HYBRIDS, ODDITIES, AND VARIATION OBSERVED IN MINNESOTA FISHES

Konrad Schmidt

For over 40 years I have collected native fishes from every county and drainage in Minnesota. With the exception of common "promiscuous" sunfish species—i.e., Bluegill (*Lepomis macrochirus*), Green Sunfish (*L. cyanellus*), and Pumpkinseed (*L. gibbosus*)—I have observed very few hybrid crosses or oddities in species. It can be difficult to determine parental crosses in hybrids, and it can be equally puzzling to identify the species of oddities. However, both hybrids and oddities almost always stand out in the catch. Variation includes more subtle differences exhibited in color or body traits of isolated populations which occur in separate drainages or disjunct distributions in the same drainage.

HYBRIDS

I have seen only four examples of darter hybrids. The first was what Ray Katula believed to be a Mud (*Etheostoma asprigene*) x Iowa (*E. exile*) Darter cross he collected from lower Pine Creek (Houston County) near the town of La Crescent, MN in 2003 (Figure 1). He has also collected the same cross in lower Waumandee Creek (Buffalo County, WI). Both localities are in the floodplain of the Mississippi River.

I don't have images for what I called a Blackside Darter (*Percina maculata*) x Slenderhead Darter (*P. phoxocephala*) cross from Hawk Creek (Renville County) in 1997. However, the specimen is cataloged at the James Ford Bell Museum of Natural History (JFBM 29267). I have only once found multiple specimens of a hybrid which I believe were Blackside Darter x Logperch (*P. caprodes*) from the Otter Tail River near Phelps (Otter Tail County) in 2004 (Figure 2.).

The images in Figure 3 are of one specimen I believe was a Logperch x River Darter (*P. shumardi*) cross from the St. Croix River downstream of Taylors Falls (Chisago County) in 1989 (JFBM 29446).

Darters are specialists which may explain the infrequent occurrences of hybrids (at least in Minnesota where only four specimens are cataloged in the Bell Museum fish collection). Many aspects of each species' life history keep them segregated from other darters under normal conditions. However, I believe the above hybrid from the St. Croix River was the result of the worst drought since the Dust Bowl of the 1930s. In 1989, the drought had persisted for three years and scores of long-standing record-high temperatures were broken, mostly in 1988. The St. Croix had not flooded since early 1987 and flows remained at record lows which greatly reduced suitable spawning habitats. Rapidly rising water temperatures in the spring may have caused a domino effect. The earliest spawning darters began weeks in advance and

Figure 1. Mud x Iowa Darter Hybrid? Pine Creek (Houston County).

Figure 2. Blackside Darter x Logperch Hybrid? Otter Tail River (Otter Tail County).

Photos by the author unless otherwise indicated.

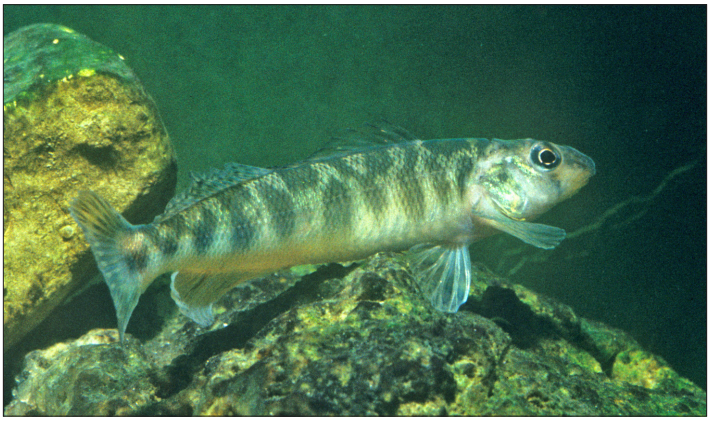


Figure 3. Logperch x River Darter hybrid? St. Croix River (Chisago County).

collided with new waves of other species also arriving ahead of schedule in the same habitats. In these confined areas milt of one darter species likely drifted into the arena of another species spawning nearby.

