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Reflections on Fisheries Conservation

Eddies

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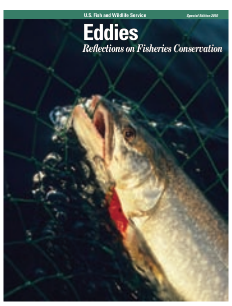

On the Cover:
Lake trout have been restored in Lake Superior, but more work is necessary elsewhere. See page 12. Doug Stamm photo

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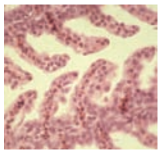
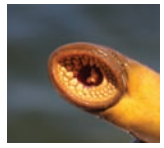




Karla Bartelt/USFWS

The M/V Spencer F. Baird *motors out into the Great Lakes. See and read more about the work of the ship on page 16.*

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

CONSERVING AMERICA'S Fisheries
U.S. Fish & Wildlife Service

Headwaters

Partnerships are a Game Changer in the Great Lakes

By Bryan Arroyo

USFWS

How we live our days is how we live our lives. In the amalgam, the fisheries conservation issues that we face today come from yesterday. The waters of the Great Lakes have been used and abused, but are resilient. Who can forget the story of a Lake Erie tributary so polluted that it caught fire? Actions of the past make the present. At present, the U.S. Fish and Wildlife Service's Fisheries Program in the Great Lakes works hard to make tomorrow all the better. The game-changer are the expansive partnerships that we are a part of and that represent a model of landscape conservation for the 21st Century.

The Great Lakes are a national treasure. Their immensity, all five together or in the singular, one cannot fully comprehend. These inland seas are the largest repository of freshwater in the entire world. Two countries—one Canadian province and eight states—and numerous Native American interests share a commonality in the commodity. These waters are an ecological and economic commodity. People derive their livelihoods from, nearby, or on them. So it stands to reason that there is a great deal of interest in the Great Lakes' fisheries.

And those fisheries are diverse. Ciscoes and whitefish and lake trout swim the deepest and darkest waters. Smallmouth bass and johnny darter swim the rocky shallows. Walleye and steelhead run up large tributary streams where they might intersect with a wading gauntlet of anglers. High up in clear tributaries, brook trout, darters, and dace cast their shadows on gravelly runs.

The U.S. Fish and Wildlife Service owns a leadership role in fisheries conservation in the Great Lakes, but by no means does my agency go at it alone. The first partnership started by a dire need during the Eisenhower Administration. The 1955 international Convention on Great Lakes Fisheries created the Great Lakes Fishery Commission, and under the auspices of that body, together both countries embarked on controlling the parasitic sea lamprey that devastated lake trout and lake whitefish fisheries. Read "An Unnatural History" in these pages, and I think you will be impressed by how well sea lamprey control has succeeded, guided by science and driven by sweat equity.

Sea lamprey isn't the only invasive species that we have to deal with. Round goby have taken hold and compete with darters and gobble up native fish eggs. And there's Asian carp. Biologist Sam Finney writes about the matter in this issue, and what we're doing for what's at stake.

To manage any fishery, managers must know what is out there. Some of the best fish population modeling going on is taking place in the Great Lakes. There is a tremendous amount of science being done in the Fisheries Program, and you see it coming to the fore, reflected in the sheer number of scientific publications originating from the Great Lakes. Be sure to read the Watermark on the matter; our scientists are publishing their research ranging from veterinarian medicine to genetics. It's impressive.

Also in this issue of *Eddies*, you'll read about the massive effort to restore lake trout to the Great Lakes that includes our ship the *M/V Spencer F. Baird*; there's a story on the ladders that let American eel slither up near-vertical walls; and another on a long-lived leviathan, the lake sturgeon.

The Great Lakes faces huge challenges down the road. Climate change could exacerbate conservation challenges and multiply the threats and stresses that fisheries face. Mike Weimer muses on the matter in his Meanders, "The Lake Effect." But don't despair. We have the long-term view. We have the tools, the competent people, and a history of successful partnerships in place to allow Landscape Conservation Cooperatives to face the challenges head on. How we live our days is our lives, and I have every confidence in the future.

Bryan Arroyo is the Assistant Director for Fisheries and Habitat Conservation in Washington, DC.

It's a dirty job

Karla Bartelt/USFWS

Dirty Jobs' *Mike Rowe, all cleaned up, poses with sea lamprey management staff after a long day of dirty work.*

Controlling invasive sea lampreys can be dirty business. So naturally Mike Rowe and his Dirty Jobs team from the Discovery Channel wanted to help battle back against this Great Lakes invader. Rowe and crew filmed a show in May near Millersburg, Michigan, which is a beehive of sea lamprey management activity each spring. Rowe helped U.S. Fish and Wildlife Service crews empty sea lamprey traps, fin-clip lampreys, electrofish for larval lampreys, and dissect recaptured lampreys to retrieve micro-coded wire tags. He donned a Tyvek suit and respirator to sterilize lampreys. The filming concluded in the evening when Rowe released sterile lampreys in a river. Four cameras caught it all, always running—and no second takes. And Rowe showed real courage by allowing a lamprey to attach to his skin with its raspy mouth—an initiation rite for our lamprey crew workers. The program aired in November. ✦ Michael Twohey

Great Lakes, great fisheries, great partnerships

The relationship between the U.S. Fish and Wildlife Service's Fisheries Program and the bi-national Great Lakes Fishery Commission stands as a model for successful fisheries management across multiple jurisdictions. The Fisheries Program has supported Great Lakes communities and agencies since 1871, while the Commission came on the scene with the 1955 Convention on Great Lakes Fisheries between the United States and Canada.

Two of the Commission's responsibilities—supporting Great Lakes fisheries research and controlling invasive sea lamprey populations—perfectly complement the Fisheries Program's endeavors in native fish and aquatic habitat conservation.

The Commission coordinates a number of interagency committees and technical workgroups addressing research, sea lamprey control, and fisheries management. The Commission's role in bringing federal, state, and tribal management agencies, researchers, and the public together through these bi-national committees is vital, making fisheries conservation easier in many ways. The Joint Strategic Plan for Management of Great Lakes Fisheries guides conservation work.

Partnerships wrought by the Commission work have effectively reduced sea lamprey numbers more than 90 percent since the 1940s.

Multi-agency, Great Lakes-wide databases on fish stocking, sea lamprey abundance, and fish barriers in tributaries exist now for all to use. The latest joint initiative, the Great Lakes mass-marking program, will answer questions about fish stocks that have been on the minds of managers for decades.

These are just a few of our joint accomplishments through partnerships stewarded by the Great Lakes Fishery Commission. You can learn more at www.glfc.org. ✦ Bob Adair

Youth Conservation Corps students "great" for our lakes

The U.S. Fish and Wildlife Service's Fisheries Program is "Employing,

Tim Smigielski/USFWS

Youth Conservation Corps participants gain real-world work experience.

Educating and Engaging" youth. Eleven students worked over the summer at four different National Fish Hatcheries in the Midwest Region. They were hired through the Youth Conservation Corps (YCC) program, and provided on-the-job training. These young people participated in a variety of projects and daily work that improved Great Lakes fisheries. The YCC workers performed fish culture duties, tagged fish for research, and helped with instructive services, such as Jordan River National Fish Hatchery's Baby Brookies, a brook trout conservation education program. The students gained valuable insight into the world of fisheries conservation. ✦ Tim Smigielski

Fisheries on Facebook

The U.S. Fish and Wildlife Service's Fisheries Program is now on Facebook at www.facebook.com/USFWS.Fisheries and we think you will "like" it. Follow us on Twitter, twitter.com/USFWSFisheries to keep up with what's happening with fishing and the Fisheries Program. ✦ Denise Wagner

FEATURED FACILITY

Pendills Creek – Sullivan Creek National Fish Hatchery Complex

Where: Brimley, Michigan
When: Pendills Creek, 1951; Sullivan Creek, 1933

Then: Both facilities were established to raise lake trout for the Great Lakes. The Civilian Conservation Corps built the Sullivan Creek facility in 1933. Formerly called Hiawatha National Fish Hatchery, the U.S. Forest Service raised trout there until 1943 when work was discontinued due to World War Two.

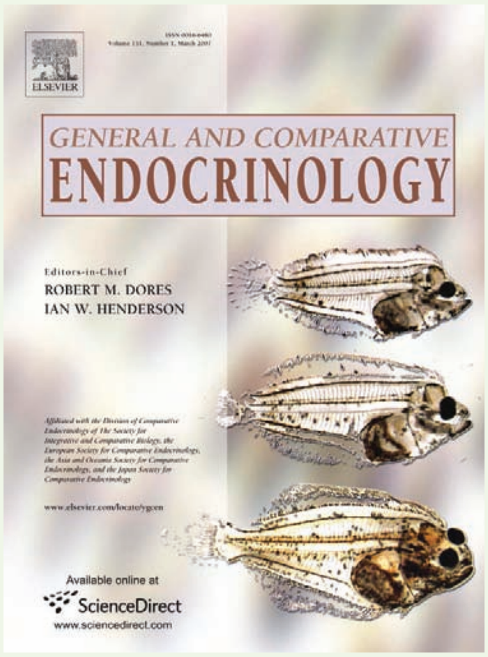
Now: The Pendills Creek – Sullivan Creek National Fish Hatchery Complex continues to raise lake trout. With restoration goals realized in Lake Superior, work now centers on Lakes Huron and Michigan. Pendills Creek produces 1.1 million lake trout a year from the egg stage. Sullivan Creek serves as a lake trout broodfish facility, providing two strains of genetically pure, disease-free eggs to partners throughout the Great Lakes basin. The Complex is raising a third strain of lake trout from Lake Huron's Parry Sound. These fish will produce offspring starting in 2011.

USFWS

Over one million lake trout leave Pendills Creek National Fish Hatchery each year for Lakes Huron and Michigan.

The Complex and its partners evaluate the survival of stocked fish to determine the best strategies for using hatchery fish to restore naturally spawning lake trout populations. Friends of Pendills Creek National Fish Hatchery conducts numerous public events at the Complex. New raceways, water filtration systems, and a new building are under construction, and will improve lake trout conservation. ✦ Kurt Schilling

Great Lakes science on display



Science Direct

This scientific journal is one of 18 titles where U.S. Fish and Wildlife Service fisheries biologists published their Great Lakes-related research over a two-year span.

Science is never done. With answers that come from research, inquiring minds ask more questions. And so it is that scientists describe the order of nature.

There is no poverty of experience or scientific credentials in the Fisheries Program of the U.S. Fish and Wildlife Service. Those credentials are very much on display in the scientific literature with peer-reviewed articles having originated in the Great Lakes basin. In only the last two years, fisheries biologists from Minnesota to New York have published their research findings—after having passed the rigor of review by other credentialed scientists—in 18 different books or science journals. In all, they published nearly 40 scientific papers spanning fish biology and management, in a surprising but illustrative set of titles. Some highlights include:

Biologist Mike Twohey at the Marquette Biological Station in Michigan is steeped in sea lamprey control. He co-authored a paper on the lamprey's reaction to natural odors in the water, published in *Animal Behavior*.

Dr. Bradley Young, stationed at the Lake Champlain Fish and Wildlife Conservation Office in New York researched lamprey, too, and reported on his findings about the invasive fish's reactions to hormones in *General and Comparative Endocrinology*.

Dr. Mike Millard, Dr. Meredith Bartron, and Shannon Julian, all stationed at the Lamar Fisheries Center in Pennsylvania, reported their research findings on brown bullhead movement in Lake Erie in the *Journal of Great Lakes Research*.

Henry Quinlan at the Ashland Fish and Wildlife Conservation Office in Wisconsin co-authored a paper on research that revealed how coaster brook trout use habitats and associate with other fish species in one of the oldest science journals in the U.S., *Transactions of the American Fisheries Society*.

