FISH COMMUNITIES OF MINNESOTA NATIONAL WILDLIFE REFUGES

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In 1983, my interest in native fishes and unusual species distributions led me to the Upper Mississippi National Wildlife and "Fish" Refuge in southeastern Minnesota. The sparse information available at that time indicated this portion of the Mississippi River, backwaters, and tributaries supported many fishes at the northern limits of their ranges. My initial forays were extremely limited in scope and targeted very few species. The bluntnose darter *(Etheostoma chlorosomum)*, which had not been reported from Minnesota waters in four decades, was the Holy Grail of my early quests. Even though no one has since found this species, my efforts did sample several fishes which I had never collected before and also established new localities for others listed endangered, threatened, or special concern in Minnesota and Wisconsin.

In 1985, I "landed" a seasonal job with the U.S. Fish and Wildlife Service (USFWS) conducting fish surveys in waterfowl production areas (WPA). The objective of this study was to identify units with large rough fish populations (usually carp and bullheads) which had degraded waterfowl habitat and water quality by "grazing and uprooting" submerged plants and increasing turbidity. Definitely not the most glamourous job for a fish biologist, but I loved it and felt like a pioneer on a frontier exploring places which had never been surveyed. The experience also made me keenly aware of the lack of information available for nongame species which typically comprise the bulk of all fish communities. This "spawned" an idea to begin fish surveys on large tracts of public lands which contained aquatic habitats and refuges topped my list of likely candidates. However, nongame species to this day remain a low priority in the funding forum which required tapping an all too common source - OOPS: Out of Pocket Support .

Generally, each refuge was sampled twice (spring and fall) with seines, kicknets, and minnow traps. Back pack electroshockers were used in rip-rapped areas. However, the Upper Mississippi River remains an ongoing study because of the unique species found there. I also received some welcomed assistance in this refuge from U.S. Fish and Service and Minnesota and Wisconsin DNR fisheries biologists who brought their boom shocking boats. Voucher specimens of every species collected in surveys conducted since 1990 have been deposited in the James Ford Bell Museum of Natural History fish collection which is housed on the St. Paul campus of the University of Minnesota. Finally, field data and narrative reports of survey results have been provided to refuge headquarters at the completion of each study.

Refuge Summaries

Eight refuges and one wetland district were surveyed from 1983 through 1996 (See Map). This included 644 samples conducted over 216 days in 18 major watersheds, 16 Minnesota counties, and 5 Wisconsin counties.

Agassiz National Wildlife Refuge is in northwestern Minnesota near Thief River Falls. The refuge was established in 1937 and encompasses 61,449 acres. Aquatic habitats consist of 19 impoundments, 5 lakes, and channelized reaches of the Thief and Mud Rivers.

Big Stone National Wildlife Refuge is in west-central Minnesota near Ortonville on the South Dakota border. The refuge was established in 1971 and encompasses 10,795 acres. Aquatic habitats include the Minnesota River, tributary streams, wetlands, impoundments, and abandoned granite quarries.

Crane Meadows National Wildlife Refuge is in central Minnesota near Little Falls. The refuge was established in 1993 and will eventually encompass 13,540 acres. Aquatic habitats include Rice and Skunk Lakes, Platte River, and Buckman, Little Rock, Rice, and Skunk Creeks.

Minnesota Valley National Wildlife Refuge is headquartered in Bloomington which is part of the Twin Cities Metro Area. The refuge was established in 1976 and will eventually encompass 24,000 acres along the lower 72 miles of the Minnesota River from Le Sueur to Fort Snelling State Park. Aquatic habitats include the mainstem Minnesota River (natural and navigation channels and associated cutoffs) and floodplain marshes, lakes, and tributary streams.

The Morris Wetland District is headquartered near Morris in west-central Minnesota. The district was established in 1963, and in 1985, encompassed approximately 42,000 acres scattered over 266 WPAs in Big Stone, Lac qui Parle, Pope, Stevens, Swift, Traverse, and Yellow Medicine Counties. Aquatic habitats include swamps, marsh, and lakes which have closed basins or connected to drainages via streams and ditches. Note: Surveys were conducted solely with passive gears (i.e., gillnets, trapnets, and minnow traps) and in only 40 WPAs which included five of the district's seven counties.

