Great Lakes Sea Lamprey: The 70 Year War on a Biological Invader
By Cory Brant
https://www.press.umich.edu/10209106/great_lakes_sea_lamprey
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PREFACE

The fight against aquatic invasive species (AIS) is in the public eye more than ever. In recent years, national news outlets have run stories on "Asian carp," a term most commonly used in North America to refer to four separate species of fishes that were brought to the continent decades ago from China. Hundreds of millions of dollars have been invested to impede Asian carp, which are already entrenched throughout the Mississippi River and its tributaries. The objective is to stop these AIS from advancing into the Great Lakes via the Chicago River, with control efforts ranging from electric fences to "carpicides," high-frequency sounds, and carbon dioxide bubbles as deterrents. Of course, Asian carp are not the first invasive fishes to threaten the Great Lakes. For that matter, they're not even the first carp from Asia to invade the region—the common carp, native to lakes and rivers across Asia and Eastern Europe, was imported to North America in the nineteenth century and today remains widespread across the continental United States and Canada.[1] These invaders have even been found in Central and South America.[2] The common carp is particularly abundant throughout the Great Lakes Basin, and, though no sustainable control strategies currently exist for the species, scientists continue to study the fish's destructive impact on the ecosystem and to investigate new approaches to its management.[3]

This ongoing work by scientists, even in the face of what might appear to be a losing battle, is not unique to the case of the common carp. Even after public and media attention on a particular AIS fades, or shifts to the next new alien species threatening the Great Lakes, the work by scientists to manage earlier invaders usually carries on. A vivid example is the subject of this book, the fight against sea lampreys in the Great Lakes. By the late 1940s sea lampreys began to reach their peak destructive potential in the Great Lakes, which in turn sparked one

of the earliest coordinated efforts to control an AIS in North America's history. While sea lampreys persist in the Great Lakes, and complete extirpation may never occur, scientists continue to improve techniques for monitoring and control.

My path studying sea lampreys began over a decade ago during my graduate work at Michigan State University. I focused on how and why sea lampreys use pheromones, and whether we can use these natural odors against them. I conducted my tests in the Ocqueoc River (a tributary of Lake Huron in Northern Michigan and a significant river in this story), and quickly realized I was studying sea lampreys in the same river where sea lamprey control began more than 70 years ago.

So many mysteries surround sea lampreys in the Great Lakes—I wanted to know the full story. How did sea lampreys get into the Great Lakes in the first place? How bad was the invasion? What lessons can be learned from the individuals that dealt with, or continue to deal with, invasive sea lampreys? Why are new Great Lakes researchers like me still searching for ways to control them?

In fall of 2015 I defended my dissertation and began a postdoctoral fellowship at the University of Michigan Water Center with a charge to answer these questions.

The sea lamprey story is captivating for many reasons, not least of all the nightmarish look of both the fish themselves and the damage they inflict on their prey. Perhaps what makes the sea lamprey story most intriguing, however, is that it's not just about the fight against a single AIS—it's the story of how modern fisheries management emerged in the Great Lakes. The sea lamprey invasion triggered an environmental awakening across the Great Lakes Basin, which includes all five Great Lakes (Superior, Michigan, Huron, Erie, and Ontario), their tributaries, and the land they drain into. In all, this is an area roughly the size of the United Kingdom, Spain, and Scotland combined. The Great Lakes are bordered by eight US states, the provinces of Ontario and Quebec, and multiple tribes and First Nations whose ancestors inhabited these shores long before Europeans arrived. The lamprey invasion dissolved political boundaries, sparked unprecedented cooperation, and led to an international treaty. A pioneering scientific spirit led to discoveries that are the backbone of a program that brought this creature under control and now protects the largest freshwater ecosystem in the world.

Too often we don't heed the lessons of those who witnessed mistakes

in our past. While writing this book, I traveled the Great Lakes Basin to talk with individuals that still remember the worst of the sea lamprey invasion, those that were charged with developing the solution, and those that work in this program today. The hope is that, knowing their stories, we can better understand the future of sea lamprey control; how other, perhaps more insidious, invasive species have gone beneath our notice, and how we can better equip ourselves to stop those yet to come.

