Fishes of the Ohio River[1]

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ABSTRACT. To date, 159 species of fishes (14 of them introduced by humans) have been reported from the Ohio River. Three native fishes (*Acipenser fulvescens, Alosa alabamae,* and *Ammocrypta asprella*) have apparently been eliminated from the river. The Ohio River fish community was severely affected by the siltation of clean gravel substrates, and the inundation of those substrates by the canalization of the river before 1927. In the past 20-30 years, populations of many species have increased, particularly in the upper third of the river. Some pollution-intolerant species which had disappeared from the upper reaches of the river between 1900 and 1950 have been returning since 1970 (e.g. *Polyodon spathula, Hiodon tergisus,* and *Carpiodes velifer*). A few pollution-tolerant species have declined in abundance since 1970 (e.g. bullheads and *Ictalurus catus*). The most abundant fishes in the lock chamber samples of 1957-87 were *Notropis atherinoides, Dorosoma cepedianum, Aplodinotus grunniens, Notropis volucellus,* and *Ictalurus punctatus.* The ongoing recovery of the Ohio River fish community should encourage us to take additional steps to protect the river from catastrophic spills of toxic materials and to reintroduce eliminated native fishes.

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INTRODUCTION

The Ohio River and its geologic predecessors, as parts of the Mississippi Drainage, have provided continuous shelter for large river fishes for 200 million years. The evolution and distribution of freshwater fishes in this large river system have been shaped by geologic events of a magnificent scale — continental drift, sea level fluctuations, climatic changes, the advance and retreat of glaciers, and the establishment of land bridges between North America and both Asia and South America. The fish community of the Mississippi Drainage is, therefore, exceptionally rich in species, harbors many ancient or relic forms, contains several evolutionary lines not found elsewhere in the world, and represents the center of adaptive radiation for freshwater fishes in North America.

Europeans first encountered the magnificent Mississippi Basin fish assemblage in the Ohio River. They arrived on the Ohio River in 1669 and found it to be perfectly sited to serve as a major transportation artery to the western lands. Between 1669 and 1800, early travelers on the Ohio made many casual references to the fishes of the river, but the first ichthyologist to visit the river was C. A. Lesueur. In 1817 and 1818, Lesueur described three species of fishes (*Hiodon tergisus, Cycleptus elongatus,* and *Moxostoma duquesnei*) he had encountered at Pittsburgh a few years before. In 1818, that most voracious hunter of "new productions," Constantine Samuel Rafinesque, traveled down the Ohio River and made the first extensive collections of its fishes. In the "Ichthyologia Ohiensis" (1820) Rafinesque described over 100 new species of fishes. Many of these species are no longer recognized, but a careful consideration of his works led Pearson and Krumholz (1984) to conclude that he had seen 52 species of fishes (Table 1; all names conform to Robbins, et al. 1980) on the Ohio River in 1818. We recognize the Ohio River as the type locality for 30 fishes, indicated by a t in Table 2 (*Alosa ohiensis,* described from the Falls of the Ohio by Evermann in 1902, is considered a synonym of *A. alabamae*). Rafinesque described 26 of these fishes (between 1818 and 1820), Lesueur three (between 1817 and 1818), and Abbott only *Lampetra aepyptera* (in 1860). It is interesting to note that all of these 52 species except *Acipenser fulvescens* have been reported from the Ohio River in the last 20 years.

After Rafinesque's 1818 voyage, few references to Ohio River fishes are found until 1838 when J. P. Kirtland began his series of papers on the fishes of Ohio. Although exact locations are difficult to determine for Kirtland's records, some of his collections were made at Cincinnati in the Ohio River (Krumholz 1981). Between 1847 and 1870, very few references to Ohio River fishes are found beyond the description of *Lampetra aepyptera* in 1860 and the 1870 mention of *Acipenser fulvescens* by Dumeril. Between 1876 and 1891, David Starr Jordan published a number of reviews and references to Rafinesque's work on the Ohio River and tried to remove some of the confusion regarding the identity of Rafinesque's brief descriptions. Jordan may not have collected fishes from the Ohio River himself; instead he examined specimens collected by Dr. John Sloan near New Albany, Indiana. Stephen A. Forbes began surveying the fishes of Illinois in the 1870's, and his monograph on the fishes of that state (Forbes and Richardson 1920) contained many references to Ohio River fishes. Between 1891 and 1910, there were several important collections made in the Ohio River by Henshall (1888, 1889), Hay (1894), Call (1896), Osburn (1901) and Evermann (1902). The work by Call (1896) on the fishes and shells of the Falls of the Ohio River at Louisville is particularly valuable for its details and style. It is interesting to read Call's comparison of the fishes he found at the Falls with those collected by Rafinesque 85 years earlier: ". . . the fishes, then more numerous than now, since sewage and similar decimating influences were at their minimum."

