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Looking Ahead to Spring's Returning Bounty: Natal Homing

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Looking Ahead to Spring's Returning Bounty:

understanding natal homing plays a part in river herring restoration efforts

by Benjamin I. Gahagan

Every year, as March rolls around and the ground begins to thaw, residents of New England earnestly anticipate those tell-tale signs of spring that begin to emerge from the long winter. Warmer weather brings us blooming forsythia, budding trees and the first migrating birds. Prominent among these initial migrants is the osprey, a bird that conservationists have successfully brought back from vastly reduced numbers just decades ago. However, osprey do not appear along the Connecticut shoreline simply because the mercury has climbed higher in our thermometers; they are following a migration overlooked by most people but eagerly watched over by a variety of wildlife, birds, and even fishermen.

Each spring, as the water temperature slowly creeps past 50° Fahrenheit, our coastal streams and rivers begin to fill with the silver bodies of alewife, and later in the spring the closely related blueback herring. Collectively these two fish species are called river herring, largely because they are so similar in appearance and behavior that they can be very difficult to tell apart. River herring visit our coastline annually as part of their spawning migration. Alewife and blueback herring are hatched in freshwater but migrate in the first year of their life to the Atlantic Ocean. There they will spend the next three to five years of their lives before returning to freshwater to spawn and renew the cycle. This life history is termed anadromy and river herring are only two of many anadromous species that visit Connecticut. Atlantic salmon, American shad, and striped bass are all anadromous fish that spend part of their life in our waters.

Aside from heralding a new spring, river herring serve an important role in our coastal and riverine ecosystems. The hundreds of thousands of fish that return to spawn are an essential food source for a wide assortment of fish, birds, reptiles and mammals. From the striped bass to the osprey and the raccoon to the snapping turtle, any animal that can capture a herring makes the most of this seasonal influx of food. As the year progresses kingfishers, otters, mink, largemouth bass, yellow



Tim Wildman, CTDEP

The appearance of the silvery bodies of alewife, a migratory river herring, is a welcome harbinger of spring in New England.

perch and many other organisms rely upon young-of-the-year herring as forage during the summer and early fall. River herring, unlike some species of salmon, are iteroparous. This means that they can spawn several times over the course of their life, making multiple trips between fresh and saltwater. This being the case, there are still many fish that expire after spawning due to the extreme output of energy these migrations require. The bodies of these spawned-out herring provide an essential link of nutrients between ocean and inland ecosystems. This return of nutrients to coastal ecosystems increases the productivity of our coastal lakes, rivers and the surrounding land.

Unfortunately, over the past 15 years the number of river herring returning to spawn have declined dramatically across not only Connecticut but also over the entire eastern coast of North America. Rivers that once shimmered with the silver bodies of river herring now see only a relative handful return each spring. The State of Connecticut was one of the first to recognize this alarming decline and in 2002 the Department of Environmental

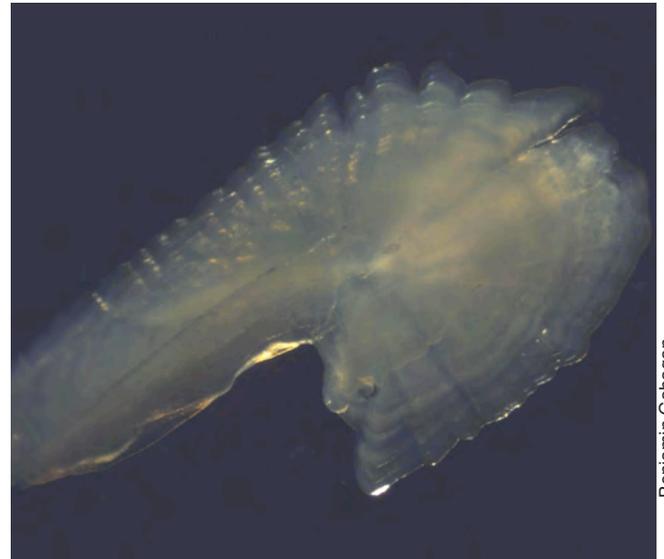
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Benjamin Gahagan

This is the cross section of an alewife otolith that has been ablated with a laser. The transect is the clearly visible groove running roughly horizontally across the section.