Also in *Transactions*, Dr. Charles Bronte at the Green Bay Fish and Wildlife Conservation Office in Wisconsin, published his research related to statistical analysis, work that will allow other fisheries biologists to refine fish management. This was but one of nine papers that Bronte published in the two-year span.

Another prodigious writer, Rob Elliot, also from the Green Bay facility, co-authored a paper on the sport harvest of lake sturgeon in the *North American Journal of Fisheries Management*.

This is only a sample of the fisheries science coming from the Great Lakes. Fish biologists have also published on veterinarian medicine, genetics, and contaminants displaying varied expertise. All that science means little, unless it is shared among other scientists through publication, as we do. ✦ Stuart Leon, Ph.D.

Partnership set to improve fish habitats

The Great Lakes, the world's largest reservoir of freshwater, holds over 300 species of fish and mussels. The habitats that these animals live in are diverse. Lake trout cruise deep-water habitat, yellow perch swim shallower waters, and big, decades-old lake sturgeon move up big tributaries. High up in the watersheds, tiny spring-fed streams provide nursery habitat for brook trout.

Despite the diversity, many habitats are compromised, and that fact has not gone unnoticed by citizens. Citizens now advocate for habitat conservation through the Great Lakes Basin Fish Habitat Partnership. The Partnership, recognized by the National Fish Habitat Action Plan, concerns itself with conserving these diverse habitats throughout the Great Lakes basin through local engagement. Two such future projects serve as examples. The Wyoming County Soil and Water Conservation District in New York will restore habitat for trout and dace. The Bad River Watershed Association in Wisconsin seeks to remove over 800 road crossings that bar upstream movement of fish. ✦ Pam Dryer

Automation improves fisheries conservation

Karla Bartelt/USFWS

A young lake trout whisks through AutoFish, never leaving the water. The system allows more fish to be tagged at less cost and less stress to the fish.

About 35 million fish are stocked in the Great Lakes each year by tribal fisheries programs, state game and fish agencies, the U.S. Fish and Wildlife Service, and Canada's Ontario Ministry of Natural Resources. These large waters and massive fisheries, coupled with the large quantities of fishes put into the lakes, necessitate a common cooperative tool over multiple jurisdictions.

AutoFish is that tool. It is an automated 44-foot-long trailer-based fish-tagging system that can process captive fish—and large numbers in a short time. Developed by Northwest Marine Technologies, the system runs trout and salmon three to five inches long through an apparatus that clips the fleshy adipose fin on the fish's back, and inserts a uniquely coded wire tag. Up to 60,000 fish can be run through the system in 8 hours.

The automated system is much more efficient and costs less than passing each fish through multiple hands to get the same job done. And it may be less stressful for the fish as they are never completely out of the water.

Three mass-marking projects started in 2010: tagging five million lake trout from National Fish Hatcheries, plus salmon in Wisconsin, Michigan, and New York. Mass-marking is done under the auspices of the Great Lakes Fishery Commission. Tags are read when fish are caught later. Data lets biologists learn about survival, fish movement, and the extent of wild populations ✦ Charles Bronte, Ph.D.

FROM THE ATTIC

Notes from D.C. Booth Historic National Fish Hatchery and Archives

Railways and fisheries conservation were coupled like boxcars for nearly 80 years, dating to the 1870s. For U.S. Fish Commission scientist, Livingston Stone, necessity was the mother of invention. The technology of raising fish was developing, but live fish couldn't be moved on dirt roads in wagons to a far destination.

In 1873, the California Commissioners of Fisheries called upon Stone and the Fish Commission for fish. Stone outfitted a car borrowed from the Central Pacific Railroad, loaded it with fish in Charlestown, New Hampshire, and headed west. The car carried a surprising assortment: 60 black bass, 11 glass-eyed perch, 110 yellow perch, 12 bullheads (hornpouts), 110 catfish, 20 tautogs, 1,500 saltwater eels, 1,000 young trout, 162 breeding lobsters, and one barrel of oysters. Joining the car at Albany, New York, were 40,000 American eel, and at Chicago, 20,000 shad. Minnows were also along to feed the larger species en route.

Sadly, the car was lost near Omaha, Nebraska, when a trestle collapsed on the Elk Horn River where at least two railroad workers died. The Fish Commission crew swam to safety. Despite the loss, the Fish Car Era was born. Railroads would move fish and eggs in specially designed, dedicated fish cars until the last federal fish car was retired in 1947.

Les Voorhis

The replica fish car is a favorite attraction at the D.C. Booth Historic National Fish Hatchery and Archives.

To help tell this story, volunteers built a replica fish car at D.C. Booth Historic National Fish Hatchery and Archives. Using a 1910 car, old photographs, reports, and an 1897 model, they created this favorite exhibit. Visitors love walking through the car and learning a little bit of the fish car story. ✦ Randi Sue Smith

Pioneers

By Tim Smigielski

Dr. John Van Oosten

USFWS

John Van Oosten (center) examines a smelt caught through the ice on Crystal Lake , Benzie County, Michigan. Van Oosten researched the collapse of the Great Lakes smelt fishery in the early 1940s.

If he could only see us now, you get the sense that Dr. John Van Oosten would be moved by the level of sophistication that biologists have in fisheries science. They manage Great Lakes fisheries using complex computer models to evaluate the status of fish stocks and predict the effects of harvest. Biologists employ satellites and GPS and sonar technology to track forage fish abundance, and soon perhaps, tagging every hatchery-reared trout and salmon stocked into the Great Lakes basin. Dr. Van Oosten would certainly be pleased with modern-day fisheries scientists who carry on his legacy of Great Lakes fisheries research, conservation, and management.

Dr. Van Oosten attended Calvin College near Grand Rapids, Michigan from 1914 to 1916, and then transferred to the University of Michigan in Ann Arbor where he received three degrees, all with specialization in zoology. He received his Ph.D. in 1926.

During his 42-year career with the U.S. Fish and Wildlife Service, the U.S. Bureau of Fisheries, and the U.S. Bureau of Commercial Fisheries, Dr. Van Oosten spent more than twenty of those years serving the University of Michigan as a Research Associate in Zoology, and as a Lecturer in the School of Natural Resources.

Before receiving his doctorate degree, he was a special investigator for the Bureau of Fisheries in the early to mid-1920s. His work investigating the collapse of the lake herring fishery in Lake Erie in 1925 was the precursor to the establishment of the Bureau's Great Lakes Biological Laboratory, in Ann Arbor in 1927. Dr. Van Oosten was named its first director when it opened and he served in that capacity for over two decades. He relinquished the responsibility in 1949. Dr. Van Oosten continued his outstanding career as a researcher at the Great Lakes Biological Laboratory in the capacity of Senior Scientist until his retirement in 1961.

That laboratory is now the Great Lakes Science Center (GLSC) operated under the U.S. Geological Survey. With an eye toward restoring, enhancing, and protecting aquatic species and their habitats, the GLSC works in cooperation with all bordering Great Lakes states, tribal fisheries management authorities, Canada, and other federal agencies, including the U.S. Fish and Wildlife Service, to meet the needs for critical scientific information for the Great Lakes basin. Fish population dynamics, prey fish assessments, harvest quotas, native species restoration, effects and control of invasive species and the overall health of the Great Lakes ecosystem were the priorities that Dr. Van Oosten built his career upon. In an ever-changing world and an ever-changing complex Great Lakes ecosystem, these issues still continue to drive the research priorities of today's GLSC.

Known for his practical fisheries management and regulation interests, Dr. Van Oosten was continually sought after for his expertise. He was a trusted advisor to the commercial fishing industry and state fisheries conservation agencies. A true champion of the Great

Lakes, he served as chairman to many committees during his career including the Lake Erie Advisory Committee; Great Lakes Lake Trout Committee; and Great Lakes Sea Lamprey Committee.

Dr. Van Oosten established a worldwide reputation as an extraordinary fishery scientist, and for that reason, President Franklin Roosevelt appointed him in 1940, as the U.S. Member of the International Board of Inquiry for Great Lakes Fisheries, and he served on the Great Lakes International Fact-Finding Commission for Fisheries.

With his dedication and leadership came notoriety for Dr. Van Oosten. He amassed an impressive array of awards and accomplishments. In 1952, he was named a Distinguished Service Honorary member by the American Fisheries Society. In 1962, Dr. Van Oosten received a Distinguished Service Citation from the U.S. Department of the Interior, with a gold medal.

Even though it would seem that one of the world's most notable and accomplished fisheries scientists had enough to do—that was just not the case. Dr. Van Oosten contributed to the professional and scientific community as an editor, and served a term as president of the American Fisheries Society. He was a Fellow with the American Institute of Fishery Research Biologists and a member of numerous other professional organizations and societies such as the American Society of Ichthyology and Herpetology; American Society of Limnology and Oceanography; the International Association of Theoretical and Applied Limnology; and the Michigan Academy of Science, Arts, and

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The Fulmar *was the first of the Great Lakes Science Center's research vessels. John Van Oosten (far right) stands with the vessel's crew at port on Lake Erie in 1932. The U.S. Fish and Wildlife Service Fisheries Program's ship, the* M/V Spencer F. Baird, *serves fisheries conservation in the Great Lakes today.*

Letters, serving as its chairman of the Zoology Section in 1935.

Over the course of his career, Dr Van Oosten authored more than 90 scientific publications, contributed to text books, and wrote for the lay reader in the popular press about the plight of the Great Lakes fisheries. He published his first scientific paper in 1923, an article about the nature of whitefish scales; his last paper was printed in 1963, covering Lake Michigan's surface currents. Dr Van Oosten passed away in 1966, at age 74.

Given that this man prodigiously published, it was fitting that a library took his name. Since its dedication in 1966 the *John Van Oosten Research Library*, which is located on the edge of north campus at the University of Michigan in Ann Arbor, has provided information to students and researchers throughout the Great Lakes basin. Dr. Van Oosten provided the seed stock for the library—thousands of books and papers went to the library. According to librarian, Christine Schmuckal, the Van Oosten collection forms the major component of the library. It's probably the most extensive library pertaining to fish and fisheries of the Great Lakes.

The library is a lasting tribute to one of the great fisheries science pioneers—a practical manager and dedicated leader—in the history of federal service to the Great Lakes. ✦

When not hunting, fishing, or coaching football, Tim Smigielski works as a Fisheries Biologist and Coordinator of Conservation Education and Partnerships for the U.S. Fish and Wildlife Service in the Midwest Region. He's stationed at the Jordan River National Fish Hatchery in Michigan.

Shortjaw Cisco

By Michael Hoff

Out of sight, out of mind, the saying goes. By virtue of where this fish makes a living—down to the dark waters of an astounding 600 feet deep—the shortjaw cisco is anything but forgotten. In fact, what was once a common fish in four of the five Great Lakes, the shortjaw cisco is top of mind for biologists, now for becoming increasingly rare. Lake Superior and a small area of northern Lake Huron constitute the last portions of the Great Lakes to hold shortjaw cisco today.

Near where these last remaining fish are currently found in the United States, is where the first shortjaw cisco specimen described for science came from, in 1908. One of America's greatest ichthyologists, Barton Warren Evermann (see *Eddies*, Summer 2010), then the U.S. Bureau of Fisheries' Chief of Scientific Inquiry, gave a name to the fish. He and fellow researcher David Starr Jordan called the fish *Coregonus zenithicus*. The genus applies to all of the cisco species. The shortjaw cisco species name refers to where Evermann and Jordan acquired the specimen, near "The Zenith City," Duluth, Minnesota.

