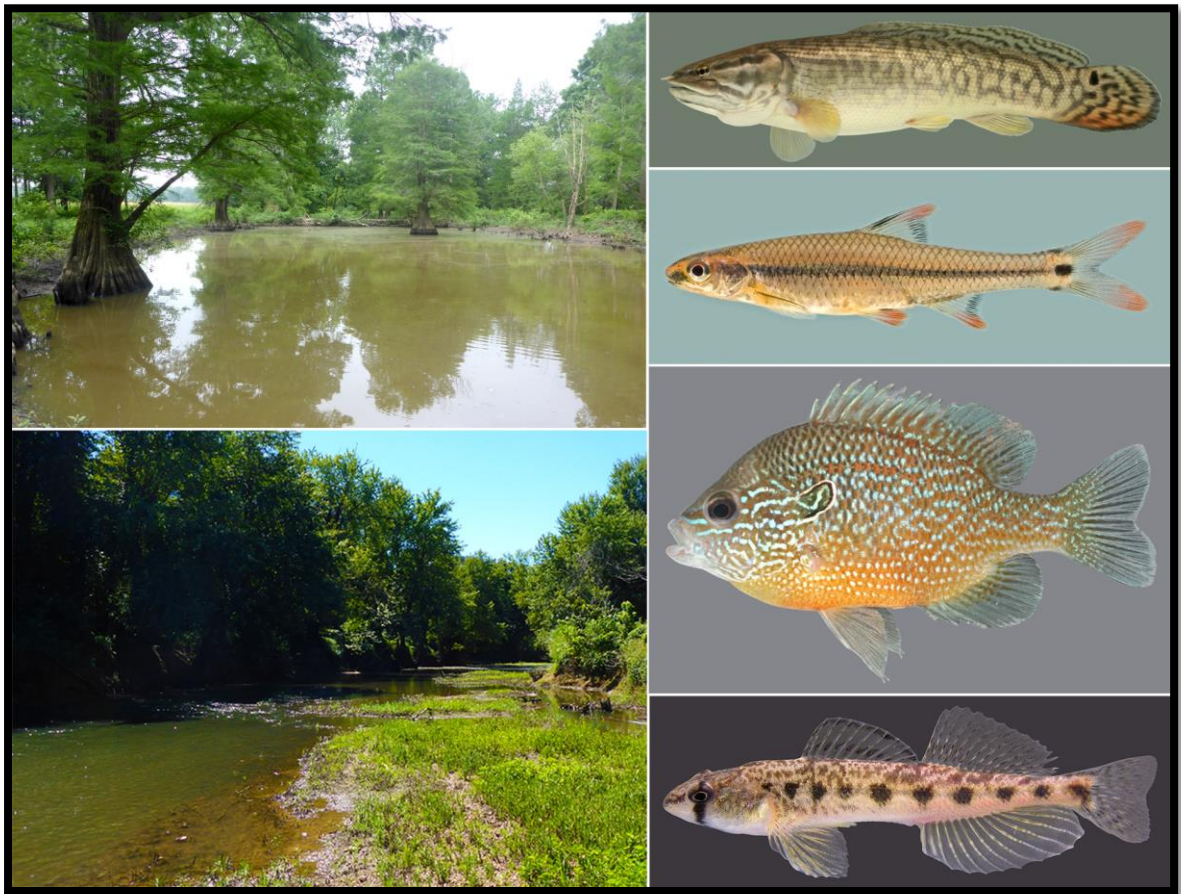


Survey and Assessment of the Fish Fauna of the Clarks River National Wildlife Refuge in Marshall, McCracken, and Graves Counties, Kentucky

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Dunn Slough Creek pond (above); Clarks River below Bryant Ford Rd. (below). Right top to bottom: Bowfin, (*Amia calva*), Taillight Shiner (*Notropis maculatus*), Dollar Sunfish (*Lepomis marginatus*), and Saddleback Darter (*Percina vigil*).

EXECUTIVE SUMMARY

1. Prior fish collection data from the Clarks River drainage were compiled and reviewed to produce a comprehensive list of species by watershed unit. We accept records as valid (confirmed) or reasonable (unconfirmed but possible) for 107 species in the entire drainage. This diversity is distributed among the lower mainstem (52 species), Clarks River including East and Middle forks (86 species), and West Fork (79 species).
2. No federally listed fish species are present in the Clarks River drainage, but 15 are considered rare or of conservation concern at the state level. Five exotic species occur or have occurred in the drainage.
3. Between 3 August and 15 June 2016, fish collections were made from 32 sites in the Clarks River and West Fork Clarks River drainages within the Clarks River NWR and proposed expansion area boundary. Sites were distributed in Riverine and Palustrine Systems to include all aquatic habitat types and representative fish species.
4. Our sampling effort produced a total of 79 species in 18 families, representing 74% of the species known from the entire Clarks River drainage and 40% of the lower Tennessee River basin fish fauna. The Clarks River upstream of the West Fork had the highest diversity (63 species), followed by the West Fork (62 species) and lower mainstem (32 species).
5. Two species, Striped Shiner and Yellow Perch, were collected for the first time in the Clarks River drainage. Multiple new occurrence localities within the Clarks River drainage are reported for 15 additional species.
6. Five state-listed (at-risk) species were present within the study area: Taillight Shiner (1 site), Black Buffalo (2 sites), Central Mudminnow (4 sites), Dollar Sunfish (7 sites), and Cypress Darter (8 sites). Multiple new occurrence localities were documented for Central Mudminnow, Dollar Sunfish, and Cypress Darter.
7. Three exotic species were collected: Common Carp, Grass Carp, and Silver Carp. Multiple new occurrence localities were documented for Grass Carp and Silver Carp. High densities of young-of-year observed at multiple locations indicate successful reproduction in both species within the Clarks River and West Fork Clarks River drainages.
8. Fish community health at three mainstem Clarks River sites was evaluated using the KIBI based on 2000 and 2015 data. KIBI scores and rankings at sites (9 and 19) were consistent (“Good”) suggesting temporal stability; however, a discrepancy at Site 3 (“Fair” in 2000, vs. “Excellent” in 2015) could reflect greater habitat disturbance and instability over time resulting in temporal variability in fish assemblage structure.
9. We agree with and reiterate recommendations proposed by Alexander (2005) to enhance and maintain environmental quality in the Clarks River NWR. Additionally, we emphasize the need for continued long-term research programs on fish communities aimed at inventories of abundance and distribution, ecosystem recovery, and riparian-riverine interactions.

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INTRODUCTION

The lower Tennessee River basin is one of the most biologically diverse river systems in the U.S., with nearly 200 species of fish, 75 freshwater mussels, 50 aquatic snails, and 20 crayfish (Woodside et al. 2004). The Clarks River drainage, a major tributary system in the lower Tennessee River basin, occupies nearly a quarter of the Jackson Purchase Region in western Kentucky. It is a low-gradient system consisting of two major forks that meander through a broad floodplain containing areas of contiguous bottomland hardwood forest, wetland complexes, overflow ponds, and meander cut-offs formed by the Clarks River. These natural palustrine systems provide excellent fish and wildlife habitat for both game and non-game species. Because of the significant resource value of this area, the U.S. Fish and Wildlife Service (USFWS) established the Clarks River National Wildlife Refuge (NWR) in 1997. The approximately 9,000 acre refuge is located in portions of Marshall, McCracken, and Graves counties. In addition to the land acquired in 1997, the USFWS has proposed an expansion area that includes 40 river miles and adds approximately to the existing acquisition boundary. A comprehensive conservation and land protection plan for the Clarks River NWR was completed in 2012 (U.S. Fish and Wildlife Service 2012).

The fish fauna of the Clarks River drainage was poorly known prior to a survey by Sisk (1969) who documented 61 species from the drainage. Kuhajda and Warren (1985) conducted an extensive review of published and unpublished collection records made prior to and subsequent to Sisk's (1969) survey, including additional collections made personally, which resulted in 87 total species for the Clarks River drainage. In their review of collection records for the Distributional Atlas of Kentucky Fishes, Burr and Warren (1986) confirmed reports of at least 79 species of fish from the Clarks River drainage based on voucher specimens maintained in various museum collections and unquestionable literature records.

Although most of the Clarks River fish fauna is extant, 15 species are considered at-risk or of conservation concern at the state level (Kentucky's Wildlife Conservation Strategy 2013; Kentucky State Nature Preserves Commission 2012). These species include Chestnut Lamprey (*Ichthyomyzon castaneus*), Southern Brook Lamprey (*Ichthyomyzon gagei*), Paddlefish (*Polyodon spathula*), American Eel (*Anguilla rostrata*), Cypress Minnow (*Hybognathus hayi*), Pallid Shiner (*Hybopsis amnis*), Taillight Shiner (*Notropis maculatus*), Black Buffalo (*Ictiobus niger*), Chain Pickerel (*Esox niger*), Central Mudminnow (*Umbra limi*), Mississippi Silverside (*Menidia audens*), Dollar Sunfish (*Lepomis marginatus*), Goldstripe Darter (*Etheostoma proeliare*), and Cypress Darter (*Etheostoma proeliare*). The Alligator Gar (*Atractoseus spatula*), a species once native to big river floodplain habitats in the Jackson Purchase, has been introduced in the lower mainstem Clarks River by the Kentucky Department of Fish and Wildlife Resources since 2009.

Since 1986, numerous fish collections have been made in the Clarks River drainage by various state and federal natural resource agencies and universities. In 2000 and 2002, a fish survey was conducted within the Clarks River NWR in conjunction with an environmental contaminants investigation (Alexander 2005). That study involved fish community sampling at seven sites in the Clarks River (five within the refuge) documenting a total of 54 species. A large volume of data collected during the past three decades, including Alexander's (2005) work, has not been reviewed and compiled to produce an accurate, up-to-date list of fishes currently existing in the Clarks River drainage.

OBJECTIVES

1. Compile and verify existing fish collection data on the Clarks River drainage from all available sources.
2. Conduct fish surveys to determine species composition, abundance, and distributions at sites sampled during 2000-2002 and assess changes to the fauna during the past 15 years.
3. Further expand the area sampled in 2000-2002 to cover any unique or significant habitats and associated species potentially missed or not present during the previous survey.
4. Establish a credible species list, expand upon the current data set, and provide recommendations for future monitoring of the fish community within the Clarks River NWR.
5. Assess fish community structure, habitat conditions, and conservation status of at-risk fish species.

STUDY AREA

The Clarks River is the largest tributary of the Tennessee River in Kentucky. The entire watershed drains 546 sq mi and is divided into two major branches, the Clarks River (East and Middle Forks) and West Fork Clarks River. The Clarks River and West Fork Clarks River upstream of the Graves-McCracken County line lies within the Mississippi Valley Loess Plains ecoregion. This is a productive agricultural area that is composed of gently rolling uplands and broad bottomlands mantled by thick loess and alluvium, and underlain by weak, unconsolidated coastal plain sediments (Woods et al. 2002).

The headwaters of the Clarks River (East Fork) originate in Henry County, Tennessee and join the Middle Fork in southern Calloway County, Kentucky. From there it drains north for 66.7 river miles through portions of Calloway, Marshall and McCracken counties. The West Fork Clarks River arises near Lynn Grove, Calloway County and flows northward for approximately 38 river miles through Marshall, Graves, and McCracken counties to its confluence with the Clarks River near Oaks in McCracken County. The middle and headwater reaches of the Clarks River drainage have definite upland features, but near the Calloway-Marshall county line, both the East and West forks enter a broad floodplain with numerous meander cut-offs, overflow pools, and spring-fed wetlands along their lower reaches (Burr and Warren 1986).

The focal area of our survey is the Clarks River NWR, including riverine, tributary, and wetland habitats within the existing refuge and expansion area (Figure 1). This area includes a 40-mile section of the Clarks River from KY 3075 (Sheehan Bridge), McCracken County, upstream to Hardin, Marshall County. It also includes an 18-mile section of the West Fork Clarks River from its mouth near Oaks, McCracken County, upstream to the Purchase Parkway, Graves County. Kaler Bottoms Wildlife Management area, a 1,832 acre tract containing wetland and cypress swamp habitat is also located within this section of the refuge expansion area.

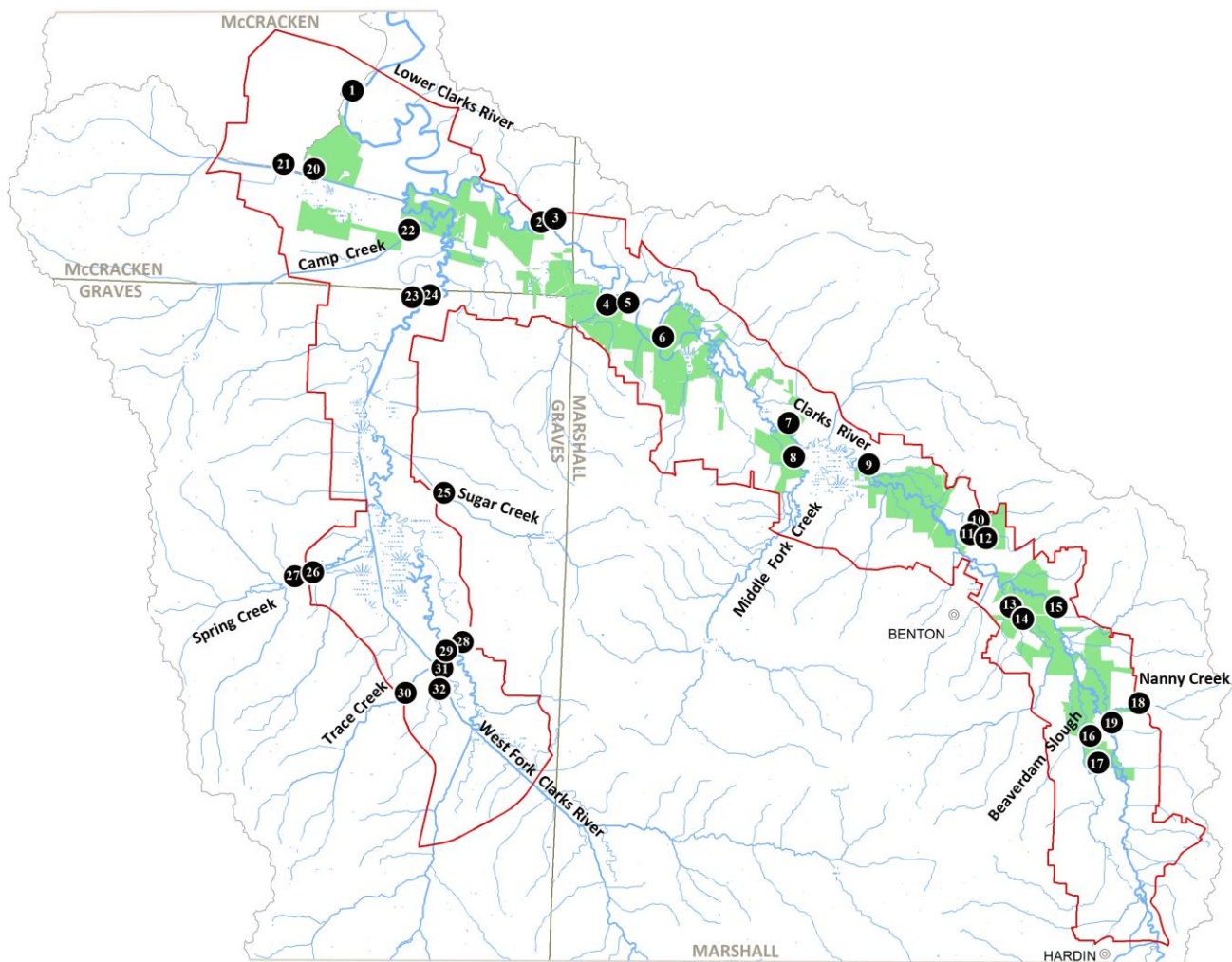


Figure 1. Sites sampled for fishes in the Clarks River drainage within or near the refuge (light green) and expansion area (red line) during 2015-2016. Site numbers correspond to Tables 3-4.

METHODS

To assess prior fish sampling effort within the Clarks River drainage, we obtained fish collection data from the Kentucky Fish and Wildlife Information System (KFWIS), Ecological Data Application System (EDAS), and online searchable natural history museum databases. These databases contain fish collection records from state and federal agencies, academic institutions, and private consultants. Fish sampling sites were chosen within the study area (Figure 1) based, in part, on refuge-specific fish collection records by Alexander (2005). Additional sites were chosen arbitrarily based on accessibility, stream or water body size, location in the drainage, and proximity to one another.

Field sampling was conducted during August and September 2015, and in June 2016. Fish collection methods were selected to capture the greatest number of species in all representative habitat types within the study area. Small to large wadeable stream habitats, including sites sampled by Alexander (2005), were sampled following protocols established by KY Division of Water (KDOW 2002). Fishes were collected using a backpack electrofisher, dip nets, and 6' X 10' or 6' X 15' (1/8" mesh) seines. At each stream site, all habitats within a 100-200m reach were worked thoroughly to ensure a representative sample. Electrofishing was performed for 500-2000 seconds, depending on the size of the stream or water body and available habitat. In larger streams, sloughs, ponds, and wetlands, electrofishing was followed by 10-20 seine hauls/sets to effectively work the same area and available habitat. Deep channel and pooled sections of the lower mainstem Clarks River (Site 1) and the pond behind the Clarks River NWR headquarters (Site 11) were sampled using boat electrofishing. Fish community health at three sites sampled during September-October 2000 by Alexander (2005) was evaluated using the Kentucky Index of Biotic Integrity (KIBI; Compton et al. 2003).

Most fish captured were identified on site, enumerated, photo-vouchered, and released. A limited number of representative specimens were retained as vouchers that were fixed in 10% formalin, and then transferred to 70% ethanol. These specimens will be archived at the Kentucky Department of Fish and Wildlife Resources (KDFWR), Frankfort. For each rare or exotic species collected, gender (when possible), total lengths (when >20 individuals), and habitat conditions were recorded. Digital photographs were also taken to document species and habitats at all sample sites.

RESULTS AND DISCUSSION

We compiled and reviewed 3,028 fish collection records from the Clarks River drainage spanning a period from 1942-2014 (Table 1). These records revealed a total of 107 species known to occur or have occurred in the Clarks River drainage (Table 2). This diversity is distributed among the Clarks River (including East and Middle forks; 86 species), West Fork (79 species), and lower mainstem Clarks River below the mouth of the West Fork (52 species). Specimen vouchers were available for 1,136 records, which were verified by Burr and Warren (1986) or personal examination. These voucher records are available from the following natural history museum databases: Southern Illinois University Carbondale, Illinois Natural History Survey, University of Michigan Museum of Zoology, Morehead State University, University of Alabama Ichthyological Collection, Cornell University Museum of Vertebrate Zoology, University of Kansas, North Carolina State Museum of Natural History, Tulane University, Yale Peabody Museum, and University of Tennessee David A. Etnier Ichthyological Collection. An additional 1,892 records, for which voucher specimens were unavailable, were reviewed and judged to be reasonable. We were able to substantiate records for some species in our 2015 field survey effort; however, voucher specimens or photos of other species are still needed for verification.

During August and September 2015, and in June 2016, fish community collections were

made from 32 sites in the Clarks River drainage within the existing refuge and proposed expansion area (Tables 3-4 Figure 1). Prior fish community data collected by Alexander (2005) were available for three of these sites for comparison. Each site was classified by habitat type (i.e., Palustrine and Riverine) based on the framework and definitions described by Cowardin et al. (1979), Burr and Warren (1986), and Alexander (2005). Sites representing each of the different habitat types sampled for fishes are shown in Figures 2-3. Habitat characteristics and water quality variables for each site are summarized in Table 4. Each site was sampled once using KDOW (2002) protocols (17 riverine sites) or qualitatively using methods to capture all species within a given area (15 palustrine sites). The lower mainstem Clarks River (Site 1) was sampled using boat electrofishing only; the refuge office pond (Site 11) was sampled using boat electrofishing and seining along the margins in two separate events. Photos and sites occurrences of all fish species captured are included in Appendix 1. Complete fish community data, including metrics for calculating a Kentucky Index of Biotic Integrity (KIBI) for these sites are included in Appendix 2. All fish sample data from boat electrofishing are treated as qualitative (presence/absence). Below is a synopsis of fish community composition and distribution, with an emphasis on rare or at-risk native species and exotic species.

