

Rights of Passage

Fish Ladders Open the Way

By Jim Thompson

For many Maryland anglers, the mere mention of the American shad can send chills down the spine and conjure up memories of crisp spring mornings on the Susquehanna River spent battling one of these magnificent fish. The American shad is just one of several species of fish referred to as anadromous; that is, they are born in the state's freshwater streams, migrate to the ocean where

they live for several years, and then return to their respective rivers to spawn. Other species of anadromous fish visiting the Bay include hickory shad as well as alewife and blueback herring, commonly grouped together and referred to as river herring.

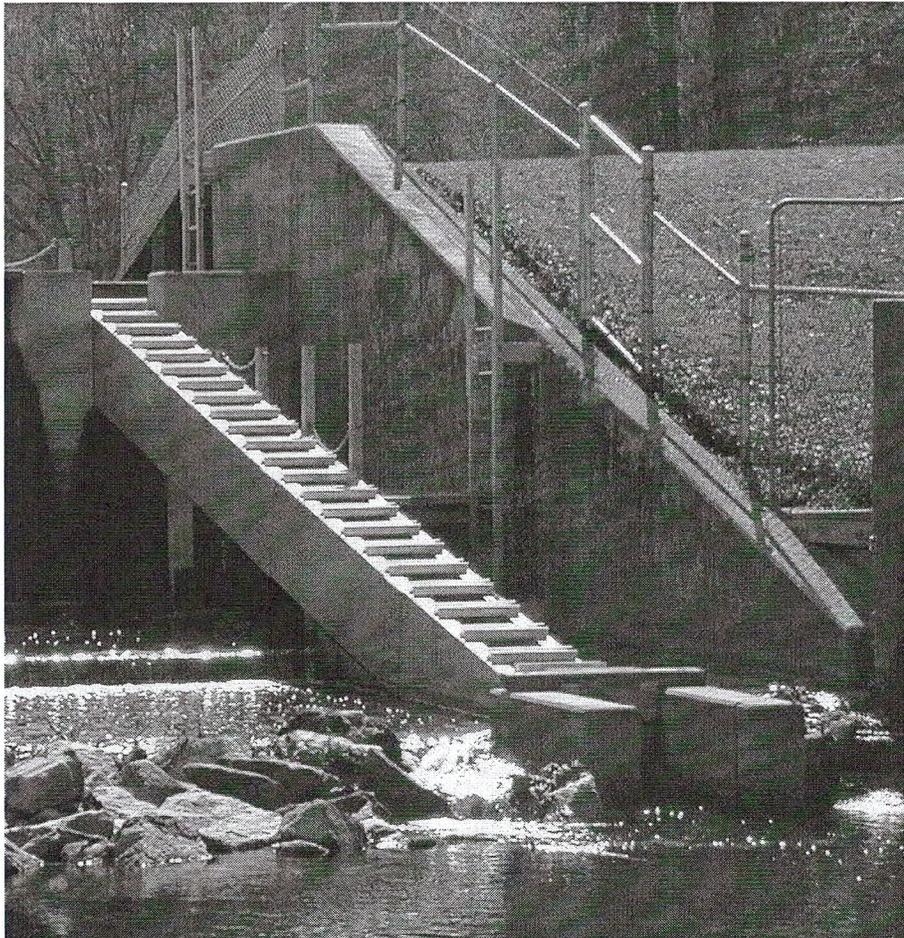
Juvenile shad and herring spend most of their time in large schools out in the Atlantic Ocean feeding on fish, shrimp, squid, fish eggs, small crabs,

plankton and other small organisms. When the fish reach sexual maturity after approximately three to four years, they begin to migrate back to the rivers where they were born. Hickory shad and herring typically arrive in the Chesapeake in March and April, although they can be seen as early as February and as late as June, depending on water temperatures. A later arrival, American shad usually return to the Bay in May. Once spawning is complete, the fish return to the ocean where they become valuable forage for larger species such as striped bass.

