

Wisconsin salmonids: Past, present and future

Rainbow trout, from Great Lakes steelhead to inland stockers and wild fisheries.



FALL WILD STEELHEAD FROM THE BOIS BRULE

A fall wild steelhead from the Bois Brule River that has been in the river long enough to lose its silvery color.



A STEELHEAD FROM THE SIOUX RIVER

Words and photos by John Lyons

Rainbow trout are the most schizophrenic of the Wisconsin salmonids. On the one hand, when referred to as steelhead, they are one of the most sought-after and revered gamefish in the state, pursued by aficionados who will brave the foulest weather and the most treacherous fishing conditions in pursuit of their quarry. Steelhead are justifiably famous for their strength and speed and are undoubtedly one of the best-fighting fish in Wisconsin.

Yet on the other hand, when referred to as rainbow trout, they can be a most domesticated creature, raised in crowded raceways at fish farms, stocked in artificial urban fishing ponds and made available for kids to catch in plastic pools in exhibition halls hosting winter fishing shows. Author Anders Halverson titled this type of rainbow trout "An entirely synthetic fish" in his 2010 book. But although they seem to have little in common, these two entities are biologically the same species. Let's explore how these very different versions of the rainbow trout came to be found in Wisconsin, where they occur today and what their future holds.

the sea as juveniles and then return to those same rivers as much larger adults to spawn.

Migratory rainbow trout are indistinguishable from resident rainbow trout as juveniles, but quite different in appearance in their lake or ocean environment, when they take on a silvery, steel-gray or chrome sheen and are known as steelhead. Some consider steelhead a form of salmon, but they differ from the other Pacific salmon, with which they often co-occur, in not always dying after spawning and retaining the capability of spawning again in a subsequent year. As adults, some resident rainbow trout rarely exceed 12 inches, but some migratory steelhead may reach more than 12 pounds.

Scientists have struggled with defining the rainbow trout. Nineteenth-century ichthyologists described nearly every distinctive population as a separate species, each with its own scientific and common name. Early settlers, fish culturists and fisheries managers paid little mind to this classification and routinely moved, mixed and cross-bred fish from different places, mongrelizing and obscuring many formerly unique biological entities. The readiness with which many distinctive populations successfully reproduced with each other eventually con-

tions will complicate the analysis.

THE PAST:

The origins of a global fish species

The rainbow trout was one of the first fishes cultured in the United States. Propagation began in the San Francisco area in the 1870's, and in 1880 a federal fish hatchery was established in the McCloud River drainage near Mount Shasta in northern California. This hatchery started with McCloud resident and migratory fish (a form of redband trout) but then later brought in migratory fish from other rivers in northern California and southern Oregon, eventually mixing and cross-breeding all of these different populations. Compared to other trout and salmon species, rainbow trout proved relatively easy to raise, and eggs from this hatchery were shipped throughout the United States and used to provide brood fish for many other hatcheries that were established in the eastern United States. From the United States, rainbow trout were eventually exported to suitable waters throughout North America and every other continent except Antarctica.

Another new fish for Wisconsin

In the late 1800's Wisconsin fisheries were in decline from environmental degradation caused by unchecked plowing, grazing, timber cutting, dam building, pollution and overfishing. Rather than effectively addressing these impacts, the preferred response in this era was to introduce new and presumably more tolerant species to the state. From 1875 through 1925, the Wisconsin and federal governments and some individual citizens stocked at least 10 non-native species in Wisconsin waters – arctic grayling from Michigan and Montana, American shad and Atlantic salmon from the East Coast, chinook salmon and rainbow

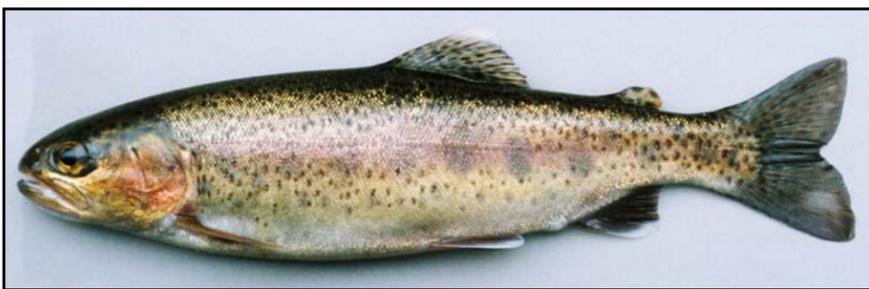
trout from the West Coast and goldfish, common carp, rudd, tench and brown trout from Europe.