Dr. Milton B. Trautman began his life's work on Ohio fishes in 1922 and collected many fishes from the Ohio River (Trautman 1981). In 1956, Lachner published a summary of fish distributions in the Ohio River Basin. This summary is of value because it was written at a time when the degradation of water quality in the upper Ohio River was at its maximum.

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TABLE 1

The 52 fishes reported from the Ohio River in 1818 by Rafinesque (after Pearson and Krumholz 1984).

Scientific Name
Lampetra appendix (DeKay)
Acipenser fulvescens Rafinesque
Scaphirhynchus platorynchus (Rafinesque)
Polyodon spathula (Walbaum)
Lepisosteus osseus (L.)
Lepisosteus platostomus Rafinesque
Lepisosteus spatula Lacepede
Anguilla rostrata (Lesueur)
Alosa chrysochloris (Rafinesque)
Dorosoma cepedianum (Lesueur)
Hiodon alosoides (Rafinesque)
Hiodon tergisus Lesueur
Esox americanus vermiculatus Lesueur
Esox lucius L.
Esox masquinongy Mitchill
Campostoma anomalum (Rafinesque)
Hybopsis amblops (Rafinesque)
Nocomis biguttatus (Kirtland)
Notemigonus crysoleucas (Mitchill)
Notropis atherinoides Rafinesque
Notropis cornutus (Mitchill) [perhaps *N. chrysocephalus*]
Pimephales notatus (Rafinesque)
Carpiodes carpio (Rafinesque)
Carpiodes velifer (Rafinesque)
Catostomus commersoni (Lacepede)
Cycleptus elongatus (Lesueur)[t]
Erimyzon oblongus (Mitchill)
Hypentelium nigricans (Lesueur)
Ictiobus bubalus (Rafinesque)
Ictiobus niger (Rafinesque)
Minytrema melanops (Rafinesque)
Moxostoma anisurum (Rafinesque)
Moxostoma duquesnei (Lesueur)
Moxostoma erythrurum (Rafinesque)
Ictalurus furcatus (Lesueur)
Ictalurus melas (Rafinesque)
Ictalurus natalis (Lesueur)
Ictalurus punctatus (Rafinesque)
Noturus flavus Rafinesque
Pylodictis olivaris (Rafinesque)
Morone chrysops (Rafinesque)
Lepomis cyanellus Rafinesque
Lepomis macrochirus Rafinesque
Micropterus dolomieui Lacepede
Micropterus punctulatus (Rafinesque)
Micropterus salmoides (Lacepede)
Pomoxis annularis Rafinesque
Etheostoma blennioides Rafinesque
Etheostoma flabellare Rafinesque
Percina caprodes (Rafinesque)
Stizostedion vitreum vitreum (Mitchill)
Aplodinotus grunniens Rafinesque

A few state and federal resource management agencies began to sample Ohio River fishes in the 1950s. Between 1957 and 1959, the Ohio River Valley Water Sanitation Commission (ORSANCO) sponsored the first comprehensive survey of aquatic life in the Ohio River (ORSANCO 1962). During this study, nearly 750,000 fish were collected throughout the river by a variety of methods. However, most of the fish were collected by rotenone samples made in lock chambers of the navigation dams.

In 1969, the passage of the National Environmental Policy Act, along with the subsequent passage of P. L. 92-500 in 1972, resulted in the production of many en-

TABLE 2

A list of the 159 fishes reported from the upper, middle, and lower thirds of the Ohio River between 1800 and 1969 (O) and since 1970 (R). An asterisk (*) indicates an introduced species, a "t" indicates a species for which the Ohio River is the type locality.