A Maryland Icon Nearly Lost

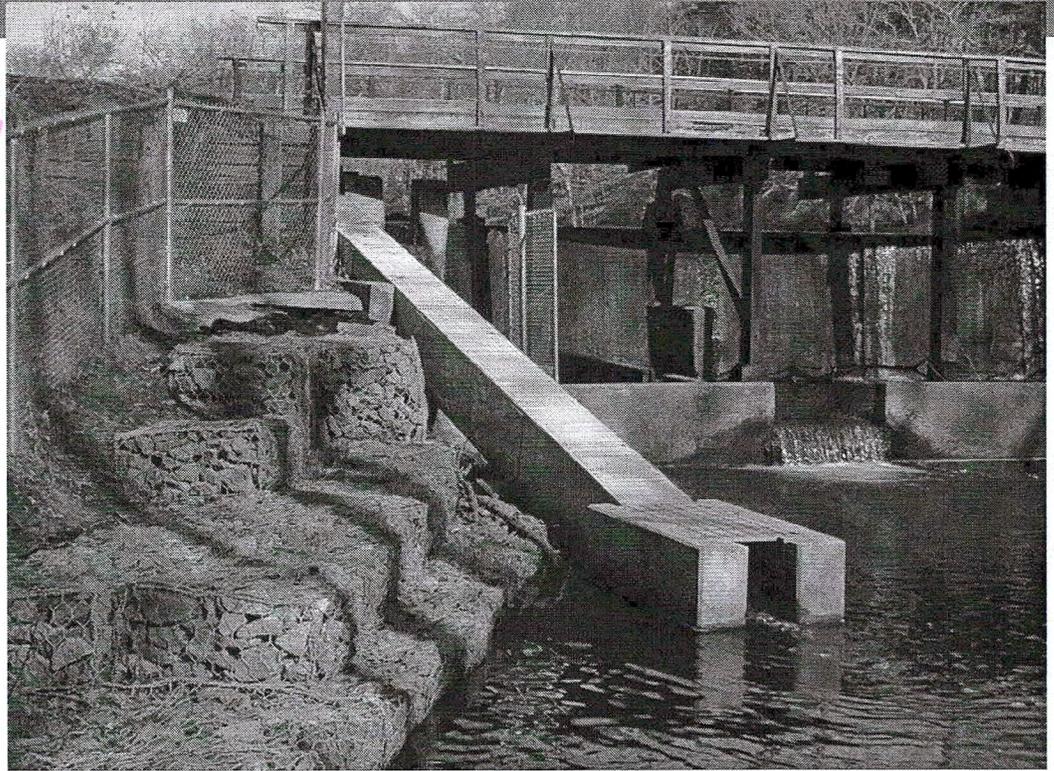
Shad and herring have long been a major cultural and economic resource in the region. To indigenous Native American tribes, the American shad was a staple food. Early European settlers depended on the annual shad runs for survival, and a barrel of the salted fish became a common fixture of many a colonial home. George Washington even had a shad fishery at Mount Vernon.

The commercial harvest for American shad began around 1800 and by its peak in 1890, landings in Maryland were in excess of 7 million pounds. Along the Atlantic seaboard, the commercial exploitation of the fish continued through the 1960s and by 1979, landings of American shad in Maryland had declined to a paltry 18,000 pounds. Herring and hickory shad suffered similar declines, and by the 1970s all four anadromous species were near collapse. Finally in 1980, the State of Maryland closed its commercial



Unicorn Dam in Queen Anne's County

Lake Bonnie Dam in Caroline County and Unicorn Dam (opposite) both use Alaskan steeppass fish ladders.



and recreational American shad fisheries, and followed with a similar closing for hickory shad one year later. River herring suffered heavy exploitation from foreign fishing fleets until 1973 when agreements between the United States and the international community limited commercial landings.

Commercial exploitation was not the only factor contributing to the decline of these anadromous fish. During the late 1800s and early 1900s the population and infrastructure within the United States exploded. Up and down the East Coast, vast expanses of forests were being harvested to provide materials for buildings, ships and other goods. Thousands of mills were constructed, as were dams that provided flood control and hydropower for factories and homes. Unfortunately, these dams prevented shad and herring from their instinctive migrations up the rivers to their historic spawning grounds, thereby limiting the habitat available to them. Simultaneously, the clearing of forests caused large amounts of sediment to be flushed into streams and rivers, smothering the eggs of the few fish able to make it up to the headwaters. To add insult to injury, increased road construction throughout the 1900s created a need for culverts to be placed where roads crossed streams, providing even more barriers.

