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Population Distribution and Abundance of the Blackfin Sucker (Thoburnia atripinnis) in the Upper Barren River System, Kentucky and Tennessee.

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DEDICATION

This thesis is dedicated to my wife Sara Stringfield, my parents John and Lisa Stringfield, and my sister Janna Stringfield for all of their support and encouragement through this process. They all played a vital role in my ability to stick with this project and finish it in a timely manner.

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Abstract

The blackfin sucker (*Thoburnia atripinnis)* is a relatively small species of fish (~155mm) endemic to the headwaters of the Barren River System (UBR) in Kentucky and Tennessee. Due to its isolated distribution and relatively small geographic inhabitance, the blackfin sucker is considered a Species of Greatest Conservation Need (SGCN) in Kentucky by the Kentucky Department of Fish and Wildlife Resources. In addition, it is included in Tennessee's list of rare wildlife as a Species of Special Concern. This study focused on determining the distribution and abundance of the blackfin sucker in those tributaries that comprise the UBR system, as well as key habitat characteristics that may play a role in their inhabitance of these streams. Fish communities were sampled between August 2011 and September 2012 using backpack electro-fishing techniques at each of 41 sampling sites throughout Kentucky and Tennessee. A species list with abundances of all fish captured was completed for each site. Habitat variables were measured including stream depth, water velocity, stream width, and substrate type. Overall, 328 individual blackfin suckers were captured at 28 of 41 sampling sites; with Tennessee sites having slightly higher abundances than those located in Kentucky. Results show that those sites sampled in Tennessee have more developed riparian zones and less agricultural influence than sites located in Kentucky. In addition, the Tennessee sites sampled in this study tended to have more rocky outcroppings and large bedrock ledges, which are prime habitats for the blackfin sucker. Because of this species endemism to the upper Barren River system, efforts should be made to conserve and maintain its population.

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Chapter 1

Introduction

Aquatic ecosystems in Kentucky, as well as world-wide, are a very unique, dynamic and delicate entity. With great risk looming in the near future, researchers are becoming ever more interested in anthropogenic disturbances and their direct correlation with the extinction of species. (May 1988) calculates that the earth's current extinction rates are one million times greater than rates of evolution. This is an alarming statement and shows just how important the conservation of these systems is.

The blackfin sucker (*Thoburnia atripinnis*), a relict species endemic to the Upper Barren River system, was first discovered by Reeve M. Bailey (1959). Its most unique physical characteristic is perhaps the one that gives the species its name. Bailey (1959) describes this feature as a jet-black blotch covering the distal half of the anterior 5 or 6 dorsal rays. Another key characteristic in most individuals is the distinctive light to dark transition just below the lateral line which is often abrupt. The blackfin sucker is a relatively small species reaching a total maximum length of 155mm (Etnier and Starnes 1993). Juveniles can reach lengths of approximately 70mm in their first year of growth (Timmons et al. 1983). In a diet study conducted by Timmons et al. (1983), chironomid larvae comprised the majority of the blackfin's diet, with as many as 334 larvae found in the largest fish captured. Within the genus *Thoburnia* are two other species, the rusty-side sucker (*Thoburnia hamiltoni*) and the torrent sucker (*Thoburnia rhothoeca*). Both these species are found in the mountain streams of Virginia and West Virginia and seem to be more adapted to a higher velocity environment (Bailey 1959). *Thoburnia* was once considered a subgenus of *Moxostoma*; but has been elevated to genus level by most taxonomists (Jenkins and Burkhead 1993).

Habitat and Conservation Status:

The blackfin sucker is endemic to the headwaters of the Barren River System in Kentucky and Tennessee, in the Greensburg Upland Subsection of the Highland Rim Province (Burr and Warren 1986). Adult blackfin suckers are associated with gently flowing pools featuring scattered slab rocks and undercut banks in larger streams (Etnier and Starnes 1993). The areas surrounded by these streams often consist of rolling hills having frequent bedrock outcrops and soil with low to medium fertility (Timmons et al. 1983). Bailey (1959) collected gravid individuals in April (water temperature 12-18C^{o}) and more specifically, a probable spawning aggregation, in a riffle area only 8cm deep.

Due to its restricted distribution to a relatively small geographical area, the blackfin sucker is considered a Species of Greatest Conservation Need (SGCN) in Kentucky by the Kentucky Department of Fish and Wildlife Resources (KDFWR 2005). It also is included in Tennessee's list of rare wildlife as a Species of Special Concern (Etnier and Starnes 1980). The Kentucky State Nature Preserves Commission has listed the blackfin sucker as threatened and designated it as a Species of Special Concern in Kentucky (KSNPC 2005). In addition to the blackfin sucker, the UBR system is home to two other endemic fish species, the teardrop darter (*Etheostoma barbouri*), and the highland rim darter (*Etheostoma kantuckeense*) (KDFWR 2005). A recent study in Kentucky found 34 blackfin suckers across nine of 30 sites sampled, only four of which were historic sites (Stillings 2010). In addition, no individuals were captured at four sites sampled in Long Creek and only two individuals were captured at one site out of seven in Peter Creek (Stillings 2010). These low numbers coupled with the blackfin's specific habitat indicate the need for further sampling throughout Kentucky and Tennessee. Because of its endemic status, many factors threaten the wellbeing of the blackfin sucker. Agriculture, mainly row crops, is prolific in the Barren River area (TDEC 2007), especially Kentucky, which can cause increased sedimentation as well as eutrophication. Increased embeddedness from agricultural runoff can bury crevices and ledges which are key habitats for blackfin suckers (Kohler and Soluk 1997).

The United States Fish and Wildlife Service (USFWS) is concerned about the conservation of the blackfin sucker due to its endemic distribution, low historic abundance and vulnerability within the Barren River system. Thus, the objective of this study was to evaluate the distribution and current status of the blackfin sucker in the upper Barren River system. Quantitative surveys were elicited at historical sites and other suitable habitats within the Barren River system. All fish species were identified and habitat variables measured. Relationships were determined among blackfin suckers and other fishes, as well as macro- and microhabitat variables. These data were used to discern any potential threats to the population in assistance to the USFWS as it prepares a status review (12-Month Finding) and determines if the blackfin sucker warrants listing under the Endangered Species Act.

Chapter 2

Study Area

In 1964, Barren Reservoir (4,000 hectares) was created by the U.S. Army Corp of Engineers by damming the Barren River (Kleber 1992). Blackfin suckers are now isolated to the Upper Barren River (UBR) because of the construction of the dam. Today, populations remain in the upper main stem of the Barren River and its tributaries which are located within the Interior Low Plateau of Kentucky and Tennessee. This eco-region in Kentucky and Tennessee is considered the unglaciated portion of the Interior Low Plateau. It is associated with areas of fairly rugged hills, deeply entrenched streams and wide-spread limestone and karst plains (Natureserve 2013). This system is said to be a priority conservation area with high ichthyological importance by the Kentucky Department of Fish and Wildlife Resources (KDFWR 2005). Four counties comprise this area in Kentucky (Allen, Barren, Metcalf and Monroe), and two counties in Tennessee (Clay and Macon). These counties can be characterized as predominately rural areas with agriculture being one of the primary land uses, especially in Kentucky. Deciduous forest accounts for 43% of the land in Tennessee counties while agriculture is still a major portion of the land use, also at 43% (TDEC 2007). Along with the Barren River itself, several main tributaries make up the UBR system, including Beaver Creek, Long Creek, Peter Creek and Skaggs Creek in Kentucky and Big Trace Creek, Hurricane Creek, Little Salt Lick Creek, Long Creek, Salt Lick Creek and Trace Creek in Tennessee. Although several disturbances exist in the watershed, nearly 93% of the stream kilometers fully support aquatic life and 23.7 kilometers are considered outstanding resource waters (KDOW 2008).

Chapter 3

Methods

A list of historic records for blackfin suckers was prepared from a variety of records and sources including the Kentucky Division of Water, Tennessee Wildlife Resources Agency, the University of Tennessee, and Stillings (2010;Table 1)[1]. Sampling sites for this study were determined using this information as well as the suitability of other sites as encountered. All sites with data older than five years were resurveyed.

Fish Sampling:

Blackfin suckers, as well as other SGCN and common species, were sampled quantitatively in accordance with the Quality Assurance Control (QAC) protocol set forth by the Kentucky Division of Water (KDOW 2008). Backpack electro-fishing (Smith and Root LR-24) was used at all sites sampled (Table 2). All species captured were identified, counted and a list of all fish species caught was generated for each site. All fish were released except for those that required identification in the lab. These individuals were fixed in 10% formalin for two weeks, leached with water for one day and preserved in 70% ethanol. Abundance was estimated for blackfin suckers and other SGCN at each site. These data are presented as catch-per-unit-of-effort (CPUE) of fish collected per minute of backpack electro-fishing. All blackfin suckers captured were measured for

[1] Tables are present in Appendix A. Figures are located in Appendix B.

length (mm) and weight (g) (Ohaus Digital Scale – CS Series). A pelvic fin clip was taken from each individual and preserved in 95% ethanol. Fin clips were kept in vials marked with the date, the individual's information (length and weight) as well as the site which it was captured. These clips were provided to the United States Fish and Wildlife Service for DNA analysis.