Table 1. Fish collection records by source compiled and reviewed to produce the list in Table 2.

Data Source	Records	Years	Vouchers
KYTC DEA stream surveys	70	1980-1982	unknown
EDAS (KDOW, KDFWR, USFWS, Murray St. Univ)	894	1988-2012	unknown
KDFWR stream surveys	461	1980-1986	unknown
KSNPC (multiple sources)	27	1965-2007	unknown
Scientific collection permit (multiple sources)	440	2004-2014	unknown
SIUC database (SIUC, INHS, MOSU, UMMZ)	873	1942-2005	all vouchered
VertNet (UAIC, CUMV, KU, NCSM, TU, YPM)	191	1953-2010	all vouchered
UTK David A. Etnier Ichthyological Collection	72	1978-2010	all vouchered

Table 2. Comprehensive list of fishes reported from the Clarks River drainage based on records from 1942-2014, as well as current (2015-2016) survey effort: 1) museum vouchers; 2) non-vouchered records needing verification; 3) verified through current survey. Status: N=native; I=introduced; EXO=exotic; EP=presumed extirpated. Rare species are in bold print.

Scientific Name	Common Name	Lower Mainstem	Clarks River	West Fork	Status
<i>Ichthyomyzon castaneus</i>	Chestnut Lamprey			2	N
<i>Ichthyomyzon gagei</i>	Southern Brook Lamprey			1	EP
<i>Lampetra aepyptera</i>	Least Brook Lamprey			1	N
<i>Polyodon spathula</i>	Paddlefish	1,2			N
<i>Atractosteus spatula</i>	Alligator Gar	1			N,I
<i>Lepisosteus oculatus</i>	Spotted Gar	2,3	1,3	1,3	N
<i>Lepisosteus osseus</i>	Longnose Gar	1,2,3	1		N
<i>Lepisosteus platostomus</i>	Shortnose Gar	1,2,3	3	2,3	N
<i>Amia calva</i>	Bowfin	2,3	3	1,3	N
<i>Hiodon alosoides</i>	Goldeye	1,2,3			N
<i>Anguilla rostrata</i>	American Eel	1			N
<i>Alosa chrysochloris</i>	Skipjack Herring	1,2,3			N
<i>Dorosoma cepedianum</i>	Gizzard Shad	1,2,3	1,2,3	1	N
<i>Dorosoma petenense</i>	Threadfin Shad	1,2			N
<i>Campostoma oligolepis</i>	Largescale Stoneroller		1,2,3	1,3	N
<i>Carassius auratus</i>	Goldfish		1		EXO
<i>Ctenopharyngodon idella</i>	Grass Carp	2,3	3	3	EXO
<i>Cyprinella lutrensis</i>	Red Shiner		3	1,3	N
<i>Cyprinella spiloptera</i>	Spotfin Shiner	2	2	2	N
<i>Cyprinella whipplei</i>	Steelcolor Shiner	1	1,2,3	1,2,3	N
<i>Cyprinus carpio</i>	Common Carp	1,2,3	1,3	1,2,3	EXO
<i>Hybognathus hayi</i>	Cypress Minnow			1	N
<i>Hybognathus nuchalis</i>	Mississippi Silvery Minnow		1,2,3	1,3	N
<i>Hybopsis amnis</i>	Pallid Shiner		1		EP
<i>Hypophthalmichthys molitrix</i>	Silver Carp	2,3	3	3	EXO
<i>Hypophthalmichthys nobilis</i>	Bighead Carp	2			EXO
<i>Luxilus chrysocephalus</i>	Striped Shiner			3	N
<i>Lythrurus fumeus</i>	Ribbon Shiner		1,2,3	1,3	N
<i>Lythrurus umbratilis</i>	Redfin Shiner		1,2,3	1,2,3	N
<i>Macrhybopsis storeriana</i>	Silver Chub			1	N
<i>Notemigonus crysoleucas</i>	Golden Shiner	1	1,2,3	1,3	N
<i>Notropis atherinoides</i>	Emerald Shiner	1,3	1,2,3	1	N
<i>Notropis boops</i>	Bigeye Shiner		1,2,3	1,3	N
<i>Notropis maculatus</i>	Taillight Shiner		3	1	N
<i>Notropis volucellus</i>	Mimic Shiner		3	1,3	N
<i>Opsopoeodus emiliae</i>	Pugnose Minnow		1,2	1	N
<i>Phenacobius mirabilis</i>	Suckermouth Minnow		1,2	1	N
<i>Pimephales notatus</i>	Bluntnose Minnow		1,2,3	1,2,3	N
<i>Pimephales promelas</i>	Fathead Minnow		1		N
<i>Pimephales vigilax</i>	Bullhead Minnow	3	1,3	1,3	N
<i>Semotilus atromaculatus</i>	Creek Chub	1	1,3	1,3	N

Table 2. Continued.

Scientific Name	Common Name	Lower Mainstem	Clarks River	West Fork	Status
<i>Carpiodes carpio</i>	River Carpsucker	1,2,3	1	2	N
<i>Carpiodes cyprinus</i>	Quillback	2			N
<i>Carpiodes velifer</i>	Highfin Carpsucker	2			N
<i>Catostomus commersonii</i>	White Sucker		1	1,3	N
<i>Cycleptus elongatus</i>	Blue Sucker	1			N
<i>Erimyzon claviformis</i>	Western Creek Chubsucker	1	1,3	1,3	N
<i>Hypentelium nigricans</i>	Northern Hog Sucker		1,2,3	1,2,3	N
<i>Ictiobus bubalus</i>	Smallmouth Buffalo	1,2,3	2,3		N
<i>Ictiobus cyprinellus</i>	Bigmouth Buffalo	1,2,3	1,3		N
<i>Ictiobus niger</i>	Black Buffalo	2,3	2,3		N
<i>Minytrema melanops</i>	Spotted Sucker	1,3	1,2,3	1,2,3	N
<i>Moxostoma erythrurum</i>	Golden Redhorse		1,2,3	1,3	N
<i>Ameiurus melas</i>	Black Bullhead	1	1	1,3	N
<i>Ameiurus natalis</i>	Yellow Bullhead	1	1,2,3	1,2,3	N
<i>Ameiurus nebulosus</i>	Brown Bullhead		2		N
<i>Ictalurus furcatus</i>	Blue Catfish	1,2			N
<i>Ictalurus punctatus</i>	Channel Catfish	1,2,3	1,2,3	1,2,3	N
<i>Noturus gyrinus</i>	Tadpole Madtom	3	1	1,3	N
<i>Noturus miurus</i>	Brindled Madtom		1,2,3	1,3	N
<i>Noturus nocturnus</i>	Freckled Madtom		1,2,3	1	N
<i>Pylodictis olivaris</i>	Flathead Catfish	1,2,3	3	1	N
<i>Esox americanus</i>	Grass Pickerel		1,3	1,2,3	N
<i>Esox niger</i>	Chain Pickerel		2		N
<i>Umbra limi</i>	Central Mudminnow		1,3	1,3	N
<i>Aphredoderus sayanus</i>	Pirate Perch		1,2,3	1,3	N
<i>Labidesthes sicculus</i>	Brook Silverside	1,3	2,3	3	N
<i>Menidia audens</i>	Mississippi Silverside	1			N
<i>Fundulus notatus</i>	Blackstripe Topminnow		2		N
<i>Fundulus olivaceus</i>	Blackspotted Topminnow	3	1,3	1,3	N
<i>Gambusia affinis</i>	Western Mosquitofish		1,2,3	1,3	N
<i>Morone chrysops</i>	White Bass	1,2,3		1	N
<i>Morone mississippiensis</i>	Yellow Bass	2	3		N
<i>Centrarchus macropterus</i>	Flier		1,2,3	1,3	N
<i>Lepomis cyanellus</i>	Green Sunfish	1,3	1,2,3	1,3	N
<i>Lepomis gulosus</i>	Warmouth	1,3	1,3	1,2,3	N
<i>Lepomis humilis</i>	Orangespotted Sunfish		1,2,3	1,3	N
<i>Lepomis macrochirus</i>	Bluegill	1,2,3	1,2,3	1,3	N
<i>Lepomis marginatus</i>	Dollar Sunfish		1,3	1,3	N
<i>Lepomis megalotis</i>	Longear Sunfish	1,2,3	1,3	1,2,3	N
<i>Lepomis microlophus</i>	Redear Sunfish		1,3		N
<i>Micropterus punctulatus</i>	Spotted Bass	3	1,2,3	1,2,3	N
<i>Micropterus salmoides</i>	Largemouth Bass	2,3	1,2,3	1,2,3	N
<i>Pomoxis annularis</i>	White Crappie	1,2,3	1,3	1,2,3	N
<i>Pomoxis nigromaculatus</i>	Black Crappie	2,3	1,3	1,3	N

Table 2. Continued.

Scientific Name	Common Name	Lower Mainstem	Clarks River	West Fork	Status
<i>Etheostoma asprigene</i>	Mud Darter		1,3	1,3	N
<i>Etheostoma chlorosoma</i>	Bluntnose Darter	1	1,3	1,3	N
<i>Etheostoma flabellare</i>	Fantail Darter		1,2	1,3	N
<i>Etheostoma gracile</i>	Slough Darter		1,2,3	1,3	N
<i>Etheostoma histrio</i>	Harlequin Darter		1,2,3	1,3	N
<i>Etheostoma kennicotti</i>	Stripetail Darter		1		N
<i>Etheostoma nigrum</i>	Johnny Darter		1,3	1,3	N
<i>Etheostoma oophylax</i>	Guardian Darter		2,3	3	N
<i>Etheostoma parvipinne</i>	Goldstripe Darter			2	N
<i>Etheostoma proeliare</i>	Cypress Darter		2,3	3	N
<i>Etheostoma rufilineatum</i>	Redline Darter			1,3	N
<i>Etheostoma stigmaeum</i>	Speckled Darter		1,2,3	1,3	N
<i>Etheostoma zonistium</i>	Bandfin Darter		1,2,3	1,3	N
<i>Perca flavescens</i>	Yellow Perch		3		
<i>Percina caprodes</i>	Logperch		1,3	1,3	N
<i>Percina maculata</i>	Blackside Darter		1,2,3	1,3	N
<i>Percina sciera</i>	Dusky Darter		1,2,3	1,3	N
<i>Percina shumardi</i>	River Darter		2		N
<i>Percina vigil</i>	Saddleback Darter		1,2,3	1,3	N
<i>Sander canadensis</i>	Sauger	1,2	1	1	N
<i>Aplodinotus grunniens</i>	Freshwater Drum	1,2,3	1,2,3	1	N
<i>Elassoma zonatum</i>	Banded Pygmy Sunfish		1,3	1,3	N
Total species (per watershed):		52	86	79	
Total species (entire drainage):		107 (102 native)			

Composition and Distribution of Fishes

Fish community sampling at seven sites in the Clarks River (five within the refuge) in 2000 by Alexander (2005) produced a total of 54 species. In a mussel survey of the Clarks River, Levine (2013) compiled a list of 69 fish species in the Clarks River (excluding West Fork) from Alexander (2005) and more recent unpublished data from Murray State University graduate students. Our sampling effort within the Clarks River NWR and expansion area during 2015-2016 produced 32 species from the lower mainstem Clarks River (1 site), 69 species from the Clarks River drainage upstream of the West Fork confluence (18 sites), and 62 species from the West Fork Clarks River drainage within the refuge expansion boundary (13 sites).

In total, we collected 79 species in 18 families (Table 5). This represents approximately 74% of the 107 species reported from the Clarks River drainage and 40% of the approximately 200 species known from the lower Tennessee River basin. Most species (80%) in our collections were members of five families: Cyprinidae (18 species), Percidae (16), Centrarchidae (12), Catostomidae (9), and Ictaluridae (7 species). The remaining 16 species represented 13 families.

The diversity of habitat types in the survey area influences fish species richness and how it is distributed. Patterns of species diversity and distribution are evident when the study area is divided into habitat systems and subsystems. Most species were found predominantly in Riverine habitats (35 species or 44%) or both Riverine and Palustrine habitats (37 species or 47%); the remaining 9% (7 species) occurred predominantly or exclusively in Palustrine habitats (Table 5). The largest number of species occurred in the Lowland Stream and River subsystem (69 or 32%), followed by Lowland Headwater Creek (52 or 24%), Pond (38 or 18%), Slough and Oxbow (33 or 16%), and Wetland (21 or 10%) subsystems (Figure 5). Often species characteristically inhabiting a river or creek were found in a slough or pond and vice versa, particularly when there was a nearby connection between the two habitat subsystems.

Our sampling within the Clarks River NWR and expansion boundary detected the presence of a large percentage (74%) of the species reported from the entire drainage. Two species, Striped Shiner (*Luxilus chrysocephalus*) and Yellow Perch (*Perca flavescens*), were collected for the first time in the Clarks River drainage. The Striped Shiner is common statewide except for the Jackson Purchase, where it is known only from a single record along the Mississippi River floodplain in Carlisle County (Burr and Warren 1986). The single individual we collected while sampling Blizzard Pond drainage ditch (site 22) is far removed from its known range. The source of this specimen is uncertain, but bait bucket introduction cannot be ruled out. The Yellow Perch has reported as sporadic and rare in the main channel of the Ohio River downstream to the lower Cumberland River (Burr and Warren 1986). More recently, it has been collected in the lower Tennessee River drainage where it has undergone rapid dispersal (Etnier and Starnes 1993). During the past decade it has been collected in areas of Kentucky Lake (e.g., tributaries of the Blood River; pers. obs.). Although once native to areas south of the Ohio River during cooler times (i.e., 12,000-16,000 years ago), Yellow Perch have been widely introduced elsewhere, often accidentally (Etnier and Starnes 1993). This species is highly adaptable to a variety of habitats; therefore, more occurrences in the Clarks River drainage are likely.

We report a new distribution records for certain species that are tolerant of a wide range of environmental conditions and are capable of extensive dispersal. The Red Shiner (*Cyprinella lutrensis*) was collected for the first time in the Clarks River upstream of the West Fork confluence (site 18). This species is very tolerant of altered or drastically fluctuating habitats and has been increasing its range in the Mississippi River basin (Etnier and Starnes 1993). In the West Fork Clarks River and Clarks River upstream of the West Fork confluence, we document multiple new locality records for two exotic species, the Grass Carp (*Ctenopharyngodon idella*) and Silver Carp (*Hypophthalmichthys molitrix*). The continued dispersal of these species in the Clarks River

drainage could be indicative of increased habitat disturbance and modification.

Previously reported occurrences for the following seven species are in need verification, either because they lack voucher specimens/photos or voucher specimens in museum collections potentially have been misidentified: Chestnut Lamprey (*Ichthyomyzon castaneus*) in West Fork, Spotfin Shiner (*Cyprinella spiloptera*) throughout drainage, Bighead Carp (*Hypophthalmichthys nobilis*) in lower mainstem, Highfin Carpsucker (*Carpiodes velifer*) in lower mainstem, Chain Pickerel (*Esox niger*) in Clarks River, and Goldstripe Darter (*Etheostoma parvipinne*) in Clarks River.

Three Clarks River sites within the NWR sampled during September-October 2000 by Alexander (2005) were re-sampled during August-September 2015 and subjected to the KIBI (Table 6). Our sampling in 2015 resulted in greater species richness and abundance at all three sites when compared with the 2000 sample data. We also collected three exotic species which were not present in 2000 samples: Common Carp at sites 3, 9, and 19; Grass Carp at sites 9 and 19; and Silver Carp at site 19). Despite differences in species richness and abundance metrics between the two sample periods, sites 9 and 19 ranked as “Good”, suggesting stability in the fish community during the past 15 years. Site 3 (most downstream site) had the largest discrepancy in species richness, composition, and abundance. The differences in IBI scores (“Fair” in 2000 vs. “Excellent” in 2015) could be interpreted as improvement to fish community health during the past 15 years; however, it could also reflect greater habitat disturbance and instability over time resulting in temporal variability in fish assemblage structure. Another factor that could explain differences in species richness and abundance values, as well as IBI scores, is variation in sampling effort (i.e., time spent sampling and sampling distance) at each site between 2000 and 2015.

Table 3. Sites sampled for fishes in the Clarks River drainage during 2015. UT = unnamed tributary. Sites shaded in yellow were also sampled in 2000 (Alexander 2005).

Site	Stream/Water Body	Location	County	Latitude	Longitude	Date Sampled
1	Clarks River	from Shennan Bridge (KY 3075), 1 stream mi. upstream	McCracken	36.99583	-88.56326	September 15, 2015
2	Lindsey impoundment	3 mi. NE of Symsonia; 0.25 mi. SW of KY 787/Powers Rd. jct.	McCracken	36.96129	-88.49788	April 12, 2016
3	Clarks River	Below KY 787 (Bryant Ford Rd.) crossing	McCracken	36.96142	-88.49350	September 14, 2015
4	Lick Creek	Off Sharpe Elva Road; 0.8 stream mi. above Clarks River confluence	Marshall	36.93910	-88.47196	September 2, 2015
5	Clarks River UT	Off Sharpe Elva Road; 50 m above Clarks River confluence	Marshall	36.93959	-88.46563	September 1, 2015
6	Dunn Slough Creek pond	0.9 mi E of Sharpe Elva Rd.	Marshall	36.93012	-88.45482	June 15, 2016
7	Clarks River	at Milliken Mill Ln bridge, downstream 150 m	Marshall	36.90689	-88.41074	June 14, 2016
8	Middle Fork Creek wetland	powerline corridor; 0.37 mi E of Milliken Mill Ln	Marshall	36.89682	-88.40886	June 14, 2016
9	Clarks River	Off Tucker Lane; 2.3 stream mi. below Egners Branch confluence	Marshall	36.89836	-88.38220	September 16, 2015
11A	Clarks River refuge pond	Clarks River NWR headquarters back property off US 641	Marshall	36.87959	-88.34554	September 15, 2015
11B	Clarks River refuge pond	Clarks River NWR headquarters back property off US 641	Marshall	36.87959	-88.34554	June 13, 2016
10	Egners Branch	Clarks River NWR headquarters off US 641; 1.1 stream mi. above Clarks River confluence	Marshall	36.88107	-88.34491	August 12, 2015
12	Clarks River UT	downstream of US 641 bridge, just S of Clarks River NWR office	Marshall	36.87881	-88.34557	June 13, 2016
13	Johns River overflow pond	Off KY 408; 1 mi. E of Benton	Marshall	36.85727	-88.33183	August 12, 2015
14	Johns River	KY 408 bridge crossing; 0.8 stream mi. above East Fork Clarks River confluence	Marshall	36.85641	-88.32866	August 12, 2015
15	Clarks River	from KY 408 bridge to Tubbs Branch confluence	Marshall	36.85921	-88.31422	June 13, 2016
16	Beaverdam Slough	Off Dogtown Rd.; Clarks River NWR Rd.; 1.2 stream mi. above Clarks River confluence	Marshall	36.82460	-88.30427	August 3, 2015
17	Myers Creek	Off Dogtown Rd.; 0.5 mi. SE of Glade Rd./Dogtown Rd. jct.	Marshall	36.81625	-88.29953	August 3, 2015
18	Nanny Creek	Off KY 1897; 0.8 stream mi. above Clarks River confluence	Marshall	36.83320	-88.28682	August 11, 2015
19	Clarks River	Off Dogtown Road; At Washburn Ford; 0.28 stream miles above Nanny Branch confluence	Marshall	36.82730	-88.29702	August 13, 2015
20	Blizzard Pond	Pond/wetland complex; 0.8 mi. W of Farrington Airpark	McCracken	36.97366	-88.57595	September 16, 2015
21	Blizzard Pond drainage ditch	0.7 stream mi. E of KY 1954 (Husband Rd.) crossing	McCracken	36.97507	-88.58716	September 16, 2015
22	Camp Creek	at KY 450 bridge, downstream 220 m	McCracken	36.95659	-88.54350	June 15, 2016
23	Horseshoe Pond	1.7 mi. NW of Symsonia; 150 m S of Waid Rd	Graves	36.93961	-88.53962	June 14, 2016

Table 3. Continued.