Of these, only common carp, brown trout and rainbow trout became widely established at the time. Common carp were certainly more tolerant, but caused major harm rather than benefits to warmwater habitats and fish species. Brown trout, as discussed in the last issue of Wisconsin Trout, improved trout fishing overall but at the expense of native brook trout. Rainbow trout started slowly in Wisconsin, but eventually became a key species supporting inland and Great Lake trout fisheries.

The exact origins of the first rainbow trout in Wisconsin, the federal hatchery in California or other federal or state hatcheries in Michigan or New York, are uncertain. But by the 1890's rainbow trout were being raised in Wisconsin government and private hatcheries and being stocked throughout the state. The first introductions in Wisconsin were a mix of resident, migratory and cross-bred fish. Rainbow trout became popular for stocking because they were relatively easy to raise at high densities compared to either brown trout or brook trout and could survive slightly higher water temperatures in captivity and the wild.

Lake Superior and its tributaries

Despite being introduced statewide in massive numbers, only in Lake Superior and certain tributaries, most notably the Bois Brule River, did naturalized, self-sustaining populations become established initially. Elsewhere in the state, regular stocking was necessary to maintain populations. Even where naturalized populations developed in Lake Superior tributaries, stocking to improve numbers continued in some waters up to 2002. Apparently, some resident rainbow trout were also present in the Bois Brule and perhaps other tributaries at



JUVENILE WILD MIGRATORY RAINBOW TROUT FROM DREW CREEK

What is a rainbow trout?

The rainbow trout, as currently recognized, is native to the Pacific slope from the northern part of Baja California in Mexico, the entire west coast of the conterminous United States and Canada, southern Alaska, and eastern Siberia and the Kamchatka Peninsula in Russia.

Within this vast range there is a bewildering variety of populations that encompass tremendous natural genetic, morphological and life-history diversity. Some populations occupy rocky rushing mountain streams and others thickly vegetated slow-moving spring runs in the desert.

Some populations are "resident" and rarely move more than a few hundred yards over the course of their lives whereas others are "migratory" or "anadromous" and migrate hundreds of miles from the rivers of their birth to a large lake or

vinced scientists that most were in fact part of the same highly variable species, the rainbow trout.

But some populations looked and behaved so differently, such as the various forms of redband trout of northern California and Nevada, Idaho, western Montana, and Oregon and Washington east of the Cascade Mountains, the golden trout of California's Sierra Nevada Mountains, the apache trout of southern Arizona, the gila trout of southeastern Arizona and southwestern New Mexico, and the poorly known but highly variable native trout of Mexico's Sierra Madre Occidental Mountains, that even today there is debate whether they represent separate species or merely particularly distinctive rainbow trout lineages. Recent advances in genetic techniques will help clarify the situation, although years of poorly documented stocking and mixing of popula-



GANARASKA STRAIN STEELHEAD FROM SAUK CREEK

The author with a stocked Ganaraska strain Steelhead from Sauk Creek in Ozaukee County, Wisconsin.



JUVENILE WILD STEELHEAD FROM THE SIOUX RIVER



JUVENILE STEELHEAD FROM A TRIBUTARY OF THE SHEBOYGAN RIVER

first, but they had disappeared by the 1950's.

The Bois Brule quickly became (and remains) a destination fishery for anglers targeting steelhead. Its importance and popularity have led to its steelhead to receive more scientific study than any other Wisconsin population. The Brule is unique among Wisconsin Lake Superior tributaries in that it has large steelhead "runs" in both the fall and spring. Other tributaries have large runs only in the spring. All Lake Superior rainbow trout spawn in the spring, but in the Brule many Steelhead ascend the river from September through December and then overwinter in deep holes, which are generally lacking in the other tributaries.

