

MINNESOTA FISHES: JUST HOW MANY SPECIES ARE THERE ANYWAY?



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INTRODUCTION

In terms of fish diversity, for a state at the northern edge and halfway between the east–west extremes of the contiguous USA, Minnesota doesn't do badly. Of the five states and two Canadian provinces bordering it, only Wisconsin boasts as many or more species. We (my fish biology colleagues and I) believe this is true, but counting species is not quite as easy as it seems. You're asking: What could be easier? Just find out if a fish species swims in your lakes or streams, then count it, right? Well, as they used to say in the Hertz rental car commercial, "not exactly."

What kinds of issues lead to "not exactly?" Quite a few, including the uncertainty of old or historical records, the uncertainty of the presence of rare species, difficulty in assessing the reproductive status of rare or invading species, questions of what to do about failed introductions, the issue of species that occur only across the border in a shared body of water, and last—but not least—difficulties in determining what a species is. Often, two or more of these issues intersect for a given species, making it even harder to decide whether or not to count it. Depending on how such issues are resolved, the total count for Minnesota could be as low as 153 or as high as 164 species. The potential impact on counts within major basins or smaller river systems can be similarly high. Let's look at some examples.

Photos by Konrad Schmidt unless otherwise indicated.

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FIGURING OUT THE COUNT

Were they ever really here?

On the surface, this one appears pretty simple, but it can cause way more gray hairs than you might think. For example, what do you do if Minnesota's ichthyological forefathers—like Albert Woolman and Ulysses Cox—reported species such as the Chestnut Lamprey (*Ichthyomyzon castaneus*) from the Minnesota River basin or the Longnose Gar (*Lepisosteus osseus*) from the Red River of the North basin (see Figure 1 for Minnesota's 10 major basins), but no one else has ever collected these species in those basins over the last 120 years? Look at the specimens, right? Good luck; they no longer exist. You might entertain the notion that the Chestnut Lamprey was misidentified, especially given that the similar Silver Lamprey (*Ichthyomyzon unicuspis*) is an inhabitant of the Minnesota River, but how could they misidentify gar? A Longnose might have been called a Shortnose, or vice versa, but no gar of any species has ever been verified from the Red. Was it a really bad day? A smudge of the pencil? We will probably never know for sure. So, without specimens to examine, following in the boot steps of our mentors, my colleagues and I choose not to list these species in these basins. "No specimens, no ✓" seems like a good rule.

Then we have the Silver Chub (*Macrhybopsis storeriana*), again clearly on the state list, but never listed for the Mississippi Headwaters basin. There was a single collection by F. Washburn from Lake Mille Lacs in 1886. Unable to locate the specimen, Eddy and Underhill (1974) did not count it. We think we have located Washburn's specimen at the U. S. National Museum, but have not yet examined it. Obviously, we cannot count it until we've verified it—except that in 1989 Konrad Schmidt (NANFA Fellow) collected three specimens from the Crow Wing River just where it enters the Mississippi, which is well into the Headwaters basin. So, we can definitely count it, right? Well, no. We are sure of the identification this time, but we can't find Konrad's specimens either. Ouch! No specimens, no ✓—at least not yet. So far, pretty simple. Just to make you as crazy as I am, here are

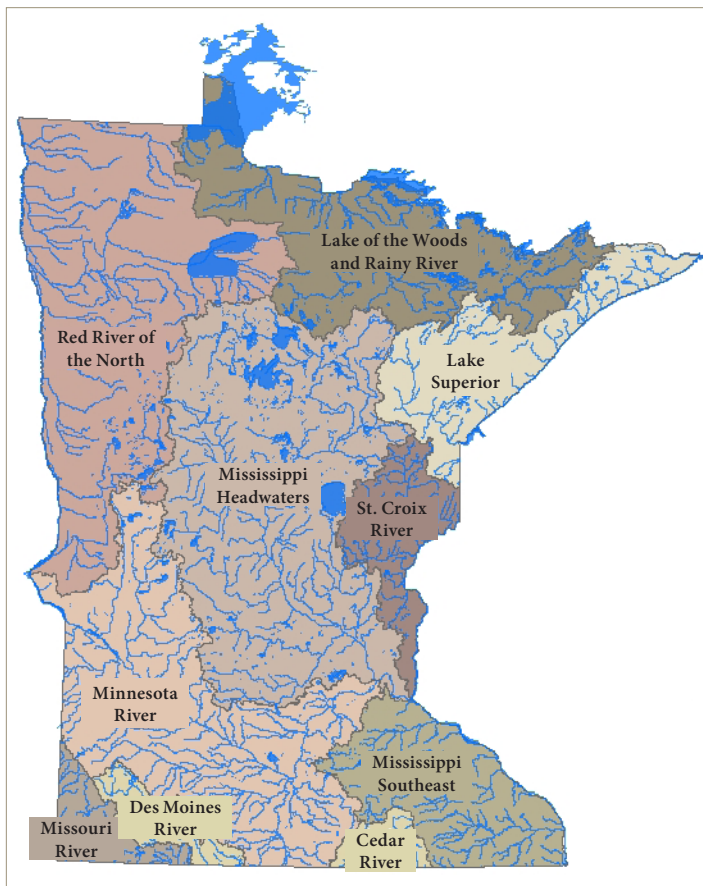


Figure 1. Locations of the 10 major basins in Minnesota (map by Nick Proulx, Minnesota Department of Natural Resources).

two more examples in this category. No specimen, no record, right? Well, in the Des Moines River basin, we have 64 records of Bluegill (*Lepomis macrochirus*) from 15 different lakes and 2 streams. These fish were collected in 23 different years between 1955 and 2012. They were collected and identified by at least 11 different biologists, including many DNR biologists, Konrad Schmidt, and James Underhill (author of *Northern Fishes* and *Fishes of the Minnesota Region*). Add to this evidence the fact that the Bluegill is vouchered widely in all nine remaining major basins of Minnesota, and we find it rather ridiculous not to acknowledge its presence in the Des Moines. A similar example is the Bowfin (*Amia calva*) in the Rainy River basin. We have 140 records reported by dozens of biologists going back to 1950. They come from 38 lakes and two streams in the Big Fork River system, mostly in the southern portion. We're not prepared to say how they got there (they were introduced into Lake of the Woods in 1984—see Stewart and Watkinson, 2004), but it is absurd to conclude they are not there (I note that specimens collected in the Baudette and Grand Rapids areas will soon be cataloged). There are several other basin-specific species that fall into this category.

