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Fishes of the Chicago Region: A Review of the Dennison and Illinois Natural History Survey Collections

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ABSTRACT

The Illinois Natural History Survey collection of fishes has vouchered a large number of specimens from northeastern Illinois including the urban Chicago area, Fox River drainage, and Kankakee River drainage. Based on specimens collected since 1990, the area has 119 native species, 17 non-native species, and 13 hybrid combinations. In particular, we report on the records recently obtained with the acquisition of a collection of fishes donated by Mr. Sam Dennison of the Metropolitan Water Reclamation District of Greater Chicago. We make general observations on the fauna and on the status of several non-native species.

INTRODUCTION

Almost 100 years ago, Meek and Hildebrand (1910) published a list of fishes that occurred within 50 miles of Chicago. Since that time there have been relatively few published species lists for the region although lists have been presented in governmental reports or on sub-regions of the area (Greenfield et al., 1984; Savitz et al., 1996) or indirectly as part of larger works (Hubbs and Lagler, 1941; Smith, 1979; Retzer, 2005).

The waterways of the Chicago area have a long history of alteration and abuse (Forbes and Richardson, 1920; Smith, 1971). Indeed, Meek and Hildebrand (1910), knowing that the fauna was undergoing drastic changes, were prompted to document the fauna at that time. The high human population density of the area led to severe water quality problems that were not addressed in a meaningful way until the 1970s with the advent of effective water quality treatment (Lerczak et al., 1992). With the passage of the Clean Water Act, water quality in the Chicago area has improved allowing improvement in the fish community (Pegg and McClelland, 2004). In addition, the connection between Lake Michigan and the Illinois and Mississippi River drainages initially resulted in extremely poor water quality in the Illinois River and now has resulted in a movement of fishes between the basins (Burr et al., 1996; Pegg and McClelland, 2004). This movement includes the dispersal of non-native species from one basin to the other. Movement of invasive species

in either direction has the potential of drastically impacting one of the basins (see Mills et al., 1994 for an excellent review of non-native species in the Great Lakes).

Collection records based on vouchered specimens provide solid data on distributions and changes in distributions of native and non-native fish species and hybrids in a region. Herein, we present a list of native species, non-native species, and hybrids for the Chicago area based on 643 samples from 403 locations in the region and represented by vouchered specimens in the Illinois Natural History Survey (INHS) Fish Collection. The area of study includes the Fox, Kankakee, and Des Plaines rivers and tributaries, Chicago canal system, and Lake Michigan (Fig. 1). We also comment on the current state of the fish assemblage within the urban Chicago area (Des Plaines River and tributaries, Chicago canal system, and Lake Michigan). The recent acquisition of a sizable collection of fishes donated by Mr. Samuel Dennison to the INHS prompted us to present a comprehensive list of fishes and make general observations on the urban Chicago area and the non-native species. Mr. Dennison built the collection of fishes from approximately 1970 to 2000 as part of his duties at the Metropolitan Water Reclamation District of Greater Chicago. This area is of particular interest as it encompasses the most heavily urbanized and altered subregion (ie., the urban Chicago area) in northeastern Illinois. Mr. Dennison had deposited some of his early materials at the INHS in the mid- 1990s. More recently, he donated a substantial collection to the INHS so that the specimens could be permanently vouchered and available to the scientific community, resource managers, and the general public. Most of this material was collected during the late 1990s.

METHODS AND MATERIALS

Specimens donated by Mr. Dennison were processed in accordance with commonly accepted natural history collection procedures. The materials were stored in mostly unsorted but unique collections (a unique collection being a mixture of species captured at the same site on the same date). About 25% of the specimens were stored originally in Carosafe. While this storage medium is safe to handle, specimens lose color and texture when in this medium for a long period. Another 25% of the collections were stored in formalin and these were soaked in water to remove the formalin. About 50% of the materials were found to be in alcohol. All specimens were switched to 70% ethanol for long-term storage.

Collections were sorted by species and catalogued into the INHS collection and incorporated into permanent holdings. Initial identifications were made by an undergraduate student worker and verified by the staff ichthyologist. Basic information (ie., location, date collected) for the cataloged materials is available by Web access of the fish collection at the INHS Web site (www.inhs.uiuc.edu).

In addition, data on field collecting methods were recorded and this supplemental information is available from the INHS Fish Collection. In general, electrofishing and seining were the methods employed.

