# Fisheries bulletin

KENTUCKY DEPARTMENT *of* FISH *and* WILDLIFE RESOURCES

## Evaluation of a Sauger Stocking Program on the Kentucky River

BY:
JASON HERRALA

BULLETIN NO. 110
MARCH 2014

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Jason Herrala, Fisheries Research Biologist

Kentucky Department of Fish & Wildlife Resources

March 2014

**Partially funded by Sport Fish Restoration Funds**

**Sport Fish Restoration Project F-40 "Statewide Fisheries Research"**

**Abstract**

Stockings of sauger and walleye *S. vitreum* have been used extensively to expand, maintain, or supplement populations, but results are extremely variable. In 2006 the Kentucky Department of Fish and Wildlife Resources began stocking sauger in the Kentucky River to bolster and reestablish a self-sustaining sauger fishery. Nocturnal electrofishing was conducted in spring and fall each year from 2006 – 2013 to assess the impacts associated with stocking. Catch rates of sauger decreased annually once stockings were discontinued. Spring catch rates of sauger were directly related to the number of sauger stocked the previous year, and fall catch rates were directly related to mean March – May discharge. Size and age structure continually shifted towards larger and older fish as the study progressed and after stocking ceased. Additionally, stocked fished comprised a large majority of the population each year. It is apparent that natural reproduction is limited throughout the river and that a high quality, self-sustaining population of sauger is likely unattainable; however, there is likely substantial use of the current sauger fishery. It is recommended that supplemental stockings of fingerling sauger (≥75,000 fingerlings/year) continue in the Kentucky River to maintain a put-grow-take fishery. If hatchery production cannot not reach this level, any excess sauger should be stocked when available.

## Introduction

Sauger *Sander canadensis* are widely distributed throughout North America, and in Kentucky they are found in the Lower Mississippi and Ohio rivers and their major tributaries such as the Green, Salt, and Kentucky rivers (Burr and Warren 1986). These rivers provide large, turbid habitat with deep water and low gradients that sauger prefer (Becker 1983; Jaeger et al. 2005; Kuhn et al. 2008). During the winter and spring, sauger congregate below dams and near creek mouths in these systems to spawn and provide substantial fisheries. Older lock and dam employees interviewed by Williams (1974) indicated that sauger were abundant in the upper reaches of the Kentucky River in the past. Presently, sauger are most often observed in the tailwaters of the first four dams (Carrollton to Frankfort) with numbers declining upstream. As early as the 1950's anglers were concerned with declining fishing success as the lock chambers were being used less frequently (Carter 1954).

Stockings of sauger and walleye *S. vitreum* have been used extensively to expand, maintain, or supplement populations (LaJeone et al. 1992), but results are extremely variable (Laarman 1978; Ellison and Franzin 1992). To combat declines in the sauger fishery in the Kentucky River, the Kentucky Department of Fish and Wildlife Resources (KDFWR) stocked 2,060,000 fry, 149,038 fingerlings, and 295 adult sauger in the Kentucky River upstream of Beattyville between 1981 and 1985. Walleye stocking began in 1989 with walleye fry and fingerlings being stocked in the same upper reaches of the Kentucky River. These stockings were never evaluated, so KDFWR implemented a percid study on the Kentucky River in winter 2002 and spring 2003. Results showed that the walleye stockings were not effective and changes were needed. Sauger are better adapted to the conditions present in the Kentucky River, and it was decided that walleye stockings would cease and sauger fingerling stockings would begin again in Pools 4 through 14. Sauger stocking, and consequently this study, began in 2006 with the hopes of reestablishing a self-sustaining sauger fishery in the Kentucky River above Lock and Dam 4.

Sauger fishing continues to increase in popularity, and it will be increasingly important to evaluate not only if natural reproduction occurs as a result of stocking efforts, but also if the population can support harvest to maintain a sustainable sport fishery (LaJeone et al. 1992; Baccante et al. 2011). The objectives of this study were to: 1) evaluate the potential of establishing a self-sustaining, recreational sauger fishery through time-limited stockings in pools 4 – 14 of the Kentucky River, and 2) estimate the use and importance of the sauger fishery on the Kentucky River.

## Study Area

The Kentucky River traverses two physiographic areas and drains approximately 6,966 square mi. It stretches from the Cumberland Plateau in southeast Kentucky and flows 265 mi northwesterly through the Bluegrass Region where it empties into the Ohio River at Carrollton, Kentucky (Burr and Warren 1986). Three forks (North, Middle, and South forks) come together at Beattyville, Kentucky to form the main stem of the Kentucky River in Lee County. From Beattyville downstream, the river is extremely channelized and there are 14 lock and dams that were put in place between 1842 and 1917 for navigation purposes. The lock chambers of Lock and Dams 1, 2, and 5 through 14 are no longer in use and movement of fish between pools is limited to high water periods in the winter. Lock and Dams

3 and 4 are operated roughly between Memorial Day and Labor Day for recreation boaters. Pools 4, 9, 10, and 11 of the Kentucky River were sampled during this study.