Site	Stream/Water Body	Location	County	Latitude	Longitude	Date Sampled
24	West Fork Clarks River	1.7 mi. NW of Symsonia; 170 m S of Waid Rd	Graves	36.93947	-88.53876	June 14, 2016
25	Sugar Creek	Off Tim Road; 1.3 mi. above West Fork Clarks River confluence	Graves	36.88751	-88.52971	August 11, 2015
26	Spring Creek overflow pond	Above KY 131 bridge crossing; 1.5 stream mi. above West Fork Clarks River confluence	Graves	36.86259	-88.57317	September 2, 2015
27	Spring Creek	Above KY 131 bridge crossing; 1.5 stream mi. above West Fork Clarks River confluence	Graves	36.86211	-88.57343	September 2, 2015
28	West Fork Clarks River	Old channel; Tim Rd. above old Casey bridge	Graves	36.84518	-88.52119	August 4, 2015
29	West Fork Clarks River UT	Off Tim Rd.; 0.6 stream mi. above West Fork Clarks River confluence	Graves	36.84084	-88.52608	August 4, 2015
30	Trace Creek	KY 301 bridge crossing; 1 stream mi. above West Fork Clarks River confluence	Graves	36.82999	-88.53938	August 4, 2015
31	West Fork Clarks River	New channel; at Pull Tight Branch confluence	Graves	36.83729	-88.52686	August 4, 2015
32	Pull Tight Branch	Off Tim Rd.; 0.4 stream mi. above West Fork Clarks River confluence	Graves	36.83136	-88.52817	August 4, 2015

Table 4. Habitat characteristics and water quality data for sites sampled in the Clarks River drainage during 2015-2016. UT = unnamed tributary. * Lindsey impoundment was drained on April 12, 2016. Refuge staff provided preserved specimens and photographs of fish.

Site	Stream/Water Body	Habitat	Subsystem	Substrate	Vegetation/Cover	Width (m)	Water Temp. (°C)	Conductivity (µS/cm)	pH
1	Clarks River	Riverine	Lowland Stream and River	mud, organic debris	instream shelter; scrub-shrub; forested	50	68.5	154	6.9
2*	Lindsey impoundment	Palustrine	Wetland	--	--	--	--	--	--
3	Clarks River	Riverine	Lowland Stream and River	mud, sand, cobble-gravel	instream shelter; scrub-shrub; forested	10	74.6	160	7.3
4	Lick Creek	Riverine	Lowland Headwater Creek	mud, sand, gravel, organic debris	instream shelter; scrub-shrub; forested	2-7	73.7	116	7.0
5	Clarks River UT	Palustrine	Slough and Oxbow	mud, organic debris	instream shelter, forested	2-6	77	165	7.2
6	Dunn Slough Creek pond	Palustrine	Pond	mud, organic debris	instream shelter; scrub-shrub; forested	29-60	80.4	185	6.5
7	Clarks River	Riverine	Lowland Stream and River	mud, sand, gravel, organic debris	instream shelter, forested	20	82.4	145	5.6
8	Middle Fork Creek wetland	Palustrine	Wetland	mud, organic debris	emergent, scrub-shrub	5	80.1	113	5.9
9	Clarks River	Riverine	Lowland Stream and River	mud, sand, cobble-gravel	instream shelter; scrub-shrub; forested	14	71.7	169	6.0
10	Eggers Branch	Riverine	Lowland Headwater Creek	mud, sand, cobble-gravel	instream shelter; scrub-shrub; forested	1-2	73.7	124	6.4
11	Clarks River refuge pond	Palustrine	Pond	mud, organic debris	instream shelter; scrub-shrub	140	91.4	85	6.4
12	Clarks River UT	Palustrine	Slough and Oxbow	mud, organic debris	emergent, aquatic bed, scrub-shrub	8	77.8	94	5.7
13	Johns River overflow pond	Palustrine	Pond	mud, organic debris	emergent, aquatic bed	80	82	68	6.5
14	Johns River	Palustrine	Slough and Oxbow	mud, organic debris	instream shelter, forested	6-7	72.2	76	6.0
15	Clarks River	Riverine	Lowland Stream and River	mud, sand, cobble-gravel	instream shelter, forested	11	82.1	149	6.7
16	Beaverdam Slough	Palustrine	Slough and Oxbow	mud, organic debris	instream shelter; scrub-shrub; forested	3-4	80.2	98	7.8
17	Myers Creek	Palustrine	Slough and Oxbow	mud, organic debris	instream shelter; scrub-shrub; forested	1-2	81.5	163	6.6
18	Nanny Creek	Riverine	Lowland Headwater Creek	sand, cobble-gravel	instream shelter; scrub-shrub; forested	2-3	77.9	70	6.2
19	Clarks River	Riverine	Lowland Stream and River	mud, sand, cobble-gravel	instream shelter; scrub-shrub; forested	13	76.1	141	7.0
20	Blizzard Pond	Palustrine	Wetland	mud, organic debris	emergent, aquatic bed, scrub-shrub, forested	230	69.5	55	7.4
21	Blizzard Pond drainage ditch	Riverine	Lowland Headwater Creek	sand, cobble-gravel	instream shelter; scrub-shrub	5	77.4	110	6.9
22	Camp Creek	Riverine	Lowland Headwater Creek	sand, cobble-gravel, organic debris	instream shelter, forested	8-10	80.1	130	6.44
23	Horseshoe Pond	Palustrine	Wetland	mud, organic debris	emergent, instream shelter, scrub-shrub	25	85.9	129	6

Table 4. Continued.

Site	Stream/Water Body	Habitat	Subsystem	Substrate	Vegetation/Cover	Width (m)	Water Temp. (°C)	Conductivity (µS/cm)	pH
24	West Fork Clarks River	Riverine	Lowland Stream and River	sand, organic debris	scrub-shrub; sparsely forested	16	87.3	100	6.3
25	Sugar Creek	Riverine	Lowland Headwater Creek	mud, sand, cobble-gravel	instream shelter; scrub-shrub; forested	2-3	79.5	72	5.9
26	Spring Creek overflow pond	Palustrine	Pond	mud, organic debris	instream shelter; scrub-shrub	82	--	--	--
27	Spring Creek	Riverine	Lowland Stream and River	mud, sand, gravel, organic debris	instream shelter; scrub-shrub	14	75.1	51	7.3
28	West Fork Clarks River	Palustrine	Slough and Oxbow	mud, organic debris	emergent, aquatic bed, instream shelter	10	74.4	60	6.1
29	West Fork Clarks River UT	Palustrine	Slough and Oxbow	mud, organic debris	instream shelter; scrub-shrub; forested	1	76.9	192	6.5
30	Trace Creek	Riverine	Lowland Headwater Creek	mud, sand, cobble-gravel	instream shelter; scrub-shrub; forested	2-7	83.8	48	6.5
31	West Fork Clarks River	Riverine	Lowland Stream and River	sand, cobble-gravel	scrub-shrub; sparsely forested	10	83.6	96	7.8
32	Pull Tight Branch	Riverine	Lowland Headwater Creek	mud, organic debris	instream shelter; scrub-shrub; forested	1	72.3	60	5.8

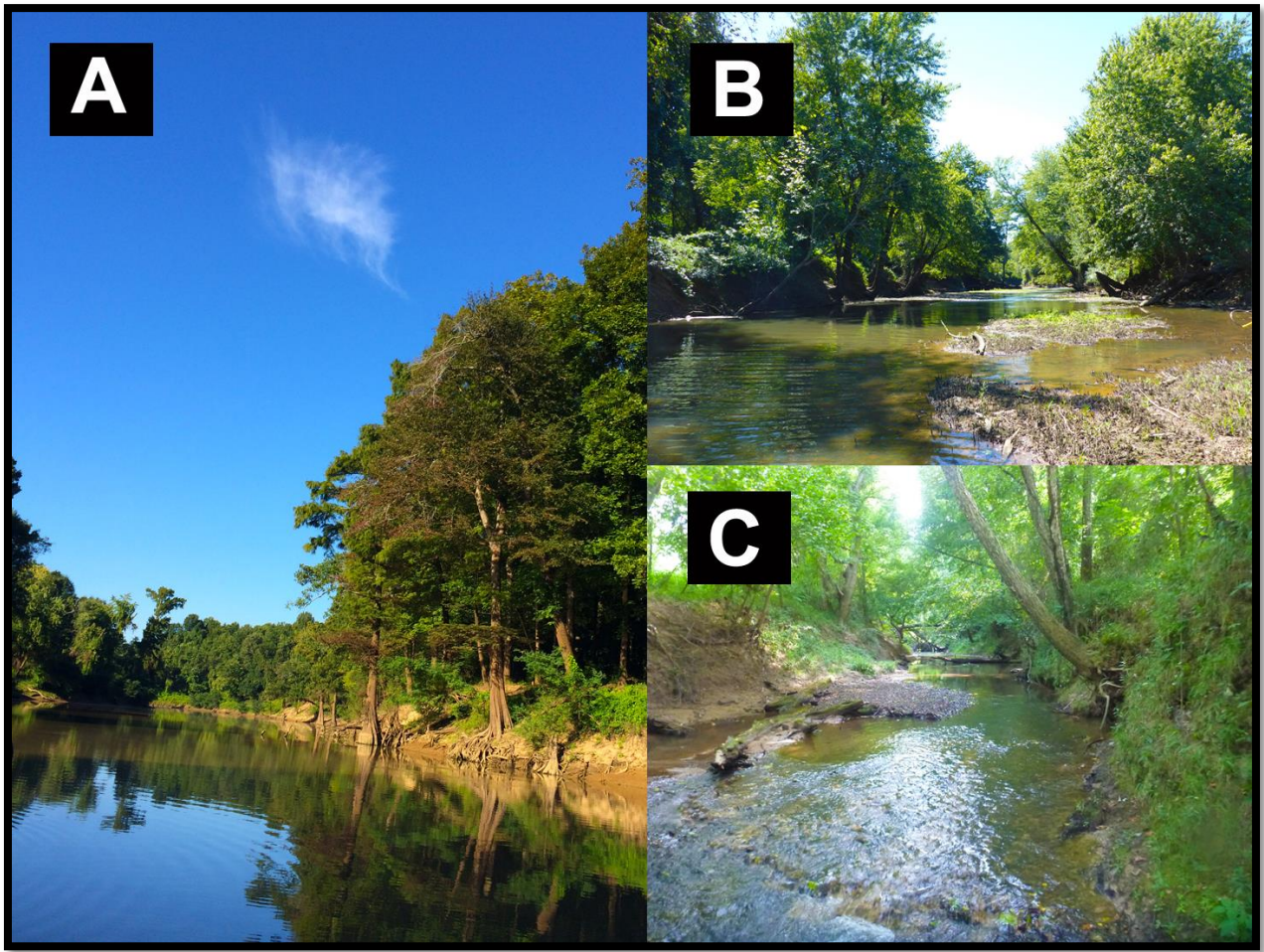


Figure 2. Examples of Riverine System habitats sampled for fishes during 2015-2016: **A)** Site 1, lower Clarks River (River Subsystem); **B)** Site 3, Clarks River at Bryant Ford Rd (River Subsystem); **C)** Site 30, Trace Creek (Creek Subsystem).

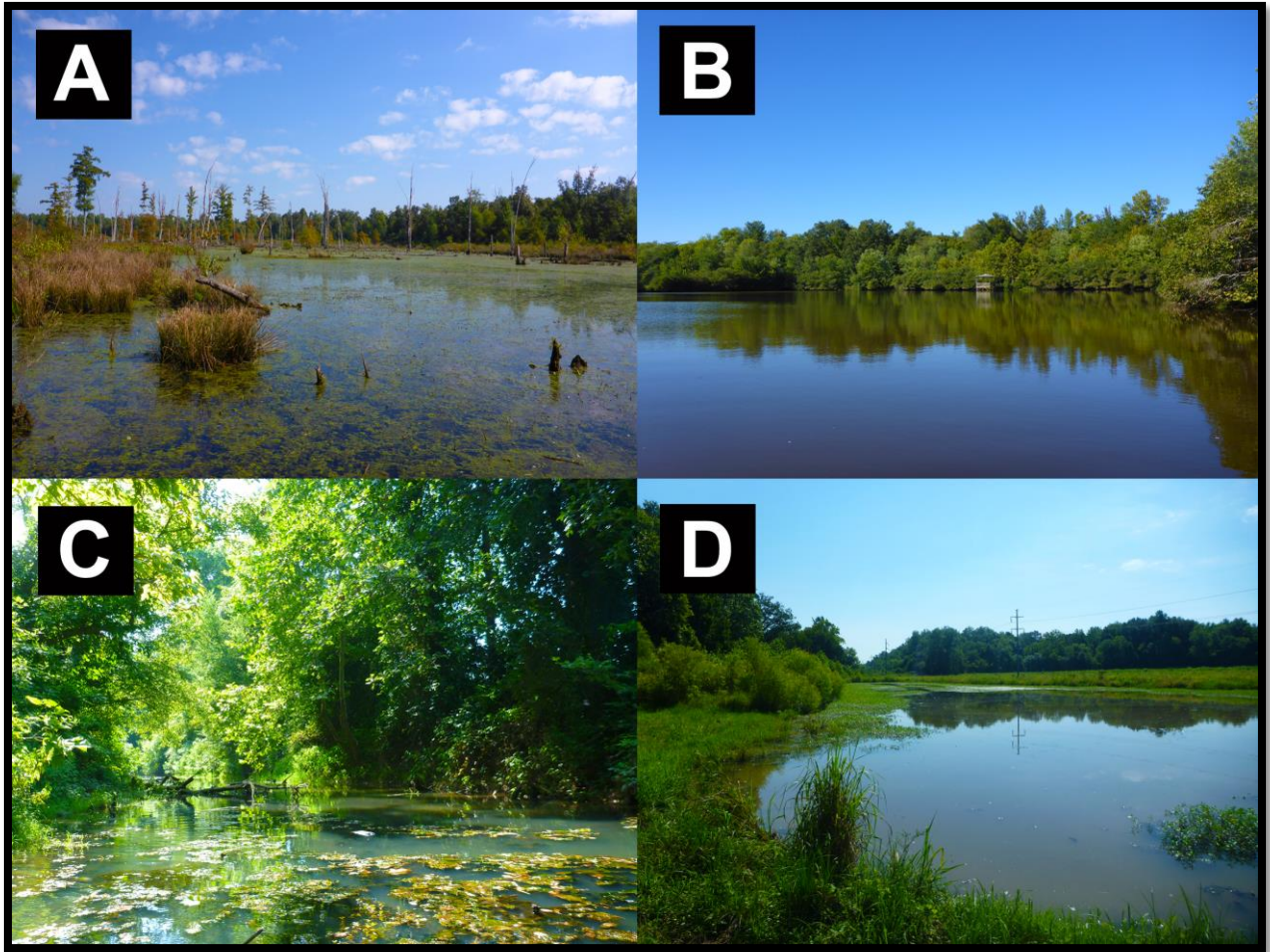


Figure 3. Examples of Palustrine System habitats sampled for fishes during 2015-2016: **A)** Site 20, Blizzard Pond (Wetland Subsystem); **B)** Site 11, Clarks River refuge pond (Pond Subsystem); **C)** Site 28, West Fork Clarks River old channel (Slough and Oxbow Subsystem); **D)** Site 13, Johns River overflow pond (Pond Subsystem).

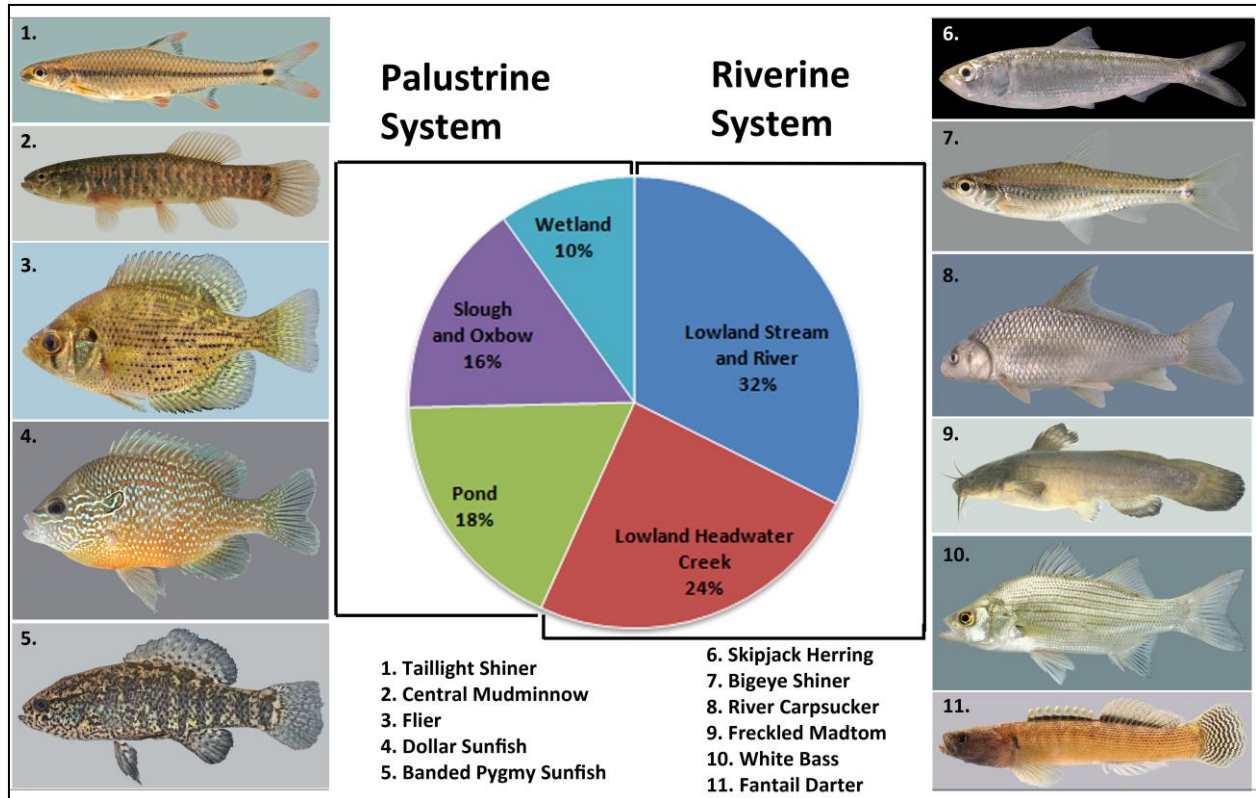


Figure 4. Habitat associations of fishes collected in the Clarks River drainage during 2015-2016. Examples of species characteristic of habitat systems and subsystems are shown on the left (Palustrine) and right (Riverine) panels.

Table 5. Summary of fishes collected at 32 sites in the Clarks River drainage during 2015-2016. Sites are categorized by habitat type and number of occurrences (sites) is indicated in columns. R = Riverine, P = Palustrine, R/P = Riverine and Palustrine. Rare species are in bold print.

