

Kansas Department of Wildlife and Parks

Wildlife Surveys and Research: Assessment of Streams on Public Lands

Study: Population Dynamics of Blue Suckers in the Kansas River

Final Report

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Kansas Department of Wildlife and Parks  
Environmental Services Section  
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## **Executive Summary:**

We studied the population dynamics of blue suckers (*Cycoreptus elongates*), a species in need of conservation in Kansas, to determine spatial and temporal patterns in abundance and growth of this species in the Kansas River. Pulsed DC electrofishing was used at 135 fixed sites to determine seasonal (April, June, September, November) distribution, and 302 random sites from May to August 2005 were sampled in summer to determine distribution throughout the river. A total of 99 fish were collected, with most of the fish between 600-700 mm total length and 8-10 years old. Only two fish less than 400 mm (age 4) were collected. Higher abundance of fish was observed in the upper river reaches, and below a low-head dam in the lower river reaches. No seasonal trends in abundance were observed in the fixed sites for spring and summer, but higher catch rates occurred during the fall and winter in the upriver sites. Blue suckers in the Kansas River had slower growth than other populations in the Great Plains including populations as far north as South Dakota. Future research on early life history and recruitment is needed to better understand the population dynamics of this rare fish.

## **Introduction:**

Blue sucker (*Cypleptus elongatus*) is a species that is distributed throughout the Mississippi and Missouri river drainages and their largest tributaries, with their range extending from Montana south to Mexico, and also as far east as Pennsylvania (Moss et al. 1983, Morey and Berry 2003, Vokoun et al. 2003). Blue sucker are an obligate large river fish that can attain 22 years of age (Vokoun et al. 2003). Many states in the Great Plains have considered blue suckers relatively rare and are commonly listed as rare or in need of conservation.

Blue suckers have declined throughout their range due to overharvest, dams, impoundments, and channelization of the rivers they inhabit causing a reduction in the number of shallow fast water habitats that these fish prefer (Tomelleri and Eberle 1990, Pfeiger 1997, Vokoun et al. 2003). Modifications on rivers throughout the Midwest have caused concern on the status of large river fishes, including the blue sucker (Williams et al. 1989, Grady 1996). Although studies have focused on spawning events (Peterson et al. 2000), very few studies have evaluated the distribution, abundance, and habitat use of blue sucker throughout a large river across several seasons.

In Kansas, blue suckers are found in the Neosho, Missouri, and Kansas rivers and are considered a species in need of conservation (Cross and Collins 1995). Moss et al. (1983) studied the age, growth, spawning, and food habits of blue sucker in the Neosho River and found that blue sucker spawning occurs from April until June. However, little is known about the Kansas River population. In fact, it was believed in the 1960's that blue suckers would only be found in the lower-most reaches of the Kansas River (Metcalf 1966). In the

Kansas River Basin, blue suckers have been found below dams where water is discharged at several reservoirs on tributaries of the Kansas River (Cross and Collins 1995).

Our study had two primary objectives. First, we wanted to determine the distribution, abundance, size structure, and growth of blue suckers throughout the entire Kansas River. Second, we wanted to determine if abundance and size structure differed seasonally throughout the river. We hypothesized that few blue suckers would be found in the upper reaches of the Kansas River (Metcalf 1966), but may congregate below a low head dam at river kilometer (rkm) 83 during spring spawning. We also expected growth of blue suckers to be similar to other populations in the lower Great Plains, but faster than populations in northern latitudes.

## **Methods:**

**Study Area:** The Kansas River begins near Junction City, Kansas at the confluence of the Smoky Hill and the Republican rivers and flows east 274 rkm where it joins the Missouri River. The Kansas River drainage area is approximately 155,000 km<sup>2</sup>, running from the High Plains of Eastern Colorado westward to Kansas City, Kansas (Colby et al. 1956) and consists of about 12% of the Missouri River watershed (Metcalf 1966). The Kansas River watershed includes eighteen federal reservoirs and nearly 13,000 small impoundments that affect discharge in the river system causing less fluctuation in flows and sediment loading downstream (Sanders et al. 1993). However Bowersock Dam (a low-head dam at rkm 83) is the only dam found on the mainstem Kansas River (Quist and Guy 1999). Sand is the dominant substrate throughout the river with few gravel beds. However, one large gravel bed is located near rkm 235 at the mouth of the Big Blue River. The river consists of many

shallow subsidiary channels, islands overgrown with trees and grasses, and sand bars (Quist et al. 1999) and mean depth is typically less than 1 m.

The lack of research conducted on the Kansas River is most likely due to the limited access on the river. A majority of the land bordering the river is owned by private land owners and only 12 public boat ramps are located in the entire 274 rkm. The limited amount of navigable water also likely accounts for the lack of research conducted on fishes of the Kansas River.