They soon revert from steely-gray to a more classic "rainbow" appearance. A fresh run of chrome-colored steelhead enters the Brule in late February through April, and both the fall and spring fish spawn together from March through early May. Eggs are deposited in shallow pits in gravel, known as redds, excavated by the female. After a spawning bout is completed, the female buries the fertilized eggs in the gravel and no further parental care is provided. The eggs hatch after 3-5 weeks, and the fry absorb their yolk sac and emerge from the gravel and become free swimming and begin feeding 2-3 weeks later.

Juveniles spend from one to three years, usually two, in the river or its tributaries before transforming into silvery smolts and migrating to the lake at 6-10 inches to grow to adulthood. They remain in the lake for one to four years, usually two, reaching 21-25 inches and 3-6 pounds before returning to the river to spawn for the first time. Many of these fish survive the rigors of reproduction and return to Lake Superior to grow larger before making additional spawning runs in subsequent years. The largest steelhead may exceed 30 inches and 10 pounds.



A STEELHEAD SMOLT FROM THE BRULE RIVER'S COPPER RIDGE

Lake Michigan and tributaries

Lake Michigan was one of the first areas of Wisconsin to receive rainbow trout, but it was not until the 1960's that stocking produced fishable results. In the late 1800's and early 1900's many attempts were made to create steelhead runs in Lake Michigan and its tributaries. However, these early efforts were unsuccessful because survival of stocked fish in the lake was low, perhaps owing to the many predatory lake trout present, and the tributaries were generally too warm to allow for successful reproduction.

Stocking ceased by about 1915. However, in the mid-1960's, with lake trout eliminated and Lake Michigan full of abundant alewife as potential prey, rainbow trout introductions recommenced.

This time around they were quite successful, with excellent survival and growth. Anglers began to take large steelhead from 5 to more than 10 pounds from the lake during summer and fall and from tributaries during the spring. Limited natural reproduction was observed in a few small cold tributaries, but the numbers of offspring produced were small compared to the angling demands, and heavy stocking was necessary to maintain the fishery. Many millions of juvenile rainbow trout have been released in the lake and its tributaries during the last 50 years, which continues today.

Inland waters

Inland introductions of rainbow trout began in the 1890's and have never stopped. However, establishment and natural reproduction has been limited or absent almost everywhere. To my knowledge the only two exceptions are the Drew Creek system in Langlade and Menominee counties, and the West Fork of the White River in Waushara County, both of which have self-sustaining populations large enough to support fishing. The Drew Creek popu-

lation originated in the 1960's when a private fish hatchery along the creek in Langlade County began to raise rainbow trout from Washington State. Fish from the hatchery soon escaped and colonized the creek and moved downstream through a short stretch of the West Branch of the Wolf River into Florence (Langlade County) and Upper Bass (Menominee County) lakes. Although the West Branch continues downstream from Upper Bass, rainbow trout did not colonize it further.

These rainbow trout are migratory, spending their first two growing seasons in Drew Creek and then at 6-9 inches moving to Florence or Upper Bass for most of the rest of their lives. In April, adults from the lakes move into Drew Creek to spawn and then return back to the lakes when finished. These adults range from 15-21 inches and 1-3 pounds, although there are unverified reports of larger fish.

The origins of the West Branch of the White River population are unknown, but rainbow trout were established there by the 1960's. This population is unique in the state in

steelhead stocked in Minnesota may enter Wisconsin.

In inland lakes and streams and in urban ponds, about 250,000 fish from the domesticated Erwin Strain are introduced annually, usually at "catchable" sizes from 6-9 inches. In this context, domesticated means that the fertilized eggs used to produce fish for stocking are obtained from "brood stock" adults maintained in the hatchery. Small numbers of brood stock up to 20 inches are sometimes added to a few inland lakes and streams to provide a trophy opportunity. Survival of inland and pond stockings is low, with most fish harvested or dying of natural causes soon after being released in the spring. However, in some waters a few fish may "carry over" and survive to the following year.