Going Against the Current

In 1987, the first Chesapeake Bay Agreement was signed by states within

the watershed, including Maryland, Pennsylvania, Virginia and the District of Columbia. This landmark agreement included commitments by each state, "to provide for fish passage at dams, and remove stream blockages wherever necessary to restore passage for migratory fish." The Bay states agreed to reopen a total of 1,357 miles of historical spawning grounds by the year 2003, of which Maryland's share was approximately 389 miles of stream. In response to this commitment, the Maryland Department of Natural Resources (DNR) created the Fish Passage Program in 1988.

The Fish Passage Program's purpose is to restore migratory fish species to at or near historic levels of the 1950s. In addition to removing or bypassing blockages, elements of the program include reintroducing target species, bio-monitoring and education. Fish passages have been provided at many of the larger blockages on Maryland waterways, including the Conowingo Dam on the Susquehanna River, and Bloede, Simkins, and Daniels dams on the Patapsco River. They have also

been provided at some of the smaller dams such as Fort Meade Dam on the Little Patuxent River, Van Bibber Dam on Winters Run, the dam at Elkton on Big Elk Creek, and Tuckahoe Lake Dam in Tuckahoe State Park.

Although one year late, the original goal of the Chesapeake Bay Agreement was surpassed in 2004 when the Bay states collectively opened 1,570 miles of historic spawning habitat. Maryland also exceeded its goal, reopening over 400 miles of stream. Meeting this goal has been a cooperative effort between DNR, the State Highway Administration, National Marine Fisheries Service, National Oceanic & Atmospheric Administration, U.S. Fish & Wildlife Service, U.S. Environmental Protection Agency, Chesapeake Bay Foundation, University of Maryland, and a multitude of others including private citizens, and local governments and watershed groups.

On January 10, 2005 the Bay states signed a new 10-year goal to complete 100 fish passage projects and reopen an additional 1,000 miles of habitat to both anadromous and resident (non-migra-

tory) fish species. Maryland is already poised to complete three projects in 2005, including two dam removals.

Getting a Lift

There are literally thousands of blockages in Maryland streams, ranging from dams and road crossings to less obvious sewer lines and pipe culverts. Due to the limited availability of both funds and manpower, plans for addressing these blockages must be prioritized. Biologists take into account many factors when ranking projects for mitigation, including the amount and quality of habitat to be opened, the presence of target species below a blockage, other stream restoration projects in the watershed and neighboring landowner cooperation.

Once a blockage has been targeted, fish passage can be accomplished in a variety of ways depending upon the situation. The removal of the blockage is usually considered to be the best solution as it allows for the waterway to return to a natural state and no structures are left to maintain. However, dam removals may not always be feasible, in part because of the large amounts of sediment found behind some dams. If removal or a breach is not an option, engineers and biologists will decide whether to install a fish passage device.

Such devices are commonly referred to as fish ladders (also fishways or fish passes). They are structures designed to allow fish the opportunity to migrate upstream and continue their function

as part of the river ecosystem. Fish ladders may be recommended when blockages are as low as 1 to 2 feet in height. Critical to evaluating whether or not a ladder is necessary are the water depth below the blockage, the water velocity, and the type of fish that need to pass.

Fish ladders consist of a series of gradually inclining steps with resting pools located at regular intervals. Most are designed with a 10 percent grade. These provide the fish with a means for active migration that simulates natural river conditions. If a fish ladder does not provide sufficient water, fish will not be attracted to the fishway; however, if too much flow is generated, fish will be deterred from using it.

The Bloede Fish Ladder Clean-up

On a wet, dreary day in early March 2004, volunteers from the Maryland Free State Flyfishers Club made their way to Patapsco State Park. Their purpose was not to go fishing,

cycling, hiking or picnicking. No, these fishermen showed up to work -- and work hard!

These anglers are part of a volunteer network that helps the Department of Natural Resources (DNR) Fish Passage Program every spring with the maintenance of its 60-plus fishways. Since the decline of the American shad and other anadromous fish in the 1960s and '70s, fish ladders have been built to re-open rivers previously blocked off by dams, culverts and other obstructions. These ladders allow shad and herring to swim past blockages

to reach critical spawning habitat upstream.