	Ohio River Mile		
Species	0-327	328-654	655-981
Ichthyomyzon bdellium	OR	O	
Ichthyomyzon castaneus	R		OR
Ichthyomyzon unicuspis	OR	OR	OR
Lampetra aepyptera[t]	O		
Lampetra appendix	O	OR	
Acipenser fulvescens	O	O	O
Scaphirhynchus platorynchus[t]	O	OR	OR
Polyodon spathula	OR	OR	OR
Lepisosteus oculatus		OR	OR
Lepisosteus osseus	OR	OR	OR
Lepisosteus platostomus[t]	OR	OR	OR
Lepisosteus spatula		O	OR
Amia calva	OR	OR	OR
Anguilla rostrata	OR	OR	OR
Alosa alabamae		O	
Alosa chrysochloris[t]	OR	OR	OR
Alosa pseudoharengus *	R	R	
Alosa sapidissima *		O	
Dorosoma cepedianum	OR	OR	OR
Dorosoma petenense		OR	OR
Hiodon alosoides[t]	OR	OR	OR
Hiodon tergisus[t]	OR	OR	OR
Oncorhynchus kisutch *		R	
Salmo gairdneri *	R		
Salmo trutta *	R	R	
Osmerus mordax		R	
Esox americanus vermiculatus	OR	OR	R
Esox lucius *	R	OR	
Esox masquinongy	OR	OR	
Esox niger			R
Campostoma anomalum	OR	OR	O
Carassius auratus *	OR	OR	OR
Clinostomus elongatus		R	
Ctenopharyngodon idella *		R	R
Cyprinus carpio *	OR	OR	OR
Ericymba buccata	OR	OR	
Hybognathus hayi			O
Hybognathus nuchalis	R	O	OR
Hybopsis aestivalis	OR	OR	OR
Hybopsis amblops[t]	OR	OR	R
Hybopsis dissimilis	R	O	
Hybopsis gracilis			R
Hybopsis meeki			OR
Hybopsis storeriana	OR	OR	OR
Hybopsis x-punctata	O		
Hypophthalmichthys molitrix *		R	R
Nocomis biguttatus		OR	
Nocomis micropogon	OR	OR	
Notemigonus crysoleucas	OR	OR	OR
Notropis ardens		R	
Notropis atherinoides	OR	OR	OR
Notropis blennius	OR	OR	OR
Notropis boops	OR	O	O
Notropis buchanani	OR	OR	OR
Notropis chrysocephalus	OR	OR	O
Notropis cornutus	OR	OR	O
Notropis emiliae			OR
Notropis fumeus		R	R
Notropis heterolepis	R		
Notropis hudsonius	R	R	O
Notropis lutrensis			OR
Notropis nubilus			O
Notropis photogenis	OR	OR	R
Notropis rubellus	OR	OR	OR
Notropis shumardi			OR
Notropis spilopterus	OR	OR	OR
Notropis stramineus	OR	OR	OR

TABLE 2 (continued)