## Methods

### Stocking

Sauger broodstock were collected each winter from various water bodies including the Ohio River, Kentucky River (outside of the study area), and Cumberland River below Wolf Creek Dam. Broodstock sauger were brought back to Pfeiffer Fish Hatchery in Frankfort, KY to be spawned. Offspring were reared to 1.5 – 2.0 in fingerlings and stocked into pools 4 – 14 of the Kentucky River. Sauger fingerlings were stocked from 2006 – 2010; stocking was discontinued from 2011 – 2013 to determine if the population was now self-sustaining.

### Sampling

Nocturnal, pulsed DC electrofishing was used to monitor sauger populations in the spring and fall of each year from 2006 – 2013. During spring sampling, four 15-minute transects were made in the tailwaters of Lock and Dams 5, 10, 11, and 12—the upper reaches of pools 4, 9, 10, and 11, respectively when water temperatures were near 50.0°F. All sauger collected were measured (nearest 0.1 in). Twelve, 15-minute transects per pool (spread evenly throughout each pool) were nocturnally electrofished in the fall when water temperatures were 60.0 – 70.0°F. Additional sampling was conducted in fall 2011 to investigate sauger abundance in other reaches of the river; the North, Middle, and South Forks and pools 7 and 8 of the Kentucky River were sampled in the fall. All sauger collected were measured (nearest 0.1 in), weighed (nearest 0.01 lbs), and otoliths were removed from a subsample of the fish collected.

### Age structure and stocked fish contribution

Fingerling sauger were marked with oxytetracylcine (OTC) at Pfeiffer Fish Hatchery prior to stocking. Otoliths were removed to estimate age structure, check for OTC marks to estimate the contribution of the stocked fish to the population, and to determine if any natural reproduction was occurring.

### Angler attitude survey

A short, informal angler attitude survey was conducted in January and February 2012 in the tailwaters of Lock and Dams 3, 4, and 5 to gather general information on use, knowledge, and satisfaction of the sauger fishery in the Kentucky River. Anglers were surveyed in the morning and afternoon, and asked questions about sauger fishing on the Kentucky River including number of trips they make annually to target sauger, their awareness of the sauger stocking programs, and their level of satisfaction with sauger fishing on the Kentucky River.

### Data Analysis

All sampling data was analyzed using SAS v. 9.2 (SAS; Cary, NC). Population parameters such as CPUE, CPUE by size class, relative weight, and mean length were calculated using KDFWR's KFAS and KSLO software run in SAS. Spring and Fall CPUE was regressed (PROC REG) against mean March – May discharge and stocking numbers. All variables were checked for normality using a Shapiro-Wilk test. Significance for all normality and regression tests was assessed at a level of $\alpha = 0.05$.

## Results

### Stocking

A total of 460,047 sauger fingerlings were stocked in pools 4 – 14 of the Kentucky River during May from 2006 – 2010; no stockings occurred from 2011 – 2013 (Table 1). All sauger stocked ranged from 1.5 – 2.0 in.

### Sampling

*Spring sampling*—No sauger were collected during spring sampling in 2006 (Total CPUE=0.0 fish/hr). After the initial stocking in May 2006, catch rates of sauger increased yearly in all tailwaters through 2009 (Total CPUE=54.3 fish/hr) after which catch rates in all tailwaters decreased. Following the final stockings of sauger in 2010, catch rates declined annually in all tailwaters sampled. By 2012, all tailwaters except Lock and Dam 12 had catch rates of sauger that were below historical averages. Lock and Dam 12 tailwater fell below its historical average (Total CPUE=8.7 fish/hr) in 2011 (CPUE=3.0 fish/hr), rose above historical average in 2012 (CPUE=10.7 fish/hr), and then fell once again in 2013 (CPUE=4.0 fish/hr). Overall mean CPUE of sauger for the length of the study was 16.9 fish/hr (Table 2).

Length frequencies of sauger were recorded each year during spring sampling. Sauger ranged from 6.6 – 18.8 in throughout the study. Total mean length for the study was 11.6 in and ranged from 8.7 in in 2007 to 14.7 in in 2013; mean length and size structure increased each spring (Table 3). Catch rates for specific size class of sauger were also monitored each spring. Catch rates of sauger <8.0 in were generally low (mean CPUE=0.6 fish/hr), and indicated that this size sauger were likely not fully recruited to electrofishing gear. Catch rates of sauger <8.0 in ranged from 0.0 fish/hr in 2006, 2011, 2012, and 2013 to 1.5 fish/hr in 2010. Sauger in the 8.0 – 11.9 in group exhibited the highest mean catch rate for all size classes examined (mean CPUE=10.0 fish/hr); however, sauger in the 12.0 – 14.9 in and ≥15 in groups dominated the catch in the last 2 years of the study. Catch rates of sauger in the 8.0 – 11.9 in class ranged from 0.0 fish/hr in 2006 to 29.0 fish hr in 2009. Catch rates of sauger in the 12.0 – 14.9 in group (mean CPUE=6.0 fish/hr) ranged from 0.0 fish/hr in 2006 to 21.3 fish/hr in 2009. Sauger ≥15.0 in had fairly low catch rates throughout the study (mean CPUE=2.0 fish/hr) and ranged from 0.0 fish/hr in 2006 to 4.5 fish/hr in 2011 (Table 4).