Rice Lake National Wildlife Refuge is in east-central Minnesota near McGregor. The refuge was established in 1935 and encompasses 18,127 acres. Aquatic habitats include the 4,500 acre Rice Lake, several miles of the Rice River, impoundments, small lakes, and wetlands.

Sherburne National Wildlife Refuge is in central Minnesota near Princeton. The refuge was established in 1965 and encompasses approximately 30,600 acres. Aquatic habitats include Battle Brook, several miles of the St. Francis River, channelized Snake River, and 23 impoundments.

Tamarac National Wildlife Refuge is in northwestern Minnesota near Detroit Lakes. The refuge was established in 1938 and encompasses approximately 43,000 acres. Aquatic habitats include the Buffalo and Otter Tail Rivers and several lakes, wetlands, and impoundments.

The Upper Mississippi River Wildlife and Fish Refuge is headquartered in Winona in southeastern Minnesota. The refuge was established in 1924 and encompasses

Minnesota National Wildlife Refuges

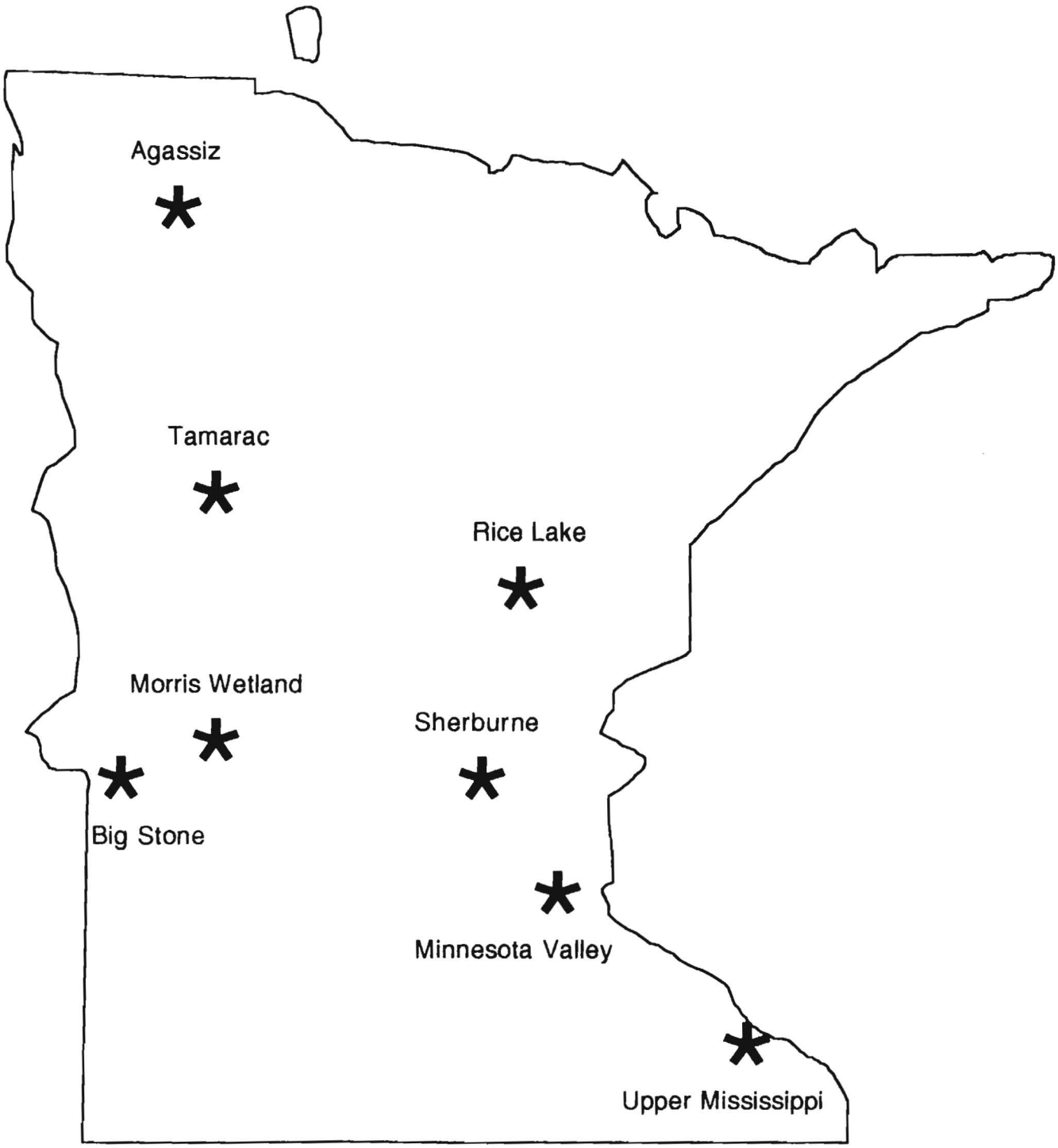

Table 1. Fish community overview for Minnesota refuges and waterfowl production areas.
The first number represents the species total and the second is percent composition of the total catch.
* - Environmental indicator frequently used for the Index of Biotic Integrity.

ECOLOGICAL NICHE	AGASSIZ	BIG STONE	CRANE MEADOWS	MINNESOTA VALLEY	MORRIS WETLAND	RICE LAKE	SHERBURNE	TAMARAC	UPPER MISSISSIPPI
FEEDING									
Filter Feeder	-	-	-	1 - 0.2	-	-	-	-	3 - 3.3
Generalist Feeder	-	2 - 7.6	2 - 4.2	2 - 2.2	-	1 - 0.1	2 - 0.7	2 - 11.0	2 - 3.2
Herbivore	1 - 2.5	2 - 7.8	-	3 - 1.1	2 - 1.3	1 - 65.4	3 - 23.6	1 - 2.6	4 - 0.6
Insectivore*	11 - 72.7	23 - 44.1	17 - 63.1	24 - 62.4	9 - 50.7	10 - 19.8	22 - 52.1	21 - 53.8	52 - 66.1
Omnivore*	3 - 24.8	4 - 39.1	4 - 5.9	6 - 32.6	4 - 44.0	3 - 10.8	5 - 22.2	4 - 31.6	9 - 7.4