***Field Collections:***

Objective 1: Entire River Sampling. The Kansas River was divided into five reaches based on logistics and obvious barriers; reach 1: rkm 0-42, reach 2: rkm 43-82, reach 3: rkm 83-161, reach 4: rkm 162-217, reach 5: rkm 218-273. Within these river reaches we randomly selected sampling sites by dividing each reach into about five segments (5-16 km) based on access. Within each segment (which could be sampled in one day) up to three randomly-selected 1.6-km sections were sampled with high-pulse DC electrofishing (7-11 A; 300-500 V; 35-40 pulses/s) for approximately 5 min per site. In addition, up to three randomly-selected supplemental 1.6-km sections were sampled within each segment with low-pulse DC electrofishing (2-6 A; 180-250 V; 15-20 pulses/s) for approximately 5 min. per site as part of an ongoing flathead catfish (*Pylodictis olivaris*) study. All random-site sampling was conducted from May-August 2005.

Shoreline habitat was also recorded at each site during this sampling. Shoreline habitat in each electrofishing site was classified as one of three categories: mud-bank (MU), rip-rap (RR; consistent length of rocky shoreline with rocks of various sizes), and log jam

(LJ; stockpile of woody debris of various sizes partially inundated extending from the shoreline into the water). Only one habitat was sampled per electrofishing site. In order to be classified as a log jam the amount of woody debris above the water had to be  $\geq 4.5$  m.

Objective 2: Seasonal Sampling. To determine seasonal distribution of blue sucker throughout the river, 36 fixed stations were also sampled during four seasons. Six sites (each with six randomly selected stations) were chosen throughout the river: Kansas City (rkm 0.5-2.9), Lawrence below Bowersock Dam (rkm 79.2-82.6), Lawrence above Bowersock Dam (rkm 83.7-85.8), Topeka (rkm 121.0-123.8), Wamego (rkm 203.6-205.9), and Manhattan (rkm 234.6-237.4). Fixed site sampling was conducted in spring (March 24<sup>th</sup> to April 6<sup>th</sup>), summer (June 27<sup>th</sup> to July 7<sup>th</sup>), fall (September 1<sup>st</sup> to 9<sup>th</sup>), and winter (November 4<sup>th</sup> to 8<sup>th</sup>) 2005.

All electrofishing (both entire river and seasonal sampling) was conducted from a 4.5 m aluminum boat mounted with a Coffelt Model VVP 15 electrofisher powered by a 5,000-watt, single phase, 240-volt AC generator. The boat was equipped with a single boom with an 8-dropper Wisconsin ring electrode. All blue sucker collected were measured (total length, TL mm), weighed (g), sexed, and tagged with an individually numbered Floy tag (model FD-94: Floy Tag Inc., Seattle, Washington) inserted through the dorsal pterygiophores near the dorsal insertion. Blue suckers were sexed by squeezing the abdominal area to release eggs or milt. The first pectoral ray and scales on the left side of every blue sucker were also removed for age analysis. After ray and scale removal the fish were released near their capture location.

**Laboratory Analysis:** In the laboratory the pectoral rays were sectioned using a Buehler Isomet Low speed saw with a diamond cutting blade. Three sections were taken from each of the rays at three different thicknesses (1.0, 1.2, and 1.4 mm). The sections were then viewed using a microscope and image analysis system (Image-Pro Plus) to determine age. Scales of blue suckers were cleaned and viewed with a microfiche reader. Blue sucker relative abundance was determined by catch per hour of electrofishing (CPUE) and size structure was determined by length frequencies.

Relative abundance of blue suckers throughout the river was assessed visually by plotting the mean CPUE in 16-km increments against river km. We used analysis of variance (ANOVA) to determine if mean blue sucker CPUE differed by habitat type for the random sites in summer. To determine if mean CPUE differed by seasons and sites (for the fixed sites), we used a repeated-measures two-way ANOVA, with individual stations as the repeated measure, and season and sites as the main effects. If  $\alpha \leq 0.05$  then relationships were considered to be significant.

## **Results:**

Entire River Sampling. A total of 99 blue suckers were captured in the Kansas River in 2005 for both the 135 fixed and 302 random sites. Blue sucker total length ranged from 242 to 782 mm and weights ranged from 86 to 5,443 g. However, most of the fish caught were in the 625 to 650 mm range (Fig. 1). Very few smaller fish were caught with only two fish caught under 425 mm. There was no difference in mean CPUE of blue suckers between high pulse and low pulse electrofishing (T-test,  $t=1.69$ ,  $DF=255$ ,  $P=0.091$ ), so both electrofishing types were combined in the random sites for further analysis. For the random sites, overall CPUE

showed that blue suckers were of low abundance in the river with the CPUE of 2.44 fish per hour, but varied considerably. Throughout the entire Kansas River there was typically higher (and more consistent) CPUE in the upper river between rkm 160-270 (Fig. 2). No blue suckers were collected within a 20 rkm area above Bowersock Dam at rkm 83 (Fig. 2). No blue suckers were caught below rkm 32 in the lower Kansas River near the mouth of the Missouri River (Fig. 2).

Age of the blue suckers ranged from age 1 to 16 years with the most abundant age at 9 years (Fig. 3) based on fin rays. Scales proved unreliable to age older fish so rays were used exclusively. Only six fish (6%) under age six were captured throughout our sampling. Mean back-calculated length at age was typically lower than other populations. Blue suckers in the Kansas River were about 200 mm at age 2, and attained 500 mm by about age 7 (Fig. 4).