Family	Scientific Name	Common Name	Favored Habitat	Riverine		Palustrine		
				River (9)	Creek (8)	Pond (4)	Slough (7)	Wetland (4)
Lepisosteidae								
	<i>Lepisosteus oculatus</i>	Spotted Gar	R/P	1	1	1		1
	<i>Lepisosteus osseus</i>	Longnose Gar	R/P	1				
	<i>Lepisosteus platostomus</i>	Shortnose Gar	R/P	2	1			
Amiidae								
	<i>Amia calva</i>	Bowfin	R/P	1		2	1	1
Hiodontidae								
	<i>Hiodon alosoides</i>	Goldeye	R	1				
Clupeidae								
	<i>Alosa chrysochloris</i>	Skipjack Herring	R	1				
	<i>Dorosoma cepedianum</i>	Gizzard Shad	R/P	1		2	1	
Cyprinidae								
	<i>Campostoma oligolepis</i>	Largescale Stoneroller	R	6	4		1	
	<i>Ctenopharyngodon idella</i>	Grass Carp	R/P	4	3	2		
	<i>Cyprinella lutrensis</i>	Red Shiner	R	2	1			
	<i>Cyprinella whipplei</i>	Steelcolor Shiner	R	7	4		1	
	<i>Cyprinus carpio</i>	Common Carp	R/P	5	4	1	1	
	<i>Hybognathus nuchalis</i>	Mississippi Silvery Minnow	R/P	4	3	1		
	<i>Hypophthalmichthys molitrix</i>	Silver Carp	R/P	3	2	2	1	1
	<i>Luxilus chrysocephalus</i>	Striped Shiner	R		1			
	<i>Lythrurus fumeus</i>	Ribbon Shiner	R/P	6	4	1	3	
	<i>Lythrurus umbratilis</i>	Redfin Shiner	R/P	3	1		2	
	<i>Notemigonus crysoleucas</i>	Golden Shiner	R/P	3	3	2	6	4
	<i>Notropis atherinoides</i>	Emerald Shiner	R	3	1			
	<i>Notropis boops</i>	Bigeye Shiner	R	2	2			
	<i>Notropis maculatus</i>	Taillight Shiner	P			1		
	<i>Notropis volucellus</i>	Mimic Shiner	R	4				
	<i>Pimephales notatus</i>	Bluntnose Minnow	R	2	4			
	<i>Pimephales vigilax</i>	Bullhead Minnow	R	6				1
	<i>Semotilus atromaculatus</i>	Creek Chub	R	3	5			1
Catostomidae								
	<i>Carpiodes carpio</i>	River Carpsucker	R	1				
	<i>Catostomus commersonii</i>	White Sucker	R	1				
	<i>Erimyzon claviformis</i>	Western Creek Chubsucker	R/P	1	6	2	3	
	<i>Hypentelium nigricans</i>	Northern Hog Sucker	R	5	2			
	<i>Ictiobus bubalus</i>	Smallmouth Buffalo	R/P	2		1		
	<i>Ictiobus cyprinellus</i>	Bigmouth Buffalo	R/P	2		1		
	<i>Ictiobus niger</i>	Black Buffalo	R/P	1		1		
	<i>Minytrema melanops</i>	Spotted Sucker	R/P	7	1	2	4	
	<i>Moxostoma erythrurum</i>	Golden Redhorse	R	4	3			

Table 5. Continued.

Family	Scientific Name	Common Name	Favored Habitat	Riverine		Palustrine		
				River (9)	Creek (8)	Pond (4)	Slough (7)	Wetland (4)
Ictaluridae								
	<i>Ameiurus melas</i>	Black Bullhead	R/P		1		1	2
	<i>Ameiurus natalis</i>	Yellow Bullhead	R/P	4	7	1	3	
	<i>Ictalurus punctatus</i>	Channel Catfish	R	6	2			
	<i>Noturus gyrinus</i>	Tadpole Madtom	R	1	3			
	<i>Noturus miurus</i>	Brindled Madtom	R	4	1			
	<i>Noturus nocturnus</i>	Freckled Madtom	R	3				
	<i>Pylodictis olivaris</i>	Flathead Catfish	R	4		1		
Esocidae								
	<i>Esox americanus</i>	Grass Pickerel	R/P	2	4	2	7	3
Umbridae								
	<i>Umbra limi</i>	Central Mudminnow	P		1		1	2
Aphredoderidae								
	<i>Aphredoderus sayanus</i>	Pirate Perch	R/P	6	5	2	6	
Atherinopsidae								
	<i>Labidesthes sicculus</i>	Brook Silverside	R/P	3		3		
Fundulidae								
	<i>Fundulus olivaceus</i>	Blackspotted Topminnow	R/P	9	7	2	6	
Poeciliidae								
	<i>Gambusia affinis</i>	Western Mosquitofish	R/P	8	7	4	6	4
Moronidae								
	<i>Morone chrysops</i>	White Bass	R	1				
	<i>Morone mississippiensis</i>	Yellow Bass	R					1
Centrarchidae								
	<i>Centrarchus macropterus</i>	Flier	P		4	1	5	2
	<i>Lepomis cyanellus</i>	Green Sunfish	R/P	8	8	2	5	1
	<i>Lepomis gulosus</i>	Warmouth	R/P	3	3	2	5	2
	<i>Lepomis humilis</i>	Orangespotted Sunfish	P			2		1
	<i>Lepomis macrochirus</i>	Bluegill	R/P	7	5	4	5	2
	<i>Lepomis marginatus</i>	Dollar Sunfish	P		1	1	5	
	<i>Lepomis megalotis</i>	Longear Sunfish	R/P	8	5		4	
	<i>Lepomis microlophus</i>	Redear Sunfish	P			3	2	
	<i>Micropterus punctulatus</i>	Spotted Bass	R/P	5				
	<i>Micropterus salmoides</i>	Largemouth Bass	R/P	6	4	3	3	1
	<i>Pomoxis annularis</i>	White Crappie	R/P	2		4	1	1
	<i>Pomoxis nigromaculatus</i>	Black Crappie	R/P	2		1		1

Table 5. Continued.

Family	Scientific Name	Common Name	Favored Habitat	Riverine		Palustrine		
				River (9)	Creek (8)	Pond (4)	Slough (7)	Wetland (4)
Percidae								
	<i>Etheostoma asprigene</i>	Mud Darter	R/P	2	1			
	<i>Etheostoma chlorosoma</i>	Bluntnose Darter	R/P	2	2	2	2	
	<i>Etheostoma flabellare</i>	Fantail Darter	R	1	3			
	<i>Etheostoma gracile</i>	Slough Darter	R/P	7	7	1	5	
	<i>Etheostoma histrio</i>	Harlequin Darter	R	6				
	<i>Etheostoma nigrum</i>	Johnny Darter	R	2	1			
	<i>Etheostoma oophylax</i>	Guardian Darter	R	3	7		2	
	<i>Etheostoma proeliare</i>	Cypress Darter	R/P	1	3	2	2	
	<i>Etheostoma rufilineatum</i>	Redline Darter	R	1	1			
	<i>Etheostoma stigmaeum</i>	Speckled Darter	R	6	2			
	<i>Etheostoma zonistium</i>	Bandfin Darter	R	5	4			
	<i>Perca flavescens</i>	Yellow Perch	R/P			1		
	<i>Percina caprodes</i>	Logperch	R	5	1			
	<i>Percina maculata</i>	Blackside Darter	R	2	2	1	1	
	<i>Percina sciera</i>	Dusky Darter	R	6	2			
	<i>Percina vigil</i>	Saddleback Darter	R	6				
Sciaenidae								
	<i>Aplodinotus grunniens</i>	Freshwater Drum	R	1				1
Elassomatidae								
	<i>Elassoma zonatum</i>	Banded Pygmy Sunfish	P	1	3	1	2	1
Total species:		79		69	52	38	33	21

Table 6. Comparison of fishes collected at three mainstem Clarks River sites during August-October in 2000 and 2015 using the Kentucky Index of Biotic Integrity (KIBI).

Fish Species		Site 3		Site 9		Site 19	
Scientific Name	Common Name	2000	2015	2000	2015	2000	2015
<i>Campostoma oligolepis</i>	Largescale Stoneroller	11	3	22	14	22	13
<i>Ctenopharyngodon idella</i>	Grass Carp				9		5
<i>Cyprinella lutrensis</i>	Red Shiner		1				
<i>Cyprinella whipplei</i>	Steelcolor Shiner	2	68	35	42	95	46
<i>Cyprinus carpio</i>	Common Carp		3		21		2
<i>Hybognathus nuchalis</i>	Mississippi Silvery Minnow	3	34	2	48		8
<i>Hypophthalmichthys molitrix</i>	Silver Carp						5
<i>Lythrurus fumeus</i>	Ribbon Shiner	30	81	86	146	1	55
<i>Lythrurus umbratilis</i>	Redfin Shiner			2	3		24
<i>Notemigonus crysoleucas</i>	Golden Shiner			1	1		
<i>Notropis atherinoides</i>	Emerald Shiner		9	3	3		
<i>Notropis boops</i>	Bigeye Shiner					1	23
<i>Notropis volucellus</i>	Mimic Shiner		13		15		2
<i>Opsopoeodus emiliae</i>	Pugnose Minnow	1					
<i>Phenacobius mirabilis</i>	Suckermouth Minnow	1					
<i>Pimephales notatus</i>	Bluntnose Minnow	1		11		2	1
<i>Pimephales vigilax</i>	Bullhead Minnow		35	5	26	11	46
<i>Hypentelium nigricans</i>	Northern Hog Sucker	2	3	1	9	1	1
<i>Ictiobus bubalus</i>	Smallmouth Buffalo				2		
<i>Minytrema melanops</i>	Spotted Sucker	1	2		1	1	1
<i>Moxostoma erythrurum</i>	Golden Redhorse		4		2		2
<i>Ameiurus natalis</i>	Yellow Bullhead		2	1			4
<i>Ameiurus nebulosus</i>	Brown Bullhead			1			
<i>Ictalurus punctatus</i>	Channel Catfish	2	23		22		
<i>Noturus gyrinus</i>	Tadpole Madtom					1	
<i>Noturus miurus</i>	Brindled Madtom	3	5	3	6		2
<i>Noturus nocturnus</i>	Freckled Madtom	1		1	2	3	1
<i>Pylodictis olivaris</i>	Flathead Catfish		4	2	4		
<i>Esox americanus</i>	Grass Pickerel						1
<i>Aphredoderus sayanus</i>	Pirate Perch		5		1	2	3
<i>Labidesthes sicculus</i>	Brook Silverside						3
<i>Fundulus olivaceus</i>	Blackspotted Topminnow		33	2	4	2	4
<i>Gambusia affinis</i>	Western Mosquitofish	4	33	8	19	12	40
<i>Centrarchus macropterus</i>	Flier			2			
<i>Lepomis cyanellus</i>	Green Sunfish		7	3	3	4	26
<i>Lepomis humilis</i>	Orangespotted Sunfish			4			
<i>Lepomis macrochirus</i>	Bluegill	3	11	2	21	2	
<i>Lepomis megalotis</i>	Longear Sunfish	4	95	7	13	60	37
<i>Micropterus punctulatus</i>	Spotted Bass		5		1	5	5
<i>Micropterus salmoides</i>	Largemouth Bass		6		1		
<i>Pomoxis nigromaculatus</i>	Black Crappie		1				

Table 6. Continued.

Fish Species		Site 3		Site 9		Site 19	
Scientific Name	Common Name	2000	2015	2000	2015	2000	2015
<i>Etheostoma asprigene</i>	Mud Darter		13				
<i>Etheostoma chlorosoma</i>	Bluntnose Darter		2				
<i>Etheostoma gracile</i>	Slough Darter		3	3	6		8
<i>Etheostoma histrio</i>	Harlequin Darter		30	1	17		2
<i>Etheostoma nigrum</i>	Johnny Darter						1
<i>Etheostoma oophylax</i>	Guardian Darter					1	2
<i>Etheostoma proeliare</i>	Cypress Darter			1			
<i>Etheostoma stigmaeum</i>	Speckled Darter	2	10	45	2	9	4
<i>Etheostoma zonistium</i>	Bandfin Darter		1	7	4	20	7
<i>Percina caprodes</i>	Logperch		12		5		
<i>Percina maculata</i>	Blackside Darter		2	1			
<i>Percina sciera</i>	Dusky Darter	5	23		20	1	6
<i>Percina vigil</i>	Saddleback Darter	37	61	13	93	5	7
	Total individuals:	113	643	275	586	261	397
	Total species:	18	35	29	34	22	34
	Total native species:	18	34	29	32	22	31
	KIBI score:	39	70	56	61	58	64
	KIBI rating:	Fair	Excellent	Good	Good	Good	Good

Species of Greatest Conservation Need

Sampling within the Clarks River NWR and expansion area detected five at-risk fish species, or species of greatest conservation need (SGCN) recognized by KDFWR. The following accounts summarize occurrences based on the August-September 2015-2016 sampling effort at 32 sites. General distribution and habitat comments are based on published studies, personal communication with experts, and our field observations.

Notropis maculatus (Hay). Taillight Shiner.—In Kentucky, the Taillight Shiner is state-listed as Threatened (Kentucky State Nature Preserves Commission 2012) and a SGCN by the KDFWR (Kentucky's Wildlife Conservation Strategy 2013). It is restricted to the Jackson Purchase where it is known to occupy oxbows, swamps, and low-gradient streams primarily along the lower Ohio and Mississippi river floodplains. It was first reported in the Clarks River drainage in 2004 when 10 specimens were collected in an old channel oxbow of the West Fork Clarks River at the KY 131 crossing, Graves County (Compton et al. 2004); it was collected at the same locality again in 2007 (D. Eisenhour, Morehead State University, pers. comm.; voucher specimens at Morehead State University). In June 2010, KDFWR biologists collected the species at two locations in the Clarks River: below US 641 crossing N of Benton and 4 mi SE of Benton, within the NWR. On 15 September 2015, we collected a single specimen while boat electrofishing the pond behind the refuge headquarters (Site 11). This individual was taken around emergent vegetation in the south corner of the pond near the outlet connecting to the Clarks River. The location is less than 0.25 miles from the location below US 641 where it was captured in 2010. On 13 June 2016, we re-sampled the emergent vegetation near the pond outlet using a 10' X 6' seine and captured another individual. It is probable that this species exists in additional Palustrine habitats (i.e., vegetated oxbows and drainage canals) in the middle and lower reaches of the Clarks River drainage.

Ictiobus niger (Rafinesque). Black Buffalo.— In Kentucky, the Black Buffalo is known mostly from scattered records in the main channels of the Ohio and Mississippi rivers. It is considered sporadic and rare in large rivers and reservoirs in the western half of the state (Burr and Warren 1986). Most accounts indicate that the distribution of the Black Buffalo is similar to the Smallmouth Buffalo (*Ictiobus bubalus*), but much less common (e.g., Pearson and Krumholz 1984). The Black Buffalo is state-listed as a species of Special Concern by the Kentucky State Nature Preserves Commission (2012) and was added as a SGCN by KDFWR (Kentucky's Wildlife Conservation Strategy 2013). Five records (one vouchered) are available for the lower mainstem and one (not vouchered) from the Clarks River upstream of the West Fork confluence; it has not been reported from the West Fork (Table 2). During boat electrofishing runs on 15 September 2015, we collected three individuals in the lower mainstem (Site 1) and one individual in the refuge headquarters pond (Site 11). Our collection at Site 20 represents the first vouchered (photo) record for Clarks River upstream of the West Fork confluence.

Umbra limi (Kirtland). Central Mudminnow.—This species reaches the southernmost edge of its range in western Kentucky, where it is usually associated with dense beds of submergent aquatic plants, organic debris, or piles of detritus. It has been reported to be occasional to locally common in the Clarks and Blood River drainages, and Terrapin Creek and Running Slough, Fulton County (Burr and Warren 1986). These populations are thought to be slightly declining according to D. Eisenhour, Morehead State University (pers. comm.). However, collecting efforts during the past 15 years have produced several new records in the Obion Creek, Bayou du Chien, and West Fork Clarks River drainages. This species is considered imperiled in Kentucky (NatureServe, 2015), state-listed as Threatened by the Kentucky State Nature Preserves Commission (2012), and a SGCN

by KDFWR (Kentucky's Wildlife Conservation Strategy 2013). Vouchered records are available for the Clarks River (two occurrences in 1979) and West Fork (18 occurrences from 1982-2010). In 2015, we collected five individuals in Egners Branch (Site 10) and one in the West Fork Clarks River oxbow (Site 28). In 2016, one specimen was collected from the Lindsey impoundment (site 2) during drawdown and another specimen was collected in the Middle Fork Creek wetland (site 8). Specimens collected at sites 10, 2, and 8 represent the first reported occurrences of this species in the Clarks River upstream of the West Fork confluence since 1979. As with the Taillight Shiner, the Central Mudminnow likely occupies additional Palustrine habitats in the middle and lower portions of the Clarks River drainage.

Lepomis marginatus (Holbrook). Dollar Sunfish.—This small sunfish is restricted to the Jackson Purchase where it inhabits spring-fed wetlands, sluggish streams, and sloughs. It is known only from Murphy Pond, Hickman County, Terrapin Creek, Graves County, and the Clarks River drainage, Graves and Marshall counties. The species is state-listed as Endangered by the KY State Nature Preserves Commission (2012), and a SGCN by KDFWR (Kentucky's Wildlife Conservation Strategy 2013). It was first documented in spring-fed perennial pools and wetlands in the West Fork drainage in 1982 (Rice et al. 1983; Warren and Cicerello 1983). It was later reported in the Clarks River near the Bryant Ford Rd. crossing by Kuhajda and Warren (1985). During 2015-2016, we collected Dollar Sunfish at six sites in the Clarks River upstream of the West Fork confluence (Sites 6, 10, 12, 14, 16, and 17) and one site in the West Fork (Site 28). The six sites in the Clarks River were all small, sluggish streams or canals (Slough and Oxbow, Lowland Headwater Creek subsystems); each site produced 1-6 individuals. We collected 23 individuals at Site 28 in the West Fork, which was an oxbow with dense beds of submerged vegetation and woody debris. Our collections at the four sites in the Clarks River are the first to be reported since 1985 and represent an upstream extension of its known distribution in the drainage.

Etheostoma proeliare (Hay). Cypress Darter.— This small darter is sporadic and rare in small to medium sized streams and margins of oxbow lakes that border the Mississippi and lower Ohio Rivers and lower Cumberland and lower Tennessee River drainages. It has been reported to be associated with areas laden with leaf litter or submerged vegetation in sluggish current, pools, or margins of streams or oxbow lakes and sloughs (Burr and Warren, 1986). Only five records for the Cypress Darter in Kentucky have been reported during the last 15 years. The species is state-listed as Threatened by the KY State Nature Preserves Commission (2012), and a SGCN by KDFWR (Kentucky's Wildlife Conservation Strategy 2013). The Cypress Darter's presence in the Clarks River drainage was unknown until 2000, when it was collected by S. Alexander at Site 9 (Tucker Lane). It was collected again the following year by R. Cicerello et al. (KY State Nature Preserves Commission) at Site 3 (Bryant Ford Rd.). The last record was reported by Thomas (2009) in an oxbow of the West Fork at KY 131 bridge, Graves County. Although our 2015-2016 sampling effort at Sites 3 and 9 failed to detect the species, we did collect it at five other sites including one (Sites 21 and 24) in the West Fork drainage and four (Sites 4, 5, 6, 10, 11, and 14) in the Clarks River upstream of the West Fork confluence. All of these occurrences were previously unreported.

Exotic Species

Our sampling effort in August-September 2015 produced three of the five exotic species known from the Clarks River drainage. The Goldfish (*Carassius auratus*) is known only from a single pre-1986 record in the Clarks River (Burr and Warren 1986). It has not been reported since and is likely not an established resident in the drainage. The Common Carp (*Cyprinus carpio*) is well-established throughout the state and is generally distributed throughout the Clarks River

drainage. It was present at 11 of the 32 sites sampled and in both Riverine and Palustrine systems. Within the past 20 years, Grass Carp (*Ctenopharyngodon idella*), Silver Carp (*Hypophthalmichthys molitrix*), and Bighead Carp (*Hypophthalmichthys nobilis*) have been documented in the Clarks River drainage. These three species are collectively referred to as Asian carps; two of these (Silver and Bighead carps) are on the federal list of Injurious Wildlife (USFWS 2007, 2011). We are aware of a single unpublished record of Bighead Carp from the lower mainstem Clarks River, but were unable to locate voucher specimens or photos to confirm the record. Our sampling at 32 sites did not detect Bighead Carp. The following accounts discuss the current presence and distribution of Grass and Silver carps in the Clarks River drainage.