Parasite	-	-	-	-	-	-	-	-	2 - 0.1
Top Carnivore*	2 - <0.1	4 - 1.1	5 - 26.8	8 - 1.5	3 - 4.0	4 - 3.4	5 - 1.4	4 - 1.0	19 - 17.8
SPAWNING									
Complex Spawner (Parental Care)	8 - 92.9	16 - 64.3	14 - 68.2	17 - 33.3	9 - 95.5	10 - 27.0	16 - 58.4	15 - 50.5	25 - 36.8
Complex Spawner (No Parental Care)	1 - 0.1	3 - 15.5	2 - 5.1	3 - 2.2	-	1 - 0.1	3 - 0.9	2 - 5.8	6 - 2.7
Simple Lithophilic Spawner*	3 - 0.7	8 - 10.0	7 - 19.1	8 - 16.7	2 - 0.5	2 - 2.7	7 - 4.1	4 - 11.3	24 - 29.5
Simple Miscellaneous Spawner	5 - 6.3	8 - 10.0	5 - 7.6	15 - 47.7	7 - 4.0	6 - 69.7	11 - 36.6	11 - 32.3	31 - 25.8
TOLERANCE									
Intolerant*	2 - 0.6	7 - 7.1	5 - 25.8	4 - 16.0	1 - 0.1	1 - 0.4	6 - 3.7	8 - 25.5	22 - 8.8
Tolerant*	3 - 24.8	5 - 42.9	5 - 9.9	5 - 33.7	4 - 82.2	4 - 13.3	5 - 47.2	4 - 34.6	5 - 8.0
STREAM SIZE									
Headwater	3 - 68.7	2 - 3.0	2 - 3.5	2 - 4.9	2 - 12.0	2 - 66.7	3 - 24.9	3 - 19.1	4 - 2.5
Large River	1 - 0.1	3 - 0.5	1 - 0.5	9 - 16.5	1 - 0.4	1 - 0.1	3 - 0.2	1 - <0.1	34 - 37.7
Pioneer	2 - 24.2	5 - 53.2	4 - 17.4	5 - 19.0	2 - 42.3	3 - 10.9	5 - 15.1	5 - 36.7	5 - 6.2
PREFERRED HABITAT									
Pool	14 - 75.2	21 - 30.7	16 - 63.4	29 - 80.4	16 - 57.6	13 - 85.7	23 - 80.5	21 - 55.0	55 - 75.9
Riffle	-	3 - 2.8	2 - 2.0	2 - 1.2	-	-	2 - 0.7	1 - 6.1	11 - 2.3
Pool and Riffle	3 - 24.8	11 - 66.2	10 - 34.6	13 - 18.4	2 - 42.4	6 -13.8	12 - 18.7	10 - 38.7	21 - 17.1
OVERALL RESULTS									
Families	7	8	9	14	8	10	9	9	22
Species	17	35	28	44	18	19	37	32	91
Exotics	-	1 - 0.5	1 - 0.4	2 - 22.7	1 - 1.5	-	1 - 5.6	-	2 - 2.0
Total Catch	10152	2011	1441	5013	10549	1859	13552	4499	14546
Minnesota Listed Fishes	-	-	-	-	-	-	-	-	4
Minnesota Limited Fishes	-	1	-	-	-	-	-	-	10
Wisconsin Listed Fishes	-	-	-	-	-	-	-	-	8
Samples	39	35	21	28	38	38	156	64	225
Year(s)	1994	1992	1996	1990	1985	1993	1988-1989	1992	1983-1996