The INHS database was searched to obtain a list of taxa for the study area from collections made during and after 1990. This search included non-Dennison records that also have been added to the INHS Fish Collection.

RESULTS

The Dennison collection contained 153 samples from 40 sites. We processed 4600 specimens containing 49 species and 8 hybrids.

Of the 49 species, 38 were native and 11 were non-native species. The five most common species, in terms of abundance of individuals, were the bluntnose minnow (*Pimephales notatus*), emerald shiner (*Notropis athernoides*), yellow perch, (*Perca flavescens*), bluegill (*Lepomis macrochirus*), and spotfin shiner (*Cyprinella spiloptera*). All of these species are indigenous to the area. The five species found at the most number of sites were the largemouth bass (*Micropterus salmoides*), bluntnose minnow, bluegill, common carp (*Cyprinus carpio*) and green sunfish (*Lepomis cyanellus*). The common carp is not a native species to the area.

The eight hybrids identified consisted primarily of crosses between the species of sunfishes (*Lepomis*) although there were two minnow combinations and a cross between the non-native white perch (*Morone americana*) and native yellow bass (*Morone mississippiensis*) (catalogue number INHS 97039).

The search of the INHS database for the entire area, including the Fox and Kankakee drainages and Dennison materials found 119 native species, 17 non-native species, and 13 hybrid combinations (Table 1). The total number of INHS records of native species, non-native species, and hybrids are, respectively, for the urban Chicago region 85, 16, and 10; for the Fox River drainage 88, 4, and 4; for the Kankakee River drainage 89, 3, and 1.

DISCUSSION

General Observations on Urban Chicago Fishes

The number of native species (119) found in the entire region is far greater than the 82 native species found by Meek and Hildebrand (1910). However, their list was general and based often on common knowledge of what was occurring in the area and not from a concerted effort to survey and voucher specimens in a collection. Indeed, their paper included 25 species that have never been known to occur in the Chicago area. Herein we report 62 native species that were not reported by Meek and Hildebrand (1910).

Despite the past problems with water pollution in the urban Chicago waterways, the area still supports a relatively diverse, although altered, fish fauna. Indeed, if all INHS records since 1990 for urban Chicago are examined, there are records for 85 native species. However, the assemblage is dominated by a few species (i.e. bluegill, green sunfish, common carp) that are generally considered to be tolerant of lower water quality and habitats (Smith, 1979). In the Dennison collections, most species are represented by few specimens. This high number of rare species strongly suggests that a high proportion of the fish fauna is at risk of extirpation from the area.

Even within the Chicago waterways, there are differences in the fish faunas among the lower Des Plaines River, Chicago canal system, and Lake Michigan. The fish community

of the lower Des Plaines drainage is in better condition in terms of the lower percentage of non-native species and hybrids than the Chicago canal system. The percent of non-native species in the Des Plaines is 10% of the total and that of the Chicago canal system is 26%. The proportion of hybrids to total number of species is 14% and 18%, respectively.

The Chicago canal system is a bit of an anomaly because the canals simply did not exist previously. The system's connection between Lake Michigan and the Illinois River system results in a mixed fauna.

The Dennison collection contained only one sample from Lake Michigan proper, which contained a fairly diverse collection of 17 species. However, the collection also had a high number of non-native species (five species; 29% of the total number of species). This number is consistent with 26 species obtained by Savitz et al. (1996) from four Chicago harbors. Other INHS Fish Collection records since 1990 indicate that 44 species occur in Lake Michigan in Cook County. Of these, 11 (25% of the total number of species) are non-native species, of which four of these are stocked salmonid species.

Also in the area, including Lake Michigan, few species considered sensitive do occur, such as the yellow perch and spotfin shiner, although in low numbers (Smith, 1979). Two species are listed as state threatened: longnose sucker (*Catostomus catostomus*) and banded killifish (*Fundulus diaphanus*). The longnose sucker is likely to occur throughout Lake Michigan but appears to rarely stray into inland waters of Illinois. The banded killifish occurs in the Wolf and Powder Horn lakes of southern Cook County. In Illinois, the killifish occurs only in one other area, the glacial lakes in Lake County (Smith, 1979, INHS collection records).

