

STATE: Kentucky

GRANT NO.: F-40-44

GRANT TYPE: Research and Survey

GRANT TITLE: Statewide Fisheries Investigations

SUBSECTION I TITLE: Stream Fisheries Investigations

PERIOD COVERED: 1 April 2021 - 31 March 2022

Research and Survey Section

Subsection I

Project II: Evaluation of new recreational and commercial regulations on catfish in the Ohio River

Project Objectives:

1. Determine abundance (CPUE), size structure, and condition of blue catfish, channel catfish, and flathead catfish in the Ohio River, and evaluate the effects of new regulations on blue, channel, and flathead catfish in the Ohio River, particularly trophy-size catfish.
2. Quantify age, growth, and mortality of the three species in each reach, and compare to previous data to determine if any changes have occurred over time.

A. ACTIVITY

The conflict between commercial fishermen and recreational catfish anglers on the Ohio River has been apparent for nearly a decade, with the main issue being a perceived switch from a harvest market predominantly for flesh to a market for sale of largely trophy fish to pay lakes. In 2013, KDFWR standardized its catfish data collection methods and began expanding the effort river-wide to more accurately estimate population dynamics of blue catfish, channel catfish, and flathead catfish. On December 1, 2014 the following regulation became law:

Recreational anglers on the main-stem Ohio River are allowed one blue catfish ≥ 35.0 in, one flathead catfish ≥ 35.0 in, and one channel catfish ≥ 28.0 in per day. Harvest of fish below their respective length limits is not regulated.

The majority of commercial fishers fishing in the legal waters of the Ohio River and its tributaries are allowed one blue catfish ≥ 35.0 in, one flathead catfish ≥ 35.0 in, and one channel catfish ≥ 28.0 in per day. However, up to 50 commercial fishers (this number was reduced to 15 commercial fishers in 2019) that harvested over 10,000 lbs of catfish in at least 2 of the last 3 years along with an additional six commercial fishers, who are chosen by a lottery drawing, are allowed a daily harvest of four (in aggregate) blue catfish and flathead catfish ≥ 40.0 in and channel catfish ≥ 30.0 inches in Kentucky's portion of the Ohio River and its tributaries open to commercial fishing below Cannelton Lock and Dam. Harvest of fish below their respective length limits is not regulated.

Accusations by recreational anglers that overharvest was still occurring on the Ohio River surfaced again in 2018. Multiple meetings were held with KDFWR staff, recreational anglers, commercial fishermen, and paylake owners to work towards another compromise. Several regulations were proposed and submitted for review. At the time of this report the following regulations have been made law:

The number of commercial fishers awarded trophy permits was reduced to 15 (previously 50).

There will be no more than two licensed commercial fisherman per boat. If more are present, they may only keep two limits of trophy catfish.

A possession limit (twice the daily limit) was placed on trophy catfish for commercial fishers. This applies when on the water and when trailering fish.

Hoop nets—Catch rate of channel catfish was 2.4 fish/net-night and has continually decreased since 2017. Flathead catfish CPUE was 0.8 fish/net night, a decrease from 1.8 fish/net-night in 2019. Water temperatures were below average during the hoop netting sampling period. Additionally, water levels were highly variable during sets. These factors may have had a negative impact on catch rates.

Electrofishing—Blue catfish CPUE (17.9 fish/hr) was the lowest since 2016 and decreased for the third straight year, but was still above the historical average (CPUE = 17.2 fish/hr). CPUE of flathead catfish was 41.7 fish/hr, which was a decrease from record highs in 2020 but still the third highest catch rate since 2004.

B. TARGET DATES FOR ACHIEVEMENT AND ACCOMPLISHMENTS

Planned achievement date - 31 March 2022
Work accomplished - 31 March 2022

C. SIGNIFICANT DEVIATIONS

Trotlines—No trotline sampling was conducted due to above average river levels in July along with staff shortages throughout the sampling period.

D. REMARKS

Water temperatures were below average during the hoop netting sampling period. Additionally, water levels were highly variable during sets. These factors may have had a negative impact on catch rates.

E. RECOMMENDATIONS

Continue sampling blue catfish, channel catfish, and flathead catfish using approved methods.

