Wisconsin salmonids: Past, present and future

Lake trout: The largest and most mysterious of the Wisconsin salmonids.

By John Lyons

Lake trout are the largest and most mysterious of the Wisconsin salmonids. Because they spend their lives at great depths and require specialized gear to be caught, relatively few Wisconsin anglers have encountered them. Despite their large size – the hook-and-line record is more than 62 pounds and a commercial fisher in Canada once caught a 102-pound specimen – their inaccessibility means they attract few devotees compared to other trout and salmon. But they are a critically important species in the Great Lakes ecosystem and a fascinating fish wherever they occur.

I've been a lake trout fan almost as long as I can remember. I clearly recall the first one I ever saw. I was five years old, and we were on vacation in the Adirondack Mountains in northern New York. By this point, I was already obsessed with fish and fishing, and whenever a boat of anglers would return to the resort where we were staying, I would rush to the dock to see what they had caught. Usually it was a stringer of undersized smallmouth bass (the size limit was 10 inches, and nearly every legal fish was kept in those days) trolled from the rocky shoals along shore, but on this day, the fishermen told me they had been out in the middle in deep water. They pulled up their stringer and showed me a dark mottled fish with a streamlined body and a large, gaping mouth. They called it a "laker." It was by far the largest fish I'd ever seen up to this point, and although in hindsight it was probably only about 20 inches, at the time it seemed like a monster. I was enthralled, and I've been so ever since.

I didn't catch my first lake trout until much later when I was conducting graduate research at the University of Wisconsin-Madison on Trout Lake in Vilas County. I needed Yellow Perch for some experiments, and the easiest (and most fun) way to get specimens was to fish for them. I was casting minnows onto a mid-lake reef when my reel developed a tangle. While sorting it out, I drifted into much deeper water and my bait fell to the bottom. When I pulled up, I had a fish, much larger than the seven-inch perch I'd been catching previously. To my delight, it was a lake trout, a mere 17 inches, but a huge thrill nonetheless. Being a hungry grad student, I of course kept the fish and broiled it for dinner that night. It remains one of the best-tasting fish I've ever eaten.

Let's look at lake trout in Wisconsin, and maybe you'll understand my fascination with the species.

What is a lake trout?

Lake trout are native to the northern half of North America, including much of Alaska and Canada and the northern conterminous United States. They are found in cold deep lakes and do poorly at water temperatures above the mid 50's. In a few very large deep lakes, including the Upper Great Lakes (Huron, Michigan, Superior) and Great Slave, Great Bear, and Mistassini lakes in northern Canada, Lake Trout have evolved into multiple forms, some so distinctive in appearance, life history and ecology that they were once considered separate species. However, all of these forms are interfertile and are now considered part of a single highly variable species.

Native American and early European fishers recognized dozens of different forms of lake trout in the Great Lakes, but scientists have grouped these into four types, lean, siscowet (also known as fat), humper (also known as banker or paperbelly), and redfin. Each of these types may in turn have (or once had) multiple divergent populations, collectively encompassing a wide range of diversity. Although there are minor genetic differences between the four types, inter-breeding sometimes occurs, producing fish with intermediate attributes known by commercial fishers as "half breeds." The lean is the type most anglers and diners are familiar with, and it is also the type found in all inland lakes. It has an elongated body, a pointed snout, dark coloration, and relatively little body fat. It lives near shore in relatively shallow water where it is captured by both sport and commercial fisheries.

The siscowet is more deep-bodied than the lean with a blunter snout, less distinctive coloration, and high concentrations of body fat, particularly in the belly. It lives offshore over very deep water, usually more than 250 feet. The high fat content is thought to be a buoyancy adaptation, allowing the fish to swim more efficiently at great depths. Siscowet have been found in the deepest parts of Lake Superior, more than 1,300 feet, but also at the surface, where they sometimes eat small birds, and they often move from deep to shallow water at night and return to the depths during the day. Anglers rarely see this form, but there is substantial commercial harvest.

The humper looks somewhat like the siscowet, but it has much lower body fat, particularly in the belly. It lives near deep "banks" or "humps" surrounded by much deeper water in offshore areas and is not found in Wisconsin waters. It does not grow as fast or as large as the other three types. It is almost never caught by anglers but is sometimes taken by commercial fishers.

The redfin is even more deep-bodied and robust than the siscowet or humper, but it has the lowest body fat of the four types. It also has relatively large and bright red or red-yellow fins. It has an intermediate growth rate and maximum size.