<u>Habitat and Physicochemical Measurements</u>:

Overall reach-scale habitats as well as microhabitats of blackfin suckers were assessed throughout this study. At the reach scale a Rapid Habitat Assessment (RBP; KDOW 2008) was completed at each site. The RBP scores each stream reach by evaluating a list of habitat parameters. Each parameter is based on a scale from 0-20 which places it into a condition category. These categories are in descending order; Optimal (16-20), Suboptimal (11-15), Marginal (6-10) and Poor (0-5). These habitat parameters include Available Cover, Pool Substrate Characterization, Pool Variability, Sediment Deposition, Channel Flow Status, Channel Alteration, Channel Sinuosity, Riparian Zone Width, Bank Stability and Vegetative Protection.

Physicochemical variables were measured at each site using a YSI Professional Plus multi-probe (Yellowsprings Instruments Inc.) and included water temperature (^{o}C), dissolved oxygen (mg/L), conductivity (µS), and pH (standard units). Sample reach length was measured and four perpendicular transects (one at each end and two at equidistant locations within the center of the reach) were established. Stream width (m)

(Trupulse 200 range finder; Laser Technology Inc.) was measured at each transect and depth (cm), flow velocity (cm/s) (Marsh McBirney Flow Meter with wading rod; Hach Co.) and substrate composition (KDOW 2008) were recorded at five equidistant points along the transect. Additionally, specific microhabitats where each blackfin sucker was captured were assessed. First, each microhabitat was categorized by habitat type including boulder, bedrock, root wad, slab rock, or slab/boulder mix. Measurements included dimensions of structure (cm), water flow velocity (cm/s), water depth (cm) and depth of crevice (cm), if applicable.

Distribution and Land Use:

One of the final products of this study was a range map of the blackfin sucker. This was generated using ArcGIS software (Esri, Redlands, CA) and included all the sites sampled as well as those sites where blackfin suckers were captured. This map includes all the tributaries to the UBR as well as the counties mentioned in both Tennessee and Kentucky. In addition, land use maps were generated which may help in gaining insight on the relationship between habitat and blackfin sucker distribution.

Statistical Analysis:

A step-wise regression (SAS 2011) was used to determine if a relationship existed between blackfin sucker CPUE and stream catchment and reach scale habitat measurements (including RBP metrics) across sites. Individual significant ($p<0.05$) contribution of each variable to the final model was evaluated with an F-test. Variable selection into the model was based on significance of a linear term ($p<0.05$), the contributing partial correlation coefficient and reduction in mean square error (SAS 2011). Stream depth and flow were $\log_{10}$ transformed to obtain better fitting models. Because of a binomial distribution, substrate percentages were arcsin square root transformed, making the distribution normal. Because of unequal microhabitat sample sizes, a Kruskal Wallis two-sample test (SAS 2011) was used to compare microhabitats where blackfin suckers were captured to general habitat measurements taken at the transects where they were not captured to determine differences between the habitat types. A distribution-free Bonferroni Multiple Comparisons test (SAS 2011) was used to determine which microhabitats significantly differed from the transect habitat data among sites.

Chapter 4

Results

A total of 8,806 fishes from 9 different families were captured during this study (Table 3). Blackfin suckers were the sixth most abundant species collected throughout the study (3.7%), with the five most commonly encountered species being *Campostoma oligolepis* (19.9%), *Cottus carolinae* (12.4%),*Semotilus atromaculatus* (12.3%), *Etheostoma caeruleum* (5.3%) and *Luxilus crysocephalus* (4.6%). A total of 328 blackfin suckers were captured across 28 of 41 sites sampled (Figures 1 and 2). Tennessee sites produced a total of 201 blackfin suckers at 14 of 15 sites; while Kentucky sites produced a total of 127 blackfin suckers at 14 of 26 sites. In addition, average (±SE) CPUE was higher among Tennessee sites (0.42 ± 0.08 blackfin suckers/min) than at Kentucky sites (0.17 ± 0.04 blackfin suckers/min). Distribution maps were generated as well as a map showing overall CPUE at each site (Figure 3). The length frequency histograms (Figure 4) show three to four age classes among all fish captured during each sampling season. A strong shift from smaller individuals in the summer to larger individuals in the spring can be seen (Figure 4). Blackfin sucker length/weight relationships followed an exponential curve (Figure 5); with total lengths ranging from 50 to 174 mm and weights from 3 to 60 g (Figure 6).

The Rapid Habitat Assessment scores (Table 4) did not show a strong trend between overall score and blackfin sucker CPUE. There was a significant negative relationship ($p=0.05$) between blackfin sucker CPUE and amount of sediment deposition across sites; however, the variable only accounted for 20% of the variation in blackfin sucker CPUE. No other variables were significantly related to blackfin sucker CPUE. Blackfin suckers were most often captured near bedrock ledges and large slabs and boulders, although some were captured in root-wad pools and more rarely, in shallow riffles. Bedrock ledges were on average (±SE), 10 ±1.7m in length with mean stream depth of 35 ±2.96cm and stream flow of 5 ±2cm/s. Bedrock ledges had an average crevice depth of 65 ±6.85cm. Slab and boulder rocks were found in areas that had an average stream depth of 43 ±4.33cm and an average stream flow of 10 ±2cm/s. Root-wad pools had a mean stream depth of 80 ±8.25cm and a stream flow of 0 cm/s. Overall, mean microhabitat depth (43.9 ±5.5cm) for blackfin sucker capture locations was significantly deeper (X^2=9.4, p=0.002) than mean site depth at non-capture sites (28.9 ±1.4cm). Multiple comparisons indicated that three blackfin sucker microhabitat types, boulder, root-wad pools and slab/boulder, were significantly deeper ($p<0.05$) than mean depth across sites, respectively. Although mean water flow velocity among blackfin sucker microhabitats was less than mean flow velocity among sites (6.8cm/s vs 9.6 cm/s), the difference was not statistically significant ($p>0.05$).

Physicochemical data (Table 5) indicated that all sites sampled had sufficient dissolved oxygen to support fish communities (at least 5mg/L). Conductivity ranged from 160 to 550 µS/cm across sites. Notably, a total of 22 blackfin suckers were captured at Boyd's Creek in Barren County where conductivity reached 550 µS/cm.

Chapter 5

Discussion

Blackfin suckers (Figure 1) were caught consistently across historic sites as well as new sites located within Kentucky and Tennessee with only a few exceptions (Figures 2 and 3). In fact, blackfin suckers were the sixth most abundant species caught during this project. Higher CPUEs were recorded at sites located within Tennessee, but other sites in Kentucky had relatively high abundances as well.

Microhabitat seems to be extremely important to the success of the blackfin sucker, as is the case with many other species. Blackfin suckers were almost exclusively captured under bedrock ledges, slab and boulders. This data is consistent with the findings of Timmons et al. (1983), where blackfin suckers were associated with pools containing overhanging brush and bedrock crevices. On a few occasions, blackfin suckers were captured under bridge pillar supports and in detritus pools and shallow riffles. Instream structure, especially those that create a crevice, seems to be a vital part of the blackfin sucker's niche.

In addition to the structure related to blackfin sucker microhabitat, depth was also a contributing variable. On average, stream depths were statistically greater at microhabitats supporting *atripinnis* than the average depth for the corresponding reach. This has management implication as blackfin suckers seem to be more associated with deeper areas and pools within a stream.

At a few of the blackfin sucker sites sampled in Kentucky, sedimentation was an obvious problem. One site sampled in particular (Site 1) on Falling Timber Creek, a known historic blackfin sucker stream, was the worst of these. Within the reach sampled, there was a substantial amount of slab and boulder rock. The site seemed to possess the microhabitat necessary for blackfin suckers; however, all the crevices were embedded with sediment. Poor plowing and disking practices coupled with a narrow riparian zone width can lead to overwhelming amounts of sediment entering an aquatic ecosystem (Dodds 2002) and the elimination of blackfin sucker habitat.

Physicochemical data did not seem to have any effect on blackfin sucker abundance. Fish were captured from sites with a wide range of water temperatures, dissolved oxygen levels, pH and conductivity. For example, Boyds Creek (Site 30) had a conductivity reading of 550 µS/cm and had a high CPUE (0.69 blackfin suckers/min).