195,000 acres which spans 284 miles of the Mississippi River from Wabasha, MN to Rock Island, IL. Aquatic habitats include the mainstem Mississippi River (navigation channel and pools), floodplain backwaters, and tributary streams. Note: Surveys were conducted in this refuge from the confluence of Wisconsin's Chippewa River to the Minnesota-Iowa border. However, this does include 1987 surveys from the adjacent Trempealeau National Wildlife Refuge in Wisconsin and were conducted while I was employed with the USFWS - Winona Fisheries Resources Office.

Ecological Niches

Before diving in, a brief course in ecology is in order to understand the scope of this information. Whether the topic is aquatic or terrestrial ecosystems, each species plays several roles or "fills" many niches in a community. Although there is never universal consensus among biologists when classifying species to specific groups, both empty and filled niches can tell a great deal about the overall health of a community and the quality of the habitat it depends on. The Index of biotic integrity (IBI) examines several facets or metrics of fish communities to assess stream water quality and habitat. In order to use this relatively new toy, biologists must be "cornered and pinned down" to put a label on many species. This always require some fine tuning, but does provide the tools to eventually score streams from pristine to poor. The niches I looked at were not all environmental indicators, but included tolerance, feeding, spawning, and preferred stream size and habitat.

TOLERANCE: A community comprised of several species intolerant to pollution, siltation, turbidity, and habitat modification (e.g., channelizaton) would reflect high quality conditions. However, another community dominated with one or two tolerant species would indicate severely degraded conditions.

FEEDING: Groups include omnivores, insectivores, top carnivores, filter feeders, generalist feeders, and parasites. Omnivores can suffice on a diverse diet which includes both plants and animals and serves as an advantage in degraded conditions with a disrupted food base. Insectivores have a much more restricted diet which is dependent on a healthy aquatic insect community and their habitat. Top carnivores which are also called piscivores feed on other vertebrates (e.g., fish) and crayfish and occupy the highest level in a healthy community's food chain. Filter feeders are planktivores which sieve small plants and animals from the water column. Generalist feeders are sometimes also referred to as generalist invertivores whose diet is often high in animal matter. However, these species possess the same advantage as omnivores in adapting to a broader range of items when degrading conditions disrupt the food base. Herbivores are the grazers in the fish community and feed on plants and algae. Parasites are restricted to the parasitic lampreys which extracts a blood meal from another fish which serves as an unwilling host.

