

The Frequency of Occurrence and Relative Abundance of Ohio Stream Fishes: 1979 Through 1995

RANDALL E. SANDERS¹, CHARLES STAUDT², DENNIS MISHNE², MARC SMITH², EDWARD T. RANKIN², CHRIS O. YODER², ROGER THOMA², DAVID ALTFATER², CHARLES BOUCHER², KELLY CAPUZZI², ROBERT MILTNER², BRIAN ALSDORF², DANIEL L. RICE³, AND TED M. CAVENDER⁴

¹*Fish Management and Research, Division of Wildlife, Ohio Department of Natural Resources, 1840 Belcher Drive G-3, Columbus, OH 43224.* ²*Ecological Assessment, Division of Surface Water, Ohio Environmental Protection Agency, 4675 Homer Ohio Lane, Groveport, OH 43125.* ³*Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Fountain Square F-1, Columbus, OH 43224.* ⁴*Division of Fishes, Museum of Biological Diversity, The Ohio State University, 1315 Kinnear Road, Columbus, OH 43212*

Introduction

Ohio streams have a rich history of ichthyological investigations. Statewide distribution maps for game fish species were first reported by Wickliff and Trautman (1931). The first edition of *The Fishes of Ohio* published statewide distribution maps for all Ohio fish species for collections made during 1840 through 1955 (Trautman, 1957). This book was revised for collections made during 1956 through 1980—a period when fish populations in many streams were severely degraded by high levels of pollution and other environmental changes (Trautman, 1981).

Although these publications are excellent sources for the historical distributions, identification, and preferred habitats of Ohio fish, they do not provide quantitative frequency of occurrence or relative abundance information for current stream fish populations that have increased as the result of improved water quality (e.g., Ohio Environmental Protection Agency [OEPA] 1992; 1995; 1996), become established through introductions, or continued to decline. The number of annual fish surveys has also increased since 1979 when OEPA began an intensive stream monitoring program (Figure 1). Additional stream surveys have also been conducted since 1979 by other state agencies and universities in search of rare and endangered fish species (Cavender and Rice, 1997; Sanders, 1995). The use of boat-mounted electrofishing gear also has added new records for fish species that inhabit large streams. With this study, we sought to answer the following questions.

- 1) How many fish species have been recently collected from Ohio streams?
- 2) What is the frequency of occurrence and relative abundance of each species?
- 3) What is the mean drainage area for each species?

Methods

Sampling Procedures

The majority of the data used in this study was collected by OEPA staff using one of two types of standardized electrofishing gear and methods designed for boatable or wadeable streams (OEPA, 1989). The two methods allow for effective sampling over a wide range of stream sizes (i.e., small creeks to large rivers). The methods use two principal types of gasoline powered pulsed Direct Current electrofishing gear: 1) 1750 watt pulsator/generator combination (T&J Manufacturers) designed for smaller, wadeable streams; and, 2) boat-mounted 3500 to 5000 watt generators and pulsator combinations (Smith-Root Type 3.5 or 5.0 GPP units), with a straight electrode configuration for wider and deeper boatable streams. Sampling was conducted during the day except for in the Ohio and Muskingum rivers where night electrofishing was also used for improved catches (Sanders, 1992). Most OEPA electrofishing sites were sampled over a fixed distance of 200 meters in small to medium size wadeable streams and 500 meters in larger size boatable streams.

