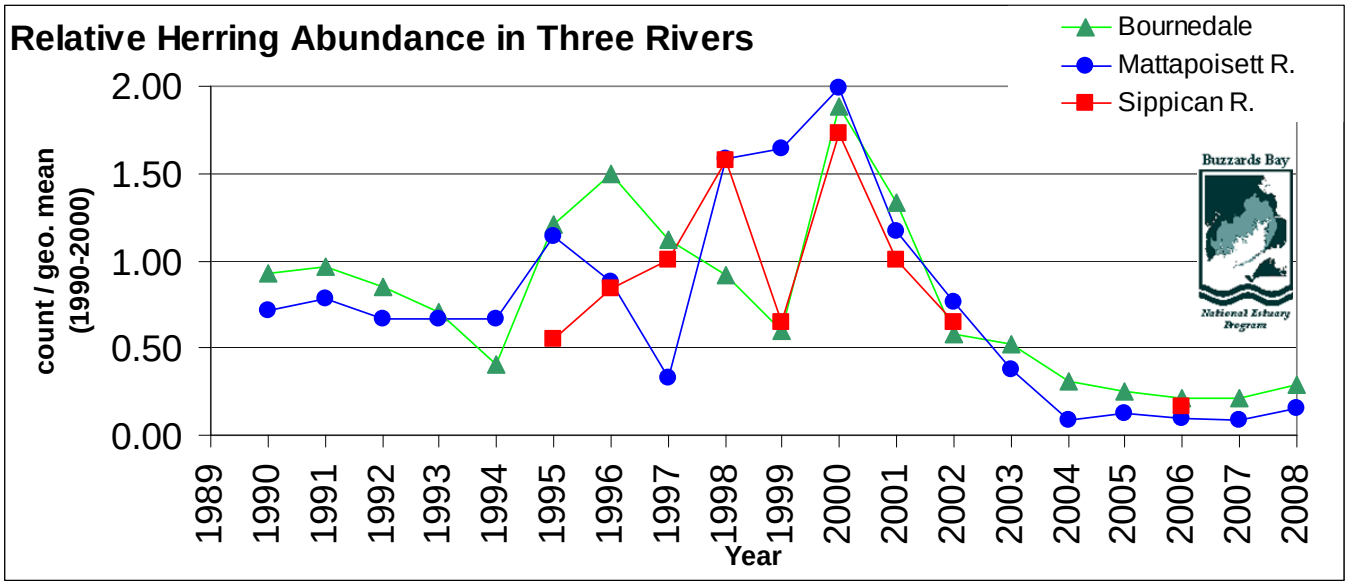


Figure 71. Herring counts in three Buzzards Bay area fish runs plotted against the geometric mean of fish abundance during the period 1990-2008.

Note that the geometric mean for the Sippican River during this period was a few hundred fish, whereas the geometric mean for the Bournedale Run for the same period was several hundred thousand fish. Counts were not available for the Sippican river from 2003 to 2005 because of various technical issues. Bournedale data courtesy of the Massachusetts Division of Marine Fisheries.

funding and technical support to towns improve herring runs in the bay's most productive river systems (Table 24.). The Buzzards Bay NEP's efforts, together with more comprehensive contributions and leadership by the Massachusetts Division of Marine Fisheries (DMF), and actions by local officials paid off. In the late 1990s, several area herring runs showed increasing return of river herring (Figure 70 and Figure 71).

However, after 2000, river herring began to show new unprecedented and precipitous declines. These declines were observed not just in Buzzards Bay, but throughout the eastern seaboard of the U.S. Herring runs which might have once had hundreds of thousands of returning fish, now were reported to have declines of 90% or more of the population. These new declines appeared to be independent of improvements or declines in water quality, changes in habitat, or development patterns of each river herring watershed. Thus, in one century, important herring runs like the Mattapoisett River went from sustaining millions of fish around 1900, to hundreds of thousands of fish in 2000, to just over 5000 fish in 2007.

The large scale disappearance of river herring has generated considerable regional debate about the causes. Factors often cited as contributing to this decline include loss and degradation of habitat, overfishing (including offshore bycatch from ocean herring fisheries), and increased predation due to recovering striped bass populations (NMFS, 2007; Hass-Castro, 2006; Wilson, 2007). In 2006, the NOAA National Marine Fisheries Service designated both blueback herring and alewives as species of concern (NMFS, 2007).