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INTRODUCTION

A Biological Invader

In the spring of 1949, Cliff Kortman wasn't sure what he was getting himself into as he headed down a sandy two-track toward a recently repurposed Civilian Conservation Corps (CCC) camp in northern Michigan. The camp was one of thousands peppered across the country—remnants of President Franklin D. Roosevelt's New Deal programs designed to provide the unemployed with work focusing on conservation and public infrastructure projects. This CCC camp rests near the shores of Lake Ocqueoc (pronounced "ah-kee-ock") in Millersburg, Michigan. The Ocqueoc River cuts through Ocqueoc Lake, state forest, and farmland and continues to meander several miles to where it spills into Lake Huron's Hammond Bay.

It wasn't a long trip to the camp for Cliff. He lived just on the other side of Ocqueoc Lake and grew up fishing and hunting with his family in the area. "We had a boat," the 87-year-old said in 2015 while sitting in his home in Rogers City, Michigan. "Oh, every night we would go down fishing."

Cliff knew something was wrong in Lake Huron. "We hardly had any fish at all in '49," he mentioned. The massive expanse of freshwater was in an ecological tailspin. Lake Michigan, Huron's hydrological twin, wasn't doing any better. Populations of slow-growing, native lake trout (*Salvelinus namaycush*) were crashing. Fishes of these freshwater seas had served as a supply of protein that fueled economic progress across North America for centuries. When the economy began to pick up following World War II, it placed increased commercial fishing pressure on the lakes. Yet within the Michigan waters of Lake Michigan annual lake trout catches went from 6.5 million pounds in 1944 to less than 400,000 by 1949.[1] By 1951 the total lake trout catch for all of Lake Michigan (Indiana, Wisconsin, Illinois, and Michigan combined) teetered at a mere

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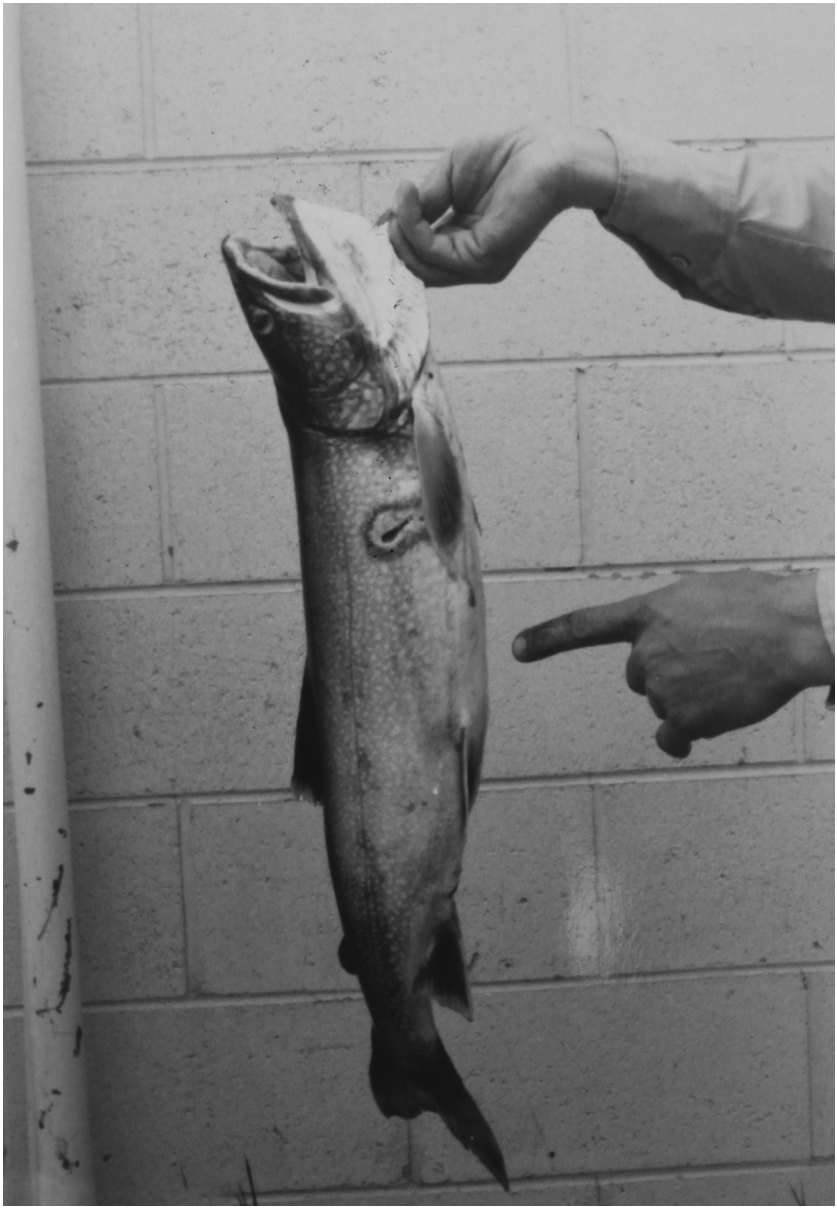


