# Wisconsin salmonids: Past, present and future

*As a first installment in a new series of articles focusing on the past, present and future of Wisconsin salmonids, author John Lyons explores our beautiful native brook trout.*

**By John Lyons**

"Brookie." Just saying or reading the word always gives me a happy little jolt. All salmonids are beautiful and fascinating, but the brook trout is hands-down my favorite. Brookies are gorgeous, particularly a male in bright spawning colors in the fall. They evoke images of the Northwoods in a bygone era, when all the rods were made of cane and a three-wet-fly rig fished across and downstream was the standard.

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**EARLY ANGLERS ON THE BOIS BRULE RIVER**
"Limiting your catch" was a phrase yet unborn at that time.

Brook trout need cold and clean water, and if a stream has a healthy population, you know it's in good shape. Occasionally, brookies can be incredibly finicky, as all trout should be sometimes, but mostly they are ready feeders, rewarding a well-matched fly and a good cast with a solid strike and a spirited fight. And if you're so inclined, they taste delicious, especially when cooked in butter over an open fire after a long day on the water. What's not to love?

## The past

Brook trout and lake trout were the only two trout or salmon species originally native to Wisconsin, and only the brook trout was regularly found in inland streams and small ponds. Brookies also have the possible distinction, along with the slimy sculpin, of being the fish species with the longest continuous residence in the state.

Recall that tens of thousands to hundreds of thousands of years ago, most of what is now Wisconsin was covered by glaciers during a series of ice ages. Only the Driftless Area, so named because of its lack of glacial drift, the material deposited by overlying glaciers, remained ice-free. But it was no doubt a harsh, tundra-like place in those days, and only a few cold-loving, stream-dwelling species could have possibly survived there when glaciers covered the surrounding lands.

The brook trout and slimy sculpin are the most-likely candidates. All the other 140-odd native Wisconsin fish species survived glaciation in refuges further south and had to colonize the state when the glaciers finally receded beginning 10,000-20,000 years ago.

Of course, to get beyond the Driftless Area, brookies also had to do some colonizing of their own, and they did it well, reaching essentially all areas of the state soon after the glaciers were gone.

Given what we know of the geology of Wisconsin and the historic distribution of coldwater streams, the Driftless Area remained a stronghold for brook trout, including northeastern Iowa, southeastern Minnesota, and perhaps a tiny piece of extreme northwestern Illinois. These populations represent the westernmost extent of the brook trout's entire native range, and only in the Appalachians of the eastern U.S. do brook trout occur further south.

Brook trout were also numerous in the "Sand County" streams of central Wisconsin, and the "Northwoods" of the northern third of the state. Some scattered populations occurred in a few spring-fed streams of eastern Wisconsin, but the streams in this region were generally too warm. Lake Superior had numerous brook trout, including the famous "coasters" that lived in nearshore areas. Lake Michigan also had coasters, but probably fewer than Lake Superior because most of its tributaries on the Wisconsin side were not suitable for brook trout.

Native Americans are believed to have moved into Wisconsin as transient hunter-gatherers soon after the ice age ended 8-10,000 years ago, although the earliest settlements excavated by archaeologists date back only 2-3,000 years. Interestingly, although brook trout are likely to have been widespread and common during this entire period, there is no conclusive evidence that they were eaten by indigenous peoples until the era of European exploration and settlement.

Numerous fish bones have been excavated at several pre-European archaeological sites around Wisconsin, indicating that fish were often an important part of the indigenous diet.

Bones of many different species have been found, including sturgeons, gars, bowfin, many different suckers, catfishes and bullheads, northern pike, muskellunge, basses, sunfishes, crappies, yellow perch, walleye, sauger, freshwater drum, and, at sites along the Great Lakes, lake trout, whitefishes, and ciscoes.

But brook trout bones are notable by their absence. Admittedly, the archaeological sites are located along larger rivers and lakes, not ideal brook trout habitats. But native Americans undoubtedly visited trout streams during their travels, so the lack of evidence for brook trout consumption is curious. But as the saying goes, the absence of evidence is not evidence of absence, and future excavations may help clarify whether brook trout were important as food for early native Americans in Wisconsin.