Table 24. Stream and herring restoration efforts in the Buzzards Bay watershed funded by the Buzzards Bay NEP.

Principal Calendar Year	Municipality	Buzzards Bay NEP Grant Award	Short Title	Primary or Secondary Benefits	Description / Comments / Outcome
1996	Mattapoisett	$5,000	Mattapoisett Herring Weir Reconstruction	primary	Construct a new concrete fish ladder and water control structure at the Mattapoisett River Herring Weir. Buzzards Bay NEP funds were to assist the town meet their match requirement on a larger state grant. DMF developed designs and oversaw the ladder construction.
1996	Rochester	$23,000	Snipatuit Road Culvert Replacement	primary	Replace inadequate culverts beneath Snipatuit Road to facilitate fish passage up Mattapoisett River into Snipatuit Pond for spawning.
1996	Westport	$2,241	Adamsville Herring Run Restoration	primary	Construct and install a new 30ft. Denil type fish ladder at Adamsville Pond in Westport. Buzzards Bay NEP assisted in permitting, DMF developed designs.
2001	Falmouth	$19,000	Cedar Lake Herring Restoration	primary	Culvert replacement under Chester St. Addressed some stormwater issues as well.
1998	Wareham	$35,000	Weweantic River Fish Ladder construction at Horseshoe Pond		Buzzards Bay NEP wrote grant proposal and received funds from DEP and MET to construct a new ladder in the long defunct bypass. Project did not proceed because of failed negotiations between property owner and town.
2003	Falmouth	$16,000	Curley Blvd. Stormwater discharge designs	primary	Remediated discharge to Dam Pond above Wild Harbor and included culvert improvements to help herring migration.
2003	Westport	$3,500	Adamsville Pond Herring Ladder restoration	primary	included culvert and stream modifications
2004	Plymouth	$15,000	Agawam River Stormwater Remediation	secondary	Reduce Sediment discharges to herring stream
2005	Fairhaven, Mattapoisett, Rochester	$73,000	Mattapoisett River Valley Aquifer Project	secondary	Multiple grants in 2004-2005 involving the purchase of lands or CRs for open space protection on hundreds of acres within water supply area, and protect stream water quality
2005	Plymouth	$15,000	Agawam River Stormwater Remediation Project	secondary	Installation of BMPs along Mast Road with secondary benefits to stream water quality
2006	Westport	$10,045	Cockeast Pond Culvert Replacement & Herring Run Improvement	primary	Replace defective culvert & improve fish approach on River Road. Buzzards Bay NEP assisted with permitting. DMF approved design
2009	Rochester	$7,500	Sippican River sediment Sampling	secondary	Conduct sediment sampling on the Sippican River/Hathaway Pond and obtain legal opinion on water and access rights related to the Hathaway Pond Dam. These are two key components in determining the feasibility of fishway improvements in the Sippican River
2009	Rochester	$20,000	Leonard's Pond Anadromous Fishway Improvement	Primary	Engineering/construction to replace inefficient wooden Denil fishway. May also provide passage for shad, eels, sea run trough and river herring.
2009	Bourne	$15,000	Fishway Restoration Phase I	secondary	Survey the fishway, surrounding salt marsh and assess the feasibility of restoring the fish run.
2010	Bourne	$45,000	Herring Pond ladder Improvements	primary	Replace collapsed culvert that is the sole entrance and exit point for a 376 acre pond that is prime herring spawning habitat.

Includes all projects completed after the completion of the 1991 Buzzards Bay CCMP.

To address alewife and blueback herring declines, Massachusetts implemented a three-year moratorium on the catch of herring beginning in December 2005. By the end of 2007, bans on herring fishing were also enacted by Rhode Island, Connecticut, and North Carolina.

These bans have not yet helped improve river herring stocks, and by the end of 2007, several fishing environmental groups asserted these actions would remain ineffective because overfishing by ocean mid-water trawling was the primary cause of these herring declines[60]. Because of the impacts to herring stocks, and presumed impacts to offshore ground fisheries, in December 2007, several environmental groups filed a federal lawsuit against the federal government to ban this trawling from certain ground fish areas[61].