Log jams had higher mean CPUE (mean=3.89 SE=1.02, N=54) compared to rip rap (mean=2.21 SE=0.49, N=106) and mud banks (mean=2.09 SE=0.49, N=118) (ANOVA  $F=18.97$ ,  $DF=3$ ,  $275$ ,  $P<0.0001$ ). Relative abundance of blue suckers was nearly 2 times greater at log jams than at mud banks or rip rap (Fig. 5).

Seasonal Sampling. Since CPUE in the fixed sites was not consistent across reaches and seasons (season by reach interaction,  $F=3.36$ ,  $DF=14$ ,  $62$ ,  $P<0.005$ ), we conducted the analysis separately by season. There was no difference in CPUE among the fixed reaches in spring ( $F=1.00$ ,  $DF=6$ ,  $30$ ,  $P=0.444$ ) or in summer ( $F=1.89$ ,  $DF=6$ ,  $30$ ,  $P=0.116$ ). In the fall there was a significant difference among the reaches ( $F=2.77$ ,  $DF=5$ ,  $24$   $P=0.041$ ). Mean CPUE was higher in the up-river reaches near Wamego and Manhattan, Kansas than the

lower-river sites (Fig. 6). A significant difference was also noticed in the winter sampling period ( $F=4.33$ ,  $DF=6, 28$ ,  $P=0.033$ ) with CPUE again much higher in the upper-river near Manhattan, Kansas (Fig. 6) when mean CPUE was 35 fish per hour.

## **Discussion:**

The blue sucker population in the Kansas River appeared to be somewhat abundant in most reaches of the river, but had lower catch rates than other studies using electrofishing (Petersen et al. 2000, Morey and Berry 2003). Metcalf (1966) believed blue sucker abundance in the river was decreasing and blue suckers probably only inhabited the lower reaches of the river. We found that blue suckers in fact still occur throughout the river and at times at relatively high abundances, particularly in the upper river reaches.

Of the total 99 blue suckers collected only 2 were less than 400 mm in length. Other studies have also shown very few small fish were caught (Rupprecht and Jahn 1980, Moss et al. 1983, Hand and Jackson 2003, Morey and Berry 2003, Vokoun et al. 2003). Some possible reasons for this includes low reproductive success of blue suckers in the Kansas River, or gear bias (i.e. the ability of young blue suckers to inhabit areas that are unable to be sampled; Morey and Berry 2003). The areas that small blue suckers may inhabit could include shallow fast current areas that were sampled by Moss et al. (1983) who had some success capturing juvenile fish, or possibly the deep areas near the wing dykes where it is too deep to efficiently sample with electrofishing. Moss et al. (1983) discusses how blue suckers are extremely habitat selective and prefer swift moving water flowing over hard substrate. This was noticed below Bowersock Dam in the shallow riffles. Larger fish were very abundant throughout the fast moving water but it was extremely hard to net them in this

habitat. Nonetheless, more research is needed on recruitment dynamics of large river fishes, including blue suckers.

In the entire river sampling (not including fixed site seasonal sampling) a total of 71 blue suckers were collected from May to August 2005. In this sampling no males or females were able to be determined, which was expected this time of year. Blue suckers seemed to be distributed throughout the river except the reaches below the Johnson County Weir near rkm 24 and the 20 km above the Bowersock Dam. Below the Johnson County Weir the river has been highly channelized with many man made rip-rap areas (which had our lowest catch rates) along the banks. The river was much deeper below the weir, which probably had an effect on the efficiency of the electrofisher. We also noticed that overall blue sucker abundance was higher in the upper reaches of the river. This 190 rkm reach is less impacted than the lower reaches, which may suggest this river reach may be more similar to pre-dam conditions than the lower river. No blue suckers were caught within 20 km above Bowersock Dam, which is similar to what Morey and Berry (2003) found in the James River, SD, where blue sucker CPUE was only 0.24 fish per hour above a low head dam compared to below the dam where CPUE was 5.4 fish per hour. The area above Bowersock Dam had slower water velocities and seemed to have a soft silty substrate. This type of habitat is not what is preferred by blue suckers, which may be why none were collected in this area.

We expected to see increased abundance of blue suckers during spring in the upriver reaches and below Bowersock Dam as fish move upriver to spawn. However, we collected very few blue suckers in spring and variability was so high there was no difference among reaches. However, our sampling efficiency at rkm 83 below the dam may have been low, and more fish may have been collected as we could see them top the water while

shocking, but the water was moving too quickly and we were unable to net the fish. The two fish that were collected below the dam in the spring were ripe males, which suggests that they may have been near the dam for spawning. Surprisingly, we did not see much difference in the fixed sites until the fall when more fish in the upper river reaches were collected. Also the highest catch rates in this study occurred in the upriver sites in winter. At the four sites sampled in winter near rkm 235, a total of 12 fish were collected. Of these twelve fish, three were ripe males suggesting that blue suckers may possibly be spawning (or preparing to spawn) in November or December. Peterson et al. (1999) showed that the southeastern blue sucker (*Cycleptus meridionalis*) gonadosomatic indexes are increasing in October to January and spawning in February to March when temperatures reach 13-14° C. No ripe females were found in the winter sampling but the fish were found in high numbers at rkm 235 occurred when water temperature was at 12° C. This could mean that blue suckers are preparing to spawn.