The shortjaw cisco is one of 10 species of fishes in the group of ciscoes that live in the northern United States and Canada. The shortjaw cisco naturally occurred in all the Great Lakes, except Lake Ontario, and northwestward in deep lakes through the Northwest Territories, Canada. This silver-sided fish grows to a maximum of 15 inches, and approaches three-quarters of a pound in weight. They become sexually mature in their fourth to sixth year, and spawn during spring and summer. Spawning males congregate first in water anywhere from 60 to 240 feet deep. The females follow, and drop up to 18,000 tiny yellow eggs over sandy or clay lake bottoms. The eggs hatch in four months. The maximum life span is 13 years. John Van Oosten, a pioneering researcher (see page 8) with the U.S. Bureau of Fisheries, learned in the 1930s that rates of growth are wildly uneven, and that the size of shortjaw cisco was no great predictor of age.

The ciscoes are closely akin to trout and salmon. In body form and habitats, there are similarities—they have a fleshy adipose fin near the tail and live in cold water. In habits, they differ. Trout live life mostly as lone rovers, whereas the ciscoes are schooling fish, and because of their propensity to not be found alone, they were in the past taken en masse in gill nets pulled from the deep.

The crushing pressure of those deep waters is where the shortjaw cisco lives its life, well suited to survive in low light and cold water, fish habitat that one would consider not so productive. Though the shortjaw lives for long periods in water as shallow as 180 feet below the surface, this is still considerably deep, and requires special adaptations for life at those depths. The pressure of life in water at 300 feet is 10 times greater than at the surface. To get along in the deep, the shortjaw cisco has high levels of fats in the flesh. Nearly all fish species have a swim bladder, a balloon-like organ that expands and contracts for buoyancy. The shortjaw cisco has a small swim bladder, and requires little change in volume. High fat content and use of the swim bladder combine to stabilize the fish in a particular place in the water. With these adaptations, the shortjaw cisco stays in deep water, without spending much energy to do so.

Deep water equates to cold water. Living in water only a few degrees above freezing benefits the shortjaw cisco, helping it store fat and conserve energy. The source of that energy is other deepwater organisms like bivalve mollusks, but especially freshwater shrimp, like the opossum shrimp.

By day, the opossum shrimp lives near lake bottoms, and migrates upward at night. Where the cisco and shrimp intersect, that is where shrimp become a meal. Given the fish's physical limitations on quickly moving up and down in the water, they can't follow the food very far. Shortjaw ciscoes eat opossum shrimp coming and going to and from the lake bottom, letting the food come to them. It's important for opossum

Paul Vecsei

The shortjaw cisco was once one of the most abundant offshore fishes in the upper Great Lakes. Now the species is one of the rarest.

shrimp to remain abundant where the shortjaw cisco can feed on them. We know what could happen otherwise.

In Lakes Huron and Michigan, opossum shrimp declined, likely the result of competition for food with the invasive zebra mussel. In the deep, offshore areas of Lake Superior, zebra mussels are not abundant because the amount of calcium, which is needed to form the mussel shells, is low. If other invasive species become abundant in Lake Superior and opossum shrimp numbers fall, then populations of shortjaw cisco would probably decline even further. But they don't have much further to go to bottom out.

Data that dates to the 1890s show that the shortjaw cisco populations have declined significantly. During the 1920s, the shortjaw cisco represented more than 90 percent of deepwater cisco commercial catches from all of Lake Superior. By the late 1990s, the fish was nearly non-existent.

These precipitous declines are why the shortjaw cisco was a candidate species under consideration for listing by the U.S. Fish and Wildlife Service under the Endangered Species Act. The shortjaw cisco is listed as follows: Threatened by the Federal Committee On Status of Endangered Wildlife in Canada; Threatened by the Michigan Department of Natural Resources; and Endangered by the Wisconsin Department of Natural Resources.

Biologists attribute the decline of upper Great Lakes shortjaw cisco populations to a combination of commercial overharvest, invasive species, and predation. The deep-bodied lake trout, called a siscowet, lives with and eats shortjaw cisco and more siscowet swim in Lake Superior today than did in the early part of the 20th Century, when shortjaw cisco were much more numerous. We will never truly know why shortjaw cisco numbers are so low now. However, irrespective of the causes of those declines, we can manage and restore the fish so that the fish isn't forever completely out of sight. ✦

If you are what you eat, then biologist Michael Hoff is a cisco—a group of fish species he's researched since 1979. Hoff, however, has never eaten the species that he writes about here. He works for the U.S. Fish and Wildlife Service in Minneapolis, MN.

By Lee Allen

Five Lakes, Three Strains, One Big Job

Lake trout conservation works through many moving parts

USFWS

Lake trout reared at National Fish Hatcheries, like this one, are marked or tagged to provide valuable information to managers when they are recovered as adults.

Like long-distance runners who keep putting one foot in front of the other, U.S. Fish and Wildlife Service fisheries biologists are diligent in their efforts to restore lake trout in the Great Lakes. And their persistence is paying off.

Freshwater char in the lakes of northern North America have been there for a long time, dependent upon cold, oxygen-rich waters up to a couple of hundred feet deep. They are late to mature, perhaps 8-10 years of age, and therefore spawn at a later age. While average lakers today weigh around seven pounds, they may grow to three feet long and over 60 pounds. Nonetheless, they are slow to put on those pounds and in the process are susceptible to overexploitation as part of a $7 billion annual commercial and sport fishery.

As one of the larger freshwater fishes, particularly one that is endowed with flesh of superb eating quality, lake trout have been eagerly sought by commercial, sport, and subsistence fishermen alike—chased by everything from long lines to gill nets.

Habitat degradation, alewife invasion, water pollution, and arrival of the parasitic eel-like sea lamprey didn't help their fight for survival either. Lampreys entered the Great Lakes as early as 1829 and proceeded to become a growing menace as the years went on. By the 1950s, continued overharvesting and the onslaught of the sea lamprey had effectively eliminated the swift, torpedo-shaped lake trout from the waters of Lakes Erie, Huron, Michigan, Ontario, and Superior.

Once the magnitude of the problem was evident, organized corrective and restorative action began half a century ago with the establishment of the Great Lakes Fishery Commission (GLFC). The U.S. Fish and Wildlife Service is a key player in the multi-disciplinary team that partners with other federal, provincial, state, and five tribal natural resource agencies to restore lake trout.

"We work under the framework of the GLFC and as part of the project to develop goals for lake trout restoration in Michigan, we do all kinds of stuff," says Mark Holey, supervisor of the Green Bay Fish and Wildlife Conservation Office. "We do netting surveys, determine the health of stocked trout, determine who is catching them, and how many are being caught. We identify impediments to restoration efforts, like the strain of fish used, and set up goals and objectives to achieve desired ends, and then we do coordinated monitoring to measure the impact of those efforts.

"The last wild lake trout was caught out of Lake Michigan in 1954 and while stocked fish from the National Fish Hatchery System do lay eggs that are fertilized, efforts to rehabilitate lake trout populations here have met with minimal success and a sustainable population has not yet been achieved," Holey says.

According to a U.S. Geological Survey report outlining restoration progress since 1970: "Lake trout stocking began in 1978 at Lake Erie and abundance has been improving annually. Stocked lake trout began reproduction on several near shore Lake Huron reefs in 1981, and intensive stocking of multiple strains has resulted in production of young lake trout each year since the early 1990s. Although fry have been detected in Lake Ontario as early as the 1980s, stocked spawning failed to produce detectable numbers until the mid-1990s when naturally produced two-year-old lake trout were noted."

There has been more success in Lake Superior where, since 1996,

USFWS

The abundance of adult lake trout is measured in Lake Michigan using gill nets during the fall spawning period.

USFWS

Biologists from the Green Bay Fish and Wildlife Conservation Office examine adult lake trout caught in Lake Michigan. They measure the fish, look for sea lamprey wounds, and for clipped fins to determine if the fish was spawned in a hatchery or in the wild.

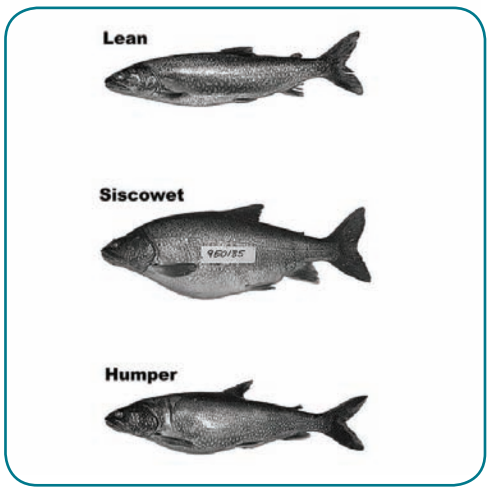
hatchery lake trout stockings have no longer been needed. A major key to a brighter future for lake trout is the control of parasitic sea lampreys which feed only on the blood of fish. Without sea lamprey control efforts, "lake trout and other large predator fish populations would be decimated," according to Holey, who has spent his 30-year career on Lake Michigan.

"Ours is an annual $16 million international mission, charged by the governments of the United States and Canada, to destroy larval sea lampreys. In the early days, our mantra was 'Kill lampreys, Stock fish,'" and without program funding to ensure this basin-wide control, the whole house of cards would go away and there would be no lake trout."

After testing more than 6,000 chemicals, the lampricide TFM (3-trifluoromethyl-4-nitrophenol) became the initial favorite method of eradication—although the Great Lakes Fishery Commission is now adopting an integrated pest management plan allowing for reduction of chemical use.

National Fish Hatcheries were the other side of the remedial coin. "There are different kinds of lake trout that like to inhabit shallow, medium, and deep water and we created up to seven different brood stocks of different strains to begin restoration," says Holey.

Dale Bast plays his part in the restoration effort as manager of Iron River National Fish Hatchery in Wisconsin. The hatchery maintains various strains of lake trout broodstock, producing 1.6 million fish per year. "We're on the leading edge of genetic issues associated with restoring species," he says. "Our wild fish broodstock is developed to keep the purity of the strain and is stocked in numbers large enough to



Charles Bronte/USFWS

The three forms of native lake trout swim the Great Lakes. They are defined by body form, depth where they live, and fat content. Top to bottom, lean lake trout; siscowet or fat lake trout; humper lake trout.


USFWS

Biologist Dale Hanson hefts a heavy lake trout. When fully restored to the Great Lakes, lake trout this size will be common, and will provide the eggs needed for natural reproduction.

be genetically sound and to stand on their own."

All stocked fish receive coded wire tag implants as well as an external fin clip which allows biologists to identify those of hatchery origin. "Tags provide detailed information regarding date and location of the stocking, strain stocked, and their rearing location," says Tracy Copeland, Deputy Manager of Lower Great Lakes Fish and Wildlife Conservation Office in Amherst, New York. Copeland's office has purview over lake trout restoration in Lakes Erie and Ontario.