Ctenopharyngodon idella (Valenciennes). Grass Carp.—Native to rivers of eastern Asia, the Grass Carp was first brought to the U.S. in 1963. It has since been widely stocked in private water bodies for vegetation control (Schofield et al. 2005). The species is tolerant of a wide range of environmental conditions, and once released, is capable of extensive migrations in open systems (Guillory and Gasaway 1978). Prior to our sampling effort, only five records were documented from the Clarks River drainage: four from the lower mainstem (1995-2014) and one from the Clarks River upstream of the West Fork confluence (2006). We collected the species from eight sites in the lower mainstem (Site 1), West Fork (Sites 21, 25, 26, and 31), and Clarks River upstream of the West Fork confluence (Sites 4, 6, 9, and 19). Young-of-year juveniles (less than 5 in. total length) were present at all sites except the lower mainstem (Site 1), where a single large adult was captured. In shallow riffles and runs of river and creek sites, young-of-year were observed schooling with Common Carp and Silver Carp, some in high densities (e.g., at Sites 25 and 31).

Hypophthalmichthys molitrix (Valenciennes). Silver Carp.—This large planktivorous species, native to large rivers of eastern Asia, was first imported to the U.S. in 1973 to control phytoplankton in eutrophic water bodies and as a food fish (Freeze and Henderson 1982). Since the mid-1990s, the species has rapidly expanded its distribution and is now self-sustaining in the Mississippi, Missouri, and Ohio River drainages (Conover et al. 2007). The first available record for Silver Carp in the Clarks River is in the lower mainstem in 2004 (TVA unpublished data). Two additional records were reported in 2006, one in the lower mainstem and one above the confluence of the West fork. An additional 17 records were reported between 2010 and 2014, all in the lower mainstem (unpublished data from TVA, KDFWR, and Murray State University). We report the presence of Silver Carp for the first time in the West Fork (Sites 25 and 31), as well as multiple records in the Clarks River upstream of the West Fork confluence (Sites 5, 8, 11, 18, and 19) and the lower mainstem (Site 1). As with Grass Carp, large adults were observed during boat electrofishing in the lower mainstem; all other sites sampled using backpack electrofishing and seining produced only young-of-year juveniles (less than 5 in. total length). High densities were observed in shallow riffles and runs at Sites 1 and 31 (River Subsystem; n = 43-170), and Site 5 (Creek Subsystem; n = 40). Silver Carp were the dominant component in schools mixed with Grass Carp and Common Carp.

Conclusions and Recommendations

Fish community sampling within the Clarks River NWR and proposed expansion area during 2015-2016 detected a total of 79 species of fish. This high level of species diversity corresponds to the rich array of habitat types, including Riverine Systems (lowland rivers and creeks) and Palustrine Systems (ponds, oxbows, sloughs, and vegetated wetlands). Prior fish community data were lacking for Palustrine systems due to the difficulty of accessing and sampling these habitats. Of the 107 species reported from the Clarks River drainage (Table 2), our sampling failed to detect 28 species;

however, several among those could be misidentifications (e.g., Spotfin Shiner, Highfin Carpsucker, Chain Pickerel, Blackstripe Topminnow, and Goldstripe Darter), one species could be extirpated (i.e., Pallid Shiner), and two were likely accidental occurrences (i.e., Goldfish and Fathead Minnow). Other species, such as lampreys, are most often detected during the spring (outside of our sampling period). Also missing from our samples were some large river species (e.g., Paddlefish, American Eel, Threadfin Shad, Bighead Carp, Silver Chub, Quillback, Blue Sucker, and Blue Catfish, and Sauger), which could be present in the lower mainstem outside of our sampling area. Species that we expected to encounter but did not detect in our samples were Pugnose Minnow and Suckermouth Minnow—both are not uncommon and were reported by Alexander (2005).

Our sampling produced two new drainage records (Striped Shiner and Yellow Perch) as well as range extensions within the Clarks River drainage for 15 species, including five SGCN and two exotic species. Fish community health at three mainstem Clarks River sites was evaluated using the KIBI based on 2000 and 2015 data. KIBI scores and rankings at sites (9 and 19) were consistent (“Good”) suggesting temporal stability; however, a large discrepancy at Site 3 (“Fair” in 2000, vs. “Excellent” in 2015) could reflect greater habitat disturbance and instability over time resulting in temporal variability in fish assemblage structure.

Changes in fish species composition, abundance, and distribution documented in this assessment demonstrate the need for periodic surveys to monitor the distribution and population status of rare species. We recommend periodic (every 5-10 years) fish sampling in the Clarks River drainage at locations established herein to serve as a baseline to assess changes to the fish community. Because our sampling involved only single visits to specific localities, there is an inherent amount of error in our ability to detect the full complement species at a given location. This is an important consideration when attempting to assess the status of rare species. Repeated sampling at sites established in this project as well as an additional array of randomly selected localities within the NWR and proposed expansion area could be used to estimate occupancy and detection probability for rare species.

The primary stressors impacting fishes and other aquatic organisms in the Clarks River drainage are clearing and drainage of wetlands and oxbows, channelization, siltation from poor agricultural practices, and domestic and industrial wastes (Burr and Warren 1986). We agree with and reiterate recommendations proposed by Alexander (2005) to enhance and maintain environmental quality in the Clarks River NWR:

1. improving cooperative farming practices on the refuge to reduce soil erosion and the associated transport of environmental contaminants to aquatic systems;
2. continue the implementation of the integrated pest management program on the refuge that couples the proper use of appropriate pesticides with other techniques;
3. installing and protecting vegetative buffer strips along stream channels, ditches, swales, and other water-conveyance conduits on the refuge; and
4. working actively with private landowners, other Federal and State agencies, and non-governmental organizations in the refuge watershed to improve land use practices.

Finally, we would like to emphasize the need for continued long-term research programs on fish communities aimed at inventories of abundance and distribution, ecosystem recovery, and riparian-riverine interactions (Warren and Burr 1994).

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APPENDIX 1

Photos and site occurrences of fishes collected from the Clarks River drainage within the National Wildlife Refuge and proposed expansion area boundaries during 2015-2016. Site numbers correspond to Tables 3-4 and map in Figure 1.



1. Spotted Gar *Lepisosteus oculatus*
Riverine sites: 1, 22
Palustrine sites: 2, 9



2. Longnose Gar *Lepisosteus osseus*
Riverine sites: 1



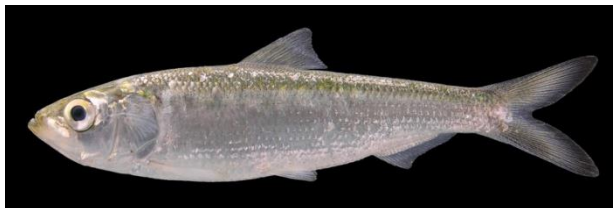
3. Shortnose Gar *Lepisosteus platostomus*
Riverine sites: 1, 7, 22



4. Bowfin *Amia calva*
Riverine sites: 1
Palustrine sites: 6, 11, 14, 20



5. Goldeye *Hiodon alosoides*
Riverine sites: 1



6. Skipjack Herring *Alosa chrysochloris*
Riverine sites: 1



7. Gizzard Shad *Dorosoma cepedianum*
Riverine sites: 1
Palustrine sites: 6, 5, 11



8. Largescale Stoneroller *Campostoma oligolepis* male (top) and female (bottom)
Riverine sites: 3, 7, 9, 15, 19, 21, 22, 25, 30, 31
Palustrine sites: 16



9. Grass Carp *Ctenopharyngodon idella*
Riverine sites: 1, 4, 9, 19, 21, 25,
Palustrine sites: 6, 26



10. Red Shiner *Cyprinella lutrensis*
male (top) and female (bottom)
Riverine sites: 3, 21, 24



11. Steelcolor Shiner *Cyprinella whipplei*
male (top) and female (bottom)
Riverine sites: 3, 7, 9, 15, 19, 21, 22, 24, 25, 30, 31
Palustrine sites: 16



12. Common Carp *Cyprinus carpio*
Riverine sites: 1, 3, 4, 9, 10, 18, 19, 21, 31
Palustrine sites: 5, 11



13. Mississippi Silvery Minnow
Hybognathus nuchalis
Riverine sites: 3, 4, 9, 19, 21, 22, 31
Palustrine sites: 6



14. Silver Carp *Hypophthalmichthys molitrix*
Riverine sites: 1, 18, 19, 25, 31
Palustrine sites: 5, 6, 8, 11



15. Striped Shiner *Luxilus chrysocephalus*
Riverine sites: 21



16. Ribbon Shiner *Lythrurus fumeus*
Riverine sites: 3, 4, 9, 15, 19, 22, 25, 27, 30, 31
Palustrine sites: 6, 14, 16, 28



17. Redfin Shiner *Lythrurus umbratilis*
male (top), immature (bottom)

Riverine sites: 9, 15, 19, 22

Palustrine sites: 12, 16



21. Taillight Shiner *Notropis maculatus*

Palustrine sites: 11



22. Mimic Shiner *Notropis volucellus*

Riverine sites: 3, 9, 19, 31



18. Golden Shiner *Notemigonus crysoleucas*

Riverine sites: 4, 9, 10, 24, 27

Palustrine sites: 2, 5, 6, 8, 11, 12, 14, 16, 20, 23, 28, 29



23. Bluntnose Minnow *Pimephales notatus*

Riverine sites: 4, 19, 21, 22, 30, 31



19. Emerald Shiner *Notropis atherinoides*

Riverine sites: 1, 3, 4, 9



24. Bullhead Minnow *Pimephales vigilax*

Riverine sites: 1, 3, 9, 19, 24, 31

Palustrine sites: 23



20. Bigeye Shiner *Notropis boops*

Riverine sites: 19, 22, 30, 31



25. Creek Chub *Semotilus atromaculatus*

Riverine sites: 10, 15, 18, 21, 24, 25, 30, 31

Palustrine sites: 23



26. River Carpsucker *Carpiodes carpio*
Riverine sites: 1



27. White Sucker *Catostomus commersonii*
Riverine sites: 27



28. Western Creek Chubsucker
Erimyzon claviformis
Riverine sites: 4, 10, 18, 22, 25, 30, 31
Palustrine sites: 5, 11, 16, 26, 28



29. Northern Hog Sucker *Hypentelium nigricans*
Riverine sites: 3, 9, 15, 19, 22, 30, 31



30. Smallmouth Buffalo *Ictiobus bubalus*
Riverine sites: 1, 9
Palustrine sites: 5, 11



31. Bigmouth Buffalo *Ictiobus cyprinellus*
Riverine sites: 1
Palustrine sites: 11



32. Black Buffalo *Ictiobus niger*
Riverine sites: 1
Palustrine sites: 11



33. Spotted Sucker *Minytrema melanops*
Riverine sites: 1, 3, 9, 15, 19, 22, 27, 31
Palustrine sites: 5, 11, 13, 14, 16, 17



34. Golden Redhorse *Moxostoma erythrurum*
Riverine sites: 3, 4, 9, 19, 22, 30, 31



38. Tadpole Madtom *Noturus gyrinus*
Riverine sites: 1, 21, 22, 25



35. Black Bullhead *Ameiurus melas*
Riverine sites: 21
Palustrine sites: 20, 23, 29



39. Brindled Madtom *Noturus miurus*
Riverine sites: 3, 9, 15, 19, 30



36. Yellow Bullhead *Ameiurus natalis*
Riverine sites: 3, 4, 7, 10, 18, 19, 21, 22, 25, 30, 31
Palustrine sites: 5, 6, 16, 28



40. Freckled Madtom *Noturus nocturnus*
Riverine sites: 9, 15, 19



37. Channel Catfish *Ictalurus punctatus*
Riverine sites: 1, 3, 4, 7, 9, 15, 21, 31



41. Flathead Catfish *Pylodictis olivaris*
Riverine sites: 1, 3, 7, 9
Palustrine sites: 11



42. Grass Pickerel *Esox americanus*
Riverine sites: 10, 15, 19, 21, 22, 25
Palustrine sites: 2, 5, 6, 11, 12, 14, 16, 17, 20, 23, 28, 29



43. Central Mudminnow *Umbra limi*

Riverine sites: 10

Palustrine sites: 2, 8, 28



44. Pirate Perch *Aphredoderus sayanus*

Riverine sites: 3, 4, 9, 10, 15, 19, 21, 22, 24, 25, 31

Palustrine sites: 5, 6, 11, 14, 16, 17, 28, 29



45. Brook Silverside *Labidesthes sicculus*

Riverine sites: 1, 19, 27

Palustrine sites: 11, 13, 26



46. Blackspotted Topminnow *Fundulus olivaceus*

Riverine sites: 1, 3, 4, 7, 9, 10, 15, 18, 19, 21, 22, 24, 25, 27, 30, 31

Palustrine sites: 5, 6, 11, 12, 14, 16, 17, 28



47. Western Mosquitofish *Gambusia affinis*

Riverine sites: 3, 4, 7, 9, 10, 15, 19, 21, 22, 24, 25, 27, 30, 31, 32

Palustrine sites: 2, 5, 6, 8, 11, 12, 13, 14, 16, 17, 20, 23, 26, 29



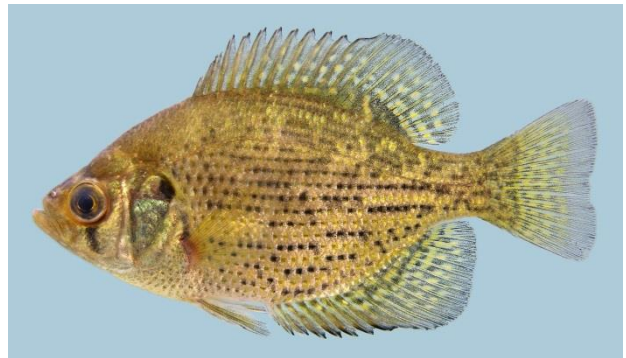
48. White Bass *Morone chrysops*

Riverine sites: 1



49. Yellow Bass *Morone mississippiensis*

Palustrine sites: 2



50. Flier *Centrarchus macropterus*

Riverine sites: 4, 21, 22, 25

Palustrine sites: 5, 6, 12, 14, 16, 20, 23, 29



51. Green Sunfish *Lepomis cyanellus*

Riverine sites: 1, 3, 4, 7, 9, 10, 15, 18, 19, 21, 22, 24, 25, 30, 31, 32

Palustrine sites: 5, 6, 8, 14, 16, 17, 28



52. Warmouth *Lepomis gulosus*

Riverine sites: 1, 4, 15, 21, 22, 31

Palustrine sites: 2, 5, 6, 11, 14, 16, 17, 20, 28



55. Dollar Sunfish *Lepomis marginatus*

Riverine sites: 10

Palustrine sites: 6, 12, 14, 16, 17, 28



53. Orangespotted Sunfish *Lepomis humilis*

Palustrine sites: 11, 23, 26



56. Longear Sunfish *Lepomis megalotis*

Riverine sites: 1, 3, 4, 7, 9, 19, 21, 22, 24, 25, 30, 31

Palustrine sites: 5, 14, 16, 17



54. Bluegill *Lepomis macrochirus*

Riverine sites: 1, 3, 4, 7, 9, 10, 21, 22, 24, 25, 27, 31

Palustrine sites: 5, 6, 11, 12, 13, 14, 16, 17, 20, 23, 26



57. Redear Sunfish *Lepomis microlophus*

Palustrine sites: 5, 6, 11, 12, 13



58. Spotted Bass *Micropterus punctulatus*
Riverine sites: 1, 3, 9, 19, 31



59. Largemouth Bass *Micropterus salmoides*
Riverine sites: 1, 3, 4, 7, 9, 10, 21, 22, 27, 31
Palustrine sites: 5, 6, 11, 12, 14, 23, 26



60. White Crappie *Pomoxis annularis*
Riverine sites: 1, 27
Palustrine sites: 6, 11, 12, 13, 23, 26



61. Black Crappie *Pomoxis nigromaculatus*
Riverine sites: 1, 3
Palustrine sites: 2, 26



62. Mud Darter *Etheostoma asprigene*, male
Riverine sites: 3, 7, 22



63. Bluntnose Darter *Etheostoma chlorosoma*
Riverine sites: 3, 4, 22, 27
Palustrine sites: 13, 14, 16, 26



64. Fantail Darter *Etheostoma flabellare*, male
Riverine sites: 22, 25, 30, 31



65. Slough Darter *Etheostoma gracile*, male
Riverine sites: 3, 4, 7, 9, 10, 15, 19, 21, 22, 24, 25, 30, 31, 32
Palustrine sites: 5, 6, 14, 16, 17, 29



66. Harlequin Darter *Etheostoma histrio*, male
Riverine sites: 3, 7, 9, 15, 19, 31



67. Johnny Darter *Etheostoma nigrum*
Riverine sites: 19, 30, 31



68. Guardian Darter *Etheostoma oophylax*
 male (top) and female (bottom)
Riverine sites: 4, 10, 18, 19, 21, 22, 24, 25, 30, 31
Palustrine sites: 16, 28



69. Cypress Darter *Etheostoma proeliare*
 male (top) and female (bottom)
Riverine sites: 4, 10, 21, 24,
Palustrine sites: 5, 6, 11, 14



70. Redline Darter *Etheostoma rufilineatum*
 male (top) and female (bottom)
Riverine sites: 30, 31



71. Speckled Darter *Etheostoma stigmaeum*
 male (top) and female (bottom)
Riverine sites: 3, 7, 9, 15, 19, 22, 30, 31



72. Bandfin Darter *Etheostoma zonistium*
 male (top) and female (bottom)
Riverine sites: 3, 4, 9, 10, 15, 19, 25, 30, 31



73. Yellow Perch *Perca flavescens*
preserved specimen
Palustrine sites: 6



74. Logperch *Percina caprodes*
Riverine sites: 3, 4, 7, 9, 15, 31



75. Blackside Darter *Percina maculata*
Riverine sites: 3, 4, 22, 31
Palustrine sites: 5, 6



76. Dusky Darter *Percina sciera*
Riverine sites: 3, 7, 9, 15, 19, 25, 30, 31



77. Saddleback Darter *Percina vigil*
male (top) and female (bottom)
Riverine sites: 3, 7, 9, 15, 19, 31



78. Freshwater Drum *Aplodinotus grunniens*
Riverine sites: 1
Palustrine sites: 2



79. Banded Pygmy Sunfish *Elassoma zonatum*
Riverine sites: 4, 7, 10, 22
Palustrine sites: 8, 11, 14, 16

APPENDIX 2

Fish community data collected in the Clarks River drainage during 2015-2016. Species of greatest conservation need are in bold type. UT = unnamed tributary.