[60] Herring Alliance. 2007. Empty Rivers The Decline of River Herring and the Need to Reduce Mid-water Trawl Bycatch. October 2007 available at http://www.herringalliance.org/images/stories/Herring_Alliance_River_Herring_Report.pdf downloaded 1/28/07

[61] NORTHWEST ATLANTIC MARINE ALLIANCE and MIDCOAST FISHERMEN'S ASSOCIATION versus United States Department of Commerce

Restoration Efforts

The diadromous fish restoration activities in the Buzzards Bay watershed have been spearheaded by the Division of Marine Fisheries, sometimes prompted or supported by municipal officials. In some areas, non-profit organizations have been instrumental in promoting actions by state and federal government, and maintaining fish runs. Most notably, the citizens group Alewives Anonymous has long been a leader managing, promoting, and enhancing the herring runs in Marion and Mattapoisett. Their actions have included volunteer efforts to clean debris and trash from streams, and to enact other stream restoration efforts.

More recently the Buzzards Bay Coalition has organized volunteers to monitor herring runs, assist with herring counts, track the condition of herring runs and monitor stream flows. The Massachusetts Division of Marine Fisheries has embraced these and similar efforts and have held workshops and produced guides for the collection of data by these citizen volunteers[62].

Most municipalities in Buzzards Bay have a herring inspector or other natural resource officer. These individuals are responsible for enforcing herring catch limits, permit compliance, condition of the herring run, and sometimes maintenance of water control structures. In most instances, the demands of herring management far exceed the time availability of these municipal officers.

During the 1990s several river systems in the Buzzards Bay watershed were identified as priorities for herring restoration by DMF and the Buzzards Bay NEP including the Mattapoisett River, Weweantic River (including the Sippican River tributary), and the Agawam River. More recently, the Buzzards Bay NEP provided funding or technical assistance (in partnership with DMF) to a number of municipalities to help restore some of the of smaller herring runs including the Adamsville Pond system in Westport.

Herring Fishery

There are roughly 8,000 acres of open pond and lake systems in the Buzzards Bay watershed, but probably only a third of this area is accessible to anadromous fish. A list of the ponds and major existing alewife runs and habitat are shown in Table 25.

Although, less important today that in past centuries, the commercial and recreational herring fishery remains important today. Smoked or kippered herring and egg roe (served for example in omelets) remain local delicacies. Many more fish are captured as bait for recreational fisherman and lobster traps.

Prior to the 2005 moratorium on the taking of herring statewide, the taking of river herring was prohibited on Tuesdays, Thursdays and Sundays, and they could be caught only with hand-held dip nets. River herring are also subject to additional regulations that may be imposed on the local community, and fishing may be banned from certain runs if the population is threatened.

Table 25. Acreage of existing Buzzards Bay alewife pond habitat.

River	Pond	Acres	Pond Primary Location
Acushnet River	Acushnet Sawmill Pond	8	Acushnet
Acushnet River	Hamlin Street	5	Acushnet
Acushnet River	New Bedford Reservoir	233	Acushnet
Agawam River	Halfway Pond	229	Plymouth
Agawam River	Pond Above Glen Charlie	34	Plymouth
Agawam River	Glen Charlie Pond	168	Wareham
Agawam River	Maple Park	20	Wareham
Agawam River	Mill Pond	138	Wareham
Agawam River	Besse Bog Reservoir	34	Wareham
Agawam River	Kennard Bog	19	Wareham
Cedar Lake Ditch	Cedar Lake	21	Falmouth
Cockeast Pond Stream	Cockeast Pond	101	Westport
Gibbs Brook	Dicks Pond	47	Wareham
Herring Brook	Wings Pond	26	Falmouth
Mattapoisett River	Rochester Fish Hatchery	32	Rochester
Mattapoisett River	Snipatuit Pond	731	Rochester
Mattapoisett River	Tinkham Pond	22	Mattapoisett
Monument (Herring) River	Great Herring Pond	413	Plymouth
Monument (Herring) River	Little Herring Pond	81	Plymouth
Red Brook (Buttermilk)	White Island Pond	322	Plymouth
Red Brook Conrail Run	Red Brook Pond	19	Bourne
Richmond Pond	Richmond Pond	54	Westport
Russells Mills Pond	Paskamanset/Slocum	4	Dartmouth
Sippican River	Leonards Pond	53	Rochester
Sippican River	Hathaway Pond	19	Rochester
Wankinco River	Tihonet Pond	93	Wareham
Wankinco River	Parker Mills Pond	82	Wareham
Westport West Branch	Grays Mill Pond	3	Little Compton
Weweantic River	Horseshoe Pond	45	Wareham
Wild Harbor River	Dam Pond	7	Falmouth
Total		2,965	