SPAWNING: Groups include simple lithophilous, simple miscellaneous, complex - parental care, and complex - no care. Simple lithophils broadcast their eggs which come in contact with and develop in bottom substrates. These eggs require clean gravel or cobble for successful reproduction and simple lithophilic species decline in streams with heavy silt loads. Simple miscellaneous spawners have buoyant, adhesive, or fast developing eggs which have little or no contact with substrates. Both complex spawners either build nests or lay adhesive eggs on the undersurfaces of rocks and are also not dependent on clean substrates.

PREFERRED STREAM SIZE AND HABITAT: Even though there is overlap, many fishes typically inhabit specific parts of a watershed from small headwaters streams to large rivers. The same general rule applies to habitats where certain fishes prefer riffles, others pools, and some both. Finally pioneers are the first species to reinvade suitable habitats following a disturbance (e.g., drought or fish kill).

Results

Overall, the surveys sampled 63,622 fish representing 100 species in 23 families. This included four Minnesota and eight Wisconsin fishes listed endangered, threatened, or special concern; and 11 species which have very limited distributions in Minnesota (Tables 1 and 2). The following community descriptions are summaries and only species comprising major components of each group are reported. For more detailed information on species composition, narrative reports and data summaries should be requested from the refuge headquarters. However, a nominal fee may be charged to cover photocopying and postage costs.

The Agassiz fish community had the greatest composition of insectivores at 72.7% and headwater species at 68.7%. However, brook sticklebacks were the dominant species in both groups. Other major groups included the complex spawners - parental care at 92.9% (fathead minnows and brook sticklebacks) and pool species at 75.2% (brook sticklebacks). Overall, the refuge surveys sampled 10,152 fish representing 17 species in 7 families

Big Stone's fish community had the most complex spawners - no care at 15.5% (central stoneroller, hornyhead chub, and creek chub), pioneers at 53.2%, and pool-riffle species at 66.2% with fathead minnows dominating both groups. Omnivores were also highly represented at 39.1% (fathead minnows). Overall, 2011 fish were sampled representing 35 species in 8 families. This included the greater redhorse which has a limited distribution in Minnesota and was collected in the Yellow Bank River.

Crane Meadows edged out Tamarac in composition of intolerant species at 25.8% and the most top carnivores at 26.8% with rock bass representing the majority in both groups. Insectivores were also abundant at 63.1% (central mudminnows, johnny darters, common shiners, and tadpole madtoms). Overall, 1441 fish were sampled representing 28 species in 9 families.

Table 2. Minnesota refuges overall species list. Codes for status, niches, and refuges follow table.