The proportion of non-native species (19%) in the urban Chicago area is very high relative to the Fox and Kankakee River drainages with 5% and 3% respectively and suggests a significantly altered fish community. The high number of hybrids also is considered to be a signal of a highly disturbed system (Karr et al., 1986); which certainly is represented by this system of fairly uniform canals and ditches. Lack of habitat diversity likely would lead to a reduction of reproductive barriers among species.

Impacts of Non-native Species

The connection now between the Lake Michigan-Atlantic Ocean and Illinois-Mississippi rivers has added an extra sense of concern with the movement of non-native species between the two systems, particularly, the occurrences of the white perch, oriental weatherfish (*Misgurnus anguillicaudatus*) and round goby (*Neogobius melanostomus*) in Chicago waterways. These are non-native species that are recent invaders to the area. The possible movement of two Asian carp species of the genus *Hypopthalmichthys* from the Illinois River to Lake Michigan is of a serious concern; however, neither of these species was found to be present in the Dennison material. Interestingly, a third Asian carp, the grass carp (*Ctenopharygodon idella*) is known to exist in Lake Michigan (INHS 59326, a Dennison specimen previously vouchered), but this single record suggests that the species remains rare in the lake, at least for the time being.

The white perch, indigenous to the Atlantic Coast of North America, arrived in Lake Ontario during the 1940s (Johnson and Evans, 1990). From there, the species spread to the other Great Lakes, arriving in Lake Michigan (including Illinois waters) during the mid- to late 1980s (Savitz et al., 1989). The species passed through the Chicago waterways into the lower Illinois River by 1991 (Irons et al., 2002) and the Mississippi River by 1993—94 (Burr et al., 1996).

The greatest concern is that the white perch will compete and hybridize with the other *Morone* species. There is evidence that the white perch eats the eggs of walleye (*Stizostedion vitreum*), white bass (*Morone chrysops*), and other fishes (Schaeffer and Margraf, 1987). Madenjian et al. (2000) demonstrated that white bass recruitment in Lake Erie declined after the invasion of white perch. Irons et al. (2002) reported hybridization between yellow bass and white perch. One sample from the Dennison collection also contained a yellow bass and white perch hybrid. Hybridization could indicate that the yellow bass gene pool is threatened by the influx of white perch genes (Irons et al., 2002).

While temperatures may limit white perch populations in parts of the Great Lakes, a study by Johnson and Evans (1990) suggests that much of Lake Michigan has temperatures suitable for the white perch. They predicted in 1990 that, coupled with the proper habitat, white perch might flourish in Lake Michigan. Records from the Dennison collection and other INHS records suggest that this prediction has proven to be true. The species now appears to have become more common than the other two native *Morone* species (yellow bass and white bass) in the urban Chicago region. Although the latter two species declined in the area before the arrival of white perch (Smith, 1979), the presence of white perch might prevent the reestablishment of the two native *Morone*. In the Dennison samples, 68 specimens of white perch were collected from 10 sites versus nine specimens from four sites for yellow bass and three specimens from two sites for white bass.

The oriental weatherfish is native to eastern Asia and has been established or collected in nine states including Illinois according to the US Geological Survey (http://nas.er.usgs.gov/queries/spCollections.asp?SpeciesID=498&State=&HUCNumber=). The species is a fairly recent invader to the area with the earliest verifiable record dating to 1987 (INHS 61129, Burr et al., 1996). At this point, these populations do not seem to be expanding (Burr et al., 1996). The Dennison materials verify their continued existence in the Chicago waterways and indicate that the population has maintained its limited geographic range. Regardless, its ability to survive in small streams suggests that it has the ability to survive in streams throughout the upper Midwest, although it might be limited to degraded small streams. Because it is a common species in the aquarium trade, populations could be expected to occur anywhere in the Midwest (Burr et al., 1996). The oriental weatherfish could become a competitor with native species, particularly darters and catfishes. They would occupy similar habitats and possibly consume the same prey items (Laird and Page, 1996).

The round goby (*Neogobius melanostomus*) is an Eurasian invader that is a native to the Black and Caspian seas (Charlebois et al., 2001). It was first found in the Great Lakes in 1990, and later spread to all of them as well as several tributaries (Charlebois et al.,

2001). The first detection of the round goby in the Chicago area appears to have been in 1994 as reported by Janssen and Jude (2001) and INHS records from Calumet Park (INHS 32982) and the Calumet River (INHS 34877). Although Laird and Page (1996) indicated that it first appeared in 1993, they provided no documentation to support this date. INHS staff in Havana, Illinois, captured one juvenile specimen in July 2004 from the Illinois River near Peoria (K. Irons pers. comm., INHS uncat.). While an electric barrier constructed at the origin of the Illinois River near Romeoville was originally designed to keep gobies out of the Illinois River, it appears that they have already established themselves in the river (D. Thomas, pers. comm.)

