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Running On: Conservation of Migratory Fishes on Long Island.

An alewives tale.

It is winter, and somewhere along the Atlantic coast swims a school of small, silvery fish. These fish are at most a foot or so in length, with a single triangular dorsal fin along their back and a deeply forked tail. These fish could easily be mistaken for Atlantic menhaden (a.k.a. 'bunker' or 'pogies'), which abound in the Chesapeake Bay and range along the eastern seaboard, or Atlantic herring, which were once a dietary staple in North America and especially Europe. But these fish are another member of the herring family. They are alewives, and they are bound for the South Shore of Long Island.

The alewives are about to embark on a remarkable migration that will take these humble fish from the depths of the ocean, along the coast, through estuarine bays, into rivers and streams, and past Long Islanders' backyards. Their goal is to reach freshwater habitats far upstream along the Atlantic coast, including those in the South Shore tributaries, in which to spawn. But in many of the rivers of Long Island and elsewhere, the journey will reach an abrupt end at a wall of concrete. Dams block nearly every major nursery area upstream of Great South Bay and its neighboring bays, from Hempstead to the Hamptons. These dams have been built from Colonial through modern times with little regard for their impact on fish.

A school of alewives makes its way upriver to spawn. (photo from NOAA)

The fish will make an incredible and often treacherous journey before confronting these barriers. As spring approaches, some unknown cue tells the alewives it is time to migrate. We do not know what exactly signals this change. It might be an internal clock that marks the passage of time. It might be changes in temperature or other oceanic conditions that accompany the change from one season to another. It is likely a combination of both the fish's own instincts and information it receives from its surrounding environment. In any case, as winter nears its end, it is time to move.

We also do not know where exactly our school is located when it begins its migration. We know that they do not travel far out into the open ocean, but can still cover the continental shelf. Many will not hug the coastline, as they can be caught in large numbers in depths of around 200 feet. They are spread from the mid-Atlantic states up through the Canadian maritime provinces. But where they begin their migration does not necessarily relate to their final destination: alewives tagged in Nova Scotia's Bay of Fundy have been recaptured still within Nova Scotian waters, but have also been found in Massachusetts, Maryland and North Carolina. Much of the offshore, over-winter phase of an alewife's life remains a mystery.

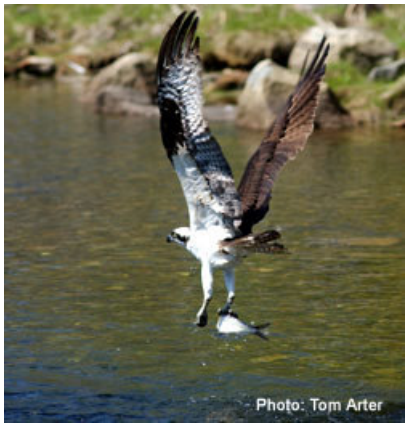
Over the winter, some of the alewives have fallen prey to oceanic predators including tunas, billfishes, whales, dolphins and cod. Leaving the deeper offshore waters hunted by these predators, the surviving members of the school make their way to the South Shore from late March to early June. Once there, they

cross between the thin, sandy barrier islands that make up the Fire Island National Seashore and separate Long Island's southern bays from the Atlantic Ocean. Now within the South Shore Estuary Reserve, more alewives will fall prey to the fierce thrashing attacks of bluefish, or will be swallowed in the broad gape of a striped bass. Seals will also move into coastal bays when the alewives begin their spawning run to feed on the migrating fish.

The blues and stripers have also recently returned to Long Island from distant over-winter haunts. Bluefish have migrated the length of the Atlantic coast from the warm waters off Florida. Striped bass have not traveled quite as far south to over-winter, but have still made a considerable trip from the waters off North Carolina and Virginia. Great South Bay and its smaller neighboring bays are now a convergence point of these Atlantic coast migrations of predators and their prey.

