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Abstract

Historical documents, Minnesota Department of Natural Resources stream surveys, and the 66,000 record distributional database of the James Ford Bell Museum of Natural History (1879-2002) were used to produce a field-usable checklist of the 160 fish species known from Minnesota waters and waters shared with its boundary states and Canadian provinces. The checklist includes distribution by eight major drainages, the conservation status for each species, and reference to nomenclatural changes over the past 20 years. Fishes are arranged according to the latest interpretations of phylogenetic relationships among species and supraspecific taxa. New distributional information is presented for six species introduced since 1986 and for 70 species with previously established occurrence.

Introduction

Minnesota has a rich heritage of ichthyological study dating back to the late 1700s. The earliest reports (1799-1846) of fishes from Minnesota waters come from myriad notes and journals of explorers and early settlers of the region (see Keating, 1823; Lanman, 1847; Coues, 1897). The first scientific contribution regarding Minnesota fishes was that of Louis Agassiz (1850), who reported on 30 species from Lake Superior. Charles Girard (1858) reported four species (*Amia calva*, *Ameiurus nebulosus*, *Ambloplites rupestris* and *Lepomis macrochirus*) from the vicinity of Fort Snelling and two other species (*Ichthyomyzon castaneus* and *Hiodon tergisus*) from two other Minnesota localities. Seth Meek (1892) collected 12 species from the Cedar River near Austin, Minnesota, and professors U. O. Cox and A. J. Woolman surveyed the lakes and streams of southwestern Minnesota, including the upper Minnesota River and Big Stone Lake, in 1882 and 1889 (Cox, 1894; Woolman, 1895).

Cox (1897) published a preliminary survey of the fishes of Minnesota based in part on collections made by members of the Minnesota Geological and Natural History Survey under the direction of State Zoologist, Henry F. Nachtrieb. In effect, this publication provided the first ichthyofaunal list for the state. In 1920, Thaddeus "Doc" Surber published a preliminary catalogue of fishes and fish-like vertebrates, which included 119 species—15 more than reported by Cox (Surber, 1920). Collections made by CCC (Civilian Conservation Corps), WPA (Works Progress Administration), and Soil Erosion Service crews from 1935 to 1942 culminated in the publication of the first edition of *Northern Fishes* (Eddy and Surber, 1943). Since then, thousands of fish collections have been made and more than 100 papers have been written about fish distributions and abundance by researchers associated with various state and federal agencies and the University of Minnesota (e.g., Eddy and Surber, 1947; Underhill, 1957, 1986; Eddy and Underhill, 1959, 1974; Nordlie et al., 1961; Eddy et al., 1963, 1972; Moore and Braem, 1965; Phillips and Underhill, 1967, 1971; Underhill and Moyle, 1968; Peterson, 1971; Anderson et al., 1977; Bailey et al., 1993; Fago and Hatch, 1993; Goldstein et al., 1996, 1999; Koel and Peterka, 1998).

Since the publication of the most recent checklist (Underhill, 1989), fish species in Minnesota have undergone numerous faunistic, distributional, phylogenetic, nomenclatural, and conservation status changes. Several historical inaccuracies also have been discovered. With the increasing use of regional, state, and local species lists to guide resource management

decisions, it is vitally important to have historically accurate and reliable floral and faunal lists. The purpose of this paper is to provide in one concise reference: 1) a field-usable, comprehensive distributional and phylogenetic checklist of all fish species known historically from Minnesota waters and waters shared with its boundary states and Canadian provinces, 2) brief accounts of six recent non-indigenous species introductions, and 3) brief accounts of new distributional records and corrections to historical occurrences for 70 additional species.

METHODS

Phylogeny and Nomenclature—World-wide diversity estimates and evolutionary divergence times were derived from Nelson (1994). We followed the phylogeny of Janvier (1997) in recognizing basal groups of fishes. Within the teleosts, we followed the phylogeny of Nelson (1994). Species were listed alphabetically following Mayden et al. (1992) with these exceptions. We retained *Notropis dorsalis* in place of *Hybopsis dorsalis* as bigmouth shiner, *Notropis topeka* in place of *N. tristis* as Topeka shiner (Opinion 1821, 1995), *Lepomis gulosus* in place of *Chaenobryttus gulosus* (Mabee 1993), and *Ammocrypta clara* in place of *Etheostoma clarum* as western sand darter (Near et al 2000). We also replaced the genus *Stizostedion* with the genus *Sander* as recognized by Kottelat (1997).

Distribution and Historic Occurrence—We included in the checklist all species determined to have been collected since the late 1700s in Minnesota and its boundary waters with the exceptions noted below. To determine historic occurrence, we reviewed documents referenced in the Introduction and examined fish survey records of the Minnesota Department of Natural Resources and Fish Collection records (N = 65,958) of the James Ford Bell Museum of Natural History (JFBM). We also consulted fish biologists from the Minnesota Department of Natural Resources (MDNR), the Minnesota Sea Grant Program, the Ontario Ministry of Natural Resources (OMNR), the U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service (USFWS), and the Wisconsin Department of Natural Resources (WDNR). Fish collection records were accepted if we had originally identified a specimen, found an extant voucher specimen or photograph that we could identify, or found an ichthyologist who could attest to the validity of a specimen. We included species collected in other states or Canadian provinces if they were collected in waters contiguous with those of Minnesota. Such species were clearly indicated in the checklist. We did not include introduced species that have not persisted (but see *Ictalurus furcatus* below), nor did we include non-indigenous species on the sole basis of angling records. Conservation status was determined by the Minnesota Department of Natural Resources in accordance with state statutes (Minnesota Rules, Chapter 6134).

COMPREHENSIVE CHECKLIST

We intended the checklist to stand alone so that it could be used in the laboratory as a data tally sheet, in the field (in laminated form) as a quick reference for watershed distribution, and in the classroom as a general reference for ichthyology students. Therefore, we designed it as a single-page (back-to-back), information-rich reference to the phylogenetic position, nomenclature, present distribution, and conservation status of Minnesota fishes (Figure 1). The symbols and codes used on the checklist are either self-explanatory or explained on the second page of the list.

At present, we recognize 158 species that occur within the boundaries of Minnesota, plus two others that occur in boundary waters. Of these 160 total species, we consider 139 to be native to Minnesota waters, plus one native in contiguous boundary waters. We have added four species collected in Minnesota waters since 1989 (*Coregonus nipigon*, *Gasterosteus aculeatus*, *Neogobius melanostomus*, and *Proterorhinus marmoratus*), two species collected in Minnesota boundary waters (*Apeltes quadracus* and *Fundulus dispar*), and one species of dubious historical occurrence (*Ictalurus furcatus*).