Relative abundance of blue suckers was highest in log jams. Most of the blue suckers captured seemed to be in the areas where random logs were abundant throughout the site and water velocity was high. The blue suckers usually were directly behind the logs and usually when one was collected in these areas there was more observed. More extensive habitat data needs to be collected before conclusive evidence on habitat selection can be determined.

The total mean length of blue suckers in the Kansas River was 634 mm, with few under 500 mm. Other studies have also shown few smaller fish collected (Rupprecht and Jahn 1980, Moss et al. 1983, Hand and Jackson 2003, Morey and Berry 2003, Vokoun et al. 2003). The blue sucker population in the Kansas River is seemed to have many older slower

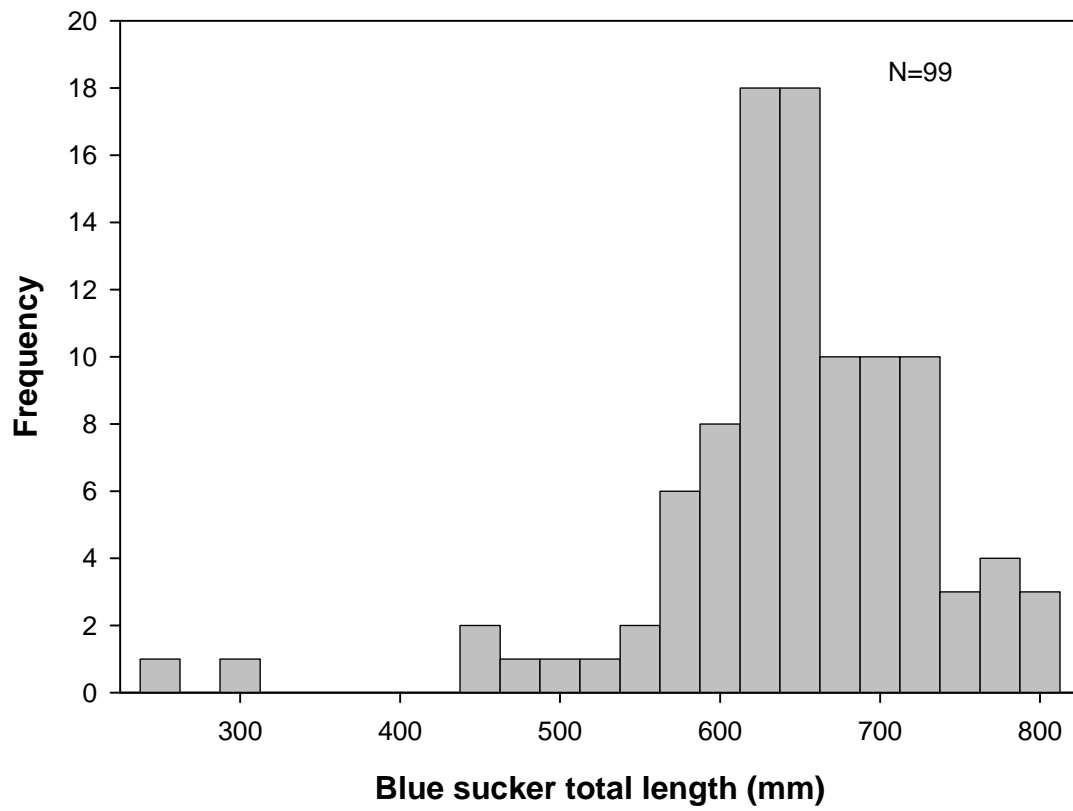
growing fish. We expected blue suckers to have faster growth than rivers further north, but similar to populations in Missouri and Kansas. However, the Kansas River population had the slowest growth of any blue sucker population found in the literature. One possible explanation is that all of our fish were aged using pectoral rays while all of the other studies used scales for aging. In a study by Burnet (1968), it was shown when aging brown trout (*Salmo trutta*) with scales only 6 out of 29 fish were aged correctly. However, fin rays were aged correctly 22 of 29 times. Rupprecht and Jahn (1980) looked at differences in aging between scales and rays of blue suckers and found that after age 7 scales become more unreliable than rays. Due to most of our fish being above age 7 we believed rays were the most reliable bony structure to age this population.

In the Kansas River blue suckers are still distributed throughout most of the river and at times they can be found in relatively high abundance. Further work needs to be done to determine why blue sucker growth in the Kansas River is slower than other populations throughout the Mississippi River Basin. Another question is why were there only two young fish found throughout the river. Although larger fish were consistently collected, it is unclear if recruitment in recent years is low, or if our gears did not collect young blue suckers. Further research on recruitment of large river fishes, including blue suckers, is needed.