The BB NEP calculated areas based on water surface boundaries, including some deep marsh area, as defined in 2007 DEP wetland conservancy maps. Some of these runs, like the Weweantic River run into Horseshoe Pond, are in poor condition. The value of pond habitat, and the biomass of fish it can sustain is a function of pond depth (volume) and other factors.

The Mattapoisett River

The DMF herring atlases (Rebeck et al, 2004a-b) contain good summaries of anadromous fish runs and impairments in the Buzzards Bay watershed, but because the Mattapoisett River run is the largest in Buzzards Bay, and considerable efforts has been applied to its restoration, it is worth providing an overview of this run.

[62] Information available at: http://www.mass.gov/dfwele/dmf/programsandprojects/anadrom.htm#anadromous last accessed:10/29/09.

The Mattapoisett River, which begins at the 731-acre Snipatuit Pond in Rochester and flows 20 miles south to its discharge into Mattapoisett Harbor, has historically contained the watershed's most productive and abundant herring populations[63]. At its peak at the turn of the twentieth century, the river had an estimated annual sustainable yield of 3000 barrels, or approximately 1.4 million fish, with the total fish stock estimated at 1.8 to 1.9 million fish per year. During the past 30 years, fish populations increased somewhat with habitat improvements, but this was followed by a collapse beginning in 2001 (see Figure 70), presumably related to offshore fishing pressures.

Local and state efforts, starting in around 1990, some partially funded by the Buzzards Bay NEP, helped allow the recovery of the herring population in the Mattapoisett River during the late 1990s.

Specifically, near the river's headwater spawning area in Snipatuit Pond, five culverts beneath Snipatuit Pond Road were undersized (30" diameter and submerged). Because herring typically migrate during daylight hours and lighted passages are required for migration, these long darkened culverts presented a significant obstacle to their upstream migration. The Buzzards Bay NEP funded solution included replacement of the small culverts with a single large box culvert, which would allow more light to reach the interior of the culvert and eliminate the existing obstacle to migration. The construction was performed by the Rochester Highway Department with guidance provided by the Massachusetts Division of Marine Fisheries.

Near the river's mouth at the Route 6 dam, additional problems were impeding fish passage on the Mattapoisett River. The fishway at the dam restricted upstream passage of alewives because it was both too steep and too turbulent. In addition, water elevations at the dam, which are controlled for municipal water supplies, required better management during normal operating conditions and during herring run season (March through May).

To accomplish these connected goals of improving the fish ladder and improving water management, the towns of Mattapoisett, Marion, Rochester, and Fairhaven joined together to seek funding for the project. Improvements to the dam structure were funded by the Commonwealth of Massachusetts with local support from each town. Additional funds for the fishway were provided by the Buzzards Bay NEP. The Massachusetts Division of Marine Fisheries helped design the Denil-type fish ladder and guide the installation efforts in December 1996.

Figure 72. This water level control structure at Cockeast Pond Westport was modified to enhance herring passage.

Many small runs need less infrastructure and cost less to restore anadromous fish passage.

This project has resulted in a dramatic increase in herring population and was considered a success story until the new widespread loss of river herring in the 21st century.

The Weweantic River

The Weweantic River run is a historically noteworthy run. Until the late 1800s, river herring passed all the way up the Weweantic River to Federal Pond (36 acres), Crane Brook Pond (today 38 acres), and Sampson Pond (302 acres), and along another tributary all the way to Wenham Pond (48 acres) near the Middleborough border. However, this run eventually was destroyed by modifications to the Tremont Pond dam. This obstruction has left Horseshoe Pond as the only alewife habitat on the river.