Historically, ichthyologists have recognized eight major drainages within the state, which are shown at the bottom of the last column in the checklist (Figure 1). The boundary between the Upper Mississippi River drainage and the Lower Mississippi River drainage is St. Anthony Falls, which acted historically as a barrier to upstream fish migration (Eddy et al., 1963). The greatest number of species occurs in the Lower Mississippi River drainage (80% of the 158 species), followed by the St. Croix River (67%), Minnesota River (60%), Lake Superior (53%), Red River of the North (52%), Upper Mississippi River (47%), Rainy/Lake of the Woods (46%), and Missouri River (27%) drainages. The number of genera and families shows the same drainage sequence (Table 1). The Lake Superior and Upper Mississippi River drainages have the greatest number of species introductions and the

highest introduced to native species ratios. The Missouri River drainage has the fewest species introductions, but the Lower Mississippi River drainage has the lowest introduced to native species ratio. The latter drainage also harbors 76% of Minnesota's endangered, threatened, and special concern species (Table 1).

Recent Non-Indigenous Species Introductions

Between 1986 and 2001, six species of non-indigenous fishes were discovered in Lake Superior and its estuaries. Five of the species were found in Minnesota waters. We do not have unequivocal evidence in each case, but we believe that all six introductions occurred when ballast waters were bilged from commercial transport vessels.

1. *Gasterosteus aculeatus*—The threespine stickleback was first collected in the Lake Superior drainage in March, 1987. Three specimens were taken from south Neebing Marsh in Thunder Bay Harbor, Ontario (Hartviksen and Momot, 1989). Additional specimens were collected in 1994 in Minnesota waters of Lake Superior. One was taken from the Poplar River near Lutsen and many were removed from Taconite Harbor cooling tanks on 8 June. Another specimen was seined from the Duluth-Superior Harbor at Connor Point, Wisconsin, on 6 July (S. A. Stephenson, OMNR, pers. comm.). Many specimens have been collected in Wisconsin waters of the Harbor and further east at the mouth of Saxine Creek since 1994 (Lyons et al., 2000; D. Pratt, WDNR, pers. comm.). From 1998 to 2000, over 100 specimens were taken from Grand Marais Harbor, Baptism River, Split Rock River, and Skunk Creek, indicating that this species has become established along the North Shore of Lake Superior.

2. *Apeltes quadracus*—The fourspine stickleback was collected from the mouth of the Neebing-McIntyre River in Thunder Bay, Ontario, in 1986 and 1987 and later from two other locations in bays of Lake Superior (Hartviksen and Momot, 1989; Momot and Stephenson, 1996). No specimens have been taken from Minnesota waters. We are unable to predict the likelihood of population establishment in Minnesota.

3. *Morone americana*—Nine specimens of white perch were collected from the St. Louis River Estuary in 1986 and 1987. Although this species has invaded other Great Lakes through migration, it most likely reached the St. Louis Estuary via ballast water. An analysis by Johnson and Evans (1990) suggested that a viable population should be difficult to establish in the St. Louis River system or in western Lake Superior since cold winter water temperatures produce high mortality in young-of-the-year white perch. However, Lyons et al. (2000) pointed out that the St. Louis Estuary lies outside winter air isotherm delimiting the species' range elsewhere in the Great Lakes. The continued collection of this species throughout the 1990s indicates that a winter-hardy population has been established in the estuary.

4. *Gymnocephalus cernuus*—The European ruffe was first collected from the St. Louis River below the Fond du Lac dam in 1986 by EA Engineering, Science and Technology, Inc. biologists and in three additional locations the following year by WDNR and USFWS biologists (Pratt et al., 1992). It has been collected in the St. Louis estuary every year since. It was taken from Sand Point and Two Harbors in Lake Superior in 1996 and from Keene Creek in Duluth in 1998. The ruffe has established a robust population in the estuary and perhaps western Lake Superior and is competing with native yellow perch (*Perca flavescens*) and trout-perch (*Percopsis omiscomaycus*) (Ogle et al., 1995). It also may be drastically reducing the forage base of emerald shiners (*Notropis atherinoides*) and spotfin shiners (*Notropis hudsonius*) (Evrard , 2000). It is unlikely that natural predation will control ruffe population growth and expansion (Ogle et al., 1996).

5. *Neogobius melanostomus*—Another ballast arrival is the round goby, which was collected in the Duluth-Superior Harbor twice in 1995. Both specimens were adults. No new specimens were found in 1996, but many were collected from the St. Louis Estuary in 1998 and subsequently, indicating that a population has been established (Minnesota Sea Grant, 1998; Lyons et al., 2000). Populations have been established in other parts of the Great Lakes as well (Marsden and Jude, 1995; Jude, 2001).

6. *Proterorhinus marmoratus*—The most recent Lake Superior ballast water arrival is the tubenose goby. Two specimens were collected from the Duluth-Superior Harbor in 2001, one on the Minnesota side by USGS biologists and one on the Wisconsin side by WDNR biologists in September 2001. One specimen was less than one year old and may have originated from natural reproduction. In 2002, ten more specimens were collected in the St. Louis River estuary from Dwight's Point to Hog Island (D. Pratt, WDNR, pers. comm.). This species is established but not common in Lake St. Clair, which occurs between Lake Erie and Lake Huron (Jude 2001.).

RECENT DISTRIBUTIONAL RECORDS AND CORRECTIONS TO HISTORICAL RECORDS

Since 1989, many stream surveys have produced an unprecedented number of new distributional records. In addition, the construction of the JFBM Fish Collection electronic database has given us the ability to quickly track new distributional records and to systematically discover errors made in the past. Below we report on changes to the published distributions of 70 species.

Among the 70 species are eight whose ranges have extended beyond St. Anthony Falls. For approximately 10,000 years, since the Mankato ice sheet receded, St. Anthony Falls acted as an effective barrier to upstream fish dispersal in the Mississippi River (Eddy et al., 1963). After the opening of the upper lock at the Falls in 1963, it became possible for fish to move beyond this barrier at least 20 km upstream to the Coon Rapids Dam, which was built in 1914. However, we had no evidence of any dispersal until 1976 when *Hypentilium nigricans* (northern hogsucker) was reported without voucher from the Mississippi River near Monticello (above the Coon Rapids dam). In 1995, *Ictalurus punctatus* (channel catfish) and *Lepomis humilis* (orangespotted sunfish) were collected just below the dam near Dunn Island, and *Percina maculata* (blackside darter) was collected in two locations above the dam. Since then, *Noturus flavus* (stonecat), *Pylodictis olivaris* (flathead catfish), *Pimephales vigilax* (bullhead minnow), and *Dorosoma cepedianum* (gizzard shad) also have been discovered at or above the Coon Rapids Dam (see individual accounts).

1. *Lampetra appendix*—The American brook lamprey was designated a species of special concern in 1984 because of its apparent extirpation from the Credit River near Savage, Minnesota; its only historic occurrence in the Minnesota River drainage (Coffin and Pfannmuller, 1988). At that time, other records indicated its distribution was restricted to a few sites in southeastern Minnesota and one site in Valley Creek, a tributary of the St. Croix River. Although the species still appears to be absent from the Credit River, it has been found recently in three other Minnesota River tributaries—Eagle Creek (JFBM 27717) and an unnamed tributary to the Minnesota River (JFBM 36607) in Scott County and Assumption Creek (JFBM 31057) in Carver County. Additionally, the American brook lamprey is now known from 48 sites in the St. Croix and Lower Mississippi drainages, which here includes the Upper Iowa River system (and see Mundahl, 1994, 1995).