Harbor seals come into coastal bays during alewife runs to feed. (photo from NOAA)

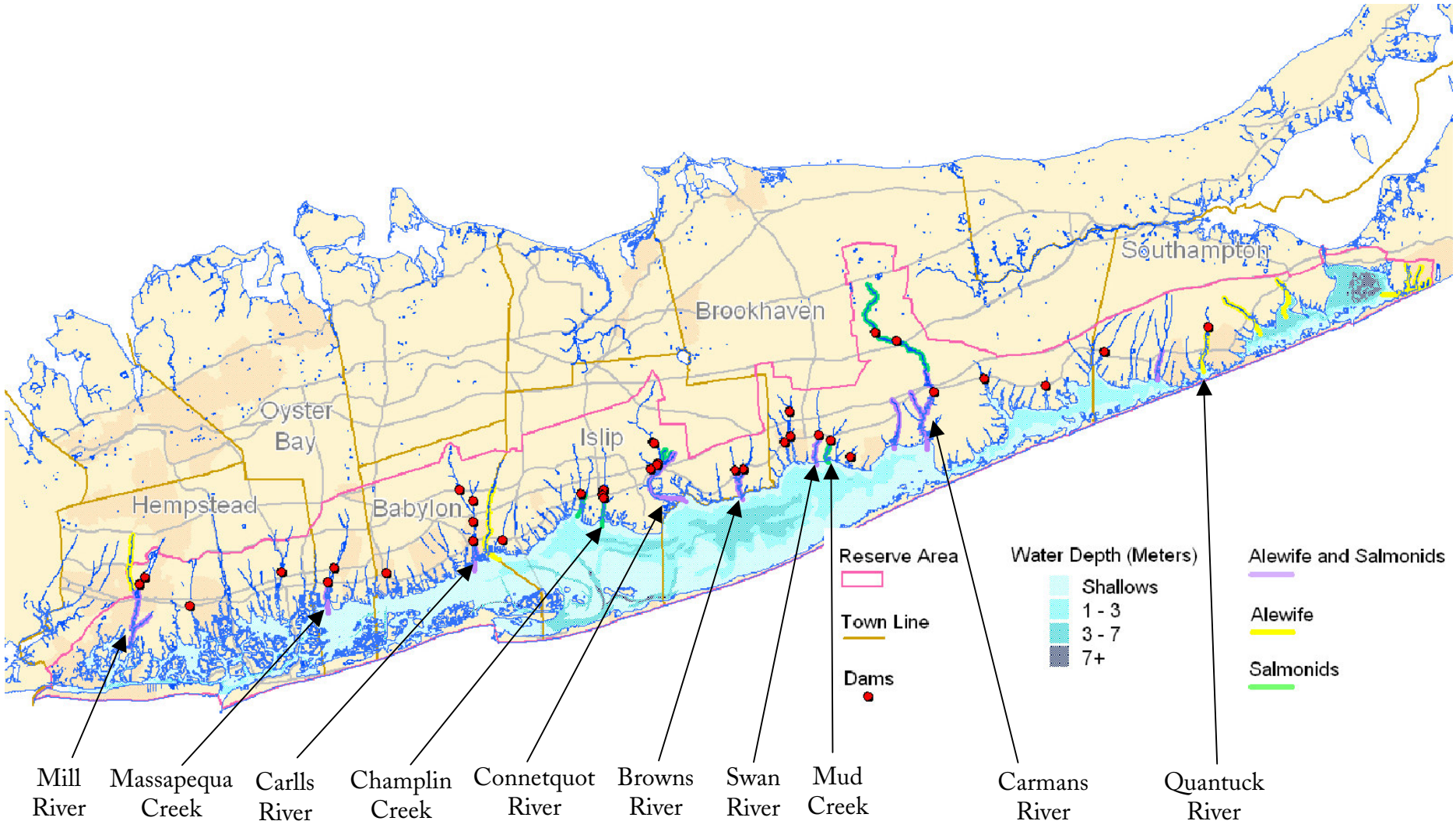
Those members of our alewife school that survive the gauntlet of blues, stripers and seals as they cross the bays and reach the river mouths now begin the final leg of their journey up out of the brackish waters of the estuary and into freshwater. As the spawning run progresses upriver, yet another migration meets that of the alewives. Ospreys have flown thousands of miles from the lush tropical rainforests of Central and South America to nest, breed and feed along the Long Island coast. Their arrival is a time when they desperately need to replenish energy supplies in preparation for breeding. These agile and sharp-sighted 'fishing hawks' scan the surface waters of rivers and bays for fish, ideally those up to 10 or 12 inches in length and one pound in weight. Those dimensions perfectly describe an adult alewife, and, accordingly, the ospreys actively hunt the energy-rich fish.