The examples we've considered so far affect the number of species attributed to a basin (and that is very important),

but they have no impact on the overall state count. There are plenty of Bluegill, Longnose Gar, Chestnut Lamprey, and even Silver Chub elsewhere in the state. However, there are three cases that affect the state count.

Let's start with the very appropriately named Ghost Shiner (*Notropis buchmanani*) (Figure 2A). It was reported 35 times from the Mississippi River between 1944 and 1953, but strangely never again. The collectors included John Appelget, John Greenbank, Ray Johnson, Melvin Monson, and others. These guys were sharp and probably knew what they had, and fortunately George Becker (*Fishes of Wisconsin*) found and examined three specimens from Pool 7 that were cataloged at UW-Stevens Point. Our initial attempts to examine these specimens or to locate any others from the heyday of this species in Minnesota failed. Then in 2010 Bob Hrabik—*A Field Guide to the Fishes of Nebraska* and new edition of *The Fishes of Missouri*, both forthcoming—located and verified the Stevens Point specimens. Somewhat later, Wisconsin's current fish guru, John Lyons, told Konrad Schmidt that the collections from the Mississippi River surveys were in the uncataloged materials of the University of Wisconsin Zoological Museum. He kindly allowed Kon to rummage through them and, sure enough, there they were, worse for the wear but definitely Ghost Shiners (they have all now been cataloged into UWZM). So, this species *was* in Minnesota and not just in Pool 7, but apparently it is now extirpated (we'll revisit this one under "Are they still here?" below). Count it as historical!

Now comes a complicated case, the Blue Catfish (*Ictalurus furcatus*) (Figure 2B). To be sure, we have no specimens, so why even bring it up? Well, Ulysses Cox started the cobble tumbling through the riffle by listing *Ameiurus lacustris*, the "Great Fork-tailed or Mississippi Cat," in his 1897 *Fishes of Minnesota*. He admitted he had "no definite record of occurrence of this fish in Minnesota," but he also acknowledged that "dark slaty-blue" cats "reaching a weight of one hundred pounds or more" had been reported by "fishermen," which we believe included both anglers and commercial fishers. Yes, Channel Catfish (*I. punctatus*) have deeply forked tails and can be slaty-blue, but do they weigh over 100 pounds? Flathead Catfish (*Pylodictis olivaris*), yes. But Flatheads don't have deeply forked tails and slaty-blue color, and even record-setting Channel Cats in our stretch of the river struggle to reach 40 pounds. The largest ever reported anywhere is only 58 pounds (from South Carolina). So, were fishers exaggerating? Likely, but more than double the weight? Further, by 1943 enough of these reports had accumulated so that Samuel Eddy and Thaddeus Surber in their first edition of *Northern Fishes* stated, "It [Blue Catfish] is frequently taken during the warmer months of the year from Lake Pepin southward in the Mississippi River." (They



Figure 2. Some Minnesota fish species that caused trouble with the count. A. Ghost Shiner, B. Blue Catfish, C. Blunt-nose Darter, and D. Starhead Topminnow. (Photo C by Fritz Rohde)

also wrote, “A very large catfish taken in the Minnesota River at Hanley Falls, Minnesota a few years ago probably belonged to this species.” This hearsay report turned out to be a Flathead. Reports of this alleged species then declined, and by 1947 Eddy and Surber were using phrases such as, “formerly occurred in the Mississippi River” and “is now rare in Minnesota waters.” Then in 1959, J. M. Maloney, a fisheries biologist from Brainerd, identified a 37-lb Blue Catfish caught in the Mississippi River near Fort Ripley, the first report actually ascribed to a professional biologist (see Eddy and others, 1963). By 1974, Eddy and Underhill declined to list it at all, although in 1989 Underhill offered the opinion

that it once occurred in the “Mississippi River north to St. Anthony Falls and was present in the Minnesota River from Fort Snelling to Mankato.” Over the past three decades, various fisher folk have sporadically reported catches of fish that could have been Blues but we still have no Minnesota vouchers. So, end of story. Not exactly.

In 1977, Minnesota DNR stocked 6,335 age-0 Blue Catfish into Lake St. Croix, and a year later a specimen was collected in Lake Pepin (a natural riverine lake of the Mississippi River) by MN DNR. Not surprisingly, almost all reports since the 1980s have been from the St. Croix River basin—all unverified from anglers and commercial fishers. What makes matters worse is the tendency for St. Croix River catfish with a forked tail to look strikingly more blue than those from the Minnesota and Mississippi rivers. So, larger fork-tailed catfish from the St. Croix might get called Blues. Pretty messy. Perhaps Blue Catfish were once a part of our native Mississippi River fish community but are no longer. Maybe they were never year-round residents but only summer migrants, a thought that seems to have occurred to Eddy and Surber. Or maybe they were really never here at all until we stocked them, which begs the question, “Are they still here?” With no historic specimens or verifiable photos and only one identification by a knowledgeable fish biologist, we can’t confirm it as an historical species. We also cannot confirm it as a successfully introduced species. So, for now, we do not list it. Of course, if it does turn up and is verified, will we call it a successful introduction or a rare historical species? Hmm.