Dr. Joe Cochran

LAKE TROUT FROM LAKE MICHIGAN

A 20-pound stocked lake trout from Lake Michigan off Milwaukee. Note the missing pelvic fin.

It lives at intermediate depths around offshore islands such as Isle Royale, Michigan, and is also not found in Wisconsin waters. It too is rarely encountered by anglers but seen by commercial fishers.

The various lake trout types share certain life history characteristics but differ in others. They are all carnivorous, eating zooplankton, opossum shrimp (mysis), other invertebrates, and especially fish, although the relative proportions of each depend on location and type. Across the range of the lake trout, growth is dependent on water temperatures and food availability with fish from colder and less productive waters growing more slowly but often surviving to older ages and reaching somewhat larger sizes.

Fast-growing southern or fertile-lake populations may live to 25 years of age with a typical maximum size of 35-40 inches and 20-30 pounds, whereas slow-growing Arctic and infertile-lake populations may exceed 50-60 years, 40 inches, and 50 pounds if not heavily fished. Over their entire range, lake trout first reach maturity at 3-27 years of age and lengths of 8-27 inches, but in Wisconsin waters they typically mature at 5-14 years and 17-24 inches.

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A SISCOWET-TYPE LAKE TROUT FROM LAKE SUPERIOR

Spawning differences are evident among the four types of lake trout in the Great Lakes region. All breed in the fall, although at somewhat different times, and some siscowet populations also spawn in the spring. Spawning occurs on silt-free rocky bottoms, usually in lakes, although historically there were populations of leans that spawned in rivers in boulder-strewn rapids or in lakes on clay bottoms, mats of bottom algae, or rooted aquatic plants. Some leans deposit their eggs as shallow as one foot, but most eggs are found at five to 50 feet.

Actual spawning locations for siscowet, humpers and redfins are unknown but are thought to be deeper. Spawning usually occurs at night, but daytime spawning populations are known. Not all adults spawn in every year. Unlike other trout and salmon species, the female lake trout does not prepare the spawning area by digging a shallow depression or "redd" in the gravel and then burying the fertilized eggs, but instead just broadcasts hundreds or thousands of eggs over the bottom for the male to fertilize and then neither sex provides any parental care.

Fall-deposited eggs hatch in the late winter or early spring and spring-deposited eggs in the summer. After their first growing season, newly hatched fish are 3-6 inches long and look similar regardless of their type. Differences in appearance do not become pronounced until several years later.

The past: An ancient resident

Lake trout have been in Wisconsin far longer than people. A lake trout fossil more than 250,000 years old was found in Dunn County in the early 1900's, easily the oldest record of a modern fish species from the state. But lake trout were forced out of Wisconsin during the ice ages, when only the Driftless Area was not covered with thick glaciers. During those times, the frigid climate of the Driftless Area would have been tolerable to lake trout, but the lakes they needed were absent, and the species survived in regions further south. When the glaciers finally receded, lake trout quickly recolonized, following the cold interconnected lakes that formed as the ice withdrew. Initially, they probably were nearly everywhere, but as the climate and water temperatures warmed, most lakes in the state became unsuitable. By the time of the first European settlements in the early 1800's, lake trout were ubiquitous in Lake Michigan and Lake Superior, but found in only two inland lakes, Trout and Black Oak in Vilas County.

Lake trout inland stocking began in the 1870's, first using eggs and progeny from Lake Michigan but eventually a variety of strains from the Midwest and Northeast. All were of the lean type. Initially, fish were planted in many lakes that were too shallow and warm, but by the early 1900's stocking was more scientifically based and limited to

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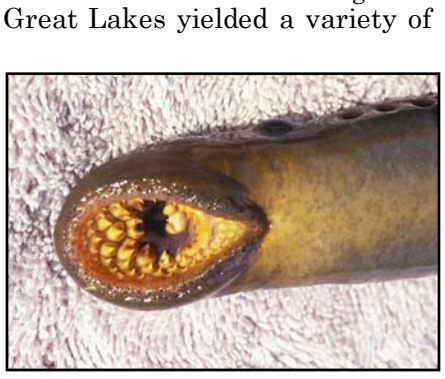
A LEAN-TYPE LAKE TROUT FROM TROUT LAKE, VILAS COUNTY

relatively deep cold waters where conditions were appropriate. In these lakes, survival of stocked fish was often good, but reproduction was minimal. Lake trout never became completely self-sustaining in any new inland Wisconsin lakes, and regular stocking was required to maintain sport fisheries.