In contrast, there is extensive evidence that the first European explorers and colonists consumed brook trout in large amounts. Early accounts relate that many streams were full of brook trout and that settlers captured and ate prodigious numbers. By the 1850's and 1860's, market fisheries had developed for brook trout (and many other species), and large numbers were captured, processed, sold and shipped to fish shops and restaurants in the growing cities of the region.

Soon thereafter, well-to-do sportsmen from these cities began to travel to the countryside to catch fish on their own, particularly in northern Wisconsin. Entrepreneurial locals began to provide rustic lodging and meals and guide service, and the Wisconsin "fishing resort" was born. Many of these resorts focused on warmwater species such as largemouth and smallmouth bass and coolwater species such as walleye, northern pike, and muskellunge, but in the area near Lake Superior, where large coasters were plentiful, several resorts focused on brook trout. Most were located on the famous Bois Brule River in Douglas County. Early sport anglers absolutely did not practice catch and release, and harvests of hundreds of trout per day were commonplace.

Larger fish were the main target, but brook trout of only 5-6" were routinely kept, sometimes to spoil and be discarded before they could be eaten.

All of this fishing pressure took its toll, and by the late 1800's anglers were already complaining that numbers and sizes of brook trout catches were down.

Whereas coasters up to five pounds had been caught earlier in the 1800's, now fish over 1-2 pounds were rare. Catches in inland streams also dropped precipitously. Stocking was seen as a solution, and the first brook trout hatchery, Nevin, still in operation today, was built south of Madison in 1876. Other trout hatcheries soon followed.

the environmental impacts of European settlement.

First came agricultural development, moving from south to north. The prairies, savannas and wooded areas were cleared and cultivated and grazed with little regard for soil or water conservation. Massive erosion and sedimentation were the results, choking streams and smothering spawning areas with sand and silt. Wetlands were steadily drained and filled, lowering the water table and drying springs.

The Driftless Area, with its highly erodible soils and steep topography, was the hardest hit, and brook trout nosedived there first.

Dams were built almost everywhere, blocking spawning runs, particularly for fish coming out of the Great Lakes. And finally the northern pineries were cut and then the land was put to the plow in doomed agricultural attempts, again contributing to massive erosion and sedimentation and declines in spring flow. Efforts to float cut logs to market resulting in tremendous damage to stream channels, and in some parts of northern Wisconsin natural channel morphology has still not fully recovered more than a century after the last logging drives.

Brook trout hit their low point in the early 1900's. By then the species was almost completely gone from the southern third of Wisconsin, uncommon and localized in the central third, and much reduced in the northern third. Coasters were eventually eliminated from the Wisconsin waters of the Great Lakes. Stocking was ramped up to compensate, but it was poorly focused, and most was of the "put and take" variety, and consequently little re-establishment occurred. If not for the introduction and spread of the more tolerant brown trout, trout fishing opportunities would have disappeared from most of the state.

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**FAMOUS COON CREEK PHOTO**
Note the rider on the horse, atop the eroded creek bank. Those soils had eroded from the hillsides in a matter of decades.

The earliest hatchery brook trout in Wisconsin were derived from local wild fish, but by 1887 brook trout from outside the state were being imported to try to increase hatchery production. Brook trout were regularly brought into Wisconsin from elsewhere, often the northeast, to bolster stocking during the next 100 years.

Although overfishing was a serious problem, the existential threat to Wisconsin brook trout was from

## First restoration project on Coon Creek

The road to recovery was slow. The first-ever watershed restoration project in the nation, under the guidance of Aldo Leopold, began in the Coon Creek Watershed in Vernon, Monroe and Lacrosse counties in the Driftless Area in the mid 1930's.

Through trial and error, this project and the many others that

followed gradually developed and implemented new agricultural practices that reduced soil erosion, slowed runoff and increased water retention on the landscape, improving the water table. Dried-up springs started to flow again, and the land slowly healed.