There is yet one more possible historic species that until recently was not even remotely on our radar—the Harelip Sucker (*Moxostoma lacerum*). Dave Neely (then of the California Academy of Sciences) and Bob Jenkins (*Freshwater Fishes of Virginia*) brought this species to Konrad’s attention in 2008 based on specimens Dave found in the Academy’s collection. Because Bob’s work is on-going, I won’t go into details here, but it is possible that specimens of this species were taken by Seth Meek in the late 1800s from southeastern Minnesota streams. We’ll have to see what Bob’s further sleuthing turns up before considering listing this one.

Are they still here?

This one is hard for everybody. We already mentioned the Ghost Shiner. It was definitely present in the Mississippi River at one time, but is it there now? Pretty unlikely. It hasn’t shown up in over 60 years. So it must be what conservation biologists call “extirpated,” meaning it is gone from a given geographic region that it once occupied, but it is not actually extinct. So, how long does a species have to go missing before you call it extirpated? There really isn’t a magic number. Why not? Partly because it’s just plain hard to find rare species, and some species are harder to detect than oth-

ers because of their microhabitat preferences, behavioral peculiarities, and other ecological eccentricities. So if you don't find it, does that mean it really isn't there? Most of the time there is some lingering doubt. Nevertheless, if biologists and other collectors are looking hard for 40 or 50 years with nary a trace, we should probably call it extirpated.

At least, that is what we thought after the Bluntnose Darter (*Etheostoma chlorosoma*) (Figure 2C) had been AWOL for 48 years. Always rare and found only in a few isolated pools and ponds in the backwaters of Mississippi River Navigation Pools 8 and 9, this small, drab Johnny Darter (*E. nigrum*) lookalike appeared to have lost its finhold in Minnesota sometime shortly after 1949. By 1996, several of us had convinced the state to call this intriguing little fish extirpated. What do you think turned up the very next year as Konrad and Ray Katula slogged through overflow pools of Pine Creek in Houston County? Given this embarrassing, albeit heartening, outcome, we have been reluctant to put "ex" next to a species' name. Still, that is precisely what we have done with the Ghost Shiner. It hasn't turned up in 1000s of collections in Minnesota or Wisconsin waters since 1953 (George Becker called it extirpated from Wisconsin in 1983).

We only have one other species on our "are they still here" list, and it has its own peculiar story. Enter the Flathead Chub (*Platygobius gracilis*), a minnow species mostly of large, turbid rivers of the prairie states and Canadian provinces. It had never been taken in Minnesota until 1984, when MN DNR fish biologist Jack Enblom found it in the Red River of the North just west of Climax, Minnesota (which amusingly is not far from Fertile, Minnesota). This is the only record from this basin anywhere in the U. S. The next closest occurrences are in the Assiniboine River near its confluence with the Red in Winnipeg, Manitoba. In 1970, McPhail and Lindsey (1970) offered arguments for how the Flathead reached Lake Winnipeg from a glacial refuge in the Missouri River basin but missed the southern connective to the Red River. Jim Underhill (1989), Todd Koel and John Peterka (1998) accepted those arguments and tapped bait bucket as the Flathead's mode of entry to Minnesota. However, Doug Watkinson (*The Freshwater Fishes of Manitoba*) suggested to me that this large, strong-swimming minnow could just have easily made it to Minnesota on its own. And, his catch data clearly show that the usual method for collecting Flatheads within the mainstem of the Red—electrofishing—underestimate its abundance when compared to trawling by a factor of 10 to 100. Very little trawling has been carried out upstream of the Assiniboine. So, this is a tough one to call. Is the Flathead still here? We need to get the Missouri trawl back into the Red.

There are quite a few species that have appeared and then disappeared from the state list over the years as a result of

attempted but failed introductions. Repeated attempts to introduce Cutthroat Trout (*Oncorhynchus clarkii*) in the 1920s and 30s met with no success, as did attempts to introduce Kokanee (landlocked Sockeye Salmon, *Oncorhynchus nerka*) and Artic Grayling (*Thymallus arcticus*) in the 1960s. The Western Mosquitofish (*Gambusia affinis*), stocked extensively in the Twin Cities metropolitan area from 1959 through 1961 to help control mosquitoes, never took hold. We have chosen not to list failed introductions; but, as noted for the Blue Catfish, we are ever on the lookout for evidence that a rare individual or population might still be around.

Have they crossed the border?

This one is particularly vexing for a number of reasons. Bear with me. Fish, of course, have not even the slipperiest concept of geopolitical borders, and they don't give a fat fishfly whether they cross them or not. Bureaucrats, on the other hand and for some admittedly good reasons, certainly do—even if they are sometimes fuzzy about exactly where the borders are. So, if a species occurs in waters shared with another state or province, just how close does it have to get to the boundary before you put it on the list? Even if a species is caught sneaking across the border, should it be listed if there is no evidence it is reproducing? (Somewhat similar to a bird biologist asking, "Does it nest here?") The question becomes more important when the species is an introduced one, with serious political and economic significance added if it's a non-native and potentially invasive. Unfortunately, all but one of our "borderline" cases fall into this last category. Let's take the non-conformist first.

Nestled amongst the maze of chutes, sloughs, ponds, and backwaters of the delta formed long ago by Wisconsin's Black River is Bullet Chute. The edge of Bullet Chute is a little over 4,000 feet from the Minnesota border that runs down the main channel of the Mississippi River. In the chute lives the strikingly beautiful Starhead Topminnow (*Fundulus dispar*) (Figure 2D), an endangered species in Wisconsin, that at least twice has ventured down the Black and into the Chute. This little topminnow prefers quiet, shallow backwaters and isolated pools where there is an abundance of submerged plant life. In the Mississippi, its preferred habitat appears to be exclusively on the Wisconsin side. So it seems unlikely that it will cross the border, but stranger things have happened. Should we count it? We tell it like it is, in the Mississippi on the Wisconsin side. Bureaucrats, biologists, and fish-lovers can decide for themselves.