Underhill (1989) reported this species mistakenly from Lake Superior drainage. Fago (1992) accepted a single record from the Bois Brule River in Wisconsin, but we have no specimens from the Lake Superior drainage.

2. *Ichthyomyzon fossor*—The northern brook lamprey was unknown from Minnesota until 1986, when it was taken from the Blackhoof River in the Lake Superior drainage (JFBM 23793). Based on its presence in western Wisconsin and southern Manitoba, Cochran and Pettinelli (1988) predicted the discovery of additional populations in Minnesota. Since 1986, northern brook lampreys have been taken from an additional six sites in the Lake Superior drainage, 25 sites in the Rainy/Lake of the Woods drainage (e.g., JFBM 31401), one site in the Zumbro River system (JFBM 24040), and one site in the Upper Iowa River (JFBM 31289). Clearly, this is a native species that has been overlooked and misidentified for a long time.

3. *Ichthyomyzon gagei*—The southern brook lamprey was unknown from Minnesota waters until 1985 (Cochran, 1987), when it was taken from a small tributary of the St. Croix River (JFBM 22867). Currently, it is known from a total of 36 sites in the St. Croix River and 13 of its tributaries in Carlton, Chisago, Kanabec, Pine, and Washington counties. This St. Croix population (which extends into Wisconsin) is over 900 km away from the next northernmost southern brook lamprey population (Cochran, 1987). Cochran favored the hypothesis that the St. Croix population is a relict of *I. gagei* (i.e., left over from when the continuous range included Minnesota), but he recognized the possibility that it may represent an independently evolved satellite species of the chestnut lamprey (*Ichthyomyzon castaneus*). A recent molecular genetic study (Mundahl et al., 1997) and a morphological study (Lyons et al., 1997) strongly suggest that this population is *I. gagei*.

4. *Acipenser fulvescens*—Lake sturgeon have not been reported from the Minnesota River drainage in any checklist or fish compendium, and we have no specimens in the Bell Museum Collection. However, we have accepted two recent angling records from the Minnesota River based upon published photographs. Both photographs permit accurate identification. The first specimen was caught below the dam in Granite Falls in 1991, and the second was caught at Riverside Park in New Ulm in 1993.

5. *Scaphirhynchus platorynchus*—Eddy and Underhill (1974) reported this species from

the lower St. Croix River and indicated that it was "common years ago." Fago and Hatch (1993) listed it as "pre-1975." On 4 April 2001, Mark Hove of the University of Minnesota collected a single specimen from the Dalles area (river kilometer 81.9) during a scuba diving excursion. To our knowledge, this is the first documented specimen from the entire drainage (JFBM 35086).

6. *Lepisosteus osseus*—There are only two records for longnose gar within the Lake Superior drainage, one from Nipigon Bay in Ontario (a 1961 record reported by Hartviksen and Momot 1989) and one in the lower reach of the Brule River, WI (reported by Moore and Braem, 1965). On the basis of these records, Underhill (1986, 1989) considered longnose gar as native to the Lake Superior drainage. Momot and Stephenson (1996) and Fago (1992) were not able to verify either record, and numerous subsequent surveys in these and other areas of the drainage have failed to collect the species. Thus, we no longer include this species in the Lake Superior drainage ichthyofauna.

We still include this species in the Red River of the North drainage list, but it has not been documented there since 1893 (Woolman, 1895). Koel (1997) considered it extirpated.

7. *Hiodon alosoides*—Underhill (1989) indicated that there were no verifiable Minnesota records of goldeye from the Lower Mississippi drainage below the St. Croix River confluence, and Fago (1992) reported no Wisconsin records for this reach after 1972. Pitlo et al. (1995) regarded goldeye as rare to uncommon in this reach of the Mississippi. We now have 13 specimens from 8 sites between Pools 2 and 9; ten of these specimens were collected in 1994 and 1995 and one in 2001 (e.g., JFRBM 28110). Despite the recent records, we still consider goldeye to be rare in the lower Mississippi River, and Wisconsin lists it as endangered (Wisconsin Department of Natural Resources 2000).

8. *Anguilla rostrata*—Underhill (1989) reported the American eel from the Upper Mississippi River drainage (above St. Anthony Falls) based on the single sight record acknowledged by Eddy et al (1963). Occasional unsubstantiated reports of this species have been made from the vicinity of St. Cloud and Coon Rapids Dam. It may be that eels sometimes circumvent the dam, but we have no specimens from above St. Anthony Falls. We follow Eddy et al. (1963) in not considering this catadromous species to be part of the Upper Mississippi River fish community.

Our only Lake Superior drainage specimens are from the Blackhoof River (JFBM 22158), but Lyons et al. (2000) reported specimens from Lake Superior proper. We have added this species to the Lake Superior list.

9. *Alosa chrysochloris*—In 1986, skipjack herring were collected in Lake Pepin for the first time since 1928. Additional specimens were taken from Lake Pepin in 1993 (JFBM 27248) and again in 2001 (JFBM 37733). Water levels in the Mississippi River were exceptionally high in all three of these years, which may have allowed skipjacks to negotiate the dams and reach Lake Pepin. Young-of-the-year were found in 1986 and 1993 but were not collected in subsequent years, suggesting that reproduction is not on-going.

Underhill (1989) did not report skipjack herring from the Minnesota River, having overlooked a specimen captured near Savage in 1899 (JFBM 7335). We also recognize this species historically in the lower St. Croix River based on old records reported and examined by Greene (1935) and accepted by Fago (1992) and by Fago and Hatch (1993).

10. *Dorosoma cepedianum*—The gizzard shad is the most recent of eight species to extend its range from the Lower to Upper Mississippi River drainage. It was collected from an unnamed tributary to the Mississippi River downstream of the Coon Rapids Dam, Anoka County, in August 2000 (JFBM 35357).

11. *Campostoma oligolepis*—The largescale stoneroller was first verified from Minnesota by Burr and Smith (1976), who reported it from four sites in the Zumbro and Root river systems. Subsequent re-analysis of JFBM collections revealed its presence in the Forest River of North Dakota (1952), and in the Redwood (1955) and Yellow Medicine rivers (1973) of Minnesota. We since have verified it from 18 sites in the Zumbro and Root river systems of the Lower Mississippi River drainage. It also has been taken from Sand Creek, Snake and Knife rivers, Rush Creek, and the St. Croix River in the upper St. Croix River system and from Otter Creek in the Cedar River system (e.g., JFBM 27541). It is likely that the unusually disjunct distribution in Minnesota is a result of continued misidentifications of this species.

12. *Couesius plumbeus*—Underhill (1989) reported the lake chub from the Rainy River/Lake of the Woods drainage based on a single specimen (JFBM 10477). We have been unable to locate the specimen and the locality data in the catalogue are incomplete. Thus, we no longer recognize the lake chub as occurring in this drainage, although Scott and Crossman

(1973) reported it within this drainage in Ontario.

13. *Cyprinella spiloptera*—Underhill (1989) reported the spotfin shiner from the Missouri River drainage in Minnesota. Two of the authors believe that they encountered this species somewhere in the drainage in recent years, but we can find no specimens. Thus, we no longer recognize the spotfin shiner as occurring in this drainage.