COMMON NAME	SCIENTIFIC NAME	STATUS	NICHES	REFUGES
LAMPREYS	PETROMYZONTIDAE			
chestnut lamprey	Ichthyomyzon castaneus	IA MB	PA	I
silver lamprey	Ichthyomyzon unicuspis		PA CN LR B	I
American brook lamprey	Lampetra appendix	IA LD ON	FF CN I HW P	I
STURGEONS	ACIPENSERIDAE			
shovelnose sturgeon	Scaphirhynchus platorynchus	LD ND	IN SL LR P	I
PADDLEFISHES	POLYODONTIDAE			
paddlefish	Polyodon spathula	MN WI ND ON	FF SL LR PR	I
GARS	LEPISOSTEIDAE			
longnose gar	Lepisosteus osseus		TC SM LR P	I
shortnose gar	Lepisosteus platostomus	ND	TC SM LR P	D I
BOWFINS	AMIIDAE			
bowfin	Amia calva		TC CC LR P	D F G I
MOONEYES	HIODONTIDAE			
goldeye	Hiodon alosoides	ON WI	IN SM LR PR	I
mooneye	Hiodon tergisus	ON	IN SM LR PR	I
HERRINGS	CLUPEIDAE			
gizzard shad	Dorosoma cepedianum		FF SM P	D I
MINNOWS	CYPRINIDAE			
central stoneroller	Campostoma anomalum	ND ON	HE CN PR	B D G I
spotfin shiner	Cyprinella spiloptera		IN SM PR	D G I
common carp	Cyprinus carpio	EX	OM T SM P	B C D E F G I
brassy minnow	Hybognathus hankinsoni		HE SM P	B C D E G I
Mississippi silvery minnow	Hybognathus nuchalis	LD	HE I SM LR P	I
common shiner	Luxilus cornutus		IN SL P	A B C G H
speckled chub	Macrhybopsis aestivalis	LD WI	IN I SM LR R	I
silver chub	Macrhybopsis storeriana	ON	IN SM LR P	I
pearl dace	Margariscus margarita	IA SD ND	IN I CN PR	A
hornyhead chub	Nocomis biguttatus	ND	IN I CN PR	B C G H
golden shiner	Notemigonus crysoleucas		IN SM P	A D E F G H I
emerald shiner	Notropis atherinoides		IN SL LR P	B D I
river shiner	Notropis blennius	ND	IN SL LR P	I
bigmouth shiner	Notropis dorsalis		IN SM PR	B C D G H I
blackchin shiner	Notropis heterodon	MB	IN I SM P	H I
blacknose shiner	Notropis heterolepis	IA ND	IN I SM P	A G H
spottail shiner	Notropis hudsonius		IN I SM LR P	B G H I
rosyface shiner	Notropis rubellus	MB ND	IN I SL R	B
sand shiner	Notropis stramineus		IN SM PR	B D I
weed shiner	Notropis texanus	WI IA	HE I LR P	D I
mimic shiner	Notropis volucellus		IN I SM LR PR	H I

Table 2. Continued.

COMMON NAME	SCIENTIFIC NAME	STATUS	NICHES	REFUGES
channel shiner	Notropis wickliffi	WI	IN LR	I
pugnose minnow	Opsopoeodus emiliae	LD WI IA ON	IN SM LR P	I
northern redbelly dace	Phoxinus eos	SD ND	HE SM HW P	A E F G H
finescale dace	Phoxinus neogaeus	SD ND	IN SM HW P	A F
bluntnose minnow	Pimephales notatus		OM CC PN PR	B C D G H I
fathead minnow	Pimephales promelas		OM T CC PN PR	A B C D E F G H I
bullhead minnow	Pimephales vigilax	LD	OM CC LR P	I
blacknose dace	Rhinichthys atratulus		GE SL HW R	B C D G H I
longnose dace	Rhinichthys cataractae		IN I SL R	C G I
creek chub	Semotilus atromaculatus		GE T CN PN PR	B C D F G H I
SUCKERS	CATOSTOMIDAE			
river carpsucker	Carpiodes carpio		OM SM LR P	I
quillback	Carpiodes cyprinus	ON	OM SM P	D I
highfin carpsucker	Carpiodes velifer		OM I SM LR P	I
white sucker	Catostomus commersoni		OM T SL PR	A B C D E F G H I
blue sucker	Cycleptus elongatus	MN WI ND	IN I SL LR R	I
northern hog sucker	Hypentelium nigricans	ON	IN I SL R	I
smallmouth buffalo	Ictiobus bubalus		IN SM LR P	D I
bigmouth buffalo	Ictiobus cyprinellus	MB ON	IN SM LR P	D I
spotted sucker	Minytrema melanops	LD ON	IN I SL LR P	I
silver redhorse	Moxostoma anisurum		IN SL LR P	I
river redhorse	Moxostoma carinatum	LD WI ON	IN I SL LR P	I
golden redhorse	Moxostoma erythrurum	MB ON	IN SL P	I
shorthead redhorse	Moxostoma macrolepidotum		IN SL LR P	A B C D E G I
greater redhorse	Moxostoma valenciennesi	LD WI ND	IN I SL P	B
BULLHEAD CATFISHES	ICTALURIDAE			
black bullhead	Ameiurus melas	ON	IN T CC P	A B C D E F G H I
yellow bullhead	Ameiurus natalis	ND	IN CC P	B C D E G H I
brown bullhead	Ameiurus nebulosus		IN CC P	C D F G H I
channel catfish	Ictalurus punctatus		TC CC LR P	I
stonecat	Noturus flavus		IN I CC R	B I
tadpole madtom	Noturus gyrinus		IN CC PR	B C D F G H I
flathead catfish	Pylodictis olivaris	ND	TC CC LR PR	I
PIKES	ESOCIDAE			
northern pike	Esox lucius		TC SM P	B C D E F G H I
MUDMINNOWS	UMBRIDAE			
central mudminnow	Umbra limi	SD ND	IN CC P	A B C D E F G H I
TROUTS	SALMONIDAE			
brown trout	Salmo trutta	EX	TC CN PR	D I
brook trout	Salvelinus fontinalis		TC I CN PR	I
TROUT-PERCHES	PERCOPSIDAE			
trout-perch	Percopsis omiscomaycus	SD	IN SM P	I

