Adult sea lamprey. Photo by Cory Brant

APPENDIX 1: SEA LAMPREY (PETROMYZON MARINUS): A FOUNDATIONAL CASE STUDY IN THE GREAT LAKES

THE DISCOVERY

The sea lamprey invasion in the Great Lakes happened over a span of nearly a century. Sea lampreys are native to the Atlantic Ocean where they have evolved for hundreds of thousands of years. The first invasive population was reported in Lake Ontario and the Finger Lakes of New York as early as the 1880s—most likely entering during the construction of the Erie Canal. Food and environmental limitations kept populations down in Lake Ontario, while Niagara Falls provided an impassible barrier into Lake Erie (and the rest of the Great Lakes). The opening of the Welland Canal allowed sea lampreys to bypass Niagara Falls and enter the upper Great Lakes. Unhindered by jurisdictional borders, the invaders spread into Lake Erie (1921), Lake Michigan (1936), Lake Huron (1937), and eventually Lake Superior (1938) (Eshenroder 2014).

THE DAMAGE

Sea lampreys are an elongated parasitic fish with a toothy suction cup-like mouth that feed by attaching themselves to other fishes, rasping away scales and tissue, secreting an anticoagulant through specialized mouth cells, and consuming mainly blood from their host. Marine dwelling sea lampreys in their native Atlantic Ocean range do not cause major damage—they evolved in that ecosystem. Once in the Great Lakes, native fishes had not evolved to survive a parasite the size of a sea lamprey and often die during an attack. It is estimated that a single sea lamprey kills up to 40 lbs. of fish in roughly 1.5 years as a parasite in the Great Lakes.

THE POLICY RESPONSE

The decline of commercially important fishes throughout the Great Lakes (mainly lake trout and lake whitefish) was obvious by the 1930s when the annual harvest began to drop below 100 million pounds—a cumulative result of over fishing, habitat loss, pollution, and sea lamprey damage (Smith and Tibbles 1980). Around this time, most fishes caught in commercial nets were wounded, dead, and nonsalable from sea lamprey attacks. The destructive power of sea lampreys compelled Canada and the United States to develop what would become the most successful collaborative relationship for combating an aquatic invasive vertebrate species known to date. The sea lamprey invasion jolted jurisdictions around the lakes to finally realize that sea lampreys were a basin-wide problem and one too big for any one jurisdiction to manage. As the Great Lakes fishery continued to collapse, it also became clear that federal resources would be needed to overcome the sea lamprey problem. The response to the sea lamprey invasion was the 1954 Convention on Great Lakes Fisheries, a treaty between Canada and the United States, which in turn created the Great Lakes Fishery Commission (GLFC, ratified 1955). The GLFC's mission over the past 60+ years has been to control sea lampreys, advance Great Lakes fisheries science, and help agencies work together protecting fisheries of common concern.

ACTION TAKEN

Scientific exploration into ways to control, and possibly eradicate, sea lampreys in the Great Lakes began in the 1940s. First attempts to control sea lampreys included experiments with mechanical weirs and traps to remove adult sea lampreys during their spring spawning migrations in tributaries—early work supported mainly by the State of Michigan. Soon more bordering states and the Province of Ontario began experimenting with traps and mechanical weirs, quickly realizing that blocking one spawning migration of sea lampreys would send more to neighboring tributaries to spawn around the basin. A federal allocation allowed continued experimentation with electrified weirs into the 1950s, establishment of a sea lamprey control research center in northern Michigan (what is now the USGS Hammond Bay Biological Station in Millersburg, MI), and continued research into additional control methods. Electrical weirs, although effective at killing and removing spawning-run sea lampreys, would require a high degree of maintenance, were dangerous for people and wildlife, and would often fail during spring flooding, allowing thousands of sea lampreys to move past and reproduce in the rivers. It was clear that barriers would not be enough to control sea lampreys. After formation of the GLFC, a highly coordinated effort to discover a way to kill the stream-dwelling larvae (multiple generations) began.

Trout River nesting adult male sea lamprey. Photo by Cory Brant

Focus was placed on finding a chemical that would kill larval sea lampreys yet leave other non-target species unharmed. After screening over 7,000 compounds in what amounted to tens of thousands of tests, a chemical was discovered in the mid-1950s—the selective toxicant known as the lampricide 3-trifluoromethyl-4-nitrophenol (TFM). For over 60 years the GLFC has implemented barriers, traps, sterilization techniques, and multiple lampricides to continue to suppress the sea lamprey population below destructive levels.

CURRENT STATUS

Sea lamprey control is administered through a binational program coordinated by the GLFC and carried out by agents with Fisheries and Oceans Canada (DFO) and the U.S. Fish and Wildlife Service (USFWS). Based on extensive stream surveying by sea lamprey control crews, several hundred streams around the Great Lakes are treated with lampricides annually, while barriers continue to block new stream sections from becoming suitable spawning habitat for sea lampreys. Sea lamprey populations throughout the Great Lakes are reduced 90% from historic numbers, allowing sport and commercial fisheries to thrive, fish restoration efforts to continue to succeed, and providing overall ecological stability that in turn has created a healthy economy around the lakes totaling 1.5 million jobs and $60 billion in wages annually.

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Sea lamprey. Photo by Cory Brant