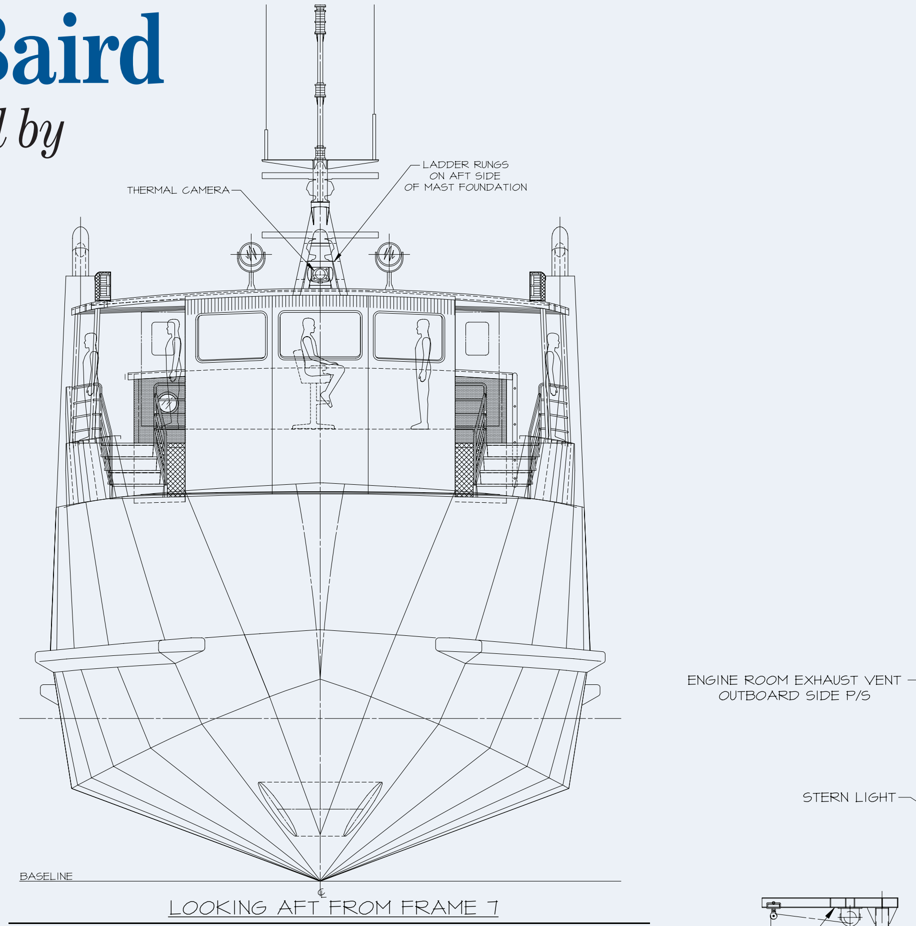
"It takes a long time to make substantial progress in trying to put the pieces together, in this case, decades. But how long did it take to bring the bald eagle back? Given all the societal demands on those waters, we're making good progress," reports Holey, and, as co-author of the Great Lakes Fishery Commission report on rehabilitating lake trout in Lake Michigan, he notes: "By 2037, rehabilitated populations in specified deep- and shallow-water habitats should be phenotypically diverse… and capable of sustaining fisheries."

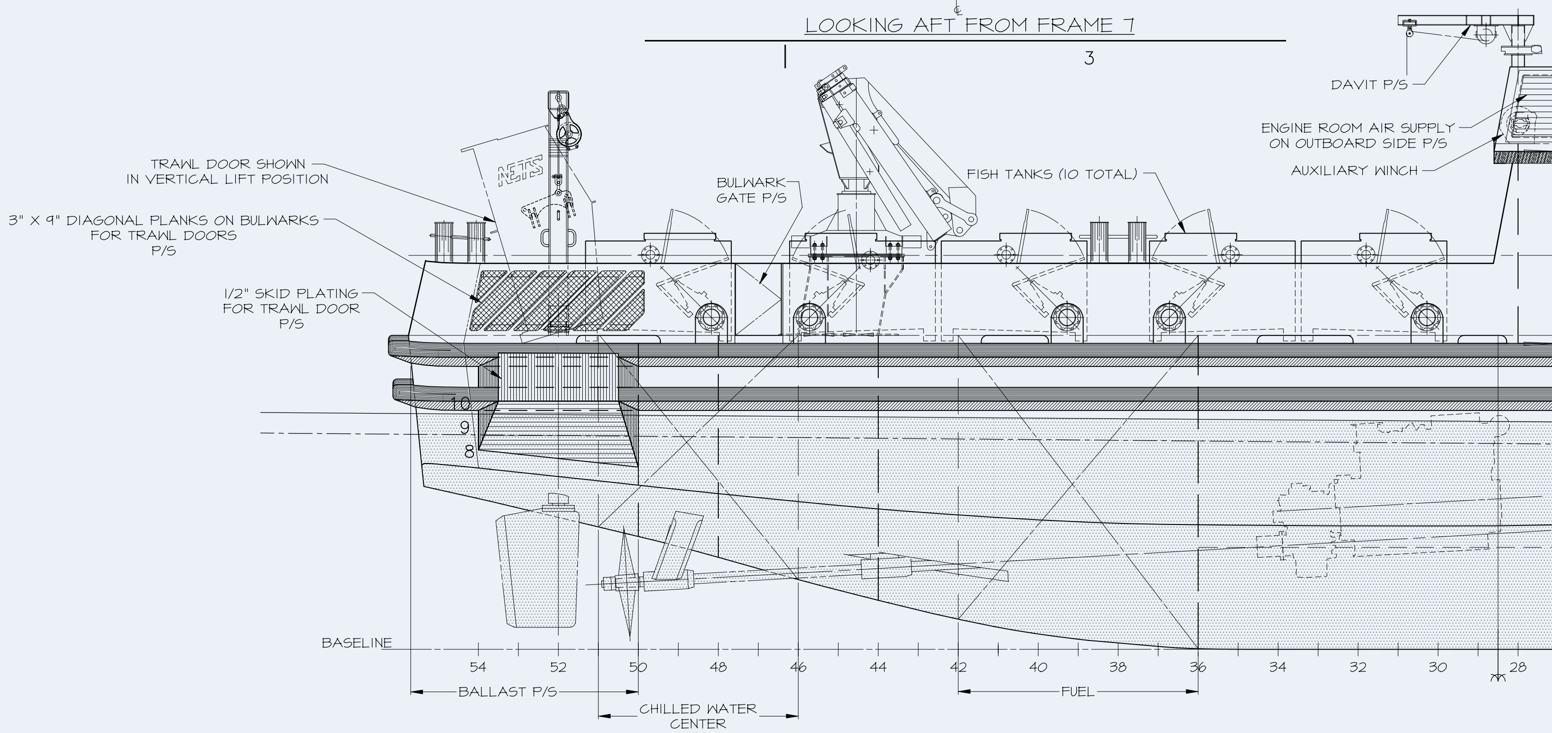
Meanwhile, all the various pieces in the conservation machinery will keep laboring, working toward that end. ✦