Bluegill, Green Sunfish, and Pumpkinseed hybrids have been mentioned previously and are frequently abundant and widespread. However, in my opinion Green Sunfish is the most "common denominator" in the three hybrids. The two parents of first generation crosses are generally easy to identify. However, if the parents were a "threesome" or multi-generational crosses, then all bets are off.

Orangespotted Sunfish (*L. humilis*) and Northern (formerly Longear) Sunfish (*L. peltastes*) hybrids, like darters (at least in Minnesota) seldom occur. I did seine one male Orangespotted Sunfish "hybrid" in 1994 from Second Fulda Lake near the town of Fulda (Murray County). I could not identify the other contributing parent(s) in the cross, but Bluegill, Green Sunfish, and Pumpkinseed all occur in the lake. This fish took my breath away, shaming every tropical and saltwater species I had ever seen. The specimen brought to mind an artist's canvas splashed with vivid and random patterns of blue, yellow, orange, and red. I have regretted ever since not having a camera with me that day! However, this final "artwork" may have also been a multi-generational cross.

Northern Sunfish hybrids show up in a few lakes with some regularity, but are by no means common or widespread

Figure 4. Male Northern Sunfish x Pumpkinseed from Loon Lake (Crow Wing County).

due to the species' restricted distribution. I have only seen crosses with Pumpkinseed and nuptial males share the same striking striations of sky-blue on the cheek and body (Figure 4). However, these hybrids retain the pugnacious character of Pumpkinseeds. Northern Sunfish, on the other hand, are very docile and make excellent choices for a community aquarium of minnows and darters. I had a pair spawn three times in the corner of a 20-gallon aquarium with about a dozen Carmine Shiners (*Notropis percobromus*). The doting parents kept the ever-trespassing school at bay, but never killed or injured a single fish.

I am aware there are scores of documented cyprinid crosses in North America. However, I have encountered them only a handful of times in Minnesota. There has never been any doubt when I have a hybrid in my hand, and I can almost always identify one parent, but I usually don't have a clue what the other may have been. I collected and cataloged an unknown hybrid from the Chippewa River near Watson (Chippewa County) in 1997 (JFBM 33694) and a Hornyhead Chub (*Nocomis biguttatus*) x unknown species cross from Dobbins Creek near Austin (Mower County) in 2008 (JFBM 45721).

During a status survey of Hornyhead Chubs (Schmidt, 2012), Barry Thoele (Lincoln Bait) and I collected crosses with Common Shiners (*Luxilus cornutus*) (Figure 5), in the Crow Wing River just above its mouth near Baxter (Morrison County) in 2008. Barry collected more 65 miles upstream near Nimrod (Wadena County) the same year. He feels they are never common, but are found throughout the Crow Wing River watershed. This stream system is the most intensively harvested in the entire state for Hornyhead Chubs (aka redtails), which is one of the most highly sought species in the bait industry. Several species utilize Hornyhead Chub's nests to spawn and Common Shiners are a frequent associate, which is one explanation for this cross.

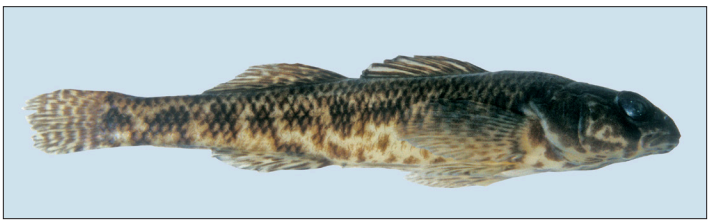
Figure 5. Hornyhead Chub x Common Shiner hybrids from the Crow Wing River (Wadena County [top, photo courtesy of Minnesota DNR] and Morrison County).

However, interbreeding can also be an indicator of a declining species nearing extirpation.

ODDITIES

Oddities are just as rare and I have only encountered four examples. I collected Johnny Darters (*E. nigrum*) with heavy brown stippling on their ventral surfaces (Figure 6) in the Artichoke River near Brookston (St. Louis County) in 1997 (JFBM 29063). At first glance I thought this may be a severe infestation of the parasite *Neascus* (aka Black Spot), but it was clearly pigment. Typically, the bellies and throats of Johnny Darters in Minnesota are an immaculate creamy white.