Site Number: 1

Stream Name: CLARKS RIVER **Catchment Area:** 566.3 sq. miles
Basin: TENNESSEE **Stream Order:** 5
County: MCCRACKEN **Ecoregion:** INTERIOR RIVER VALLEYS AND HILLS
Lat Dec: 37.04786
Long Dec: -88.54234
Location: from Sheenan Bridge (KY 3075), 1 stream mi. upstream
Collection Date: 9/15/2015
Collection Method: BOAT ELECTROFISHER
Collector: M.Thomas, S.Brandt, A.Martin
Collection Number: MRT-15-129

Species	Individuals
<i>Lepisosteus oculatus</i>	6
<i>Lepisosteus osseus</i>	4
<i>Lepisosteus platostomus</i>	3
<i>Amia calva</i>	7
<i>Hiodon alosoides</i>	4
<i>Dorosoma cepedianum</i>	206
<i>Ctenopharyngodon idella</i>	1
<i>Cyprinus carpio</i>	3
<i>Hypophthalmichthys molitrix</i>	170
<i>Notropis atherinoides</i>	38
<i>Pimephales vigilax</i>	19
<i>Carpiodes carpio</i>	1
<i>Ictiobus bubalus</i>	8
<i>Ictiobus cyprinellus</i>	4
<i>Ictiobus niger</i>	3
<i>Minytrema melanops</i>	4
<i>Ictalurus punctatus</i>	5
<i>Noturus gyrinus</i>	3
<i>Pylodictis olivaris</i>	3
<i>Fundulus olivaceus</i>	49
<i>Labidesthes sicculus</i>	3
<i>Morone chrysops</i>	1
<i>Lepomis cyanellus</i>	2
<i>Lepomis gulosus</i>	3
<i>Lepomis macrochirus</i>	55
<i>Lepomis megalotis</i>	57
<i>Micropterus punctulatus</i>	3
<i>Micropterus salmoides</i>	4
<i>Pomoxis annularis</i>	3
<i>Pomoxis nigromaculatus</i>	2
<i>Aplodinotus grunniens</i>	8

Native Species Richness: 28
Darter + Madtom + Sculpin: 1
Water Column Richness: 11
Intolerant Richness: 1
Top Carnivore Richness: 11
Simple Lithophil Richness: 2
Minnow Richness: 5
Headwater Richness: 0
Darter Richness: 0

Taxa Richness (TR): 31
Total No of Individuals (TNI): 682
Percent Omnivores: 42.08
Percent Insectivores excluding Tolerants: 18.04
Percent Tolerants: 12.17
Percent Pioneers: 19.94
Percent Facultative Headwater: 99.56

Site Number: 2

Stream Name: CLARKS RIVER **Catchment Area:** 0.1 sq. miles
Basin: TENNESSEE **Stream Order:** 1
County: MCCRACKEN **Ecoregion:** INTERIOR RIVER VALLEYS AND HILLS
Lat Dec: 36.9609
Long Dec: -88.49835
Location: Wetland; Lindsey Impoundment; 3 mi. NE of Symsonia; 0.25 mi. SW of KY 787/Powers Rd. jct.
Collection Date: 4/12/2016
Collection Method: OTHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-16-103

Species	Individuals
<i>Lepisosteus oculatus</i>	1
<i>Notemigonus crysoleucas</i>	3
<i>Esox americanus</i>	2
<i>Umbra limi</i>	1
<i>Gambusia affinis</i>	1
<i>Morone mississippiensis</i>	1
<i>Lepomis gulosus</i>	1
<i>Pomoxis annularis</i>	1
<i>Aplodinotus grunniens</i>	1

Native Species Richness: 9
Darter + Madtom + Sculpin: 0
Water Column Richness: 4
Intolerant Richness: 1
Top Carnivore Richness: 4
Simple Lithophil Richness: 0
Minnow Richness: 1
Headwater Richness: 0
Darter Richness: 0

Taxa Richness (TR): 9
Total No of Individuals (TNI): 12
Percent Omnivores: 25
Percent Insectivores excluding Tolerants: 16.67
Percent Tolerants: 33.33
Percent Pioneers: 8.333
Percent Facultative Headwater: 91.66

Site Number: 3

Stream Name: EAST FORK CLARKS RIVER **Catchment Area:** 309 sq. miles

Basin: TENNESSEE

Stream Order: 5

County: MCCRACKEN

Ecoregion: INTERIOR RIVER VALLEYS AND HILLS

Lat Dec: 36.96139

Long Dec: -88.49444

Location: Below KY 787 (Bryant Ford Rd.) crossing

Collection Date: 9/14/2015

Collection Method: BACKPACK ELECTROFISHER, SEINE

Collector: M.Thomas, S.Brandt

Collection Number: MRT-15-128

Species	Individuals
<i>Camptostoma oligolepis</i>	3
<i>Cyprinella lutrensis</i>	1
<i>Cyprinella whipplei</i>	68
<i>Cyprinus carpio</i>	3
<i>Hybognathus nuchalis</i>	34
<i>Lythrurus fumeus</i>	81
<i>Notropis atherinoides</i>	9
<i>Notropis volucellus</i>	13
<i>Pimephales vigilax</i>	35
<i>Hypentelium nigricans</i>	3
<i>Minytrema melanops</i>	2
<i>Moxostoma erythrurum</i>	4
<i>Ameiurus natalis</i>	2
<i>Ictalurus punctatus</i>	23
<i>Noturus miurus</i>	5
<i>Pylodictis olivaris</i>	4
<i>Aphredoderus sayanus</i>	5
<i>Fundulus olivaceus</i>	33
<i>Gambusia affinis</i>	33
<i>Lepomis cyanellus</i>	7
<i>Lepomis macrochirus</i>	11
<i>Lepomis megalotis</i>	95
<i>Micropterus punctulatus</i>	5
<i>Micropterus salmoides</i>	6
<i>Pomoxis nigromaculatus</i>	1
<i>Etheostoma asprigene</i>	13
<i>Etheostoma chlorosoma</i>	2
<i>Etheostoma gracile</i>	3
<i>Etheostoma histrio</i>	30
<i>Etheostoma stigmaeum</i>	10
<i>Etheostoma zonistium</i>	1
<i>Percina caprodes</i>	12
<i>Percina maculata</i>	2
<i>Percina sciera</i>	23
<i>Percina vigil</i>	61

Native Species Richness: 34
Darter + Madtom + Sculpin: 11
Water Column Richness: 8
Intolerant Richness: 6
Top Carnivore Richness: 4
Simple Lithophil Richness: 11
Minnow Richness: 9
Headwater Richness: 0
Darter Richness: 10

Taxa Richness (TR): 35
Total No of Individuals (TNI): 643
Percent Omnivores: 18.66
Percent Insectivores excluding Tolerants: 57.85
Percent Tolerants: 27.68
Percent Pioneers: 23.01
Percent Facultative Headwater: 95.8

Site Number: 4

Stream Name: LICK CREEK **Catchment Area:** 5.7 sq. miles
Basin: TENNESSEE **Stream Order:** 2
County: MARSHALL **Ecoregion:** INTERIOR RIVER VALLEYS AND HILLS
Lat Dec: 36.9391
Long Dec: -88.47196
Location: Off Sharpe-Elva Road; 0.8 stream river miles above Clarks River confluence
Collection Date: 9/2/2015
Collection Method: BACKPACK ELECTROFISHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-126

Species	Individuals
<i>Ctenopharyngodon idella</i>	1
<i>Cyprinus carpio</i>	3
<i>Hybognathus nuchalis</i>	37
<i>Lythrurus fasciolaris</i>	1
<i>Notemigonus crysoleucas</i>	1
<i>Notropis atherinoides</i>	1
<i>Pimephales notatus</i>	1
<i>Erimyzon claviformis</i>	2
<i>Moxostoma erythrurum</i>	1
<i>Ameiurus natalis</i>	3
<i>Ictalurus punctatus</i>	2
<i>Aphredoderus sayanus</i>	47
<i>Fundulus olivaceus</i>	7
<i>Gambusia affinis</i>	74
<i>Elassoma zonatum</i>	3
<i>Centrarchus macropterus</i>	1
<i>Lepomis cyanellus</i>	7
<i>Lepomis gulosus</i>	12
<i>Lepomis macrochirus</i>	18
<i>Lepomis megalotis</i>	7
<i>Micropterus salmoides</i>	2
<i>Etheostoma chlorosoma</i>	3
<i>Etheostoma gracile</i>	38
<i>Etheostoma oophylax</i>	2
<i>Etheostoma proeliare</i>	9
<i>Etheostoma zonistium</i>	1
<i>Percina caprodes</i>	1
<i>Percina maculata</i>	5

Native Species Richness: 26
Darter + Madtom + Sculpin: 7
Water Column Richness: 7
Intolerant Richness: 2
Top Carnivore Richness: 1
Simple Lithophil Richness: 5
Minnow Richness: 7
Headwater Richness: 1
Darter Richness: 7

Taxa Richness (TR): 28
Total No of Individuals (TNI): 290
Percent Omnivores: 16.55
Percent Insectivores excluding Tolerants: 48.28
Percent Tolerants: 37.58
Percent Pioneers: 16.2
Percent Facultative Headwater: 80.68

Site Number: 5

Stream Name: CLARKS RIVER **Catchment Area:** 0.6 sq. miles
Basin: TENNESSEE **Stream Order:** 1
County: MARSHALL **Ecoregion:** INTERIOR RIVER VALLEYS AND HILLS
Lat Dec: 36.93959
Long Dec: -88.46563
Location: UT-Off Sharpe-Elva Road; 50 m above Clarks River confluence
Collection Date: 9/1/2015
Collection Method: BACKPACK ELECTROFISHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-125

Species	Individuals
<i>Dorosoma cepedianum</i>	3
<i>Cyprinus carpio</i>	19
<i>Hypophthalmichthys molitrix</i>	40
<i>Notemigonus crysoleucas</i>	1
<i>Erimyzon claviformis</i>	1
<i>Ictiobus bubalus</i>	1
<i>Minytrema melanops</i>	1
<i>Ameiurus natalis</i>	2
<i>Esox americanus</i>	6
<i>Aphredoderus sayanus</i>	8
<i>Fundulus olivaceus</i>	1
<i>Gambusia affinis</i>	97
<i>Centrarchus macropterus</i>	13
<i>Lepomis cyanellus</i>	9
<i>Lepomis gulosus</i>	4
<i>Lepomis macrochirus</i>	8
<i>Lepomis megalotis</i>	4
<i>Lepomis microlophus</i>	1
<i>Micropterus salmoides</i>	3
<i>Etheostoma gracile</i>	3
<i>Etheostoma proeliare</i>	1
<i>Percina maculata</i>	1

Native Species Richness: 20
Darter + Madtom + Sculpin: 3
Water Column Richness: 7
Intolerant Richness: 1
Top Carnivore Richness: 2
Simple Lithophil Richness: 2
Minnow Richness: 3
Headwater Richness: 0
Darter Richness: 3

Taxa Richness (TR): 22
Total No of Individuals (TNI): 227
Percent Omnivores: 11.45
Percent Insectivores excluding Tolerants: 16.74
Percent Tolerants: 61.23
Percent Pioneers: 11.89
Percent Facultative Headwater: 98.23

Site Number: 6

Stream Name: DUNN SLOUGH CREEK **Catchment Area:** 0.1 sq. miles
Basin: TENNESSEE **Stream Order:** 1
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.93012
Long Dec: -88.45482
Location: Wetland; 0.9 mi E of Sharpe Elva Rd.
Collection Date: 6/15/2016
Collection Method: BACKPACK ELECTROFISHER, SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-16-50

Species	Individuals
<i>Amia calva</i>	1
<i>Dorosoma cepedianum</i>	1
<i>Ctenopharyngodon idella</i>	4
<i>Hybognathus nuchalis</i>	4
<i>Hypophthalmichthys molitrix</i>	8
<i>Lythrurus fumeus</i>	1
<i>Notemigonus crysoleucas</i>	1
<i>Ameiurus natalis</i>	1
<i>Esox americanus</i>	1
<i>Aphredoderus sayanus</i>	4
<i>Fundulus olivaceus</i>	1
<i>Gambusia affinis</i>	20
<i>Centrarchus macropterus</i>	2
<i>Lepomis cyanellus</i>	1
<i>Lepomis gulosus</i>	5
<i>Lepomis macrochirus</i>	9
<i>Lepomis marginatus</i>	1
<i>Lepomis microlophus</i>	2
<i>Micropterus salmoides</i>	1
<i>Pomoxis annularis</i>	5
<i>Etheostoma gracile</i>	6
<i>Etheostoma proeliare</i>	1
<i>Perca flavescens</i>	1
<i>Percina maculata</i>	3

Native Species Richness: 22
Darter + Madtom + Sculpin: 3
Water Column Richness: 7
Intolerant Richness: 1
Top Carnivore Richness: 4
Simple Lithophil Richness: 1
Minnow Richness: 5
Headwater Richness: 0
Darter Richness: 3

Taxa Richness (TR): 24
Total No of Individuals (TNI): 84
Percent Omnivores: 8.333
Percent Insectivores excluding Tolerants: 29.76
Percent Tolerants: 40.47
Percent Pioneers: 21.42
Percent Facultative Headwater: 91.66

Site Number: 7

Stream Name: CLARKS RIVER **Catchment Area:** 295.5 sq. miles
Basin: TENNESSEE **Stream Order:** 4
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.90689
Long Dec: -88.41074
Location: at Milliken Mill Ln bridge, downstream 150 m
Collection Date: 6/14/2016
Collection Method: BACKPACK ELECTROFISHER, SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-16-46

Species	Individuals
<i>Lepisosteus platostomus</i>	1
<i>Camptostoma oligolepis</i>	1
<i>Cyprinella whipplei</i>	1
<i>Ameiurus natalis</i>	1
<i>Ictalurus punctatus</i>	4
<i>Pylodictis olivaris</i>	1
<i>Fundulus olivaceus</i>	2
<i>Gambusia affinis</i>	6
<i>Elassoma zonatum</i>	1
<i>Lepomis cyanellus</i>	7
<i>Lepomis macrochirus</i>	1
<i>Lepomis megalotis</i>	2
<i>Micropterus salmoides</i>	4
<i>Etheostoma asprigene</i>	1
<i>Etheostoma gracile</i>	3
<i>Etheostoma histrio</i>	2
<i>Etheostoma stigmaeum</i>	1
<i>Percina caprodes</i>	1
<i>Percina sciera</i>	3
<i>Percina vigil</i>	1

Native Species Richness: 20
Darter + Madtom + Sculpin: 7
Water Column Richness: 5
Intolerant Richness: 4
Top Carnivore Richness: 3
Simple Lithophil Richness: 5
Minnow Richness: 2
Headwater Richness: 0
Darter Richness: 7

Taxa Richness (TR): 20
Total No of Individuals (TNI): 44
Percent Omnivores: 11.36
Percent Insectivores excluding Tolerants: 40.91
Percent Tolerants: 43.18
Percent Pioneers: 22.72
Percent Facultative Headwater: 88.63

Site Number: 8

Stream Name: MIDDLE FORK CREEK **Catchment Area:** 0.1 sq. miles
Basin: TENNESSEE **Stream Order:** 1
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.89682
Long Dec: -88.40886
Location: Wetland; powerline corridor; 0.37 mi E of Milliken Mill Ln.
Collection Date: 6/14/2016
Collection Method: SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-16-47

Species	Individuals
<i>Hypophthalmichthys molitrix</i>	1
<i>Notemigonus crysoleucas</i>	30
<i>Umbra limi</i>	1
<i>Gambusia affinis</i>	30
<i>Elassoma zonatum</i>	1
<i>Lepomis cyanellus</i>	30

Native Species Richness: 5	Taxa Richness (TR): 6
Darter + Madtom + Sculpin: 0	Total No of Individuals (TNI): 93
Water Column Richness: 1	Percent Omnivores: 32.25
Intolerant Richness: 1	Percent Insectivores excluding Tolerants: 2.15
Top Carnivore Richness: 0	Percent Tolerants: 96.77
S imple Lithophil Richness: 0	Percent Pioneers: 32.25
Minnow Richness: 2	Percent Facultative Headwater: 97.84
Headwater Richness: 0	
Darter Richness: 0	

Site Number: 9

Stream Name: EAST FORK CLARKS RIVER **Catchment Area:** 250 sq. miles

Basin: TENNESSEE

Stream Order: 5

County: MARSHALL

Ecoregion: MISSISSIPPI VALLEY LOESS PLAI

Lat Dec: 36.89861

Long Dec: -88.38222

Location: Off Tucker Lane; 2.3 stream mi. below Egners Branch confluence

Collection Date: 9/16/2015

Collection Method: BACKPACK ELECTROFISHER, SEINE

Collector: M.Thomas, S.Brandt, M.Johnson

Collection Number: MRT-15-132

Species	Individuals
<i>Camptostoma oligolepis</i>	14
<i>Ctenopharyngodon idella</i>	9
<i>Cyprinella whipplei</i>	42
<i>Cyprinus carpio</i>	21
<i>Hybognathus nuchalis</i>	48
<i>Lythrurus fumeus</i>	146
<i>Lythrurus umbratilis</i>	3
<i>Notemigonus crysoleucas</i>	1
<i>Notropis atherinoides</i>	3
<i>Notropis volucellus</i>	15
<i>Pimephales vigilax</i>	26
<i>Hypentelium nigricans</i>	9
<i>Ictiobus bubalus</i>	2
<i>Minytrema melanops</i>	1
<i>Moxostoma erythrurum</i>	2
<i>Ictalurus punctatus</i>	22
<i>Noturus miurus</i>	6
<i>Noturus nocturnus</i>	2
<i>Pylodictis olivaris</i>	4
<i>Aphredoderus sayanus</i>	1
<i>Fundulus olivaceus</i>	4
<i>Gambusia affinis</i>	19
<i>Lepomis cyanellus</i>	3
<i>Lepomis macrochirus</i>	21
<i>Lepomis megalotis</i>	13
<i>Micropterus punctulatus</i>	1
<i>Micropterus salmoides</i>	1
<i>Etheostoma gracile</i>	6
<i>Etheostoma histrio</i>	17
<i>Etheostoma stigmaeum</i>	2
<i>Etheostoma zonistium</i>	4
<i>Percina caprodes</i>	5
<i>Percina sciera</i>	20
<i>Percina vigil</i>	93

Native Species Richness: 32
Darter + Madtom + Sculpin: 9
Water Column Richness: 8
Intolerant Richness: 7
Top Carnivore Richness: 3
Simple Lithophil Richness: 11
Minnow Richness: 11
Headwater Richness: 0
Darter Richness: 7

Taxa Richness (TR): 34
Total No of Individuals (TNI): 586
Percent Omnivores: 23.54
Percent Insectivores excluding Tolerants: 39.25
Percent Tolerants: 40.61
Percent Pioneers: 10.75
Percent Facultative Headwater: 95.39

Site Number: 10

Stream Name: EGNERS BRANCH
Catchment Area: 4.2 sq. miles
Basin: TENNESSEE
Stream Order: 2
County: MARSHALL
Ecoregion: MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.8812
Long Dec: -88.34499
Location: At USFWS Clarks River National Wildlife Refuge Headquarters property; 1.09 stream miles
Collection Date: 8/12/2015
Collection Method: BACKPACK ELECTROFISHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-123

Species	Individuals
<i>Cyprinus carpio</i>	2
<i>Notemigonus crysoleucas</i>	24
<i>Semotilus atromaculatus</i>	15
<i>Erimyzon claviformis</i>	9
<i>Ameiurus natalis</i>	2
<i>Esox americanus</i>	2
<i>Umbra limi</i>	5
<i>Aphredoderus sayanus</i>	15
<i>Fundulus olivaceus</i>	6
<i>Gambusia affinis</i>	2
<i>Elasoma zonatum</i>	4
<i>Lepomis cyanellus</i>	10
<i>Lepomis macrochirus</i>	7
<i>Lepomis marginatus</i>	6
<i>Micropterus salmoides</i>	2
<i>Etheostoma gracile</i>	4
<i>Etheostoma oophylax</i>	22
<i>Etheostoma proeliare</i>	23
<i>Etheostoma zonistium</i>	1

Native Species Richness: 18
Darter + Madtom + Sculpin: 4
Water Column Richness: 4
Intolerant Richness: 3
Top Carnivore Richness: 2
Simple Lithophil Richness: 1
Minnow Richness: 3
Headwater Richness: 1
Darter Richness: 4

Taxa Richness (TR): 19
Total No of Individuals (TNI): 161
Percent Omnivores: 26.7
Percent Insectivores excluding Tolerants: 59.01
Percent Tolerants: 39.75
Percent Pioneers: 29.19
Percent Facultative Headwater: 54.03

Site Number: 11A

Stream Name: CLARKS RIVER Catchment Area: 1 sq. miles
Basin: TENNESSEE Stream Order: 1
County: MARSHALL Ecoregion: MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.87959
Long Dec: -88.34554
Location: Wetland/Pond; USFWS Clarks River National Wildlife Refuge Headquarters back property
Collection Date: 9/15/2015
Collection Method: BOAT ELECTROFISHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-130

Species	Individuals
<i>Lepisosteus oculatus</i>	8
<i>Amia calva</i>	4
<i>Dorosoma cepedianum</i>	1
<i>Cyprinus carpio</i>	3
<i>Hypophthalmichthys molitrix</i>	4
<i>Notemigonus crysoleucas</i>	4
<i>Notropis maculatus</i>	1
<i>Ictiobus bubalus</i>	1
<i>Ictiobus cyprinellus</i>	1
<i>Ictiobus niger</i>	1
<i>Minytrema melanops</i>	1
<i>Pylodictis olivaris</i>	1
<i>Fundulus olivaceus</i>	22
<i>Labidesthes sicculus</i>	1
<i>Lepomis gulosus</i>	2
<i>Lepomis macrochirus</i>	1
<i>Lepomis microlophus</i>	4
<i>Micropterus salmoides</i>	7
<i>Pomoxis annularis</i>	3