Species	Ohio River Mile 0–327	328–654	655–981
Notropis umbratilis			R
Notropis venustus			O
Notropis volucellus	OR	OR	OR
Notropis whipplei	OR	OR	OR
Phenacobius mirabilis	OR	OR	OR
Phoxinus erythrogaster	O		
Pimephales notatus†	OR	OR	OR
Pimephales promelas	OR	OR	
Pimephales vigilax	OR	OR	OR
Rhinichthys atratulus	OR	R	
Semotilus atromaculatus	OR	OR	OR
Carpiodes carpio†	OR	OR	OR
Carpiodes cyprinus	OR	OR	OR
Carpiodes velifer†	OR	OR	OR
Catostomus commersoni	OR	OR	R
Cycleptus elongatus†	OR	OR	OR
Erimyzon oblongus			R
Erimyzon sucetta	O	O	R
Hypentelium nigricans	OR	OR	O
Ictiobus bubalus†	OR	OR	OR
Ictiobus cyprinellus	OR	OR	OR
Ictiobus niger†	OR	OR	OR
Minytrema melanops†	OR	OR	OR
Moxostoma anisurum†	OR	OR	OR
Moxostoma carinatum	OR	OR	OR
Moxostoma duquesnei†	OR	OR	
Moxostoma erythrurum†	OR	OR	OR
Moxostoma macrolepidotum	OR	OR	OR
Moxostoma valenciennesi		O	
Ictalurus catus *	OR	R	R
Ictalurus furcatus	OR	OR	OR
Ictalurus melas†	OR	OR	OR
Ictalurus natalis	OR	OR	OR
Ictalurus nebulosus	OR	OR	OR
Ictalurus punctatus†	OR	OR	OR
Noturus eleutherus	O	R	OR
Noturus flavus†	OR	OR	OR
Noturus gyrinus	O	OR	OR
Noturus miurus	OR	R	OR
Noturus nocturnus			OR
Noturus stigmosus			OR
Pylodictis olivaris†	OR	OR	OR
Aphredoderus sayanus		R	OR
Percopsis omiscomaycus	OR	OR	
Lota lota		O	O
Fundulus diaphanus *	OR		
Fundulus heteroclitus *	O		
Fundulus notatus	OR	OR	OR
Fundulus olivaceus			O
Gambusia affinis		R	OR
Labidesthes sicculus	OR	OR	OR
Morone chrysops†	OR	OR	OR
Morone mississippiensis		R	OR
Morone saxatilis *	R	R	R
Ambloplites rupestris	OR	OR	OR
Centrarchus macropterus			OR
Lepomis cyanellus†	OR	OR	OR
Lepomis gibbosus	OR	OR	R
Lepomis gulosus	OR	OR	OR
Lepomis humilis	OR	OR	OR
Lepomis macrochirus†	OR	OR	OR
Lepomis megalotis	OR	OR	OR
Lepomis microlophus	OR	OR	OR
Micropterus dolomieui	OR	OR	OR
Micropterus punctulatus†	OR	OR	OR
Micropterus salmoides	OR	OR	OR
Pomoxis annularis†	OR	OR	OR
Pomoxis nigromaculatus	OR	OR	OR
Ammocrypta asprella	O	O	
Ammocrypta pellucida	OR	O	
Etheostoma asprigene			O
Etheostoma blennioides†	R	OR	O
Etheostoma caeruleum	OR	OR	
Etheostoma flabellare†	OR	OR	
Etheostoma kennicotti		O	
Etheostoma nigrum	OR	OR	R
Etheostoma spectabile	R	R	
Etheostoma variatum	OR	OR	
Etheostoma zonale	R	R	
Perca flavescens	OR	OR	R
Percina caprodes†	OR	OR	OR
Percina copelandi	R	R	
Percina evides	O		
Percina macrocephala	O		
Percina maculata	OR		O
Percina phoxocephala		R	
Percina sciera	R	O	O
Percina shumardi	OR	OR	R
Stizostedion canadense	OR	OR	OR
Stizostedion vitreum vitreum	OR	OR	OR
Aplodinotus grunniens†	OR	OR	OR
Cottus carolinae		O	O
Totals O	107	110	101
R	109	116	102
O+R	122	132	119

vironmental reports, environmental impact statements, and compliance reports. These reports often contain data on fish collections made at specific sites. Pearson and Krumhoz (1984) examined 95 of these reports prepared between 1970 and 1983. We have examined an additional 26 such reports published since 1983, along with unpublished data gathered by ORSANCO and at the University of Louisville.

Effects of Human Actions on the Ohio River Environment

When the first Europeans visited the Ohio River they found it to be a beautiful, clear (except during floods) river flowing through hardwood forests, and protected by many marshes and other wetlands. The early settlers cleared the forests and drained many of the wetlands between 1800 and 1900. The river was thus subjected to siltation from the erosion of soils from cleared fields and pastures.

As the human population of the Ohio Basin grew, the river received ever larger volumes of domestic sewage, industrial effluents, and mine drainages. The pollution was concentrated in the upper river from Pittsburgh to Wheeling, and immediately below Cincinnati and Louisville. The lower 150-200 miles of the River was not polluted as badly, since fewer people live along that portion of the river, and several large tributaries provide additional dilution. Since 1960, considerable progress has been made towards reducing point source pollution in the river as a result of the actions of ORSANCO and the implementation of the Clean Water Act and its amendments. Improvements have been most dramatic in the upper 200 miles of the river where the pollution was most severe (ORSANCO 1986).

Beginning in 1885, the U.S. Army Corps of Engineers installed a series of low dams to provide a canal-

ized river for navigation purposes. When completed in 1927, this system included 50 locks and dams and provided a nine-foot navigation channel throughout the year. After 1955, this system was modified to its present configuration of 17 dams between 16 and 37 feet high and three dams 10-13 feet high. The most important effect of human environmental disturbances on Ohio River fishes has probably been the siltation and inundation of much of the original clean gravel or rubble substrate of the river bed. This coarse substrate provided the predominant lithophilic fishes with their preferred spawning substrate, which is now in short supply (Pearson and Krumholz 1984). The dams also interfered with fish movements, eliminating the spring run of *Alosa alabamae*, and seriously impairing those of other fishes.