Table 2. Continued.

COMMON NAME	SCIENTIFIC NAME	STATUS	NICHES	REFUGES
PIRATE PERCHES	APHREDODERIDAE			
pirate perch	Aphredoderus sayanus	MN WI IA	IN SM P	I
CODFISHES	GADIDAE			
burbot	Lota lota	IA	TC SL PR	C F I
KILLIFISHES	CYPRINODONTIDAE			
banded killifish	Fundulus diaphanus	SD ND MB	IN I SM P	D H
SILVERSIDES	ATHERINIDAE			
brook silverside	Labidesthes sicculus	ON	IN SM LR P	I
STICKLEBACKS	GASTEROSTEIDAE			
brook stickleback	Culaea inconstans		IN CC HW P	A B C D E F G H I
TEMPERATE BASSES	PERCICHTHYIDAE			
white bass	Morone chrysops		TC SM LR P	I
SUNFISHES	CENTRARCHIDAE			
rock bass	Ambloplites rupestris		TC I CC P	B C G H I
green sunfish	Lepomis cyanellus		IN CC PN P	B D E G H I
pumpkinseed	Lepomis gibbosus		IN CC P	B C D E G H I
warmouth	Lepomis gulosus	LD ON	TC CC P	I
orangespotted sunfish	Lepomis humilis	ON	IN CC P	B D I
bluegill	Lepomis macrochirus		IN CC P	A B C D E F G H I
smallmouth bass	Micropterus dolomieu		TC I CC P	C I
largemouth bass	Micropterus salmoides		TC CC P	A B C D F G H I
white crappie	Pomoxis annularis	ON	TC CC P	D I
black crappie	Pomoxis nigromaculatus		TC CC P	A B D E G H I
PERCHES	PERCIDAE			
crystal darter	Ammocrypta asprella	MN WI	IN I SL LR R	I
western sand darter	Ammocrypta clara	LD WI IA	IN I SL LR	I
mud darter	Etheostoma asprigene	LD WI	IN LR	I
Iowa darter	Etheostoma exile		IN I SM P	A B C D E F G H I
fantail darter	Etheostoma flabellare		IN CC HW R	I
johnny darter	Etheostoma nigrum		IN CC PN PR	A B C D F G H I
banded darter	Etheostoma zonale		IN I SL R	I
yellow perch	Perca flavescens		IN SM P	B C E F G H I
logperch	Percina caprodes	ND	IN SL PR	C D G H I
blackside darter	Percina maculata	ON	IN SL PR	B D G I
slenderhead darter	Percina phoxocephala		IN I SL LR R	D I
river darter	Percina shumardi	ND ON	IN SL LR R	I
sauger	Stizostedion canadense		TC SL LR P	I
walleye	Stizostedion vitreum		TC SL LR P	D E I
DRUMS	SCIAENIDAE			
freshwater drum	Aplodinotus grunniens		IN SM LR P	D I