14. & 15. *Nocomis biguttatus* and *Notemigonus crysoleucas*—Underhill (1989) reported the hornyhead chub and the golden shiner from the Missouri River drainage, but we have been unable to find specimens. Thus, we no longer include them in the list from that drainage.

16. *Notropis anogenus*—The status of the pugnose shiner in Minnesota is unclear. Prior to 1970, it was known from 40 sites across a wide portion of central Minnesota, where it inhabited vegetated areas in clear glacial lakes and streams. Post-1970 surveys have located pugnose shiners at 39 sites, but only four of these coincide with historical sites (e.g., Cass Lake, JFBM 26660; Fish Lake, JFBM 29365). Removal of littoral vegetation from lakes and an increase in lake and stream siltation have been linked to this species' demise in other states (Smith, 1979; Trautman 1981; Lyons et al., 2000), and many pre-1970 Minnesota sites now exhibit these types of degradation. However, it is now clear that this species is more widespread than once thought.

Until recently, the only record of pugnose shiner from the Lake Superior drainage was in the Floodwood River, collected by John Moyle in 1941 (uncatalogued). With no vouchered specimen, Eddy and Underhill (1974) excluded it from the species list for that drainage. In May 2002, one specimen was collected from Long Lake (Itasca and St. Louis counties, JFBM 39064), about 7.1 km northwest of the Moyle collection site.

17. *Notropis atherinoides*—Eddy and Underhill (1974) stated that the emerald shiner had been collected from all drainages in the state, but Underhill (1989) did not include it in the Missouri River drainage. The first vouchered specimen in this drainage was collected in 1996 from the Ocheyedan River in Nobles County (JFBM 28738). Further sampling in this river system needs to be undertaken. Emerald shiners have not been collected in the Iowa portion of this drainage for several decades.

18. *Notropis blennius*—The river shiner has been reported from the Upper Mississippi River drainage of Minnesota based on the report of Hubbs and White (1923). We have not located the specimen but believe that it was misidentified because no additional individuals of this species have been taken above St. Anthony Falls. A previously reported river shiner from Leech Lake was actually *Notropis volucellus*. Thus, we no longer recognize this species as occurring in the Upper Mississippi River drainage.

19. *Notropis heterodon*—The only extant specimens of blackchin shiner from the Lake Superior drainage were collected in Pequaywan Lake, St. Louis County, in 1922 (JFBM 10447). Smith and Moyle (1944) also reported their occurrence in Two Island River, but we do not have the specimens. This species is present in the Lake Superior drainage in Wisconsin and further east, but it has not been reported along the North Shore in Ontario (Stephenson and Momot, 1994).

20. *Notropis heterolepis*—Underhill (1989) reported the blacknose shiner from the Missouri River drainage, but we been unable to verify this record.

21. *Notropis hudsonius*—The spottail shiner was taken for the first time in the Missouri River drainage of Minnesota in 1997 (JFBM 38075). It was collected in the Ocheyedan River in Nobles County, which is also the only stream in the Missouri River drainage to harbor emerald shiners.

22. *Notropis ludibundus*—The sand shiner was previously reported from the Upper Mississippi River drainage (Underhill, 1989), but we could not verify its occurrence there.

23. *Notropis texanus*—A survey in 1984 revealed the weed shiner in three locations in the Shell River (e.g., JFBM 23738). These are the only records of this species from the Upper Mississippi River drainage. They were overlooked in the 1989 checklist (Underhill, 1989). The weed shiner is not very common in Minnesota and it exhibits a highly disjunct distribution. Thus, the Shell River population may represent an overlooked native population, or it may be the result of an inadvertent "bait bucket" introduction.

24. *Notropis topeka*—Recent surveys have proven this species to be common and widespread in small prairie streams tributary to the Missouri River in Lincoln, Murray, Nobles, Pipestone, and Rock counties (Hatch, 2001). From 1997 through 2001, it was collected from a total of 107 sites in 17 streams. An additional 85 intensively sampled sites in the Des Moines River system yielded no Topeka shiners (Dahle 2001). There are only two historic records outside the area of these surveys. One is from

Okabena Lake in Nobles County, 1947, but remains unverified. Intensive sampling of the watershed from the lake to the headwaters of Okabena Creek in 1998 produced no Topeka shiners (Hatch, 1998). The other record is from an unnamed tributary about 26 km east of Austin in Mower County, most likely in the Cedar River system (UMMZ 127672). Underhill (1957) and Eddy and Underhill (1974) mistakenly reported that these specimens were collected by Seth Meek in 1890. However, they were collected by George Myer and William Gosline in 1939. Thus, there should be only one site in Mower County shown on the map of Bailey and Allum (1962). Intensive sampling in the Cedar River watershed from 1953 through the present have produced no further specimens of this species.

The Topeka shiner was listed as a species of special concern in 1996. The U.S. Fish and Wildlife Service listed it as endangered in January 1999.

25. *Opsopoeodus emiliae*—The pugnose minnow reaches its northern-most distribution in Minnesota. It was listed as special concern in 1984 because of its unknown and possibly rare abundance in the state (Coffin and Pfannmuller, 1988). Recent surveys have shown it to be common to abundant, but sporadically distributed, in many backwater areas of the Mississippi River from Dakota County to Houston County and in three sites in the Root and Zumbro rivers. Population size appears to fluctuate widely across years.

26. *Phoxinus erythrogaster*—Underhill (1989) reported the southern redbelly dace in the Minnesota River drainage based on three collections. We have identified the specimens from two of these collections (the third is not extant) as northern redbelly dace (*P. eos*). Thus, we no longer recognize this species as occurring in the Minnesota River drainage.

27. *Phoxinus neogaeus*—The finescale dace was recently collected from a small, direct tributary of the Mississippi River in Dakota County (JFBM 29262). The tributary is known locally as Valley Creek and is labeled as Colonial Creek on some older road maps. This is the first record of this species in the Lower Mississippi River drainage.

28. *Pimephales vigilax*—Thirteen specimens collected from the Blue Earth River in 1945 and 1948 were identified as bullhead minnows by ichthyologist Raymond E. Johnson. Eddy and Underhill (1974) subsequently reported that intensive sampling in the Minnesota River drainage produced no further specimens, which led Underhill (1989) to regard the species as restricted to the Lower Mississippi River drainage. We have not been able to verify the 1940s records. However, we now have a single record from the Minnesota River in Fort Snelling State Park, collected by Konrad Schmidt in 1989 and verified by James Underhill. Unfortunately this specimen is not extant. We also have a single specimen collected in 2000 from the upper Mississippi River at the Coon Rapids Dam (JFBM 35491), which is the only record above St. Anthony Falls.

29. *Platygobio gracilis*—The flathead chub has been collected only once (1984) from Minnesota waters in the Red River of the North drainage near Climax in Polk County (JFBM 22917). However, the species also has been reported from the lower Red River of the North upstream of Lake Winnipeg in Manitoba. We believe that this single occurrence in Minnesota may be the result of introductions into a North Dakota reservoir of the Sheyene River. This species was not found in the extensive surveys of 1993-1995 (Goldstein et al., 1996; Koel, 1997).