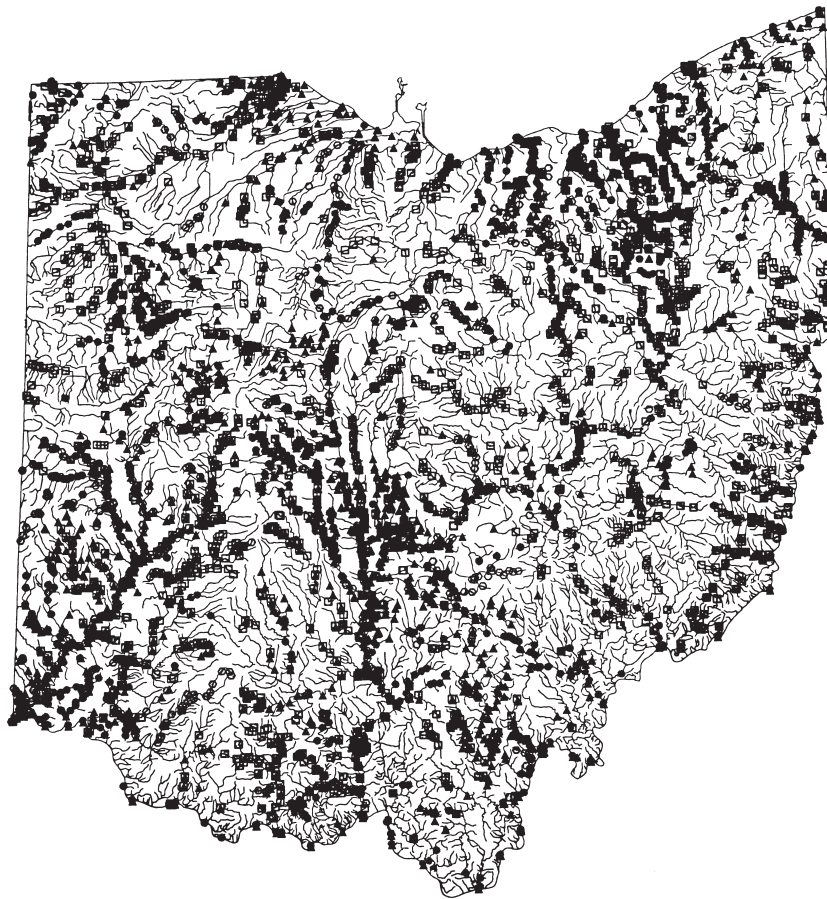


Figure 1. Ohio ECOS fish sampling locations (multiple symbol types) for surveys conducted during 1979 through 1995.

Additional surveys were conducted by staff from the Ohio Department of Natural Resources Division of Natural Areas and Preserves (ODNAP) and The Ohio State University Museum of Biological Diversity (OSUMBD) using nylon seines or electrofishing gear. Electrofishing gear consisting of a 1750 watt generator wired to a catch-net was generally employed on medium to large streams. Seines were also used in the larger streams in conjunction with electrofishing. Smaller streams were primarily sampled with seines. Night sampling was done almost exclusively with seines. Most of the seines used in these surveys were 1.8 m X 3.6 m with 30.2 mm or 28.6 mm ace mesh and 1.8 m X 3.0 m with 30.2 mm ace mesh. All seines employed during these surveys were of nylon construction with a double weighted lead line. Sampling efforts were not standardized between the various surveys particularly those that were targeting specific species, such as the eastern sand darter, *Ammocrypta pellucida*, and northern madtom, *Noturus stigmosus*. All available habitats were sampled at most sites until no new species were encountered. All fish collected during a sample were identified to species and released. Vouchers of rare and difficult to identify species were preserved in formalin and deposited at the OSUMBD.

Data Base Query and Additional Records

A computer program was written to query Ohio ECOS (a statewide multi-agency biological database maintained by the OEPA)¹ by fish species for stream locality records collected during 1979 through 1995. The software consisted of FoxPro for Windows version 2.6 using DBF format files. The search was limited to data collected by the OEPA Ecological Assessment staff, including the Ohio River surveys conducted for the Ohio Department of Natural Resources Division of Wildlife (ODOW) (Sanders, 1995), and miscellaneous records from the ODNAP and the OSUMBD. All available data (other sources and records through 1997) were included for rare species collected from less than or equal to five streams (*e.g.*, White, 1987). Only a few selected hybrids that were collected for the period 1979 through 1995 were included because of the difficulty in identification. This study excluded all records for fish collected in Lake Erie, inland lakes, and ponds (*i.e.*

¹ For data requests and information about Ohio ECOS, contact Dennis Mishne, Division of Surface Water, Ohio Environmental Protection Agency, 4675 Homer Ohio Lane, Groveport OH 43125.

Table 1. List of Ohio's stream fishes and their frequency of occurrence and relative abundance based on sampling conducted during 1979 through 1995.