Project II: Evaluation of new recreational and commercial regulations on catfish in the Ohio River

FINDINGS

Commercial fishing for catfish has long existed on the Ohio River; however, harvesting trophy-sized fish to sell to pay lake owners has become more prevalent while a market for flesh also remains popular. At the same time, catch and release trophy catfishing has become extremely popular for recreational anglers on the Ohio River. Different viewpoints on how the fishery should be managed has led to conflict between recreational anglers and commercial anglers. Recreational catfish anglers came to KDFWR asking for more stringent regulation for both recreational and commercial anglers, because of a perceived decline in trophy catfish numbers. KDFWR began looking at some basic population parameters of the three major catfish species (blue catfish, channel catfish, flathead catfish) in the Ohio River beginning in 2004. The study was initiated to obtain baseline information on length frequency, weight, and age profiles of these three species and determine methods to more effectively sample each of these species. The conflict was again brought up at a commission meeting in 2012 and it was decided that one additional year of intense sampling would be conducted before a decision on potential regulations was made. Data prior to 2013 was collected from different pools each year and lacked the consistency and standardization to effectively monitor trends of catfish populations in the Ohio River. In 2013 methods for all gear types were standardized and additional effort was put towards sampling to more accurately estimate population dynamics of blue catfish, channel catfish, and flathead catfish in the Ohio River.

A public meeting was held in October 2013 to present catfish data that had been gathered during this project and discuss potential regulations that may be put in place. Both recreational and commercial anglers were in attendance and given the opportunity to share their thoughts and suggestions. In November 2013, the following regulations designed to give some protection to trophy catfish were proposed to the Fisheries Committee:

Recreational anglers on the main-stem Ohio River will be allowed one blue catfish ≥ 35.0 in, one flathead catfish ≥ 35.0 in, and one channel catfish ≥ 28.0 in per day. Harvest of fish below their respective length limits will not be regulated.

The majority of commercial fishers fishing in the legal waters of the Ohio River and its tributaries will be allowed one blue catfish ≥ 35.0 in, one flathead catfish ≥ 35.0 in, and one channel catfish ≥ 28.0 in per day. However, 44 commercial fishers that harvested over 10,000 lbs of catfish in at least 2 of the last 3 years along with an additional six commercial fishers, who will be chosen by a lottery drawing, will be allowed a daily harvest of four (in aggregate) blue catfish and flathead catfish ≥ 40.0 in and channel catfish ≥ 30.0 inches in Kentucky's portion of the Ohio River and its tributaries open to commercial fishing below Cannelton Lock and Dam. Harvest of fish below their respective length limits will not be regulated.

After hearing comments from stakeholders in attendance and discussion with the Fisheries Division Director, the Fisheries Committee voted unanimously to pass the proposed regulations on to the full Commission. The regulations were passed by the full Commission at their meeting in December 2013. In June 2014, the regulation was made law; however, an injunction on the regulation was filed by commercial fishers shortly after its enactment and regulations on commercial fishers were not enforceable until December 1, 2014.

Accusations by recreational anglers that overharvest was still occurring on the Ohio River surfaced again in 2018. A working group comprised of the KDFWR Fisheries Committee, KDFWR Director of Fisheries and staff biologist, recreational anglers, commercial fishermen, and paylake owners was formed so that all parties were represented in discussions. Multiple workgroup meetings were held to work towards another compromise. Several regulations were proposed and submitted for review. At the time of this report the following regulations have been made law:

The number of commercial fishers awarded trophy permits is 15 (previously 50).

No more than two licensed commercial fisherman per boat. If more are present, they may only keep two limits of trophy catfish.

A possession limit (twice the daily limit) was placed on trophy catfish for commercial fishers. This applies when on the water and when trailering fish.

Hoop Net Surveys

Channel catfish hoop net surveys—Department hoop netting was conducted in the Meldahl, Cannelton, and Smithland pools to gather data from hoop net catch of channel catfish and flathead catfish. Single nets baited with ZOTE[®] soap were set overnight for three consecutive net nights in the main stem of the Ohio River. Hoop nets were fished for a total of 162 net-nights: 81 in Meldahl Pool, 54 in Cannelton Pool, and 27 in Smithland Pool (Table 1). Effort was less than the intended 90 net-nights per pool (incomplete sample) in the Cannelton and Smithland pools due to high water and dangerous sampling condition during the sampling window of April - June. Overall catch rate of channel catfish was 2.4 fish/net-night. This is a decrease from 4.5 fish/net-night in 2019 and below the historical average (4.4 fish/net-night; Table 2).

Lengths of channel catfish ranged from 4.5 – 27.4 in with a mean length of 16.0 in (Table 3). Hoop net catch rates were also examined for different size groups of channel catfish. Channel catfish catch rates decreased from 2019 catch rates for all size groups and were all below historical averages (Table 4).

Flathead catfish hoop net surveys—Netting was conducted simultaneously with baited channel catfish hoop nets in the Meldahl, Cannelton, and Smithland pools. Singles nets were set overnight for three consecutive nights in the main stem of the Ohio River. Hoop nets were fished for a total of 156 net-nights: 81 in the Meldahl Pool, 45 in the Cannelton Pool, and 30 in the Smithland Pool (Table 5). Overall CPUE of flathead catfish was 0.8 fish/net-night.