*Fall sampling*—Catch rates of sauger for each year were lower in the fall than in the spring, with the exception of 2006 where spring sampling occurred before the stocking program began. Fall mean CPUE of sauger throughout the study was 4.7 fish/hr and ranged from 1.6 fish/hr in 2012 to 10.2 fish/hr in 2011. Unlike spring catch rates, fall catch rates did not follow a declining pattern once stocking was stopped. Rather, CPUE of sauger in fall was sporadic but generally low (Table 5). Exploratory sampling

in 2011 provided a wide spread of results, as CPUE ranged from 1.3 fish/hr in the Middle Fork of the Kentucky River to 18.6 fish/hr in Pool 7. Mean CPUE of these additional efforts was 8.6 fish/hr. These numbers were slightly lower than CPUE of pools 4, 9, 10, and 11, but did fall within range (Table 6).

As with spring sampling, length frequencies of sauger were recorded each year during fall sampling. Sauger ranged from 5.8 – 19.2 in throughout the study. Total mean length for the study was 11.5 in and ranged from 7.8 in in 2006 and 15.3 in in 2013; mean length and size structure increased each fall (Table 7). Catch rates for specific size class of sauger were also monitored each fall. Catch rates of sauger <8 in were generally low (mean CPUE=0.6 fish/hr), and ranged from 0.0 fish/hr in 2012, and 2013 to 1.5 fish/hr in 2006. Sauger in the 8.0 – 11.9 in ranged exhibited the highest mean catch rate for all size classes examined (mean CPUE=2.1 fish/hr); however, sauger in the ≥15 in group dominated the catch in the last 2 years of the study. Catch rates of sauger in the 8.0 – 11.9 in class (mean CPUE=2.1 fish/hr) ranged from 0.2 fish/hr in 2012 to 5.5 fish hr in 2011. Catch rates of sauger in the 12.0 – 14.9 in group (mean CPUE=1.4 fish/hr) ranged from 0.0 fish/hr in 2006 to 2.9 fish/hr in 2009. Sauger ≥15 (mean CPUE=0.7 fish/hr) ranged from 0.0 fish/hr in 2006 and 2007 to 1.9 fish/hr in 2011 (Table 8).

Relative weight ($W_r$) estimates were obtained each fall during sampling. Mean $W_r$ of sauger for the study was 83, and ranged from 76 in 2009 and 2013 to 88 in 2006 and 2007. $W_r$ was also examined for specific size groups. $W_r$ tended to decrease as size of sauger increased. Sauger in the 8.0-11.9 in group had a mean $W_r$ of 85, and ranged from 77 in 2009 to 89 in 2007 and 2011. Sauger in the 12.0-14.9 in group had a mean $W_r$ of 79, and ranged from 74 in 2009 to 85 in 2008. Sauger ≥15 in had mean $W_r$ of 77, and ranged from 74 in 2009 and 2013 to 81 in 2010 and 2012 (Table 9).

Age structure and stocked fish contribution

Otoliths examined from sauger collected each spring indicated that CPUE by age class decreased as age increased (Table 10). Mean CPUE of age-1 sauger was 13.2 fish/hr, and ranged from 0.0 fish/hr in 2006 to 30.9 fish/hr in 2009. Mean CPUE of age-2 sauger was 4.3 fish/hr, and ranged from 0.0 fish.hr in 2006 to 14.4 fish/hr in 2009. Age-3 sauger had a mean CPUE of 2.3 fish/hr, and ranged from 0.0 fish/hr in 2006 to 7.0 fish/hr in 2011. Mean CPUE of age-4 sauger was 0.4 fish/hr; age-4 sauger were only collected in 2011. No sauger older than age-4 were collected throughout the study. Otoliths were not taken in 2012 or 2013; however, large fish were collected during spring samples in 2012 and 2013 that may have been age-4 or older fish (Tables 3 and 10). Stocked fish dominated the catch each year. OTC marked fish accounted for 74.4 – 100.0% of sauger collected each year (Table 11).

Angler attitude survey

A total of 78 anglers were surveyed in the tailwaters of Lock and Dams 3, 4, and 5 of the Kentucky River. Twenty-three of those anglers (29%) were actively targeting sauger. Of those 23 sauger fishermen, 14% indicated that they fished the Kentucky River for sauger less than 5 times a year, 29% fished the Kentucky River for sauger 5 – 10 times per year, and 57% targeted sauger on the Kentucky River more than 10 times a year. The majority of sauger fishermen (62%) indicated that they were satisfied with the sauger fishery in the Kentucky River, while only 5% of fishermen surveyed were dissatisfied with the fishery. The remaining 33% of anglers surveyed were either neutral or had no

opinion of the sauger fishery in the Kentucky River. Lastly, sauger anglers were asked if they knew that KDFWR was stocking sauger into the Kentucky River, and 65% indicated that they were aware.

Catch rate analysis

A Shapiro-Wilk test was conducted on all independent variables to test for normality. Number of sauger stocked during the current year ($P$=0.24), number of sauger stocked the previous year ($P$=0.24), and average March – May discharge ($P$=0.25) were all normally distributed. Multiple linear regression models indicated that spring catch rates were significantly influenced by stockings the previous year ($P$<0.01), indicating that increased stocking rates in one year will lead to higher catch rates the following spring (Figure 1). Additionally, fall catch rates were significantly influenced by average March – May discharge ($P$=0.01); greater spring discharge resulted in greater fall catch rates (Figure 2).