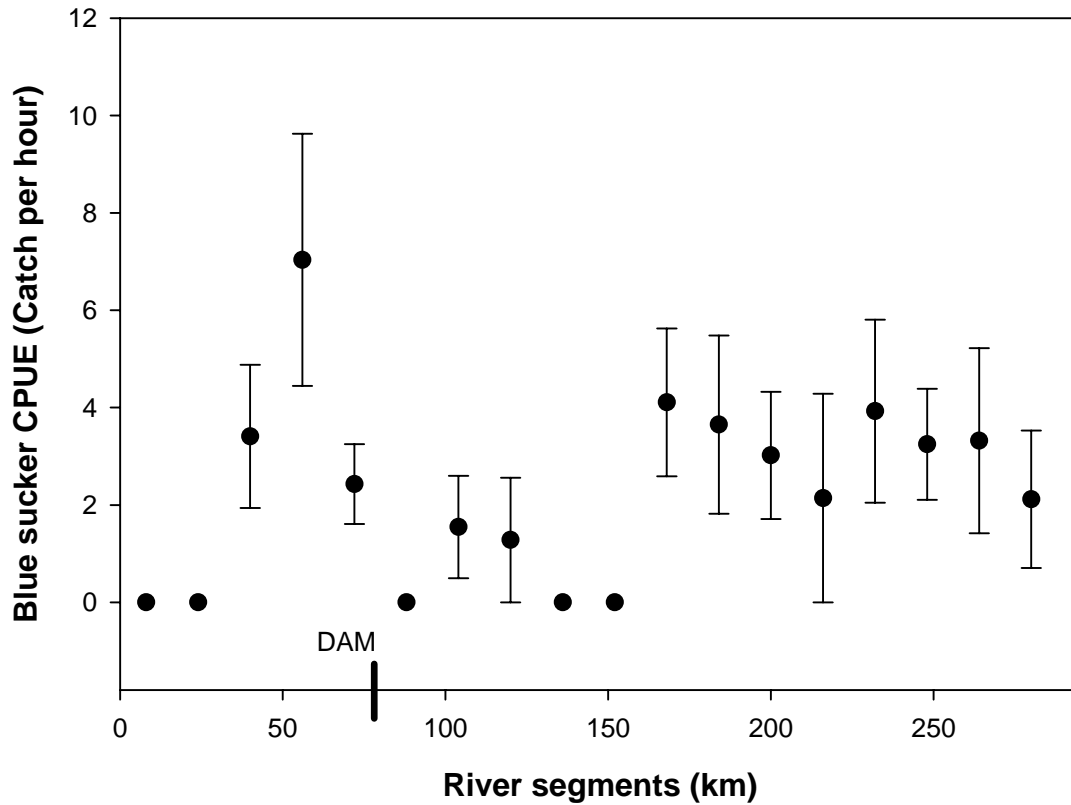
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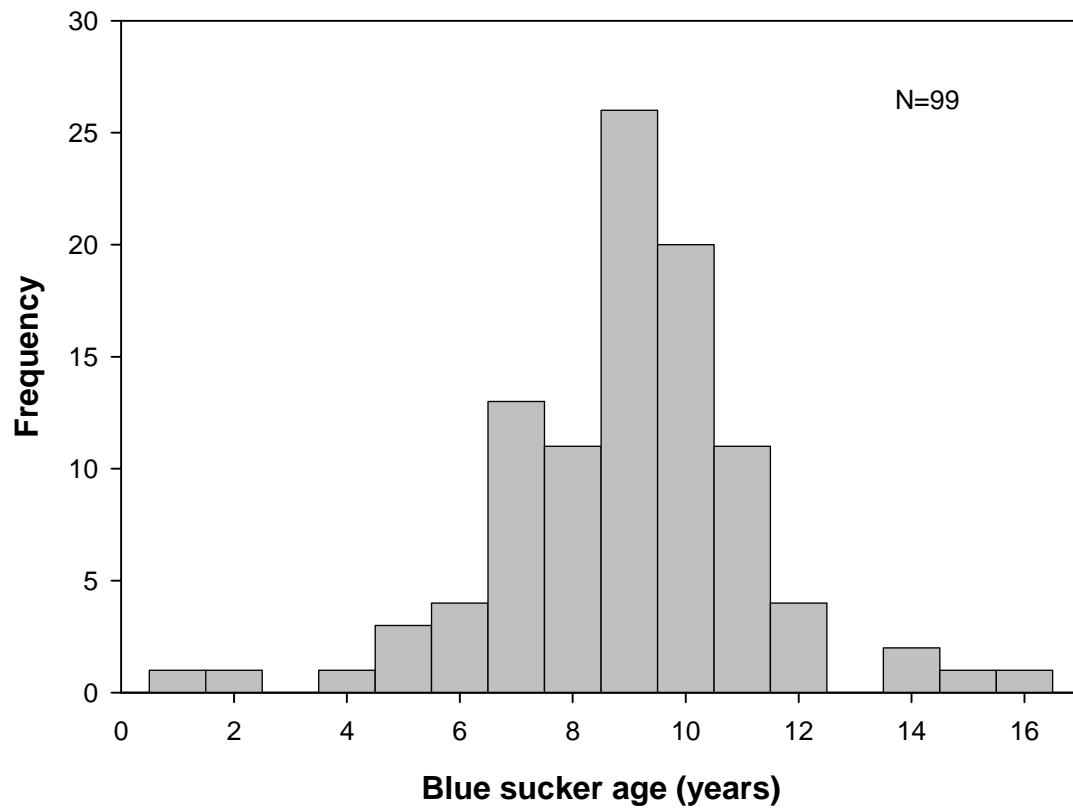
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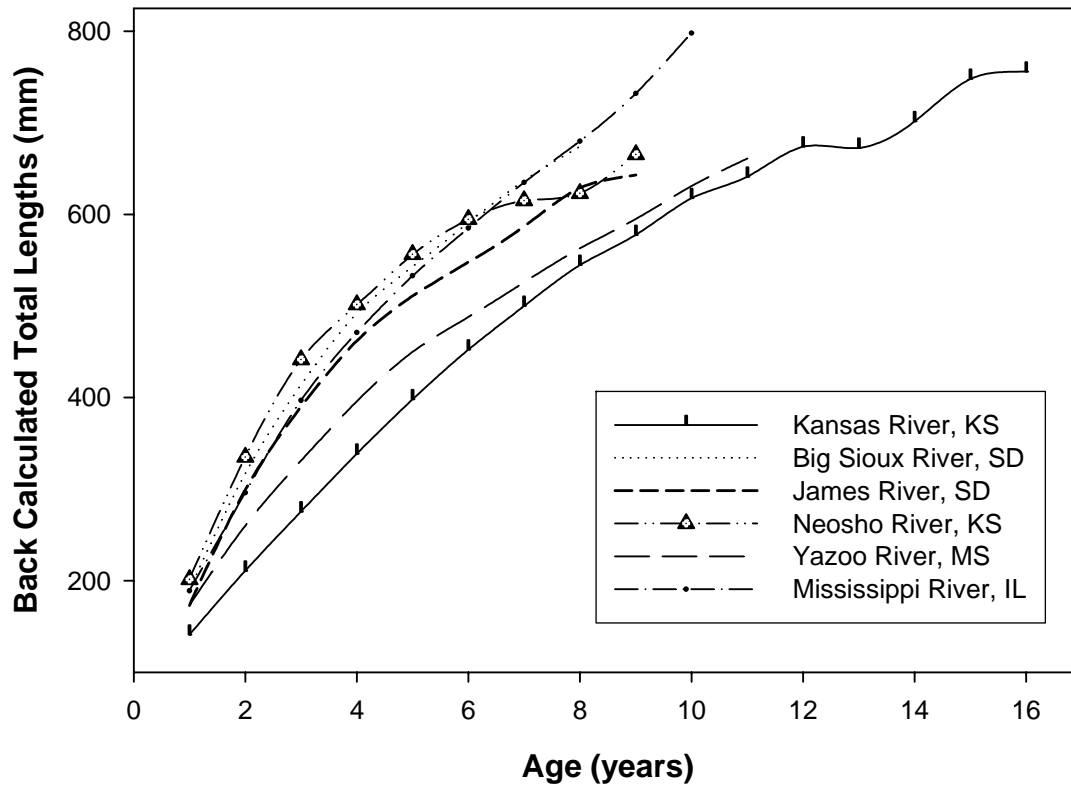
**Figure 1.** Length frequency of blue suckers collected in the Kansas River from rkm 0 to rkm 275 by electrofishing from March to November, 2005.