By Aaron Woldt

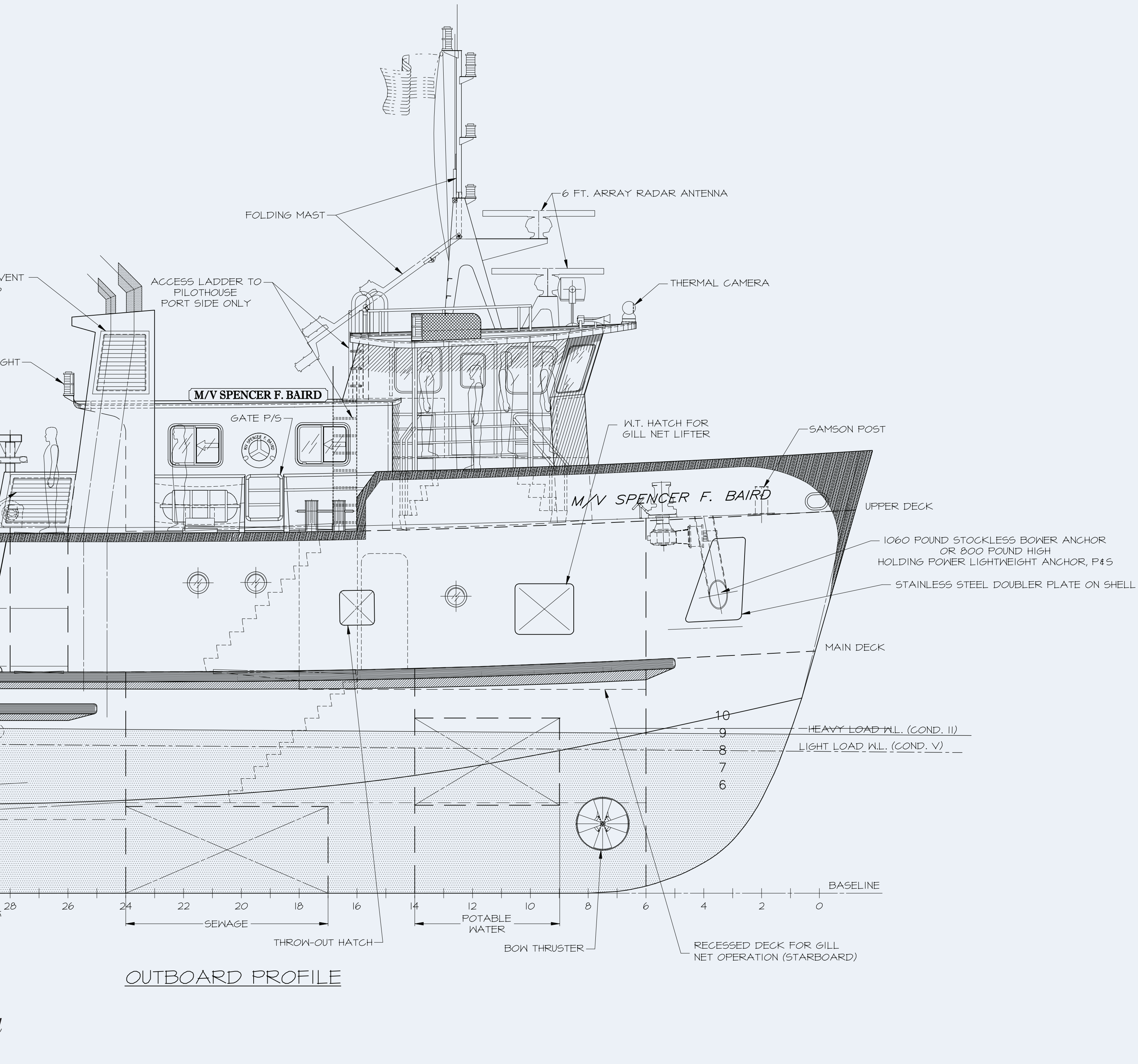
M/V Spencer F. Baird

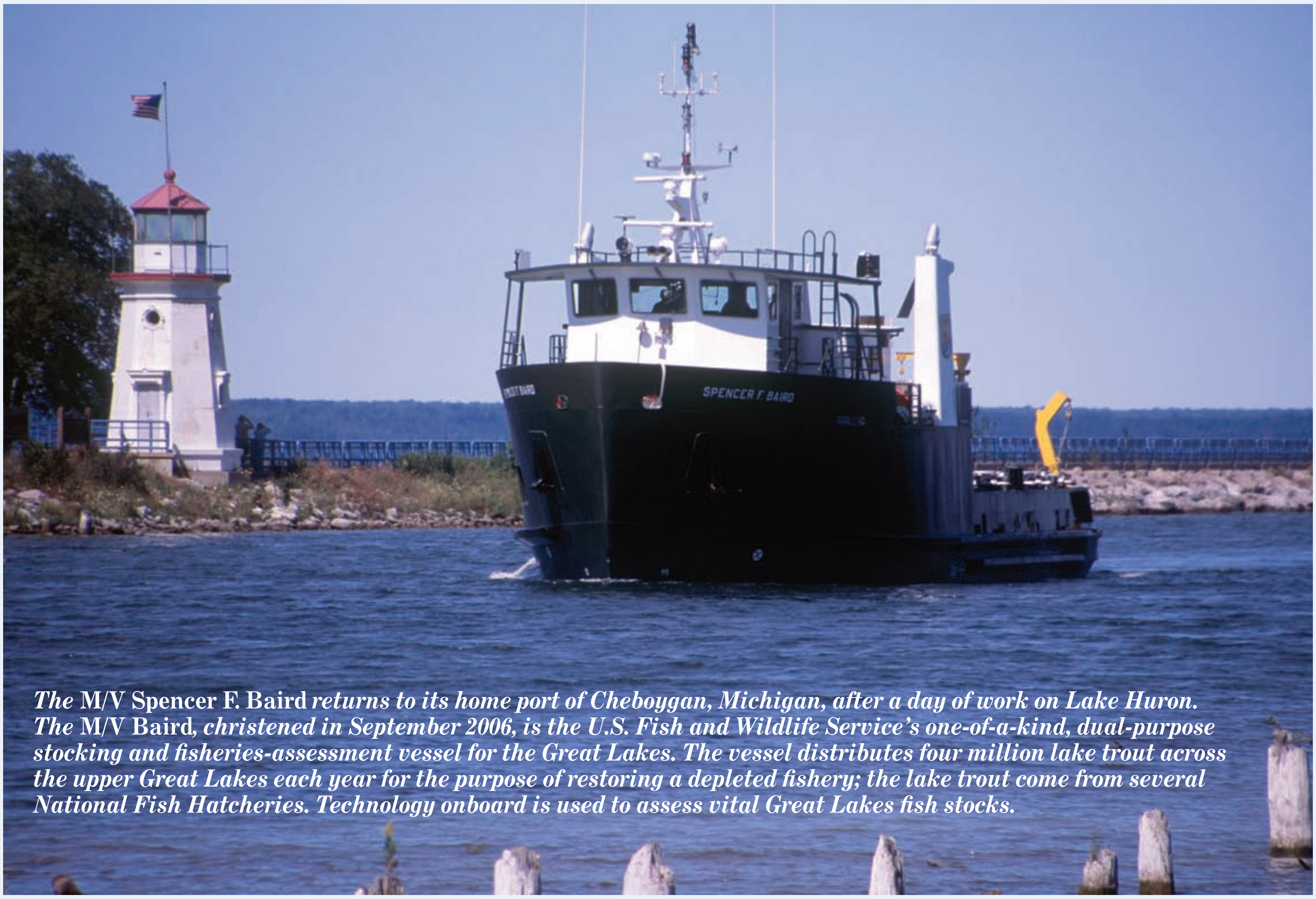
Architectural rendering of vessel by Timothy Graul Marine Design. Vessel dimensions: 95' 0" long X 31' 6" wide. Vessel houses a crew of nine.





The M/V Spencer F. Baird *began its Great Lakes' lake trout restoration mission in the spring of 2007, when it completed its first stocking trip in Lake Huron. The* Baird *is equipped with 10 above-deck fish tanks, an oxygen concentrator and delivery system, and a 3,000-gallon water chiller, all used to carry and stock fish via gravity (no fish pumps). Lake trout are literally poured out of the ship. The vessel is also outfitted with gill nets and bottom- and mid-water trawling systems. Its hydroacoustic fishery assessment equipment is state-of-the-art technology.*


FOLDING MAST
6 FT. ARRAY RADAR ANTENNA
THERMAL CAMERA
ACCESS LADDER TO PILOTHOUSE PORT SIDE ONLY
M/V SPENCER F. BAIRD
GATE P/S
W.T. HATCH FOR GILL NET LIFTER
SAMSON POST
M/V SPENCER F. BAIRD
UPPER DECK
1060 POUND STOCKLESS BOWER ANCHOR OR 800 POUND HIGH HOLDING POWER LIGHTWEIGHT ANCHOR, P&S
STAINLESS STEEL DOUBLER PLATE ON SHELL
MAIN DECK
HEAVY LOAD W.L. (COND. II)
LIGHT LOAD W.L. (COND. V)
BASELINE
SEWAGE
POTABLE WATER
THROW-OUT HATCH
BOW THRUSTER
RECESSED DECK FOR GILL NET OPERATION (STARBOARD)
OUTBOARD PROFILE



The M/V Spencer F. Baird *returns to its home port of Cheboygan, Michigan, after a day of work on Lake Huron. The* M/V Baird*, christened in September 2006, is the U.S. Fish and Wildlife Service's one-of-a-kind, dual-purpose stocking and fisheries-assessment vessel for the Great Lakes. The vessel distributes four million lake trout across the upper Great Lakes each year for the purpose of restoring a depleted fishery; the lake trout come from several National Fish Hatcheries. Technology onboard is used to assess vital Great Lakes fish stocks.*

Karla Bartelt/USFWS

Fishery biologists (l to r) Adam Kowalski, Aaron Woldt, and Scott Koproski set a large-mesh gill net for lake trout off the stern of the M/V Spencer F. Baird.

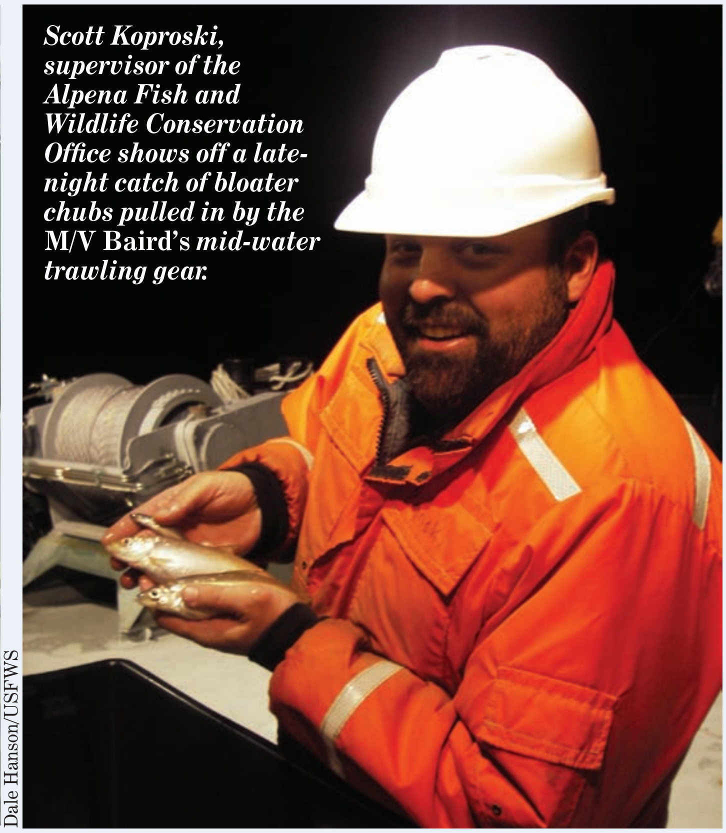
Dale Hanson/USFWS

First Officer Dave Bohn and biologists Aaron Woldt and Scott Koproski use the M/V Baird's *starboard-side winch to launch and retrieve the vessel's SeaBird depth and temperature recorder.*

Adam Kowalski/USFWS

Inside the wet lab of the M/V Baird, *biologist Adam Kowalski, Third Assistant Engineer Keith Colborn, and biologist Scott Koproski untangle lake trout from a gill net on a mid-lake spawning reef. The scientists will use growth data from these fish to make future management decisions.*

Dale Hanson/USFWS



Scott Koproski, supervisor of the Alpena Fish and Wildlife Conservation Office shows off a late-night catch of bloater chubs pulled in by the M/V Baird's *mid-water trawling gear.*

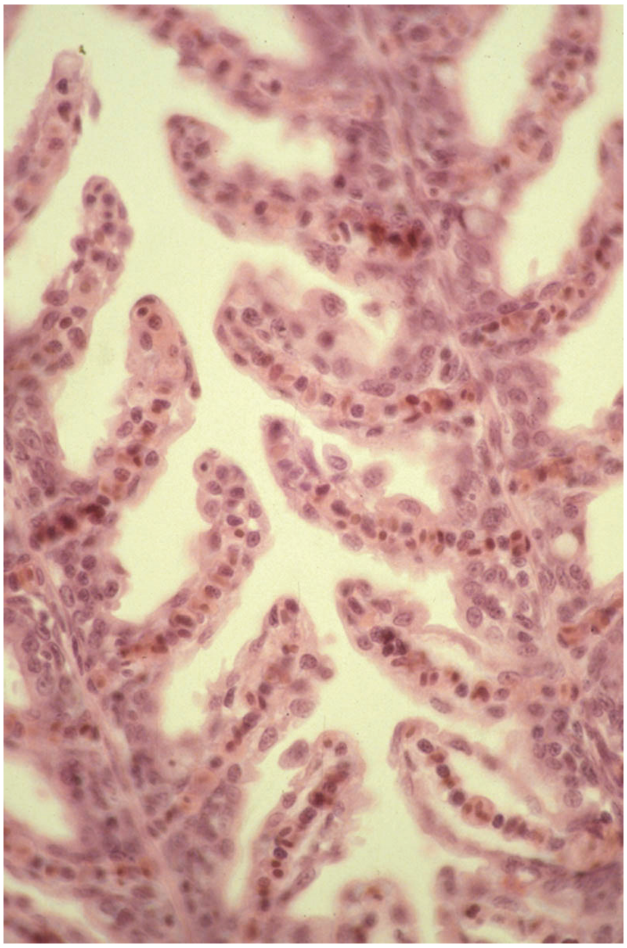
Dale Hanson/USFWS

A truck from Pendills Creek National Fish Hatchery in Brimley, Michigan, delivers a load of about 100,000 yearling lake trout to the M/V Spencer F. Baird. *The vessel delivered these trout to deep waters next to offshore, lake trout spawning reefs. Stocking fish offshore helps ensure better survival by avoiding predatory fish nearshore and bird predators from above. Also, juvenile fish will imprint on spawning habitat, where they return as mature adults.*

Karla Bartelt/USFWS

By Ken Phillips

Fish Get Herpes, Too
Battling EED virus in lake trout



Sue Marequenski/Wisconsin DNR

Fish health biologists can see that the EED virus caused damage to this lake trout gill, amplied many times.

"Routine." That's probably the best way to describe fish health work in the Great Lakes when I began my fish health career in 1995. Perform routine inspections at each of our hatcheries twice each year, an occasional troubleshooting case, but never any major mortality at any of the National Fish Hatcheries in Midwest Region. Outbreaks of viral hemorrhagic septicemia, or VHS, as it's commonly called, the deadly fish disease that would cause numerous fish kills throughout the Great Lakes, were still over the horizon.

Turn back the clock 10 years earlier. Working as a microbiologist at the La Crosse Fish Disease Control Center, as my shop was called back then, would have been anything but routine. Hatchery and fish health professionals were faced with a disease outbreak of epidemic proportions that threatened the efforts to restore native lake trout in the upper Great Lakes. Young lake trout being reared at several state and federal hatcheries in Wisconsin and Michigan were rapidly becoming ill and dying.

Biologists were puzzled by the mortality. Whatever was causing the mortality was like nothing that had been seen before. Quickly, the fish became lethargic, swam erratically, their eyes hemorrhaged, and their skin blotched. Standard testing turned up negative. Unable to identify the "bug" causing the epidemic and desperate to stop the losses, biologists treated the fish with antibiotics and chemical theraputents—all to no avail. Fish that did not fall victim to the disease were euthanized to contain the spread. Valuable captive broodfish were moved to Charlevoix Fish Hatchery in Michigan.

Biologists also had a wide array of complex names for the disease, including Iron River syndrome, lake trout epidermal hyperplasia, and epizootic epitheliotropic disease (EED). Eventually biologists settled on EED for the name. No matter what it was called, more questions lingered. Was this deadly disease caused by a bacteria or virus? Where did it come from? Why was it spreading so rapidly?