Any anadromous fish restoration strategy for the Weweantic River will be defined by the restoration approach taken at Tremont Pond. That is because the Tremont Pond is now an insurmountable barrier to anadromous fish, cutting off hundreds of acres of ponds and dozens of miles of upstream habitat. Because water in the dam is 24 feet above stream level, either a fish elevator, or an expensive series of ladders and pools would need to be installed. Because Tremont Pond (31 acres) and all the previously mentioned former herring ponds upstream total 550 acres, a comprehensive Weweantic River anadromous fish restoration effort would increase anadromous fish habitat appreciably in the Buzzards Bay watershed.

The Weweantic contains the state's only licensed rainbow smelt runs. Currently the smelt, which must lay their eggs in brackish water, only use the lower river to the Horseshoe Pond dam. In the 1990s, DMF had developed designs for the installation of a Denil Ladder at Horseshoe Pond, but the project fell through because a lack of agreement with the dam owner of the time. Subsequently there was some discussion about removal of

[63] Snipatuit Pond originally was connected to the Quitticas Ponds, but about 1755, colonists of Rochester dug a ditch to connect the Pond to the Mattapoisett River to establish a new run on that river.

the Horseshoe Pond dam altogether to increase smelt and blueback habitat above the dam. If the Horseshoe Pond dam is removed and the pond is drained, without any action at Tremont Pond, the Weweantic River watershed would no longer be good habitat for alewives.

Because of the social values associated with ponds, and controversies that may arise from dam removal, it is important that the Town of Wareham, property owners, and abutters develop a consensus as to the restoration solutions that will need to be implemented in these two ponds.

Smaller Herring Runs

There are a number of smaller herring runs around Buzzards Bay (e.g. see Table 26). Many of these have various degrees of impairments. Not all these small runs are listed in the Belding 1921 publication, or in DMF's herring atlases. In fact, wherever there is a stream with unimpeded passage to a small pond, some number of river herring will attempt to travel to the pond. Some of these smaller ponds are functioning well for their size, others have various degrees of impairments.

Table 26. List of potential alewife pond habitat and acreage in the Buzzards Bay watershed.

River	Pond System	Acres	Primary Location of Pond
Agawam River	Half Way Pond	229	Plymouth
Bourne Pond Brook	Bourne Pond	11	Bourne
Buttonwood Brook	Buttonwood Park Pond	10	New Bedford
East Branch Westport	Copicut Reservoir	621	Dartmouth
East Branch Westport	Cornell Pond	16	Dartmouth
East Branch Westport	Lake Noquochoke	181	Dartmouth
East Branch Westport	Forge Pond Dam	4	Dartmouth
Paskamanset/Slocum	Smith Mills Dam	5	Dartmouth
Paskamanset/Slocum	Turner Pond	95	Dartmouth
Pocasset River	Mill Pond	1	Bourne
Pocasset River	Shop Pond	2	Bourne
Pocasset River	The Basin	2	Bourne
Pocasset River	Freeman and Upper Pond	4	Bourne
Wankinco	East Head Pond	85	Plymouth
Weweantic River	Sampson Pond	302	Carver
Weweantic River	Federal Pond	126	Plymouth
Weweantic River	Crane Brook Bog Pond	38	Carver
Weweantic River	Dunham Pond	49	Carver
Weweantic River	Horseshoe Pond	59	Wareham
Weweantic River	Wenham Pond	48	Carver
Weweantic River	Tremont Mill Pond	36	Wareham
Total		1,695	

The BBNEP calculated areas based on water surface boundaries, including some deep marsh area, as defined in 2007 DEP wetland conservancy maps. Some of these ponds, like those on the Weweantic River and Westport East Branch would never become accessible without overcoming the first dam on each system (Tremont Pond and Lake Noquochoke dams respectively), and even then, each subsequent pond may pose its own special set of obstacles.. The value of pond habitat, and the biomass of fish it can sustain is a function of pond depth (volume) and other factors.