A cornerstone of the Great Lakes fishery

Historically, lake trout were abundant in both Lake Michigan and Lake Superior. They were a keystone predator, at least partially controlling populations of their prey and determining the structure and functioning of the overall Great Lakes food web. Native Americans and early European settlers fished both lakes heavily for lake trout, particularly the more easily accessible nearshore leans. Although the Great Lakes yielded a variety of



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THE MOUTH OF A SEA LAMPREY

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ALEWIFE, THE KEY FOOD FISH FOR TOP PREDATORS IN LAKE MICHIGAN

food fishes, lake trout were among the most prized.

As European settlement increased, fishing pressure also rose dramatically, particularly in Lake Michigan. In the late 1800's an average of four to five million pounds of lake trout were harvested each year from throughout Lake Michigan, an unsustainable amount. Coupled with environmental degradation of the lake, overfishing caused the capture rate and average size of lake trout to decline. Fishers set even more nets and began to fish further from their home ports to maintain catches. Despite increased effort, annual harvest declined to an average of two to three million pounds by the 1930's. In Lake Superior, fishing pressure and environmental damage were less, and annual harvest during the first half of the 20th century remained relatively stable and averaged about four million pounds for the entire lake. Then the sea lamprey arrived.

The collapse and recovery of Great Lakes lake trout

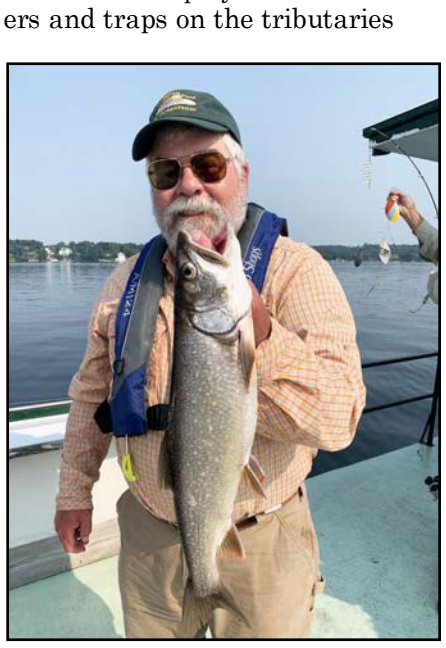
Sea lamprey are native to the North Atlantic Ocean and its tributaries and are a blood parasite on fish and marine mammals. The refurbishment of the Welland Canal in the 1930's to allow ocean-going ships to bypass Niagara Falls provided an avenue for sea lamprey to enter the Upper Great Lakes. Once there, they found ideal habitat and became abundant. And they turned into a predator.

Native parasitic lampreys occurred in the Great Lakes and caused few problems, but the much larger sea lampreys were deadly. Sea lampreys reached 2-4 pounds and consequently sucked far more blood than their smaller native cousins, which were usually less than half a pound.

In the North Atlantic, sea lampreys parasitized hosts weighing hundreds or even thousands of pounds such as large sharks and whales, and they rarely caused mortality. But in the Great Lakes, the largest fish were 20-40-pound lake trout, and most were much smaller.

At this ratio of lamprey to host size, over 10 times more than in the ocean, sea lamprey attacks were often fatal. In the late 1940's, fishers began to catch lake trout with sea lampreys attached. Lake trout numbers went into freefall, and by the mid 1950's, sea lamprey had completely eliminated lake trout from Lake Michigan and driven populations to low levels in Lake Superior. Burbot and lake whitefish populations were also devastated.

The U.S. and Canadian governments began a crash program to control sea lamprey numbers. Barriers and traps on the tributaries



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SWTU'S TOPF WELLS WITH A BIG GREEN LAKE TROUT

where lampreys spawned helped, but populations remained too high. In the late 1950's, dogged work by U.S. Fish and Wildlife scientists led to the development of a highly selective and relatively safe lampricide, 3-trifluormethyl-4-nitrophenol or TFM. This chemical killed larval lampreys in streams before they became parasitic. A massive joint U.S.-Canada operation began to treat all the lamprey-suitable tributaries of the Great Lakes, a complicated and expensive proposition that continues to this day. The effort was successful, and although sea lampreys were not eliminated, they were reduced to the point that recovery of Great Lakes fish populations could begin.