A lake trout caught in Lake Michigan showing strange wounds near Ludington, Michigan. (Photo courtesy of the Great Lakes Fishery Commission.)

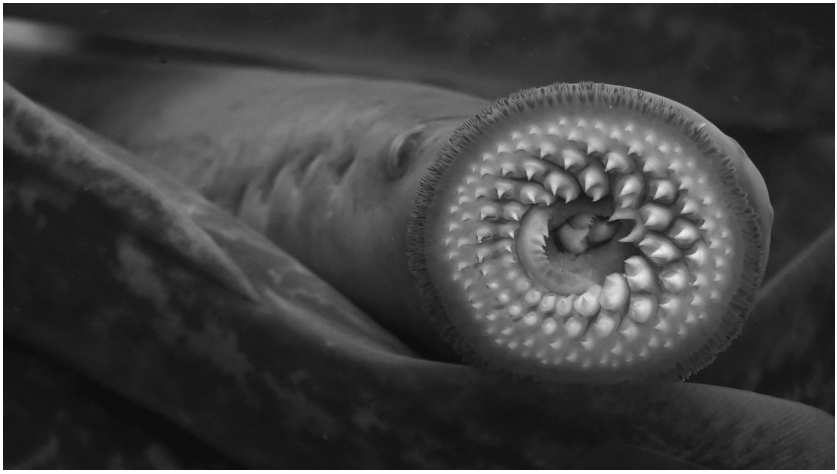
11,000 pounds.[2] The complete eradication of lake trout was becoming a reality in Lake Michigan, and Lake Huron wasn't far behind. That fall of 1949 the Michigan Fish Commission (formed in 1873, the predecessor to today's Michigan Department of Natural Resources Fisheries Division) set more than 15,000 feet of net—nearly the length of 42 football fields—over a historically booming lake trout reef. The reef was off Waukegan, Illinois, in over 215 feet of water. They let their nets out for four days straight and caught only six peckish lake trout, five of which had strange rasping sores on their sides.[3]

Cliff's father once owned most of the land around the river on the other side of Ocqueoc Lake but was forced to sell about 18 acres of it during the Great Depression. Cliff farmed what was left during high school with his family but needed another source of income. When he pulled into the CCC camp, he met an ambitious University of Michigan graduate student named Vernon C. Applegate. Originally from New York City, Applegate had a Queens accent and an intense work ethic. He was based at the CCC camp, investigating a bizarre and destructive new creature that plagued the fishes in lakes Huron and Michigan. With just one more field season left to complete his PhD, he was quick to offer Cliff a job.

The work was unlike anything Cliff had ever known—a unique situation that would allow him to roll up his sleeves and work outdoors in a river he loved. He immediately took to the work alongside Applegate as a right-hand maintenance man and biological technician. Cliff didn't know it at the time, but he would spend the next 38 years of his life as one of the pioneer scientists that would turn the tide on the most destructive predator ever to enter the Laurentian Great Lakes. Cliff and Applegate were just a few of the hundreds who spent their careers combating this problem, a battle that continues today.