Reforestation of the Northwoods began. Scientific fisheries management was initiated, including standardized fish population surveys, more rational stocking polices, effective regulations on fish harvest and efforts to improve trout stream habitat. Early stream improvements were often poorly conceived, ineffective and short lived, but much was learned from these failures, and habitat techniques steadily improved.

By the 1970's and 1980's, more than 40 years of rehabilitation had begun to yield fruit. Stream hydrology and water and habitat quality had improved to the point that many formerly degraded streams could once again support self-sustaining trout populations, at least for brown trout.

Groups like TU and local fishing and conservation clubs worked with the DNR to improve trout streams in an effective manner. Trout stocking began to incorporate fish of wild origin (i.e., eggs and milt collected from wild fish) rather than just domesticated fish, which had been raised in the hatchery for many generations and had lost much of their natural wariness and "stream smarts."

As a result, survival and establishment of stocked fish jumped markedly. Brook trout began to reproduce again in the headwaters of many streams. Strict harvest regulations protected newly emerging populations. By the late 1990's, brookies in southern Wisconsin were doing better than at any time in the previous 100 years, and Northwoods brookies were on the upswing as well.

## The present

Although exact numbers are hard to determine, as of 2020 self-sustaining brook trout populations occupy about 3,500 miles of streams statewide. Populations supported partially or completely by stocking cover another 3,000 or so miles of stream.

Most of these streams are in the Northwoods, but there are also many good populations in the Driftless Area and the Sand Counties, and a few scattered brook trout creeks in eastern and southeastern Wisconsin. Additionally, there are over 100 brook trout "spring ponds,"— cold, spring-fed ponds of a few acres or less, almost exclusively in the Northwoods, particularly in and around Langlade County.

Some of these spring ponds have the potential to produce large fish of two or more pounds. However, coaster populations remain extirpated from the Wisconsin Great Lakes.

The current distribution of brook trout in Wisconsin streams, about 6,500 miles, although impressive by the debased standards of the early 1900's, is but a shadow of what it was before European settlement.

Habitat suitability models from the DNR estimate that in 1820 more than 20,000 miles of Wisconsin streams were probably suitable for brook trout. Over 10,000 miles of these streams, mainly headwaters, have since been so modified by agriculture, urbanization, forest clear-cutting, ditching and straightening, pollution, or dams that they no longer can support any trout, despite the improved land use and restoration efforts of the past decades.

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**EARLY ATTEMPTS TO STEM EROSION ON COON CREEK**

Farmers used willow branches to stem bank erosion in those earliest attempts at erosion control.

But perhaps up to 3,000 miles of larger streams that currently lack brook trout have perfectly adequate habitat and water quality conditions. In these streams, the reason for the absence of brook trout appears to be the non-native brown trout.

Brown trout grow larger and are more aggressive, and they are capable of displacing brook trout in many situations. Particularly in the Driftless Area, a healthy brown trout population usually eliminates brook trout or restricts them to tiny tributaries and headwater areas with icy cold water.

Where water temperatures are especially low, the brown trout's advantages are lessened. There is some suggestion that some types of stream habitat improvement, particularly increases in deep undercut banks, tilt the scales in favor of brown trout. Although the newly created habitat is suitable for brookies, it is even more favorable for browns, and the high densities of brown trout that result drive brook trout away through antagonistic behaviors and the threat of predation.

If brown trout are excluded and removed, as has been done in Seas Branch in Vernon County, brook trout numbers rebound quickly, and they readily occupy the deep undercut areas. Brown trout suppression of brook trout seems to be less of a problem in northern Wisconsin, where perhaps brook trout are better able to deal with the longer and harsher winters.

## Coasters

The coaster brook trout of Lake Superior have drawn substantial attention and research during the last 25 years.

Coasters get their name from their habit of staying close to shore during their time in the lake, where they can be caught from shore or small boats in relatively shallow water. They typically spend their first 1-4 years in the tributary stream where they were born before migrating downstream to the lake, although some fish spend their entire lives in the lake, spawning on nearshore gravel shoals.