Likely, the species also will become established throughout the tributaries of the Illinois River. Indeed, two large adults from Flag Creek, a tributary of the Des Plaines, in the INHS collection (INHS 97590), suggest that the species will flourish in smaller streams of Illinois and the Midwest. Phillips et al. (2003) found the species has become established in four tributaries of Lake Erie and is a dominant species in at least one of the tributaries.

Competition between the round goby and native fishes is a major concern. According to a recent study, it is believed that the round goby has caused a local extinction of the mottled sculpin (*Cottus bairdi*) in the Calumet Harbor area of Lake Michigan (Janssen and Jude, 2001). This scenario may occur in many habitats throughout Lake Michigan and with other species such as darters in Illinois River tributaries.

A number of salmonid species occur in the area, particularly throughout Lake Michigan (Laird and Page, 1996). Although the brook trout (*Salvelinus fontinalis*) and lake trout (*Salvelinus namaycush*) are native to Lake Michigan, the others, coho salmon (*Oncorhynchus kisutch*), rainbow trout (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha*), and brown trout (*Salmo trutta*) are not native to the area. What differentiates these species from the other non-native species is that they are intentionally stocked in Lake Michigan, and none except perhaps the brown trout would be able to maintain self-sustaining populations in southern Lake Michigan (Smith, 1979). Given their cold-water requirements, any escape into the Illinois River system will not result in any permanent populations of non-native salmonids being established.

While the Chicago region does support a relatively high number of native species, the proportion of non-native species is high. Although efforts are beginning to control the spread of non-native species, it is unlikely that any of these species currently present will be eliminated from the area. Some of these non-native species will likely continue to have an impact on the local native fish fauna and broader aquatic community.

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Figure 1. Map of the northeastern Illinois containing the area of study. Large bold text are county names.

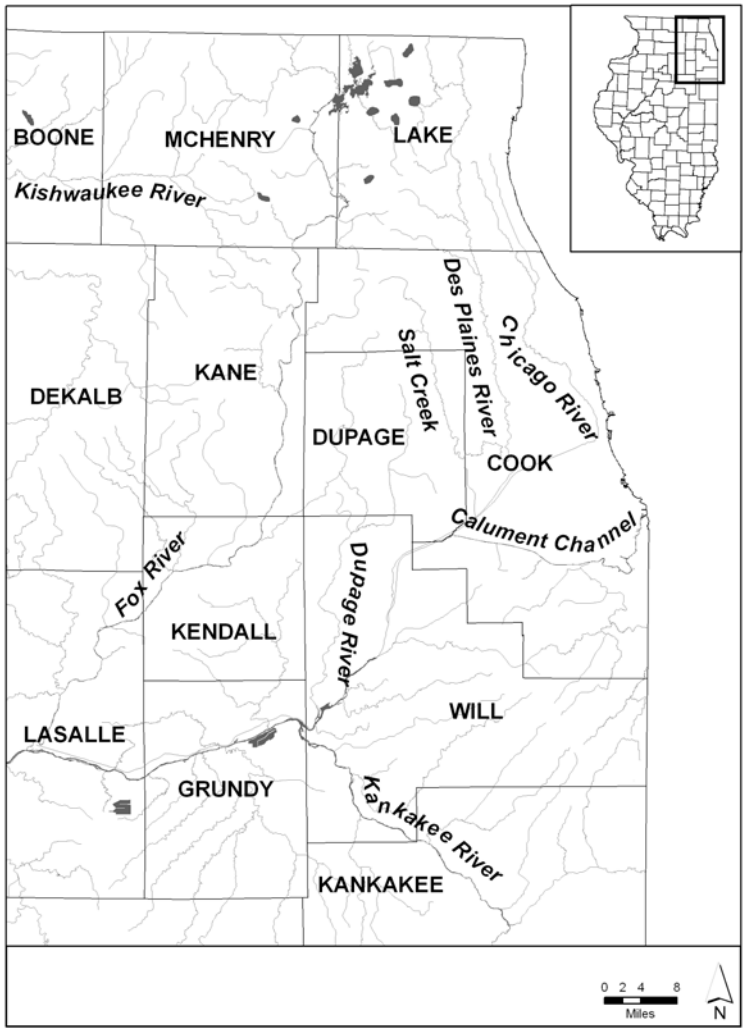

Table 1. Fishes of the Chicago, Illinois region based on vouchered INHS fish collection data. Based on materials collected after 1990. I = non-native species, A = found in part or all of area comprised of Des Plaines drainage, Chicago canal system & Lake Michigan, B = found in the Fox River drainage, C = found in the Kankakee River drainage.