Volunteers are critical to the success of the Fish Passage Program and, ultimately, to the restoration of the species. Early spring rains carrying tons of winter debris often clog the fishways, making it difficult for the fish to properly use the ladder. With so many fish ladders across the state, it is a daunting task for DNR staff to routinely visit each site and make sure the ladders are free of sticks, leaves and other debris.

Such was the case last spring. As a result of 2003's record rainfall and the pounding of Tropical Storm Isabel, some fishways were in bad shape. DNR was facing the reality that the Bloede fishway on the Patapsco River might not be operational, or at least not in time for the spring migration. With little money available to contract a backhoe and crew to come in and clean



A fish eye view – looking up the Alaskan steppass fish ladder at the Unicorn Dam



Many design factors are taken into account when engineers determine which type of fish passage device to install. Every blockage in a river represents a unique situation and challenge, and each fish ladder is therefore carefully designed and placed. No one design will accommodate all fish, as each species has different physical characteristics that need to be taken into consideration. If a restoration project is aimed at several target species, ladders must be designed for the weakest swimmer. **Shad can be blocked by an obstruction only one foot high, while herring are unable to jump over obstructions at all, requiring a moderately sloped fishway.**

Fish passage types include the Alaskan steppass fish ladder, a denil



a very special place in their hearts. When they learned of the condition of the fishway and the limited resources available to fix it up, they came to the rescue.

On March 6 nearly two-dozen anglers, some with sons

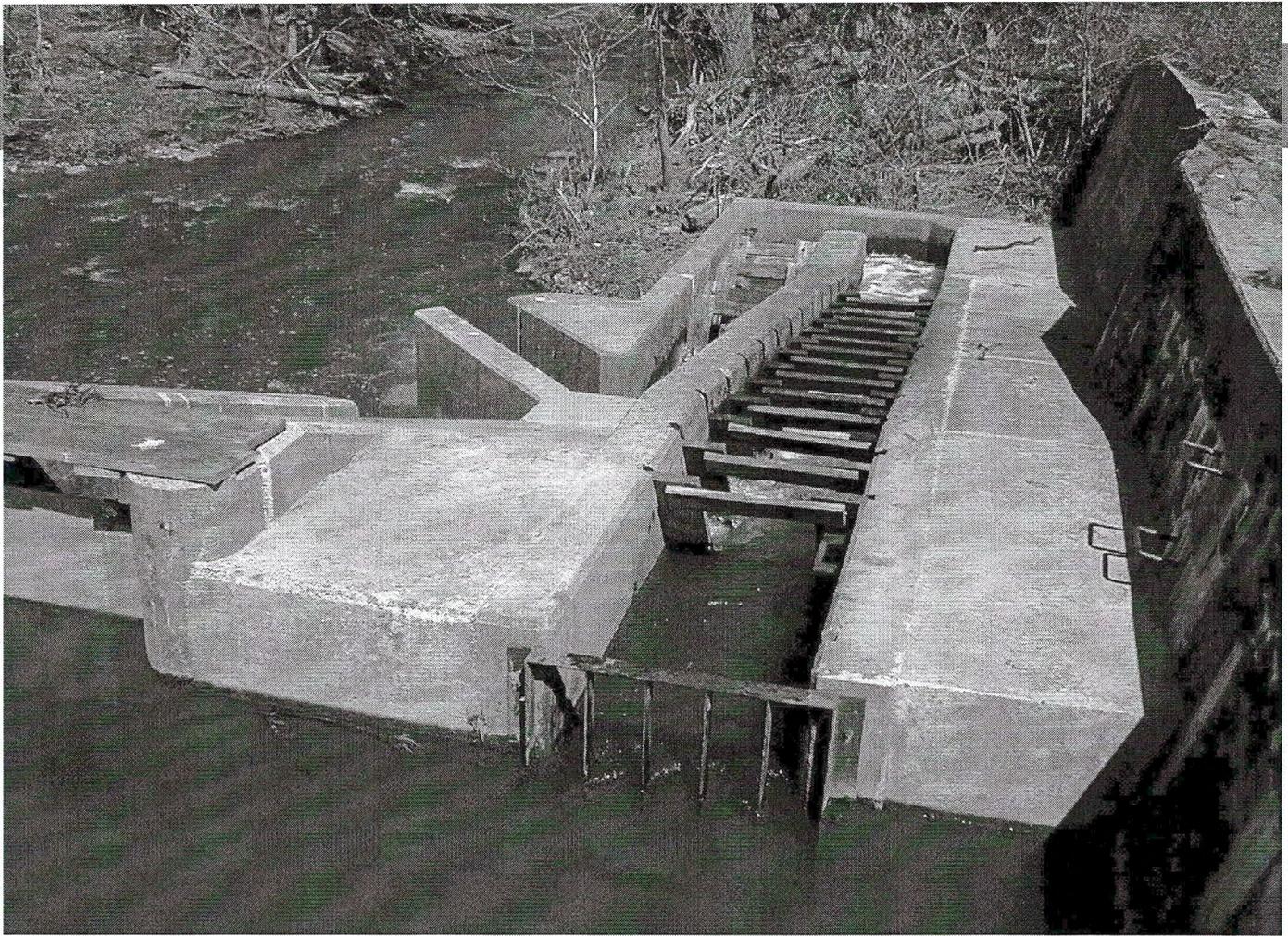
hand cranks and elbow grease to haul the rocks out and stack them on the shore. As one crew handled the boulders at the entrance of the ladder (the downstream end) another crew was busy cleaning sticks, leaves, mud and trash from the exit (the upstream end). The high water had deposited more than a pick-up truck full of sediment in front of the ladder. So much, in fact, that the exit of the ladder where the fish swim out had been completely buried!