## Discussion

Little data exists on the contribution and success of sauger stockings; however, stocking plays an integral role in the management of walleye in North America (Goeman 2002). Though it may have a large role, its success in terms of establishing self-sustaining fisheries is highly questionable. Many studies (Cleary and Mayhew 1961; Koppelman et al. 1992; McWilliams and Larscheid 1992; Paragamian and Kingery 1992; Li et al. 1996; Vandergoot and Betttoli 2003) have reported the poor success rates of stocking walleye fry, and the increased survival and year-class contribution of stocked fingerlings. Heidinger and Brooks (1998) found that stocking fingerling sauger in the Illinois River contributed substantially to year-classes, particularly when natural reproduction was low and stocking did not follow a strong natural year-class. Our study supports the notion that stocked fingerling can have significant contributions to year-classes in the Kentucky River, as stocked sauger accounted for 74.4 – 100.0% of sauger populations and spring catch rates were directly related to number of fished stocked.

Spring catch rates of sauger in the Kentucky River decreased immediately after stocking was discontinued. Additionally, contribution of wild sauger never exceeded 25.6% once stockings were discontinued, and mean length of sauger in the both the spring and fall continued to increase as a result of shifting size and age structure resulting from limited natural recruitment. These trends indicate that very little natural reproduction is occurring in the Kentucky River. Furthermore, spring catch rates were directly related to the previous year's catch rate, strengthening the evidence that sauger are not self-sustaining in the Kentucky River.

Sauger populations fluctuate naturally due to biotic and abiotic factors, and year-class strength can be highly variable. Colby et al. (1979) and Pitlo (2002) found that environmental factors before, during, and after spawning govern reproductive success of sauger, ultimately relating to year-class strength. Discharge rates have been shown to affect year-class strength of walleye in multiple river systems (MacCrimmon and Skobe 1970; Swain 1974; Nelson and Walburg 1977). Our study corroborates those findings; fall catch rates of sauger were directly influenced by increase March – May discharge. Increased March – May discharge may have allowed sauger to reach flooded backwater areas where forage was abundant.

Populations may also exhibit long-term declines due to high exploitation (Hesse et al. 1994; Pegg et al. 1996; Sullivan 2003). The brief angler attitude survey conducted in our study indicated that exploitation was not unexpectedly high, but with such little natural reproduction even low levels of harvest may not be sustainable. It should be noted that our angler attitude survey was not conducted throughout what many consider to be the sauger fishing season (December – April). Rather it only encompassed January – March, and efforts to survey anglers were limited to weekdays. Therefore, use of the sauger fishery and exploitation rates on the Kentucky River are likely an underestimate.

Bellgraph et al. (2008) suggested that community changes could cause declines in fish populations. Food abundance is also known to affect year-class strength of walleye in rivers (Kleinert and Mraz 1966; Priegel 1970; Li and Mathias 1982; Madaenjian et al. 1996; Hansen et al. 1998). Johnson et al. (1988) found that small gizzard shad *Dorosoma cepedianum* were the most important prey for all ages of sauger. Forage indices are not available for the Kentucky River; however, shad production in the Kentucky River is extremely variable, and decreased forage availability may hinder survival of sauger.

Habitat loss and alteration is also a concern for riverine sauger populations (Hesse et al. 1994; Macenia et al. 1996; Pegg et al. 1997; McMahon and Gardner 2001). Loss of spawning habitat due to channel alteration and barriers to migration are cited as some of the most commonly identified factors contributing to the decline of sauger populations (Graeb et. al 2009). The Kentucky River is extremely channelized, and a series of 14 lock and dams limit fish movement through the river. Only locks 3 and 4 are operational and use is limited to the recreational boating season, further hindering movement potential and access to off-channel rearing habitats. Pegg et al. (1997) found that sauger moved up to 125 mi from tagging locations in the Lower Tennessee River, and other studies have documented high movement rates of sauger through North America (Collete et al. 1977; Penkal 1992). The longest pool on the Kentucky River is Pool 1 (27 mi). Limited habitat availability within pools and inability to move freely between pools may be resulting in poor natural reproduction of sauger in the Kentucky River.

Management implications and recommendations

Catch rates of sauger have decreased each year since stocking was halted. It is apparent that natural reproduction is limited throughout the river and that a high quality, self-sustaining population of sauger is likely unattainable; however, there is likely substantial use of the current sauger fishery. Extreme changes to alter habitat (dam removal) are unlikely to occur, so continued stockings are needed to support a put-grow-take fishery. Future studies should be aimed at determining if current regulations on sauger in the Kentucky River (no size limit and 6 fish daily creel limit) are the best management options for the fishery. It is recommended that supplemental stockings of fingerling sauger ( ≥75,000 fingerlings/year) continue in the Kentucky River to maintain a put-grow-take fishery. If hatchery production cannot not reach this level, any excess sauger should be stocked when available. Additionally, any excess walleye could be stocked throughout the river to provide a second put-grow-take fishery.