30. *Rhinichthys cataractae*—The longnose dace has been reported from the Minnesota drainage based on the records of Woolman and Cox from Dougherty Creek at Brown's Valley and the Pomme de Terre River at Appleton (Cox, 1897). However, we have not collected this species anywhere in the drainage despite considerable sampling in the 1970s, 1990s, and in 2001. We no longer recognize this species as occurring in the Minnesota River drainage. Its reported occurrence in the Missouri River drainage in Underhill (1989) was a clerical error.

31. *Cycleptus elongatus*—Underhill (1989) regarded the blue sucker as occurring in the Lower Mississippi River drainage, Wisconsin portion of the St. Croix River drainage, and the South Dakota portion of the Missouri River drainage. We now have verified records from the St. Croix River (uncatalogued) and the Minnesota River (Carver Co., JFBM 24441; Nicollet Co., JFBM 30374). We also have additional records from the Mississippi River in Hennepin, Ramsey, Washington, Wabasha, Winona, and Houston counties (e.g., JFBM 28832).

32. *Hypentelium nigricans*—In August 1996, Ecological Services biologists (MDNR) captured northern hogsuckers (JFBM 28723) in the Mississippi River at Anoka. These are the first vouchered specimens from upstream of St. Anthony Falls, but biologists from Xcel Energy Co. have reported this species in the river near Monticello (further upstream) every year since 1976. We now have specimens from there (JFBM 36735, 36855), from the North Fork of

the Crow River in Meeker County (JFBM 35235), and from the Mississippi River at St. Cloud (JFBM 38105). It appears that the northern hogsucker managed to circumvent Coon Rapids Dam at least 25 years ago, quite possibly during the flood water of 1965. Its population is now well established in the Upper Mississippi River drainage.

33. *Ictiobus bubalus*—In September 1995, members of the MDNR captured two smallmouth buffalo (JFBM 28391), one below the Breckenridge Dam in the Otter Tail River and one below the Kidder Dam in the Red River of the North drainage. Formerly, this species was known only from the Minnesota and Lower Mississippi River drainages and from Lake St. Croix (Underhill, 1989).

34. *Ictiobus cyprinellus*—On 29 July 2001, a 6.8 kg bigmouth buffalo was taken by an angler just below the Blanchard Dam in Morrison County. This is the first verified record (JFBM 38101) from the Upper Mississippi River drainage since the early 1900s (Eddy and Underhill, 1974). A second specimen was taken at the mouth of Elm Creek near Anoka in October 2002 by MPCA biologists. Eddy and Surber (1947) acknowledged the presence of a "landlocked" population in the vicinity of Brainerd at the turn of the last century, and they considered this population the source for a specimen from Grand Rapids captured in 1894 and reported by Cox (1897). Until recently, we had considered this species extirpated from the Upper Mississippi River drainage. It is unclear whether the recent specimens are descendants of the Brainerd population or recent ascendants from the lower Mississippi River.

We now also have a second record of this species within the Missouri River drainage. It was collected from the Ocheyedan River in Nobles County in 1997 (JFBM 38073).

35. *Ictiobus niger*—Although this species was known historically from the Mississippi River as far north as Lake Pepin (Phillips and Underhill, 1971; Becker, 1983), there were no verified records from Minnesota waters before 1983. Since that time, several specimens have been taken from Minnesota and Wisconsin waters of Navigation Pools 4, 7, and 8 in the Mississippi River (JFBM 30336) (Pitlo et al., 1995). We also have two recent specimens from the Minnesota River, one captured in 1998 near St. Peter (JFBM 30337) and the other captured and photographed (uncatalogued) in 2002 near the Black Dog Power Plant, Dakota County. In addition, one specimen was caught by an angler in 1990 in the lower portion of the Cottonwood River, tributary to the Minnesota River (we have not seen this specimen, which was identified by Huon Newberg, MDNR). These records, along with 12 historical Wisconsin records in the Mississippi River from Lake Pepin through pool 9 (Becker, 1983), clearly establish the black buffalo as part of Minnesota's fish fauna.

36. *Moxostoma carinatum*—The river redhorse was first collected from state waters in the Minnesota River in 1899 (e.g., JFBM 7297); however, no additional specimens have since been taken from that drainage. This species is also known from the Kettle River (1996, JFBM 28589), the St. Croix River (1979-1997, e.g., JFBM 29466), and Lake St. Croix (1966, JFBM 29174) in the St. Croix River drainage, and from Navigation Pools 2 and 4-9 (1993-2001, e.g., JFBM 28025) in the lower Mississippi River system.

37. *Moxostoma duquesnei*—In 1984, the black redhorse was known from only six sites in the Zumbro and Root River systems (Coffin and Pfannmuller, 1988). It is now known from 17 sites in the above river systems and four sites in the Upper Iowa River system, although it appears to occur in low numbers at all sites (see Schmidt, 1993). There is an unsubstantiated report of a black redhorse from Pool 4 in the Mississippi River. It may have been a stray from the Zumbro River, but Lyons et al. (2002) considered it more likely an erroneous report.

38. *Moxostoma valenciennesi*—Based on a detailed analysis of specimens collected from Minnesota and neighboring states carried out by Phillips and Underhill (1971), Eddy and Underhill (1974:290) stated that the "presence of the greater redhorse in Minnesota is doubtful." Historically, this species was included on the faunal list (*M. rubreques* in Eddy and Surber 1943) on the basis of a single adult specimen collected in 1948 from the Mississippi River at LaCrosse, Wisconsin (UMMZ 156836) and a single juvenile also collected from the Mississippi, but at Minneapolis in 1926 (UMMZ 71967). We now know that the greater redhorse, although apparently not abundant, is widely distributed in five major watersheds of Minnesota (Figure 1). The JFBM collection now has a total of 33 specimens from the Otter Tail River in the Red River of the North drainage (e.g., JFBM 25189); Lake Andrusia, Inguadona Lake, Ossawinamakee Lake, Sauk River, Long Prairie River, and the Mississippi River in the Upper Mississippi River drainage (e.g., JFBM 36305); the Snake, Sunrise, and St. Croix rivers in the St. Croix River drainage (e.g., JFBM 28598); Elm Creek, the Yellow Bank, Redwood, and Minnesota rivers of the Minnesota River

drainage (e.g., JFBM 25995); and the Straight, Root, and Mississippi rivers of the Lower Mississippi River drainage (e.g., JFBM 31765). It also is possible that this species is present in the Rainy/Lake of the Woods drainage. An early juvenile specimen (48 mm SL) collected in 1894 from Lake of the Woods (USNM 61510) has been identified by Dr. Robert E. Jenkins, Roanoke College, Virginia, as *M. valenciennesi*.

39. *Ameiurus natalis*—Eddy and Underhill (1974) considered the yellow bullhead rare in Minnesota and not present in the Red River of the North, Lake Superior, and Missouri River drainages. We now have numerous collections of this species from the Red River of the North drainage, two collections from the Missouri River drainage (JFBM 38078, 38088), and one collection from the St. Louis River in the Lake Superior drainage (JFBM 29117).

