Temporal Change in Fish Assemblages of Triplett Creek, Kentucky

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Abstract: Historical records and natural history collections have been used as important tools to determine the status of populations. The objectives of this project were to compile a list of the fishes that have inhabited Triplett Creek and to identify changes in the fish assemblage in Triplett Creek. Historical records and vouchered specimens document 80 species from 19 families in the Triplett Creek system between 1890 and 1998. In a survey of the Triplett Creek system in 1999 and 2000, 16,554 specimens were collected, representing 54 species from 11 families. At least 3 fish species are considered extirpated from Triplett Creek, and 3 new fish species [*Gambusia affinis* (western mosquitofish), *Moxostoma macrolepidotum* (shorthead redhorse), *Percina copelandi* (channel darter)] were collected. A comparison of 3 collecting periods using Jaccard's Coefficient of Community Similarity (CC) indicates that the fish assemblages are similar (pre-1950 vs. 1950–1998 CC=0.77; pre-1950 vs. 1999–2000 CC=0.66; 1950–1998 vs. 1999–2000 CC=0.69). Differences in collecting methods and intensity were considered important factors limiting the detection of changes in the fish assemblage.

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The southeastern United States supports the greatest diversity of freshwater fishes found in North America (Warren et al. 2000). Preservation of biodiversity in this region is a goal that has been outlined by states (Ky. Nat. Resour. and Environ. Protection Cabinet and Ky. Long-Term Policy Res. Ctr. 1997) and by organizations such as the Southeastern Fishes Council (Warren et al. 2000). The freshwater fauna of the Southeast faces many threats, the most severe of which includes dam building, channelization, deforestation, pollution, and other impacts associated with population growth (Etnier and Starnes 1993, Warren et al. 2000). Many of these impacts have caused fragmentation or extirpation of freshwater fish populations (Warren et al. 2000). Population sizes often become severely limited before efforts are made to conserve a species. Lack of available long-term research on most species prevents all but the sharpest declines in population size from being readily detectable (Shaffer et al. 1998).

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Conservation of southeastern fishes has been impeded by the limited available information on their habitat requirements and life history (Warren et al. 2000). Documentation of existing biodiversity is the critical first step towards the protection of the rich natural heritage of this region. Historical survey data, even in its most basic form, can be a useful tool in determining the conservation status of populations. Often researchers turn to previous survey data and natural history collections in order to document changes in the status of fish species or assemblages of fishes (Edwards and Contreras-Balderas 1991, Reznick et al. 1994, Weaver and Garman 1994, Patton et al. 1998, Shaffer et al. 1998). Although statistical analysis may not be possible due to different collecting methodologies or inadequate data, simple presence/absence data can be useful in determining changes in fish assemblages (Shaffer et al. 1998).

Considerable historical data is available for Triplett Creek, a major tributary of the Licking River in northeastern Kentucky. The first of 2 historical periods of fish collection occurred before most anthropogenic disturbances to Triplett Creek. These collections, primarily made by Gilbert and Henshall in 1890 (Woolman 1892) and Welter in 1936–1938 (Welter 1938), focused on the mainstem of Triplett Creek near Morehead. A renewed period of intense collecting began in the mid-1970s led by L. M. Meade and ichthyology classes of Morehead State University. Meade continued collecting, primarily in the mainstem of Triplett Creek, until the mid-1990s. Although few of his records are published, nearly all specimens collected were vouchered in the Morehead State University Collection of Fishes (MOSU). In addition, the North Fork of Triplett Creek was intensively sampled by seining and boat electrofishing in 1984–1987 by Tim Slone and Kentucky Fish and Wildlife Resources (T. Slone, Morehead State Univ., unpubl. Master's thesis).