**Acknowledgements**

I would like to express my thanks for the hard work and dedication put into this project by my peers at KDFWR. I thank Doug Henley and Sara Tripp for their previous leadership and undertaking of this project. I also thank Jeff Crosby, Katie Spears, Danny Duval, David Baker, Nick Keeton, and Jason McDowell for the extensive time they put in electrofishing each Spring and Fall. Lastly, I thank Gerry Buynak and Ryan Oster for their thoughtful and helpful reviews of this manuscript. Funding for this project was provided through a federal grant, F-40-R "Statewide Fisheries Research" under the Sport Fish Restoration Program.

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Table 1. Number of sauger fingerlings stocked in pools 4-14 of the Kentucky River 2006-2013.

| | Pool | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Total |
| 2006 | 11,050 | 0 | 0 | 11,050 | 10,850 | 10,900 | 11,050 | 11,130 | 0 | 0 | 10,290 | 76,320 |
| 2007 | 78 | 0 | 0 | 7,833 | 0 | 8,540 | 10,700 | 8,080 | 0 | 0 | 7,833 | 43,064 |
| 2008 | 30,345 | 0 | 0 | 19,712 | 19,712 | 19,712 | 19,712 | 19,712 | 0 | 19,712 | 19,712 | 168,329 |
| 2009 | 15,719 | 0 | 0 | 12,340 | 12,340 | 12,340 | 0 | 24,835 | 0 | 12,368 | 12,310 | 102,252 |
| 2010 | 10,000 | 0 | 0 | 7,500 | 10,000 | 7,500 | 7,500 | 10,000 | 0 | 0 | 17,582 | 70,082 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 67,192 | 0 | 0 | 58,435 | 52,902 | 58,992 | 48,962 | 73,757 | 0 | 32,080 | 67,727 | 460,047 |

Table 2. Number of sauger collected and CPUE (fish/hr) of sauger collected from selected tailwaters of the Kentucky River during spring sampling from 2006 - 2013. Standard error is in parentheses.

| | Tailwater | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lock and dam 5 | | Lock and dam 10 | | Lock and dam 11 | | Lock and dam 12 | | Total | |
| Year | Sauger | CPUE | Sauger | CPUE | Sauger | CPUE | Sauger | CPUE | Sauger | CPUE |
| 2006 | 0 | 0.0 (0.0) | 0 | 0.0 (0.0) | 0 | 0.0 (0.0) | 0 | 0.0 (0.0) | 0 | 0.0 (0.0) |
| 2007 | 2 | 1.0 (1.0) | 32 | 16.0 (8.8) | 5 | 2.5 (1.3) | 0 | 0.0 (0.0) | 39 | 5.6 (2.1) |
| 2008 | 13 | 13.0 (5.5) | 33 | 33.0 (6.8) | 21 | 21.0 (8.7) | 2 | 2.0 (1.0) | 69 | 17.3 (3.9) |
| 2009 | 41 | 41.0 (17.5) | 86 | 86.0 (25.3) | 51 | 51.0 (27.3) | 39 | 39.0 (7.7) | 217 | 54.3 (10.6) |
| 2010 | 28 | 28.0 (9.1) | 55 | 55.0 (7.2) | 29 | 29.0 (4.4) | 19 | 19.0 (4.4) | 131 | 32.8 (4.6) |
| 2011 | 24 | 24.0 (17.0) | 47 | 47.0 (6.8) | 22 | 22.0 (19.4) | 3 | 3.0 (1.0) | 96 | 24.0 (7.2) |
| 2012 | 10 | 10.0 (2.7) | 24 | 24.0 (2.8) | 1 | 1.0 (1.0) | 16 | 10.7 (3.0) | 51 | 11.3 (2.3) |
| 2013 | 10 | 10.0 (6.0) | 0 | 0.0 (0.0) | 1 | 1.0 (1.0) | 4 | 4.0 (2.8) | 15 | 3.8 (1.8) |
| Total | 128 | 14.2 (2.4) | 277 | 30.8 (2.8) | 130 | 14.4 (3.6) | 83 | 8.7 (0.9) | 618 | 16.9 (1.2) |

Table 3. Length frequency, CPUE (fish/hr), and mean length (in) of sauger by inch class from the tailwaters of Lock and Dam 5, 10, 11, and 12 of the Kentucky River in Spring 2006 - 2013. Standard error is in parentheses.

| | Inch class | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Total | CPUE | Mean length |
| 2006 | | | | | | | | | | | | | | | 0 | 0.0 (0.0) | |
| 2007 | | | 9 | 22 | 6 | | | | | | 2 | | | | 39 | 5.6 (2.1) | 8.7 |
| 2008 | | | 4 | 15 | 14 | 15 | 7 | 2 | 4 | 4 | 4 | | | | 69 | 17.3 (3.9) | 10.0 |
| 2009 | | | 3 | 31 | 46 | 32 | 7 | 23 | 30 | 32 | 8 | 3 | 2 | | 217 | 54.3 (10.6) | 11.0 |
| 2010 | | 4 | 2 | 3 | 20 | 30 | 21 | 19 | 14 | 8 | 5 | 5 | | | 131 | 32.8 (4.6) | 11.1 |
| 2011 | | | | 6 | 18 | 16 | 7 | 8 | 9 | 14 | 8 | 7 | 3 | | 96 | 24.0 (7.2) | 12.3 |
| 2012 | | | | | | 5 | 13 | 9 | 6 | 10 | 3 | 3 | 1 | 1 | 51 | 11.3 (2.3) | 13.1 |
| 2013 | | | | | 1 | 2 | 1 | | | 1 | 3 | 4 | 2 | 1 | 15 | 3.8 (1.8) | 14.7 |
| Total | | 4 | 18 | 77 | 105 | 100 | 56 | 61 | 63 | 69 | 33 | 22 | 8 | 2 | 618 | 16.9 (1.2) | 11.6 |