FAMILY common name (Scientific Name)	No. Streams ¹	No. Sites ²	Mean Drain. Area ³	Mean Rel. No. ⁴	Max. Rel. No. ⁵	No. Fish ⁶	DOW Status ⁷
CYPRINIDAE (carps and minnows)							
creek chub (<i>Semotilus atromaculatus</i>)	882	3,231	185	154	6,293	513,314	-
bluntnose minnow (<i>Pimephales notatus</i>)	758	3,908	730	109	11,846	522,650	-
central stoneroller (<i>Campeostoma anomalum</i>)	754	3,082	461	185	10,960	650,967	-
striped shiner (<i>Luxilus chrysocephalus</i>)	594	2,558	407	69	1,640	184,725	-
blacknose dace (<i>Rhinichthys atratulus</i>)	545	1,385	92	110	3,524	153,602	-
silvertjaw minnow (<i>Notropis buccatus</i>)	466	1,236	181	43	2,287	46,578	-
common carp (<i>Cyprinus carpio</i>)	438	2,851	2,222	26	2,723	95,019	Non-native
spottin shiner (<i>Cyprinella spiloptera</i>)	373	2,284	1,508	57	5,620	159,199	-
fathead minnow (<i>Pimephales promelas</i>)	343	970	302	59	4,977	46,137	-
sand shiner (<i>Notropis stramineus</i>)	302	1,494	780	51	2,768	80,216	-
golden shiner (<i>Notemigonus crysoleucas</i>)	234	883	851	15	978	10,544	-
southern redbelly dace (<i>Phoxinus erythrogaster</i>)	210	345	12	57	1,077	13,946	-
rosefin shiner (<i>Lythrurus ardens</i>)	198	669	110	49	1,218	22,713	-
silver shiner (<i>Notropis photogenis</i>)	180	982	570	28	1,125	28,940	-
redfin shiner (<i>Lythrurus umbratilis</i>)	173	550	164	31	1,500	15,423	-
common shiner (<i>Luxilus cornutus</i>)	164	516	1,780	135	62	31,607	-
suckermouth minnow (<i>Phenacobius mirabilis</i>)	164	743	1,478	33	1,440	25,898	-
emerald shiner (<i>Notropis atherinoides</i>)	154	893	7,354	61	10,000	76,359	-
rosyface shiner (<i>Notropis rubellus</i>)	145	584	506	33	751	21,735	-
goldfish (<i>Carassius auratus</i>)	143	628	2,034	17	822	9,886	Non-native
common carp x goldfish hybrid	100	494	2,709	6	104	2,334	Non-native
river chub (<i>Nocomis micropogon</i>)	96	461	759	40	825	25,505	-
mimic shiner (<i>Notropis volucellus</i>)	82	283	1,473	22	734	6,308	-
redside dace (<i>Clinostomus elongatus</i>)	67	111	28	23	288	2,184	-
hornyhead chub (<i>Nocomis biguttatus</i>)	59	215	136	25	443	5,042	-
steelcolor shiner (<i>Cyprinella whipplei</i>)	47	281	1,990	20	750	8,474	-
bigeye chub (<i>Notropis amblops</i>)	36	97	730	24	278	2,179	-
rosyside dace (<i>Clinostomus funduloides</i>)	34	71	9	66	606	1,380	Threatened
bullhead minnow (<i>Pimephales vigilax</i>)	31	213	5,592	18	3,000	5,744	-
spottail shiner (<i>Notropis hudsonius</i>)	28	136	5,838	17	500	1,872	-
gravel chub (<i>Erimystax x-punctatus</i>)	21	169	2,881	29	1,260	5,204	-
silver chub (<i>Macrhybopsis storeriana</i>)	15	106	40,940	19	232	2,145	-
bigeye shiner (<i>Notropis boops</i>)	15	28	34	46	528	899	Threatened
ghost shiner (<i>Notropis buchanani</i>)	14	51	3,296	21	480	1,780	-
streamline chub (<i>Erimystax dissimilis</i>)	12	76	1,418	8	64	557	-
bigmouth shiner (<i>Notropis dorsalis</i>)	11	32	43	80	1,262	2,859	Threatened
grass carp (<i>Ctenopharyngodon idella</i>)	10	12	1,742	3	10	16	Non-native
tonguetied minnow (<i>Exoglossum laurae</i>)	7	39	127	15	78	695	Threatened
river shiner (<i>Notropis blennioides</i>)	7	51	35,748	16	404	846	-
longnose dace (<i>Rhinichthys cataractae</i>)	5	14	36	79	225	903	-
channel shiner (<i>Notropis wickliffi</i>)	9	80	51,377	18	182	1,369	-
popeye shiner (<i>Notropis ariommus</i>)	2	8	207	83	408	191	Endangered

Table 1. List of Ohio's stream fishes and their frequency of occurrence and relative abundance based on sampling conducted during 1979 through 1995, con't.