The main disturbances in the Triplett Creek system are similar to those of many rural Southeastern streams. These include excessive siltation due to poor agricultural practices and logging activities, gravel mining, all terrain vehicle activity, and pollution from untreated sewage (Burr and Warren 1986; T. Slone, Morehead State Univ., unpubl. Master's thesis; K.A. McCafferty, Morehead State Univ., unpubl. Master's thesis). In addition, the city of Morehead, with a population of about 8,000, and Morehead State University, with an enrollment of about 9,000, create additional disturbances to the watershed, including urban runoff, loss of the floodplain to development, impoundments, and channelization. There are 3 small dams in the Triplett Creek system. The largest of these is a 3-m low-head dam constructed in 1935 on Triplett Creek mainstem in Morehead which creates a small impoundment that serves as the water source for Morehead State University (Joe Planck, pers. commun.). Two additional small (1- to 2-m) dams are located in the upper portion of Triplett Creek and the middle portion of the mainstem of North Fork of Triplett Creek. In 1972, a 3.2-km reach of the mainstem of Triplett Creek was widened, straightened and deepened (U.S. Army Corps Eng., pers. commun.) for the purpose of flood control. The upstream end of the channelized reach begins below the 3-m dam in Morehead. A sewage treatment plant is located in the lower part of the Triplett Creek watershed, but releases its effluent into the Licking River. There are 9 sites identified by the U.S. Environmental Protect. Agency with discharges into the Triplett Creek system. Anthropogenic disturbances to the Triplett Creek system have generally increased during the past 100 years as the population has grown in the watershed.

The availability of extensive historical collection information provides an opportunity to examine whether increasing anthropogenic disturbances are associated with changes to the ichthyofauna. The objectives of this study are to compile an updated list of fishes inhabiting Triplett Creek and to identify temporal changes in fish assemblages of Triplett Creek.

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Methods

Sample Site

Triplett Creek, a fifth order upland stream in Rowan County, Kentucky, is a major tributary of the Licking River. The Triplett Creek watershed, which drains 487 km^2, lies within portions of the Unglaciated Allegheny Plateau and the Knobstone Escarpment and Knobs subsection of the Bluegrass Region (Burr and Warren 1986). The watershed primarily consists of steep hills covered by hardwood forests overlaying Mississippian and Pennsylvanian shales, siltstones, and sandstones. Valley floors have largely been converted to row crops and pasture. Nine km above its mouth, Triplett Creek splits into 2 equally-sized branches, the North Fork of Triplett Creek and a southern branch. Although the southern branch is occasionally referred to as "South Fork of Triplett Creek" (Burr and Warren 1986) we follow U.S. Geological Survey maps in calling it simply "Triplett Creek."

Collecting Protocol

Fish populations were sampled at 30 sites located on Triplett Creek and its major tributaries. Nineteen of the sites were located on the mainstem of Triplett

Creek. In order to form a more complete picture of the fish community and to examine seasonal differences in distribution and abundance, most sites were sampled 3 times during the course of a year: spring (Apr–May 1999); late summer/fall (Aug–Oct 1999); and winter (Jan–Mar 2000). A site was defined as including at least 1 run, 1 riffle, and 1 pool. Fishes were sampled at each site with a 3.1- x 1.9-m (3-mm mesh) seine for 60 minutes or until it was determined that a representative sample had been obtained. In the fall, following seining, each site was sampled with a backpack electrofisher (Smith-Root model 15D generator powered) in an effort to capture species that are difficult to capture with a seine. Although we had hoped to sample some downstream areas with a boat electrofisher as had been done by Slone (Morehead State Univ., unpubl. Master's thesis), large log jams and fallen trees blocked access from launching areas. Fishes that were easily identifiable were recorded and released. The rest of the fishes were preserved in 10% formalin and identified in the laboratory. Voucher specimens were placed in 45% isopropanol and cataloged in MOSU. Fish nomenclature follows Mayden et al. (1992) except that we recognize *Ammocrypta* as a valid genus in agreement with Wood and Mayden (1997) and Near et al. (2000).

To document historical fish assemblages, the holdings of museum collections were canvassed to locate specimens from Triplett Creek. Relevant material was found at MOSU, SIUC, CU, USNM, UMMZ, and Eastern Kentucky University (EKU). In addition to museum collections, published data on Triplett Creek fishes were gathered from the scientific literature, including the Kentucky Fish and Wildlife Resources Fisheries Bulletin. Data from historical records were divided into 3 collecting periods: Period 1, collections between 1890–1949; Period 2, collections made between 1950–1998; and Period 3, collections made between 1999–2000, including this study. The time periods were assigned based on discreet breaks in collecting activity during which little or no collecting occurred.

