The Tidal Exchange

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THIS ISSUE

HARBOR ESTUARY NEWS

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Helping to Restore Anadromous Fish Passage

Fish Ladder Feasibility on the Rahway River

Mark Jaworski and Ryan Brown

Dams, dikes, culverts and other structures prevent migrating fish in the New York – New Jersey Harbor Estuary, and throughout the coastal United States, from reaching their native upstream spawning grounds. Many structures located on streams and rivers are used for drinking water, electricity generation, flood control, irrigation and other benefits. The New York – New Jersey Harbor Estuary Program (HEP) provided funding for a feasibility study to determine how to best restore historical fish migration routes along the lower reaches of the Rahway River in New Jersey, while preserving beneficial uses of the river.

The ultimate purpose of this project is to allow native anadromous fish populations to reach upstream historical spawning and rearing areas in the Rahway River that are currently inaccessible due to a dam. The installation of a fish ladder at the Rahway Water Supply Dam could be a first step in restoring the fishery in the lower section of the river and could lead to further opportunities for restoration

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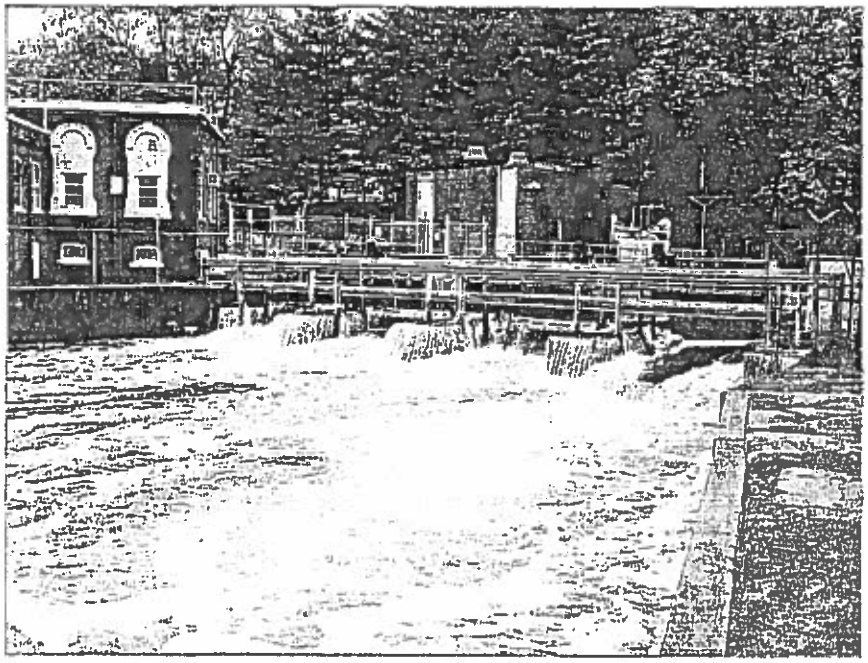


The proposed location for the fish ladder is along the dam (the right side of this photo). This would allow the fish to swim around the dam while allowing the dam to operate at its current capacity. Photo courtesy of Mark Jaworski, Western Solutions

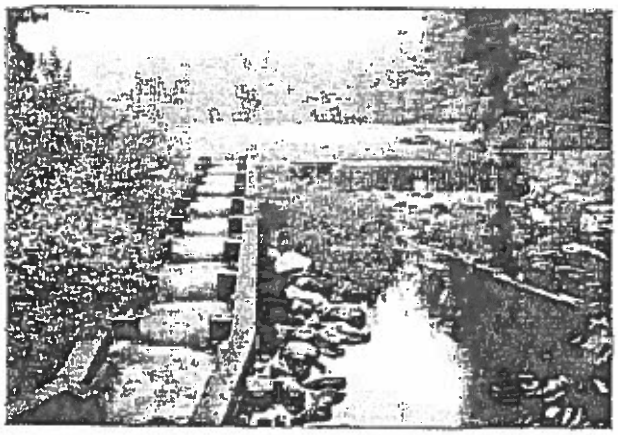
Fish Ladders
(from page 1)

efforts upstream.

While dams and other structures can provide valuable services to cities and communities, quite often they form insurmountable barriers that keep native fish from reaching important natal spawning, feeding, and rearing habitats. As a result, some populations of native fish species (e.g. American shad, alewife, and other river herring) have been reduced or even eliminated from these areas.

In fact, fish population studies show a deteriorating trend in populations such as American shad and American eel in the Harbor Estuary. Because juvenile fish of these species are the prey of a variety of larger, adult fish species such as striped bass, restoring their populations is important to the entire Harbor Estuary ecosystem.