In Lake Michigan and tributaries, a total of about 450,000-500,000 steelhead of four different strains. Arlee, Chambers Creek, Ganaraska and (when available) Skamania are stocked each year. The use of different strains diversifies and increases fishing opportunities in terms of where fish occur in Lake Michigan and when they enter tributaries for



RESIDENT WILD RAINBOW FROM THE WEST BRANCH WHITE RIVER



SKAMANIA STEELHEAD FROM THE MENOMINEE RIVER

that it consists of resident fish. Naturally produced rainbow trout occur throughout the 16-mile length of the West Branch, but are present only as strays in the White River into which the West Branch flows. They reach a maximum size of about 15 inches and one pound although most fish are under a foot. They do not migrate downstream to the White River Flowage even though co-occurring brown trout, which are 5-10 times more abundant, often do.

**THE PRESENT
Current stocking**

Most rainbow trout fisheries in Wisconsin rely on stocking to persist. The Wisconsin Department of Natural Resources (DNR) raises 700,000-750,000 rainbow trout annually at 3-5 hatcheries for stocking into Lake Michigan and tributaries, inland streams and lakes, and artificial urban fishing ponds. Dozens of commercial operations annually produce more than a million more rainbow trout for sale as food, use in private fee-fishing ponds and fishing show events, and occasional private stockings into public inland waters as permitted by the DNR. No rainbow trout stocking currently takes place in Wisconsin's waters of Lake Superior or its tributaries, although

spawning. Other strains such as Erwin, Shasta and Kamloops, were tried prior to 2010 but dropped because of poor success. None of the strains can be consistently identified based on appearance alone, and the DNR uses internal tags or external fin-clips and the timing and location of spawning runs to distinguish them.

The domesticated Arlee strain, a mix of several migratory West Coast forms that was developed in Montana, is stocked directly in nearshore areas of the lake and near the mouth of a few larger tributaries. Arlees remain in relatively shallow water for much of the year and are more available to shore anglers than the other strains, which tend to stay further offshore except for their spawning migrations. Arlees first enter spawning streams in December and their run and actual spawning peaks in March. They are a deep-bodied fish that may exceed 30 inches and 10 pounds.

The Chambers Creek, Ganaraska and Skamania strains are semi-domesticated, that is, their eggs are obtained from previously stocked fish migrating for spawning into either the Root River in Racine County or the Kewaunee River in Kewaunee County.

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LETTER TO THE EDITOR

I read with interest Tom Wiensch's letter regarding coaster brook trout, in particular his statement that "it's hard to imagine that any significant portion" of TU members would oppose his idea to make brook trout catch-and-release only on the Brule River to effect a return of the coasters. For what it's worth, here's one member who disagrees.

I've been fishing the Bois Brule since I was in high school in the mid-1960's, mostly for stream trout on the upper river but also for steelhead in the fall. Aside from my practical knowledge, I sought out on-line information on coasters before writing this letter. In particular, I reviewed a 1996 report entitled "Status of Brook Trout in Lake Superior" that appears to be a joint production of the U.S. Fish and Wildlife Service and the Wisconsin DNR, as well as an undated Wisconsin DNR publication entitled "Lake Superior Coaster Brook Trout."

These confirm Wiensch's suggestion that the coaster decline was caused in large part by overfishing. However, the overfishing, including commercial fishing in Lake Superior, that caused the coaster populations to plummet occurred in the 1880's to be followed by the severe environmental degradation caused by logging the virgin forests. Then there is the added competition from subsequently-introduced non-native trout such as browns and rainbows. There is also a suggestion that, although coasters are not a distinct ge-

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They are stocked mainly in tributaries. The Chambers Creek Strain originated from Washington State and was developed in New York State. Chambers Creek fish enter spawning streams beginning in mid-November with their migration peaking and actual spawning taking place in March and early April. Spawners typically range from 25-29 inches and 6-9.5 pounds.