Petromyzontidae	
Lampetra appendix C	American brook lamprey
Petromyzon marinus I, A	sea lamprey
Lepisosteidae	
Lepisosteus osseus A,B,C	longnose gar
Lepisosteus platostomus C	shortnose gar
Amiidae	
Amia calva A,C	bowfin
Hiodontidae	
Hiodon alosoides C	goldeye
Clupeidae	
Alosa chrysochloris A,C	skipjack herring
Alosa pseudoharengus I,A	alewife
Dorosoma cepedianum A,B,C	gizzard shad
Cyprinidae	
Campostoma anomalum A,B,C	central stoneroller
Campostoma oligolepis B	largescale stoneroller
Carassius auratus I,A	goldfish
Carassius auratus x *Cyprinus carpio* A	
Couesius plumbeus A	lake chub
Ctenopharyngodon idella I,A,B	grass carp
Cyprinella lutrensis A,C	red shiner
Cyprinella lutrensis x *C. spiloptera* A,C	
Cyprinella spiloptera A,B,C	spotfin shiner
Cyprinella whipplei B	steelcolor shiner
Cyprinus carpio I,A,B,C	common carp
Ericymba buccata C	silverjaw minnow
Hybopsis amnis C	pallid shiner
Hybognathus nuchalis B	Mississippi silvery minnow
Hypophthalmichthys nobilis I,C	bighead carp
Luxilus chrysocephalus A,B,C	striped shiner
Luxilus cornutus B	common shiner
Lythrurus umbratilis A,B,C	redfin shiner
Nocomis biguttatus A,B,C	hornyhead chub
Notemigonus crysoleucas A,B,C	golden shiner
Notropis anogenus B	pugnose shiner
Notropis atherinoides A,B,C	emerald shiner
Notropis buchanani A,C	ghost shiner
Notropis chalybaeus C	ironcolor shiner
Notropis dorsalis A,B,C	bigmouth shiner
Notropis dorsalis x *N. rubellus* B	
Notropis heterodon B	blackchin shiner
Notropis heterolepis B	blacknose shiner
Notropis hudsonius A,B	spottail shiner
Notropis ludibundus A,B,C	sand shiner
Notropis rubellus A,B,C	rosyface shiner
Notropis rubellus x *Luxilus chrysocephalus* B	
Notropis texanus C	weed shiner
Notropis volucellus B,C	mimic shiner
Opsopoeodus emiliae B,C	pugnose minnow
Phenacobius mirabilis A,B,C	suckermouth minnow
Phoxinus erythrogaster A,B,C	southern redbelly dace
Pimephales notatus A,B,C	bluntnose minnow
Pimephales promelas A,B,C	fathead minnow
Pimephales vigilax B,C	bullhead minnow
Rhinichthys atratulus B,C	blacknose dace
Rhinichthys cataractae A	longnose dace
Scardinius erythrophthalmus I,A,B	rudd
Semotilus atromaculatus A,B,C	creek chub
Catostomidae	
Carpiodes carpio A,B,C	river carpsucker
Carpiodes cyprinus A,B,C	quillback
Carpiodes velifer B	highfin carpsucker
Catostomus catostomus A	longnose sucker
Catostomus commersoni A,B,C	white sucker
Erimyzon oblongus A	creek chubsucker
Erimyzon sucetta B,C	lake chubsucker
Hypentelium nigricans A,B,C	northern hog sucker
Ictiobus bubalus A,B,C	smallmouth buffalo
Ictiobus cyprinellus A,C	bigmouth buffalo
Ictiobus niger A,C	black buffalo
Minytrema melanops A,C	spotted sucker
Moxostoma anisurum A,B,C	silver redhorse
Moxostoma carinatum B,C	river redhorse
Moxostoma duquesnei B,C	black redhorse
Moxostoma erythrurum A,B,C	golden redhorse
Moxostoma macrolepidotum A,B,C	shorthead redhorse
Moxostoma valenciennesi B	greater redhorse
Cobitidae	
Misgurnus anguillicaudatus I,A	Oriental weatherfish
Ictaluridae	
Ameiurus melas A,B,C	black bullhead
Ameiurus natalis A,B,C	yellow bullhead
Ameiurus nebulosus C	brown bullhead
Ictalurus punctatus A,B,C	channel catfish
Noturus exilis A,B,C	slender madtom
Noturus flavus A,B,C	stonecat
Noturus gyrinus A,B,C	tadpole madtom
Pylodictus olivaris B,C	flahead catfish
Esocidae	
Esox americanus A,B,C	grass pickerel
Esox lucius A,B,C	northern pike
Esox lucius x *E. masquinongy* A	tiger muskie