Benjamin Gahagan

This is a whole otolith from the same alewife, viewed vertically. Each fish has 2 sagittal otoliths.

Protection (DEP) announced the emergency closure of the river herring fishery. The Connecticut DEP has established management strategies with the goal of restoring river herring and other diadromous fish populations to their past levels. One of the primary tools employed in this effort has been to restore breeding habitat by removing dams that block fish migration or, when this option is not possible, installing passage so that fish may bypass the dam. Leading up to the removal of a dam or building a fish ladder the DEP 'seeds' the area by trapping incoming pre-spawn fish at locations with strong river herring runs and transporting them to these 'new' runs. While stream seeding has been successful in many cases little is known about the actual ability of river herring to return to the body of water that they originated in, a phenomenon known as "natal homing". Precise estimates of natal homing would help managers more directly quantify the amount of support they are providing through their trap and transport efforts.

To address some of the questions surrounding natal homing abilities in river herring researchers at the University of Connecticut, including Dr. Jason Vokoun and myself, both with the Department of Natural Resources and the Environment and Dr. Eric Schultz in the Department of Ecology and Evolutionary Biology, with funding from Connecticut Sea Grant, have undertaken a research program using an emerging technique, otolith microchemistry. All fish, in their inner ear canals, have

otoliths (ear stones). Otoliths are continually formed throughout the life of the fish, growing outward from an initial core. The otolith grows in proportion to the actual growth rate of the fish, and as a result, otoliths have growth rings much like those found in trees. As with tree rings, these growth rings can be used to determine the age of fish. Fisheries scientists and managers, knowing this, have long used otoliths to age fish and provide valuable data about population structure. Otoliths are primarily made of calcium carbonate but also include trace amounts of other elements. The calcium carbonate and other trace elements that compose the otolith are extracted from the water the fish was inhabiting at the time that growth layer was created. By combining knowledge about the chemical differences in bodies of water, and the unique temporal properties of the otolith, researchers are now able to analyze the microchemical 'history' of a captured fish. Properly analyzed, the trace element microchemistry of the otolith can reveal in which watershed a fish began life.

To estimate the natal homing abilities of river herring we began collecting returning adults from ten sites across the state of Connecticut in the spring of 2008. Using the information from the otoliths of a fish we can isolate the signature of the water the fish was hatched in and resided in before emigrating to saltwater as a juvenile. By comparing the microchemical signature of a fish's first year of life to the water body to which it

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Tim Wildman, CTDEP

The blueback herring, another migratory river herring, can be difficult for the novice to tell apart from the alewife. Together, these migratory spawners are an essential food source for a very wide assortment of fish, birds, reptiles, and mammals.

returned, we can determine if they match up or not, essentially discovering if a spawning fish returned to the place it began life, or strayed from another site.

By estimating natal homing in river herring we can help fishery managers make more informed decisions and we can also contribute to the body of knowledge about these imperiled fish. Homing rates can help us better estimate the number of returning adults we can expect when a new run is being seeded, leading to improved efficiency and allocation of fish from runs that remain strong. Additionally, if it is discovered that straying rates from nearby runs are high, we can also expect 'wandering' fish from these runs to augment returning fish, meaning fewer fish need to be trapped and trucked to new locations. The amount of homing and straying occurring also informs scientists about the connectivity of runs and can help determine if, in essence, each run of fish is an independent population or if many runs combine to form a population. When many runs or seemingly independent groups of organisms are actually connected through migration and interbreeding they form a metapopulation, which should be managed differently than if every run is an isolated population.

As is often the case, as we strive to solve the problems in the world around us we must uncover as many pieces of the puzzle as we can to piece the picture back

together. Scientific research is an essential tool in this process and is only made possible by organizations such as Sea Grant which support this vital work. There are many questions surrounding the collapse of river herring runs in the last 15 years, but as we continue to learn more about these fish, their life history, and the part they play in their ecosystems, we move closer to the answers that will lead to a day in early spring when children playing by a stream will stop and look at the wave of silver swimming by, and overhead an osprey will be watching too.

About the Author:

Benjamin Gahagan is a masters degree student in the University of Connecticut's Department of Natural Resources and the Environment. His thesis work, described here, is supported by Connecticut Sea Grant, the Sounds Conservancy/Quebec-Labrador Foundation, and the College of Agriculture and Natural Resources at the University of Connecticut.