After examination of land use maps (Figure 6) for those counties containing sample sites, it seems as though Macon and Clay counties, both in Tennessee, are seemingly more forested than those four counties in Kentucky. This fact may have implication seeing as though blackfin sucker abundances and CPUEs were higher across Tennessee sites. Land use coverage in Allen, Barren, Metcalfe and Monroe counties in Kentucky is predominately hay/pasture land and or row crops. This also may play a role in the increased sedimentation that was noticed at several sites located in Kentucky.

Blackfin sucker lengths and weights were very consistent with the findings of Timmons et al. (1983) and Bailey (1959). Individuals ranged from 50mm TL to 174mm

TL. There were three age classes present during the spring sampling season and four age classes present during the summer and fall sampling seasons. This is encouraging data because this shows that the individuals located within the sample reaches had a successful spawning season with recruitment.

Among the Creek systems that showed consistently low abundances was the Peter Creek system. A total of five sites were sampled within this system; three sites on Peter Creek proper and two sites on Caney Fork. Historically, blackfin suckers have been recorded throughout the Peter Creek system, including Peter Creek proper itself. During this study, no blackfin suckers were captured in Peter Creek proper. This follows the findings of Stillings 2010 closely, as only two blackfin suckers were captured at one of four sites sampled at Peter Creek proper. However, a total of 37 blackfin suckers were captured at two sites on Caney Fork during this study. This is much different from the findings of Stillings 2010, as no blackfin suckers were captured at two sites sampled on Caney Fork. Habitat analysis showed that, on average, those sites sampled in Peter Creek proper had much less bedrock (19%) than those sampled in Caney Fork (68%). Perhaps this is a reflection of the amount of microhabitat present and reinforces the idea that microhabitat may be one of the leading factors contributing to blackfin sucker presence/absence and or abundance.

There were also other sites encountered while conducting field work that had man-made barriers present. Low water bridges were a common theme as well as a concrete impoundment for a saw mill at Pinchgut Creek (Figure 7). These barriers can hinder the movement of fishes and limits the amount of habitat that can be accessed. Also, these types of structures can lead to genetic isolation and even extirpation from certain areas.

In summary, blackfin suckers were captured throughout the historic range of the species and at some sites, in very high abundances. Microhabitat appears to be the most important limiting factor associated with blackfin suckers and the one that is most easily observed. Sedimentation creates a major problem with this microhabitat and needs to be the focus for any management and conservation efforts. In addition, riparian zone width seems to play a role as those sites in Tennessee tended to have higher abundances than those more open and agriculturally dominated sites found in Kentucky. With all of this said, the fact remains that the blackfin sucker is an endemic species to a small geographical area and therefore warrants special attention.

It is important to note that this study was not designed to estimate blackfin sucker population size but was instead a survey of known historic locations in order to update distribution information. Future studies on the blackfin sucker need to be population oriented to gain more knowledge about the population itself, as well as an estimate of its numbers. Perhaps a random sampling effort could be implemented which would provide a much better idea of the overall size and health of the population.

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APPENDIX A:

TABLES

Table 1. Dated historical records of blackfin suckers in the Upper Barren River system.

Date	County	State	Latitude	Longitude	Stream
7/8/1951	Macon	TN	36.6085	-85.9688	White Oak Creek
4/7/1953	Macon	TN	36.3209	-85.5101	Salt Lick Creek
6/17/1959	Macon	TN	36.5173	-85.8848	Long Hungry Creek
6/18/1959	Macon	TN	36.5989	-85.9226	Salt Lick Creek
6/18/1959	Macon	TN	36.5712	-85.8686	Salt Lick Creek
5/23/1961	Macon	TN	36.5445	-85.9414	Long Fork Creek
5/23/1961	Macon	TN	36.3448	-85.5849	White Oak Creek
8/6/1961	Macon	TN	36.5909	-85.8803	Salt Lick Creek
7/26/1963	Clay	TN	-	-	Big Trace Creek
11/7/1965	Macon	TN	-	-	Salt Lick Creek
8/14/1967	Macon	TN	-	-	Long Creek
8/14/1967	Macon	TN	-	-	Salt Lick Creek
4/21/1969	Clay	TN	-	-	Trace Creek
11/8/1969	Macon	TN	36.3650	-85.5310	Salt Lick Creek
8/15/1971	Macon	TN	36.3715	-85.5545	Long Creek
8/15/1971	Macon	TN	36.3720	-85.5430	Salt Lick Creek
6/16/1972	Macon	TN	-	-	Long Fork
6/15/1973	Clay	TN	36.58035	-85.78082	Trace Creek
5/21/1975	Clay	TN	36.3550	-85.4205	Hurricane Creek
3/20/1976	Macon	TN	36.3557	-85.5520	Long Fork Creek
3/20/1976	Macon	TN	36.3160	-85.5614	Long Fork Creek
3/20/1976	Clay	TN	36.3607	-85.4229	Hurricane Creek
6/17/1976	Macon	TN	36.3102	-85.5605	Long Fork Creek
6/16/1977	Clay	TN	36.3450	-85.4650	Big Trace Creek
2/23/1982	Sumner	TN	36.1847	-86.2420	Cumberland River
4/23/1983	Macon	TN	36.31004	-85.56053	Long Fork Creek
4/15/1987	Macon	TN	-	-	Little Salt Lick Creek
3/31/1989	Clay	TN	-	-	Hurricane Creek
4/4/1992	Clay	TN	-	-	Hurricane Creek
4/25/1995	Barren	KY	36.8333	-85.9639	Peter Creek
4/25/1995	Barren	KY	36.85054	-85.96135	Caney Fork
10/16/1996	Barren	KY	36.85054	-85.96135	Caney Fork
10/17/1996	Metcalfe	KY	36.9389	-85.7372	Falling Timber Creek
10/28/1996	Macon	TN	36.3639	-85.5525	Long Fork Creek
10/28/1996	Clay	TN	36.3637	-85.4334	Line Creek
10/29/1996	Macon	TN	36.3725	-86.0641	Long Creek

Table 1. *continued*.

Date	County	State	Latitude	Longitude	Stream
7/25/1997	Barren	KY	36.8333	-85.9639	Peter Creek
7/13/2001	Allen	KY	36.66056	-86.00083	Puncheon Creek
7/24/2001	Barren	KY	36.8333	-85.9639	Peter Creek
8/7/2001	Monroe	KY	36.635	-85.90556	Salt Lick Creek
5/29/2003	Clay	TN	36.58649	-85.77739	Trace Creek
5/29/2003	Clay	TN	36.55749	-85.77929	Wilson Branch
7/23/2005	Macon	TN	36.3205	-85.5248	Long Hungry Creek
5/27/2008	Macon	TN	36.6374	-86.0707	Hanging Rock Branch
-	Monroe	KY	36.6664	-85.7396	Gully Creek
-	Monroe	KY	36.7108	-85.7707	East Fork Barren River
-	Monroe	KY	36.6565	-85.9212	Salt Lick Creek
-	Monroe	KY	36.9781	-85.9317	Salt Lick Creek
-	Allen	KY	36.6499	-86.0023	Puncheon Creek
-	Barren	KY	36.9427	-85.9005	Boyds Creek
-	Barren	KY	36.9242	-85.8056	Falling Timber Creek
-	Barren	KY	36.805	-85.6861	Skaggs Creek
-	Barren	KY	36.8331	-85.9644	Peter Creek

Table 2. Blackfin Sucker Sampling Sites in the Upper Barren River system, 2011-2012.