In the lake, coasters tend to avoid deep open water, instead staying near shore in bays and river mouths not far from their streams or shoals of origin. After some time in the lake, during which time they grow much faster and larger than do the resident brook trout that remain in the tributaries for their entire lives, many coasters return to the tributaries to spawn.

Usually, spawners return to the same stream where they were born. Spawning is a stressful and energetically expensive activity, and many fish die during or soon afterwards, but some fish survive and are able to spawn again in succeeding years.

Although gone from the Wisconsin and Minnesota tributaries of Lake Superior, small coaster populations persist in a few streams of the Upper Peninsula of Michigan, Isle Royale, and the north shore of Ontario.

The largest remaining population, although substantially down from its heyday 100 years ago, is in the Nipigon River, Ontario, the source of the world record brook trout at 14.5 pounds in 1915. There has been great interest in restoring coasters in Minnesota and Wisconsin, but efforts to date have been unsuccessful.

In the 1990's and early 2000's, it was thought that coasters might be a distinct strain of brook trout, separate genetically from the stream residents they coexisted with. With this in mind, offspring from some of the remaining coaster populations were raised in hatcheries and then stocked into new waters, including Whittlesey Creek near Ashland, Wisconsin. But this approach proved ineffective.

Subsequent genetic analyses have indicated that each coaster population is somewhat unique and probably adapted to specific local conditions. Coasters from a single or several nearby streams are more closely related genetically to the resident brook trout of those same streams than they are to the coasters of other streams further away. In other words, the resident and the coaster brook trout of a particular stream or set of nearby streams are the same genetic entity. Indeed, it is thought that both stream-residents and coasters might be produced by the same parents.

This implies that all of the brook trout in that stream or streams are potential coasters (or residents), and rather than being hard-wired genetically, the likelihood of a particular fish remaining in the stream or migrating downstream to the lake during its lifetime is largely determined by the specific ecological conditions it experiences. But exactly what conditions trigger migration remain unclear. And with the major habitat and biological changes that have occurred in Wisconsin Lake Superior tributaries since coasters disappeared, especially the establishment of non-native brown trout, rainbow trout, and coho salmon, one wonders if the appropriate conditions for brook trout migration could ever actually occur again.

Experimental exclusion and removal of non-native salmonids from a high-quality brook trout tributary might help answer this question. Thus, coaster brook trout potential may still exist in Wisconsin, but whether coasters will ever reappear remains to be seen.

## Wild versus domestic

As mentioned earlier, the stocking of "wild" versus domestic brook trout by the DNR has contributed greatly to the current expansion of brook trout populations. Recent advancements in our understanding of the genetic make-up of Wisconsin brook trout populations have been used to improve the wild stocking program.

When the program began, the choice of donor streams for wild brook trout for use in the hatchery was driven mainly by which streams had enough adults to provide sufficient eggs. However, there was always a question of what genetic strains of brook trout were in these donor streams. Ideally, the goal was to stock wild Wisconsin-, or at least Upper Midwest-genome fish, rather than strains that had evolved elsewhere and then been introduced into the state.

The thinking, backed by results from other stocking and restoration efforts elsewhere in North America, was that Wisconsin or Upper Midwest fish would be better adapted to local conditions and more likely to persist going forward. But recall that fish from outside Wisconsin and the Upper Midwest had been stocked here regularly since 1887, and that hatchery fish had long been domesticated. It was unknown whether the original "native" wild strain still existed or whether it had been replaced or diluted by hybridization with domesticated or non-native strains.

Finally, within the last 15 years or so, sufficiently sophisticated genetic tools became available to ad-

**COASTER BROOK TROUT NO LONGER IN BOIS BRULE**

The Bois Brule River in Douglas County is a northwoods river with excellent brook trout populations in the headwaters and tributaries. The main channel, shown here, is now dominated by brown trout, rainbow trout and coho salmon. Formerly this river was known for producing large coaster brook trout, but they no longer occur here.

dress this issue. A collaborative multi-state effort determined that there was still a distinctive wild "Upper Midwest" strain, possibly descended from those brook trout that may have survived the ice ages in the Driftless Area, and that it was still present in Minnesota, Wisconsin and at least parts of Michigan.