FAMILY common name (Scientific Name)	No. Streams	No. Sites	Mean Drain. Area	Mean Rel. No.	Max. Rel. No.	No. Fish	DOW Status
CYPRINIDAE (carps and minnows), continued.							
pugnose minnow (<i>Opsopoeodus emiliae</i>)	2	6	206	2	8	95	Endangered
speckled chub (<i>Machyobopsis aestivalis</i>)	1	3	39,472	1	1	3	Endangered
blacknose shiner (<i>Notropis heterolepis</i>)	1	2	17	1	1	2	Endangered
Mississippi silvery minnow (<i>Hypognathus nuchalis</i>)	1	1	26	2	2	1	Endangered
CATOSTOMIDAE (suckers)							
white sucker (<i>Catostomus commersoni</i>)	806	3,496	308	62	1,714	258,744	-
northern hog sucker (<i>Hypentelium nigricans</i>)	483	2,464	820	40	1,110	126,181	-
golden redhorse (<i>Moxostoma erythrurum</i>)	335	2,155	2,528	34	624	91,552	-
quillback (<i>Carpoides cyprinus</i>)	171	1,158	4,296	9	407	9,932	-
black redhorse (<i>Moxostoma duquesnei</i>)	157	919	1,598	23	416	23,565	-
spotted sucker (<i>Mintytrema melanops</i>)	154	806	1,553	11	419	9,895	-
silver redhorse (<i>Moxostoma anisurum</i>)	137	937	2,823	11	286	10,918	-
shorthead redhorse (<i>Moxostoma macrolepidotum</i>)	96	793	4,713	21	670	20,460	-
smallmouth buffalo (<i>Ictiobus bubalus</i>)	41	354	12,023	8	171	4,333	-
river carpsucker (<i>Carpoides carpio</i>)	37	396	6,082	19	308	12,228	-
bigmouth buffalo (<i>Ictiobus cyprinellus</i>)	35	165	3,440	4	30	635	-
highfin carpsucker (<i>Carpoides velifer</i>)	35	221	3,573	4	30	614	-
creek chubsucker (<i>Erimyzon oblongus</i>)	33	59	43	7	44	267	-
river redhorse (<i>Moxostoma carinatum</i>)	29	250	6,260	5	36	946	<i>Special Interest</i>
black buffalo (<i>Ictiobus niger</i>)	11	134	11,500	4	22	567	-
greater redhorse (<i>Moxostoma valenciennesi</i>)	6	32	746	7	43	174	<i>Threatened</i>
lake chubsucker (<i>Erimyzon sucetta</i>)	8	8	15	36	160	49	<i>Threatened</i>
blue sucker (<i>Cycleptus elongatus</i>)	4	9	5,170	4	10	31	Endangered
harelip sucker (<i>Lagocheila lacera</i>)	0	0	992	0	0	0	Extinct
CENTRARCHIDAE (sunfishes)							
green sunfish (<i>Lepomis cyanellus</i>)	724	3,639	964	40	2,244	173,676	-
bluegill (<i>Lepomis macrochirus</i>)	635	3,251	2,100	26	906	99,919	-
largemouth bass (<i>Micropterus salmoides</i>)	552	2,707	2,077	11	414	30,364	-
rock bass (<i>Ambloplites rupestris</i>)	382	2,421	1,042	18	619	57,028	-
smallmouth bass (<i>Micropterus dolomieu</i>)	325	2,119	2,470	20	580	53,235	-
longear sunfish (<i>Lepomis megalotis</i>)	298	1,749	2,348	42	613	95,315	-
pumpkinseed (<i>Lepomis gibbosus</i>)	244	1,125	1,144	17	920	21,252	-
white crappie (<i>Pomoxis annularis</i>)	233	1,283	1,441	9	263	9,132	-
black crappie (<i>Pomoxis nigromaculatus</i>)	157	825	2,434	8	700	4,687	-
orangespotted sunfish (<i>Lepomis humilis</i>)	155	920	1,464	17	548	15,400	-
spotted bass (<i>Micropterus punctulatus</i>)	123	689	6,346	21	396	20,595	-
warmouth (<i>Lepomis gulosus</i>)	114	446	1,775	6	71	2,388	-
redear sunfish (<i>Lepomis microlophus</i>)	39	770	2,522	6	85	249	Non-native

Table 1. List of Ohio's stream fishes and their frequency of occurrence and relative abundance based on sampling conducted during 1979 through 1995, continued.