Now from topminnows to the so-called "invasive Asian carp." It's not one species but four, and they did not invade North America (that's not what biologists mean by *invasive*). Three of the four were brought here intentionally to help control plant and algal growth in aquacultural ponds and to

boost fish production (the fourth was an inadvertent hitchhiker with one of the others). Through a series of accidental escapes and illegal stockings, they spread rapidly, all managing to become “invasive.”

Grass Carp (*Ctenopharyngodon idella*) was the first to reach Minnesota. In July of 1977 (yeah, way back then), 15 of them were removed from a pond close to the Mississippi River near Winona. Nobody knows who put them there, but for sure they didn't parachute in. In 1981, an undisclosed number were removed from two ponds on the Somerset Golf Course in Mendota. They were stocked there intentionally to control vegetation (sound familiar?). Grass Carp didn't turn up in the Mississippi itself until 1986 (Minnesota was quick to point out they were found on the Wisconsin side). They were taken in another pond on the Owatonna Golf Course in Steele County in 1987, and then in Okamanpeedan Lake, a border lake shared with Iowa, in 1990 and 1997. From 1994 to 2013, they were found 15 times in the Mississippi River downstream of Navigation Pool 3 on both sides of the border. One was even found just into the St. Croix River in 2006 near Point Douglas. Then in May 2013, a bow angler skewered one in the Mississippi north of Sartell (Mississippi Headwaters basin), which is beyond the dams at Coon Rapids, St. Cloud, and Sartell, suggesting that if this fish can't get there on its own, we'll be more than happy to help it. Clearly the border has been crossed, aided by humans or not, and there are plenty of records. The fish from Sartell was a diploid, gravid female (diploids can breed; triploids are sterile), but we really don't know how many of the Grass Carp out there are diploids, and we have no evidence of any reproduction (only adults have been collected). So, they are here, but if they are not reproducing, should they be counted? Again, we tell it like it is—present but not reproducing (= not established).

What about the other Asian carps? It took awhile for the second one, the Bighead Carp (*Hypophthalmichthys nobilis*), to get here. Somewhat surprisingly, our first record came from the St. Croix River near Bayport in 1996 (commercial fishermen again). It took until 2003 for a second record to come in (Mississippi River Navigation Pool 5A), followed by a third in 2007 (this time at the upper end of Lake Pepin in Navigation Pool 4). Commercial fishers, mostly contracted to survey for MN DNR, caught six more Bigheads (five records) on both sides of the border in the Mississippi River and two more near the mouth of the St. Croix River through November 2012. No additional Bigheads were captured until a 40-pounder turned up in Navigation Pool 2 near Cottage Grove on July 17, 2014. Two eDNA studies, one in 2011 and a more rigorous one in 2012, failed to detect this species in Minnesota waters (but the technique also failed to consistently detect it in Iowa where populations are established).

We have specimens and verified photos of adults but no evidence of any reproduction. So, like the Grass variety, Bigheads are here but not yet established.

We have to say about the same for Silver Carp (*H. molitrix*), although we have fewer records and contradictory eDNA data (the more rigorous analysis being negative). The first Silver Carp we know of were single individuals taken from Navigation Pool 8 in 2008 and 2009, both on the Wisconsin side of the border. The next two were taken in Minnesota waters from Navigation Pool 6 on two different dates in 2012. In 2013, the carcass of a fifth fish was found on the spillway of Lock and Dam 5, and a sixth fish turned up in Pool 2 along with the Bighead in July 2014. No evidence of reproduction and, to our knowledge, Silvers have not yet gone airborne in waters that border Minnesota.

There are two non-native species of stickleback that turned up in the Lake Superior basin near Thunder Bay, Ontario, in the middle 1980s. They almost certainly arrived by way of ballast water exchanges of Great Lakes commercial ships. One of them, the Threespine Stickleback (*Gasterosteus aculeatus*), quickly became established along Minnesota's Northshore and in the St. Louis River estuary, probably as a result of multiple introductions and migration. No question that it is now a part of that basin's fish community. But the other, the Fourspine Stickleback (*Apeltis quadracus*), has turned up nowhere outside of the Thunder Bay area, a little over 40 miles from the Minnesota border. According to Fritz Fischer of the Ontario Ministry of Natural Resources, this species continues to be collected there on a fairly regular basis but seems to have no inclination to move our direction. We list it as an Ontario species.

White Perch (*Morone americana*), Ruffe (*Gymnocephalus cernua*), Freshwater Tubenose Goby (*Proterorhinus semilunaris*), and Round Goby (*Neogobius melanostomus*) are other species that reached Minnesota waters through ballast exchanges in Lake Superior, and each has established itself in a variety of locations.

Species or not?

Once again, you would think this one is pretty straightforward. Just consult an authority such as, *Common and Scientific Names of Fishes from the United States, Canada, and Mexico*, and you're good to go! Sort of, but the list only comes out once every 10 years, and it doesn't resolve all of the controversies. Let's take lampreys as an example. We've known for a very long time that many species of lampreys come in pairs. Adults of one species are large, have rings of well-developed teeth in their circular, jawless mouths, and are external parasites on large bony fishes. Adults of the other species are much smaller, have much reduced teeth, and are nonparasitic—they actually don't feed at all (Figure 3)!