However, some self-sustaining populations were derived from domesticated hatchery strains that might include genetic material from the Northeast. Indeed, one of the original wild brook trout program streams, Ash Creek in Richland County, contained the domesticated strain.

The distribution of Upper Midwest and domesticated stream populations has now been mapped, and going forward, only the Upper Midwest strain will be used in the wild brook trout stocking program.

## The future

Unfortunately, prospects for brook trout in Wisconsin are grim because of climate change. If the climate warms as expected and nothing changes in terms of watershed land use and stream management, DNR projections are that Wisconsin will lose about two-thirds of its brook trout stream mileage by 2060.

These losses will be episodic and abrupt rather than gradual, and they will be driven by periodic droughts and hot periods. All parts of the state will be vulnerable, and populations that are marginal now will be the first to disappear.

Although significant reductions in brook trout populations are almost inevitable, there are things that can reduce the losses.

First and foremost, we must work to reduce the concentrations of greenhouse gases in the atmosphere. These gases drive global warming, and as they continue to increase, so too will global temperatures.

If the 2060 projections are bad, then the projections for 2100 will be even worse unless greenhouse gases are brought under control. We must advocate for and implement policies and actions that both decrease gas emissions, such as reduced burning of fossil fuels and increase uptake of gases already in the atmosphere, such as restoring forests, grasslands, wetlands and other vegetated areas.

Without aggressive action, the brookie's days in Wisconsin are numbered.

While we work to reduce greenhouse gases in the atmosphere over the long term, we also need to ameliorate the effects of a steadily warming climate on our brook trout streams in the short term.

Habitat suitability for brook trout in Wisconsin is driven by groundwater. More groundwater means greater flows and colder summer water temperatures and more resistance to drought and hot weather.

Watershed and riparian land-uses that promote greater infiltration of precipitation into the soil and the water table will ultimately maintain and improve groundwater flows, offsetting the impacts of warmer weather.

Examples include protecting and restoring wetlands, grasslands, forests and other naturally, permanently vegetated areas that allow precipitation to be absorbed into the ground.

Other examples include adopting and expanding regenerative agricultural practices that avoid exposing and compacting bare soil and that reduce runoff such as rotational grazing, no-till cultivation, and use of cover crops during fallow periods; minimizing impervious surfaces, such as roads, parking lots, sidewalks, building roofs, in future development, and routing of runoff from existing impervious surfaces into infiltration areas. Also, we need to continue reconnecting stream channels to their floodplains, which slows and spreads out flood waters, allowing them to better soak in.

Because groundwater inputs are sometimes derived from areas far afield, land-use management must be done broadly at watershed scales and cannot be limited just to areas along streams.

Besides groundwater, the other factor that can help deal with water temperature rises during increasingly hot weather is shade. Wisconsin studies have shown that a heavily shaded stream reach may be more than 5 degrees cooler than a similar reach open to the sun on a hot summer day. That 5-degree difference may be literally a matter of life and death to the brook trout.

But promoting shade is tricky. Forested stream corridors that block the sun may be desirable but can take decades to develop. And early in their development, wooded streambanks may be dominated by dense growths of box elders, willows, alders, and other shrubs. Shade from these shrubs may keep the water cool, but this shade also eliminates the understory vegetation that anchors and stabilizes the stream banks, leading to wide shallow channels that provide little brook trout habitat and are difficult to fish.

The shrubs also often attract beaver, whose effects on stream temperatures and brook trout populations are sometimes negative, although in other cases may be hard to predict.

Consequently, many currently applied Wisconsin stream habitat improvement techniques remove shrubby riparian vegetation and "open up" stream banks in order to narrow and deepen the channel, discourage beaver, and improve fishing access. Yet this opening up eliminates shading, potentially leading to warmer water.

New ideas and perhaps new techniques are needed to manage riparian vegetation to reduce water temperatures while still insuring good-quality habitat and fishability. And these new ideas must come quickly, as the clock is ticking for Wisconsin brookies.

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