Site	Stream	Latitude	Longitude	Access Location	St.
1	Falling Timber Creek	36.91849	-85.86772	At State Highway 63	KY
2	Peter Creek	36.77454	-85.79919	At State Highway 63	KY
3	Caney Fork	36.84828	-85.96371	At State Highway 3179	KY
4	Long Creek	36.65903	-86.11202	At Amos-Long Creek Road	KY
5	Glover Creek	36.89582	-85.77105	At Shives Road	KY
6	Falling Timber Creek	36.92746	-85.80309	At Burkseville Road	KY
7	Caney Fork	36.84978	-85.95515	At Payne Mill Road	KY
8	Peter Creek	36.83337	-85.9644	At State Highway 3179	KY
9	Nobob Creek	36.85298	-85.80062	At Temple Hill Road	KY
10	Peter Creek	36.80327	-85.91249	At Smith Cemetery Road	KY
11	Long Creek	36.64832	-86.10652	At State Highway 1578	KY
12	Dry Creek	36.70354	-86.10719	At Dry Creek Road	KY
13	Puncheon Creek	36.62972	-86.00544	At M. Roark Road	KY
14	Pinchgut Creek	36.65726	-86.02689	At State Highway 1333	KY
15	Indian Creek	36.69439	-85.9559	At State Highway 87	KY
16	Puncheon Creek	36.61952	-86.01171	At Oak Knob Road	TN
17	Long Fork Creek	36.51406	-85.93372	At Leo Whitley Road	TN
18	Trace Creek	36.55991	-85.7794	At Happy Springs Road	TN
19	White Oak Creek	36.5931	-85.97822	At Antioch Road	TN
20	Long Fork Creek	36.5983	-85.92301	At Galen Road	TN
21	Salt Lick Creek	36.59101	-85.882	At Parkhurst Road	TN
22	Mill Creek	36.66641	-85.73988	At Watson Hill Road	KY
23	East Fork Barren River	36.67397	-85.78442	At Lyons Road	KY
24	Line Creek	36.6094	-85.73127	At Line Creek Road	TN
25	Line Creek	36.60934	-85.71406	At Clementsville Road	TN
26	Salt Lick Creek	36.55429	-85.87322	At Heady Ridge Road	TN
27	Little Salt Lick Creek	36.58025	-85.85432	At Powell Road	TN
28	Swanigan Creek	36.99842	-85.82271	At Mt. Pisgah Road	KY
29	Beaver Creek	37.00904	-85.80919	At Mt. Pisgah Road	KY
30	Boyds Creek	36.94277	-85.90047	At C.T. Talley Road	KY
31	West Fork	36.59448	-86.14658	At Westfork Creek Road	TN
32	Clifty Creek	36.58701	-86.11602	At Clifty Road	TN
33	White Oak Creek	36.5299	-85.9884	At White Oak Creek Lane	TN
34	Puncheon Creek	36.59214	-86.02172	At Puncheon Creek Road	TN
35	Skaggs Creek	36.80706	-85.73489	At State Highway 678	KY
36	Indian Creek	36.71219	-85.91197	At Fountain Run Road	KY
37	Walnut Creek	36.77732	-86.11237	At Parkhurst Road	KY
38	Rhoden Creek	36.73618	-86.07822	At Maysville Road	KY

Table 2. *continued*.

Site	Stream	Latitude	Longitude	Access Location	St.
39	Little Salt Lick Creek	36.575391	-85.83855	At Langford Road	TN
40	Sugar Creek	36.66495	-85.84696	At John Strode Road	KY
41	Sugar Creek	36.68736	-85.82536	At Sugar Creek Road	KY

Table 3. Fish abundance at sites sampled in the Upper Barren River system 2011-2012.

SITES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Family Genus species										
Lepisosteidae										
Lepisosteus osseus	0	0	0	0	0	0	0	0	0	0
Cyprinidae										
Campostoma oligolepis	5	52	38	0	21	3	40	0	27	1
Chrosomus erythrogaster	0	0	0	0	0	0	0	0	0	0
Cyprinella galactura	0	0	0	0	2	0	0	0	0	0
Cyprinella spiloptera	0	0	0	0	0	0	0	0	0	0
Cyprinus carpio	0	0	0	0	0	0	0	0	0	0
Hybopsis amblops	0	0	0	0	0	0	0	0	0	0
Luxilus crysocephalus	0	0	3	1	5	1	0	0	1	0
Lythrurus ardens	0	0	5	3	0	2	0	0	0	0
Nocomis effusus	0	0	0	0	0	0	0	0	0	0
Notemigonus crysoleucas	0	0	2	0	0	0	1	0	0	0
Notropis atherinoides	0	0	0	0	0	0	0	0	0	0
Notropis leuciodus	0	0	0	0	0	0	0	0	0	0
Pimephales notatus	0	10	18	0	11	0	2	2	17	0
Rhinichthys atratulus	0	0	0	0	0	0	0	0	0	0
Rhinichthys cataracte	0	0	0	0	0	0	0	0	0	0
Semotilus atromaculatus	0	3	31	0	0	0	45	2	5	1
Catostomidae										
Catostomus commersonnii	0	0	0	0	0	0	0	0	0	0
Hypentelium nigricans	9	4	2	1	0	0	0	1	2	2
Minytrema melanops	1	0	0	0	0	0	0	0	0	0
Moxostoma duquesnii	0	0	0	0	0	0	0	0	0	0
Moxostoma erythrurum	1	0	0	0	0	0	0	0	0	0
Thoburnia atripinnis	0	0	18	1	0	0	19	0	1	0
Ictaluridae										
Ameiurus natalis	1	1	1	1	24	14	0	2	2	12
Noturus elegans	0	0	0	0	0	0	0	0	0	0
Fundulidae										
Fundulus catenatus	0	16	5	5	1	6	3	0	4	0
Atherinidae										
Labidesthes sicculus	0	0	0	0	0	0	0	0	0	0
Cottidae										
Cottus carolinae	0	1	57	5	45	29	46	31	9	34
Centrarchidae										
Ambloplites rupestris	2	0	3	1	12	1	0	1	4	4

Table 3. *continued*.

SITES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Family Genus species										
Lepomis cyanellus	2	4	7	3	14	4	1	3	11	2
Lepomis gulosus	0	0	1	0	0	0	0	0	0	0
Lepomis macrochirus	8	3	5	0	8	3	0	0	0	0
Lepomis megalotis	13	0	1	1	13	6	0	0	28	5
Micropterus dolomieu	0	0	0	0	4	2	0	0	0	0
Micropterus punculatus	2	1	7	1	0	0	0	0	0	0
Percidae										
Etheostoma barrenense	0	0	0	0	0	7	1	1	4	0
Etheostoma bellum	0	0	0	0	0	0	0	1	3	1
Etheostoma blennioides	1	7	6	5	13	3	6	3	28	0
Etheostoma caeruleum	1	14	23	1	10	3	9	10	2	10
Etheostoma flabellare	0	0	0	1	3	4	0	0	1	0
Etheostoma kantuckeense	0	0	0	0	0	0	2	1	0	0
Etheostoma nigrum	0	0	0	0	0	0	0	0	0	0
Etheostoma simoterum	0	6	0	0	0	0	0	0	0	0
Etheostoma zonale	0	2	0	0	0	4	0	1	1	1
Percina caprodes	12	0	1	0	1	0	0	0	0	1

Table 3. *continued*.

SITES	11	12	13	14	15	16	17	18	19	20
Family Genus species										
Lepisosteidae										
Lepisosteus osseus	0	0	0	0	0	0	0	0	0	0
Cyprinidae										
Campostoma oligolepis	7	50	25	16	25	20	19	50	32	29
Chrosomus erythrogaster	0	63	0	2	0	0	6	1	0	0
Cyprinella galactura	0	0	0	0	0	0	0	0	0	0
Cyprinella spiloptera	0	0	0	0	0	0	0	0	0	0
Cyprinus carpio	0	0	0	0	0	0	0	0	0	0
Hybopsis amblops	0	0	0	0	0	0	6	0	0	0
Luxilus crysocephalus	3	2	4	1	22	5	4	0	12	15
Lythrurus ardens	1	0	2	0	0	0	0	1	1	0
Nocomis effusus	0	0	6	0	0	5	4	0	1	2
Notemigonus crysoleucas	0	0	0	0	0	0	0	0	0	0
Notropis atherinoides	0	0	0	0	0	0	0	0	0	0
Notropis leuciodus	0	0	4	0	0	0	8	0	8	9
Pimephales notatus	0	0	6	2	2	3	12	10	13	7
Rhinichthys atratulus	0	13	0	2	0	0	0	0	0	0
Rhinichthys cataracte	0	0	0	0	0	0	9	0	0	0
Semotilus atromaculatus	0	57	9	32	27	30	6	50	0	0
Catostomidae										
Catostomus commersonnii	0	0	0	0	0	0	0	0	0	0
Hypentelium nigricans	0	0	1	1	1	10	4	1	0	2
Minytrema melanops	0	0	0	0	2	2	0	0	2	0
Moxostoma duquesnii	0	0	0	0	0	0	0	0	0	0
Moxostoma erythrurum	0	0	0	0	0	0	0	0	0	1
Thoburnia atripinnis	2	0	3	10	1	1	3	27	24	2
Ictaluridae										
Ameiurus natalis	2	0	0	0	0	0	0	0	2	1
Noturus elegans	0	0	0	0	0	0	0	0	0	0
Fundulidae										
Fundulus catenatus	0	2	0	5	2	0	6	2	0	15
Atherinidae										
Labidesthes sicculus	0	0	0	0	0	0	0	0	0	0
Cottidae										
Cottus carolinae	9	3	13	29	40	32	69	11	46	36
Centrarchidae										
Ambloplites rupestris	7	0	0	6	6	0	7	4	29	19

Table 3. *continued*.