40. *Ictalurus furcatus*—We are unable to ascertain whether or not the blue catfish is native to Minnesota. The species occurs in the Mississippi and Missouri rivers to the south of Minnesota, but there are no authenticated records from anywhere in Minnesota or Wisconsin. However, Eddy and Surber (1943:154) state that blue catfish were "frequently taken during the warmer months from Lake Pepin southward in the Mississippi River." They also conjectured that a very large catfish (almost 2m long and over 70 kg) taken from the Minnesota River near Hanley Falls might have been a blue catfish. Eddy et al (1963) did not accept an unsubstantiated report of a blue catfish (16.8 kg) from the Mississippi River near Fort Ripley in 1959. Phillips et al. (1982) suggested that this species at one time may have been present in Minnesota as a result of northward summer migrations during the years prior to extensive lock and dam construction on the Mississippi River. The few authenticated records of this species north of the Missouri River confluence are from late summer months, which is consistent with this suggestion.

In 1977, the Minnesota Department of Natural Resources stocked 6,335 yearling blue catfish into Lake St. Croix. Two specimens, presumably from this stocking, were collected the following year in Lake Pepin by DNR personnel. In recent years, numerous anglers have claimed to have caught large blue catfish from the lower St. Croix, but none has been authenticated. Fago and Hatch (1993) reported it as an introduced species in the St. Croix River drainage, and Lyons et al. (2000) considered the species a failed introduction in Wisconsin. Because we have no physical evidence of their occurrence in Minnesota prior to the 1977 stocking effort, we have chosen to recognize the blue catfish as an introduced species.

41. *Ictalurus punctatus*—The channel catfish is another species that now occurs in the Upper Mississippi River drainage. In this case, the species was intentionally released above Coon Rapids Dam by Minnesota Department of Natural Resources in 1963 and 1974 (Enblom, 1977). In 1995 and 1996, we received two vouchered records from the Mississippi River at Coon Rapids Dam and at Anoka (JFBM 28725), two from the Crow River at the mouth (JFBM 28312) and at Delano, and two from Rice Creek in Ramsey County (e.g., JFBM 35575). Since then, channel catfish have been collected as far north as the Blanchard Dam near Royalton (JFBM 38250). This species also was stocked in Boom Lake in Brainerd in the mid-1990s. Clearly, the channel catfish has become a part of the Upper Mississippi River fish community.

42. *Noturus flavus*—In 1998 and 2000, stonecats were taken in the vicinity of the Coons Rapids Dam, but no specimens were deposited in the Museum. We now have a specimen from that area that was collected on 30 August 2001 (JFBM 38116). This is one of eight species whose range extension to the Upper Mississippi River has been documented in the past six years.

Recently, we discovered that Raymond Johnson identified this species from the St. Louis River in 1942, but we were unable to locate the specimens. MDNR reported it in the estuary in 1981, 1986, and 1990. In 1997, MPCA collected it from the North Fork of the Nemadji River in Carlton County (JFBM 29397). Apparently this species has been present in the Lake Superior drainage for some time, but it is rare.

43. *Pylodictis olivaris*—In 1999, this species was collected in the Mississippi River in the vicinity of Monticello (JFBM 31905). It became the sixth new species whose range was extended beyond St. Anthony Falls (Upper Mississippi River).

44. *Umbra limi*—The central mudminnow was collected for the first time from the Missouri River drainage in 1997. It was found in an unnamed tributary to Kanaranzi Creek in Nobles County (JFBM 29375).

45. *Esox masquinongy*—The first specimens of muskellunge in Minnesota waters of the St. Croix River drainage were captured in July 1996. They were taken from the St. Croix River in Pine County downstream of Wisconsin's Clam River by members of the Minnesota Pollution Control Agency. Becker (1983) considered this species common in the St. Croix River north to the Trego Dam. Fago (1992) considered the early St. Croix records

uncertain, and Fago and Hatch (1993) listed this species as introduced in the St. Croix River drainage. Lyons et al (2000) implied an historical occurrence in the drainage citing the work of LeBeau (1992) but did identify it as native there. No Minnesota authors recognize this species from the St. Croix River drainage and no authenticated Wisconsin records exist prior to stocking efforts. We consider the present St. Croix population to be the result of introductions. This species also has been introduced into the Otter Tail River system of Red River of the North drainage.

46. *Osmerus mordax*—The rainbow smelt is an introduced species that was first verified in Minnesota waters of Lake Superior in 1946 (Phillips et al., 1982). The species has since been introduced or migrated to 26 inland lakes in 5 Minnesota counties (Franzin et al., 1994; MDNR records). These lakes include (years of collection in parentheses): Chester (1979-1994), Devilfish (1971-1984), Gneiss (1979), Gunflint (1983-1994), Hungry Jack (1971-1994), Kimball (1972-1974), Magnetic (1978-79), Rose (1987-1992), Saganaga (1982-1992), Trout (1984-1987), and West Bearskin (1982-1993) in Cook County; Buckeye (1995), Kennedy (1977), and Pokegama (1990) in Itasca County; Lake of the Woods (1991) in Lake of the Woods County; Bass (1995), Burntside (1989), Eagles Nest 1&2 (1989), Hanson (1989), Lac La Croix (1989), Little Long (1989), Namakan (1990), Rainy (1990), and Shagawa (1979) in St. Louis County; and Grindstone (1984) in Pine County. In addition, rainbow smelt have been found in Lake St. Croix (1976) and in navigation Pool 8 of the Mississippi River (1993, JFBM 35887) but are not established in either locality.

47. *Coregonus clupeaformis*. In 1967, several specimens of lake whitefish were taken in commercial seines from Lake St. Croix. The captures were reported but the specimens were not saved. Recently, Mr. Howard Krosch, formerly of the Minnesota Department of Natural Resources, provided us with a definitive photograph of one of the specimens, which he had identified on site. We are uncertain about how these fish reached Lake St. Croix; and, to our knowledge, no other specimens have been reported from the St. Croix River drainage. We do not consider this species part of the St. Croix River drainage fish community.

48. *Coregonus nigripinnis*—The blackfin cisco has been incorrectly recognized as part of the Minnesota ichthyofauna since Evermann and Smith (1894) reported it from Lake Miltona in Douglas County. Cox (1897) and Surber (1920) agreed with Evermann and Smith (1894) and speculated that it was probably the common species in other deep lakes of the state, especially in the north. Eddy and Surber (1943) correctly indicated that the cisco species found in inland lakes was *Coregonus artedi*, not *C. nigripinnis*. However, based on the work of Koelz (1929), Eddy and Surber recognized *C. nigripinnis* (cf., *Leucichthys nigripinnis cyanopterus*) as a common species along the north shore of Lake Superior. Eddy and Underhill (1974) continued to recognize this taxon in Lake Superior. Based on the work of Todd and Smith (1980), Underhill (1986, 1989) no longer recognized this taxon as part of the Lake Superior fauna. While *C. nigripinnis* is still considered a valid species that once occurred in lakes Michigan and Huron, Todd and Smith persuasively demonstrated that *C. nigripinnis cyanopterus* from Lake Superior was not distinguishable from *C. zenithicus*. We, therefore, now recognize Lake Superior specimens originally identified as *C. nigripinnis* to be *C. zenithicus*.