I also found male monochrome green Iowa Darters (Figure 7) in the headwaters of the Pomme de Terre River (Otter Tail County) in 2003. Normally, males exhibit bands of blue and red in the body and blue or green and red in the first dorsal fin. I suspect both examples are results from local environmental factors (e.g., dietary, habitat, or water chemistry) and not population variation from isolation since both streams have no physical barriers such as dams or falls. Furthermore, both species are common and widespread occurring in all Minnesota drainages with no disjunct populations.



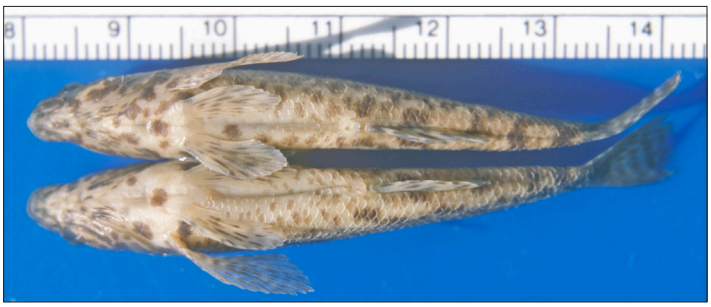


Figure 6. Johnny Darter from the Artichoke River (St. Louis County).

Figure 7. Iowa Darter from the Pomme de Terre River (Otter Tail County).

I have collected one very peculiar sunfish (Figure 8) from Coon Creek near Coon Rapids (Anoka County) in 2012. I thought this may be a Green Sunfish because of its elongated body; however, the pigment covering the body is a dark sapphire blue. After the specimen expired I sent it to Bruce Bauer (POWER Engineers, Inc.) who has worked with every sunfish species and many hybrids. He confirmed it was indeed a green and deposited it in the University of Tennessee, Knoxville fish collection (UT 90.4266). The had fish lived for over a year in captivity and exhibited a very atypical behavior for the species. It was always very timid in the aquarium when feeding and never aggressive toward other species.

The only minnow oddities I've collected are Fathead Minnows (*Pimephales promelas*) with very little pigment. The bodies are almost transparent, revealing the red gills and black peritoneum in the belly. Sporadic, pearly white scales produce a glitter effect. I shot the image above (Figure 9) in 1988 but do not have the locality. I had assumed they

Figure 8. Green Sunfish from Coon Creek (Anoka County).

Figure 9. Fathead Minnow.

were bait bucket releases of rosy red Fathead Minnows (Figure 10) until these later became available in pet stores. The morph and rosy reds are clearly two different critters.

VARIATION

I believe I have only detected the most obvious examples of variation. Future aquarists and fish biologists with sharper eyes and greater patience will have to uncover the rest. Minnesota Rainbow Darter (*E. caeruleum*) populations are the most notable for exhibiting different colors and bands on the body and fins (Figure 11).

The Otter Tail River population is in the Hudson Bay drainage and is the most northwestern occurrence for the species. The other populations are in the Mississippi River drainage, but also isolated (Figure 12).

NANFA Fellow Ray Katula (Onalaska, WI) has likewise observed these differences in both Minnesota and Wisconsin populations (Katula, 2012). His summary of Minnesota rainbow populations follows:

> The Zumbro 'bows are more robust and colorful then their Root River cousins. Zumbros are also chunkier with more vivid blues and reds. Rainbows in western Minnesota are more mottled and less colorful. Phalens are slightly mottled, but still maintain a fair amount of color and have a golden hue. Typically but not always present is a Y or upside U at the top of the vertical blue band between the first and second dorsal fin. St. Croix rainbows possess the brightest colors and most vivid blues and reds of all Minnesota varieties.

Figure 10. Rosy Red.