Data Analysis

Jaccard's Coefficient of Community Similarity (CC) was used to examine the change in fish assemblages observed among the 3 collecting periods. Jaccard's Coefficient was chosen because it is a robust test, not heavily influenced by differences in collecting intensity or method, and because presence/absence data was the only information consistently available for each historical record. This metric is computed as the proportion of unique species captured in 2 samples and ranges from 0 indicating no similarity to 1.0 indicating identical assemblages. Jaccard's Coefficient does not allow statistical inferences to be made, but values less than 0.60 generally are interpreted as indicating substantial differences in species presence/absence (Lohr and Fausch 1997). Jaccard's Coefficient was calculated excluding those fishes represented in the Triplett Creek system by a single specimen in an attempt to include only those fishes that are "real members" of the fish assemblage and reduce the emphasis on rare species (Matthews 1998).

Results

In 1999–2000, a total of 16,554 individuals and 54 fish species from 11 families were collected at 30 sites in 85 collections. Sites 1, 2, 3, 5, and 10 were not sampled during the winter period because of inaccessibility due to ice or flooding. The species comprising the top 50% of all individuals collected were *Pimephales notatus* (bluntnose minnow, 29%), *Luxilus chrysocephalus* (striped shiner, 15%) and *Cyprinella spiloptera* (spotfin shiner, 10%). In the spring, 3,214 individuals from 39 species were collected between 23 April 1999 and 21 May 1999. The fish species comprising the top 50% of all individuals collected in the spring were bluntnose minnow (16%), spotfin shiner (16%), striped shiner (14%), and *Rhinichthys atratulus* (blacknose dace, 9%). In the fall, 9,638 individuals from 53 species were collected between 26 August 1999 and 10 October 1999. The fish species comprising the top 50% of all individuals collected in the fall were bluntnose minnow (29%), striped shiner (14%), and *Cyprinella whipplei* (steelcolor shiner, 8%). In the winter 3,702 individuals from 31 species were collected between 16 January 2000 and 12 March 2000. The fish species comprising the top 50% of all individuals collected in the winter were bluntnose minnow (34%) and steelcolor shiner (16%).

A survey of historical data found that 60 species were documented in the Triplett Creek system before 1950 (Period 1). Between 1950 and 1998 (Period 2), a total of 74 species were recorded in the Triplett Creek system (Table 1). Jaccard's Coefficient was higher than 0.6 (0.66–0.77) for all comparisons among the 3 collecting periods (Table 2), indicating that assemblages of each of the time periods were similar. Ten species, *Ichthyomyzon bdellium* (Ohio lamprey), *Lepisosteus osseus* (longnose gar), *Dorosoma cepedianum* (gizzard shad), *Cyprinus carpio* (common carp), *Macrhybopsis aestivalis* (speckled chub), *Ameiurus melas* (black bullhead), *Ameiurus nebulosus* (brown bullhead), *Ictalurus punctatus* (channel catfish), *Noturus flavus* (stonecat), and *Esox americanus* (grass pickerel), only were collected during the first 2 historical periods. Five species, *Polyodon spathula* (paddlefish), *Hiodon tergisus* (mooneye), *Alosa chrysochloris* (skipjack herring), *Percopsis omiscomaycus* (trout-perch), and *Fundulus notatus* (blackstripe topminnow) only were collected during the first historical period, prior to 1950. Twelve species, *Anguilla rostrata* (American eel), *Notemigonus crysoleucas* (golden shiner), *Carpiodes carpio* (river carpsucker), *Carpiodes velifer* (highfin carpsucker), *Ictiobus bubalus* (smallmouth buffalo), *Ictiobus cyprinellus* (bigmouth buffalo), *Moxostoma carinatum* (river redhorse), *Oncorhynchus mykiss* (rainbow trout), *Culaea inconstans* (brook stickleback), *Pomoxis nigromaculatus* (black crappie), *Percina oxyrhynchus* (sharpnose darter), and *Stizostedion canadense* (sauger) only were reported during the second historical period, between 1950 and 1998. Three species, *Moxostoma macrolepidotum* (shorthead redhorse), *Gambusia affinis* (western mosquitofish), and *Percina copelandi* (channel darter) had not been recorded in the Triplett Creek system prior to Period 3.