FAMILY common name (Scientific Name)	No. Streams	No. Sites	Mean Drain. Area	Mean Rel. No.	Max. Rel. No.	No. Fish	DOW Status
PERCIDAE (perches)							
johnny darter (<i>Etheostoma nigrum</i>)	647	2,297	203	32	2,600	68,751	-
fantail darter (<i>Etheostoma flabellare</i>)	486	1,436	158	34	968	49,360	-
rainbow darter (<i>Etheostoma caeruleum</i>)	426	1,637	779	46	1,343	72,713	-
greenside darter (<i>Etheostoma blennioides</i>)	421	2,048	638	39	1,071	90,089	-
blackside darter (<i>Percina maculata</i>)	277	1,033	278	9	133	9,083	-
logperch (<i>Percina caprodes</i>)	246	1,347	3,315	10	268	13,926	-
orangethroat darter (<i>Etheostoma spectabile</i>)	195	512	209	34	675	10,798	-
banded darter (<i>Etheostoma zonale</i>)	180	858	947	24	1,311	22,082	-
yellow perch (<i>Perca flavescens</i>)	90	397	1,400	9	291	3,254	-
walleye (<i>Stizostedion vitreum</i>)	56	240	5,973	4	50	747	-
sauger (<i>Stizostedion canadense</i>)	53	376	10,711	11	255	6,814	-
sauger x walleye (<i>S. canadense</i> x <i>S. vitreum</i>)	49	358	3,201	9	191	2,869	-
variegate darter (<i>Etheostoma variatum</i>)	40	171	993	40	462	6,655	-
slender darter (<i>Percina sciera</i>)	37	103	1,772	6	62	551	-
duskyhead darter (<i>Percina phoxocephala</i>)	16	90	12,096	5	31	572	-
eastern sand darter (<i>Ammocrypta pellucida</i>)	15	43	3,978	5	30	248	-
bluebreast darter (<i>Etheostoma camurum</i>)	10	51	1,577	11	90	497	-
least darter (<i>Etheostoma microperca</i>)	9	28	17	52	470	455	-
river darter (<i>Percina shumardi</i>)	5	30	60,951	10	50	251	-
Tippicanoe darter (<i>Etheostoma tippicanoe</i>)	6	36	1,272	10	72	362	-
channel darter (<i>Percina copelandi</i>)	3	31	57,298	4	36	110	-
Iowa darter (<i>Etheostoma exile</i>)	3	3	50	2	2	5	-
spotted darter (<i>Etheostoma maculatum</i>)	3	5	545	11	30	105	-
longhead darter (<i>Percina macrocephala</i>)	0	0	1,505	0	0	0	-
gilt darter (<i>Percina evides</i>)	0	0	52,800	0	0	0	-
crystal darter (<i>Ammocrypta asprella</i>)	0	0	33,798	0	0	0	-
ICTALURIDAE (catfishes)							
yellow bullhead (<i>Ameiurus natalis</i>)	536	2,159	332	11	366	25,637	-
black bullhead (<i>Ameiurus melas</i>)	286	695	353	7	373	3,838	-
brown bullhead (<i>Ameiurus nebulosus</i>)	180	576	731	18	2,300	4,218	-
channel catfish (<i>Ictalurus punctatus</i>)	164	1,303	5,055	13	336	19,841	-
stonecat (<i>Noturus flavus</i>)	145	584	721	7	192	4,466	-
brindled madtom (<i>Noturus miurus</i>)	71	217	533	6	73	1,268	-
tadpole madtom (<i>Noturus gyrinus</i>)	58	172	239	6	53	901	-
flathead catfish (<i>Pylodictis olivaris</i>)	43	482	10,283	5	48	2,416	-
mountain madtom (<i>Noturus eleutherus</i>)	5	14	5,114	45	306	541	-
northern madtom (<i>Noturus stigmosus</i>)	5	11	3,841	7	23	305	-
white catfish (<i>Ameiurus catus</i>)	1	1	3,190	2	2	1	-
blue catfish (<i>Ictalurus furcatus</i>)	1	1	69,476	2	2	1	-
Scioto madtom (<i>Noturus trautmani</i>)	0	0	554	0	0	0	-

Table 1. List of Ohio's stream fishes and their frequency of occurrence and relative abundance based on sampling conducted during 1979 through 1995, continued.