Native Species Richness: 17
Darter + Madtom + Sculpin: 0
Water Column Richness: 8
Intolerant Richness: 0
Top Carnivore Richness: 5
Simple Lithophil Richness: 1
Minnow Richness: 4
Headwater Richness: 0
Darter Richness: 0

Taxa Richness (TR): 19
Total No of Individuals (TNI): 70
Percent Omnivores: 15.71
Percent Insectivores excluding Tolerants: 42.86
Percent Tolerants: 21.42
Percent Pioneers: 10
Percent Facultative Headwater: 100

Site Number: 11B

Stream Name: CLARKS RIVER **Catchment Area:** 1 sq. mile
Basin: TENNESSEE **Stream Order:** 1
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.87959
Long Dec: -88.34554
Location: Wetland/Pond; USFWS Clarks River National Wildlife Refuge Headquarters back property
Collection Date: 6/13/2016
Collection Method: SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-16-45

Species	Individuals
<i>Lepisosteus oculatus</i>	1
<i>Notemigonus crysoleucas</i>	3
<i>Notropis maculatus</i>	1
<i>Erimyzon claviformis</i>	1
<i>Esox americanus</i>	1
<i>Aphredoderus sayanus</i>	1
<i>Fundulus olivaceus</i>	1
<i>Gambusia affinis</i>	1
<i>Elassoma zonatum</i>	2
<i>Lepomis gulosus</i>	1
<i>Lepomis humilis</i>	3
<i>Lepomis macrochirus</i>	1
<i>Micropterus salmoides</i>	1
<i>Etheostoma proeliare</i>	15

Native Species Richness: 14	Taxa Richness (TR): 14
Darter + Madtom + Sculpin: 1	Total No of Individuals (TNI): 33
Water Column Richness: 7	Percent Omnivores: 9.09
Intolerant Richness: 1	Percent Insectivores excluding Tolerants: 72.73
Top Carnivore Richness: 3	Percent Tolerants: 18.18
Simple Lithophil Richness: 0	Percent Pioneers: 18.18
Minnow Richness: 2	Percent Facultative Headwater: 48.48
Headwater Richness: 0	
Darter Richness: 1	

Site Number: 12

Stream Name: CLARKS RIVER **Catchment Area:** 0.009 sq. miles
Basin: TENNESSEE **Stream Order:** 1
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.87881
Long Dec: -88.34557
Location: UT: downstream of US 641 bridge, just S of Clarks River NWR office
Collection Date: 6/13/2016
Collection Method: SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-16-44

Species	Individuals
<i>Lythrurus umbratilis</i>	1
<i>Notemigonus crysoleucas</i>	1
<i>Esox americanus</i>	1
<i>Fundulus olivaceus</i>	1
<i>Gambusia affinis</i>	1
<i>Centrarchus macropterus</i>	1
<i>Lepomis macrochirus</i>	1
<i>Lepomis marginatus</i>	2
<i>Lepomis microlophus</i>	1
<i>Micropterus salmoides</i>	1
<i>Pomoxis annularis</i>	1

Native Species Richness: 11
Darter + Madtom + Sculpin: 0
Water Column Richness: 6
Intolerant Richness: 0
Top Carnivore Richness: 3
Simple Lithophil Richness: 1
Minnow Richness: 2
Headwater Richness: 0
Darter Richness: 0

Taxa Richness (TR): 11
Total No of Individuals (TNI): 12
Percent Omnivores: 8.333
Percent Insectivores excluding Tolerants: 50.00
Percent Tolerants: 33.33
Percent Pioneers: 33.33
Percent Facultative Headwater: 100

Site Number: 13

Stream Name: JOHNS RIVER **Catchment Area:** 1 sq. miles
Basin: TENNESSEE **Stream Order:** 1
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.85727
Long Dec: -88.33183
Location: Pond; pond built by USFWS on refuge property; Off KY 408; 1 mi. E of Benton
Collection Date: 8/12/2015
Collection Method: SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-121

Species	Individuals
<i>Minytrema melanops</i>	1
<i>Gambusia affinis</i>	50
<i>Labidesthes sicculus</i>	14
<i>Lepomis macrochirus</i>	4
<i>Lepomis microlophus</i>	3
<i>Pomoxis annularis</i>	1
<i>Etheostoma chlorosoma</i>	5

Native Species Richness: 7
Darter + Madtom + Sculpin: 1
Water Column Richness: 3
Intolerant Richness: 0
Top Carnivore Richness: 1
Simple Lithophil Richness: 1
Minnow Richness: 0
Headwater Richness: 0
Darter Richness: 1

Taxa Richness (TR): 7
Total No of Individuals (TNI): 78
Percent Omnivores:
Percent Insectivores excluding Tolerants: 29.49
Percent Tolerants: 69.23
Percent Pioneers: 8.974
Percent Facultative Headwater: 93.58

Site Number: 14

Stream Name: JOHNS RIVER **Catchment Area:** 7.79 sq. miles
Basin: TENNESSEE **Stream Order:** 2
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.85641
Long Dec: -88.32866
Location: At HWY 408 bridge crossing; 0.8 stream miles above East Fork Clarks River confluence
Collection Date: 8/12/2015
Collection Method: BACKPACK ELECTROFISHER, SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-122

Species	Individuals
<i>Amia calva</i>	1
<i>Lythrurus fasciolaris</i>	10
<i>Notemigonus crysoleucas</i>	9
<i>Minytrema melanops</i>	1
<i>Esox americanus</i>	6
<i>Aphredoderus sayanus</i>	2
<i>Fundulus olivaceus</i>	6
<i>Gambusia affinis</i>	5
<i>Elassoma zonatum</i>	1
<i>Centrarchus macropterus</i>	5
<i>Lepomis cyanellus</i>	4
<i>Lepomis gulosus</i>	8
<i>Lepomis macrochirus</i>	16
<i>Lepomis marginatus</i>	1
<i>Lepomis megalotis</i>	1
<i>Micropterus salmoides</i>	4
<i>Etheostoma chlorosoma</i>	1
<i>Etheostoma gracile</i>	37
<i>Etheostoma proeliare</i>	1

Native Species Richness: 19
Darter + Madtom + Sculpin: 3
Water Column Richness: 9
Intolerant Richness: 1
Top Carnivore Richness: 3
Simple Lithophil Richness: 1
Minnow Richness: 2
Headwater Richness: 0
Darter Richness: 3

Taxa Richness (TR): 19
Total No of Individuals (TNI): 119
Percent Omnivores: 7.563
Percent Insectivores excluding Tolerants: 62.18
Percent Tolerants: 31.93
Percent Pioneers: 25.21
Percent Facultative Headwater: 66.38

Site Number: 15

Stream Name: CLARKS RIVER **Catchment Area:** 233.8 sq. miles
Basin: TENNESSEE **Stream Order:** 4
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.85921
Long Dec: -88.31422
Location: from KY 408 bridge to Tubbs Branch confluence
Collection Date: 6/13/2016
Collection Method: BACKPACK ELECTROFISHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-16-43

Species	Individuals
<i>Campostoma oligolepis</i>	5
<i>Cyprinella whipplei</i>	18
<i>Lythrurus fumeus</i>	13
<i>Lythrurus umbratilis</i>	2
<i>Semotilus atromaculatus</i>	4
<i>Hypentelium nigricans</i>	2
<i>Minytrema melanops</i>	1
<i>Ictalurus punctatus</i>	2
<i>Noturus miurus</i>	1
<i>Noturus nocturnus</i>	1
<i>Esox americanus</i>	2
<i>Aphredoderus sayanus</i>	1
<i>Fundulus olivaceus</i>	11
<i>Gambusia affinis</i>	20
<i>Lepomis cyanellus</i>	13
<i>Lepomis gulosus</i>	1
<i>Lepomis megalotis</i>	15
<i>Etheostoma gracile</i>	4
<i>Etheostoma histrio</i>	3
<i>Etheostoma stigmaeum</i>	5
<i>Etheostoma zonistium</i>	3
<i>Percina caprodes</i>	2
<i>Percina sciera</i>	3
<i>Percina vigil</i>	18

Native Species Richness: 24
Darter + Madtom + Sculpin: 9
Water Column Richness: 7
Intolerant Richness: 7
Top Carnivore Richness: 1
Simple Lithophil Richness: 9
Minnow Richness: 5
Headwater Richness: 0
Darter Richness: 7

Taxa Richness (TR): 24
Total No of Individuals (TNI): 150
Percent Omnivores: 4
Percent Insectivores excluding Tolerants: 60.67
Percent Tolerants: 33.33
Percent Pioneers: 22
Percent Facultative Headwater: 90

Site Number: 16

Stream Name: BEAVERDAM SLOUGH **Catchment Area:** 5.7 sq. miles
Basin: TENNESSEE **Stream Order:** 2
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.8246
Long Dec: -88.30427
Location: Off Dogtown Road; Off Clarks River National Wildlife Refuge Road; 1.18 stream miles
Collection Date: 8/3/2015
Collection Method: BACKPACK ELECTROFISHER, SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-112

Species	Individuals
<i>Campostoma oligolepis</i>	1
<i>Cyprinella whipplei</i>	2
<i>Lythrurus fumeus</i>	27
<i>Lythrurus umbratilis</i>	13
<i>Notemigonus crysoleucas</i>	9
<i>Erimyzon claviformis</i>	1
<i>Minytrema melanops</i>	2
<i>Ameiurus natalis</i>	14
<i>Esox americanus</i>	5
<i>Aphredoderus sayanus</i>	8
<i>Fundulus olivaceus</i>	21
<i>Gambusia affinis</i>	15
<i>Elassoma zonatum</i>	1
<i>Centrarchus macropterus</i>	7
<i>Lepomis cyanellus</i>	20
<i>Lepomis gulosus</i>	22
<i>Lepomis macrochirus</i>	5
<i>Lepomis marginatus</i>	6
<i>Lepomis megalotis</i>	42
<i>Etheostoma chlorosoma</i>	7
<i>Etheostoma gracile</i>	21
<i>Etheostoma oophylax</i>	4

Native Species Richness: 22
Darter + Madtom + Sculpin: 3
Water Column Richness: 10
Intolerant Richness: 0
Top Carnivore Richness: 1
Simple Lithophil Richness: 2
Minnow Richness: 5
Headwater Richness: 1
Darter Richness: 3

Taxa Richness (TR): 22
Total No of Individuals (TNI): 253
Percent Omnivores: 9.09
Percent Insectivores excluding Tolerants: 62.06
Percent Tolerants: 35.57
Percent Pioneers: 37.94
Percent Facultative Headwater: 86.95

Site Number: 17

Stream Name: MYERS CREEK

Basin: TENNESSEE

County: MARSHALL

Lat Dec: 36.81622

Long Dec: -88.2995

Location: UT_off Dogtown Road; 0.9 stream miles above Myers Creek confluence

Collection Date: 8/3/2015

Collection Method: BACKPACK ELECTROFISHER

Collector: M.Thomas, S.Brandt

Collection Number: MRT-15-113

Catchment Area: 0.4 sq. miles

Stream Order: 1

Ecoregion: MISSISSIPPI VALLEY LOESS PLAIN

Species	Individuals
<i>Minytrema melanops</i>	1
<i>Esox americanus</i>	1
<i>Aphredoderus sayanus</i>	1
<i>Fundulus olivaceus</i>	38
<i>Gambusia affinis</i>	60
<i>Lepomis cyanellus</i>	3
<i>Lepomis gulosus</i>	3
<i>Lepomis macrochirus</i>	1
<i>Lepomis marginatus</i>	1
<i>Lepomis megalotis</i>	5
<i>Etheostoma gracile</i>	13

Native Species Richness: 11

Darter + Madtom + Sculpin: 1

Water Column Richness: 5

Intolerant Richness: 0

Top Carnivore Richness: 1

Simple Lithophil Richness: 1

Minnow Richness: 0

Headwater Richness: 0

Darter Richness: 1

Taxa Richness (TR): 11

Total No of Individuals (TNI): 127

Percent Omnivores:

Percent Insectivores excluding Tolerants: 48.82

Percent Tolerants: 50.39

Percent Pioneers: 10.23

Percent Facultative Headwater: 89.76

Site Number: 18

Stream Name: NANNY CREEK **Catchment Area:** 1.68 sq. miles
Basin: TENNESSEE **Stream Order:** 2
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.8332
Long Dec: -88.28682
Location: Off HWY 1897; 0.77 stream miles above East Fork Clarks River confluence
Collection Date: 8/11/2015
Collection Method: BACKPACK ELECTROFISHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-120

Species	Individuals
<i>Cyprinus carpio</i>	3
<i>Hypophthalmichthys molitrix</i>	1
<i>Semotilus atromaculatus</i>	74
<i>Erimyzon claviformis</i>	5
<i>Ameiurus natalis</i>	2
<i>Fundulus olivaceus</i>	2
<i>Lepomis cyanellus</i>	3
<i>Etheostoma oophlax</i>	4

Native Species Richness: 6
Darter + Madtom + Sculpin: 1
Water Column Richness: 1
Intolerant Richness: 1
Top Carnivore Richness: 0
Simple Lithophil Richness: 0
Minnow Richness: 3
Headwater Richness: 0
Darter Richness: 1

Taxa Richness (TR): 8
Total No of Individuals (TNI): 94
Percent Omnivores: 84.04
Percent Insectivores excluding Tolerants: 11.70
Percent Tolerants: 87.23
Percent Pioneers: 87.23
Percent Facultative Headwater: 17.02

Site Number: 19

Stream Name: CLARKS RIVER **Catchment Area:** 198.5 sq. miles
Basin: TENNESSEE **Stream Order:** 4
County: MARSHALL **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.82753
Long Dec: -88.29668
Location: Off Dogtown Road; At Washburn Ford; 0.28 stream miles above Nanny Branch confluence
Collection Date: 8/13/2015
Collection Method: BACKPACK ELECTROFISHER, SEINE
Collector: M.Thomas. S.Brandt
Collection Number: MRT-15-124

Species	Individuals
<i>Campostoma oligolepis</i>	13
<i>Ctenopharyngodon idella</i>	5
<i>Cyprinella whipplei</i>	46
<i>Cyprinus carpio</i>	2
<i>Hybognathus nuchalis</i>	8
<i>Hypophthalmichthys molitrix</i>	5
<i>Lythrurus fumeus</i>	55
<i>Lythrurus umbratilis</i>	24
<i>Notropis boops</i>	23
<i>Notropis volucellus</i>	2
<i>Pimephales notatus</i>	1
<i>Pimephales vigilax</i>	46
<i>Hypentelium nigricans</i>	1
<i>Minytrema melanops</i>	1
<i>Moxostoma erythrurum</i>	2
<i>Ameiurus natalis</i>	4
<i>Noturus miurus</i>	2
<i>Noturus nocturnus</i>	1
<i>Esox americanus</i>	1
<i>Aphredoderus sayanus</i>	3
<i>Fundulus olivaceus</i>	4
<i>Gambusia affinis</i>	40
<i>Labidesthes sicculus</i>	3
<i>Lepomis cyanellus</i>	26
<i>Lepomis megalotis</i>	37
<i>Micropterus punctulatus</i>	5
<i>Etheostoma gracile</i>	8
<i>Etheostoma histrio</i>	2
<i>Etheostoma nigrum</i>	1
<i>Etheostoma oophylax</i>	2
<i>Etheostoma stigmaeum</i>	4
<i>Etheostoma zonistium</i>	7
<i>Percina sciera</i>	6
<i>Percina vigil</i>	7

Native Species Richness: 31
Darter + Madtom + Sculpin: 10
Water Column Richness: 9
Intolerant Richness: 7
Top Carnivore Richness: 2
Simple Lithophil Richness: 10
Minnow Richness: 12
Headwater Richness: 1
Darter Richness: 8

Taxa Richness (TR): 34
Total No of Individuals (TNI): 397
Percent Omnivores: 15.86
Percent Insectivores excluding Tolerants: 46.35
Percent Tolerants: 43.82
Percent Pioneers: 27.95
Percent Facultative Headwater: 94.71

Site Number: 20

Stream Name: BLIZZARD PONDS **Catchment Area:** 8 sq. miles
Basin: TENNESSEE **Stream Order:** 1
County: MCCRACKEN **Ecoregion:** INTERIOR RIVER VALLEYS AND HILLS
Lat Dec: 36.97366
Long Dec: -88.57595
Location: Pond/Wetland Complex; 0.78 air miles W of Farrington Airpark
Collection Date: 9/16/2015
Collection Method: BACKPACK ELECTROFISHER
Collector: M.R. Thomas, S.Brandt
Collection Number: MRT-15-131A

Species	Individuals
<i>Amia calva</i>	1
<i>Notemigonus crysoleucas</i>	45
<i>Ameiurus melas</i>	4
<i>Esox americanus</i>	1
<i>Gambusia affinis</i>	20
<i>Centrarchus macropterus</i>	5
<i>Lepomis gulosus</i>	7
<i>Lepomis macrochirus</i>	1

Native Species Richness: 8
Darter + Madtom + Sculpin: 0
Water Column Richness: 4
Intolerant Richness: 0
Top Carnivore Richness: 2
Simple Lithophil Richness: 0
Minnow Richness: 1
Headwater Richness: 0
Darter Richness: 0

Taxa Richness (TR): 8
Total No of Individuals (TNI): 84
Percent Omnivores: 58.33
Percent Insectivores excluding Tolerants: 14.29
Percent Tolerants: 83.33
Percent Pioneers: 9.523
Percent Facultative Headwater: 100

Site Number: 21

Stream Name: BLIZZARD PONDS

Catchment Area: 9.21 sq. miles

Basin: TENNESSEE

Stream Order: 4

County: MCCRACKEN

Ecoregion: INTERIOR RIVER VALLEYS AND HILLS

Lat Dec: 36.97597

Long Dec: -88.59991

Location: BLIZZARD PONDS DRAINAGE CANAL UPSTREAM OF KY 1954 BRIDGE

Collection Date: 9/16/2015

Method: BACKPACK ELECTROFISHER, SEINE

Collector: M.R. Thomas, S.Brandt

Collection Number: MRT-15-131B

Species	Individuals
<i>Campostoma oligolepis</i>	125
<i>Ctenopharyngodon idella</i>	13
<i>Cyprinella lutrensis</i>	24
<i>Cyprinella whipplei</i>	3
<i>Cyprinus carpio</i>	32
<i>Hybognathus nuchalis</i>	39
<i>Luxilus chrysocephalus</i>	1
<i>Pimephales notatus</i>	15
<i>Semotilus atromaculatus</i>	28
<i>Ameiurus melas</i>	1
<i>Ameiurus natalis</i>	10
<i>Ictalurus punctatus</i>	8
<i>Noturus gyrinus</i>	3
<i>Esox americanus</i>	3
<i>Aphredoderus sayanus</i>	5
<i>Fundulus olivaceus</i>	26
<i>Gambusia affinis</i>	16
<i>Centrarchus macropterus</i>	2
<i>Lepomis cyanellus</i>	12
<i>Lepomis gulosus</i>	4
<i>Lepomis macrochirus</i>	18
<i>Lepomis megalotis</i>	39
<i>Micropterus salmoides</i>	2
<i>Etheostoma gracile</i>	6
<i>Etheostoma oophylax</i>	2
<i>Etheostoma proeliare</i>	4

Native Species Richness: 24
Darter + Madtom + Sculpin: 4
Water Column Richness: 5
Intolerant Richness: 2
Top Carnivore Richness: 2
Simple Lithophil Richness: 1
Minnow Richness: 9
Headwater Richness: 1
Darter Richness: 3

Taxa Richness (TR): 26
Total No of Individuals (TNI): 441
Percent Omnivores: 35.6
Percent Insectivores excluding Tolerants: 21.32
Percent Tolerants: 30.61
Percent Pioneers: 26.53
Percent Facultative Headwater: 90.24