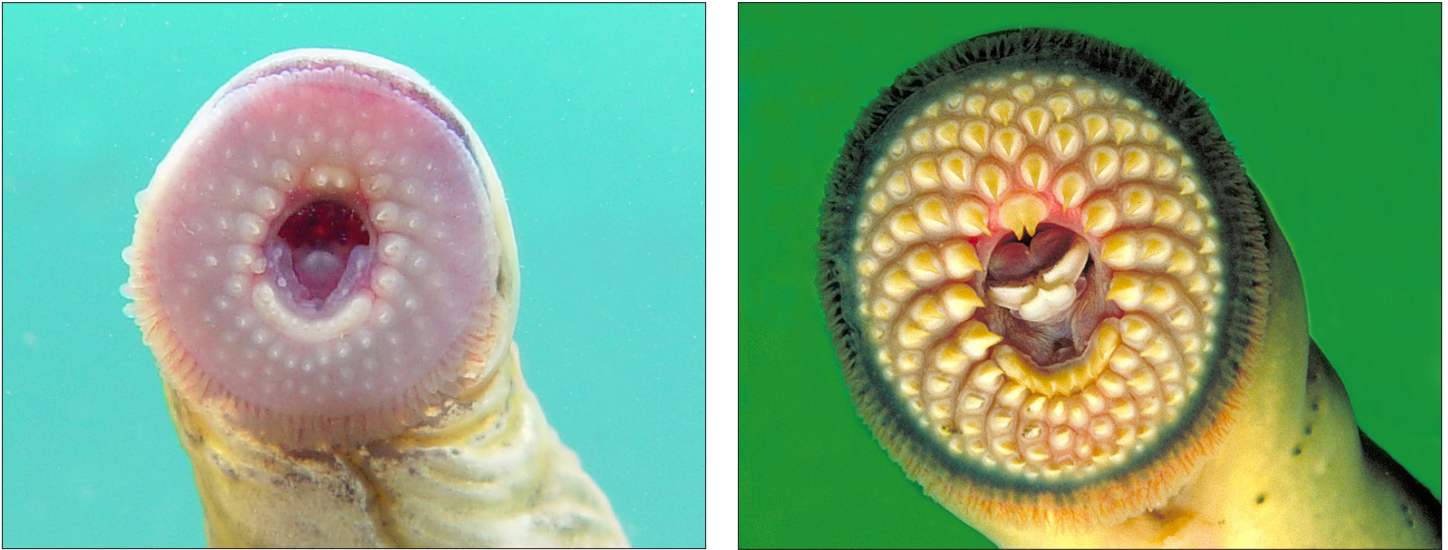


Figure 3. The non-parasitic Northern Brook Lamprey (left) and the parasitic Silver Lamprey.

So, at least as adults, they look different (a basis for morphological species) and they make their livings in very different ways (a basis for ecological species). You would expect, then, that a peek at the DNA of these species would confirm their distinctness. For some, it does. For others, it suggests just the opposite—in fact, it strongly suggests that some “pairs” are interbreeding (so, not good phylogenetic or biological species). If we go with either of these last two species concepts, we would drop the Northern Brook Lamprey (*Ichthyomyzon fossor*) and the Southern Brook Lamprey (*I. gagei*), reducing the number of lamprey species in the state from six to four. In this case, we are sticking with the 7th Edition of *Common and Scientific Names* until other ichthyologists weigh in (Page et al., 2013).

My next example takes us right over the waterfall and into a plunge pool that may have no bottom. Ciscoes, including the Bloater (*Coregonus hoyi*) and Kiyi (*C. kiyi*), are cool fish that live in cool—downright cold in some cases—usually clean, often deep lakes of the north. *Common and Scientific Names* recognizes six species that have at one time or another appeared on our state list. Two of them were listed in error and do not occur here. Until fairly re-



Figure 4. The Cisco, also known as the lake herring or tullibee, was thought to be the only species of cisco in Minnesota’s inland lakes. There may be several, depending on what you call a species.

cently, we thought that only one of them lived in our inland lakes—the rest hung out only in Lake Superior (Figure 4). Then, my mentor and friend David Etnier (*Fishes of Tennessee*), identified the Shortjaw Cisco (*C. zenithicus*) hiding amongst the usual ciscoes (Cisco = Lake Herring, *C. artedi*) in Lake Saganaga (“Sag”), an inland lake of the Rainy River basin—a surprise to say the least. “Ets” also found a third type of cisco hidden in the buckets of fish from that lake, one that had been described in 1929 but by 1973 was considered just a peculiar kind of Lake Herring. Yet, Ets was sure this was a separate species, the Nipigon Cisco (*C. nipigon*), and he published a scientific paper presenting his data and arguments. Some scientists accepted his arguments, others did not, and still others wanted more data. The real problem here is that most of the species in this group are what scientists call “phenotypically plastic.” In this particular situation, it means that what an individual looks like is highly dependent on the environment in which it grows up. So within ciscoes, individuals of the same species from different lakes can look different, and individuals from different species but the same lake can look similar. It’s hard to sort out with the characteristics we normally use to distinguish and identify species. And, so far, looking at the genes hasn’t been very helpful either. While “Sag” is a fairly large inland lake with lots of bays and inlets, it seems unlikely that it would lead to three consistently different phenotypic forms of Lake Herring across a number of years. So, for now, I agree with Ets that there are three species there, even though one of them remains off the *Common and Scientific Names* list. That adds a species to the list. But take the cisco species number with a half-cup of cornmeal because, frankly at this time, the whole notion of what a good cisco species is remains deep down in that plunge pool.