Nature of the Beast

So what *was* this biological invader that Cliff came face-to-face with in 1949? Anyone but Cliff might have turned and walked back out the door after Applegate revealed a specimen of the creature responsible for plaguing the fishery. It was a sea lamprey (*Petromyzon marinus*). In the Great Lakes, this animal garners about as much respect as a deer tick or a mosquito, yet it is far more sensational to lay eyes on.

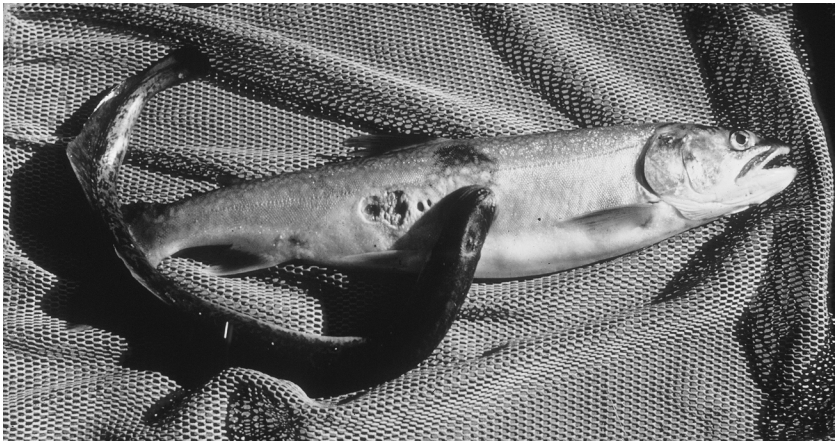


The sea lamprey up close. (Photo by the author.)

The sea lamprey is an outsider in the animal kingdom—it defies most of the basic traits seen across vertebrates. The organism is capable of traveling hundreds of miles upriver against swift currents with a snake-like swimming style. Its body is strong yet flexible, with cartilage rather than bones. Adult sea lampreys are sometimes mistakenly called "lamprey eels" or simply "eels" because of their body shape. These are not eels. Eels have jaws, bones, and paired fins (of the order Anguilliformes) while sea lampreys have no jaw, a cartilaginous skeleton, and no paired fins (order Petromyzontiformes).

The stealthy sea lamprey draws oxygen out of the water through a row of seven open gill pores on each side of its head. The barrel-shaped gills constantly contract and expand to push water like little hearts (unlike the C-shaped gills of a "typical" fish). The resemblance of the dark gill openings to the animal's eyes and nostrils even led early naturalists to mistakenly give sea lampreys the name *nine-eyes*, as on first glance the gills, eye, and nostril together give sea lamprey the appearance of having a row of nine eyes on each side of its head.[4]

This creature is one of the largest parasites on earth. It evolved an efficient way to feed long before animals could bite or chew. A jawless, suction-cup-like mouth containing rows of sharp teeth that look as though they've been stained with coffee adorns the sea lamprey's head.



Lake trout caught with a sea lamprey still attached, c. 1950s. (Photo courtesy of the John Van Oosten Library, US Geological Survey.)

Calling these "teeth' is incorrect; they're more like small horns made of keratin—a structural protein that also makes up our hair and fingernails. The animal vacuums itself to the side of an unsuspecting fish while the horn-teeth assist with grip. Thermal-sensitive cells inside the suction-cup mouth allow the parasite to distinguish between warm- and cold-blooded hosts. They're only interested in cold-blooded prey. Once firmly attached to a fish, a sharp beaklike tongue projects from the center of the sea lamprey's throat to wear away scales and break through capillaries. Specialized cells secrete an anticoagulant to keep blood flowing while hundreds of tiny fingerlike filaments around the mouth help maintain a tight seal on the victim. The unlucky host's health degrades as the parasite clings and feeds like a lazy hitchhiker. Sea lampreys will detach from a host if it dies and hunt down another. In just a little over a year, the sea lamprey consumes enough blood to grow from the length of a pinky finger to the length of a forearm. It's estimated that only one in seven fish attacked by a sea lamprey survives the experience.

A Fitting Host

Sea lampreys are choosy about their next meal when there are plenty of fish species to choose from. They prefer hosts that are large enough to