SITES	11	12	13	14	15	16	17	18	19	20
Family Genus species										
Lepomis cyanellus	7	0	2	8	7	6	1	3	3	1
Lepomis gulosus	0	0	0	0	0	0	0	0	0	0
Lepomis macrochirus	0	0	0	0	6	0	5	0	7	3
Lepomis megalotis	1	0	0	3	0	2	0	0	12	0
Micropterus dolomieu	1	0	0	0	0	0	3	0	9	0
Micropterus punculatus	0	0	0	0	1	0	0	0	0	0
Percidae										
Etheostoma barrenense	2	0	1	3	2	0	8	6	0	2
Etheostoma bellum	0	0	3	0	2	1	0	2	4	3
Etheostoma blennioides	10	0	4	1	6	1	1	1	0	7
Etheostoma caeruleum	7	8	13	18	12	15	37	10	17	3
Etheostoma flabellare	4	23	11	21	0	25	19	5	1	1
Etheostoma kantuckeense	0	2	0	0	0	0	3	1	0	0
Etheostoma nigrum	0	0	0	0	0	0	0	0	0	0
Etheostoma simoterum	0	0	0	0	0	0	0	0	0	0
Etheostoma zonale	1	0	0	0	2	0	0	0	1	1
Percina caprodes	0	0	0	0	30	0	0	0	0	0

Table 3. *continued*.

SITES	21	22	23	24	25	26	27	28	29	30
Family Genus species										
Lepisosteidae										
Lepisosteus osseus	2	0	0	0	0	0	0	0	0	0
Cyprinidae										
Campostoma oligolepis	13	60	31	35	35	80	100	100	25	17
Chrosomus erythrogaster	0	0	0	0	0	0	2	0	0	0
Cyprinella galactura	0	0	0	0	0	0	0	0	0	0
Cyprinella spiloptera	0	0	0	25	0	0	0	0	0	0
Cyprinus carpio	0	0	0	0	0	0	0	0	0	1
Hybopsis amblops	0	0	0	0	0	0	0	0	0	0
Luxilus crysocephalus	8	7	25	15	40	9	19	9	0	0
Lythrurus ardens	0	1	0	0	3	1	0	0	2	0
Nocomis effusus	4	0	0	0	0	6	4	0	0	0
Notemigonus crysoleucas	0	0	0	0	0	0	0	0	0	0
Notropis atherinoides	0	3	0	0	0	0	0	3	0	0
Notropis leuciodus	13	2	0	0	13	12	12	0	0	0
Pimephales notatus	13	35	13	17	12	0	0	0	2	3
Rhinichthys atratulus	0	0	0	0	0	0	0	0	0	0
Rhinichthys cataracte	0	0	0	0	0	0	0	0	0	0
Semotilus atromaculatus	0	6	0	25	30	2	13	45	30	100
Catostomidae										
Catostomus commersonnii	0	0	0	0	0	0	0	0	1	0
Hypentelium nigricans	8	3	21	12	15	6	13	24	23	18
Minytrema melanops	0	0	2	3	0	1	0	1	1	0
Moxostoma duquesnii	0	0	0	0	0	0	0	0	0	0
Moxostoma erythrurum	4	0	0	0	0	0	0	0	0	0
Thoburnia atripinnis	16	20	2	10	4	7	36	0	0	22
Ictaluridae										
Ameiurus natalis	21	8	7	3	3	5	0	16	0	12
Noturus elegans	3	0	4	0	0	27	0	0	0	0
Fundulidae										
Fundulus catenatus	0	23	19	15	0	12	0	22	0	0
Atherinidae										
Labidesthes sicculus	0	0	0	0	0	0	0	0	0	0
Cottidae										
Cottus carolinae	12	1	12	38	42	8	22	28	22	100
Centrarchidae										
Ambloplites rupestris	23	5	37	7	12	14	4	14	9	7

Table 3. *continued*.

SITES	21	22	23	24	25	26	27	28	29	30
Family Genus species										
Lepomis cyanellus	8	69	8	7	6	9	0	0	6	11
Lepomis gulosus	0	0	0	0	0	0	0	0	0	0
Lepomis macrochirus	9	0	0	6	3	0	2	6	6	12
Lepomis megalotis	7	6	22	7	0	20	0	12	7	0
Micropterus dolomieu	3	0	2	0	0	9	0	0	0	0
Micropterus punculatus	1	11	3	0	0	0	1	1	0	0
Percidae										
Etheostoma barrenense	0	9	3	5	0	8	0	12	0	0
Etheostoma bellum	6	6	4	4	6	0	7	0	0	0
Etheostoma blennioides	7	31	6	3	19	2	0	29	33	8
Etheostoma caeruleum	11	7	12	11	8	22	14	16	3	3
Etheostoma flabellare	0	3	0	3	1	11	22	43	0	0
Etheostoma kantuckeense	0	1	0	0	0	1	1	0	0	0
Etheostoma nigrum	0	0	0	0	0	0	0	0	0	0
Etheostoma simoterum	0	0	0	0	0	0	0	0	0	0
Etheostoma zonale	1	9	4	2	2	0	0	0	0	0
Percina caprodes	0	11	18	0	0	0	0	0	0	1

Table 3. *continued*.

SITES	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**
Family Genus species											
Lepisosteidae											
Lepisosteus osseus	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae											
Campostoma oligolepis	35	35	75	50	100	40	85	100	182	30	65
Chrosomus erythrogaster	1	20	3	0	0	0	60	25	13	12	37
Cyprinella galactura	0	0	0	0	0	0	0	0	0	0	0
Cyprinella spiloptera	0	0	0	0	7	0	0	0	0	1	0
Cyprinus carpio	0	0	0	0	0	0	0	0	0	0	0
Hybopsis amblops	0	0	0	0	2	0	0	0	0	0	0
Luxilus crysocephalus	30	30	65	27	18	19	0	0	1	0	0
Lythrurus ardens	2	1	3	1	2	11	0	0	2	0	0
Nocomis effusus	0	0	0	8	0	25	0	0	0	0	0
Notemigonus crysoleucas	0	0	0	0	0	0	0	0	0	0	0
Notropis atherinoides	0	1	4	0	4	0	0	0	0	20	0
Notropis leuciodus	0	4	10	0	0	11	0	0	0	0	0
Pimephales notatus	1	0	0	0	13	15	20	8	14	17	10
Rhinichthys atratulus	3	9	0	6	0	12	30	0	8	0	1
Rhinichthys cataracte	0	0	0	0	0	0	0	0	0	0	0
Semotilus atromaculatus	35	40	100	50	9	35	80	75	0	35	74
Catostomidae											
Catostomus commersonnii	0	0	0	0	1	0	0	0	0	4	0
Hypentelium nigricans	12	0	15	11	23	15	5	0	0	2	0
Minytrema melanops	0	0	0	0	0	0	0	0	0	0	0
Moxostoma duquesnii	0	0	0	0	0	2	0	0	0	1	0
Moxostoma erythrurum	0	0	0	0	0	0	0	0	0	0	0
Thoburnia atripinnis	24	0	25	8	0	16	3	9	14	0	0
Ictaluridae											
Ameiurus natalis	0	0	4	0	1	5	0	2	0	2	0
Noturus elegans	0	0	1	0	0	0	0	0	0	0	0
Fundulidae											
Fundulus catenatus	2	24	18	6	45	13	2	2	2	16	18
Atherinidae											
Labidesthes sicculus	0	0	0	0	0	0	0	0	0	19	0
Cottidae											
Cottus carolinae	40	35	15	80	1	19	10	25	23	6	4
Centrarchidae											
Ambloplites rupestris	3	0	9	3	3	7	0	0	0	0	0

Table 3. *continued*.

SITES	31	32	33	34	35	36	37	38	39	40	41
Family Genus species											
Lepomis cyanellus	5	6	4	0	8	7	25	18	0	12	0
Lepomis gulosus	0	0	0	0	0	0	1	0	0	0	0
Lepomis macrochirus	0	0	7	0	10	0	1	8	4	5	0
Lepomis megalotis	0	0	4	0	6	8	0	5	0	4	0
Micropterus dolomieu	0	1	5	0	0	0	0	0	0	0	0
Micropterus punculatus	0	0	0	0	0	0	0	0	0	3	0
Percidae											
Etheostoma barrenense	3	3	6	8	22	4	0	0	2	0	0
Etheostoma bellum	0	0	0	0	0	2	0	0	0	0	0
Etheostoma blennioides	0	0	0	0	19	8	0	0	3	0	0
Etheostoma caeruleum	9	20	18	10	12	25	17	12	9	6	0
Etheostoma flabellare	12	12	30	10	9	0	15	0	11	0	0
Etheostoma kantuckeense	2	0	6	0	1	0	4	7	7	6	55
Etheostoma nigrum	0	0	0	0	0	0	0	0	0	1	0
Etheostoma simoterum	0	0	0	0	0	0	0	0	0	0	0
Etheostoma zonale	0	0	0	0	2	0	0	0	0	0	0
Percina caprodes	0	0	0	2	0	5	1	0	0	0	0

Table 4. Total scores from the Rapid Habitat Assessment at each site sampled in the Upper Barren River system, 2011-2012.