Table 4. Spring electrofishing CPUE (fish/hr) by size group for sauger collected from the tailwaters of Lock and Dam 5, 10, 11, and 12 of the Kentucky River from 2006 - 2013. Standard error is in parentheses.

| | Size Group | | | | |
|---|---|---|---|---|---|
| Year | <8 in | 8-11.9 in | 12-14.9 in | ≥15.0 in | Total |
| 2006 | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 2007 | 1.3 (0.6) | 4.0 (1.7) | 0.0 (0.0) | 0.3 (0.3) | 5.6 (2.1) |
| 2008 | 0.9 (0.7) | 12.0 (4.3) | 2.4 (1.4) | 0.9 (0.7) | 16.2 (3.9) |
| 2009 | 0.8 (0.5) | 29.0 (8.9) | 21.3 (7.2) | 3.3 (1.6) | 54.3 (10.6) |
| 2010 | 1.5 (0.9) | 18.5 (5.5) | 10.3 (3.5) | 2.5 (1.4) | 32.8 (4.6) |
| 2011 | 0.0 (0.0) | 11.8 (4.3) | 7.8 (4.4) | 4.5 (2.1) | 24.0 (7.2) |
| 2012 | 0.0 (0.0) | 4.0 (1.4) | 5.6 (1.2) | 1.8 (0.7) | 11.3 (2.3) |
| 2013 | 0.0 (0.0) | 1.0 (0.6) | 0.3 (0.3) | 2.5 (1.4) | 3.8 (1.8) |
| Total | 0.6 (0.1) | 10.0 (1.1) | 6.0 (0.9) | 2.0 (0.3) | 18.6 (1.3) |

Table 5. Number of sauger collected and CPUE (fish/hr) of sauger collected from pools 4, 9, 10, 11 of the Kentucky River during Fall 2006 - 2013. Standard error is in parentheses.

| | Pool | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | | 9 | | 10 | | 11 | | Total | |
| Year | Sauger | CPUE | Sauger | CPUE | Sauger | CPUE | Sauger | CPUE | Sauger | CPUE |
| 2006 | | | 7 | 2.3 (1.2) | 11 | 3.7 (1.7) | | | 18 | 3.0 (1.0) |
| 2007 | 9 | 3.0 (1.9) | 17 | 5.7 (2.8) | 3 | 1.0 (0.5) | 8 | 2.7 (2.0) | 37 | 3.1 (1.0) |
| 2008 | 31 | 10.3 (3.0) | 8 | 2.9 (1.2) | 15 | 5.0 (1.4) | 12 | 4.0 (1.5) | 66 | 5.6 (1.0) |
| 2009 | 16 | 5.3 (1.7) | 26 | 8.7 (1.9) | 10 | 3.3 (1.0) | 37 | 12.3 (2.9) | 89 | 7.4 (1.1) |
| 2010 | 18 | 6.0 (1.7) | 21 | 7.0 (2.7) | 3 | 1.0 (0.5) | 7 | 2.3 (1.3) | 49 | 4.1 (0.9) |
| 2011 | 47 | 16.9 (8.3) | 45 | 15.0 (4.0) | 15 | 5.0 (2.7) | 11 | 3.7 (1.9) | 118 | 10.2 (2.5) |
| 2012 | 10 | 3.3 (1.2) | 0 | 0.0 (0.0) | 1 | 0.3 (0.3) | 6 | 2.0 (1.0) | 17 | 1.6 (0.5) |
| 2013 | 18 | 6.0 (1.4) | 5 | 1.7 (0.8) | 6 | 2.0 (1.0) | 2 | 0.7 (0.7) | 31 | 2.6 (0.6) |
| Total | 149 | 7.3 (1.0) | 129 | 5.4 (0.5) | 64 | 2.7 (0.3) | 83 | 4.0 (0.3) | 425 | 4.7 (0.1) |

Table 6. Number of sauger collected and CPUE (fish/hr) of sauger collected from the exploratory sample site of pools 7, 8, and the North, Middle, and South forks of the Kentucky River during Fall 2011. Standard error is in parentheses.

| Study site | No. of transects | Effort (hr) | No. of sauger | CPUE |
|---|---|---|---|---|
| Pool 7 | 12 | 2.0 | 38 | 18.6 (4.4) |
| Pool 8 | 12 | 3.0 | 43 | 13.2 (2.5) |
| North Fork | 2 | 0.5 | 3 | 6.0 (2.0) |
| Middle Fork | 3 | 0.8 | 1 | 1.3 (1.3) |
| South Fork | 6 | 1.5 | 6 | 4.0 (1.0) |
| Total | 35 | 7.8 | 91 | 8.6 (0.6) |