49. *Coregonus nipigon*—The Nipigon cisco was identified in 1991 from Lake Saganaga, Cook County, by David A. Etnier (JFBM 25376). Although Robins et al. (1991) and Mayden et al. (1992) do not recognize this particular species, recent studies of coregonine populations in Lake Saganaga by D. A. Etnier (University of Tennessee) and B. A. Shields (Oregon State University) indicate that *C. nipigon* is a distinct and recognizable species. Arguments for the validity of this species will be forthcoming (D. Etnier, University of Tennessee, pers. comm.). This species should be searched for in large, deep lakes of the Boundary Waters Canoe Area.

50. *Coregonus reighardi*—The shortnose cisco is another example representing confusion with the identification of deepwater ciscoes. Koelz (1924) described this species from Lake Michigan and later recognized a subspecific form, *C. reighardi dymondi*, from Minnesota waters of Lake Superior (Koelz, 1929). This taxon was recognized by all Minnesota authorities until Todd and Smith (1980) showed it to be a variant of *C. zenithicus*. Underhill (1986, 1989) did not include *Coregonus reighardi* in his lists, and we now recognize Lake Superior specimens originally identified as *C. reighardi* to be *C. zenithicus*. *Coregonus reighardi* is a valid but extinct species that occurred in lakes Huron and Michigan.

51. *Coregonus zenithicus*. In 1991, Dr. David Etnier identified the shortjaw cisco from

Lake Saganaga in the Rainy River/Lake of the Woods drainage (JFBM 25370). This is the only Minnesota record from this drainage, but Crossman (1976) noted that four specimens of this species had been identified from the Canadian waters of Basswood Lake. This is another species that may be present in other deep lakes of the Boundary Waters Canoe Area.

52. *Aphredoderus sayanus* --Prior to 1989, the pirate perch was known from only 5 sites in southeastern Minnesota. It is now known from 12 sites, all of which are in the lower Mississippi River and the mouths of its tributaries in Wabasha, Winona, and Houston counties (e.g., JFBM 30203). Despite the increase in records, this species remains rare in Minnesota.

53. *Fundulus diaphanus*—The banded killifish was recently documented from Lake of the Woods (JFBM 38110). This is the first verified record from the Rainy River/Lake of the Woods drainage. This species is relatively common in the St. Croix River drainage of Wisconsin (Fago, 1992; Lyons et al., 2000), but it was not collected in upper St. Croix River system of Minnesota until 2000 and 2001 (JFBM 38098, Aitkin County; JFBM 38112, Pine County).

54. *Fundulus dispar*– The starhead topminnow has never been reported from Minnesota waters, but one specimen were collected in 1996 from the lower Black River in Wisconsin near its confluence with the Mississippi River in Navigation Pool 7 (JFBM 28393), which reaches Minnesota shores. This species has been collected previously from the lower reaches of the Black River in Wisconsin (Fago 1992).

55. *Fundulus sciadicus*—The plains topminnow was unknown in the state before 1973 (Anderson et al., 1977). By 1989, it had been found in 9 sites in the Rock River system of Rock and Pipestone counties. Surveys in the 1990s increased the known sites to 16 and the number of tributaries from 4 to 8, all still within the Rock River system (e.g., JFBM 30011). This species remains one of the rarest inhabitants of our southwestern prairie streams.

56. *Cottus cognatus*—Underhill (1989) inadvertently indicated that within the St. Croix River drainage, the slimy sculpin was restricted to Wisconsin waters. While this is true for the upper St. Croix River system, it is not so for the lower St. Croix River system. Slimy sculpins historically were abundant in Valley Creek, Washington County (Eddy and Underhill, 1974), where they still occur (JFBM 30728).

57. *Cottus ricei*– Until 1998, this species was known only from Lake Superior in Minnesota. In 1998, two specimens were collected from the Baptism River (JFBM 30117). In 2000, Dr. David Etnier (University of Tennessee) retrieved a specimen from the stomach of a lake trout caught in Saganaga Lake (UT 129.669). He collected a second specimen there in 2002. We suspect that this species, as well as the deepwater sculpin (next account), occur in a number of the deep boundary water lakes in Minnesota.

58. *Myoxocephalus thompsoni*—The deepwater sculpin was formerly known only from Lake Superior, where a somewhat recent collection was made off Beaver Bay in 183 m of water (1982). The species now has been collected from Saganaga Lake in Cook County. Dr. David Etnier (University of Tennessee) collected it there for the first time in 1985 and on several occasions thereafter (JFBM 24402, 22866, 25373). It may well occur in other deep lakes of the Boundary Waters.

Recently, a single specimen of deepwater sculpin was found in a 1969 collection of fishes from Lake St. Croix (JFBM 38097). We have no doubt that this is a legitimate record, but we do not believe there is an established population of deepwater sculpins in Lake St. Croix.

59. *Morone mississippiensis*—The yellow bass has been reported sporadically in the Mississippi River from Navigation Pool 8 up to Lake Pepin, but we have no specimens in the Bell Museum Collection, nor have we examined any from Minnesota waters. Wisconsin specimens verified by Becker (1983) and accepted by Fago (1992) are from below Navigation Pool 9. We deem the yellow bass another of Minnesota's rare species.

60. *Lepomis gulosus*—The warmouth is native to the Lower Mississippi River drainage and possibly the lower St. Croix River system. Reports from the past 20 years include Lake Winona (1983-1989, e.g., JFBM 34787), the old channel of Root River (1995), and Mississippi River Navigation Pools 5 through 9 (1982-1995, e.g., JFBM 29244). Additional specimens have been collected from the St. Croix River drainage of Wisconsin (Fago, 1992).

For the past 40 years, the Minnesota Department of Natural Resources (MDNR) and various anglers have sporadically reported this species from Big Ole Lake and, in one instance, East Lake near Marcell, MN, which lie in the Big Fork River system of the Rainy River/Lake of the Woods drainage. We have recently verified the identification of three specimens from Big

Ole Lake (JFBM 38114). MDNR personnel indicate that this species was stocked in a few lakes in that area prior to 1960.

61. *Lepomis humilis*—The orangespotted sunfish was historically present in the Minnesota River, Missouri River, and Lower Mississippi River drainages. However, in 1995 specimens were collected from the Upper Mississippi River drainage in the Mississippi River at the Coon Rapids Dam (JFBM 28389), the mouths of Elm Creek (JFBM 28316) and Crow River (e.g., JFBM 28313), lower Elk River (JFBM 28288), and an outlet on Swartout Lake in the Clearwater River system (JFBM 28289). In 2000, specimens were taken at three sites in the headwater regions of the Crow River in Renville County (e.g., JFBM 35305). This species may have gained access to the Upper Mississippi River drainage while the dam at Coon Rapids was being replaced in the early 1990s, or it may have been introduced.