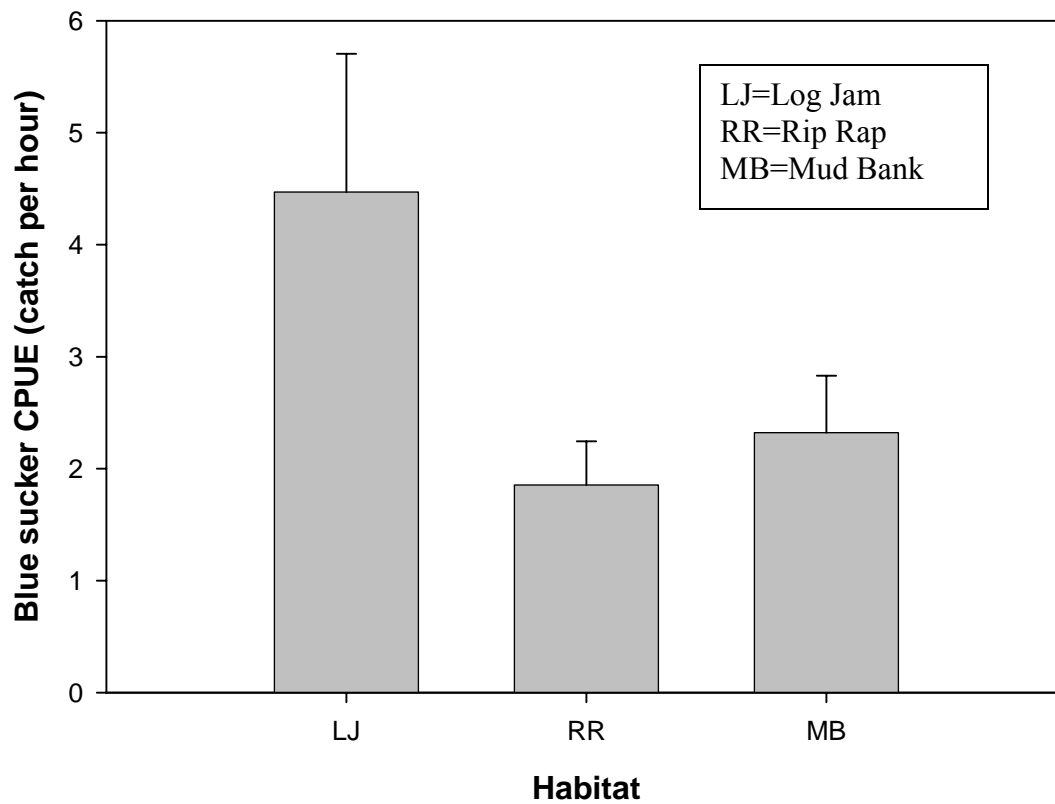
**Figure 2.** Blue sucker mean catch per unit effort (number per hour of electrofishing) for 278 random sites sampled throughout the Kansas River from rkm 0 to rkm 275 from June to August, 2005. Error bars represent 1 standard error.