Site	Date	Temperature ©	D.O. (mg/L)	pH (S.U.)	Conductivity (µS)	CPUE Blackfins/ min
1	10/25/2011	13.8	7.76	8.35	351	0.000
2	10/25/2011	13.3	5.45	8.6	297.8	0.000
3	11/1/2011	15.4	3.07	9.1	263.5	0.633
4	11/8/2011	14.2	5.58	8.28	190.2	0.048
5	3/20/2012	17.4	9.25	8.93	259.7	0.000
6	3/20/2012	19.4	7.7	8.78	261.3	0.000
7	4/3/2012	18.9	9.72	8.64	246.7	0.566
8	4/3/2012	21.4	5.09	8.57	284.1	0.000
9	4/10/2012	14.7	12.44	8.81	412.6	0.040
10	4/10/2012	15.7	7.17	8.87	265.4	0.000
11	4/17/2012	16.5	6.62	8.49	179.5	0.063
12	4/17/2012	15.3	6.48	8.51	228.1	0.000
13	4/17/2012	15.7	6.32	8.46	183.7	0.096
14	4/24/2012	14.3	5.84	8.29	184.7	0.252
15	4/24/2012	13.9	6.91	8.73	274.1	0.030
16	4/24/2012	13.9	6.24	8.7	168.2	0.025
17	5/11/2012	17.4	5.92	8.36	203.1	0.085
18	5/11/2012	19.9	4.49	8.75	200.8	0.849
19	5/17/2012	19	4.34	8.55	187.4	0.679
20	5/17/2012	19.8	3.93	8.3	194.1	0.103
21	5/17/2012	23.1	3.89	8.34	185.1	0.480
22	6/7/2012	19.8	10.99	8.68	405.6	0.659
23	6/7/2012	21.6	7.38	8.58	283.3	0.081
24	6/21/2012	24.8	8.44	8.75	337.7	0.284
25	6/21/2012	22.7	5.93	8.49	335	0.145
26	8/23/2012	22.8	6.9	7.98	191.3	0.203
27	8/23/2012	21.1	8.89	8.37	218.7	1.080
28	8/30/2012	21.4	6.08	8.11	432.3	0.000
29	8/30/2012	21.4	5.98	8.39	483.4	0.000
30	8/30/2012	24.4	5.86	8.64	550	0.688
31	9/13/2012	19.7	7.39	8.53	270.6	0.772
32	9/13/2012	21.4	7.89	8.51	215.1	0.000
33	10/4/2012	17.8	7.89	8.33	160.5	0.686
34	10/4/2012	17.8	8.01	8.13	200.4	0.235
35	10/10/2012	12.6	12.41	8.57	348.9	0.000
36	10/10/2012	12.6	9.62	8.59	313.6	0.479
37	10/25/2012	13.1	10.22	8.3	297.7	0.095

Table 4. *continued*.

Site	Date	Temperature ©	D.O. (mg/L)	pH (S.U.)	Conductivity (µS)	CPUE Blackfins/ min
38	10/25/2012	17.4	7.32	8.12	281.3	0.345
39	11/1/2012	9.5	13.24	8.52	159.4	0.582
40	11/15/2012	6.3	6.69	7.85	198.7	0.000
41	11/15/2012	10.4	9.92	8.19	289	0.000

Table 5 . Physicochemical data for all sites sampled in the Upper Barren River system 2011-2012.

Site	Date	Temperature (^{o}C)	D.O. (mg/L)	pH (S.U.)	Conductivity (µS)	Blackfin Abundance
1	10/25/2011	13.8	7.76	8.35	351	0
2	10/25/2011	13.3	5.45	8.6	297.8	0
3	11/1/2011	15.4	3.07	9.1	263.5	18
4	11/8/2011	14.2	5.58	8.28	190.2	1
5	3/20/2012	17.4	9.25	8.93	259.7	0
6	3/20/2012	19.4	7.7	8.78	261.3	0
7	4/3/2012	18.9	9.72	8.64	246.7	19
8	4/3/2012	21.4	5.09	8.57	284.1	0
9	4/10/2012	14.7	12.44	8.81	412.6	1
10	4/10/2012	15.7	7.17	8.87	265.4	0
11	4/17/2012	16.5	6.62	8.49	179.5	2
12	4/17/2012	15.3	6.48	8.51	228.1	0
13	4/17/2012	15.7	6.32	8.46	183.7	3
14	4/24/2012	14.3	5.84	8.29	184.7	10
15	4/24/2012	13.9	6.91	8.73	274.1	1
16	4/24/2012	13.9	6.24	8.7	168.2	1
17	5/11/2012	17.4	5.92	8.36	203.1	3
18	5/11/2012	19.9	4.49	8.75	200.8	27
19	5/17/2012	19	4.34	8.55	187.4	24
20	5/17/2012	19.8	3.93	8.3	194.1	2
21	5/17/2012	23.1	3.89	8.34	185.1	16
22	6/7/2012	19.8	10.99	8.68	405.6	20
23	6/7/2012	21.6	7.38	8.58	283.3	2
24	6/21/2012	24.8	8.44	8.75	337.7	10
25	6/21/2012	22.7	5.93	8.49	335	4
26	8/23/2012	22.8	6.9	7.98	191.3	7
27	8/23/2012	21.1	8.89	8.37	218.7	36
28	8/30/2012	21.4	6.08	8.11	432.3	0
29	8/30/2012	21.4	5.98	8.39	483.4	0
30	8/30/2012	24.4	5.86	8.64	550	22
31	9/13/2012	19.7	7.39	8.53	270.6	24
32	9/13/2012	21.4	7.89	8.51	215.1	0
33	10/4/2012	17.8	7.89	8.33	160.5	25
34	10/4/2012	17.8	8.01	8.13	200.4	8
35	10/10/2012	12.6	12.41	8.57	348.9	0
36	10/10/2012	12.6	9.62	8.59	313.6	16
37	10/25/2012	13.1	10.22	8.3	297.7	3

Table 5. *continued*.

Site	Date	Temperature (°C)	D.O. (mg/L)	pH (S.U.)	Conductivity (µS)	Blackfin Abundance
38	10/25/2012	17.4	7.32	8.12	281.3	9
39	11/1/2012	9.5	13.24	8.52	159.4	14
40	11/15/2012	6.3	6.69	7.85	198.7	0
41	11/15/2012	10.4	9.92	8.19	289	0

APPENDIX B:

FIGURES

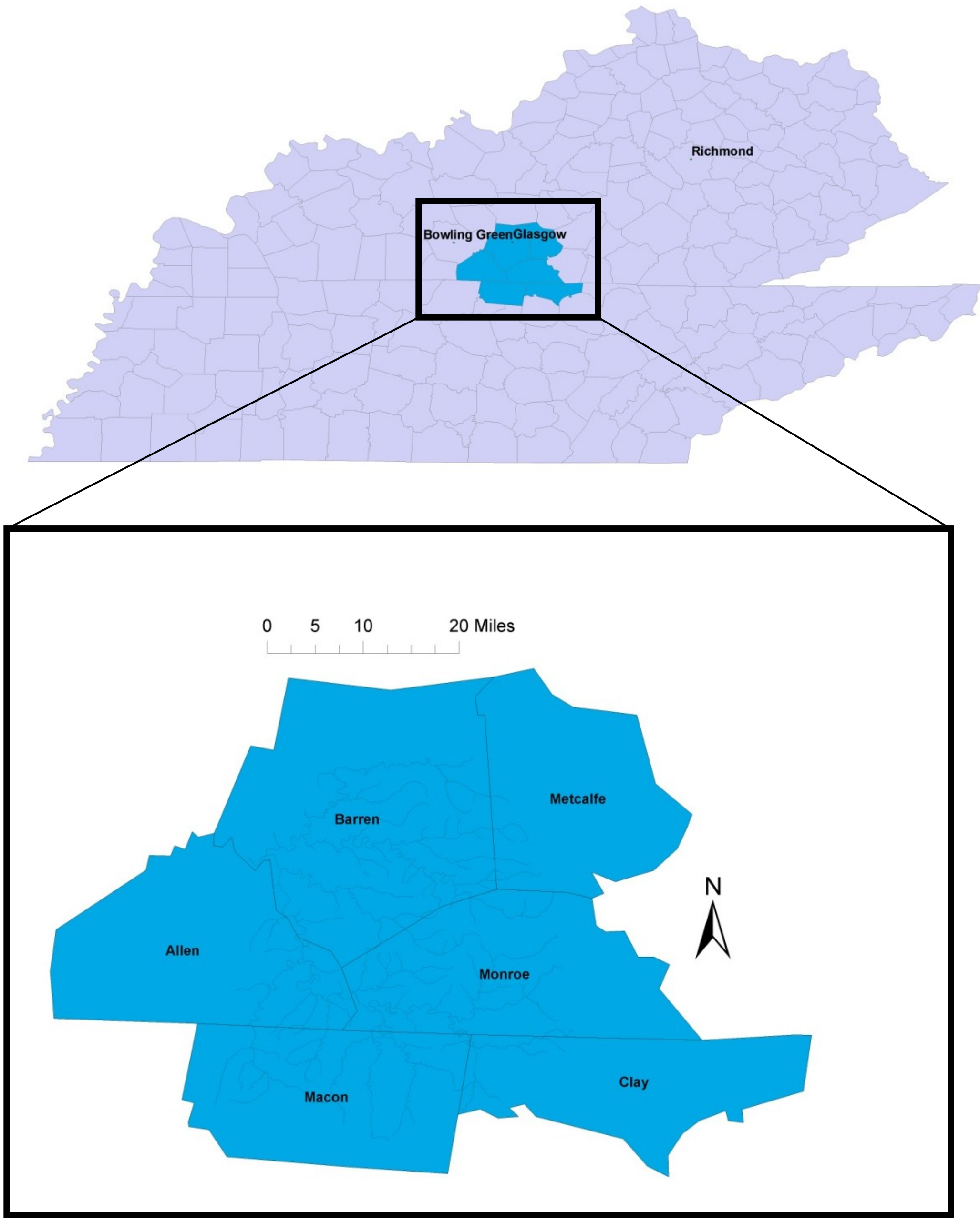

Figure 1. Relative location and counties of sampling efforts for blackfin suckers in the Upper Barren River system, Kentucky and Tennessee, 2011-2012.

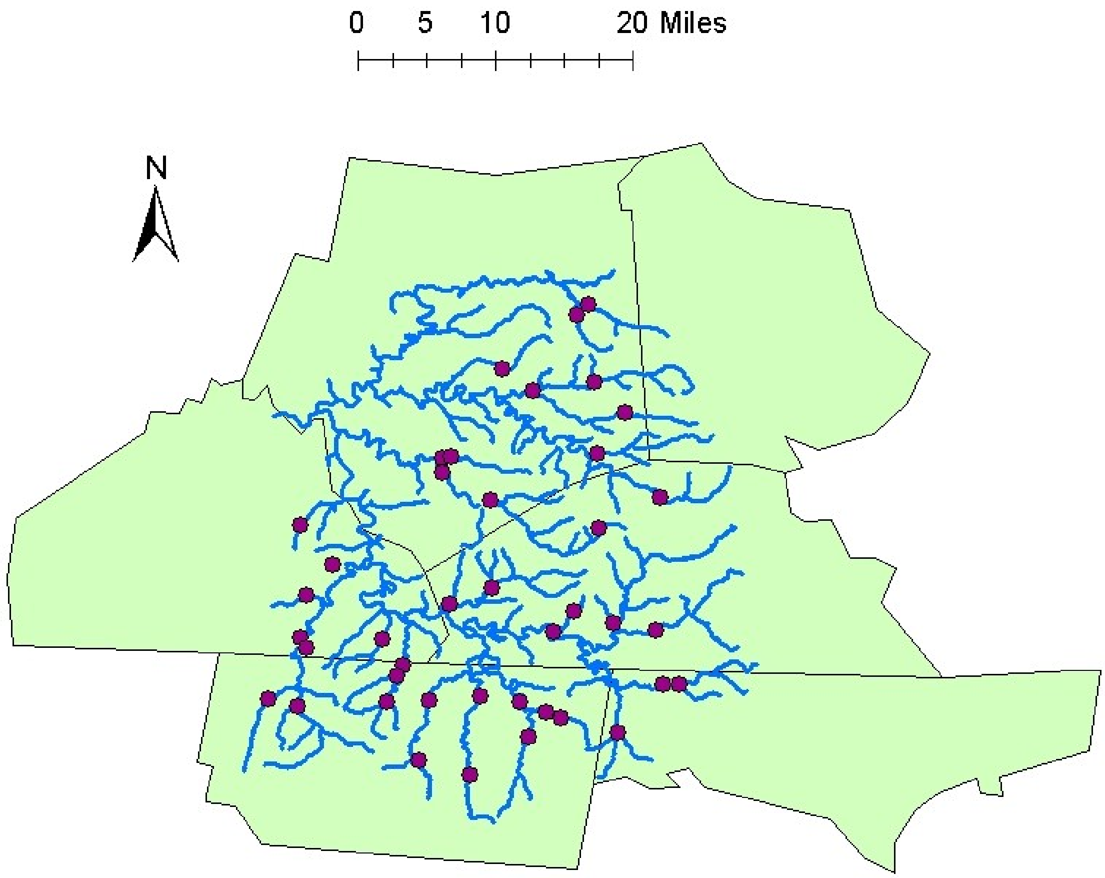

Figure 2. Blackfin Sucker sampling locations in the Upper Barren River system, Kentucky and Tennessee 2011-2012.

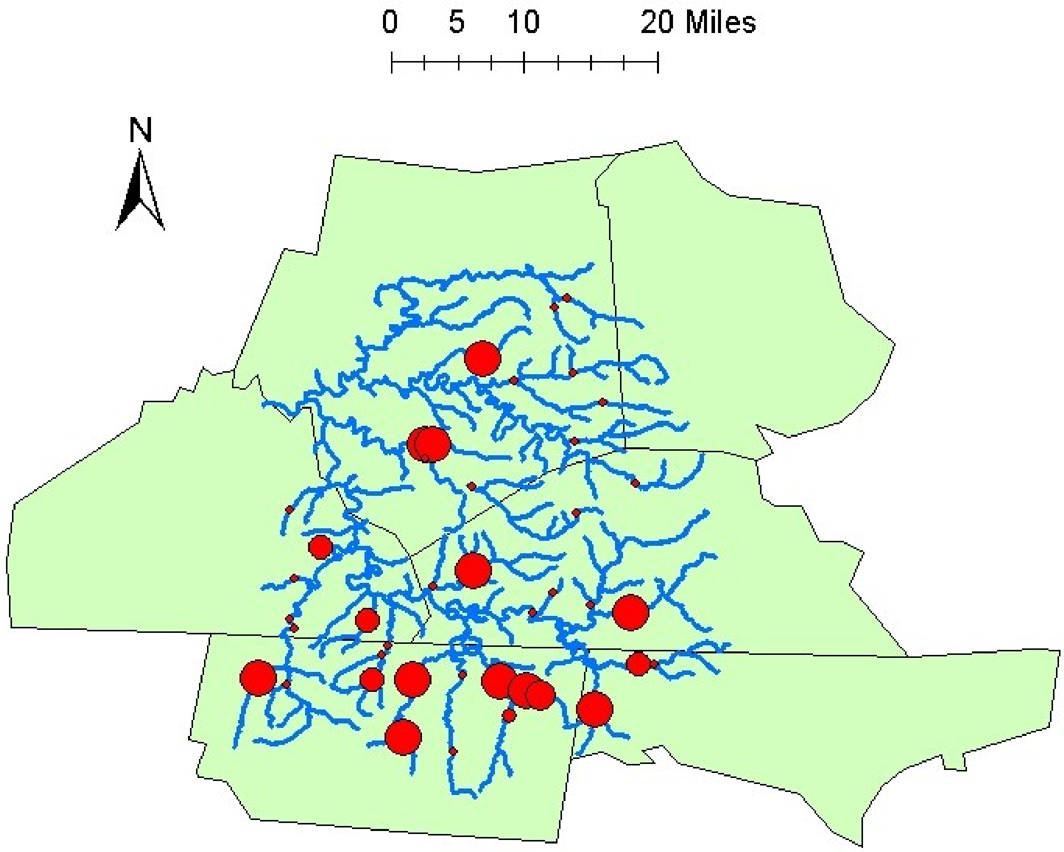

Figure 3. Catch-per-unit-of-effort (CPUE) of blackfin suckers across all sites sampled within the upper Barren River system, 2011-2012 (larger points equate to higher CPUEs).