Lengths of flathead catfish ranged from 13.5 – 45.6 in with a mean length of 26.2 in (Table 6). Hoop net catch rates of different size groups were also examined, and all size groups were at or below 2019 catch rates (Table 7). Trophy flathead catfish (≥ 35.0 in) were captured at 0.1 fish/net-night, and were observed in all pools sampled.

Electrofishing Surveys

Low-pulse DC electrofishing was conducted in seven pools in June 2021: Meldahl, Markland, McAlpine, Cannelton, Newburgh, JT Myers, and Smithland. A total of 35.0 hr of electrofishing effort was conducted resulting in a total catch of 627 blue catfish and 1,460 flathead catfish (Table 8). Overall CPUE of blue catfish was 17.9 fish/hr and above the historical average of 17.2 fish/hr (Table 9). Overall flathead catfish CPUE was 41.7 fish/hr, and although below 2020 levels, was still above the historical average (35.7 fish/hr).

Blue catfish collected with electrofishing ranged from 3.2 – 45.8 in with a mean length of 16.3 in (Table 10). Electrofishing catch rates were also examined for different size groups of blue catfish. CPUE of <12.0 in fish increased and was the highest since 2013. CPUE of 12.0 – 19.9 in fish decreased for the third consecutive year while CPUE of 20.0 – 29.9 in fish and 30.0 – 34.9 in fish also saw decreased from 2020 catch rates. Trophy CPUE was 0.5 fish/hr as it has been for five of the last six years. (Table 11). Trophy blue catfish were observed in all pools except the McAlpine Pool.

Flathead catfish lengths ranged from 2.3 – 46.7 in with a mean length of 14.4 in (Table 10). Electrofishing CPUE for all size groups examined were above their historical averages; however, all size groups except that 12.0 – 19.9 in size group saw decreases from 2020 (Table 12). Trophy flathead catfish were observed in all pools sampled except the McAlpine Pool.

Relative Weight

Relative weight (W_r) was also calculated for each species of catfish. Fish collected from all sampling methods used in 2021 were combined to provide a more representative estimate for the entire population of each catfish species. Overall W_r of blue catfish ($N=479$) in 2021 was 112 (Table 13). Flathead catfish ($N=1,069$) overall relative weight was 114, and channel catfish ($N=314$) overall relative weight was 87. Overall, blue catfish and flathead catfish appear to be in great condition throughout the river as they both had record high W_r .

Age, Growth, and Mortality

In spring 2017, otoliths (up to 5 per inch class for fish <30.0 in and up to 3 per inch class for fish ≥ 30.0 in) were taken from blue catfish, channel catfish, and flathead catfish to assess growth rates for each species. Separate samples were taken from the upper and trophy permit sections. Von Bertalanffy growth equations were calculated for each species (Table 14). Male blue catfish seemed to grow faster in the upper section, but the opposite was observed in the trophy permit section. On average, it took blue catfish 17.7 years to reach trophy size (≥ 35.0 in; Table 15). Channel catfish exhibited slightly faster growth in the upper section of the Ohio River, but no large differences were seen in growth between sexes. Overall, channel catfish reached trophy size (28.0 in) at 20.0 years (Table 16). There was no noticeable difference in growth rates of flathead catfish between sexes; however, flathead catfish exhibited faster growth in the trophy permit section of the Ohio River. On average a flathead catfish in the upper section reached trophy size (35.0 in) at 20.6 years, while flathead catfish in the trophy permit section reached trophy size nearly three years quicker at 17.7 years. Overall, flathead catfish reached trophy size at 20.1 years (Table 17). Growth of all three species of catfish sampled was extremely variable, particularly as fish grew older and larger, with some fish growing much slower than the Von-Bertalanffy model described and some growing much faster.

Total annual mortality estimates were made on all three species of catfish based off length-at-age of capture data from otoliths and paired with unaged catfish collected with multiple sampling techniques in 2017. Length frequency data from 2021 was paired with the 2017 age-length key to provide mortality estimates for 2021. Using Fishery Analysis and Modeling Simulator (FAMS), a separate weighted catch-curve regression was run on each species of catfish for each sampling method to calculate a range of total annual mortality estimates. As a precautionary step, the highest mortality estimate calculated for each species is reported to avoid underestimates and potentially masking problems in the populations. In 2021, river-wide total annual mortality for blue catfish was 23.7%. Channel catfish total annual mortality was 20.7%, and flathead catfish total annual mortality was 19.8% (Table 18). This is highest estimate of flathead catfish mortality since the project began.