CONCLUSIONS

In the end, how do we resolve all of these problems? We could just report them as they are and let others decide for themselves. This is what we do in our list. We also need to take some responsibility for interpreting the list and providing counts for each major basin and the state as a whole, and our rules follow. We accept a record if we (Konrad Schmidt or I) have personally identified the specimen, found an existing voucher specimen or verifiable photograph for the record, or found a knowledgeable fish biologist who could attest to the validity of the specimen. Any record, historical or current, that represents an unusual occurrence must be verified against a voucher specimen. We accept the occurrence of a common species within a basin (e.g., Bluegill or Bowfin) without voucher if it has been reported at multiple sites by multiple fish biologists over a period of ten years or more. Our reasoning is that a common species will not be misidentified systematically by different collectors over time. We list species that occur outside of Minnesota's borders but within waters immediately shared with another state or province by designating the state or province, but list them as occurring outside the borders. We acknowledge acceptable records of species that are not reproducing in Minnesota and designate them as such. Finally, we do not list failed introductions.

We list 163 species (in 26 families and 82 genera) for which there are acceptable records in Minnesota or its boundary waters (Table 1). This means the Blue Catfish is not counted, even though it has a row in the list (we want to keep it on everyone's radar). The counts across the 10 major basins vary from 37 to 129 species, depending on how species are counted. Leaving out species not within the state's borders makes little difference, except in the three smallest basins (Des Moines, Cedar, and Missouri), all bordering Iowa. Of the 163 species listed, 143 are native to the state. Two species—Starhead Topminnow (native) and Fourspine Stickleback (non-native)—have yet to be taken on the Minnesota side of the border. Dropping them for "legal" purposes reduces the totals to 161 and 142. Three species—the Northern and Southern Brook lampreys, and the Nipigon Cisco (all native)—may turn out to be versions of other already listed species. That would lower the numbers to 158 and 139. If we further eliminate the species for which there is no evidence of reproduction in Minnesota—the three Asian carps and the Atlantic Salmon (*Salmo salar*) (all non-native), and the Flathead Chub (native)—the numbers fall to 153 and 138. What count will you go with? Well, that's up to you.

ACKNOWLEDGEMENTS

Table 1 was constructed with the assistance of Konrad Schmidt. It could not have been done without his knowledge and experience. Thanks to TJ DeBates, Ryan Doorenbos, and

Taylor Polomis (Minnesota Department of Natural Resources); Fritz Fischer (Ontario Ministry of Natural Resources); Bob Hrabik (Missouri Department of Conservation); John Lyons (Wisconsin Department of Natural Resources); John Olson (Iowa Department of Natural Resources); and Doug Watkinson (Fisheries and Oceans Canada) for their input and discussions regarding historic distributions of species and establishment of introduced populations. Finally, thanks to Nick Proulx (Minnesota Department of Natural Resources) for producing the map in Figure 1.

References

- Becker, G. C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison.
- Cox, U. O. 1897. A preliminary report on the fishes of Minnesota. Geological and Natural History Survey of Minnesota, Zoological Series 3, Pioneer Press Co., St. Paul.
- Eddy, S., and T. Surber. 1943. Northern fishes with special reference to the upper Mississippi Valley. University of Minnesota Press, Minneapolis.
- Eddy, S., and T. Surber. 1947. Northern fishes with special reference to the upper Mississippi Valley. revised edition. University of Minnesota Press, Minneapolis.
- Eddy, S., and J. C. Underhill. 1974. Northern Fishes with special reference to the upper Mississippi Valley, 3rd edition. University of Minnesota Press, Minneapolis.
- Eddy, S., J. B. Moyle and J. C. Underhill. 1963. The fish fauna of the Mississippi River above St. Anthony Falls as related to the effectiveness of this falls as a migration barrier. Proceedings of the Minnesota Academy of Science 30:111–115.
- Koel, T. M., and J. J. Peterka. 1998. Stream fishes of the Red River of the North basin, United States: A comprehensive review. Canadian Field-Naturalist. 112:631–646.
- McPhail, J. D., and C. C. Lindsey. 1970. Freshwater fishes of Northwestern Canada and Alaska. Fisheries Research Board of Canada, Bulletin 173. Ottawa, Ontario. 381 pp.
- Page, L. M., H. Espinosa-Pérez, L. T. Findley, C. R. Gilbert, R. N. Lea, N. E. Mandrak, R. L. Mayden, and J. S. Nelson. 2013. Common and scientific names of fishes from the United States, Canada, and Mexico, 7th edition. American Fisheries Society, Special Publication 34, Bethesda, Maryland.
- Phillips, G. L., W. D. Schmid, and J. C. Underhill. 1982. Fishes of the Minnesota region. University of Minnesota Press, Minneapolis.
- Stewart, K.W., and D.A. Watkinson. 2004. The freshwater fishes of Manitoba. University of Manitoba Press, Winnipeg.
- Underhill, J. C. 1989. The distribution of Minnesota fishes and late Pleistocene glaciation. Journal of the Minnesota Academy of Science 55:32–37.