MATERIALS AND METHODS

In their earlier summary of the status of Ohio River fishes, Pearson and Krumholz (1984) reviewed the published reports of fish distributions through 1983. No attempt has been made to repeat all of the citations contained therein, but all subsequent reports (26) which have come to our attention since 1983 have been cited. Of particular value have been the ongoing lock chamber rotenone collections sponsored by ORSANCO, U.S. EPA, and several state agencies (ORSANCO 1988); the Ohio River Ecological Study, sponsored by a consortium of power companies (Geo-Marine, Inc. 1984, 1986a, 1986b; Environmental Science and Engineering, Inc. 1987, 1988); and the annual reports of the Ohio River biologists employed by the Kentucky Department of Fish and Wildlife Resources (Jackson 1985, 1986a, 1986b; Henley 1987, 1988). These three monitoring programs have different, but compatible, objectives and all provide valuable insight to the composition and well-being of the Ohio River fish community. We also obtained distribution data from the reports by EA Environmental Science and Technology, Inc. (1987), Duquesne Light Co. (1983, 1984, 1986), Cincotta et al. (1986), Lobb (1987, 1988), Sanders and Yoder (1989), Simon (1986), Tolin and Schettig (1983), and United States Fish & Wildlife Service (USFWS) (1985). In gathering distribution data, we have considered only records for the Ohio River mainstem and its directly-connected embayments created by the navigation dams. Records from the mouths of tributaries and flood plain lakes were excluded. Finally, we have spent many days on the river with students and other biologists collecting fishes with seines, electrofishing devices, hoop nets, trawls, and gill and trammel nets. During these trips, we have sought the observations of fishermen and others on the river. These activities have provided some of the locality records we refer to, but more importantly, they have provided the overall sense of how the character of the river and fish populations have changed.

RESULTS

To date, 159 species of fishes have been reported from the Ohio River. Five of these (*Osmerus mordax, Esox niger, Hybopsis gracilis, Notropis ardens,* and *Percina phoxocephala*) were recorded for the first time in the five years since Pearson and Krumholz listed 154 species in 1984. *Osmerus mordax,* recorded at Ohio River Mile 560 (= ORM 560; or miles below Pittsburgh) in 1986, has apparently spread through the lower Missouri and upper Mississippi Rivers in the last 15 years, following introductions from the Great Lakes into the upper Missouri River in 1971, and possibly through movements down the Illinois River (Mayden et al. 1987). *Hybopsis gracilis* was known only from the Missouri and middle Mississippi River drainages until Burr and Warren (1986) reported it from the Ohio River near its mouth. *Notropis ardens* is a relatively common inhabitant of small streams along the middle portion of the Ohio River, but was first reported from the Ohio at the Falls (ORM 605) in 1984 (Froedge 1986). The Falls area, during summer low-water periods, presents a riffle environment which often harbors species normally considered small stream inhabitants (e.g. *Campostoma anomalum, Semotilus atromaculatus, Notropis chrysocephalus, Etheostoma* spp.) (Froedge 1986). *Percina phoxocephala* was collected from the Ohio River by night electrofishing in 1988 at ORM 355 (Sanders 1988). *Esox niger* was reported at ORM 919 in 1987 (Henley 1988), and probably strayed from nearby oxbow lakes and marshes.

All distribution records were divided into three reaches of the river: upper (ORM 0-327), middle (ORM 328-654), and lower (ORM 655-981) and into two periods: old (1800-1969) and new (1970-1988) (Table 2). More species (132) were reported from the middle third of the river than from the upper (122) and lower (119) thirds of the river. This greater species richness was seen in both the old and new records. The number of species reported solely from each third of the river were 9 in the upper, 10 in the middle, and 16 in the lower (Table 2). Three of these species in the upper third were introduced (*Salmo gairdneri, Fundulus diaphanus,* and *Fundulus heteroclitus*), as were two in the middle third (*Alosa sapidissima* and *Oncorhynchus kisutch*). All 15 of the exclusive species in the lower third are native fishes. The upper and middle thirds of the river have received much more attention from collectors than the lower third. We suspect that an equal amount of collecting effort on the lower third would reveal even more species than have been reported from each of the upper two-thirds, partly because the lower reaches of the Ohio should draw species from the Mississippian center of North American fish distribution (Robison 1986, Burr and Page 1986). Reash and Van Hassel (1988) reported higher catch rates of small-stream-preferring fishes in the upper Ohio River, while species which preferred large river habitats had higher catch rates in the middle Ohio River. An examination of species confined to each section of the river indicates that most of the abundant species are found in all three sections of the river, and it is the relatively rare fishes, or occasional strays from small streams which have been found in only a single reach of the river.