Table 1. Fish species documented in Triplett Creek, Kentucky for 3 collecting periods. Families are arranged in phylogenetic order following Mayden et al. (1992). "X" signifies presence of the species.

Family	Species	Before 1950	1950–1998	1999–2000
Petromyzontidae	*Ichthyomyzon bdellium*	X	X	
	Lampetra aepyptera	X	X	X
Polyodontidae	*Polydon spathula*	X		
Lepisosteidae	*Lepisosteus osseus*	X	X	
Hiodontidae	*Hiodon tergisus*	X		
Anguillidae	*Anguilla rostrata*		X	
Clupeidae	*Alosa chrysochloris*	X		
	Dorosoma cepedianum	X	X	
Cyprinidae	*Campostoma anomalum*	X	X	X
	Cyprinella spiloptera	X	X	X
	Cyprinella whipplei	X	X	X
	Cyprinus carpio	X	X	
	Ericymba buccata	X	X	X
	Hybopsis amblops	X	X	X
	Luxilus chrysocephalus	X	X	X
	Lythrurus umbratilus	X	X	X
	Macrhybopsis aestivalis	X	X	
	Nocomis micropogon	X	X	X
	Notemigonus crysoleucas		X	
	Notropis atherinoides	X	X	X
	Notropis boops	X	X	X
	Notropis ludibundus	X	X	X
	Notropis photogenis	X	X	X
	Notropis rubellus	X	X	X
	Notropis volucellus		X	X
	Phoxinus erythrogaster		X	X
	Pimephales notatus	X	X	X
	Pimephales promelas	X		X
	Rhinichthys atratulus	X	X	X
	Semotilus atromaculatus	X	X	X
Catostomidae	*Carpiodes carpio*		X	
	Carpiodes cyprinus		X	X
	Carpiodes velifer		X	
	Catostomus commersoni	X	X	X
	Hypentelium nigricans	X	X	X
	Ictiobus bubalus		X	
	Ictiobus cyprinellus		X	
	Minytrema melanops		X	X
	Moxostoma anisurum		X	X
	Moxostoma carinatum		X	
	Moxostoma duquesnei	X	X	X
	Moxostoma erythrurum	X	X	X
	Moxostoma macrolepidotum			X
Ictaluridae	*Ameiurus melas*	X	X	
	Ameiurus natalis	X	X	X
	Ameiurus nebulosus		X	
	Ictalurus punctatus	X	X	

(table 1 continues)

Table 1. *(continued)*

Family	Species	Before 1950	1950–1998	1999–2000
Ictaluridae	*Noturus flavus*	X	X	
	Noturus miurus	X	X	X
	Pylodictus olivaris	X	X	
Esocidae	*Esox americanus*	X	X	
	Esox masquinongy	X	X	X
Salmonidae	*Oncorhynchus mykiss*		X	
Percopsidae	*Percopsis omiscomaycus*	X		
Atherinidae	*Labidesthes sicculus*	X	X	X
Fundulidae	*Fundulus catenatus*		X	X
	Fundulus notatus	X		
Poeciliidae	*Gambusia affinis*			X
Gasterosteidae	*Culaea inconstans*		X	
Centrarchidae	*Ambloplites rupestris*	X	X	X
	Lepomis cyanellus	X	X	X
	Lepomis gulosus		X	X
	Lepomis macrochirus	X	X	X
	Lepomis megalotis	X	X	X
	Micropterus dolomieu	X	X	X
	Micropterus punctulatus	X	X	X
	Micropterus salmoides	X	X	X
	Pomoxis annularis	X	X	X
	Pomoxis nigromaculatus		X	
Percidae	*Ammocrypta pellucida*	X		X
	Etheostoma blennioides	X	X	X
	Etheostoma caeruleum	X	X	X
	Etheostoma flabellare	X	X	X
	Etheostoma nigrum	X	X	X
	Etheostoma variatum	X	X	X
	Etheostoma zonale	X	X	X
	Percina caprodes	X	X	X
	Percina copelandi			X
	Percina maculata	X	X	X
	Percina oxyrhynchus		X	
	Stizostedion canadense		X	
Sciaenidae	*Aplodinotus grunniens*	X	X	
Cottidae	*Cottus bairdi*	X	X	X