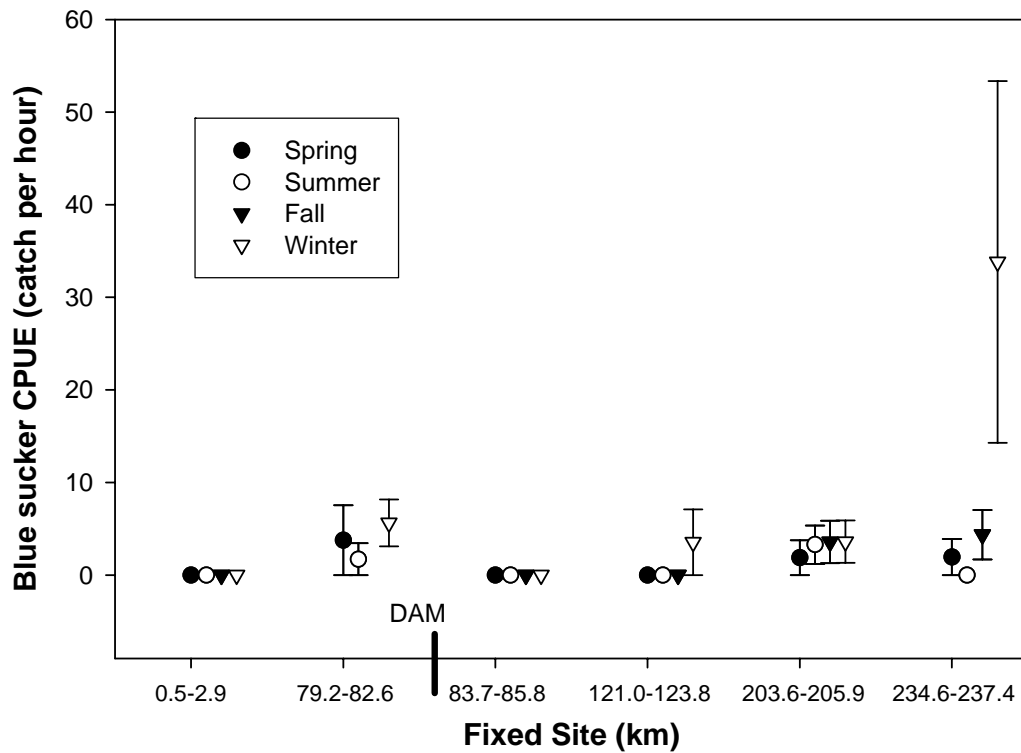
**Figure 3.** Age frequency of blue suckers collected in the Kansas River from rkm 0 to rkm 275 by electrofishing from March to November, 2005.



**Figure 4.** Comparison of back calculated mean length at age of blue suckers collected in the Kansas River and other rivers in the Midwest and Southeast. The data for the Big Sioux and James River came from Morey and Berry (2003), the data for the Mississippi River came from Rupprecht and Jahn (1980), the data for the Neosho River came from Moss et al. (1983), and the data for the Yazoo River came from Hand and Jackson (2003).



**Figure 5.** Mean catch per unit effort (number per hour of electrofishing) of blue suckers in log jams, rip rap, and mud bank habitats in the Kansas River from June to August 2005. Error bars represent 1 standard error.



**Figure 6.** Blue sucker mean catch per unit effort (number per hour of electrofishing) in the Kansas River for 36 fixed stations in 6 reaches during the spring, summer, fall, and winter of 2005. Bowersock Dam is noted at rkm 83. Error bars represent 1 standard error.

Appendix 1. Codes for fish species used in Appendix 2.