According to Johnson (1987), 18% (28 species) of the 159 fishes reported from the Ohio are considered rare enough to be protected by law in one or more of the states bordering the Ohio River. An additional 13% (21 species) are considered to be of "special concern" by one or more of these same states because of ". . . low numbers, limited distribution, or recent declines" (Johnson 1987). The Ohio River populations which might be particularly threatened would include *Ichthyomyzon unicuspis, Lampetra aepyptera, Acipenser fulvescens, Polyodon spathula, Lepisosteus spatula, Alosa alabamae, Hybopsis gracilis, Cycleptus elongatus, Ammocrypta asprella, Percina copelandi,* and *P. phoxocephala.*

Introduced and Extirpated Species

Fourteen species of fishes have been introduced to the Ohio River by humans (if we consider that *Perca flavescens* and *Osmerus mordax* entered the Ohio River without human assistance). Only four of these (*Cyprinus carpio, Carassius auratus, Ictalurus catus,* and *Fundulus diaphanus*) have definitely established reproducing populations, although tentative reports of reproduction have been made for *Morone saxatilis* (Simon 1986) and *Hypophthalmichthys*

molitrix. Of the remaining eight species (*Osmerus mordax, Alosa pseudoharengus, Alosa sapidissima, Oncorhynchus kisutch, Salmo gairdneri, Salmo trutta, Esox lucius,* and *Fundulus heteroclitus*), only *Osmerus mordax* and *Esox lucius* could reasonably be expected to establish themselves.

Nineteen species of fishes reported before 1970 have not been reported since (Table 2). Two of these were introduced species which failed to establish reproducing populations (*Alosa sapidissima* and *Fundulus heteroclitus*). Some are of doubtful origin or identification (*Lota lota* and *Moxostoma valenciennesi,* respectively). Most of the remaining species prefer small stream habitats and probably were never abundant in the Ohio River. Only *Acipenser fulvescens, Alosa alabamae,* and *Ammocrypta asprella* were large river, native fishes which may be considered extirpated from the river of today. The installation of navigation dams may have interfered with the reproductive migrations of the shad and sturgeons, while the inundation of suitable riffle areas probably reduced darter numbers.

Of the 20 species which have been reported only since 1970 (Table 2), seven were introduced by humans (*Alosa pseudoharengus, Oncorhynchus kisutch, Salmo gairdneri, Salmo trutta, Ctenopharyngodon idella, Hypophthalmichthys molitrix,* and *Morone saxatilis*). One (*Osmerus mordax*) has had its range severely adjusted by human action, and three may be maintaining small populations which were only recently discovered in the Ohio River (*Hybopsis gracilis, Percina copelandi,* and *P. phoxocephala*). The others are primarily small stream species which have probably strayed into the Ohio River from tributaries.

Range Extensions

Since the report of Pearson and Krumholz (1984), range extensions have been reported in an upstream direction for 12 species, in a downstream direction for 15 species, and both upstream and downstream for six species (Table 3). Species which have been reported further upstream than prior to 1983 include *Polyodon spathula* (ORM 429-341), *Hiodon tergisus* (ORM 260-54), *Carpiodes carpio* (ORM 54-35), *Carpiodes velifer* (ORM 170-54), *Ictiobus bulbalus* (ORM 54-35), *Moxostoma anisurum* (ORM 35-13), *Hypentelium nigricans* (ORM 35-13), *Notropis rubellus* (ORM 35-13), and *Morone saxatilis* (ORM 126-13) in the upper third of the river; *Dorosoma petenense* (ORM 390-341) in the middle third of the river; and *Lepisosteus oculatus* (ORM 846-560) in the lower third of the river (Table 3). The extensions into the upper third of the river were made principally by fishes which prefer large river habitats, and are probably direct responses to the continuing improvement of water quality in the upper Ohio River (ORSANCO 1986, Van Hassel et al. 1988).