FAMILY common name (Scientific Name)	No. Streams	No. Sites	Mean Drain. Area	Mean Rel. No.	Max. Rel. No.	No. Fish	DOW Status
CLUPEIDAE (herrings)							
gizzard shad (<i>Dorosoma cepedianum</i>)	272	1,972	3,674	105	19,998	288,499	-
alewife (<i>Alosa pseudoharengus</i>)	12	26	2,865	7	100	63	Non-native
skipjack herring (<i>Alosa chrysochloris</i>)	11	112	31,872	8	109	851	-
threadfin shad (<i>Dorosoma petenense</i>)	4	12	41,767	2	6	17	Non-native
ESOCIDAE (pikes)							
grass pickerel (<i>Esox americanus vermiculatus</i>)	237	926	225	8	126	7,962	-
northern pike (<i>Esox lucius</i>)	58	222	575	3	27	536	-
muskellunge (<i>Esox masquinongy</i>)	15	33	1,070	3	6	67	Special Interest
northern pike x muskellunge hybrid	5	6	5,999	3	5	12	Non-native
COTTIDAE (sculpins)							
mottled sculpin (<i>Cottus bairdi</i>)	228	590	130	87	2,260	51,613	-
CYPRINODONTIDAE (killifishes)							
blackstripe topminnow (<i>Fundulus notatus</i>)	156	539	209	35	1,490	11,733	-
eastern banded killifish (<i>F. diaphanus diaphanus</i>)	5	11	2,099	43	268	233	Non-native
western banded killifish (<i>F. diaphanus menona</i>)	4	8	32	11	14	80	Endangered
UMBRIDAE (mudminnows)							
central mudminnow (<i>Umbra limi</i>)	119	281	71	19	1,242	4,722	-
ATHERINIDAE (silversides)							
brook silverside (<i>Labidesthes sicculus</i>)	117	462	2,070	12	768	3,963	-
SCIAENIDAE (drums)							
freshwater drum (<i>Aplodinotus grunniens</i>)	114	833	7,321	24	1,193	26,170	-
PERCOPSIDAE (trout-perches)							
trout-perch (<i>Percopsis omiscomaycus</i>)	90	310	546	17	411	4,598	-
PETROMYZONTIDAE (lampreys)							
least brook lamprey (<i>Lampetra aepyptera</i>)	88	156	85	8	104	1,233	-
American brook lamprey (<i>Lampetra appendix</i>)	33	94	631	16	285	1,219	-
silver lamprey (<i>Ichthyomyzon unicuspis</i>)	14	50	21,038	2	10	79	-
sea lamprey (<i>Petromyzon marinus</i>)	11	98	2,988	3	8	1,108	Non-native
northern brook lamprey (<i>Ichthyomyzon fossor</i>)	11	16	21	14	23	61	Endangered
mountain brook lamprey (<i>Ichthyomyzon greeleyi</i>)	3	9	376	23	78	123	Endangered
Ohio lamprey (<i>Ichthyomyzon bdellium</i>)	2	6	26,698	1	2	3	Endangered

Table 1. List of Ohio's stream fishes and their frequency of occurrence and relative abundance based on sampling conducted during 1979 through 1995, continued.

FAMILY common name (Scientific Name)	No. Streams	No. Sites	Mean Drain. Area	Mean Rel. No.	Max. Rel. No.	No. Fish	DOW Status
PERCICHTHYIDAE (temperate basses)							
white bass (<i>Morone chrysops</i>)	69	552	10,246	12	1,268	8,061	-
white perch (<i>Morone americana</i>)	33	169	2,991	40	3,500	5,555	Non-native
white x striped bass (<i>M. chrysops</i> x <i>M. saxatilis</i>)	12	57	37,454	7	33	397	Non-native
striped bass (<i>Morone saxatilis</i>)	4	34	61,686	6	43	203	Non-native
GASTEROSTEIDAE (sticklebacks)							
brook stickleback (<i>Culaea inconstans</i>)	69	132	29	28	805	3,432	-
threespine stickleback (<i>Culaea aculeatus</i>)	1	1		1	1	1	Non-native
LEPISOSTEIDAE (gars)							
longnose gar (<i>Lepisosteus osseus</i>)	46	328	9,955	4	123	1,352	-
shortnose gar (<i>Lepisosteus platostomus</i>)	3	5	13,443	3	8	11	Endangered
alligator gar (<i>Lepisosteus spatula</i>)	0	0	69,344	0	0	0	Extirpated
AMIIDAE (bowfins)							
bowfin (<i>Amia calva</i>)	28	91	4,875	4	24	269	-
SALMONIDAE (trouts)							
rainbow trout (<i>Oncorhynchus mykiss</i>)	26	91	1,137	14	426	1,052	Non-native
brown trout (<i>Salmo trutta</i>)	15	49	112	14	90	696	Non-native
brook trout (<i>Salvelinus fontinalis</i>)	8	8	0.3	2	10	151	<i>Threatened</i>
coho salmon (<i>Oncorhynchus kisutch</i>)	7	12	1,281	13	103	66	Non-native
chinook salmon (<i>Oncorhynchus tshawytscha</i>)	1	2		4	4	15	Non-native
HIODONTIDAE (mooneyes)							
mooneye (<i>Hiodon tergisus</i>)	8	110	23,704	4	18	321	<i>Special Interest</i>
goldeye (<i>Hiodon alosoides</i>)	2	3	22,541	2	4	4	Endangered
ANGUILLIDAE (freshwater eels)							
American eel (<i>Anguilla rostrata</i>)	8	8	2,654	2	2	8	<i>Threatened</i>
OSMERIDAE (smelts)							
rainbow smelt (<i>Osmerus mordax</i>)	5	6	4,629	2	3	8	Non-native
POECILIIDAE (livebearers)							
western mosquitofish (<i>Gambusia affinis</i>)	4	4	4,821	3	5	6	Non-native

Table 1. List of Ohio's stream fishes and their frequency of occurrence and relative abundance based on sampling conducted during 1979 through 1995, continued.

