

ABSTRACT NOT FOR CITATION WITHOUT AUTHOR PERMISSION.

The title, authors, and abstract for this completion report are provided below. For a copy of the full completion report, please contact the author via e-mail at egoerig@fas.harvard.edu.

Questions? Contact the GLFC via email at research@glfc.org or via telephone at 734-662-3209 ext. 119.

Comparative swimming performance of anadromous and landlocked sea lamprey

Project ID – 2023-CAS-541014

Elsa Goerig¹, Benjamin Marcy-Quay², Aaron Heisey³, Annaliese Seibel³, Nicholas Johnson², Theodore Castro-Santos³

¹Harvard University – Museum of Comparative Zoology

² U.S. Geological Survey, Great Lakes Science Center, Hammond Bay Biological Station

³ U.S. Geological Survey, Eastern Ecological Science Center, S.O. Anadromous Fish Conte Research Laboratory

January 2026

ABSTRACT:

Sea lamprey (*Petromyzon marinus*) is native to rivers on the Atlantic coasts of North America and Europe but are invasive throughout the Great Lakes region. Extensive efforts are ongoing to develop selective passage techniques that will allow native sea lamprey to pass barriers in their native range but that will exclude sea lamprey in their invasive range. Because of the destructive potential of sea lamprey in the Great Lakes, the nature and scope of studies that can be performed within experimentally released invasive sea lamprey is limited. One solution is to conduct experiments with sea lamprey within the native range. Recent work on anadromous sea lamprey in their native range has confirmed that swimming ability could be an attribute by which to sort sea lamprey from other fishes. However, sea lamprey in the native range are larger than the invasive ones, and swimming performance is known to be allometric, which raises concerns about whether and to what extent information gleaned from native sea lamprey can be transferred to the Great Lakes system. Thus, there remains a need to assess the extent to which the native and invasive populations are similar, as well as to quantify any allometric differences in swimming performance. We addressed this need by studying the swimming performance of both native and GL populations using identical apparatus, with the aim of determining the extent of the difference in swimming performance of native and Great Lakes sea lamprey, and to assess whether these differences can be described by a single allometric relationship.

Wild anadromous and landlocked sea lamprey were collected in traps during their spring spawning migration in the Connecticut and Cheboygan watersheds, respectively. Fish were tagged with PIT-tags and subjected to swimming performance trials in a custom-made Blazka swim chamber designed to prevent attachment by lampreys. Fish were then measured, photographed, sampled for fat content using non-lethal methods, and euthanized. Following this, we removed the gonads and homogenized the specimens to perform measurements of energy proximate composition. Swimming performance data from both populations were analyzed using the critical swimming speed (Ucrit) methodology, and a time-to-event analytical framework to quantify the relationship between swim speed and time to fatigue (endurance), and how environmental and biological covariates may affect this relationship.

The two populations of sea lamprey differed in critical swimming speed and endurance. However, the direction and magnitude of effect differed between the two experimental methods: anadromous sea lamprey had a significantly higher Ucrit than landlocked sea lamprey but slightly lower endurance under faster flows. However, our findings suggest that once differences in body length are accounted for, there is relatively little difference in the prolonged and sprinting swimming ability between the two populations. The explanation for these conflicting findings is unknown but may be related to differing behavioral responses to the two methodologies. Further analyses are ongoing,

including behavioral and kinematic analysis of trial recordings, and these may help to interpret the data. Besides, we found no evidence of any effect of environmental covariates, including water temperature and diel period (i.e., day or night) on swimming performance using either test methodology.

The results from this project improve knowledge on sea lamprey swimming ability over their geographic distribution range, which has implications for both conservation and control management programs. They also inform whether and to what extent results obtained with anadromous lamprey are transferable to Great Lakes river systems.