Commercial Fishing Industry

Commercial fishing for catfish has long been present in the Ohio River, but concerns of potential overharvest have warranted further investigations. Harvest of blue catfish began increasing from 2004 to 2005 and has remained near 200,000 – 250,000 lbs through 2018 with the exception of a large peak in 2012 (Figure 1). Record harvest of blue catfish (388,274 lbs) was observed in 2021. Channel catfish harvest has fluctuated, but generally increased from 2007 – 2013 then gradually declined from 2013 - 2019. Channel catfish harvest for 2021 was 127,166 lbs. Flathead catfish trends are similar to channel catfish; however, harvest has been slightly increasing since 2018. Unfortunately, commercial fish harvest reports do not include detailed information about gear (number of net nights, baited vs. unbaited, length of gillnet, etc.); however, the number of hooks fished for trotlines as well as number of hoop nets fished is required to be reported. Although trotline and hoop net harvest should not be considered indicative of the entire commercial catfish harvest, it is the best available method to analyze trends in commercial catfish harvest rates. Effort (number of hooks for trotlines and number of nets for hoop nets) and pounds harvested by method were examined to determine if harvest rates varied over the years. Trotlines are more effective at capturing blue catfish, while hoop nets are more effective when targeting flathead catfish

according to commercial harvest data. Channel catfish appear to be captured efficiently by both trotlines and hoop nets. Each species was examined according to the most effective gear. The harvest rate of blue catfish increased sharply from 2004 to 2005, then increased gradually from 2005 – 2019. Harvest rate reached an all-time high in 2019 and 2021 was the second highest recorded harvest rate (Figure 2). Recent decreases in total pounds of catfish harvested in 2013, 2014, and 2018 described above are likely not a result of decreased harvest rates, but rather a decrease in effort. Additionally, the harvest rate remaining high in 2021 indicates that the amount of fish harvested is not solely a result of increased effort. Channel catfish trotline harvest rates has been extremely consistent since 2004, but reached a historical high in 2020 and remained near those levels in 2021 (Figure 2). Channel catfish and flathead catfish harvest in commercial nets have both remained between 5 – 15 pounds/net; however, a drastic spike in harvest occurred in 2012 and 2013 (Figure 3). Reasons for this extreme peak in harvest are not known, but could be a result of prolonged favorable fishing conditions or demand for fish.

Table 1. CPUE (fish/net-night) of channel catfish collected during baited hoop net surveys in Meldahl, Cannelton, and Smithland pools of the Ohio River in spring 2021. Standard errors are in parentheses.

Pool	Effort (net nights)	No. of channel catfish	CPUE
Meldahl	81	264	3.3 (0.9)
Cannelton	54	104	1.9 (0.6)
Smithland	27	15	0.6 (0.2)
Total	162	383	2.4 (0.5)

Table 2. CPUE (fish/net-night) of channel catfish collected during baited hoop net surveys on the Ohio River in spring 2017 - 2021. Standard errors are in parentheses.

Year	CPUE
2017	8.0 (1.1)
2018	3.8 (0.5)
2019	4.5 (0.8)
2021	2.4 (0.5)
Mean	4.4 (0.5)

Table 3. Length frequency and CPUE (fish/net-night) of channel catfish collected during baited hoop net sampling in the Meldahl, Cannelton, and Smithland pools during spring 2021 on the Ohio River. Standard errors are in parentheses.

Pool	Inch class																								Total	CPUE
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27		
Meldahl			1	2	9	11	6	7	9	7	18	17	29	27	28	27	16	11	6	13	9	7	1	3	264	3.3 (0.9)
Cannelton	1	2	1	2	9	13	14	15	9	4	3	4	6	10	5	2	1		1	1	1				104	1.9 (0.6)
Smithland						1	1		2	2			1	1		2	3	1	1						15	0.6 (0.2)
Total	1	2	2	4	18	25	21	22	20	13	21	21	36	38	33	31	20	12	8	14	10	7	1	3	383	2.4 (0.5)

Table 4. CPUE (fish/net-night) by size group of channel catfish collected during baited hoop net surveys on the Ohio River in spring 2017 - 2021. Standard errors are in parentheses.

Year	Size group (in)				Total
	<12.0	12.0 - 19.9	20.0 - 27.9	≥28.0	
2017	1.5 (0.3)	4.5 (0.7)	1.0 (0.2)	<0.1 (<0.1)	7.0 (1.0)
2018	0.7 (0.1)	2.5 (0.4)	0.6 (0.1)	<0.1 (<0.1)	3.8 (0.5)
2019	0.8 (0.2)	2.6 (0.5)	1.0 (0.3)	<0.1 (<0.1)	4.5 (0.8)
2021	0.6 (0.1)	1.3 (0.4)	0.5 (0.1)	0.0	2.4 (0.5)
Mean	0.9 (0.1)	2.8 (0.3)	0.8 (0.1)	<0.1 (<0.1)	4.4 (0.5)

Table 5. CPUE (fish/net-night) of flathead catfish collected during unbaited hoop net surveys in Meldahl, Cannelton, and Smithland pools of the Ohio River in spring 2021. Standard errors are in parentheses.