In 2000–2001, Kimberly Strand (formerly, University of Minnesota) studied Rainbow Darter morphology of preserved specimens in the James Ford Bell Museum of Natural History fish collection. She submitted the following summary of her results:

> Rainbow darters, *Etheostoma caeruleum* are found in eight major drainages in the state of Minnesota, all are river populations except for one population, the Lake Phalen population. The body morphometrics of the Lake Phalen population of rainbow darters shows unique characteristics, including: higher, on average, number of unpored scales on the lateral line; lower, on average, number of scales above the lateral line; lower, on average, number of scales above and below the lateral line; lower number of scales around the caudal peduncle; decreased nape scalation; and about half of the specimens lacked a complete supratemporal canal, unlike all of the sampled populations.
>
> The Ottertail River population does also show unique characteristics including: higher number of rays on the second dorsal fin; lower number of scales around the caudal peduncle, but similar to

Figure 11. Variation exhibited in Minnesota Rainbow Darter populations. Mississippi River drainage unless indicated.

Otter Tail River (Otter Tail County). Hudson Bay drainage.

Yellow Medicine River (Yellow Medicine County). Minnesota River system.

St. Croix River (Washington County).

Phalen Lake (Ramsey County).

Prairie Creek (Goodhue County). Cannon River system.

Upper Iowa River (Fillmore County).

the Lake Phalen population; the lowest average number of scales above the lateral line; on average the number of pored lateral line scales were the lowest in all populations studied; and the number of unpored scales one of the highest.

Other populations do show potential for a variety of unique characteristics; however more samples are needed from most drainages for statistical purposes.

I have encountered three examples of variation in minnows. I collected my first Lake Chub (*Couesius plumbeus*) in 1989 from Lake Superior at the mouth of the Brule River (Cook County). This fish was drab and gray and all specimens I have collected since from Lake Superior have been the same except a few have exhibited a small patch of red at the base of the pectoral fins. However, the first time I collected Lake Chubs several miles inland from the Swamp River (Cook County) I stumbled on to something very different. All these fish had red covering both sides below the lateral stripe. Small patches of red were also present above the gill covers, face, and base of the dorsal fin (Figure 13). Initially, I thought these were nuptial males, but specimens kept in aquariums retained this color throughout the year.

The Swamp River is a tributary of the Pigeon River which forms the international boundary with Canada for its en-

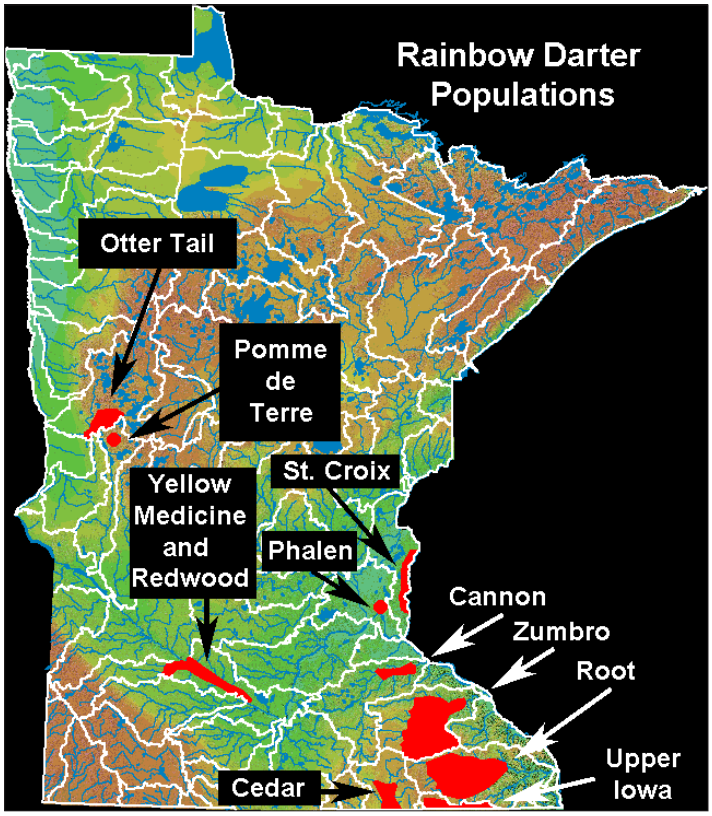


Figure 12. Extant Rainbow Darter populations in Minnesota. Extirpated populations are not shown (i.e., lower Pomme de Terre, Blue Earth, and Credit rivers).

tire length to Lake Superior near Grand Portage. The last 20 miles of river tumbles over an escarpment of several cascades and falls. The last one is Pigeon Falls, which is the highest vertical waterfall in Minnesota at 120 feet (Figure 14). I believe these barrier falls have isolated the inland populations for thousands of years. Lake Chubs exhibiting the same red characteristics occur in the Brule River system above barrier falls. However, other inland populations are likely extirpated. Specimens have not been collected in the Poplar River north of Lutsen (Cook County) since 1941 (JFBM 12084 and 13078) and Grand Lake west of Duluth (St. Louis County) since 1955 (JFBM 16674).