Many restoration efforts underway in the United States at this time focus on restoring fish migrations by removing or bypassing impediments. Where removal of a dam or other barrier is not feasible, fish passage structures such as fish ladders or bypass channels have been constructed to allow fish to swim over or around the dam to reach critical upstream habitat where they can spawn.



Computer rendering of an operational fish ladder on the left. Reservoir with dam is in the background.
Image courtesy of Alexey Sergeev

Fish ladders connect flow upstream of an impediment to downstream waters. Fish ladders typically consist of a sloping chute that is divided by weirs which create a step-wise series of descending pools. As water flows over each weir, fish ascend the ladder by swimming or jumping into successively higher pools (see Page 6 for more information on fish ladders). Fish have been observed gathering at the Rahway Water Supply Dam during the time frame in which spawning anadromous fish would be expected to ascend the river.

For the Rahway River study, a preliminary screening of design alternatives indicated that two types of fish passage alternatives may be feasible: a fish bypass design and a steeppass ladder design. The full study concluded that both proposed fish passage alternatives are feasible and would meet the project's fish passage goals while allowing the dam to operate in its current capacity.

HEP Funding

Funding for the Fish Passage Feasibility Study at the Rahway River Water Supply Dam was made available through a Conceptual Habitat Restoration Plan Grant offered through an open Request for Proposal (RFP) process by the Harbor Estuary Program and the Hudson River Foundation. The proposal submitted by Weston Solutions, Inc. pledged matching in-kind services toward this project and documented the support of the Rahway River Association and the cooperation of both the City of Rahway, NJ, Union County, and United Water, Inc.

Rahway River Water Supply Dam

The Rahway River, located within the Harbor Estuary region, is home to several dams that have precluded historical seasonal spawning migrations of native fishes. The Rahway River drains a watershed of roughly 41 square miles and is 24 miles long, originating in Springfield, NJ and flowing to Linden, NJ where it drains

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What Prevents Fish From Going Upstream?

A number of structural barriers and impediments can prevent fish from entering streams or tributaries where they spawn, or in the case of the American eel, where they mature. Here's a quick rundown of some of the structures that provide benefits to our communities but can keep fish from reproducing in their native waters.

Dams and spillways are used to contain water for drinking water reservoirs, for generating electricity, or to build lakes for parks or recreation. Most dams, unless modified, are impassable by fish.

Tide gates keep freshwater from mixing with salt water, which often creates freshwater lakes above the tide gates and salt water marshes below. The salt water marshes can contain rare marsh wildlife and habitats. Like dams, tide gates are often impassable.

Concrete channeling of stream beds is used to control flooding or change the course of the stream to allow for density in urban or suburban areas. Concrete channels increase the volume and velocity of streams preventing fish from finding resting spots on their upstream journey.

Culverts typically consist of large pipes built under roads at stream crossings to move stream flow under the roadway and prevent flooding and washouts of roads. Culverts can prevent fish from passing in dry weather or low tide, and concentrate the flow and increase stream velocity during wet weather.

Fish restoration efforts may not be feasible nor desirable for some impediments. Poor water quality or stream conditions may not allow for successful spawning even when impediments are overcome. In some areas, natural barriers such as waterfalls or rapids prevent fish passage and indicate that fish migration may not have occurred historically.

into the Arthur Kill, a tidal estuary. The most downstream obstruction on the Rahway River is the Rahway Water Supply Dam operated by United Water, Inc. The dam is located near two HEP habitat restoration sites (AK3J and AK3K) immediately south of the Union County Rahway River Park. The primary function of the Rahway Water Supply Dam is as the name implies, for water supply for the city of Rahway.

Target Fish Species

Based on the literature, the primary suspected species targeted for upstream passage at the Rahway River Water Supply Dam are the following:

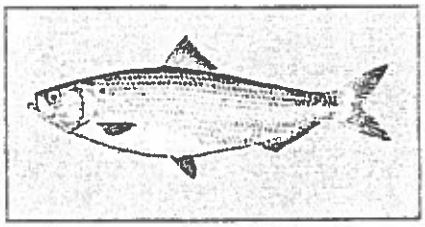
- alewife, *Alosa pseudoharengus*
- blueback herring, *Alosa aestivalis*
- gizzard shad, *Dorosoma cepedianum*
- white perch, *Morone Americana*
- American eel, *Anguilla rostrata*

Alewife and blueback herring are collectively referred to as river herring due to their similarity in appearance, home range, and life histories. River herring, gizzard shad, and white perch are all anadromous fish species (i.e., adults spawn in freshwater; juveniles migrate to marine environments where they grow to sexual maturity); whereas American eel are catadromous (adults spawn in the marine environment; the young migrate to freshwater habitats where they grow to sexual maturity).