Site Number: 22

Stream Name: CAMP CREEK

Catchment Area: 14.7 sq. miles

Basin: TENNESSEE

Stream Order: 3

County: MCCRACKEN

Ecoregion: INTERIOR RIVER VALLEYS AND HILLS

Lat Dec: 36.95659

Long Dec: -88.5435

Location: at KY 450 bridge, downstream 220 m

Collection Date: 6/15/2016

Collection Method: BACKPACK ELECTROFISHER

Collector: M.Thomas, S.Brandt

Collection Number: MRT-16-51

Species	Individuals
<i>Lepisosteus oculatus</i>	1
<i>Lepisosteus platostomus</i>	1
<i>Camptostoma oligolepis</i>	10
<i>Cyprinella whipplei</i>	1
<i>Hybognathus nuchalis</i>	45
<i>Lythrurus fumeus</i>	2
<i>Lythrurus umbratilis</i>	3
<i>Notemigonus crysoleucas</i>	1
<i>Notropis boops</i>	6
<i>Pimephales notatus</i>	37
<i>Erismyzon claviformis</i>	1
<i>Hypentelium nigricans</i>	4
<i>Minytrema melanops</i>	1
<i>Moxostoma erythrurum</i>	4
<i>Ameiurus natalis</i>	7
<i>Noturus gyrinus</i>	1
<i>Esox americanus</i>	4
<i>Aphredoderus sayanus</i>	4
<i>Fundulus olivaceus</i>	8
<i>Gambusia affinis</i>	25
<i>Elassoma zonatum</i>	3
<i>Centrarchus macropterus</i>	6
<i>Lepomis cyanellus</i>	19
<i>Lepomis gulosus</i>	4
<i>Lepomis macrochirus</i>	20
<i>Lepomis megalotis</i>	36
<i>Micropterus salmoides</i>	3
<i>Etheostoma asprigene</i>	7
<i>Etheostoma chlorosoma</i>	2
<i>Etheostoma flabellare</i>	14
<i>Etheostoma gracile</i>	6
<i>Etheostoma oophylax</i>	1
<i>Etheostoma stigmaeum</i>	3
<i>Percina maculata</i>	2

Native Species Richness: 34
Darter + Madtom + Sculpin: 8
Water Column Richness: 14
Intolerant Richness: 2
Top Carnivore Richness: 4
Simple Lithophil Richness: 7
Minnow Richness: 8
Headwater Richness: 2
Darter Richness: 7

Taxa Richness (TR): 34
Total No of Individuals (TNI): 292
Percent Omnivores: 30.82
Percent Insectivores excluding Tolerants: 40.07
Percent Tolerants: 39.04
Percent Pioneers: 40.06
Percent Facultative Headwater: 86.98

Site Number: 23

Stream Name: HORSESHOE POND **Catchment Area:** 0.1 sq. miles
Basin: TENNESSEE **Stream Order:** 1
County: GRAVES **Ecoregion:** INTERIOR RIVER VALLEYS AND HILLS
Lat Dec: 36.93961
Long Dec: -88.53962
Location: Pond; 1.7 mi. NW of Symsonia; 150 m S of Waid Rd
Collection Date: 6/14/2016
Collection Method: BACKPACK ELECTROFISHER, SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-16-48

Species	Individuals
<i>Notemigonus crysoleucas</i>	30
<i>Pimephales vigilax</i>	5
<i>Semotilus atromaculatus</i>	2
<i>Ameiurus melas</i>	1
<i>Esox americanus</i>	5
<i>Gambusia affinis</i>	30
<i>Centrarchus macropterus</i>	5
<i>Lepomis humilis</i>	1
<i>Lepomis macrochirus</i>	4
<i>Micropterus salmoides</i>	5
<i>Pomoxis annularis</i>	2

Native Species Richness: 11
Darter + Madtom + Sculpin: 0
Water Column Richness: 4
Intolerant Richness: 0
Top Carnivore Richness: 3
Simple Lithophil Richness: 0
Minnow Richness: 3
Headwater Richness: 0
Darter Richness: 0

Taxa Richness (TR): 11
Total No of Individuals (TNI): 90
Percent Omnivores: 42.22
Percent Insectivores excluding Tolerants: 6.67
Percent Tolerants: 85.55
Percent Pioneers: 13.33
Percent Facultative Headwater: 97.77

Site Number: 24

Stream Name: WEST FORK CLARKS RIVER **Catchment Area:** 187.1 sq. miles
Basin: TENNESSEE **Stream Order:** 5
County: GRAVES **Ecoregion:** INTERIOR RIVER VALLEYS AND HILLS
Lat Dec: 36.93947
Long Dec: -88.53876
Location: 1.7 mi. NW of Symsonia; 170 m S of Waid Rd
Collection Date: 6/14/2016
Collection Method: BACKPACK ELECTROFISHER, SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-16-49

Species	Individuals
<i>Lamprey ammocoete</i>	1
<i>Cyprinella lutrensis</i>	2
<i>Cyprinella whipplei</i>	16
<i>Notemigonus crysoleucas</i>	1
<i>Pimephales vigilax</i>	2
<i>Semotilus atromaculatus</i>	1
<i>Aphredoderus sayanus</i>	10
<i>Fundulus olivaceus</i>	4
<i>Gambusia affinis</i>	20
<i>Lepomis cyanellus</i>	6
<i>Lepomis macrochirus</i>	3
<i>Lepomis megalotis</i>	3
<i>Etheostoma gracile</i>	8
<i>Etheostoma oophylax</i>	2
<i>Etheostoma proeliare</i>	5

Native Species Richness: 15
Darter + Madtom + Sculpin: 3
Water Column Richness: 2
Intolerant Richness: 1
Top Carnivore Richness: 0
Simple Lithophil Richness: 0
Minnow Richness: 5
Headwater Richness: 2
Darter Richness: 3

Taxa Richness (TR): 15
Total No of Individuals (TNI): 84
Percent Omnivores: 7.142
Percent Insectivores excluding Tolerants: 57.14
Percent Tolerants: 39.28
Percent Pioneers: 17.85
Percent Facultative Headwater: 79.76

Site Number: 25

Stream Name: SUGAR CREEK
Basin: TENNESSEE
County: GRAVES
Lat Dec: 36.88751
Long Dec: -88.52971
Location: Off Tim Road; 1.3 miles above West Fork Clarks River confluence
Collection Date: 8/11/2015
Collection Method: BACKPACK ELECTROFISHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-119

Catchment Area: 6.8 sq. miles
Stream Order: 2
Ecoregion: MISSISSIPPI VALLEY LOESS PLAIN

Species	Individuals
<i>Camptostoma oligolepis</i>	2
<i>Ctenopharyngodon idella</i>	72
<i>Cyprinella whipplei</i>	3
<i>Hypophthalmichthys molitrix</i>	5
<i>Lythrurus fumeus</i>	12
<i>Semotilus atromaculatus</i>	11
<i>Erimyzon claviformis</i>	5
<i>Ameiurus natalis</i>	11
<i>Noturus gyrinus</i>	1
<i>Esox americanus</i>	1
<i>Aphredoderus sayanus</i>	3
<i>Fundulus olivaceus</i>	4
<i>Gambusia affinis</i>	1
<i>Centrarchus macropterus</i>	1
<i>Lepomis cyanellus</i>	6
<i>Lepomis macrochirus</i>	1
<i>Lepomis megalotis</i>	7
<i>Etheostoma flabellare</i>	8
<i>Etheostoma gracile</i>	1
<i>Etheostoma oophylax</i>	13
<i>Etheostoma zonistium</i>	10
<i>Percina sciera</i>	2

Native Species Richness: 20
Darter + Madtom + Sculpin: 6
Water Column Richness: 5
Intolerant Richness: 3
Top Carnivore Richness: 1
Simple Lithophil Richness: 2
Minnow Richness: 6
Headwater Richness: 2
Darter Richness: 5

Taxa Richness (TR): 22
Total No of Individuals (TNI): 180
Percent Omnivores: 12.22
Percent Insectivores excluding Tolerants: 32.22
Percent Tolerants: 23.33
Percent Pioneers: 16.66
Percent Facultative Headwater: 75.55

Site Number: 26

Stream Name: SPRING CREEK **Catchment Area:** 1 sq. miles
Basin: TENNESSEE **Stream Order:** 1
County: GRAVES **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.86259
Long Dec: -88.57317
Location: Pond/Wetland; off HWY 131; overflow from Spring Creek
Collection Date: 9/2/2015
Collection Method: SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-127B

Species	Individuals
<i>Ctenopharyngodon idella</i>	2
<i>Erimyzon claviformis</i>	1
<i>Gambusia affinis</i>	50
<i>Labidesthes sicculus</i>	1
<i>Lepomis cyanellus</i>	6
<i>Lepomis humilis</i>	4
<i>Lepomis macrochirus</i>	100
<i>Micropterus salmoides</i>	1
<i>Pomoxis annularis</i>	5
<i>Pomoxis nigromaculatus</i>	1
<i>Etheostoma chlorosoma</i>	29

Native Species Richness: 10
Darter + Madtom + Sculpin: 1
Water Column Richness: 4
Intolerant Richness: 0
Top Carnivore Richness: 3
Simple Lithophil Richness: 0
Minnow Richness: 1
Headwater Richness: 0
Darter Richness: 1

Taxa Richness (TR): 11
Total No of Individuals (TNI): 200
Percent Omnivores:
Percent Insectivores excluding Tolerants: 17.50
Percent Tolerants: 78.5
Percent Pioneers: 55.5
Percent Facultative Headwater: 85.5

Site Number: 27

Stream Name: SPRING CREEK **Catchment Area:** 12.1 sq. miles
Basin: TENNESSEE **Stream Order:** 3
County: GRAVES **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.86213
Long Dec: -88.57343
Location: Above HWY 131 bridge crossing; 1.45 stream miles above West Fork Clarks River
Collection Date: 9/2/2015
Collection Method: SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-127A

Species	Individuals
<i>Lythrurus fumeus</i>	20
<i>Notemigonus crysoleucas</i>	2
<i>Catostomus commersonii</i>	1
<i>Minytrema melanops</i>	20
<i>Fundulus olivaceus</i>	18
<i>Gambusia affinis</i>	10
<i>Labidesthes sicculus</i>	1
<i>Lepomis macrochirus</i>	20
<i>Micropterus salmoides</i>	1
<i>Pomoxis annularis</i>	1
<i>Etheostoma chlorosoma</i>	10

Native Species Richness: 11
Darter + Madtom + Sculpin: 1
Water Column Richness: 2
Intolerant Richness: 0
Top Carnivore Richness: 2
Simple Lithophil Richness: 2
Minnow Richness: 2
Headwater Richness: 0
Darter Richness: 1

Taxa Richness (TR): 11
Total No of Individuals (TNI): 104
Percent Omnivores: 2.884
Percent Insectivores excluding Tolerants: 47.12
Percent Tolerants: 51.92
Percent Pioneers: 19.23
Percent Facultative Headwater: 89.42

Site Number: 28

Stream Name: WEST FORK CLARKS RIVER **Catchment Area:** 131.8 sq. miles
Basin: TENNESSEE **Stream Order:** 6
County: GRAVES **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.8456
Long Dec: -88.5217
Location: Off Tim Road; Relict Channel; Old Casey Bridge crossing
Collection Date: 8/4/2015
Collection Method: BACKPACK ELECTROFISHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-116

Species	Individuals
<i>Lythrurus fumeus</i>	11
<i>Notemigonus crysoleucas</i>	17
<i>Erimyzon claviformis</i>	13
<i>Ameiurus natalis</i>	1
<i>Esox americanus</i>	1
<i>Umbra limi</i>	1
<i>Aphredoderus sayanus</i>	1
<i>Fundulus olivaceus</i>	26
<i>Lepomis cyanellus</i>	1
<i>Lepomis gulosus</i>	2
<i>Lepomis marginatus</i>	23
<i>Etheostoma oophylax</i>	12

Native Species Richness: 12
Darter + Madtom + Sculpin: 1
Water Column Richness: 4
Intolerant Richness: 1
Top Carnivore Richness: 1
Simple Lithophil Richness: 0
Minnow Richness: 2
Headwater Richness: 1
Darter Richness: 1

Taxa Richness (TR): 12
Total No of Individuals (TNI): 109
Percent Omnivores: 16.51
Percent Insectivores excluding Tolerants: 71.56
Percent Tolerants: 27.52
Percent Pioneers: 35.77
Percent Facultative Headwater: 88.07

Site Number: 29

Stream Name: WEST FORK CLARKS RIVER **Catchment Area:** 0.4 sq .miles
Basin: TENNESSEE **Stream Order:** 1
County: GRAVES **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.84084
Long Dec: -88.52608
Location: UT_West Fork Clarks River; Off Tim Road; 0.6 stream miles above West Fork Clarks
Collection Date: 8/4/2015
Collection Method: SEINE
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-115

Species	Individuals
<i>Notemigonus crysoleucas</i>	50
<i>Ameiurus natalis</i>	24
<i>Esox americanus</i>	1
<i>Aphredoderus sayanus</i>	2
<i>Gambusia affinis</i>	20
<i>Centrarchus macropterus</i>	40
<i>Etheostoma gracile</i>	2

Native Species Richness: 7
Darter + Madtom + Sculpin: 1
Water Column Richness: 2
Intolerant Richness: 0
Top Carnivore Richness: 1
Simple Lithophil Richness: 0
Minnow Richness: 1
Headwater Richness: 0
Darter Richness: 1

Taxa Richness (TR): 7
Total No of Individuals (TNI): 139
Percent Omnivores: 53.23
Percent Insectivores excluding Tolerants: 31.65
Percent Tolerants: 67.62
Percent Pioneers:
Percent Facultative Headwater: 98.56

Site Number: 30

Stream Name: TRACE CREEK

Basin: TENNESSEE

County: GRAVES

Lat Dec: 36.82999

Long Dec: -88.53938

Location: Off HWY 301 bridge crossing; 1 stream mile above West Fork Clarks River confluence

Collection Date: 8/4/2015

Collection Method: BACKPACK ELECTROFISHER

Collector: M.Thomas, S.Brandt

Collection Number: MRT-15-118

Catchment Area: 6.4 sq. miles

Stream Order: 3

Ecoregion: MISSISSIPPI VALLEY LOESS PLAIN

Species	Individuals
<i>Lamprey ammocoete</i>	2
<i>Camptostoma oligolepis</i>	14
<i>Cyprinella whipplei</i>	3
<i>Lythrurus fumeus</i>	3
<i>Notropis boops</i>	2
<i>Pimephales notatus</i>	1
<i>Semotilus atromaculatus</i>	41
<i>Erimyzon claviformis</i>	8
<i>Hypentelium nigricans</i>	2
<i>Moxostoma erythrurum</i>	3
<i>Ameiurus natalis</i>	5
<i>Noturus miurus</i>	2
<i>Fundulus olivaceus</i>	4
<i>Gambusia affinis</i>	3
<i>Lepomis cyanellus</i>	8
<i>Lepomis megalotis</i>	3
<i>Etheostoma flabellare</i>	15
<i>Etheostoma gracile</i>	2
<i>Etheostoma nigrum</i>	2
<i>Etheostoma oophylax</i>	13
<i>Etheostoma rufileatum</i>	5
<i>Etheostoma stigmaeum</i>	8
<i>Etheostoma zonistium</i>	54
<i>Percina sciera</i>	1

Native Species Richness: 24
Darter + Madtom + Sculpin: 9
Water Column Richness: 6
Intolerant Richness: 5
Top Carnivore Richness: 0
Simple Lithophil Richness: 6
Minnow Richness: 6
Headwater Richness: 3
Darter Richness: 8

Taxa Richness (TR): 24
Total No of Individuals (TNI): 204
Percent Omnivores: 23.03
Percent Insectivores excluding Tolerants: 62.25
Percent Tolerants: 29.9
Percent Pioneers: 30.88
Percent Facultative Headwater: 35.78

Site Number: 31**Stream Name:** WEST FORK CLARKS RIVER **Catchment Area:** 126.1 sq. miles**Basin:** TENNESSEE**Stream Order:** 3**County:** GRAVES**Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN**Lat Dec:** 36.83729**Long Dec:** -88.52686**Location:** Channelized portion off Tim Road; At Pull Tight Branch confluence**Collection Date:** 8/4/2015**Collection Method:** BACKPACK ELECTROFISHER, SEINE**Collector:** M.Thomas. S.Brandt**Collection Number:** MRT-15-117

Species	Individuals
<i>Camptostoma oligolepis</i>	6
<i>Ctenopharyngodon idella</i>	27
<i>Cyprinella whipplei</i>	57
<i>Cyprinus carpio</i>	23
<i>Hybognathus nuchalis</i>	1
<i>Hypophthalmichthys molitrix</i>	43
<i>Lythrurus fasciolaris</i>	91
<i>Notropis boops</i>	8
<i>Notropis volucellus</i>	3
<i>Pimephales notatus</i>	6
<i>Pimephales vigilax</i>	12
<i>Semotilus atromaculatus</i>	2
<i>Erimyzon claviformis</i>	3
<i>Hypentelium nigricans</i>	6
<i>Minytrema melanops</i>	1
<i>Moxostoma erythrurum</i>	7
<i>Ameiurus natalis</i>	9
<i>Ictalurus punctatus</i>	3
<i>Aphredoderus sayanus</i>	1
<i>Fundulus olivaceus</i>	10
<i>Gambusia affinis</i>	60
<i>Lepomis cyanellus</i>	28
<i>Lepomis gulosus</i>	1
<i>Lepomis macrochirus</i>	5
<i>Lepomis megalotis</i>	27
<i>Micropterus punctulatus</i>	1
<i>Micropterus salmoides</i>	1
<i>Etheostoma flabellare</i>	2
<i>Etheostoma gracile</i>	11
<i>Etheostoma histrio</i>	5
<i>Etheostoma nigrum</i>	4
<i>Etheostoma oophylax</i>	1
<i>Etheostoma rufilineatum</i>	7
<i>Etheostoma stigmaeum</i>	1
<i>Etheostoma zonistium</i>	2
<i>Percina caprodes</i>	3
<i>Percina maculata</i>	2
<i>Percina sciera</i>	6
<i>Percina vigil</i>	4

Native Species Richness: 36
Darter + Madtom + Sculpin: 12
Water Column Richness: 10
Intolerant Richness: 6
Top Carnivore Richness: 2
Simple Lithophil Richness: 11
Minnow Richness: 12
Headwater Richness: 2
Darter Richness: 12

Taxa Richness (TR): 39
Total No of Individuals (TNI): 490
Percent Omnivores: 12.04
Percent Insectivores excluding Tolerants: 53.06
Percent Tolerants: 29.79
Percent Pioneers: 17.95
Percent Facultative Headwater: 95.1

Site Number: 32

Stream Name: PULL TIGHT BRANCH **Catchment Area:** 1.7 sq. miles
Basin: TENNESSEE **Stream Order:** 2
County: GRAVES **Ecoregion:** MISSISSIPPI VALLEY LOESS PLAIN
Lat Dec: 36.83136
Long Dec: -88.52817
Location: Off Tim Road; 0.4 stream miles above West Fork Clarks River confluence
Collection Date: 8/4/2015
Collection Method: BACKPACK ELECTROFISHER
Collector: M.Thomas, S.Brandt
Collection Number: MRT-15-114

Species	Individuals
<i>Gambusia affinis</i>	7
<i>Lepomis cyanellus</i>	1
<i>Etheostoma gracile</i>	1

Native Species Richness: 3	Taxa Richness (TR): 3
Darter + Madtom + Sculpin: 1	Total No of Individuals (TNI): 9
Water Column Richness: 0	Percent Omnivores:
Intolerant Richness: 0	Percent Insectivores excluding Tolerants: 11.11
Top Carnivore Richness: 0	Percent Tolerants: 88.88
Simple Lithophil Richness: 0	Percent Pioneers: 11.11
Minnow Richness: 0	Percent Facultative Headwater: 88.88
Headwater Richness: 0	
Darter Richness: 1	