The four minnows, one silverside and one darter whose reported ranges expanded in both upstream and downstream directions since 1983 are small stream species which stray into the Ohio River. Their extensions probably reflect increased collecting efforts using gear types which are selective for small fishes, rather than a significant change in distribution. The same could be said for most of the 15 species which were recently reported downstream of their 1970-83 distribution (Table 3). Only *Esox lucius, E. masquinongy* and *Cycleptus elongatus* could be considered species which prefer large river habitats. The distributions of the two pikes reflect continued stocking efforts by resource agencies, not responses to environmental variations. The extension of *Cycleptus elongatus* (from ORM 744 to 946) may reflect its increased abundance throughout the river since 1975 (Pearson and Krumholz 1984), but may also simply reflect the lack of collecting effort in the lower third of the river.

TABLE 3

Range extensions along the Ohio River reported since 1983. These are extensions compared to the 1970-83 distributions reported by Pearson and Krumholz (1984). We assumed that records from the last 80 miles of the river indicate a distribution down to the mouth (ORM 981).

Direction of extension & Species	1970-1983 Distribution (ORM)	1984-1988 Distribution (ORM)
Upstream		
Polyodon spathula	427-981	341-981
Lepisosteus oculatus	846-981	560-981
Dorosoma petenense	390-981	341-981
Hiodon tergisus	260-981	54-981
Esox americanus vermiculatus	597-981	54-981
Carpiodes carpio	54-981	35-981
Carpiodes velifer	170-981	54-981
Hypentelium nigricans	35-604	13-604
Ictiobus bubalus	54-981	35-981
Moxostoma anisurum	35-981	13-981
Notropis rubellus	35-981	13-981
Morone saxatilis	126-981	13-981
Upstream and downstream		
Ericymba buccata	54-287	35-605
Nocomis micropogon	54-470	35-560
Notropis chrysocephalus	54-518	35-605
Pimephales promelas	161-279	77-560
Labidesthes sicculus	54-260	35-981
Etheostoma zonale	35-494	13-560
Downstream		
Esox lucius	35-344	35-494
Esox masquinongy	35-368	35-776
Campostoma anomalum	35-571	35-605
Hybopsis aestivalis	260-494	260-981
Notropis hudsonius	13-54	13-494
Notropis stramineus	13-597	13-981
Phenacobius mirabilis	177-494	177-981
Rhinichthys atratulus	35-77	35-494
Cycleptus elongatus	54-744	54-981
Etheostoma blennioides	54-494	54-560
Etheostoma caeruleum	54-518	54-605
Etheostoma flabellare	54-518	54-605
Etheostoma nigrum	13-494	13-981
Etheostoma spectabile	54-77	54-454
Etheostoma zonale	54-494	54-560

Trends in Abundance

Lock chamber rotenone collections have been made at more or less regular intervals on the Ohio River since 1957 (Pearson and Krumholz 1984, ORSANCO 1988). The results of 291 such collections were examined and fishes were ranked on the basis of numbers/ha of lock chamber area in different sections of the river. The five most abundant fishes throughout the river between 1957 and 1987, according to these collections, were *Notropis atherinoides, Dorosoma cepedianum, Aplodinotus grunniens, Notropis volucellus,* and *Ictalurus punctatus*. The two shiners were most abundant in the upper third of the river, while *Aplodinotus grunniens* was most abundant in the lower

two-thirds of the river, and *Dorosoma cepedianum* and *Ictalurus punctatus* were distributed relatively uniformly throughout the river. Van Hassel et al. (1988) summarized the results of the Ohio River Ecological Research Program (ERP) sponsored on the upper half of the Ohio River since 1973. The ERP has employed a variety of gear types (gill nets, seines, electrofishers, trawls, and hoop nets). It is interesting that *Notropis atherinoides* and *Dorosoma cepedianum* were also the most abundant species collected in the ERP, followed by *Pimephales notatus*, *Ictalurus punctatus*, and *Cyprinus carpio*. The gear types employed in the ERP favor the representation of shallow-water, near-shore fishes, while the lock chamber samples are biased towards deep-water, channel forms. In the lock chamber samples, *Cyprinus carpio*, bullheads (three species combined—*Ictalurus melas*, *I. natalis*, and *I. nebulosus*), *Alosa chrysochloris*, *Pomoxis annularis*, and *Dorosoma petenense* were the sixth to tenth most abundant species.