The crews worked for nearly five hours before the job was finished, just in time to be greeted by a torrential downpour. Many thanks go out to the men and women of the Free State Flyfishers of Maryland and all the other volunteers who have helped maintain the state's fish ladders, helping ensure a healthy, prolific future for our migratory fish populations. ❖

out the nearly dozen 100-plus pound boulders that had been washed into the fishway, the fishermen stepped in.

As a group, the Free State Flyfishers spend a good bit of time fishing the Patapsco, and the river and its inhabitants hold

and daughters in tow, showed up to help clean out the Bloede ladder. Program staff provided a large cargo net and the group took over from there. While one group of volunteers climbed into the fish ladder to roll the large rocks into the net, others used



Winters Run in Harford County uses a denile fishway fish ladder.

fish ladder, pool and weir structure, a fish lift, a notch, natural fishways like rock ramps, or a combination of these. Each of these devices fit a specific situation; **Alaskan steeppass ladders and denil-type fish ladders are the most commonly used in Maryland.** The hydrological design behind a denil or steeppass fishway is very complex, but the basic idea is to provide a continuous stream of low velocity water so the fish can ascend the fishway and exit above the dam or blockage to access upstream habitat. Both structures are similar to a chute with baffles inside. The baffles slow down the water, allowing the fish to follow their instinct to swim upstream against the current without tiring. **Steeppass fishways are particularly well suited for small dams, and they are relatively easy to install and maintain.** A denil fishway is larger and best for medium to large dams.

Once fish passage has been provided at a site, the structure must be monitored to ensure it is operating properly and fish are able to ascend above the former blockage. Through such monitoring, biologists have documented **at least 33 species of fish that have ascended fish passage structures in Maryland, including primary target species such as shad and river herring.**

Over the Top

To continue to function properly, fish ladders must be maintained and kept clear of debris such as sticks and leaves that can act as a blockage unless removed. The Fish Passage Program relies heavily on its volunteers to help keep its fishways clear during the critical spring spawning season (see sidebar). Their dedicated efforts are vital to the program and greatly appreciated.

Maryland's Fish Passage Program is **an overwhelming success**, lifting not just populations of our historic migratory fish – but the spirits of the biologists and anglers who care about them as well. ❖

For more information about Maryland's Fish Passage Program, to report a fish blockage or learn how to become a volunteer, email Jim Thompson at jthompson@dnr.state.md.us.

Jim Thompson graduated from Frostburg State University with a B.S. in fish and wildlife management in May of 1999. He started with DNR that summer working in Ocean City on a tuna tagging study. Since then he's worked various seasonal jobs studying crabs, eels and finfish in the Chesapeake Bay. Jim has been with the Fish Passage Program since 2001. When not working, he can usually be found fishing, hunting, crabbing or trapping. Jim provided the photographs for this article.