FAMILY common name (Scientific Name)	No. Streams	No. Sites	Mean Drain. Area	Mean Rel. No.	Max. Rel. No.	No. Fish	DOW Status
POLYODONTIDAE (paddlefish) paddlefish (<i>Polyodon spathula</i>)	5	10	68,263	1	1	50	<i>Threatened</i>
GOBIIDAE (gobies) round goby (<i>Neogobius melanostomus</i>)	1	1	10,000	4	4	2	Non-native
APHREDODERIDAE (pirate perch) pirate perch (<i>Aphredoderus sayanus</i>)	0	0	110	0	0	0	Endangered
GADIDAE (cods) burbot (<i>Lota lota</i>)	1	1	705	1	1	1	<i>Special Interest</i>
ACIPENSERIDAE (sturgeons) lake sturgeon (<i>Acipenser fulvescens</i>) shovelnose sturgeon (<i>Scaphirhynchus platyrhynchus</i>)	0 0	0 0	61,176 68,219	0 0	0 0	0 0	Endangered Endangered

¹ Total number of different streams in which each species was collected (e.g. Ohio River, Clear Creek).

² Total number of different sites/locations at which each species was collected.

³ This value is a measure of the average size of stream collected from based on the average of the drainage area (square miles) of each collection site/location. OEPA uses drainage area instead of stream order for biological criteria calculations.

⁴ The mean relative number is the average number of fish collected electrofishing a distance of 1.0 kilometer (km) using the boat method and 0.3 km using the wading method. It is OEPA's average catch-per-unit-effort (CPUE) based on the number collected per standardized distance electrofished.

⁵ The maximum relative abundance is the highest relative abundance/CPUE for each species (see above).

⁶ The total number of individual fish collected during 1979 through 1995.

⁷ The current Ohio Department of Natural Resources, Division of Wildlife Conservation Status. **Endangered** denotes a native species or subspecies threatened with statewide extirpation. *Threatened* denotes a species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists. Continued or increased stress will result in its becoming endangered. *Special Interest* denotes a species or subspecies which might become threatened in Ohio under continued or increased stress or for which there is concern, but adequate information does not exist to determine its status. **Extirpated** denotes a species or subspecies that occurred in Ohio at the time of European settlement and has since disappeared from the state. **Extinct** denotes a species or subspecies that occurred in Ohio at the time of European settlement and has since disappeared from its entire range. Non-native denotes a species, subspecies, or hybrid that did not occur in Ohio at the time of European settlement, but has since invaded or been introduced into Ohio.

Table 1 is not a complete list of Ohio fishes). Incidental catches from streams (e.g. whitetail shiner, *Cyprinella galactura*, and pacu, *Colossoma spp.*) during this study period were also excluded.

Although the authors are aware of recent changes in fish nomenclature, nomenclature follows Robins *et al.* (1991) for consistency. Subspecies listed by Trautman (1981) such as the northern and Ohio shorthead redhorse (*Moxostoma macrolepidotum macrolepidotum* and *Moxostoma macrolepidotum breviceps*, respectively) were not included except for the western and eastern banded killifish (*Fundulus diaphanus menona* and *Fundulus diaphanus diaphanus*, respectively) due to the western banded killifish's status as a state endangered species (ODOW, 1998). The listing order for species in Table 1 was completed by starting with the species collected in the most streams followed by all other species in that family in descending order followed by the next most frequently occurring species based on the total number of streams until all other stream species were accounted for. All other Ohio fish species previously reported in a stream by Trautman (1981) were also included for a historical perspective.

Results

The study revealed 13,164 fish collections from 4,919 sites were made in 961 Ohio streams during 1979 through 1995. A total of 4,792,712 fish of 153 species (26 families) were captured (Table 1). The most frequently occurring species (percent of 961 streams) were creek chub, *Semotilus atromaculatus* (91.6%), white sucker, *Catostomus commerson* (83.8%), bluntnose minnow, *Pimephales notatus* (78.9%), central stoneroller, *Campostoma anomalum* (78.4%), green sunfish, *Lepomis cyanellus* (75.4%), and johnny darter, *Etheostoma nigrum* (67.1%).