CONTINENTAL AND MAJOR STATE BASINS:		HUDSON BAY		GREAT LAKES	MISSISSIPPI RIVER							BASINS COMBINED	STATE CONSERVATION STATUS
		RED RIVER	RAINY RIVER	L. SUPERIOR	MISSISSIPPI RIVER HW	ST. CROIX RIVER	MINNESOTA RIVER	DES MOINES RIVER	CEDAR RIVER	MISSISSIPPI RIVER SE	MISSOURI RIVER		
COMMON NAME	SCIENTIFIC NAME												
Shiner, Emerald	<i>Notropis atherinoides</i>	n	n	n	n	L	n			n	n	n	
Shiner, Ghost	<i>Notropis buchanani</i>									ex		ex	
Shiner, Golden	<i>Notemigonus crysoleucas</i>	n	n	n	n	n	n	n	n	n	n	n	
Shiner, Mimic	<i>Notropis volucellus</i>	n	n	n	n	n	n	n	n	n		n	
Shiner, Pallid	<i>Hybopsis amnis</i>					n	n			n		n	E
Shiner, Pugnose	<i>Notropis anogenus</i>	n		n	n	n	n	IA		n	IA	n	T
Shiner, Red	<i>Cyprinella lutrensis</i>										n	n	
Shiner, Redfin	<i>Lythrurus umbratilis</i>								n	n		n	S
Shiner, River	<i>Notropis blennioides</i>	n	n			L	n	IA	n	n	IA	n	
Shiner, Sand	<i>Notropis stramineus</i>	n			n	n	n	n	n	n	n	n	
Shiner, Spottfin	<i>Cyprinella spiloptera</i>	n			n	n	n	n	n	n	IA	n	
Shiner, Spottail	<i>Notropis hudsonius</i>	n	n	n	n	n	n			n	n	n	
Shiner, Topeka	<i>Notropis topeka</i>							IA			n	n	S
Shiner, Weed	<i>Notropis texanus</i>	n			n	L	n			n		n	
Stoneroller, Central	<i>Campostoma anomalum</i>	n			n	n	n	n	n	n	n	n	
Stoneroller, Largescale	<i>Campostoma oligolepis</i>	ND				U	n		n	n		n	

CATFISHES, NORTH AMERICAN—ICTALURIDAE

Bullhead, Black	<i>Ameiurus melas</i>	n	n	n	n	n	n	n	n	n	n	n	
Catfish, Blue	<i>Ictalurus furcatus</i>					K				K		K	
Bullhead, Brown	<i>Ameiurus nebulosus</i>	n	n	n	n	n	n	n	n	n	n	n	
Bullhead, Yellow	<i>Ameiurus natalis</i>	n	n	n	n	n	n	n	n	n	n	n	
Catfish, Channel	<i>Ictalurus punctatus</i>	n		n	i	n	n	n	i	n	n	n	
Catfish, Flathead	<i>Pylodictis olivaris</i>				m	n	n			n	IA	n	
Madtom, Slender	<i>Noturus exilis</i>								n			n	E
Madtom, Tadpole	<i>Noturus gyrinus</i>	n	n	n	n	n	n	n	n	n	n	n	
Stonecat	<i>Noturus flavus</i>	n		n	m	n	n	n	n	n	n	n	

CODS—GADIDAE

Burbot	<i>Lota lota</i>	n	n	n	n	n	n			n		n	
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DRUMS & CROAKERS—SCIAENIDAE

Drum, Freshwater	<i>Aplodinotus grunniens</i>	n	n	m	m	n	n	IA	IA	n	m	n	
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FRESHWATER EELS—ANGUILLIDAE

Eel, American	<i>Anguilla rostrata</i>			n	n	L	n			n		n	S
American eel migrates into Minnesota waters as adult but reproduces in the Sargasso Sea.													

GARS—LEPISOSTEIDAE

Gar, Longnose	<i>Lepisosteus osseus</i>					L	n			n	IA	n	
Gar, Shortnose	<i>Lepisosteus platostomus</i>				n	L	n			n	n	n	

GOBIES—GOBIIDAE

Goby, Freshwater Tubenose	<i>Proterorhinus semilunaris</i>			i								i	I
Goby, Round	<i>Neogobius melanostomus</i>			i								i	I

HERRINGS—CLUPEIDAE

Skipjack Herring	<i>Alosa chrysochloris</i>					L	n			n		n	E
Alewife	<i>Alosa pseudoharengus</i>			i								i	I
Gizzard Shad	<i>Dorosoma cepedianum</i>				m	L	n			n	n	n	