Esox masquinogy B muskie
Umbridae
Umbra limi A,B,C central mudminnow
Salmonidae
Coregonus clupeaformis A lake whitefish
Coregonus hoyi A bloater
Oncorhynchus kisutch I,A coho salmon
Oncorhynchus mykiss I.A rainbow trout
Oncorhynchus tshawytscha I,A chinook salmon
Prosopium cylindraceum A round whitefish
Salmo trutta I,A brown trout
Salvelinus namaycush A lake trout
Percopsidae
Percopsis omiscomaycus A,C trout-perch
Aphredoderidae
Aphredoderus sayanus C pirate perch
Gadidae
Lota lota A burbot
Atherinidae
Labidesthes sicculus A,B,C brook silverside
Fundulidae
Fundulus diaphanus A,B banded killifish
Fundulus dispar B,C starhead topminnow
Fundulus notatus A,B,C blackstripe topminnow
Poeciliidae
Gambusia affinis A,B,C mosquitofish
Poecilia latipinna I,A sailfin molly
Gasterosteidae
Culaea inconstans A,B brook stickleback
Gasterosteus aculeatus I,A threespine stickleback
Pungitius pungitius A ninespine stickleback
Cottidae
Cottus bairdi A,B,C mottled sculpin
Cottus cognatus A slimy sculpin
Myoxocephalus thompsoni A deepwater sculpin
Moronidae
Morone americana I,A,C white perch
Morone americana x *M. mississippiensis* A
Morone chrysops A,B,C white bass
Morone chrysops x *M. saxatilis* A
Morone mississippiensis A,B yellow bass
Centrarchidae
Ambloplites rupestris A,B,C rock bass
Lepomis cyanellus A,B,C green sunfish
Lepomis cyanellus x *L. gibbosus* A,B
Lepomis cyanellus x *L. humilis* A
Lepomis gibbosus A,B,C pumpkinseed
Lepomis gibbosus x *L. macrochirus* A
Lepomis gibbosus x *L. megalotis* A
Lepomis gulosus A,B,C warmouth
Lepomis humilis A,B,C orangespotted sunfish
Lepomis humilis x *L. macrochirus* A
Lepomis macrochirus A,B,C bluegill
Lepomis megalotis A,C longear sunfish
Lepomis microlophus I,B redear sunfish
Micropterus dolomieu A,B,C smallmouth bass
Micropterus dolomieu x *M. salmoides* B
Micropterus punctulatus I,A spotted bass
Micropterus salmoides A,C largemouth bass
Pomoxis annularis A,B,C white crappie
Pomoxis nigromaculatus A,B,C black crappie
Percidae
Ammocrypta clara C western sand darter
Etheostoma asprigene B mud darter
Etheostoma caeruleum B,C rainbow darter
Etheostoma chlorosomum B,C bluntnose darter
Etheostoma exile A,B Iowa darter
Etheostoma flabellare A,B,C fantail darter
Etheostoma gracile B slough darter
Etheostoma microperca A,B,C least darter
Etheostoma nigrum A,B,C johnny darter
Etheostoma spectabile A,B,C orangethroat darter
Etheostoma zonale B,C banded darter
Perca flavescens A,B yellow perch
Percina caprodes A,B,C logperch
Percina maculata A,B,C blackside darter
Percina phoxocephala A,B,C slenderhead darter
Sander vitreus A,B,C walleye
Sciaenidae
Aplodinotus grunniens A,B,C freshwater drum
Gobiidae
Neogobius melanostomus I,A round goby