Major Issues

Lack of State and Local Commitments

In Belding's 1921 treatise on the alewife fishery of Massachusetts, he summarizes obstacles facing many of the runs in Buzzards Bay, including the need to construct fishways at a number of dams, or to enable passageway through certain bog systems. Many of the obstacles identified by Belding report remain a problem 90 years later, notably including the need for fishways at Lake Noquochoke, Russells Mills, and Smith Mills dams in Dartmouth, and Tremont Pond dam in Wareham. Because of elevations at these sites, they require appreciable expenditures for ladders; perhaps on the order of hundreds of thousands of dollars each. Action at these sites have not occurred for nearly a century because of lack of interest and financial commitment by municipalities and the state to develop solutions. The installation of a fishway at Noquochoke is a particularly interesting case because it could also lead to access of pond habitat that did not exist in Belding's time. The 621-acre Copicut Reservoir at the headwaters of the Copicut River was not built until 1972.

Dam Removal

Whereas the protection and restoration of alewives depends on the preservation of ponds, the restoration of shad depends on dam removal and restoration of gravel type streams. However, the issue of dam removal is often controversial. Many ponds in the Buzzards Bay watershed are artificial impoundments in that they are the result of old mill dam construction, or in some cases impoundments from agriculture, particularly cranberry bogs. It has been argued that centuries of these human activities have created an environment that favors pond spawning species like alewives, over stream spawning species like shad.

To some degree this argument is imperfect because prior to European settlement, beavers were ubiquitous, creating a massive network of interconnected streams and beaver created ponds throughout the watershed. By the 1800s, beaver populations in Massachusetts were becoming locally extinct, and some of the natural beaver ponds were being supplanted by dams to power water wheels of various grain and industrial mills. Still, the hydrological landscape of Buzzards Bay has been altered in innumerable ways that have created habitat for some species, while eliminating habitat for others.

In this context, selecting sites for dam removal requires careful assessment to determine whether any rare or endangered species would be affected, or if loss of adjoining surface waters and bordering vegetated wetlands is both politically and environmentally acceptable.

In the Buzzards Bay watershed, the removal of the dam at the former Acushnet Sawmill site is being evaluated using New Bedford Superfund NRDA funds. On the Weweantic River, removal of the dam at Horseshoe Pond to create new shad habitat has been discussed, but not yet studied.

Minor versus Major Habitat

As noted in the Division of Marine Fisheries Herring Atlas: "With a small number of exceptions, the important river herring spawning/nursery habitats on coastal streams have been made accessible through the construction of fishways. Many of these structures have become deteriorated and are often of obsolete design. The emphasis of future work should be on the replacement of these fish ladders in order to preserve or augment the populations they serve rather than to create new populations by accessing minor habitats" (Rebeck et al., 2004a).

While this approach and policy makes sense from the state level in terms of allocating state resources, from the municipal perspective, some communities may host a number of impaired "minor habitats", and they may have a strong desire to restore these sites. Cumulatively the surface area of minor ponds in Buzzards Bay exceeds the area of all the great ponds combined.

While the assertion is true that most large coastal freshwater systems now have migratory fish access and that improving deteriorated structures can likely provide the greatest benefits at the least cost (per fish restored), in reality many of the larger restoration projects remain difficult to implement because of the high costs. Small pond systems often have small costs associated with their repair (culvert replacements, one or two step concrete ladders). Adding fish passageways to some of these small pond systems could add hundreds of acres of alewife habitat to the Buzzards Bay watershed, so creating access to these ponds has merit. For example, the Buzzards Bay NEP funded two small herring projects in Falmouth, and one in Westport for a cumulative cost of $10,700 (Table 24).

Water Management Issues and Bog Operations

As noted in the DMF herring report (recommendations in Table 27), large numbers of juvenile herring are killed each year due to cranberry bog operations. Despite the fact that a simple and inexpensive screening system exists, the apparent reluctance of growers to utilize it is disappointing. For this reason it is important that water withdrawal permits issued by the state not only ensure that there is adequate flow in rivers during juvenile fall downstream migrations, but that permittees are required to use appropriate screening of water withdrawal intakes to prevent stranding, mutilation, entrainment or impingement of young herring.