Pearson and Krumholz (1984) and Van Hassel et al. (1988) have pointed out that many fishes in the upper half of the river have increased in numbers since 1970 as water quality in the upper reaches improved. Certainly many forage species (*Notropis atherinoides* and *Dorosoma cepedianum*), several predators (*Stizostedion canadense*, *Pomoxis annularis*, *Hiodon alosoides* and *H. tergisus*), and some of the less pollution-tolerant suckers (*Moxostoma* spp. and *Cycleptus elongatus*) have increased in the upper half of the river since 1970. At the same time, there have been declines in a few species, usually those regarded as pollution tolerant (all of the bullheads and *Cyprinus carpio*). The decline of the bullheads has been most dramatic in the upper third of the river and has been accompanied (since 1980) by a gradual decline in numbers of the introduced *Ictalurus catus*. Between 1980 and 1988, *Ictalurus furcatus* increased in the lower two-thirds of the river and actually replaced bullheads on the ten-most-abundant list from the lock chamber samples.

Other fishes which seem to be increasing in abundance since 1970 include *Polyodon spathula*, *Carpiodes cyprinus*, *Carpiodes velifer*, *Notropis hudsonius*, and *Morone saxatilis*. In 1988, fishermen at McAlpine Dam reported very large catches (over 25 fish per person on some days) of yearling *M. saxatilis*, and in the McAlpine lock chamber sample of September, 1988 large numbers of young-of-the-year *M. saxatilis* were collected. These catch rates may indicate spawns in 1987 and 1988, or they may be aberrant concentrations of stocked fish linked to the drought conditions of this summer. State agencies also stock *M. chrysops* X *M. saxatilis* hybrids in the river in large numbers. Although *Polyodon spathula* increased after 1970, the stimulation of a small but intensive fishery for the roe of this species since the Iranian caviar embargo of the 1980s may be slowing or even reversing this recovery.

SUMMARY AND CONCLUSIONS

1. Of the 52 species which Rafinesque described from the Ohio River in 1818, all except *Acipenser fulvescens* have been reported from the river within the last 20 years. Of the 30 species for which the Ohio river is the type locality, all but two have been reported from the river since 1980. *Lampetra aepyptera* has not been reported since Abbott described it in 1860, and *Hybopsis amblops* has been reported from a few sites in the 1970's, but the records need verification.

2. Of the 159 species which have been reported from the Ohio River, 14 were introduced by humans (seven since 1970) and at least four have established reproducing populations. Apparently, only three native, large-river species have been extirpated from the river (*Acipenser fulvescens*, *Alosa alabamae*, and *Ammocrypta asprella*).

3. Although species richness is greatest in the middle portion of the river (132 species), this may reflect greater collecting effort in this area. Sampling efforts in the lowest third of the river have been much less than those in each of the upper two-thirds, yet the number of species (119) collected in the lower river is almost as great as that (122) of the upper third.

4. Some large river species (e.g. *Polyodon spathula*, *Lepisosteus oculatus*, *Hiodon tergisus*, and *Carpiodes velifer*) have moved upstream in the last 20 years as water quality improved dramatically in the upper half of the river. The ranges of some small stream species were extended downstream in the last 20 years, but this may reflect an increase in collecting effort in the lower river.

5. Populations of pollution-tolerant species (e.g. bullheads and *Cyprinus carpio*) have declined in the upper third of the river over the past 20 years, while populations of many relatively pollution-intolerant species (e.g. Hiodontids, *Moxostoma* spp. and *Stizostedion*) have increased.

6. The continuing improvements in water quality in the Ohio River and the responses of the fish community to this trend are most encouraging. However, the diesel fuel spill of 1988 above Pittsburgh should remind us that such major, catastrophic spills are a constant threat to the Ohio River fish community. We must make every effort to prevent such catastrophes involving toxic materials being transported upon, stored adjacent to, or manufactured and used along the Ohio River and its tributaries.

7. The recovery of many fish populations should serve as a spur to the public, and to resource management agencies, to take aggressive actions to restore the magnificent *Acipenser fulvescens* and the smaller but equally admirable *Ammocrypta asprella* to the Ohio River. Introductions of non-native species should be discouraged.

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