

Genetic Characteristics of Great Lakes and Atlantic Coast Sea Lamprey

Sea Grant researchers have opened up the discussion about the parasitic sea lamprey which negatively impacts the economically important Great Lakes salmonid fishery. Their genetic evidence shows that sea lamprey populations appeared in the region soon after glaciation and their lack of homing fidelity precludes use of some management and control practices.

The parasitic sea lamprey: native or invasive?

The sea lamprey, *Petromyzon marinus*, is an anadromous parasitic fish native to North Atlantic coasts. Its range in North America extends from Newfoundland to Florida. The sea lamprey has expanded its range into the Great Lakes from the Atlantic through the St. Lawrence River, Hudson River, Erie Canal and Welland Canal. Its impact on the Great Lakes economically valuable salmonid fishery has been great, contributing to large declines of all salmonid species throughout the Great Lakes. Because of its damaging impacts, management practices have been used to control sea lamprey numbers and thus reduce harm to the fishery, but they are costly.

Effective control may be helped with detailed information of the biology and ecology of sea lamprey including knowledge of sea lamprey population genetics. An important question to answer was: Does the sea lamprey have any homing ability, and if so, could that be exploited as a control method? Another question dealt with the exact invasion history of sea lamprey into the Great Lakes. Some believed that the sea lamprey is native to the St. Lawrence and Lake Ontario. The question of the native status in Lake Ontario is controversial and

needed definitive evidence to say one way or the other. Some speculate that if the sea lamprey is native, that perhaps weakens the case for lamprey control.



The sea lamprey is parasitic and its powerful mouth parts keep it firmly attached its host, in this case a lake trout.
Photo courtesy of the Great Lakes Sea Grant Network

A look at lamprey genetics reveals a native species with no homing fidelity

In 2000 to 2001 scientists Isaac Wirgin (New York University) and John Waldman (formerly of Hudson River Foundation) conducted a study into the genetic characteristics of Great Lakes and Atlantic Coast sea lamprey populations. Through examining mitochondrial DNA (mtDNA), the project goals were to estimate the genetic distance between Great Lakes and Atlantic coast populations; test whether sea lamprey show homing fidelity; and compare the genotypic frequencies among regions to help determine whether the sea lamprey is native to Lake Ontario.

The project results showed that there are fixed genetic differences between North American and European populations of sea lamprey. Genetic work from the project supports the hypothesis that sea lamprey do not exhibit strong homing fidelity. The genetic data studied provides evidence that sea lamprey are not recent migrants from the Atlantic as previously thought and are likely native to Lake Ontario. Sea lamprey could have colonized Lake Ontario after the retreat of the glaciers possibly through the St. Lawrence River.

These results have implications for both research and management. There has been an ongoing debate among people about the native status of sea lamprey. This study was the first to show genetic evidence for considering sea lamprey as native to Lake Ontario. Since this project, another lab at Michigan State University also provided evidence that sea lamprey are native to Lake Ontario. Thus there is now greater genetic evidence to consider sea lamprey native to Lake Ontario.

This scientific evidence has resulted in a change in thinking among many that previously thought sea lamprey do not belong in the Great Lakes at all to a recognition that sea lamprey are part of the native fauna that are now out of balance with the ecosystem.

There is recognition that a desirable goal is to keep sea lampreys at a low population level. The finding that sea lampreys do not have strong homing fidelity is unique among anadromous species, most of which return to their natal streams. Because of their parasitic nature, they would disperse randomly depending upon what fish host

they were on. This information is useful for management since it rules out any control plans that would seek to take advantage of any homing ability thus saving valuable resources for other methods.

Because of the findings from this study and the Michigan State work, the Great Lakes Fishery Commission is considering the possibility of setting up an independent panel to review the research and make recommendations for new management and control practices.

Publications

Branca, B.A., and D. MacNeill. 2004. Sea Lamprey: Lake Ontario's native son? *Coastlines* 33(3):10-11.

Rodríguez Muñoz, R., J.R. Waldman, C. Grunwald, N.K. Roy, and I. Wirgin. 2004. Absence of shared mitochondrial DNA haplotypes between sea lamprey from North American and Spanish rivers. *Journal of Fish Biology* 64(3):783-787.

Waldman, J.R., C. Grunwald, N.K. Roy, and I.I. Wirgin. 2004. Mitochondrial DNA analysis indicates sea lampreys are indigenous to Lake Ontario. *Transactions of the American Fisheries Society* 133(4):950-960.

Waldman, J.R., C. Grunwald, and I.I. Wirgin. 2006. Origin of sea lamprey *Petromyzon marinus* in Lake Champlain based on mitochondrial DNA sequence analysis. *Transactions of the American Fisheries Society*. 135:1076-1085.