The most abundant species (percent of total catch) were central stoneroller (13.6%), bluntnose minnow (10.9%), creek chub (10.7%), gizzard shad, *Dorosoma cepedianum* (6.0%), and white sucker (5.4%). The species with the highest catch-per-unit-effort (CPUE) based on mean relative number² were gizzard shad (19,998), bluntnose minnow (11,846), and central stoneroller (10,960).

Species inhabiting the smallest streams (based on mean drainage area) were brook trout, *Salvelinus fontinalis*, rosyside dace, *Clinostomus funduloides*, and southern redbelly dace, *Phoxinus erythrogaster* (0.3, 9 and 12 sq. mi., respectively). Species inhabiting the largest streams were blue catfish, *Ictalurus furcatus*, paddlefish, *Polyodon spathula*, and river darter, *Percina shumardi* (> 60,000 sq. mi.). Because Ohio has more small streams than large streams, species inhabiting small streams tended to be collected more frequently than species inhabiting large streams. For example, creek chub with a mean drainage area of 185 square miles, were collected from 882 streams whereas longnose gar, *Lepisosteus osseus*, with a mean drainage area of 9,955 square miles, were collected from only 46 streams.

This study showed that nine historically occurring (in streams) fish species were not collected from any Ohio stream during the 1979 through 1995 period. The last reported stream collections for these species were harelip sucker, *Lagochila lacera* (Blanchard and Auglaize rivers in 1893); longhead darter, *Percina macrocephala* (Walhonding River in 1939); gilt darter, *Percina evides* (Maumee River in 1893); crystal darter, *Ammocrypta asprella* (Ohio River in 1899); Scioto madtom, *Noturus trautmani* (Big Darby Creek in 1957); alligator gar, *Lepisosteus spatula* (Ohio River in 1946); pirate perch, *Aphredoderus sayanus* (Auglaize River in 1942)³; lake sturgeon, *Acipenser fulvescens* (Ohio River in 1971); and shovelnose sturgeon, *Scaphirhynchus platyrhynchus* (Ohio River in 1939). The results of this study were used to revise the current status of Ohio's endangered, threatened, and special interest fish species. These revisions are listed in Table 1 (ODOW, 1998).

Discussion

Of the 162 fish species recorded from Ohio streams (Table 1), 143 are native (nine were not captured during the 1979 through 1995 study period) and 19 are nonnative. The results of this study along with observations by the authors show that the distribution and abundance of some fish species have increased, while others appear stable, and some have apparently decreased. Species that have expanded their range or returned to their pre-1955 distribution (Trautman, 1981) include many native large stream fishes such as the blue sucker, *Cycleptus elongatus*, greater redhorse, *Moxostoma valenciennesi*, river

² The mean relative number is the average number of fish (used here by species) collected electrofishing a distance of 1.0 kilometer (km) using the boat method and 0.3 km using the wading method. It is OEPA's average catch-per-unit-effort (CPUE) based on the number collected per standardized distance electrofished.

³ A re-introduction project by the ODOW is currently underway in the Auglaize River.

redhorse, *Moxostoma carinatum*, slenderhead darter, *Percina phoxocephala*, and channel darter, *Percina copelandi*. These increases are primarily attributed to improved water quality as the result of reduced pollutant loadings from point source discharges; however, the use of electrofishing gear and more intense field sampling has also added new records.

A number of non-native fishes such as the white perch, *Morone americana*, and goldfish, *Carassius auratus*, have also markedly expanded their distribution in streams. Although rosyside dace, *Clinostomus funduloides*, and longnose dace, *Rhinichthys cataractae*, have increased distributions as the result of more intense sampling, many species that inhabit small streams continue to decline due to the degradation of habitat resulting from excessive sedimentation, encroachment, culverting, channelization, suburbanization and other forms of hydromodification. One such species, the blacknose shiner, *Notropis heterolepis*, appears to have been recently extirpated. Another sensitive small stream species, the bigeye chub, *Notropis amblops*, continues to decline. Changes in occurrence and abundance for other Ohio stream fishes are also evident when data presented in Table 1 is compared with Trautman (1981).

Future changes in the distribution and abundance of Ohio stream fishes are dependant on the ability of environmental and natural resource managers not only to protect and restore water quality through successful point and nonpoint source pollution control programs, but the protection and restoration of stream habitats (e.g. protect and restore riparian forests, natural floodplains and wetlands; reduce sedimentation; remove dams; exclude livestock; other activities conducive to diverse, free-flowing habitats) as well.

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