Table 7. Length frequency, CPUE (fish/hr), and mean length (in) of sauger from pools 4, 9, 10, and 11 of the Kentucky River in Fall 2006 - 2013. Standard error is in parentheses.

| | Inch class | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Total | CPUE | Mean length |
| 2006 | | 2 | 7 | 9 | | | | | | | | | | | | 18 | 3.0 (1.0) | 7.8 |
| 2007 | | 4 | 6 | 12 | 5 | 2 | 4 | 3 | | | | | | | | 37 | 3.1 (1.0) | 9.1 |
| 2008 | | 1 | 1 | 10 | 3 | 3 | 14 | 22 | 7 | 3 | 1 | 1 | | | | 66 | 5.6 (1.0) | 11.1 |
| 2009 | 1 | 2 | 2 | 5 | 18 | 14 | 5 | 14 | 6 | 15 | 4 | 1 | 1 | 1 | | 89 | 7.4 (1.1) | 11.2 |
| 2010 | | 1 | 13 | 6 | | 1 | 1 | 7 | 14 | 3 | 2 | 1 | | | | 49 | 4.1 (0.9) | 10.6 |
| 2011 | 1 | 1 | 1 | 9 | 14 | 18 | 24 | 13 | 4 | 12 | 12 | 6 | 2 | 1 | | 118 | 10.2 (2.5) | 12.0 |
| 2012 | | | | 2 | | | | | 1 | 1 | 5 | 5 | 2 | | 1 | 17 | 1.6 (0.5) | 15.2 |
| 2013 | | | | | | 2 | 4 | 3 | | 3 | 5 | 7 | 7 | | | 31 | 2.6 (0.6) | 15.3 |
| Total | 2 | 11 | 30 | 53 | 40 | 40 | 52 | 62 | 32 | 37 | 29 | 21 | 12 | 2 | 1 | 425 | 4.7 (0.1) | 11.5 |

Table 8. Fall electrofishing catch rate (fish/hr) by size group for sauger collected from pools 4, 9, 10, and 11 of the Kentucky River from 2006-2013. Standard error is in parentheses.

| | Size Group | | | | |
|---|---|---|---|---|---|
| Year | <8 in | 8-11.9 in | 12-14.9 in | ≥15 in | Total |
| 2006 | 1.5 (0.6) | 1.5 (1.8) | 0.0 (0.0) | 0.0 (0.0) | 3.0 (1.0) |
| 2007 | 0.8 (0.5) | 1.9 (1.0) | 0.3 (0.3) | 0.0 (0.0) | 3.1 (1.0) |
| 2008 | 0.2 (0.2) | 2.6 (1.0) | 2.7 (1.0) | 0.2 (0.2) | 5.6 (1.0) |
| 2009 | 0.4 (0.4) | 3.5 (1.3) | 2.9 (0.9) | 0.6 (0.4) | 7.4 (1.1) |
| 2010 | 1.2 (0.4) | 0.7 (0.4) | 2.0 (0.8) | 0.3 (0.2) | 4.1 (0.9) |
| 2011 | 0.3 (0.3) | 5.5 (2.0) | 2.5 (0.6) | 1.9 (0.5) | 10.2 (2.5) |
| 2012 | 0.0 (0.0) | 0.2 (0.1) | 0.2 (0.1) | 1.2 (0.4) | 1.6 (0.5) |
| 2013 | 0.0 (0.0) | 0.5 (0.2) | 0.5 (0.2) | 1.6 (0.4) | 2.6 (0.6) |
| Total | 0.6 (0.1) | 2.1 (0.3) | 1.4 (0.1) | 0.7 (0.1) | 4.7 (0.1) |

Table 9. Relative weight (Wr) estimates obtained from sauger collected in pools 4, 9, 10, and 11 of the Kentucky River from 2007-2013. Standard error is in parentheses.

| | Size Group | | | |
|---|---|---|---|---|
| Year | 8-11.9 in | 12-14.9 in | ≥15 in | Mean |
| 2006 | 88 (1.6) | | | 88 (1.6) |
| 2007 | 89 (1.2) | 85 (5.7) | | 88 (1.2) |
| 2008 | 83 (0.8) | 81 (0.9) | 77 (1.1) | 82 (0.7) |
| 2009 | 77 (1.4) | 74 (1.1) | 74 (2.0) | 76 (0.8) |
| 2010 | 84 (2.1) | 81 (2.0) | 81 (4.6) | 83 (1.4) |
| 2011 | 89 (2.3) | 78 (1.4) | 77 (0.9) | 86 (1.7) |
| 2012 | 86 (0.7) | 76 (4.5) | 81 (1.4) | 81 (1.3) |
| 2013 | 81 (1.0) | 75 (2.2) | 74 (1.4) | 76 (1.1) |
| Total | 85 (0.2) | 79 (0.7) | 77 (0.5) | 83 (0.1) |

Table 10. Electrofishing catch rates (fish/hr) for each age of sauger collected in the Kentucky River in Spring 2006 - 2013. Standard error is in parentheses.