Commencing in the mid-1950's, state, provincial and federal agencies began stocking large numbers of lake trout in the Great Lakes. A variety of strains were used, but nearly all were leans. In Lake Superior, lamprey control, stocking and highly restrictive fishing regulations led to the gradual recovery of lake trout populations, including all four types, but in Lake Michigan, progress was slow. Stocked fish survived and grew well there but had little reproduction. Evidence accumulated that organic pollutants, particularly PCBs (polychlorinated biphenyls), prevented egg and larval survival. Years of pollution control eventually reduced PCB concentrations, and by the 2000's, successful spawning started to occur.

The present: Inland lakes

Currently, inland fisheries management of lake trout focuses on 11 lakes, Trout and Black Oak with their native populations; five nearby small lakes Little Trout, Long, Pallette, and White Sand in Vilas County and Big Carr in Oneida County, that serve as refuges for the Trout and Black Oak strains; and four other lakes with introduced populations, Big Cedar in Washington County, Big Green in Green Lake County, Geneva in Walworth County, and Goto in Langlade County.

Lake Trout numbers and reproduction have declined in Trout and Black Oak for reasons that are not clear, and stocking of fish raised from eggs taken from each lake coupled with highly restrictive fishing regulations are employed to help maintain their populations. The five nearby small lakes receive occasional plantings of either the Trout Lake or Black Oak Lake strain. No reproduction is expected in these, but survival is generally good, and they act as back-ups in case Trout Lake or Black Oak Lake suffers a catastrophic loss of lake trout. Fishing for Lake Trout is prohibited in Pallette and under the same restrictive regulations as in Trout and Black Oak in the other four lakes.

The remaining four lakes are stocked regularly, Goto with the Trout Lake strain and the other three with the Seneca Lake strain developed in New York. Little natural reproduction is expected. All four lakes have more liberal fishing regulations. Big Green is particularly popular and has several guides that specifically target lake trout during both the ice-fishing and open-water periods.

No specific contaminant advisories are in place for inland lake trout, and the Wisconsin DNR recommends that the general statewide human consumption guidelines for predatory fishes such as walleye, pike, bass, and catfish are followed, no more than one meal per week for men and for women over 50 and no more than one meal per month for children under 15 and women under 50.

Lake Michigan

After many years, natural reproduction of lake trout in Lake Michigan has finally reached significant levels again. Stocking is still needed, and commercial fishing is still banned in Wisconsin, but about 25 percent of the lake trout population is now derived from spawning in the lake. This percentage has been growing over the last two decades, and the hope is that it will continue to improve. However, nearly all of the lake trout in Lake Michigan appear to be leans derived from semi-domesticated strains, and all of the many distinctive populations that once occurred in the lake, including Siscowet, have been lost.

Lake trout are caught in good numbers by boat anglers in Lake Michigan, and although they aren't as popular as salmon, lake trout have saved many a charter boat trip when the salmon weren't biting. However, eating lake trout from Lake Michigan is constrained by mercury and PCB contamination. The Wisconsin DNR recommends only one meal per week of lake trout less than 22 inches, one per month of lake trout 22-30 inches and no consumption of lake trout over 30 inches.

Lake Superior

Lake Superior is the stronghold for lake trout in Wisconsin. Reduction of sea lamprey coupled with supplemental stocking and harvest controls have largely recovered the lean population, and nearly all fish are naturally produced. No fish have been stocked in the Apostle Islands Management Unit in Iron, Ashland, and eastern Bayfield counties in more than 20 years, and only limited stocking still takes place in the Western Lake Superior Management Unit in western Bayfield and Douglas counties. Siscowets, which were never stocked, are now thriving.

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CLASSIC LAKE SUPERIOR GILL-NETTING BOAT

The Barney Devine, a commercial gill-netting boat in Cornucopia Harbor, Bayfield County, Lake Superior.

Currently, the biggest challenge for lake trout in Lake Superior is managing sport and commercial harvest. Lake trout are the most important sport fish in the Apostle Islands area, but they are also a valuable commercial species. To protect the population and meet legal obligations, lake trout catches need to be carefully regulated and equitably allocated between Ojibwe tribal and Wisconsin non-tribal fishers. On the non-tribal side, harvest needs to be further partitioned between sport and commercial fisheries. Management of the lake trout fishery is complicated, and the division of fish among the various fishing groups is often contentious.