The Ganaraska Strain is from the West Coast and was developed in Ontario. Ganaraskas also begin migrating in November, and their run and actual spawning peaks in April and early May, 2-4 weeks later than Chambers Creek fish. Ganaraskas are a little smaller, usually ranging from 23-26 inches and 4-7 pounds.

The Skamania strain was developed in Washington State and the DNR obtained its first eggs from Indiana. Stocking began in the early 2000's but was paused after 2008 because of concerns over the potential for the newly arrived disease Viral Hemorrhagic Septicemia to enter the hatchery system. After modifications of procedures for obtaining and handling eggs, stocking of the Skamania strain recommenced in 2018 and 2019. Because the adults aren't expected to return in significant numbers until 2022, the success of these most recent stockings is uncertain.

Skamania provide the potential for a true summer-through-winter stream fishery. Skamanias begin entering tributaries as early as late June or early July when rains raise river levels, and their run peaks from mid-September through mid-December with spawning taking place in late December through February. Skamanias also have the potential to reach larger sizes than other strains, with spawning fish of 28-32 inches and 8-12 pounds.

Wild rainbow trout management

Efforts to manage self-sustaining populations of rainbow trout in Wisconsin focus on preserving genetic integrity and protecting juveniles and spawning fish from overharvest. Rainbow trout stocking does not occur in Lake Superior and its tributaries, the Drew Creek system or the West Branch of the White River. This prevents hatchery strains from interbreeding with naturalized populations and potentially eliminating any unique attributes that allow these populations to remain viable.

Supplemental stocking does occur in the few Lake Michigan tributaries with natural reproduction because these localized populations are thought to be too small to withstand the heavy fishing pressure that

occurs during the steelhead run.

Size limits and season closures shield self-sustaining rainbow trout populations from overharvest. In Lake Superior tributaries, the steelhead season runs from late March to mid-November, allowing anglers access to the fall and spring runs but not the overwintering period. The size limit is 26 inches with a daily bag limit of one, protecting all first-time steelhead spawners from harvest.

Lake Michigan tributaries have a 10-inch size limit, which eliminates harvest of naturally reproduced juveniles before they venture to the lake.

Drew Creek has a size limit of 8 inches, which also protects more than 95 percent of juveniles before they move downstream to Florence and Upper Bass lakes, and trout harvest is prohibited from mid-October to early May, preventing removal of the adults coming out of the lakes to spawn. The lakes themselves are private and have little fishing pressure.

The West Branch of the White River has a 12-inch size limit for rainbow trout, which safeguards more than 99 percent of the fish, and harvest is not allowed during the March-April spawning period.

THE FUTURE

Lake Superior and tributaries

Climate change clouds the future for Lake Superior steelhead. Projections indicate that by mid-century warming temperatures and more variable precipitation will reduce the amount of tributary habitat available for spawning and rearing of juveniles. The Brule and other top-quality tributaries such as the Sioux River in Bayfield County will remain suitable, but the ability of many others to produce steelhead will be reduced or lost.

Interestingly, as Lake Superior itself warms, it may become more suitable for steelhead. Right now the lake is generally too cold for maximum steelhead growth. However, whether a warmer Lake Superior will mean better steelhead growth and survival depends on the availability of sufficient food, and how the current cold-adapted food web will respond to climate change is uncertain.

Lake Michigan and tributaries

As they do now, in the future Lake Michigan steelhead fisheries will continue to depend on and be determined by stocking, but not just of rainbow trout. The Lake Michigan trout and salmon sport fishery is

currently managed for five species, steelhead, brown trout, lake trout, Coho salmon and chinook Salmon, all of which are largely or completely dependent on fish from hatcheries.

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netic variant, the subsequent stocking of non-native brookies may have decreased the anadromous tendencies of Brule River brook trout. The problem I see with Wiensch's proposal is that it will be impossible to recreate the pristine pre-1900 conditions that fostered the coaster fishery.