Through pathology and the use of electron microscopes, researchers eventually were able to determine that a herpes virus was responsible for the epidemic. Yes, fish get herpes too. The same family of viruses that can cause cold sores or genital herpes in humans also has members that cause disease in fish. Although the virus has been called salmonid herpesvirus 3 and lake trout herpesvirus, virologists have settled on the name epizootic epithieliotropic disease virus, or EEDv.

Despite determining the cause of the deadly disease and giving it a name, biologists still had to determine a way to control the spread of the virus. Making this even more difficult was the fact that tissue cell culture, the traditional method used to screen for viruses, was ineffective for EEDv. Then, as quickly as the disease appeared, it was gone. And in its vacancy, a lot of questions remained: how was the virus transmitted between fish? Where did it come from? What caused the initial outbreak? Why did the outbreak suddenly stop?

Even though EEDv had apparently disappeared, the U.S. Fish and Wildlife Service and natural resource agencies took steps to prevent future outbreaks. Hatcheries reared fewer fish; grew them larger and of better quality. Future broodstock were isolated where they could be screened for diseases and would receive a stress test before being transferred to a broodstock facility. Agencies also limited the number of strains being reared at each hatchery, as well as limiting the number of transfers between hatcheries. All of these practices were put into place through the cooperation of the natural resource agencies in the Great Lakes.

As part of the Great Lakes Fishery Commission, the Great Lakes Fish Health Committee (GLFHC) brings together representatives from Great Lakes natural resource agencies to make recommendations regarding fish health. Besides the U.S. Fish and Wildlife Service, members of the committee include each of the states bordering the Great Lakes, Tribal agencies, Fisheries Oceans Canada, and the province of Ontario.

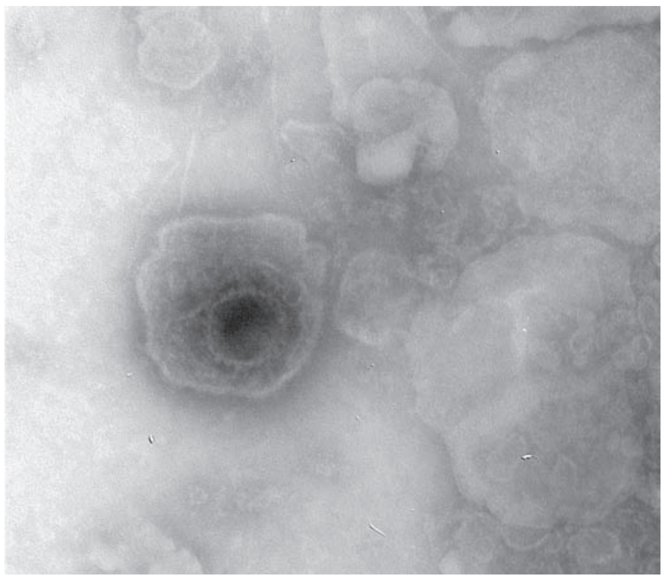
Fast-forward to 2003. All was quiet on the EEDv front. The last report of EEDv had come in 1989. The management practices put into place worked. Or so everyone thought. Then EEDv reappeared at Wisconsin's Les Voigt State Fish Hatchery. Mortality in lake trout was low in the 2003 outbreak, compared to what happened in the 1980s. Because there was not a field test to detect the virus, biologists could only detect it once the virus caused a disease outbreak. The virus was probably present all along, but went undetected.

All was not lost with the outbreak of EEDv at the Les Voigt hatchery. It gave biologists an opportunity to develop a diagnostic tool to find infections. Working with the Wisconsin DNR and with the support of the GLFHC, researchers at the University of California-Davis were able to develop a molecular test for EEDv. This was good news for fish health practitioners.

Currently, the La Crosse Fish Health Center and its partner agencies in the Great Lakes use the tool to screen wild lake trout populations to understand the distribution of EEDv in their natural habitat. Further refinements in the diagnostic tool are needed, and as they are made, lake trout conservation and management will improve. ✦

Sue Marquenski/Wisconsin DNR

EED virus caused internal bleeding in the eye of this lake trout.



Ron Hedrick/University of California–Davis

Viruses are mircoscopic in size. This image of the EED virus was taken by an electron micrograph.

Ken Phillips wrote "Diagnosing Disease" in *Eddies*, fall 2008. He's a microbiologist at the LaCrosse Fish Health Center in Onalaska, WI.

By Kay Hively

It's a Long, Strange Trip

American eel conservation in New York

Bob Michelson

Young American eel are called "elvers." Fresh in from the sea, they stage at the mouths of rivers before heading upstream to spend decades in fresh water. When mature, they swim back out to the sea to spawn and die.

The American eel has a life-history much different than any other fish in the Great Lakes. And its conservation status has been pondered by the U.S. Fish and Wildlife Service, for good reason. The population of American eel in the Great Lakes is down.

The American eel declined for a number of reasons. They are a delicacy which makes them a target for commercial fishing. Eels have been a menu favorite in Europe and Asia for generations. Human consumption has severely impacted populations of European eel which now faces extinction. That species has seen an estimated 99 percent reduction in current populations.

This dramatic reduction in the number of European eels has impacted American eels as commercial harvesting in North America has increased to replace the smaller catches of the European species. The uptick in commercial fishing, combined with impediments on waterways, pollution, parasites, and changes in climate and oceanic currents, have raised concerns over the future of the American eel.

According to U.S. Fish and Wildlife biologist Stephen Patch, about one million eels entered the Great Lakes, primarily Lake Ontario, in 1985. By the mid-1990s, that number had fallen to about 1,000. However, with work already done to assist with eel passage, that number has now grown to about 20,000 moving upstream to the Great Lakes each year. But this may be the peak number.

To improve the conservation status of American eel, the U.S. Fish and Wildlife Service, Canadian agencies and provinces, and several state and local agencies have banded together to protect this unique creature. They cooperate with the New York Power Authority (NYPA).

As inhabitants of both marine and fresh waters, the American eel is unique in many ways. They are born in the relatively warm waters of the Sargasso Sea, between the West Indies and the Azore Islands.

Eventually they make their way to the United States by literally drifting on ocean tides. Once they reach North America, they are able to swim on their own. Thus begins their move into rivers and streams all along the Atlantic coast where they will spend most of their lives in American waters, and there is where the concern of the NYPA comes in.

These eels can live up to 30 years before they are ready to spawn. When mature, they begin another journey back to the area where they were born. Reaching "their" spot in the Sargasso Sea, these adults spawn and die, leaving millions of their offspring to begin their long, strange trip to American waters.

It is, in fact, this natural journey of life that has thrown the eels into population decline. According to Tracy Copeland, biologist at the Lower Great Lakes Fish and Wildlife Conservation Office in Buffalo, New York, the U.S. Fish and Wildlife Service is working with an international team seeking a permanent solution to eel passage into and out of the Great Lakes. The spawning population of the future is in the Great Lakes now, and it is imperative for them to return downstream and make their way back to the ocean to reproduce.

Several ideas for solving the passage problems, both into and out of the Great Lakes, are being considered. Sophisticated "eel ladders" on the St. Lawrence River have proven effective. The NYPA built a ladder to keep eels out of the company's large hydro turbines. And the ladder was designed to be used only by eels, making it a barrier to invasive species which continually threaten the Great Lakes. To use the ladder, a creature must be able to "slither," something most fish cannot do, but it's a natural movement for an eel. The ladder is a major factor in the increase in eel populations.

More ladders need to be built. Short of that, to ensure the fish has access to and from the sea, fishery managers may "trap and transfer," where migrating eels are funneled and trapped. The fish would be carted around the impediment in an "eel portage."

That may be what it takes for the American eel in the long strange trip of it natural migration, and to ensure its conservation status into the future. ✦

NYPA

American eel, about two years old, slither up this near-vertical wall to habitats upstream in the Lake Ontario basin.

By John Bryan

Conserving a Long-lived Leviathan: Lake Sturgeon

Betsy Trometer/USFWS

Biologist Venessa Pereira holds a lake sturgeon that was caught, tagged, and released back into the lower Niagara River in August 2010. It's from one of the few remnant lake sturgeon populations in Lake Ontario. Tagging fish helps fishery managers better understand fish populations.

"When you capture a lake sturgeon and look into its eyes, it's different from every other fish—almost as if it has a personality," says Henry Quinlan, a biologist for the U.S. Fish and Wildlife Service's Ashland Fish and Wildlife Conservation Office, Wisconsin. The lake sturgeon is the largest and longest-lived inhabitant of the Great Lakes. Fossil records confirm that the species has existed here unchanged for more than 100 million years.

"For thousands of years they coexisted with Indians," says Rob Elliott, Lake Sturgeon Coordinator for the U.S. Fish and Wildlife Service's Green Bay Fish and Wildlife Conservation Office. "There was a symbiotic relationship between Indians and sturgeon, and it has always been revered and an important religious symbol," he continues, punctuating his point. "But it took only 40 years to wipe them out."

Perhaps the most important factor to enable a comeback is the systematic collaboration now taking place throughout the Great Lakes. A workshop in 2000 was the precursor for the bi-annual Great Lakes Sturgeon Coordination Meeting. The overall purpose is "to manage fisheries in a coordinated manner," says Elliott who organized the 2008 coordination meeting.

There are also collaborative efforts focused on individual waters. Elliott was the principal investigator for the 2002 to 2006 lake-wide status assessment of lake sturgeon in Lake Michigan—a project that involved the U.S. Fish and Wildlife Service, tribal agencies, Michigan State University, Purdue University, University of Georgia, Michigan Tech., Central Michigan University, and state agencies of Michigan and Wisconsin.

Other collaborations include the Great Lakes Sturgeon Tributary Database and Geographic Information System, the Great Lakes Sturgeon Tag Identification Database, and the Great Lakes Sturgeon Web Site. All maintained by the U.S. Fish and Wildlife Service, they receive information from federal, state, university, tribal, and other organizations.

The decimation of lake sturgeon began with the arrival of Europeans. At first they slaughtered sturgeon as large trash fish that destroyed their nets. Later they used their oily bodies to fuel steamboats. Then the lake sturgeon became prized for its meat and eggs and other derivatives such as isinglass—a gelatin from the inner lining of the swim bladder and vertebrae that was used for glues, as a clarifying agent in jellies, and to make windows for early motor vehicles. Then came hydropower dams; they prevented access to spawning grounds, and deforestation and agriculture that caused siltation.

USFWS

Young lake sturgeon swim in an aquarium at the Genoa National Fish Hatchery in Wisconsin, showing the great range of colors the species possesses.

The path to recovery has many elements. "Habitat limitation is a major impediment," says Elliott about Lake Michigan's sturgeon. This will be mitigated as pathways are created through dams and as other projects are put in place such as the manmade spawning reefs in the Detroit River. In some places—such as Michigan's upper Black River—there are organized groups of volunteers who monitor key spawning areas to guard against poaching.

Doug Aloisi is the Lake Sturgeon Coordinator for the U.S. Fish and Wildlife Service's Genoa National Fish Hatchery in Wisconsin. His words help explain widespread interest: "It's a fascinating fish, a long-lived critter. When you look at them you fall in love with them. They're so ugly they're cute."

Lake sturgeon are long and slender and covered with five rows of boney plates called scutes. Below an upturned snout are four barbels and

Fossil records confirm that the species has existed here unchanged for more than 100 million years. …"But it took only 40 years to wipe them out."

an extendable tube-mouth. They can live more than 100 years, grow 8 feet long, and weigh over 300 pounds.

Average sexual maturity occurs at 10 years in males and 25 years in females. Spawning takes place in the spring on rocky or pebbly substrates. Females spawn every four to nine years, and males twice as often. The eggs hatch in about a week and juveniles reach seven inches by fall.

"If you're gentle, they're gentle back," reports Elliott about collecting spawning sturgeon by hand. "You put one hand around the tail and scoop up under the belly with the other. But I've been out with people who have been knocked flat. You can get very wet at this."