A related problem is that of strandings caused by heavy summer and fall withdrawals by municipal water supplies that cause the cessation of stream flow, or drops in pond levels that preclude juvenile migration. The issue is becoming increasingly problematic on the Mattapoisett River where continuing large municipal withdrawals during drought years, coupled with water diversions for cranberry operations have caused the river to run dry during critical herring migration periods. This issue is discussed also in Action Plan 10. Managing Water Withdrawals to Protect Wetlands, Habitat, and Water Supplies.

Other Issues Identified by DMF

As noted in various DMF reports, most river herring fisheries are under local control through the authority granted by Section 94 of Chapter 130. Many towns however, are unaware that changes in their local regulations must be approved of the Director of the Division of Marine Fisheries. In their 2004 report (Rebeck, 2004a-c) DMF recommended that "In order to insure biologically sound and legally valid local management, the Director should inform cities and towns of this condition and request them to submit current regulations and subsequent changes for approval."

The DMF has stressed that local officials and property owners often ignore the downstream passage of adults and juveniles, and juvenile mortality in particular can be an important limiting factor in population productivity. An often reported impact is that water withdrawals or diversions can strand or kill thousands of juvenile fish. DMF (2004) notes "Large numbers of juvenile herring are killed each year due to cranberry bog operations. A simple, inexpensive screening system has been developed which will prevent most of these losses. Despite publicizing the availability of this system through industry media, growers have been reluctant to utilize it. Appropriate screening of water withdrawal intakes to prevent stranding, mutilation, entrainment or impingement of young herring should be made a condition of any state permits required for the agricultural operation." Accidental release of pesticides from agricultural lands causing dramatic losses of juveniles is another recurring problem.

Shoaling of pond outlets and encroachment of vegetation impacts river herring populations in some systems. The deposition and shoaling of sediments, in combination with late season water levels has prevented the migration of large portions of juveniles. Increased water draw downs by agriculture or public water supplies (both groundwater and surface waters) often exacerbates these problems. At sites with these recurring problems, DMF

recommends the installation and maintenance of outlet structures that would retain depth, reduce deposition and provide for easier maintenance. The emphasis of anadromous fish management in coastal streams has focused on river herring, American shad, and rainbow smelt. Consequently little is known about white perch and tomcod populations in the Commonwealth. DMF has recommended that more resources should be directed toward these species and management strategies that would protect them be developed. The stocking of shad has been largely unsuccessful in Massachusetts. The Division of Marine Fisheries has recommended development of a program similar to that successfully adopted in other states of taking eggs and rearing them in a hatchery to fry size before their release. However Massachusetts has no such hatchery constructed. This technique should be developed in Massachusetts and applied to the appropriate river habitat of Buzzards Bay.

Management Approaches

Because bycatch appears to be the principal cause of river herring population declines in Massachusetts the National Marine Fisheries should implement controls to limit the catch and bycatch of river herring in offshore waters. Such an undertaking would compliment state efforts to protect these populations. This also means the New England and Mid-Atlantic Fishery Management Councils would need to better monitor river herring bycatch. To protect river herring, the Secretary of Commerce should consider taking emergency action to implement these new measures.

Because a large area of upstream habitat remains inaccessible in the Weweantic River watershed, DMF should consider and evaluate the fish ladders, bypasses, and dam removal at Horseshoe Pond and the Tremont Pond dam. A fish elevator at Tremont Pond may cost hundreds of thousands of dollars, but the costs of dam removal may be higher, and the protection of wetlands and social values at Tremont Pond may preclude dam removal at this site.

Water diversion and pumping for agricultural purposes is one of the most significant causes of juvenile herring fatalities. Simple requirements like requiring screens on intakes can greatly mitigate these impacts. Better management of water withdrawals is needed on some Buzzards Bay watershed rivers and tributaries. DEP could require, as a condition in all state water withdrawal permits, that there is adequate flow in rivers during juvenile fall downstream migrations. Permittees should always be required to use appropriate screening of water withdrawal intakes to prevent stranding, mutilation, entrainment or impingement of young herring. The costs for the state to implement such requirements are negligible, and would be modest for water withdrawal permittees. Adoption of new rules and regulations could

Table 27. General recommendations for Massachusetts herring restoration.

(From Rebeck et al., 2004b.)