Pool	Effort (net nights)	No. of Flathead Catfish	CPUE
Meldahl	81	59	0.7 (0.1)
Cannelton	45	52	1.2 (0.3)
Smithland	30	13	0.4 (0.2)
Total	156	124	0.8 (0.2)

Table 6. Length frequency and CPUE (fish/net/night) of flathead catfish collected during unbaited hoop net sampling in the Meldahl, Cannelton, and Smithland pools during spring 2021 on the Ohio River. Standard errors are in parentheses.

Pool	Inch class																							Total	CPUE										
	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35			36	37	38	39	40	41	42	43	44	45
Meldahl					1	2	2	3	4	7	5	6	5	2	3	2	3	2	1	4	1	1	1	1	1			1	1					59	0.7 (0.1)
Cannelton	1	1			1		1	3	6	2	3	8	8	2	1	3	1	1	1	2	1	2		1				1	1			1		52	1.2 (0.3)
Smithland						1	1				5				2			1			1	1		1									13	0.4 (0.2)	
Total	1	1			2	3	4	6	10	14	8	14	13	6	4	5	5	3	2	7	3	3	2	2	1		1	2		1	1	1	124	0.8 (0.2)	

Table 7. CPUE (fish/net-night) by size group of flathead catfish collected during unbaited hoopnet surveys on the Ohio River in spring 2019 - 2021. Standard errors are in parentheses.

Year	Size group (in)					Total
	<12.0	12.0 - 19.9	20.0 - 29.9	30.0 - 34.9	≥35.0	
2019	0.0	0.1 (<0.1)	1.1 (0.1)	0.3 (0.1)	0.2 (0.1)	1.8 (0.2)
2021	0.0	0.1 (<0.1)	0.5 (0.2)	0.1 (0.1)	0.1 (>0.1)	0.8 (0.2)
Mean	0.0	0.1 (<0.1)	0.8 (0.2)	0.2 (0.1)	0.2 (0.1)	1.3 (0.2)

Table 8. Effort and CPUE (fish/hr) of blue catfish and flathead catfish collected during electrofishing surveys on the Ohio River in June 2021. Standard errors are in parentheses.

Pool	No. of transects	Effort (hr)	No. of Blue		No. of Flathead	
			Catfish	CPUE	Catfish	CPUE
Meldahl	20	5.0	39	7.8 (1.7)	232	46.4 (5.9)
Markland	20	5.0	63	12.6 (4.3)	181	36.2 (6.0)
McAlpine	20	5.0	49	9.8 (4.0)	158	31.6 (4.3)
Cannelton	20	5.0	84	16.8 (6.7)	311	62.2 (5.8)
Newburgh	20	5.0	97	19.4 (3.0)	213	42.6 (5.4)
JT Myers	20	5.0	163	32.6 (7.3)	243	48.6 (5.5)
Smithland	20	5.0	132	26.4 (5.8)	122	24.4 (3.7)
Total	140	35.0	627	17.9 (2.0)	1460	41.7 (2.2)

Table 9. CPUE (fish/hr) of blue catfish and flathead catfish collected during electrofishing surveys on the Ohio River from 2004 - 2021. Standard errors are in parentheses.

Year	Species	
	Blue catfish	Flathead catfish
2004	0.0	14.5 (4.1)
2009	1.6 (0.8)	15.5 (4.1)
2010	11.9 (4.0)	17.1 (3.3)
2013	11.4 (4.8)	38.9 (5.1)
2014	19.3 (3.2)	32.8 (2.6)
2015	19.0 (3.8)	37.6 (3.6)
2016	17.5 (2.7)	35.5 (2.2)
2017	25.2 (2.7)	40.6 (2.1)
2018	39.8 (5.7)	54.0 (4.7)
2019*	22.2 (2.6)	40.2 (2.4)
2020	20.1 (2.4)	59.6 (3.0)
2021	17.9 (2.0)	41.7 (2.2)
Mean	17.2 (3.0)	35.7 (4.1)

*Incomplete sample due to high water

Table 12. CPUE (fish/hr) by size group of flathead catfish collected during electrofishing surveys on the Ohio River from 2004 - 2021. Standard errors are in parentheses.