<b>Code</b>	<b>Species</b>
BBF	Bigmouth buffalo
BCF	Blue catfish
BGS	Bluegill
BHM	Bullhead minnow
BKC	Black crappie
BNM	Bluntnose minnow
BSU	Blue sucker
CCF	Channel Catfish
CRP	Common Carp
ESH	Emerald shiner
FDR	Freshwater drum
FHC	Flathead catfish
FHM	Fathead minnow
GCP	Grass carp
GOE	Goldeye
GSF	Green sunfish
GZS	Gizzard shad
LMB	Largemouth bass
LNG	Longnose gar
OSN	Orangespotted sunfish
QUI	Quillback
RCS	River carpsucker
RRH	River redhorse
RSH	Red shiner
SAE	Saugeye
SBF	Smallmouth buffalo
SCP	Silver carp
SHR	Shorthead redhorse
SKM	Suckermouth minnow
SMB	Smallmouth bass
SMT	Slender madtom
SNG	Shortnose gar
SSH	Sand shiner
SST	Shovelnose sturgeon
WAE	Walleye
WBS	White bass
WCP	White crappie

Appendix 2. Location, date, and species of all fish collected by electrofishing in the Kansas River, Kansas, 2005. Species codes are listed in Appendix 2; fish sampled two or fewer times are listed in Appendix 3.

DATE	River Mile	Lat	Long	Effort (s)	BBF	BCF	BGS	BHM	BNM	BSU	CCF	CRP	ESH	FDR	FHC	FHM	GCP	GOE	GSF	GZS	LMB	LNG	OSN	QUI	RCS	RSH	SBF	SCP	SHR	SKM	SNG	SSH	SST	WBS	WCP	
4/2/2005	0.3	39.11327113	-94.61515317	303											2					3					2		2	1								
5/18/2005	0.3	39.11327113	-94.61515317	349								8		8	1											12	1					1	1			
7/7/2005	0.3	39.11327113	-94.61515317	378										4	1											2										
9/3/2005	0.3	39.11327113	-94.61515317	341									3	4	3											2										
11/6/2005	0.3	39.11327113	-94.61515317	330									3		1						3					1										
4/2/2005	0.5	39.11083569	-94.61692502	312										1														1								
5/18/2005	0.5	39.11083569	-94.61692502	342				1					4	7												4										
7/7/2005	0.5	39.11083569	-94.61692502	331										2												3						1				
9/3/2005	0.5	39.11083569	-94.61692502	317									1	6	1											3						1	1			
11/6/2005	0.5	39.11083569	-94.61692502	317									4	2	1						2							1								
4/2/2005	0.8	39.10653208	-94.61747906	313							1			3					1		2															
5/18/2005	0.8	39.10653208	-94.61747906	325	1								1	1												5							1			
7/7/2005	0.8	39.10653208	-94.61747906	338			1					2		1	1	1							2			2	1						3			
9/3/2005	0.8	39.10653208	-94.61747906	308										1	1											3										
11/6/2005	0.8	39.10653208	-94.61747906	316	2						1			3					1		1					1		1								
4/2/2005	1	39.10427551	-94.61606051	300										1												4		6								
5/18/2005	1	39.10427551	-94.61606051	331										1							1		1			1	1	3	2							
7/7/2005	1	39.10427551	-94.61606051	326		1								1	1																		1			
9/3/2005	1	39.10427551	-94.61606051	325									3															1	1							
11/6/2005	1	39.10427551	-94.61606051	321	2									2							3					6										
5/20/2005	1.3	39.10236441	-94.61430644	363																						2										
4/2/2005	1.5	39.09777593	-94.61220651	318								1		3																						
5/18/2005	1.5	39.09777593	-94.61220651	347									4	2	2											1										
5/20/2005	1.5	39.09777593	-94.61220651	345											1																					
7/7/2005	1.5	39.09777593	-94.61220651	348										1					1							1										
9/3/2005	1.5	39.09777593	-94.61220651	317								2	4		2														1			1				
11/6/2005	1.5	39.09777593	-94.61220651	310									3	1							2															
4/2/2005	1.8	39.09383534	-94.60962354	309										2												1										
5/18/2005	1.8	39.09383534	-94.60962354	317									5	1												3		1								
7/7/2005	1.8	39.09383534	-94.60962354	347										2	1		1																1			

























Appendix 3. Species collected two or fewer times that are not listed in Appendix 2 for clarity.

Species	Date	River mile	Lat	Long	Number
Black crappie	7/5/2005	53.7	39.00197304	-95.24173773	1
River redhorese	9/8/2005	147.2	39.18620509	-96.52344044	1
Saugeye	11/6/2005	77.3	39.06890002	-95.60033491	1
Smallmouth bass	5/24/2005	142.8	39.17663051	-96.47801270	1
Smallmouth bass	5/25/2005	128.9	39.19286165	-96.31758101	1
Slender madtom	6/1/2005	156.9	39.14585344	-96.62300077	1
Slender madtom	7/8/2005	51.7	38.97605142	-95.23391121	1
Walleye	11/4/2005	147.5	39.18674824	-96.52927852	2