Finally, I dispute Wiensch's statement that there has been "no improvement" in the last 30 years of brook trout fishing on the Brule. It has been perhaps 20 years since the 10-inch, artificials-only regulation was imposed on the stretch from Stone's Bridge to Winnebiquou, which is the prime brookie water on the Brule, and it has begun to pay off.

When I started fishing the Brule it was rare to catch a brookie over 7-8 inches; most were in the 5-6 inch range. Now, while there may be fewer small fish, the increased size of the brookies brought to the net is very noticeable. In the last five years I have caught and released a number of brookies in the 14-15 inch range. The current regulations seem to work well.

Most anglers on the upper Brule already practice catch and release, but many of us like the option of keeping a few for the pan now and then. Banning the taking of any brook trout to support the pipe dream of reestablishing the pre-1900 coaster population is not warranted, and likely to fail because that alone will not recreate the pre-1900 conditions that allowed the coasters to exist.

—Mike Heffernan

will also affect stream flows and lake levels, and during dry periods, many smaller tributaries may become inaccessible to steelhead migrating from the lake.

There are major concerns that too many salmonids may collapse prey populations in Lake Michigan, leading to a decline in the fishery. This appears to have already happened in Lake Huron. Federal and state fisheries managers responsible for Lake Michigan try to balance total salmonid stocking levels with food availability, but prey abundances, particularly alewife, are currently relatively low, and there is little room for error.

In some years, when natural vari-

Inland waters

As is the case now, with the exception of the Drew Creek system and the West Branch of the White River, the future of rainbow trout in Wisconsin's inland waters will be completely determined by hatchery production and stocking policies. Climate change may have a relatively limited effect on these fisheries.

Even in the projected warmer climate of mid-century, spring water temperatures should still be cold enough for short-term (1-2 month) survival of domestic rainbow trout. However, carry-over will be greatly reduced, and in most streams no fish will survive the summer after their release.

Fortunately, the most recent projections indicate that both the Drew Creek system and the West Branch of the White River are likely to remain cold enough at mid-century to support their wild, self-sustaining rainbow trout populations. However, the amount of suitable habitat in each stream will be gradually reduced as temperatures increase, and summer habitat in Florence Lake and Upper Bass Lake in the Drew Creek system will become increasingly marginal. If warming trends are not controlled, both populations are likely to be greatly stressed and perhaps eliminated by late century.



DNR'S LEE KERNAN IN 1968

Lee Kernan, Former Wisconsin DNR Chief of Fisheries Lee Kernan holding one of the first large stocked rainbow trout to be caught from Lake Michigan, Door County, in 1968. Photo courtesy of Lee Kernan.

ations in survival and abundances threaten to push the predator-prey relationship out of balance, the best response might be to decrease or even temporarily stop stocking. However, many angling groups and lakeshore communities dependent on fishing tourism resist this, perhaps understandably, making management difficult and putting the overall salmonid fishery, including steelhead, at risk.

Because most Wisconsin Lake Michigan streams are already too warm for rainbow trout during summer, climate change will have less of an effect on steelhead runs in Lake Michigan than in Lake Superior. However, higher water temperatures do threaten the few small naturally reproducing steelhead populations in Lake Michigan tributaries. More variable precipitation

Conclusions

Rainbow trout fisheries in Wisconsin are a mix of wild self-sustaining populations and stocked domesticated and semi-domesticated populations. Nearly all fish, wild or stocked, appear to be migratory, but the West Branch of the White River supports a unique resident population of rainbow trout.

In the Lake Superior basin all populations are wild whereas in inland waters and the Lake Michigan basin nearly all are maintained by stocking. The Bois Brule River has the best wild population, whereas several Lake Michigan tributaries have large hatchery-maintained runs of different steelhead strains. Climate change and, in Lake Michigan, overstocking are the biggest future threats to rainbow trout populations and fisheries in Wisconsin waters.

John Lyons is a member of the Southern Wisconsin Chapter of Trout Unlimited and is Curator of Fishes at the University of Wisconsin Zoological Museum. This is the third in his ongoing series. Brook trout and brown trout were discussed in previous issues of Wisconsin Trout.