An osprey catches an alewife to help refuel from its long migration. (photo courtesy of Tom Arter)

Hoping to dodge the ospreys' sharp talons as they dodged the hungry jaws of bluefish, striped bass and a myriad of oceanic predators, the remaining alewives push on upstream toward their spawning grounds. Here is where dams put an often too abrupt end to the alewives' journey. (See graphic on page 3.) Not only does blockage of their migratory routes compromise the alewives' reproduction, but it also prevents them from acting as an ecological link between the sea and freshwater habitats that works against the river flow. Many of these dams have outlived whatever purpose they once served and could be torn down. All could be redesigned with simple fish ladders to accommodate the migrations of alewives and other fish. It is time to let the fish back in.

Despite the blockages, the fish may still spawn; alewives are quite resilient and can use a range of bottom types, flow conditions and salinity levels. But they often miss out on optimal habitat, which typically exists further upstream, or spawn in conditions that are too crowded. Accessible habitats are often degraded due to stream bank devegetation and consequent erosion and siltation, and water pollution. The net result of blocked migration routes and degraded habitats, combined with losses at the hands of human predators, is fewer alewives along the South Shore, perhaps too few to adequately serve their important ecological roles.



Map of the South Shore Estuary Reserve, showing the historical location of runs of alewives and salmonids (brook, brown and rainbow trout), as well as dams that block their migratory routes. Major tributaries with significant amounts of inaccessible upstream spawning habitat are labeled. (Map courtesy of New York Department of State, Division of Coastal Resources)

The upstream-downstream migratory habits of alewives classify them among the **diadromous** fishes, and they are not the only member of this group using the tributaries of Long Island's southern bays. All play important ecological and economic roles, and all can benefit if the impacts they face are reversed. Given the importance of diadromous species as forage fish and as a living link between the sea, bays, rivers and lakes, conservation of these fishes is an important part of **ecosystem-based management**, wherein decisions are made not just with a single species in mind, but rather with an eye to the role that species play as part of an integrated ecosystem.

What are diadromous fishes?

Diadromous fishes are species that **use both marine and freshwater habitats** during their life cycle. Species can be **anadromous**, living primarily at sea but migrating up rivers to spawn, or **catadromous**, living primarily in lakes, ponds and rivers but migrating out to sea to spawn.

The anadromous strategy is far more common, with the suite of Pacific salmon species being perhaps the best-known examples. But the Atlantic coast is not lacking in anadromous fishes. Large rivers in the Maine support the last remaining wild spawning runs of our own East coast salmon, the Atlantic salmon (*Salmo salar*), in the United States. Rivers throughout the Northeast support runs of the alewives (*Alosa pseudoharengus*) that we followed above, along with its close cousins the American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), and hickory shad (*Alosa mediocris*), and the Atlantic sturgeon (*Acipenser oxyrinchus*) and rainbow smelt (*Osmerus mordax*). The anadromous striped bass (*Morone saxatalis*) abounds in estuaries along the coast, though its spawning runs locally are confined to the Hudson River estuary. Furthermore, sea-run strains of the native brook trout (*Salvelinus fontinalis*) and non-native brown trout (*Salmo trutta*) and rainbow trout (*Onchorhynchus mykiss*) exist alongside resident freshwater populations in the Northeast.

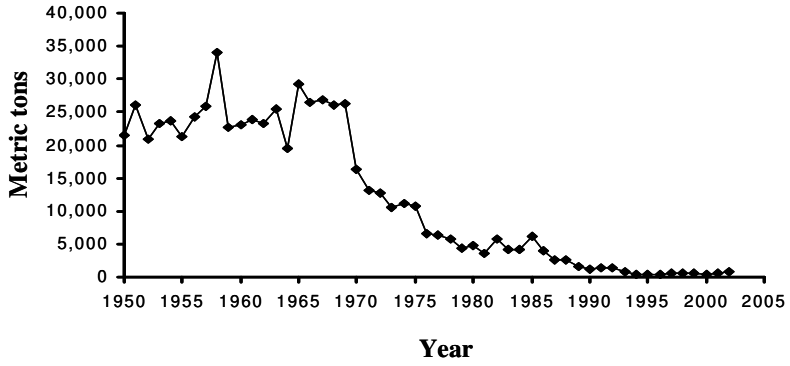
Although the catadromous strategy is less common, the Atlantic coast is home to one major catadromous species, the American eel (*Anguilla rostrata*). Juveniles of this species migrate up rivers to grow and mature, before migrating out to the Sargasso Sea to spawn with eels from along the coast. Sadly (for the eels, at least), they, like Pacific salmon, die after their one chance to spawn.