In 2011, Chris Domeier (Minnesota Department of Natural Resources Area Fisheries Office in Ortonville) emailed me about Carmine Shiner (*Notropis percobromus*) specimens he had collected from Big Stone Lake, which straddles the Minnesota-South Dakota border. The news instantly piqued my interest because this was the only known Minnesota population occurring in a lake. I asked Chris to send me the preserved specimens and brought them along on a road trip with Bob Hrabik (Missouri Department of Conservation) to Knoxville, Tennessee, for a visit with Dave Etnier. He may be officially retired from the University of TN, but continues to be the Energizer

Figure 14. Pigeon Falls on the Pigeon River.

Figure 13. Lake Chubs from (top) the Swamp River (Cook County) and Lake Superior (Lake County).

Figure 15. Carmine Shiner? from Big Stone Lake (Big Stone County).

Figure 16. Sand Shiner from Beaver Creek (Rock County).

Bunny pursuing his pet research projects. Dave still possesses the wonderful curiosity of a true biologist and actually showed a child-like anticipation waiting to open the peculiar presents I brought him. He poured the specimens into a sorting pan and spread them out. He was silent for several seconds panning up and down and left and right. Both Bob and I could sense that he was puzzled. Finally he said, "These are not like any *percobromus* I've ever seen!" (Figure 15). Bob and I exchanged shocked glances. This was a prophetic statement from someone who has described more than his share of new species during his career. Without another word he briskly headed down the hall for the fish collection where he pulled specimens from several states in the Carmine's range. Batch by batch he compared them only superficially to the Big Stone Lake specimens. The specimens from other states did not stand out from one another, but Dave started commenting on the deeper body shape and origins of the fin bases of the Big Stone Lake specimens. These differences were plain as day and no one had yet uttered the words "meristic study."

The following year, Chris Domeier invited me out to collect additional specimens. This gave me the opportunity to see the habitat where these Carmines were coming from. Both lake sites were at the mouth of streams and we collected many in the interface between lake and stream, but abundance dropped dramatically outside this zone, either lakeward or upstream. Chris suggested one more collection from the Little Minnesota River, which enters Big Stone Lake near Browns Valley, MN. We headed west into South Dakota for about 7 miles to a bridge crossing and Carmines were again common, but not restricted to narrow habitat types where we found them in the lake. Dave examined them and cataloged all the specimens as *Notropis* cf. *percobromus* (UT 44.12390, 44.12624, 44.12625, and 44.12631). The jury remains out indefinitely whether this is an undescribed species, but I'm quite satisfied for now to simply appreciate another species population exhibiting variation.

The last example is from the extreme southwestern corner of Minnesota, where a sliver of the Missouri River drainage holds the Plains Topminnows (*Fundulus sciadicus*), Topeka Shiner (*Notropis topeka*), and Red Shiner (*Cyprinella lutrensis*), all of which occur nowhere else in the state. This has been my destination for decades in search of these species, but I also encountered very odd looking Sand Shiners (*N. stramineus*) which mimic some of the characters present in Topeka Shiners including what very much looks like a faint chevron at the base of the caudal fin. At first I thought these may be hybrids, but eventually I had no problem telling the two species apart. I mentioned these differences to Bob Hrabik and he agreed the Sand Shiners in the Missouri River drainage of his state were likewise atypical (Figure 16).

Again, I have no doubt there are additional hybrids, oddities, and population variation occurring in Minnesota, but these quests and discoveries will be left to others. Future progress on variation will also require more lab than field work using mitochondrial DNA to determine how different populations are from one another.

References

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