| | No. of | Age | | | |
|---|---|---|---|---|---|
| Year | sauger | 1 | 2 | 3 | 4 |
| 2006 | 0 | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 2007 | 39 | 5.3 (2.1) | 0.0 (0.0) | 0.3 (0.3) | 0.0 (0.0) |
| 2008 | 69 | 12.8 (3.4) | 2.1 (0.8) | 0.9 (0.7) | 0.0 (0.0) |
| 2009 | 217 | 30.9 (7.1) | 14.4 (3.9) | 3.3 (1.2) | 0.0 (0.0) |
| 2010 | 131 | 19.1 (3.4) | 5.4 (1.3) | 2.5 (1.3) | 0.0 (0.0) |
| 2011 | 96 | 11.2 (4.1) | 3.6 (1.5) | 7.0 (3.0) | 2.2 (1.0) |
| 2012* | | | | | |
| 2013* | | | | | |
| Total | 552 | 13.2 (1.0) | 4.3 (0.6) | 2.3 (0.4) | 0.4 (0.2) |

*No sauger were collected for age and growth in 2012 and 2013.

Table 11. Number and percent contribution of stocked sauger colleceted during Spring 2006-2013.

| Year | Marked (%) | Unmarked (%) |
|---|---|---|
| 2006 | | |
| 2007 | 33 (100.0) | 0 (0.0) |
| 2008 | 28 (100.0) | 0 (0.0) |
| 2009 | 48 (92.3) | 4 (7.7) |
| 2010 | 76 (83.5) | 15 (16.5) |
| 2011 | 58 (74.4) | 20 (25.6) |
| 2012* | | |
| 2013* | | |
| Total | 195 (83.3) | 39 (16.7) |

*No sauger were collected for age and growth in 2012 and 2013.

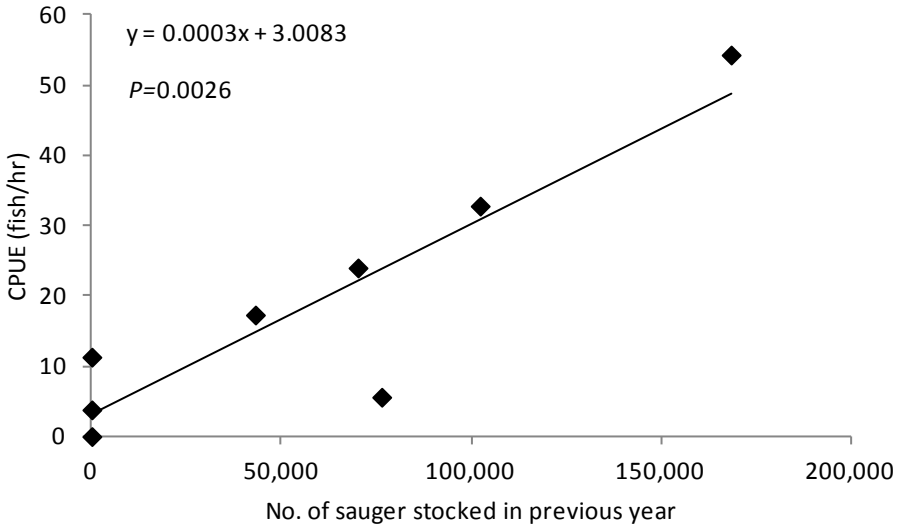


Figure 1. Regression of Spring CPUE (fish/hr) against the number of sauger stocked in the previous year from 2006 – 2013.

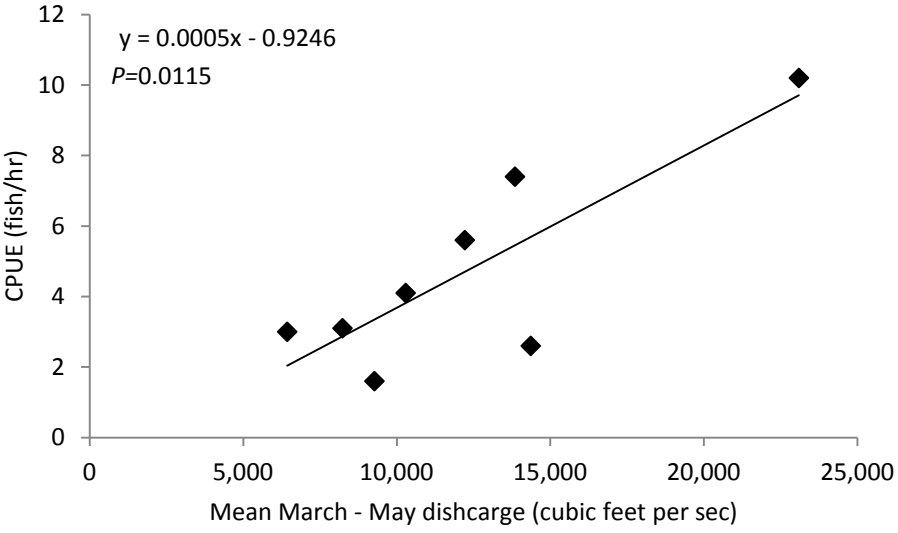


Figure 2. Regression of Fall CPUE (fish/hr) against mean March – May discharge from 2006 – 2013.