Larger diadromous species are naturally absent from Long Island, including Atlantic salmon, American shad and Atlantic sturgeon. But South Shore tributaries are important habitats for several diadromous species: Alewives and blueback herring, collectively known as 'river herring', and American eel and rainbow smelt still make their way up rivers along the South Shore to reach feeding, spawning and nursery grounds. Sea-run brook, brown and rainbow trout also make spawning runs in South Shore tributaries.

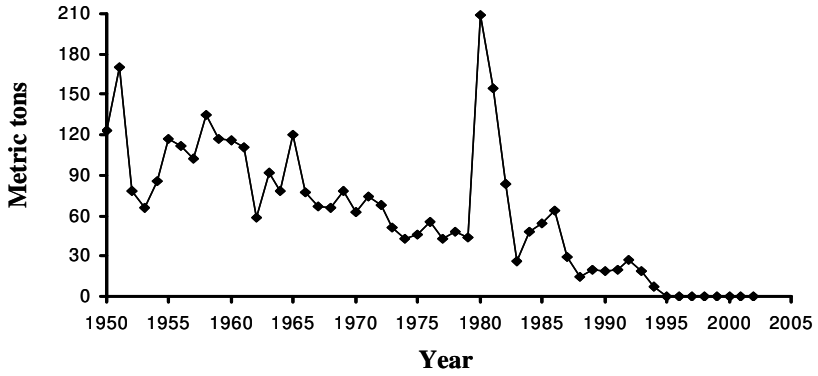
Fisheries for Long Island's diadromous fishes

Long Island's diadromous species are popular quarry of fishermen. American eels once supported one of the largest and most valuable commercial fisheries on Long Island, and continue to support a minor commercial fishery, as well as recreational fishing. Eels are popular both as a food fish for people and as a baitfish, especially for striped bass. River herring are also fished to a minor degree as a food fish, but more often as bait for both hook and line fishing and lobster pots. Anadromous and resident strains of all three trout species are certainly important sport fishes on Long Island.

In fact, it is fisheries statistics that give us the best insights, but unfortunately also the most troubling insights, into the status of diadromous fishes. Commercial fisheries landings of river herring in the mid-Atlantic states were consistent from the 1950s through the 1970s, but have since steadily declined to negligible levels in recent years. Declines in commercial landings of American eel have been ongoing for an even longer period of time. Although natural variability in reproduction contributed to a few years of high catches in the early 1980s, the dominant trend has been downward, and the eel fishery today is but a shadow of what it once was. Overfishing is certainly a part of these troubling trends, but increased blockages of waterways, habitat degradation, and declining water quality have also contributed to the collapse of diadromous fish stocks.



Landings of river herring in the mid-Atlantic states from 1950-2002 reflecting the dramatic decline in coastwide population size.



Landings of American eel in New York State from 1950-2002 reflecting the long-term decline in local population size. (data for both species from the National Marine Fisheries Service)

By the numbers – ecological importance of Long Island's diadromous fishes.

Dinner is served: feeding key predators

Perhaps the most important role of Long Island's diadromous fishes is as food for the larger predators that support our own economy and recreation, and the best scientific information on this role is for river herring. Up and down the Atlantic coast, alewives and blueback herring figure prominently into the diet of fish and wildlife that capture the attention of anglers and other outdoor enthusiasts. Some striking figures:

- In the Chesapeake Bay, nearly 80% of the diet of striped bass can be river herring during May, coinciding with the herring migration.
- In North Carolina, 33% of the diet of striped bass can be river herring during winter, rising to 50% during the spring migration period.

- Along the Northeast coast, from New Jersey to Maine, up to 33% of the diet of striped bass can be river herring during the spring migration period.
- In the Hudson River estuary, up to 40% of the diet of bluefish can be river herring during the summer months when bluefish return to cooler northern waters.
- In Saint John Harbor, New Brunswick, the abundance of harbor seals is 5 times the yearly average during the peak of the alewife run.
- Reproductive success of ospreys in Connecticut and Rhode Island has been up to 50% greater than Long Island birds. Some biologists hypothesize that the difference is due to larger river herring runs in New England. Ospreys are intimately entwined with the history of the environmental movement on Long Island, and of Environmental Defense in particular.

These figures all show the tremendous contribution that diadromous fish can make to key wildlife species. Indeed, some speculate that, after the stunning revival of stripers on the Atlantic coast during the 1990s, their numbers, or at least the size and quality of fish, are compromised today due to declines in forage fish populations. Others have speculated that the devastating collapse of the Atlantic cod fishery was due in part to declines in numbers of alewives, depriving the cod of an important food source.