Aloisi has collected spawning brood fish in the Wolf River with long-handled nets. "We lay them on the bank and strip-spawn them with gentle pressure on the stomach," he says. They mix milt with eggs onsite—splitting each female's eggs into five sections and fertilizing each section with milt from a different male. By early fall the hatched sturgeon are ready for micro-tagging and stocking.

There are records of commercial harvests on the Great Lakes beginning in the mid-1800s and peaking in 1885 with a total of 8.6 million pounds—half of which came from Lake Michigan. But harvests declined rapidly, and by 1929 Lake Michigan's harvest had dropped to 2,000 pounds.

One Great Lakes river that remains much as it has always been is the Bad River. "It is one of the best examples of a historically preserved system," says Quinlan. "It has no dam and only minor human impact. The Bad River Indian Reservation encompasses most of the lower watershed."

Quinlan's collaborative work with tribal biologists and researchers includes examining hundreds of sturgeon collected with gill nets each spring. A decade ago Quinlan worked with the Bad River and Red Cliff bands of Lake Superior Chippewa to collect eggs for rearing and stocking, and to focus on genetics and mating schemes. "This is a great story of tribal stewardship," says Quinlan.

Additional research takes place throughout the Great Lakes. Betsy Trometer, Lake Sturgeon Coordinator for the U.S. Fish and Wildlife Service's Lower Great Lakes Fish and Wildlife Conservation Office in NY, is currently assessing the sturgeon population in the lower Niagara River—from the falls to the mouth at Lake Ontario. New research includes "tracking movement of adults with radio tags," she reports. "Radio tags can't be read below 60 feet, but you can track them from shore," she explains. "We've learned that all age classes are there in the

Josh Schloesser/USFWS

Biologist Henry Quinlan, Ashland Fish and Wildlife Conservation Office, poses with an adult lake sturgeon captured during the 2010 spawning run in Wisconsin's Bad River. This female sturgeon was estimated to be 39 years old and likely making her fourth or fifth spawning run.

Henry Quinlan/USFWS

Joshua Schloesser, Ashland Fish and Wildlife Conservation Office, checks mats at the lower falls of Wisconsin's Bad River for lake sturgeon eggs. Egg mats were set at known spawning grounds, and at a site where spawning habitat was created. No eggs were found.

Lower Niagara," says Trometer. "And they are reproducing."

Another lower Niagara River researcher will map the depth contours, substrates, and even some current patterns. Sturgeon collection data will be overlaid to provide leading-edge information about movement and patterns.

Lake Superior restoration efforts have included a partnership between Minnesota and Wisconsin that successfully stocked sturgeon in the St. Louis River from the 1980s until 2000. It is hoped that in future years when the fish reach sexual maturity they will return to spawn.

Other leading-edge work includes Aloisi's research with geneticists to develop protocols for successfully getting hatchery sturgeon to accept an artificial diet—such as krill meal—while simultaneously preserving a healthy gene pool. "Natural diets are expensive, labor intensive, and inconvenient," says Aloisi.

Additional research includes streamside rearing: circulating nearby river water through a hatchery. "Hatchery fish don't know which rivers to spawn in," says Elliot, "unless they're part of a streamside rearing process." This procedure is only eight years old, and success will be determined in future years when the females reach spawning age.

Why is the lake sturgeon so important? "They require good habitat and fairly good water quality," says Trometer. "Their return is a sign of these things."

"I look at a 50- or 60-pound fish and it probably has some demographics similar to mine," says Quinlan. "You just generate a respect and relationship with lake sturgeon that's different from all other fish." ✦

By Craig Springer

An Unnatural History

Controlling the parasitic sea lamprey in the Great Lakes

Karla Bartelt/USFWS

Biologist Janet McConnell from the Marquette Biological Station, programs a portable automatic water collector in preparation of a TFM treatment.

Gauzy morning light leaks through dense mature oaks and maples, in a square woodlot next to an Indiana farm road. It's only a few miles from the Michigan state line, just below the bottom end of Lake Michigan. Right angles predominate in this place from artificial lines laid on the landscape. It's well-settled here, the artifices of people everywhere. Roads run over section lines straight as ribbons lain over low hills in near-perfect square-mile blocks. They make the checkerboard you can see from the air. On the ground, you can hear the distant drone of a bush hog, and the comings and goings of occasional cars and farm implements as people live out their day in this slice of rural Midwest.

The backlighting of the morning sun illuminates the bugs that float on the beams. They remind you of dust defying gravity, caught in light bending through dirty widows. A spattering of left-over yellow sunlight hits a tiny rill barely big enough to name. The rill, no bigger than a groove in the glacial till, gets much attention from fish biologists. This manicured site in the Midwest belies what's below. Swimming in this pleasant little purl of water is an alien invader that's become naturalized – very well established such that it is likely to remain – and entirely by accident. Its existence here is incongruous, if not bizarre, like finding ice cream in an oven.

The sea lamprey, as its name implies, is naturally at home in the salty waters of the Atlantic. But the unintended consequences of connecting the Great Lakes more directly to the seaboard for commerce via the Welland Canal, essentially put the lamprey in this otherwise bucolic scene. Their invasion into the Great Lakes dates to 1829, and by the 1940s, they populated all of the Great Lakes. A saltwater fish swims in the tiniest of freshwater upland farm creeks ringing much of the Great Lakes basin. It's had a real down side.

The lamprey is a fish. On the evolutionary scale, it's primitive, without scales and without bones. It owns a slightly conical-shaped circular mouth loaded with rings of raspy teeth. It's a parasitic pest. It makes a living by clinging to the flanks of other fishes and rasping a hole in its host, sucking body fluids and flesh as it clings along for the ride. As you might guess, that's hard on a host fish, and fish species native to the Great Lakes like the lake trout have suffered from it.

In the 20-month parasitic adult lifespan of a sea lamprey, it will kill 40 pounds of fish. Only one out of seven fish parasitized will survive. Lake trout are not the only fish to host the invasive lamprey; steelhead, lake sturgeon, salmons, walleye, and yellow perch often get the parasite. But lake trout have taken a measurable toll: prior to the lamprey explosion in the 1950s, about 15 million pounds of lake trout a year were harvested from Lakes Superior and Huron. Ten years later, only 300,000 pounds were pulled from nets. In Lake Michigan alone, lake trout harvest went from 5.5 million pounds in 1946, to a mere 402 pounds seven years later.

With Great Lakes fisheries devastated by invasive sea lamprey, the U.S. Fish and Wildlife Service directed the scientific testing of some 6,000 substances to determine what might control the lamprey.

The suction mouth of a sea lamprey has rows of sharp teeth and rasping tongue used during its parasitic life stage to feed on fish.


Karla Bartelt/USFWS

The sea lamprey is a fish, and you can see its gill slits behind the eye on this adult.


Karla Bartelt/USFWS

Biologist Jacob Nichols from the Marquette Biological Station checks a trap on Michigan's Trout River, built into a low-head barrier. Adult sea lampreys swim into the trap on their upstream spawning migration. Males caught there are sterilized and put back in the wild.

In 1958, the compound commonly called "TFM" proved its worth. The selective lampricide could effectively suppress the invasive parasite. Under the auspices of the Great Lakes Fishery Commission, biologists now apply TFM in about 250 streams tributary to the Great Lakes, such as the unassuming rill on the Indiana-Michigan state line.

It's not the adult lamprey themselves that are sought by biologists applying TFM to streams. The adult spawning lampreys swim into the tributaries in the spring of the year to spawn, and then die. Their eggs hatch in gravels, and the worm-like larvae move into muck to live out the next several years before turning to parasitism and moving into open lake water. It's in this stage that TFM is designed to kill sea lamprey – the larval stage while still living in streams.

While TFM is the primary means of suppressing sea lamprey populations, it's not the only one. Other methods complement one and all. Barriers have been built across several streams to block sea lamprey from moving upstream to spawn. They are poor swimmers in river current, and barriers built to concentrate flows, essentially push the unwanted fish back downstream, the stream flow reacting much like that from a hose nozzle. Other barriers put electrical current in the water, repelling the fish. No matter the type, effective barriers reduce the necessity of applying TFM to some waters.

Another control method disrupts the life cycle, stopping life before it starts, through sterilization. Artificially sterilized male sea lamprey swimming among and competing with virulent males for mates reduces the number of eggs fertilized. A female may lay eggs, but serviced by a sterile male yields dead eggs and no young. Traps put out in strategic sites in the Great Lakes basin, usually associated with lamprey barriers, collect male lampreys. Those males are taken to Hammond Bay Biological Station and injected with a sterilant, and then returned to the wild. Once in their spawning phase, incidentally, sea lampreys are no longer parasitic.

A great deal of experience and scientific experimentation has brought sea lamprey control a long way from the nadir of the 1950s. From Lake Champlain to the top of Lake Superior, well trained and dedicated biologists go after sea lamprey in a measured, deliberate way. On any application of TFM for example, the U.S. Fish and Wildlife Service's Fisheries Program will have deployed in the field, workers with an impressive array of expertise: chemistry, limnology, fisheries science, and hydrology. The field work is physically demanding, too.

The work is paying off. Sea lamprey numbers are down by 90 percent, and desirable sport and commercial fisheries valuable to people are on the rebound. The past can't be undone, but with science and technology, fisheries professionals can rewind a bit. And it starts upstream, in the smallest of rills in the uplands that pour into the Great Lakes. ✦


Karla Bartelt/USFWS

How much of the lampricide TFM to put in a stream depends on how much water is flowing by. Biologist Janet McConnell from the Marquette Biological Station is using a flow meter to answer that question.

By Sam Finney

Keeping Asian Carp out of the Great Lakes

Comprehensive plan and leading-edge technology show promise

Karla Bartelt/USFWS

Biologist Shawn Sanders from Iron River National Fish Hatchery holds a bighead carp captured in Lockport Pool of the upper Illinois waterway, in December 2009.

Asian carp, accidentally released into the Mississippi River basin have steadily spread north and could invade the Great Lakes. And the consequences could be quite bad. But the U.S. Fish and Wildlife Service's Fisheries Program is trying to staunch the flow of fish northward, to protect the Great Lakes.

Toward that end, the Fisheries Program created and is implementing a national management and control plan, one that will restrain Asian carp. The plan prescribes well over 100 management actions ranging from public outreach, policy changes, and commercial fishing harvest increases, to Asian carp impact mitigation via fish stocking, finding Asian carp-specific poisons, and designing effective fish barriers.

Collectively, four species of fish—black carp, grass carp, silver carp and bighead carp—are known as Asian carp. They were brought into the U.S. from the 1960s through the 1980s as a tool for of clearing algae-laden ponds, eating unwanted aquatic plants, and ridding aquaculture catfish ponds of snails and their associated parasites. Responsibly used, black carp and grass carp both have utility in aquaculture and aquatic plant management, but the risk of their escape into the wild is high. Both could gorge themselves on important wild aquatic plants, or native imperiled mussels. Black carp are regularly captured in the lower Mississippi River basin.

Silver carp and bighead carp are unequivocally a true menace. Throughout their lives, they feed on tiny plants and animals called plankton, and directly compete with native fishes that need the same nutrient-rich food, especially so at the juvenile stage. After escaping wastewater treatment and aquaculture facilities, and swimming their way up the Mississippi River and into the Illinois River, these alien invaders now knock on the door of the Great Lakes. This proverbial door is an electric barrier built by the U.S. Army Corps of Engineers to prevent the exchange of aquatic nuisance species between the two great basins: the Mississippi River, and the Great Lakes. A canal system, constructed over 100 years ago to flush Chicago's wastewater down river to the Gulf of Mexico, connects the two basins.