Table 2. Jaccard's Coefficient of Community similarity among 3 collecting periods in Triplett Creek, Kentucky.

	pre-1950	1950–1998	1999–2000
Pre-1950	–	0.77	0.66
1950–1998		–	0.69
1999–2000			–

Discussion

Jaccard's Coefficient of Community Similarity indicates that fish community composition of Triplett Creek was fairly similar in each successive collecting period. Given the long time span and large scale of the study (i.e., the fish assemblages of the entire watershed), the lack of change is not unexpected (Matthews 1998). Jaccard's Coefficient indicates that Period 1 and Period 2 were most strongly similar to each other, possibly due in part to the greater number of species collected during those 2 periods. Periods 1 and 3 were the least similar of the collecting periods, with the most obvious difference between the 2 periods being the lack of migratory fishes and fishes characteristic of larger streams from Period 3. Even though sampling effort in Period 3 was probably more intensive than previous periods, the shorter time span would have increased the likelihood of "missing" rare fishes or fishes that irregularly occur as waifs from the Licking River.

Considering the limited number of sites (13) sampled in Period 1, and their limited geographic distribution (primarily in Triplett Creek mainstem), it is probable that the number of species in the system prior to 1950 was considerably higher than what was recorded (60 species). If intensive collections had been made in Period 1, prior to the most devastating of the anthropogenic disturbances, it is likely that more substantial changes would be evident in the fish assemblages.

Period 2 saw more intense collecting, particularly in North Fork of Triplett Creek and the middle portion of Triplett Creek, using additional methods, including boat electrofishing. Five of the species collected during this period were only captured by boat electrofishing. The greater ichthyofaunal richness documented (74 species) during this period likely reflects a greater diversity of collecting sites and techniques rather than temporal change in the ichthyofauna.

Three of the 54 species collected in Period 3 were recorded for the first time from the Triplett Creek system. Shorthead redhorse and channel darter are fairly common in proximate areas of the Licking River (Burr and Warren 1986) and probably occur infrequently as waifs in the Triplett Creek system. These uncommon species are restricted to the lower portion of Triplett Creek, and were likely missed in earlier collections. The western mosquitofish is probably not native to eastern Kentucky, but has been widely introduced to control mosquitoes (Burr and Warren 1986) and may have recently colonized the Triplett Creek system.

Twenty-nine species previously known from the Triplett Creek area were not collected in the Period 3. Some of these fishes (e.g., longnose gar, *Ictiobus spp.*, large ictalurids) occupy large pools, habitats difficult to collect using a seine or a backpack shocker. These fishes were mainly collected using a boat electrofisher in the North Fork of Triplett Creek during Period 2. Many fishes not collected in the recent survey, including Ohio lamprey, paddlefish, American eel, clupeids, speckled chub, large catostomids, and stonecat, are migratory or are more typical of larger streams (Burr and Warren 1986, Etnier and Starnes 1993). Their absence in our survey may reflect their irregular or seasonal use of Triplett Creek. However, some of these (e.g., Ohio lamprey and stonecat) are sensitive to anthropogenic disturbances and the possibility of their absence due to extirpation cannot be discounted. Documenting their presence in Triplett Creek may require sampling in the appropriate habitat, at the appropriate time of year, and with the appropriate equipment. Some species (e.g., black and brown bullheads, grass pickerel) have always been uncommon and their absence in our recent collections may reflect their rarity.