Table 2. Continued. Status, Niche, and Refuge Codes

STATUS	NICHES		REFUGES
EX - Exotic Species	CC - Complex/Parental Care	P - Pools	A - Agassiz
IA - Listed in Iowa	CN - Complex/No Care	PA - Parasite	B - Big Stone
LD - Limited Distribution (MN)	FF - Filter Feeder	PN - Pioneer	C - Crane Meodows
MB - Listed in Manitoba	GE - Generalist Feeder	PR - Pools/Riffles	D - Minnesota Valley
MN - Listed in Minnesota	HE - Herbivore	R - Riffles	E - Morris Wetalnd
ND - Listed in North Dakota	HW - Headwater	SL - Simple Lithophil	F - Rice Lake
ON - Listed in Ontario	I - Intolerant	SM - Simple/Miscellaneous	G - Sherburne
SD - Listed in South Dakota	IN - Insectivore	T - Tolerant	H - Tamarac
WI - Listed in North Dakota	LR - Large River	TC - Top Carnivore	I - Upper Mississippi
	OM - Omnivore		

Minnesota Valley had the largest percentage of exotics at 22.7% (common carp). However, insectivores (emerald shiners and Iowa darters), large river species (emerald shiners), and pool species (emeralds, lowas, and carp) were also common at 62.4%, 16.5%, and 80.4% respectively. Overall, 5013 fish were sampled representing 44 species in 14 families. This includes the unusual occurrence of the weed shiner in the lower Minnesota River at the mouth of Rilely Creek. Note: Additional 1994 surveys were conducted in Eagle Creek, but these results are not reported in the refuge narrative or overall species list (Table 2). Significant finds include the American brook lamprey *(Lampetra appendix)* which had not been reported from the Minnesota drainage in half a century, and the burbot, which the Bell Museum's fish collection revealed was the first occurrence of this species reported from the drainage.

The Morris Wetland District had the highest composition of tolerant species at 82.2% (fathead minnows and black bullheads), omnivores at 44.0% (fatheads), and complex spawners - parental care at 95.5% (fatheads, black bullheads, and brook sticklebacks). Overall, 10,549 fish were sampled representing 18 species in 8 families.

Rice Lake had the most herbivores at 65.4%, simple miscellaneous spawners at 69.7%, and pool species at 85.7% with northern redbelly dace dominating all three groups. Headwater species at 66.7% was another major component in this community, but again, represented by the same fish. Overall, 1859 fish were sampled and represented 19 species in 10 families.

Sherburne had a large pool component at 80.5% with northern redbelly dace and black bullheads comprising the bulk of the group. Overall, the surveys, which spanned two years, sampled 13,552 fish representing 37 species in 9 families.

Tamarac had the most generalist feeders at 11.0% (creek chubs) and riffle species at 6.1% (blacknose dace). Intolerant species were also well represented at 8 fishes and 25.5% of the total catch (Iowa darters). This was second only to the Upper Mississippi in species and Crane Meadows in composition. Overall, 4499 fish were sampled representing 32 species in 9 families.

The Upper Mississippi had the greatest abundance of filter feeders at 3.3% (gizzard shad), insectivores at 66.1% (emerald shiners and bluegills), parasites at 0.1% (chestnut and silver lampreys), top carnivores at 17.8% (largemouth bass), simple lithophilic spawners at 29.5% and large river species at 37.7.0% (emerald shiners in both groups). In numbers, this refuge also had the most intolerant species at 22, filter feeders at 3, insectivores at 52, omnivores at 9, top carnivores at 19, both complex spawners: parental care at 25, and no care at 6, simple lithophilous spawners at 24, simple miscellaneous spawners at 31, large river species at 34, pool species at 55, riffle species at ll, and pool-riffle species at 21. Overall, this refuge had the largest total catch at 14,546 fish, species diversity at 91 species and 22 families, Minnesota listed and limited distribution species at 4 and 10 respectively, and Wisconsin listed species at 8.

Recommendations

Standardized surveys should be conducted on a regular basis, perhaps every 10 years, and the IBI should be applied to assess and monitor the environmental quality of all aquatic habitats. The IBI methodology has been evolving from strictly warmwater streams to now include new metrics and more are under development for trout streams (coldwater), impoundments, and lakes.

Reference

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