Year	Size group (in)					Total
	<12.0	12.0 - 19.9	20.0 - 29.9	30.0 - 34.9	≥35.0	
2004	9.3 (4.2)	5.0 (1.1)	0.3 (0.3)	0.0	0.0	14.5 (4.1)
2009	8.4 (1.7)	4.3 (0.2)	2.6 (0.2)	0.0	0.3 (<0.1)	15.5 (4.1)
2010	8.8 (1.9)	6.0 (2.1)	2.1 (0.5)	0.2 (<0.1)	0.0	17.1 (3.3)
2013	14.9 (4.5)	17.2 (1.1)	6.3 (1.8)	0.3 (0.1)	0.2 (0.2)	38.9 (5.1)
2014	12.3 (2.6)	15.9 (3.7)	4.3 (0.2)	0.3 (0.1)	0.1 (<0.1)	32.8 (2.6)
2015	15.8 (2.1)	14.6 (4.2)	5.6 (0.9)	0.9 (0.4)	0.7 (0.3)	37.6 (3.6)
2016	10.9 (1.6)	16.0 (4.2)	7.2 (1.3)	0.8 (0.3)	0.6 (0.3)	35.5 (2.2)
2017	12.5 (1.1)	15.5 (1.0)	10.7 (0.9)	1.1 (0.2)	0.8 (0.2)	40.6 (2.1)
2018	22.0 (2.8)	15.3 (1.0)	13.5 (1.2)	1.9 (0.3)	1.2 (0.2)	54.0 (4.7)
2019*	15.0 (1.8)	12.9 (0.9)	10.1 (0.8)	1.4 (0.3)	0.8 (0.2)	40.2 (2.4)
2020	33.1 (2.4)	13.3 (0.9)	10.8 (0.8)	1.1 (0.2)	1.3 (0.2)	59.6 (3.0)
2021	18.4 (1.5)	15.0 (1.1)	6.8 (0.6)	0.9 (0.2)	0.6 (0.1)	41.7 (2.2)
Mean	15.1 (2.0)	12.6 (1.3)	6.7 (1.2)	0.7 (0.2)	0.6 (0.1)	35.7 (4.1)

*Incomplete sample due to high water

Table 13. Relative weight (W_r) of blue catfish, channel catfish, and flathead catfish collected from the Ohio River using trotlines, hoop nets, electrofishing and catfish tournaments from 2013 - 2021.

Year	Species		
	Blue catfish	Channel catfish	Flathead catfish
2013	112	100	99
2014	105	97	92
2015	109	100	98
2016	107	97	106
2017	106	89	107
2018	104	90	101
2019	99	86	99
2020	107		107
2021	112	87	114
Mean	106	93	102

Table 14. von Bertalanffy growth parameters used to estimate length-at age for blue catfish, channel catfish, and flathead catfish collected from the Ohio River in 2017 where L_∞ = theoretical maximum length, K =body growth coefficient, and t_0 =time coefficient.

Parameter	Blue catfish	Channel catfish	Flathead catfish
L_∞ (in)	55.0	35.0	55.0
K	0.051	0.074	0.040
t_0	-2.086	-1.783	-4.556

Table 15. Mean length (in) at age calculated with the von Bertalanffy growth equation based on otoliths taken from blue catfish from the Ohio River in spring and summer of 2017.

Section	Sex	Age																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Upper	Male	7.2	9.9	12.4	14.8	17.1	19.3	21.3	23.2	25.0	26.7	28.3	29.8	31.2	32.6	33.8	35.0	36.2	37.2	38.2	39.2
	Female	9.7	11.6	13.5	15.2	16.9	18.5	20.0	21.5	22.9	24.3	25.6	26.8	28.0	29.2	30.2	31.3	32.3	33.3	34.2	35.1
	Total	7.6	10.0	12.4	14.6	16.7	18.6	20.5	22.3	24.0	25.6	27.1	28.6	29.9	31.2	32.5	33.6	34.8	35.8	36.8	37.7
Trophy permit	Male	9.0	11.2	13.4	15.4	17.3	19.2	20.9	22.6	24.2	25.7	27.1	28.5	29.8	31.0	32.2	33.3	34.4	35.4	36.4	37.3
	Female	7.3	9.9	12.4	14.7	16.9	19.0	20.9	22.8	24.6	26.2	27.8	29.3	30.7	32.0	33.3	34.5	35.6	36.7	37.7	38.6
	Total	8.3	10.6	12.8	14.9	16.9	18.8	20.6	22.3	24.0	25.5	27.0	28.4	29.7	31.0	32.2	33.3	34.4	35.4	36.4	37.3
Overall	Male	8.7	11.1	13.3	15.4	17.4	19.4	21.2	22.9	24.5	26.1	27.5	28.9	30.3	31.5	32.7	33.9	34.9	36.0	36.9	37.9
	Female	11.9	13.4	15.0	16.4	17.8	19.2	20.5	21.7	23.0	24.1	25.3	26.3	27.4	28.4	29.4	30.3	31.2	32.1	32.9	33.7
	Total	8.0	10.4	12.6	14.7	16.7	18.6	20.4	22.2	23.8	25.4	26.8	28.2	29.6	30.9	32.1	33.2	34.3	35.3	36.3	37.2