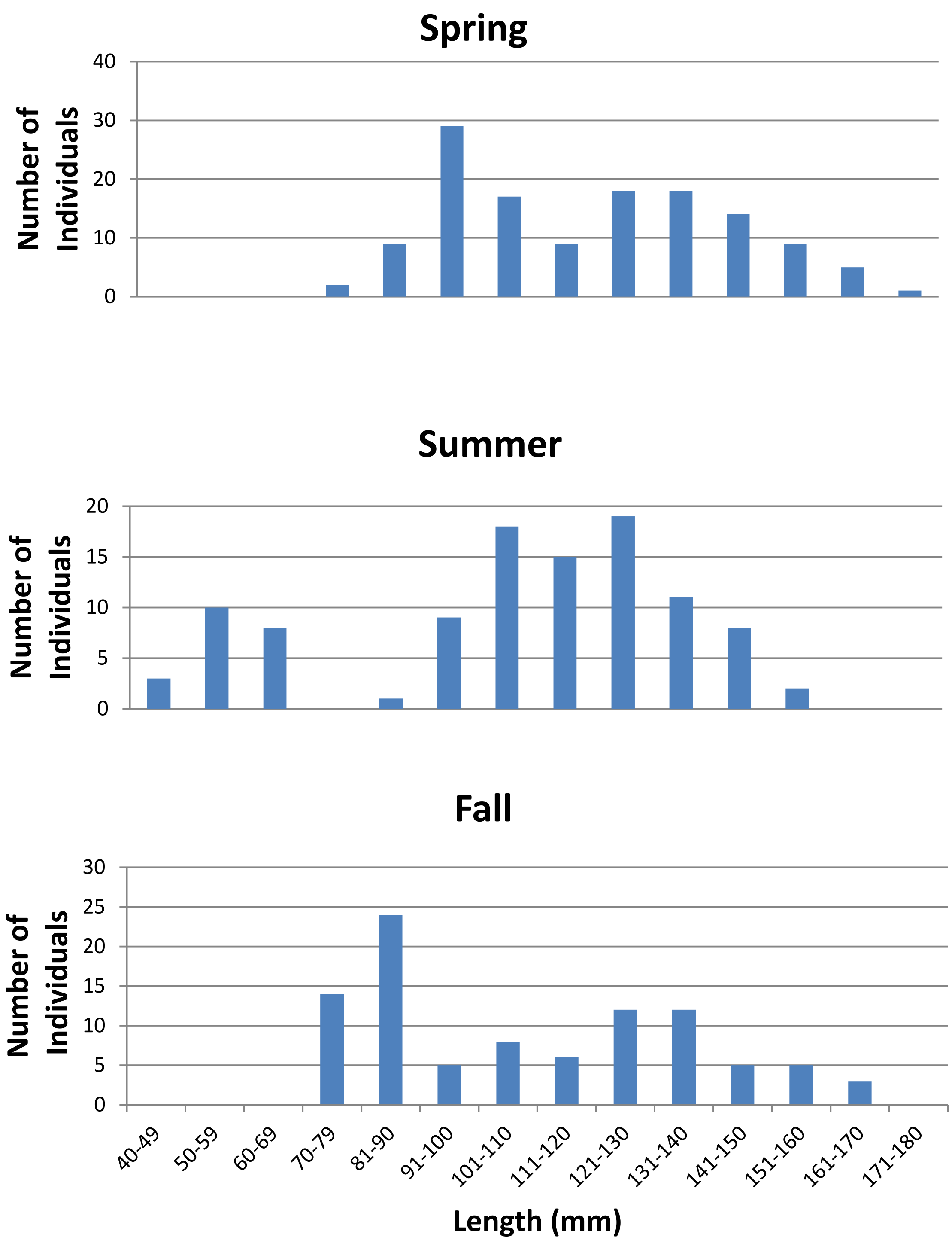

Figure 4. Length frequency histograms of all blackfin suckers captured during each sampling season in the upper Barren River system, Kentucky and Tennessee, 2011-2012.

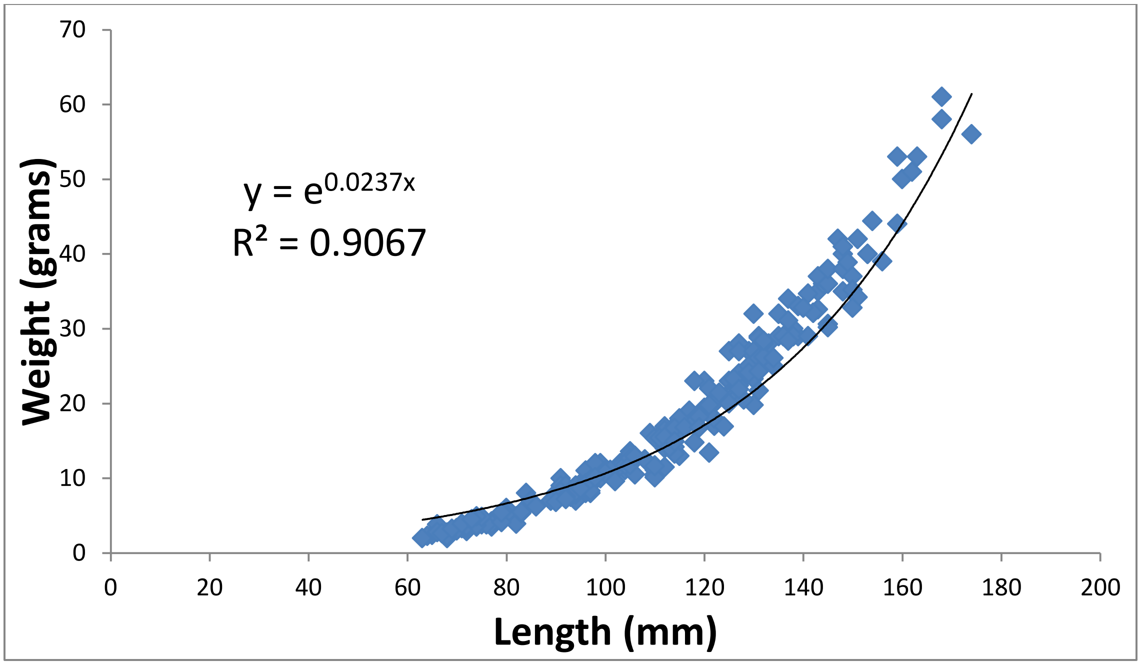

Figure 5. Length/weight relationship and logistic growth equation for all blackfin suckers captured within the upper Barren River system, Kentucky and Tennessee, 2011-2012.

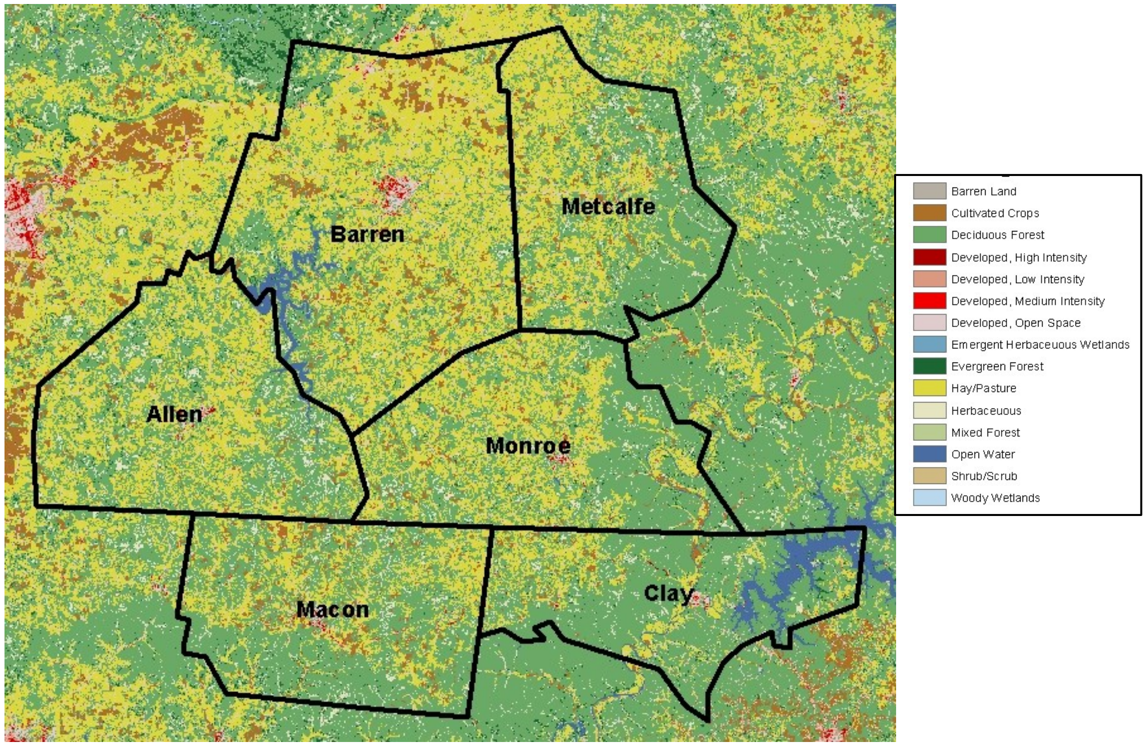

Figure 6. Land use coverage for the six counties sampled for blackfin suckers in Tennessee and Kentucky, 2011-2012. *Source*: Esri, Redlands, CA.

Figure 7. Concrete impoundment for a saw mill operation, encountered during sampling efforts at Pinchgut Creek, Allen County KY (36.65726 -86.02689).