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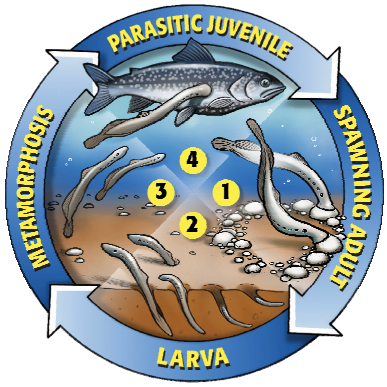
Great Lakes Science Center

Sea Lamprey: A Great Lakes Invader

The USGS Great Lakes Science Center is dedicated to providing scientific information for restoring, enhancing, managing, and protecting living resources and their habitats in the Great Lakes region. The USGS Great Lakes Science Center is headquartered in Ann Arbor, Michigan, and has biological stations and research vessels located across the Great Lakes Basin.

SEA LAMPREY LIFE CYCLE



Background

Sea lamprey (*Petromyzon marinus*) are primitive, jawless fish native to the Atlantic Ocean and were one of the first invasive species to enter the Great Lakes. Sea lamprey entered the Great Lakes through ship canals and locks built to bypass Niagara Falls. They first appeared in Lake Ontario around 1835 and, following improvements to the Welland Canal in 1919, spread into Lake Erie and eventually, the three upper Great Lakes. Today, they are present in all five of the Great Lakes and cause severe damage to lake trout and other valuable fish. Although sea lamprey resemble eels, sea lamprey do not have jaws and possess only cartilage. Adult sea lamprey have a well-developed sense of smell and a sucking disk for a mouth, which is filled with sharp teeth surrounding a file-like tongue.

Sea lamprey attach to fish with their sucking disk and consume body fluids, often killing the fish. In this way, the species has had an enormous negative impact on the Great Lakes fishery. Sea lamprey were a major cause of lake trout, whitefish, and chub population collapses in the Great Lakes during the 1940s and 1950s. Currently, scientists employ numerous methods to control sea lamprey populations in the Great Lakes.

Sea Lamprey Life Cycle

Adult sea lamprey build nests in gravel areas of tributary streams. Using the suction power of their oral disks, sea lamprey are able to move rocks around to create horseshoe shaped nests, in which eggs are laid, fertilized, and hatched (quadrant 1, life cycle figure). A single female typically carries 80,000 - 100,000 eggs, with an approximate 10% hatch rate. Upon hatching, larvae are typically swept downstream before settling out in low flow areas and burrowing into sediment to live for 3 - 10+ years as filter feeders (quadrant 2). Once larvae reach a size of around 150 mm, a major physical and physiological transformation occurs, in which lamprey larvae develop eyes, a suction mouth, fins, and an appetite for fish body fluids (quadrant 3). The transformed lamprey move into the Great Lakes in search of food and are then considered parasitic. Once in the Lakes, sea lamprey begin feeding on fluids of other fish and are able to increase in mass about 10x in a single year (quadrant 4). After 12 - 20 months of feeding, during which time a single sea lamprey can destroy up to 40lbs of fish, sea lamprey return to streams for spawning.

Sea Lamprey Control

The Great Lakes Fishery Commission (GLFC), an international organization

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U.S. Geological Survey

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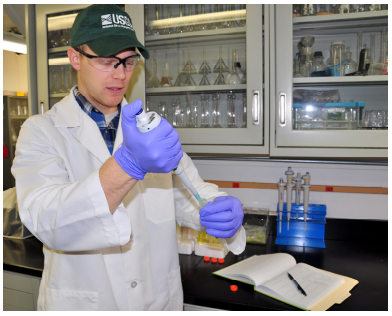

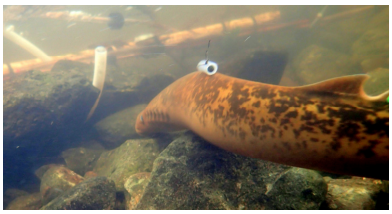

established by the United States and Canada through the 1954 Convention on Great Lakes Fisheries, implements the sea lamprey control program on the Great Lakes. Formation of the GLFC allowed formal sea lamprey control to begin. Initially, a team of researchers at Hammond Bay Biological Station (HBBS), located in Millersburg, Michigan, attempted to control lamprey by preventing the fish from spawning. To do so, mechanical and electrical barriers were built in streams known to have lamprey. However, various circumstances (including seasonal flooding) made these barriers mostly ineffective.

Secondly, these same HBBS researchers tested numerous chemicals and eventually discovered a selective pesticide that killed sea lamprey larvae and left non-target species generally unharmed (U.S. EPA approved). Stream treatments began in tributaries of Lake Superior in the late 1950s, and in tributaries of lakes Huron and Michigan in the 1960s. Of the 5,747 tributaries of the Great Lakes, 490 are known to produce sea lamprey and 181 are currently being treated on a regular cycle by the U.S. Fish and Wildlife Service and Fisheries and Oceans Canada, with hope of controlling this exotic species and protecting native lake trout and other valuable species.

During the time of highest sea lamprey abundance (1950s), up to 85% of large Great Lakes fish exhibited sea lamprey wounds. Sea lamprey primarily feed on native lake trout; within 20 years of the sea lamprey invasion, lake trout abundance had fallen to a record low. The sea lamprey control program has successfully reduced sea lamprey populations by 90%. Lake trout populations are restored in Lake Superior and natural reproduction is on the rise in Lake Huron.

Current Sea Lamprey Research

Hammond Bay Biological Station (HBBS) continues to be the hub for sea lamprey control research today. The GLFC and USGS partner together, through a Memorandum of Understanding with the USGS Great Lakes Science Center, to jointly manage and operate HBBS. Biologists at HBBS conduct research to increase pesticide application effectiveness, develop new control techniques, and improve understanding of how many sea lamprey are present in the Great Lakes and where they are located.

More specifically, researchers are currently examining the possibilities of altering sea lamprey behavior through the use of odorants, such as pheromones (attractants) and repellents. Adult lamprey are attracted to streams where larvae are present (*i.e.,* streams where survival of young is highly probable) by an odor emitted from larvae. Alternatively, the odor of dead sea lamprey is highly repulsive. Once in a stream, male sea lamprey release pheromones that attract females to their nest. Scientists are identifying these odorants so they can be used to increase trap catch, reduce sea lamprey reproduction, and make lampricide applications more effective.

USGS scientists are also utilizing acoustic telemetry, which uses sound waves emitted from a tag placed within the fish, to track sea lamprey movements and better estimate sea lamprey population abundance. Determining sea lamprey “hot spots” and movement patterns will allow for better control.

In addition, new and innovative trapping solutions are being explored to improve lamprey trapping techniques without hindering non-target fish passage in streams. Scientists are working to understand natural migratory pathways to intercept migrating sea lamprey and developing guidance systems that will direct sea lamprey into traps.

While sea lamprey control is on-going, current USGS research is working to improve the process and make sea lamprey control methods as efficient and successful as possible.

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