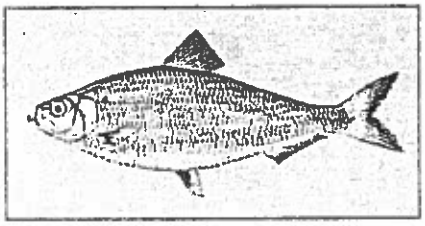
River herring and gizzard shad are members of the family Clupeidae (herrings and shads). In New Jersey, adult herring migrate from the ocean to freshwater spawning areas from early spring through early summer. After hatching, young-of-the-year fish typically remain in freshwater nursery habitats for several months prior to migrating to estuarine and eventually marine environments to grow and mature. After reaching sexual maturity, the adults return to their natal streams to spawn.

No Fish Jumping ?

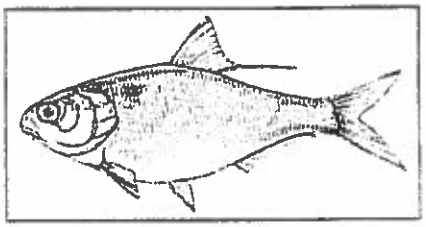
Unlike many fish ladders found in the Pacific Northwest, both the Alaska Steeppass and Vertical Slot ladders in the Northeast are designed for fish that have no jumping capability such as alewives, blueback herring and American eels. Though this means we won't see fish jumping upstream,



Blueback Herring, *Alosa aestivalis*
Image from US Fish and Wildlife Service



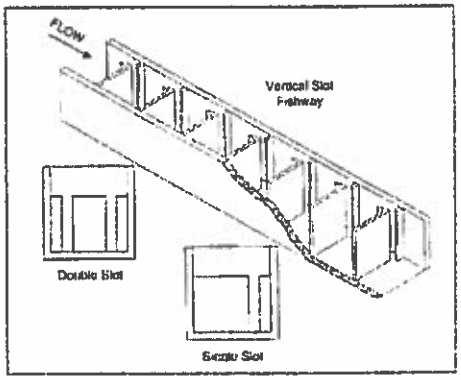
Alewife, *Alosa pseudoharengus*
Image from US Fish and Wildlife Service



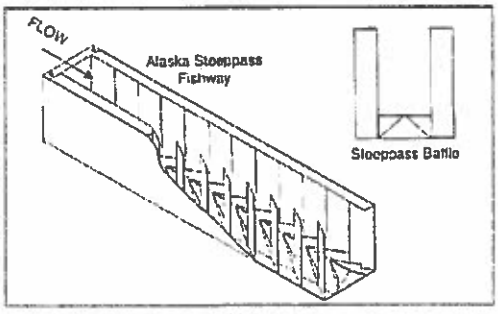
Gizzard Shad, *Dorosoma cepedianum*
Image from US Fish and Wildlife Service

Fish Ladders

The Vertical Slot ladder, or step pool, weir design ladder is constructed on site and consists of baffles spaced evenly along the length of the ladder, often with vertical slots within the baffles. The baffles create pools of water while the slots allow for fish to pass up through the baffles. The pools and eddies that are created provide more slowly flowing water for fish to rest in as they make their way up the ladder. An important feature of the Vertical Slot ladder is that the baffles can be removed and replaced, allowing for more control of the flow to aid fish passage when water volumes are higher or lower than normal. The removable baffles also allow the fish ladder to be closed when fish are not migrating, which provides for better water control at the dam site.



Vertical Slot Fish Ladder Design
Image from Odeh, M. ed. 1999
Innovations in fish passage technology
American Fisheries Society, Bethesda, Maryland



Alaska Steeppass Fish Ladder Design
Image from Odeh, M. ed. 1999
Innovations in fish passage technology
American Fisheries Society, Bethesda, Maryland

The Alaska Steeppass fish ladder is a pre-fabricated aluminum chute that can be designed and built to match the features of a particular site. This type of ladder is installed on-site with limited modification of the ladder required. The steeppass design consists of vanes along the sides and bottom that point up and at angles towards the flow of water. The vanes create turbulence and reduce the water velocity while keeping enough water flowing down the ladder for fish to swim through. If the vanes were not in place, the steady unaltered flow of water would not provide enough volume for the migrating fish to pass up the ladder. The Alaska Steeppass ladder is particularly effective for small dams or remote locations as the ladder can be easily installed on site.

we may still be able to watch the fish migrate. With some additional planning, both fish ladders being considered for the Rahway River could be designed to include viewing stations to allow people to see the ladder and, at the right time and place, the migrating fish. Educational enhancements such as these may be sponsored by a local or regional for-profit organization.