Going against the flow: delivering nutrients upstream

Nitrogen of marine origin has been found within the highest leaves and branches of the tallest trees in temperate rainforests of British Columbia, Canada. The most likely source of this nitrogen is decomposing salmon, caught in rivers and dragged into the forest by bears and wolves. This dramatic example of nutrients making their way from the ocean to the tops of 100+ foot trees illustrates an important role of diadromous fishes. Rainwater run-off carries material from land into rivers and streams, which then transport that material out to sea. However, river flow is one-directional, and river flow cannot cycle matter back from the marine realm to rivers, lakes and land. But fishes can swim against river flow, and create a reverse pathway delivering nutrients back upstream. Several researchers have identified important contributions of river herring to lake and stream ecosystems:

- In Virginia's Rappahannock River, the tissues of a predatory catfish included approximately 42% carbon of marine origin. This substantial carbon contribution could only have entered the ecosystem through the catfish's river herring prey.
- Also in Virginia, 36% of the carbon in the total weight of predators in Ward's Creek is of marine origin following the annual river herring migrations.
- In Maine, the proportion of alewives in the diet of white perch in coastal lakes is 15-60% in late spring and early summer, when the alewives return to their freshwater spawning habitat from the sea. The proportion of alewives in the white perch diet can reach 100% in late summer and fall, when the recently hatched alewives have grown to a size where they become a preferred prey item for the perch.

White perch are a native sport fish on Long Island, and river herring probably play a similar role in their feeding ecology locally, in addition to generally being an important conduit of nutrients to freshwater ecosystems.

Environmental Defense plans to restore diadromous fishes on Long Island.

Despite the importance and diminished status of diadromous fishes, their plight has received relatively little attention along the South Shore. This may be due in part to the fact that, unlike other estuaries, the southern bays of Long Island lack a single, central 'signature' river as a focal point. However, numerous tributaries flow south on Long Island, as the accompanying map illustrates, and collectively they can support large populations of river herring, eels, and brook trout. But, as the map also shows, many of these waterways are dammed, which means vast areas of spawning habitat have been lost.

Environmental Defense has organized a group of local stakeholders, including personnel from the South Shore Estuary Reserve office, NY Department of Environmental Conservation, NY Department of Transportation, NY Department of State, US Fish and Wildlife Service, Trout Unlimited, The Nature Conservancy, Suffolk County, the Town of Brookhaven, other local municipalities, and representatives of fishing organizations, to increase diadromous fish conservation efforts along the South Shore. The first objective of this group will be to finalize installation of a fish ladder planned for the first dam on the Carmans River, a project for which the Art Flick Chapter of Trout Unlimited has long been an advocate. This project will be an invaluable learning experience about the regulatory and logistical obstacles to be faced in fish passage projects. It will also provide an important precedent and public education opportunity.

The narrow spillway at the Swan River dam in Brookhaven (left) prevents fish from reaching the large area of spawning habitat in Swan Lake (right, top). Installation of a fish ladder like this one from the Parker River in Massachusetts (right, bottom) can allow fish to swim past this obstacle. (ladder photo from NOAA)

The next goal is to conduct a survey of as many South Shore tributaries as possible to fully document the presence and size of existing diadromous fish runs. Because there are a large number of tributaries and the arrival of migrating fish can be difficult to predict, this will require recruiting as many members of the local community as possible to gather information. The observations of school groups, naturalist clubs, fishing clubs and others who spend time on the South Shore rivers and creeks, along with more formal scientific information, need to be collected into a single centralized database. This will help determine whether proposed development projects are likely to impact diadromous fish runs. It will also assist in planning the next generation of restoration projects along the South Shore.

There are numerous opportunities for diadromous fish restoration projects along the South Shore. Mathematical models suggest that opening migratory pathways will result in the greatest changes in fish populations, and this will be our main focus. Where possible, we will explore the possibility of dam removal, as this not only allows migration but also restores the overall river ecosystem. Where removal is not practical, we will work to install fish ladders or step pools to allow fish to circumvent barriers. Additionally, we will work to improve habitat and water quality, and reform fisheries management to help diadromous fish populations increase and serve their vital ecological roles.

For more information on diadromous fish ecology and conservation, or to share ideas and observations, please contact Jake Kritzer at jkritzer@environmentaldefense.org.