Underhill (1989) did not report this species from the Red River of the North drainage in Minnesota, but it has been taken at the mouth of the Otter Tail River in 1991 and in Lake Traverse in 1985 (Koel, 1997).

62. *Lepomis megalotis*—The longear sunfish has a very spotty, but wide distribution in Minnesota. Recent reports establish it in numerous lakes in the Upper Mississippi River drainage (e.g., JFBM 24010), in at least three lakes in the Rainy River/Lake of the Woods drainage (e.g., JFBM 21881), and McCarrons Lake (Ramsey County, no extant specimens) in the Lower Mississippi River drainage. Specimens have also been collected from Wisconsin's Yellow River in the upper St. Croix River system (JFBM 24235). Both the Minnesota and Wisconsin specimens are assignable to *L. m. peltastes*, the northern longear sunfish (Trautman 1981).

63. *Crystallaria asprella*—Studies of the crystal darter carried out in the 1990s increased the number of Minnesota records from 5 to 14 (Schmidt, 1995; Hatch, 1997). This species occurs in small numbers at three sites in the lower St. Croix River (JFBM 30068), eight sites in the Mississippi River from just north of Redwing to the state's southern border (e.g., JFBM 30341), and four sites in the Zumbro River between Millville and Kellogg (e.g., JFBM 30315). The crystal darter's habit of burrowing in sand and pebble bottoms makes it harder to collect than most darter species, but we still believe that they are relatively rare in Minnesota, as they appear to be elsewhere (George et al., 1996).

64. *Etheostoma asprigene*—The mud darter is restricted to the lower St. Croix River system and the Lower Mississippi River drainage. Recent collections are from the St. Croix River in 1989 and 1998 (e.g., JFBM 30283); Mississippi River Navigation Pools 4-9 from 1987 to 1999 (e.g., JFBM 31885); eleven small, direct tributaries to the lower Mississippi River from 1984 to 1999 (e.g., JFBM 30236); the lower Root River in 1995 (JFBM 28186); the lower Whitewater River in 1994 (JFBM 27574); and Wisconsin's lower Black River in 1996 (JFBM 29310).

65. *Etheostoma caeruleum*—The rainbow darter was taken on two occasions in 1996 from Lake Phalen in Ramsey County and on several occasions through 2001 (e.g., JFBM 29298). This is the only occurrence of this species from a lake environment in Minnesota. Typically, rainbow darters inhabit gravel and rubble-riffles of small to moderate sized streams (Kuehne and Barbour, 1983; Page, 1983), although Cahn (1927) reported them exclusively from ten "larger gravel lakes" in southern Wisconsin and Winn (1958) found then in the outlet to a lake in Michigan. We do not know how these darters reached Lake Phalen; it is possible they represent an aquarium release. The population appears to be well-established there.

Historically, this species was common and abundant in the Cannon River (Lower Mississippi River drainage) from the Byllsby Dam to riffles below the mouth of Belle Creek. Numerous attempts to collect them in the 1990s in this reach of the river failed. The last documented collections are from the late 1970s. We do not know what caused their disappearance, but the timing of this loss coincides with several fish kills that the MDNR has associated with operation of the Byllsby Dam.

66. *Etheostoma chlorosoma*—Four specimens of bluntnose darter were collected in Navigation Pool 9 near the Iowa border in 1944, and two were collected from an overflow pool near the mouth of the Root River in 1945 (not catalogued). Intensive sampling for this species in the 1980s and 1990s produced no new individuals and in 1996 the bluntnose darter was considered extirpated (Schmidt, 1991; Lyons et al 2000). In 1997, one of the authors (KPS) and Ray Katula, found a single young-of-the-year specimen in Pine Creek (JFBM 29263). Katula collected a second specimen from the Mississippi River near Winona in 2001 (JFBM 38690). The bluntnose darter is Minnesota's rarest fish species and undoubtedly will be added to the list of protected species.

67. *Etheostoma microperca*—Prior to 1990, the least darter was known from 31 sites—16 of which were mapped by Burr (1978)—in 10 streams and nine lakes scattered across the southern three-fourths of the state. Surveys from 1990 through 2002 added 47 sites in nine new streams and 41 new lakes, mostly in the Otter Tail River system and the Upper Mississippi River drainage. A collection from Long Lake on the border of Itasca and St. Louis counties was the first record of the least darter in the Lake Superior drainage (JFBM 39065). Minnesota populations represent the northwestern limit of the species' range, are disjunct from those of the Ozark and eastern Great Lakes regions, and exhibit life history parameters different from those of populations near the center of the range (Johnson and Hatch, 1991).

68. *Percina maculata*—The blackside darter is one of eight species whose range has extended into the Upper Mississippi River drainage. Since 1995, it has been collected from the Sauk River (JFBM 36596), North Fork of the Crow River (JFBM 35608), the Mississippi River at Monticello and Anoka (JFBM 36167, 36730), an unnamed tributary to the Mississippi River in Anoka County (JFBM 35359), County Ditch 2 (Stearns, Co.; JFBM 37511), Elk River (JFBM 30616), Coon Creek (JFBM 36489), and the Crow River (JFBM 36817). We expect this species to continue to spread within the Upper Mississippi River drainage. Although Fago and Hatch (1993) listed this species as native to the upper St. Croix River system, our database and other literature suggest it was introduced above the Dalles in the 1950s (Greene, 1935; Underhill, 1957; Becker, 1983).

69. *Percina shumardi*—The river darter was collected twice in 1998 from the lower Minnesota River in the vicinity of Fort Snelling State Park (JFBM 29818, 29828), and there is a single unverified record from Fort Snelling State Park in 1975. Whether or not there is an established population in this area is not known at this time. A large population of river darters occurs at the first riffle downstream of Lock and Dam No. 1 on the Mississippi River, which is only 4 km from the mouth of the Minnesota River.

70. *Aplodinotus grunniens*— The freshwater drum was recently documented from Lake of the Woods (JFBM 38109). This is the first verified record from the Rainy River/Lake of the Woods drainage. This species also appears to have been introduced into the St. Louis River estuary where it was first collected by WDNR biologists in 1981 and has been collected by them frequently since that time (D. Pratt, WDNR, pers. comm.). MDNR reported it in their catches in 1986, 1987, 1991, 1992 and 2000.

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Table 1. Number of fish families, genera, introduced species, native species and endangered-threatened-special concern (ETS) species in 8 major drainage in Minnesota, excluding *Fundulus dispar* and *Apeltes quadracus*. 1 = Red River of the North, 2 = Rainy River/Lake of the Woods, 3 = Upper Mississippi River, 4 = Lake Superior, 5 = St. Croix River, 6 = Minnesota River, 7 = Missouri River, 8 = Lower Mississippi River.

	1	2	3	4	5	6	7	8	All
Number of families	20	17	18	21	25	21	10	26	27
Number of genera	49	41	47	51	63	56	29	69	80
Number of introduced species	9	6	10	16	7	4	3	7	19
Number of native species	73	67	65	67	99	91	39	119	139
Total number of species	82	73	75	83	106	95	42	126	158
Number of ETS species	3	3	2	6	8	7	2	16	21