Future Steps

In order to further evaluate both fish ladder designs and develop a conceptual design plan, a number of future steps were identified in the feasibility study. One potential limitation, the presence and location of buried underground utilities within the path of the proposed fish ladder, was identified during the evaluation. Other data gaps to be addressed include the need for detailed biological and habitat information, specifically pertaining to populations and distribution of anadromous and catadromous fish species that may potentially utilize the fish ladder. In addition, more data is needed to confirm that sufficient spawning habitat upstream of the dam exists, and whether habitat enhancements are necessary or feasible.

Similar restoration efforts, including anadromous fish passage restoration, are currently being conducted elsewhere within the Rahway River watershed by the United States Army Corps of Engineers, United States Fish and Wildlife Service, the City of Rahway and other stakeholders such as the Rahway River Association. One particular restoration project is currently being conducted on the Robinson Branch of the Rahway River. As part of a $1.1 million dollar restoration and improvement project, a fish ladder has been installed at the Milton Lake Dam to aid in the migration of white perch and gizzard shad to their historical spawning grounds. ♦

Mark Jaworski *is a Client Service Manager with Weston Solutions, Inc. Mark has been a long time advocate of ecological restoration projects within the Harbor and has been an active member of the HEP Habitat Work Group since 1999.*

Ryan Brown, *a Senior Scientist with Weston Solutions, Inc., has been the lead fisheries biologist on numerous fisheries and aquatic habitat investigations and was responsible for conducting the fish passage feasibility evaluation.*

Important New Jersey CSO Legislation Enacted

Dan Zeppenfeld

New Jersey recently enacted legislation, Assembly Bill No. 3563, signed into law as PL 2005, c. 301, that appropriates $30,000,000 to the New Jersey Department of Environmental Protection to provide grants to local government units for wastewater treatment system projects. The New Jersey Combined Sewer Overflow (CSO) Control Program will benefit significantly from this action. The legislation provides a total of $30,000,000 for 24 entities to fund up to 20 percent of the cost for the development and evaluation of pathogen control alternatives and cost performance analyses for combined sewer systems as required pursuant to the New Jersey Pollutant Discharge Elimination System Permits issued by the Department. The Legislation also provides $24,180,000 for the purpose of financing up to 20% of the project construction costs for wastewater treatment system projects. The moneys will be used for a wide variety of wet weather water quality improvement projects including separate sanitary and storm water systems and combined sewer systems and non-point source pollution abatement. ♦

Dan Zeppenfeld is with the NJ Dept. of Environmental Protection.

HEP Awards Grants to 10 Partners for 3 Estuary Stewardship Projects

As part of a new initiative to support regional partnerships and promote stewardship within the estuary, HEP established a Stewardship Grant Program in 2006. The first round of grants awarded will support the work of ten partner organizations with a total of $94,700 in funding for three regional projects. For more information, visit www.harborestuary.org/stewardship.htm.

New York/New Jersey Harbor Education Program

Partners
Brooklyn Center for the Urban Environment
New Jersey Marine Sciences Consortium
Funding: $20,000

Friends of the Estuary

Partners
Association of New Jersey Environmental Commissions
Council on the Environment of New York City
Future City Inc.
New York Academy of Sciences
New York City Soil and Water Conservation District
Funding: $45,000

Increasing Harbor Stewardship through Oyster Restoration in New York City

Partners
The River Project
NY/NJ Baykeeper
New York Harbor School
Funding: $29,770

Fish Ladder Proposal

North American Wildlife

Name_____Date_____

Directions: Read the article entitled: Helping to Restore Anadromous Fish Passage. Answer the following questions.

1. List three (3) beneficial purposes of dams, dikes, and culverts.

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2. How do dams, dikes, and culverts affect anadromous fish?

3. What proposal is being made to fix the problems with the relationship between the fish and the structures?

4. Name two (2) species of anadromous fish that are affected by the structures.

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5. Describe a fish ladder.

6. Does one type of fish ladder work for ALL fish species? Why or why not?

7. Discuss one (1) question, problem, or limitation that must be further explored in order to determine the effectiveness of fish ladders in the river system.