We consider 3 species extirpated from the Triplett Creek system: trout-perch, blackstripe topminnow, and sharpnose darter. The trout-perch is known only from a single specimen collected in the 1930s (Welter 1938) in the North Fork of Triplett Creek. Recent records are unavailable from the Licking River drainage and the species is almost certainly extirpated from the entire drainage. Although apparently once widespread in Triplett Creek (Welter 1938), the blackstripe topminnow has not been taken in Triplett Creek since the 1930s. The vegetated backwaters that this species prefers (Burr and Warren 1986) have become rare in the Triplett Creek system (pers. observ.). The blackstripe minnow persists in low numbers in neighboring tributaries of the Licking River (Burr and Warren 1986, pers. observ.), and may be able to recolonize Triplett Creek if critical habitat reappears. The sharpnose darter typically inhabits larger streams and is represented in Triplett Creek by a single specimen collected in 1986 (SIUC). Although it was common in proximate areas of the Licking River until 1984 (MOSU), our subsequent intensive collections have failed to locate sharpnose darters. We believe the sharpnose darter extirpated in Triplett Creek and proximate areas of the Licking River.

Several species reported in Triplett Creek by previous workers are considered misidentifications of other similar and more common fishes. Brewer (1980) reports *Notropis ardens* (=*Lythrurus fasciolaris*, rosefin shiner) from the Triplett Creek system. However, this species does not occur in the Licking River drainage and specimens from Triplett Creek identified as *N. ardens* are considered to be misidentifications of the common and morphologically similar *Lythrurus umbratilus* (redfin shiner). The brown bullhead, which is rare in eastern Kentucky (Burr and Warren 1986), was reported as common by Welter (1938) and Clark (1941), but these are considered to be based on specimens of the black bullhead (Burr and Warren 1986). The single valid specimen of the brown bullhead was collected in 1967 in North Fork of Triplett Creek (MOSU). Burr and Warren's (1986) range map shows *Etheostoma spectabile* (orangethroat darter) from the headwaters of Triplett Creek. Although the species is known from the Licking River drainage, no voucher specimens exist and it almost certainly represents a misidentification of the abundant and morphologically similar *Etheostoma caeruleum* (rainbow darter).

Six non-indigenous species have been collected in the Triplett Creek system. The common carp was brought to the United States from Eurasia (Fuller et al. 1999). This species has established reproducing populations throughout the Licking River drainage and has become seasonally common in some parts of the Triplett Creek system. Remaining non-indigenous species, including northern studfish, golden shiner, *Pimephales promelas* (fathead minnow), and brook stickleback, likely had their origin from baitbucket introductions. Two species, golden shiner and brook stickleback, each are represented in the Triplett Creek system by a single specimen collected below the dam in Morehead, a popular fishing area in Period 2. The fathead minnow has been collected from several sites in the Triplett Creek system during both Period 2 and 3. Prior to this survey, northern studfish had been collected at numerous sites in the Licking River drainage, but the species was represented in the Triplett Creek system by a single specimen collected below the dam in Morehead in 1983 (Meade 1992). In our survey, northern studfish was common and present at most sites in the lower and middle portion of Triplett Creek, indicating that this species has established reproducing populations. Collections in this same area in 1997–1998 by one of us (DJE) did not contain northern studfish, indicating colonization of the lower Triplett Creek system was very recent. It is possible that rapid colonization may have been enhanced by disturbances affecting this part of Triplett Creek (e.g., channelization) (Weaver and Garman 1994, Pringle 1997). The last non-indigenous species, rainbow trout, is stocked regularly in the Triplett Creek system by the Kentucky Department of Fish and Wildlife Resources (Lew Kornman, Ky. Div. Fish and Wildl. Resour., pers. commun.).

Although the fish assemblages of the Triplett Creek system have not been shown to have changed extensively during the last 100 years, loss of some sensitive species and establishment of non-indigenous species has been documented. Conservation of the ichthyofauna of this system is still of great importance because of its remarkably high species richness (83) (K. A. McCafferty, Morehead State Univ., unpubl. Master's thesis). Neighboring tributaries of the Licking River have lower species richness: Fox Creek, which drains 304.2 km^2, has 46 species; Slate Creek, which drains 598 km^2, has 75 species; and Salt Lick Creek, which drains 114.8 km^2, has only 22 species (Burr and Warren 1986). It is important to protect the Triplett Creek system in order to prevent further damage to this "hotspot" of ichthyofaunal diversity.

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