Every 10 years, the state and the Ojibwe negotiate a fishing agreement covering tribal versus non-tribal allocations and fishing regulations and monitoring and enforcement procedures. The most recent agreement was signed in 2018. Detailed monitoring, computer modeling and statistical analysis by Wisconsin DNR and tribal biologists are used to develop a total allowable catch (TAC) of lake trout for each of the two management units. Tribal fishers, specifically the Red Cliff Band and the Bad River Band of the Lake Superior Ojibwe, get one half of the TAC and the state the other half. Of the state's half, sport anglers get two thirds and commercial fishers one third. To ensure that the TAC is not exceeded, tribal and non-tribal commercial fishers receive tags that they must attach to all captured lake trout. Once they have used all their tags, they must stop fishing. In the Apostle Islands Management Unit, where lake trout recreational fishing is greatest, the total angling catch is tracked via a creel survey, and if more than a specified number are

***LAKE TROUT**, from page 15*

harvested, the lake trout sport fishery is closed for the year.

Leans are the backbone of the recreational fishery, but Siscowet are actually more abundant in the lake and caught in greater amounts by commercial fishers. Leans are preferred for eating because most people consider siscowets too fatty. However, siscowets have commercial value if smoked or rendered for fish oil. Because of some mercury, PCB and PFAS (perfluoroalkyl and polyfluoroalkyl substances) contamination, the Wisconsin DNR recommends people eat no more than one meal of Lake Superior lake trout, of any size, per month.

The future: Inland lakes

The outlook for inland lake trout in Wisconsin is cloudy because of global warming. Two climate change trends are most worrisome, longer summers and more intense precipitation. In summer, lake trout are restricted to the cold bottom layer of the inland lakes. The longer the summer, the more liable this bottom layer is to run out of dissolved oxygen. If this happens, lake trout will be forced into shallower warmer water that still has dissolved oxygen and will experience thermal stress and perhaps die.

More intense rainstorms can lead to greater runoff of nutrients into the lakes, accelerating the decline in bottom dissolved oxygen during summer. Poor land use in the surrounding watershed and along the lake shore can further add nutrients, making the problem even worse. Summer bottom oxygen conditions are already marginal in Geneva and Big Cedar lakes in warm years, and such years are expected to become more common. If climate warming cannot be halted, even the lakes with the best bottom conditions, Trout and Big Green, will eventually lose their lake trout.

Lake Michigan

The big question for lake trout in Lake Michigan is whether natural reproduction will continue to improve to the point that they eventually become self-sustaining. Current projections are encouraging, but the lake ecosystem has been destabilized from invasions of many non-native species over the years and is highly dynamic and unpredictable.

Of particular importance is the food base. The Lake Michigan sport fishery is currently managed for five top predators, lake trout, brown trout, rainbow trout, coho salmon, and chinook salmon. All of them feed primarily to almost exclusively on alewife, a non-native species. Alewife were formerly extremely abundant, but in the last two decades their numbers have declined. The food needs of the five predators now almost exceed the amount of alewife available. If alewife numbers get too low, the fishery for trout and salmon could collapse, as has happened in Lake Huron. To prevent this, management agencies have been reducing trout and salmon stocking, but this is unpopular with anglers. And as natural reproduction increases, which has been the case for lake trout in the lake proper and for chinook salmon in tributaries in Michigan, agencies have less direct control over predator numbers and are more at the mercy of natural fluctuations in predator abundance. Several future scenarios are plausible, some of them not good.

Lake Superior

In Wisconsin, lake trout are most secure going forward in Lake Superior. Climate change is warming the lake, but it is so big and has so much volume that it should continue to have good lake trout habitat for many years. However, some nearshore areas may gradually become less suitable, and successful sport and commercial fishing may require longer and more expensive trips to offshore areas. Loss of nearshore habit will affect leans more than siscowets. Sea lampreys remain a threat, and effective control must continue for lake trout to thrive.

Conclusions

Lake trout have long been and continue to be an important species in Wisconsin, providing unique sport fishing opportunities in a few inland lakes and serving as a keystone top predator and supporting valuable sport and commercial fisheries in the Great Lakes. Overfishing, sea lamprey predation and pollution problems that had devasted Great Lakes lake trout have been brought under control, and Lake Superior populations have largely recovered, and Lake Michigan populations are improving. Climate change threatens inland lake trout, and possible collapse of the food base is a major concern in Lake Michigan. Future prospects are best for lake trout in Lake Superior.

A member of the Southern Wisconsin Chapter of Trout Unlimited John Lyons is curator of fishes at the University of Wisconsin Zoological Museum.