Table 16. Mean length (in) at age calculated with the von Bertalanffy growth equation based on otoliths taken from channel catfish from the Ohio River in spring and summer of 2017.

Section	Sex	Age																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Upper	Male	6.6	9.1	11.5	13.6	15.6	17.3	18.9	20.4	21.7	22.9	24.0	25.0	25.9	26.7	27.5	28.2	28.8	29.3	29.9	30.3
	Female	5.7	8.7	11.5	13.9	16.1	18.1	19.8	21.4	22.8	24.1	25.2	26.3	27.2	28.0	28.7	29.4	30.0	30.5	30.9	31.4
	Total	6.4	8.9	11.1	13.2	15.0	16.8	18.3	19.8	21.1	22.3	23.4	24.4	25.3	26.1	26.9	27.6	28.2	28.8	29.3	29.8
Trophy permit	Male	7.8	9.5	11.1	12.6	14.0	15.3	16.5	17.6	18.7	19.7	20.7	21.6	22.4	23.2	23.9	24.6	25.2	25.8	26.4	26.9
	Female	8.0	9.7	11.2	12.7	14.1	15.5	16.7	17.8	18.9	19.9	20.9	21.8	22.6	23.4	24.1	24.8	25.4	26.0	26.6	27.1
	Total	7.6	9.4	11.1	12.7	14.1	15.5	16.8	18.0	19.1	20.1	21.1	22.0	22.9	23.7	24.4	25.1	25.8	26.4	26.9	27.5
Overall	Male	7.4	9.5	11.4	13.2	14.9	16.4	17.8	19.1	20.3	21.4	22.5	23.4	24.3	25.1	25.9	26.6	27.2	27.8	28.3	28.8
	Female	7.8	9.6	11.3	12.9	14.4	15.8	17.1	18.3	19.4	20.5	21.5	22.4	23.2	24.0	24.8	25.5	26.1	26.7	27.3	27.8
	Total	6.5	8.5	10.4	12.2	13.8	15.3	16.7	18.0	19.2	20.4	21.4	22.4	23.3	24.1	24.9	25.6	26.3	26.9	27.5	28.0

Table 17. Mean length (in) at age calculated with von Bertalanffy growth equation based on otoliths taken from flathead catfish from the Ohio River in spring and summer of 2017.

Section	Sex	Age																																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Upper	Male	9.4	11.3	13.0	14.7	16.3	17.9	19.4	20.8	22.2	23.5	24.8	26.0	27.2	28.3	29.4	30.4	31.4	32.4	33.3	34.2	35.0	35.8	36.6	37.3	38.0	38.7	39.4	40.0	40.6	41.2	41.8	42.3	42.8
	Female	11.3	13.1	14.8	16.4	18.0	19.5	20.9	22.3	23.6	24.9	26.1	27.2	28.4	29.4	30.5	31.5	32.4	33.3	34.2	35.0	35.8	36.6	37.4	38.1	38.8	39.4	40.0	40.6	41.2	41.8	42.3	42.8	43.3
	Total	11.0	12.7	14.4	16.0	17.5	19.0	20.4	21.8	23.1	24.3	25.5	26.7	27.8	28.9	29.9	30.9	31.8	32.8	33.6	34.5	35.3	36.1	36.8	37.5	38.2	38.9	39.5	40.1	40.7	41.3	41.8	42.3	42.8
Trophy permit	Male	5.7	8.3	10.8	13.1	15.3	17.4	19.4	21.3	23.1	24.7	26.3	27.8	29.3	30.6	31.9	33.1	34.3	35.4	36.4	37.4	38.3	39.2	40.1	40.9	41.6	42.3	43.0	43.6	44.2	44.8	45.3	45.9	46.3
	Female	5.2	7.8	10.4	12.8	15.0	17.2	19.2	21.1	22.9	24.7	26.3	27.8	29.3	30.7	32.0	33.2	34.4	35.5	36.6	37.5	38.5	39.4	40.2	41.0	41.8	42.5	43.2	43.8	44.4	45.0	45.5	46.0	46.5
	Total	5.6	8.2	10.7	13.0	15.2	17.3	19.3	21.2	23.0	24.7	26.3	27.8	29.2	30.6	31.9	33.1	34.2	35.3	36.4	37.4	38.3	39.2	40.0	40.8	41.6	42.3	43.0	43.6	44.2	44.8	45.3	45.8	46.3
Overall	Male	8.8	10.7	12.6	14.3	16.0	17.6	19.2	20.6	22.0	23.4	24.7	26.0	27.2	28.3	29.4	30.5	31.5	32.5	33.4	34.3	35.1	36.0	36.8	37.5	38.2	38.9	39.6	40.2	40.8	41.4	42.0	42.5	43.0
	Female	9.3	11.3	13.2	15.0	16.7	18.3	19.9	21.4	22.9	24.3	25.6	26.9	28.1	29.3	30.4	31.4	32.5	33.4	34.4	35.3	36.1	36.9	37.7	38.5	39.2	39.9	40.5	41.2	41.8	42.3	42.9	43.4	43.9
	Total	7.6	9.6	11.6	13.6	15.4	17.1	18.8	20.4	21.9	23.4	24.8	26.1	27.4	28.6	29.8	30.9	32.0	33.0	34.0	34.9	35.8	36.6	37.4	38.2	39.0	39.7	40.4	41.0	41.6	42.2	42.8	43.3	43.8