1. With a small number of exceptions, the important river herring spawning/nursery habitats on coastal streams have been made accessible through the construction of fishways. Many of these structures have become deteriorated and are often of obsolete design. The emphasis of future work should be on the replacement of these fish ladders in order to preserve or augment the populations they serve rather than to create new populations by accessing minor habitats.

2. Most river herring fisheries are under local control through the authority granted by Section 94 of Chapter 130. Many towns having this control, however, are unaware that approval of the Director of the Division of Marine Fisheries is required by the statute and often change their regulations without consulting DMF. In order to insure biologically sound and legally valid local management, the Director should inform cities and towns of this condition and request them to submit current regulations and subsequent changes for approval.

3. River herring passage issues have dealt primarily with upstream migration of adults. Downstream passage of adults and more importantly juveniles has been largely ignored and, in some systems, may be an important limiting factor in population productivity. Future work should take this into consideration and place appropriate emphasis on this phase of the life cycle and the problems which are associated with it.

4. Large numbers of juvenile herring are killed each year due to cranberry bog operations. A simple, inexpensive screening system has been developed which will prevent most of these losses. Despite publicizing the availability of this system through industry media, growers have been reluctant to utilize it. Appropriate screening of water withdrawal intakes to prevent stranding, mutilation, entrainment or impingement of young herring should be made a condition of any state permits required for the agricultural operation.

5. Shoaling of pond outlets and encroachment of vegetation has seriously impacted river herring populations in some systems. Deposition of sandy material at the outlets in combination with low late summer/fall water levels has prevented the escapement of large segments of year classes and caused them to be lost to the population either through winter kill or greatly reduced growth rates. Outlet structures which would retain depth, reduce deposition and provide for easier maintenance should be developed and installed at stream outlets where appropriate.

6. The emphasis of anadromous fish management in coastal streams has been on river herring, American shad and rainbow smelt. Consequently little is known about white perch and tomcod populations in the Commonwealth. In the future more attention should be directed toward these species and management strategies which would protect them should be developed.

7. Several large coastal streams, notably the Taunton, Charles and Neponset Rivers, appear to have excellent potential for development of American shad populations. Many years of stocking with adult fish and eggs have yielded negligible results, however. Other states have had success through hatchery egg taking and rearing to fry size before release. This technique should be developed in Massachusetts and applied to the above streams.

8. Removal of dams should be considered as an alternative to fishway construction where appropriate.

be achieved within two years of initiation of such an effort.

Many smaller herring runs may be a priority for restoration by municipalities, even though they may not be a priority by the state for funding. While the state does not have the manpower and funding to restore the many lesser anadromous fish passageway impairments in the Buzzards Bay watershed, where requested, DMF should provide technical assistance to municipalities interested in restoring minor anadromous fish habitats. To a large degree the state already provides local assistance, but due to manpower constraints, restoration of minor habitat is a low priority. Technical assistance and guidance from DMF in these cases is much appreciated. This support may require some reallocation of funds or manpower.

DMF should dedicate more resources, or seek additional funding, to evaluate white perch, tomcod, and other less well studied anadromous and stream fish populations. Additional staff may be needed to conduct research and monitoring, and the effort might be undertaken in collaboration with university research studies.

DMF and municipal natural resource officers identify juvenile herring impairment sites and develop written guidelines and MOUs with relevant growers and property owners to implement practices to minimize the stranding or destruction of juvenile and adult migrating fish. A watershed evaluation and GIS database could be used to track trouble sites, and would be a useful planning tool for all levels of government. This effort could be undertaken with existing staff. Site specific written guidelines could help ensure compliance with adopted strategies and promote a better understanding of the problems and solutions for each site. Agreements could also be developed between town resource agencies and the property owner. NGOs could facilitate agreements.

Financial Solutions

The regulatory solutions identified in this action plan have negligible costs to government and modest costs to those with water withdrawal permits. Government (state and local) may need to provide some additional funding for natural resource staff. Most of the costs of this action plan are to develop and implement designs to eliminate or repair fish passageway structures and obstacles. The installation of a fish counter on a particular stream might cost up to $40,000, and federal grants might be available for such devices.

Monitoring Progress

The success of measures untaken under this action plan can be measured by tracking the abundance of anadromous fish traveling upstream. These counts can be determined through automated fish counters and by the use volunteers to undertake field counts on representative dates and times.

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