As bighead carp and silver carp invaded the Illinois River, they were first noticed in the 1990s by commercial fishermen, and then natural resource agency staff. It wasn't long before the fish had taken over and become the most numerous fish in the Illinois River. In some surveys, these invaders comprise 95 percent of a day's catch. The fish invasion continued and Asian carp inched closer and closer to the barrier. The U.S. Fish and Wildlife Service's LaCrosse Fish and Wildlife Conservation Office has monitored the carp advance since 2001, via its annual "Carp Corral and Goby Roundup" (see *Eddies* winter 2008). In recent years, the Corps of Engineers, Illinois Department of Natural Resources, and U.S. Fish and Wildlife Service have closely monitored carp populations near the barrier using traditional fishery techniques, such as netting and electrofishing. A lack of catch near the barrier seemed to indicate that Asian carp were not finding the upper river and canal habitats to their liking, and their advance was slowing.

Enter "environmental DNA." It's a technique refined by scientists at the University of Notre Dame, used to determine if the DNA from an organism, in this case silver carp and bighead carp, exists in a water sample. The technique is quite sensitive in its ability to detect the presence of the target organism, by testing the water. While traditional gears told fishery managers that the Asian carp front had miles of river and two dams separating it from the electric barrier, environmental DNA told biologists that Asian carp, or at least their DNA, was near, and sadly, past the barrier.

As DNA was found closer and closer to the barrier, and eventually a single bighead carp was captured directly downstream of the barrier with free access to challenge the barrier, the wheels in Washington turned toward solutions. A multi-agency "Asian Carp Summit" was held at the White House in conjunction with Senate and House testimony and concurrent with a related Supreme Court lawsuit. The result was the Asian Carp Control Strategy Framework, a $78.5 million multi-agency, multi-tiered approach to keep Asian carp out of the Great Lakes.

Since then, the electric barrier's operation settings have been optimized. A second electric barrier is under construction, and will be completed in late 2010. Both barriers are being thoroughly tested. Commercial fisherman on contract are working downstream of the barrier to reduce Asian carp populations. The fewer fish out there, the less likelihood of fish challenging the barrier. Biologists continue to monitor waters above the barrier for potential Asian carp. The entire fishery over a three-mile stretch of the Calumet River was examined by rotenone, a plant-derived fish toxicant, in May 2010. No Asian carp were found. On a bigger scale, biologists are indentifying other pathways by which Asian carp may invade the Great Lakes. Physically dividing the two great basins, as they naturally once were, has become a legitimate option.

Still, questions remain. Are there enough fish living past the barrier to establish an Asian carp population in the Great Lakes? Is a population already established? Will Asian carp flourish in the Great Lakes, as they have in the Mississippi River basin?

One thing is definitely known. We need to keep Asian carp out of the Great Lakes. Asian carp DNA has been found and a single specimen has been captured on the lake side of the barrier, these findings have come about from intensive fishery work on the water. Many are cautiously optimistic that few fish exist above the barrier. With the management actions currently prescribed, few Asian carp, if any, will find their way into the Great Lakes in the future. ✦

Sam Finney is the U.S. Fish and Wildlife Service's Asian Carp Management Coordinator, stationed at the Carterville Fish and Wildlife Conservation Office in Carterville, Illinois. For more information, see www.asiancarp.org.

By Mike Weimer

The Lake Effect

Vivid are my earliest memories of growing up along the Great Lakes. I recall one fishing expedition with my dad and brother in the shadow of a huge steel-arched bridge on the Niagara River near Buffalo, New York. I caught a rock bass off a rip-rap eddy upstream of an oil refinery, downstream from a marina and a coal-burning power plant. Tires and cans bobbed in the water. Not an idyllic scene, but my focus was on the fish. The second the bobber jerked below the surface and jogged into the current, it was me who was hooked. I now realize the symbolism of that tenacious rock bass, living in a very tough and unfriendly aquatic world that then typified the Great Lakes.

By anyone's measure, the Great Lakes are a global treasure, massive in scale. The statistics are staggering. In total, the lakes contain 95 percent of the entire supply of freshwater for the United States. If spread evenly from coast to coast, these 6 quadrillion gallons would submerge the entire country under almost 10 feet of water. Lake Superior is 1,300 feet deep. Michigan's Great Lakes shoreline alone totals over 3,000 miles, more coastline than any other state, but Alaska. The basin is shared by eight states and one Canadian province, and is home to dozens of Tribes and First Nations. Hundreds of fish, plant, and insect species live in the Great Lakes, and nowhere else on the planet. The superlatives come easy for this gigantic ecosystem.

But look beyond the facts and figures describing volume and scale, and you'll find a unique culture evolved in accordance with everything inherent to life along inland seas. Ships dot the horizon, some almost a thousand feet long, visiting from around the world. Each of the five lakes—Superior, Michigan, Huron, Erie and Ontario—owns a personality, each its own gravity, ringed by the cities and towns where everything is based on the water. Architects design buildings to look onto the lakes; roads and railroads follow shorelines. And the Great Lakes are large enough to dictate weather, especially on the eastern and southern shores. Lake-effect snowstorms are often measured in feet, not inches, fed by the non-stop supply of evaporating lake water transformed to snow by freezing Arctic air, and dumped inland in ridiculous amounts. So, as the big lakes go, so go the cities and counties that border their shores.

The irony of catching rock bass beneath the smokestack factories in the 1960s, typified the realities of living in a compromised watershed, heavily taxed by multiple, often conflicting users. In those days, phosphorous and other nutrients were discharged into the lakes in incredibly high amounts, leading to algae blooms. What blooms also dies. A complete depletion of life-sustaining oxygen from the water was commonplace when the algae died; fish kills were far more common. In late summer, it was a regular sight to see tractors raking beaches to remove huge amounts of aquatic vegetation after it had drifted ashore, "seaweed" fed by the chemicals entering the water. It would be piled high and left to bake in the summer sun, attracting thousands of flies. Visibility through murky water was often measured in inches, not feet. Aquatic insects like the mayfly struggled to exist, especially in Lake Erie and the industrialized embayments of the other lakes. Great Lakes rivers literally caught on fire due to extremely high levels of flammable chemicals discharged directly into their waters. Perhaps a low point in the minds of many Americans was in June 22, 1969, the day the Cuyahoga River caught on fire in Cleveland, Ohio. In fact, the river had caught on fire on nine previous occasions, dating back to 1868. To add insult to injury, Lake Erie was "officially" declared dead by the media in the 1960s, and its demise was even referred to in *The Lorax*, the 1971 children's book written by Dr. Seuss about the demise of the our natural world.

In addition to these fiascos, stories abounded of the loss of species after species due to pollution, overfishing or habitat loss from dams, turbines, or other barriers to fish passage. In its heyday in the late 1890s, the commercial fishing harvest in the Great Lakes totaled 147 million pounds annually, a number that could not be sustained. I grew up hearing stories of the legendary blue pike, a cousin of the walleye that was native to Lake Erie and was last caught over 40 years ago and declared extinct by the U.S. Fish and Wildlife Service in 1983. Another story learned early on was of the parasitic nonnative sea lamprey, which invaded the upper Great Lakes from the Atlantic Ocean following construction and expansion of shipping canals, leading in large part to the collapse of the trout and salmon fishery during the 1950s and 60s.

Fortunately, Dr. Seuss had good reason to remove the line, “I hear things are just as bad up in Lake Erie,” in later versions of *The Lorax*. He became aware that the lake was improving. The Great Lakes were beginning to heal, realizing the benefits of environmental laws such as the Clean Water Act, passed in 1972, and bi-national fishery management practices and sea lamprey control. Across the basin, individuals and stakeholder groups were concurrently working to protect and restore habitat and species in their own backyards, with a collective and synergistic effect felt across the landscape. Since that ecological ebb in the 1960s, fish and insect populations have rebounded, water quality has improved significantly, and other key indicators of ecosystem health point in a positive direction. The Great Lakes now support a fishery estimated at $7 billion annually.

But big challenges remain. Faster and larger transoceanic ships unwittingly transport new aquatic invaders. The current tally of species introduced into the Great Lakes stands over 180. Best known is the zebra mussel, first discovered in Lake St. Clair in the 1980s, likely arriving in the ballast water of ships from eastern Europe. Add in the round goby, spiny water flea, Eurasian ruffe, and dozens of other species, and you have a daunting lineup of biological pollutants. Asian carp have made their way toward the Great Lakes from the Mississippi River basin, becoming well-established in the Illinois River and more recently detected further north in the Chicago Area Waterway System. Disease pathogens such as Viral Hemorrhagic Septicemia, more commonly called VHS, are being detected in fish populations, as well as trace levels of pharmaceuticals discarded down drains. And climate change, the big wild card, will have long-term impacts at the landscape level, changing not just temperatures but entire climate patterns and the hydrology of rivers, streams, lakes and even oceans, with a cascading effect ultimately felt across all levels. Data show dramatic impacts already, especially in the polar regions where ice cover has diminished to low levels, to the detriment of ice-dependant species. Many of the species endemic to the Great Lakes evolved in the cold, deep waters formed within the lake basins following the retreat of the Laurentian Ice Shield, and could be seriously impacted by changes to water temperatures of even a few degrees. These emerging issues present daunting challenges.

But while today’s threats to the ecosystem are imposing, a collective and organized effort to conserve, protect, and restore the Great Lakes is being carried out—day in and day out—on every lake and river in the basin. Passionate and devoted residents of Great Lakes communities collaborate with agencies, non-governmental organizations, academia, and industry to restore tributaries; tear down antiquated, defunct dams and other barriers to fish passage; clean up toxic hotspots; restore collapsed fisheries; and eradicate invasive species. Longstanding cross-border alliances work tenaciously and strategically, using state-of-the-art science to focus on-the-ground efforts for maximum results. And Congressional support for Great Lakes resources is strong, as witness to their importance to constituents of all ages and stakeholder groups. Critical support arrived in 2010, with the appropriation of $475 million to the Environmental Protection Agency for the Obama Administration’s Great Lakes Restoration Initiative. These funds are proving critical in supporting community-based resource restoration programs through competitive grants, advancing lake sturgeon and lake trout restoration, and battling aquatic invasive species in all eight Great Lakes states.

An indelible lesson is that the Great Lakes are survivors, having been witness to incredible changes, both natural and manmade, since their formation 10,000 years ago. The water is cleaner now and there are no more stories of burning rivers. The Great Lakes continue to be challenged by the unexpected, but they are survivors nonetheless—like that brassy battler, the big rock bass that I caught on the Niagara River between the smokestacks and car tires 40 years ago. ✦

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Eddies

Reflections on Fisheries Conservation

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Winter 2010/2011

Making a Splash

Throw a top-water lure onto glassy water, and watch what happens. There's a splash. Then the ripples fan out in concentric rings, the energy pushing outward away from where the lure landed.

There's more being cast than a piece of painted wood. Before any lure catches a fish, it first has to catch a fishermen—it has to be purchased. And from there starts a concentric ring that ripples through the economy, having consequences to your wallet.

Fish have intrinsic value, and they have measurable economic value. The Great Lakes recreational fisheries have remarkable worth. According to a 2008 economic study by the American Sportfishing Association, fishing in the Great Lakes is worth $7 billion a year. That's more than lure sales; anglers spend on clothes, gas, motels, food, and a whole lot more. And that means employment: nearly 38,000 jobs in eight states exist because of angling, underscoring that conservation is important to people. ✦ Todd Turner

Doug Stamm

Fishing reels in big dollars from businesses of all types, from the mom-and-pop to large corporations. No matter the size of business, they all have one thing in common, they hire people. Fishing in the Great Lakes has a major and measurable effect on the economy.