CONTINENTAL AND MAJOR STATE BASINS:		HUDSON BAY		GREAT LAKES	MISSISSIPPI RIVER							BASINS COMBINED	STATE CONSERVATION STATUS	
		RED RIVER	RAINY RIVER	L. SUPERIOR	MISSISSIPPI RIVER HW	ST. CROIX RIVER	MINNESOTA RIVER	DES MOINES RIVER	CEDAR RIVER	MISSISSIPPI RIVER SE	MISSOURI RIVER			
COMMON NAME	SCIENTIFIC NAME													
SILVERSIDES, NEW WORLD—ATHERINOPSIDAE														
Silverside, Brook	<i>Labidesthes sicculus</i>			m	n	n	n				n		n	
SMEELTS—OSMERIDAE														
Smelt, Rainbow	<i>Osmerus mordax</i>		i	i	i	i					i		i	I
STICKLEBACKS—GASTEROSTEIDAE														
Stickleback, Brook	<i>Culaea inconstans</i>	n	n	n	n	n	n	n	n	n	n	n	n	
Stickleback, Fourspine	<i>Apeltes quadracus</i>			i ON									i ON	
Stickleback, Ninespine	<i>Pungitius pungitius</i>		n	n	n								n	
Stickleback, Threespine	<i>Gasterosteus aculeatus</i>			i									i	
STURGEONS—ACIPENSERIDAE														
Sturgeon, Lake	<i>Acipenser fulvescens</i>	r	n	n	m	n	n				n		n	S
Sturgeon, Shovelnose	<i>Scaphirhynchus platyrhynchus</i>					L	n				n		n	
SUCKERS—CATOSTOMIDAE														
Buffalo, Bigmouth	<i>Ictiobus cyprinellus</i>	n			n	L	n	n	n	n	n	n	n	
Buffalo, Black	<i>Ictiobus niger</i>					L	n			n	IA, SD	n	n	T
Buffalo, Smallmouth	<i>Ictiobus bubalus</i>	m				n	n	n		n	n	n	n	
Carp sucker, Highfin	<i>Carpionodes velifer</i>					L	n		IA	n			n	
Carp sucker, River	<i>Carpionodes carpio</i>				m	L	n			n	n	n	n	
Hog Sucker, Northern	<i>Hypentelium nigricans</i>	n			m	n	n	IA	n	n			n	
Quillback	<i>Carpionodes cyprinus</i>	n	n		m	n	n	n	n	n	n	n	n	
Redhorse, Black	<i>Moxostoma duquesnei</i>								n	n			n	S
Redhorse, Golden	<i>Moxostoma erythrurum</i>	n	n		m	n	n	IA	n	n	n	n	n	
Redhorse, Greater	<i>Moxostoma valenciennesi</i>	n	n		n	n	n			n			n	
Redhorse, River	<i>Moxostoma carinatum</i>					n	n			n			n	
Redhorse, Shorthead	<i>Moxostoma macrolepidotum</i>	n	n	n	n	n	n		n	n	n	n	n	
Redhorse, Sliver	<i>Moxostoma anisurum</i>	n	n	n	n	n	n	IA	IA	n			n	
Sucker, Blue	<i>Cycleptus elongatus</i>					n	n			n			n	S
Sucker, Longnose	<i>Catostomus catostomus</i>		n	n									n	
Sucker, Spotted	<i>Minytrema melanops</i>					L	n			n			n	
Sucker, White	<i>Catostomus commersoni</i>	n	n	n	n	n	n	n	n	n	n	n	n	
SUNFISHES—CENTRARCHIDAE														
Bass, Largemouth	<i>Micropterus salmoides</i>	n	n	n	n	n	n	n	n	n	n	m	n	
Bass, Rock	<i>Ambloplites rupestris</i>	n	n	n	n	n	n	IA	n	n	n	n	n	
Bass, Smallmouth	<i>Micropterus dolomieu</i>	i	i	n	n	n	n		n	n	n	n	n	
Bluegill	<i>Lepomis macrochirus</i>	n	n	n	n	n	n	n	n	n	n	n	n	
Crappie, Black	<i>Pomoxis nigromaculatus</i>	i	n	n	n	n	n	n	n	n	n	m	n	
Crappie, White	<i>Pomoxis annularis</i>	i			i	n	n	n	n	n	n	n	n	
Pumpkinseed	<i>Lepomis gibbosus</i>	n	n	n	n	n	n	n	n	n	n	n	n	
Sunfish, Green	<i>Lepomis cyanellus</i>	n	n	n	n	n	n	n	n	n	n	n	n	
Sunfish, Northern	<i>Lepomis peltastes</i>	i	n		n	UWI							n	S
Sunfish, Orangespotted	<i>Lepomis humilis</i>	n			m		n	n	n	n	n	n	n	
Warmouth	<i>Lepomis gulosus</i>		m			LWI				n			n	S

CONTINENTAL AND MAJOR STATE BASINS:		HUDSON BAY		GREAT LAKES	MISSISSIPPI RIVER							BASINS COMBINED	STATE CONSERVATION STATUS
		RED RIVER	RAINY RIVER	L. SUPERIOR	MISSISSIPPI RIVER HW	ST. CROIX RIVER	MINNESOTA RIVER	DES MOINES RIVER	CEDAR RIVER	MISSISSIPPI RIVER SE	MISSOURI RIVER		
COMMON NAME	SCIENTIFIC NAME												
TEMPERATE BASSES—MORONIDAE													
White Bass	<i>Morone chrysops</i>	i			m	n	n			n	n	n	
White Perch	<i>Morone americana</i>			i								i	I
Yellow Bass	<i>Morone mississippiensis</i>						m			n		n	S
TOPMINNOWS—FUNDULIDAE													
Killifish, Banded	<i>Fundulus diaphanus</i>	n	n		n	n	n		n	n	n	n	
Topminnow, Plains	<i>Fundulus sciadicus</i>										n	n	T
Topminnow, Starhead	<i>Fundulus dispar</i>								WI		WI		
TROUTS & SALMONS—SALMONIDAE													
Bloater	<i>Coregonus hoyi</i>		n	n								n	
Cisco	<i>Coregonus artedi</i>	n	n	n	n	m						n	
Cisco, Nipigon	<i>Coregonus nipigon</i>		n									n	S
Cisco, Shortjaw	<i>Coregonus zenithicus</i>		n	n								n	S
Kiyi	<i>Coregonus kiyi</i>			n								n	S
Salmon, Atlantic	<i>Salmo salar</i>			i								i	
Salmon, Chinook	<i>Oncorhynchus tshawytscha</i>			i								i	
Salmon, Coho	<i>Oncorhynchus kisutch</i>			i								i	
Salmon, Pink	<i>Oncorhynchus gorbusha</i>			i								i	
Trout, Brook	<i>Salvelinus fontinalis</i>	i	i	n	i	n	n			n		n	
Trout, Brown	<i>Salmo trutta</i>	i	i	i	i	i	i	i	i	i		i	
Trout, Lake	<i>Salvelinus namaycush</i>		n	n	m	i						n	
Trout, Rainbow	<i>Oncorhynchus mykiss</i>	i	i	i	i	i	i		i IA	i		i	
Whitefish, Lake	<i>Coregonus clupeaformis</i>	n	n	n	n							n	
Whitefish, Pygmy	<i>Prosopium coulteri</i>			n								n	S
Whitefish, Round	<i>Prosopium cylindraceum</i>			n								n	
TROUT-PERCHES—PERCOPSIDAE													
Trout-perch	<i>Percopsis omiscomaycus</i>	n	n	n	n	n	n			n	n	n	

Number of species listed (-K)	85	76	84	86	114	102	56	69	129	69	163	46
Number of species within state boundaries	84	74	83	86	112	102	40	61	128	55	161	46
Number of species native to the basin within state boundaries	72	67	66	63	103	96	37	57	120	49	142	34

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