Table 18. Maximum total annual mortality rates of blue catfish, channel catfish, and flathead catfish collected from the Ohio River using trotlines, hoopnets, and electrofishing from 2013 - 2021.

Year	Species		
	Blue catfish	Channel catfish	Flathead catfish
2013	18.7	32.2	18.8
2014	24.7	26.8	18.7
2015	20.0	20.6	15.9
2016	17.4	16.8	16.0
2017	18.9	27.9	18.2
2018	19.8	28.0	18.0
2019	17.3	23.3	17.1
2020	26.6		19.5
2021	23.7	20.7	19.8
Mean	20.8	24.5	18.0

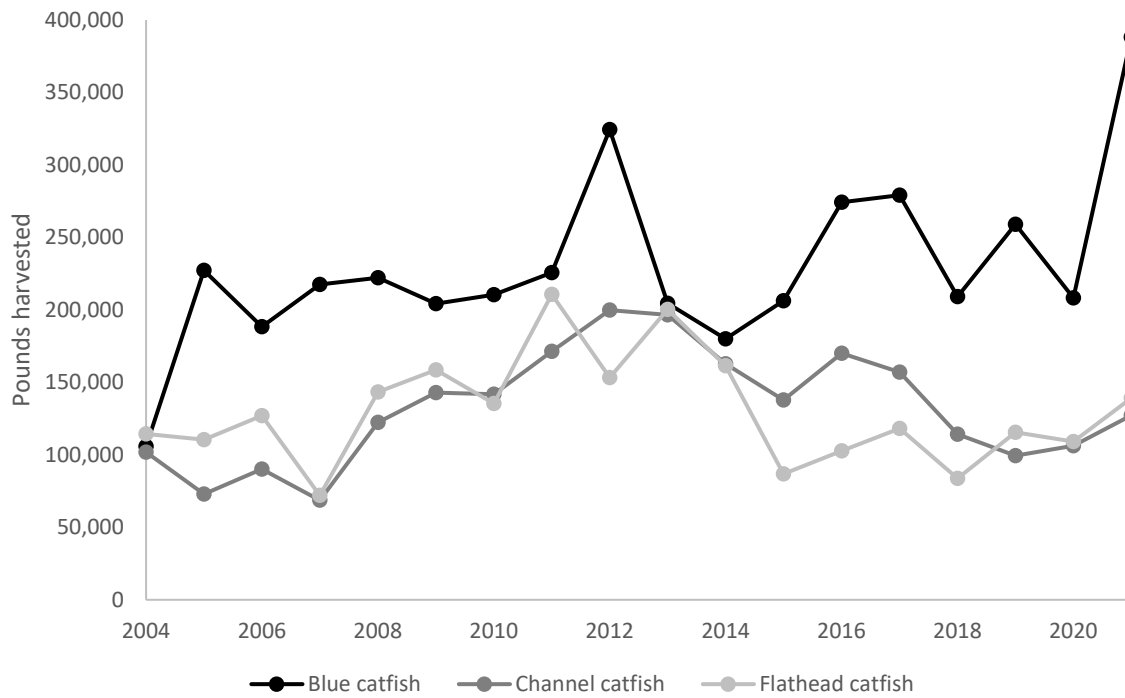


Figure 1. Total pounds of blue catfish, channel catfish, and flathead catfish harvested by commercial fishermen from the Ohio River from 2004 – 2021.

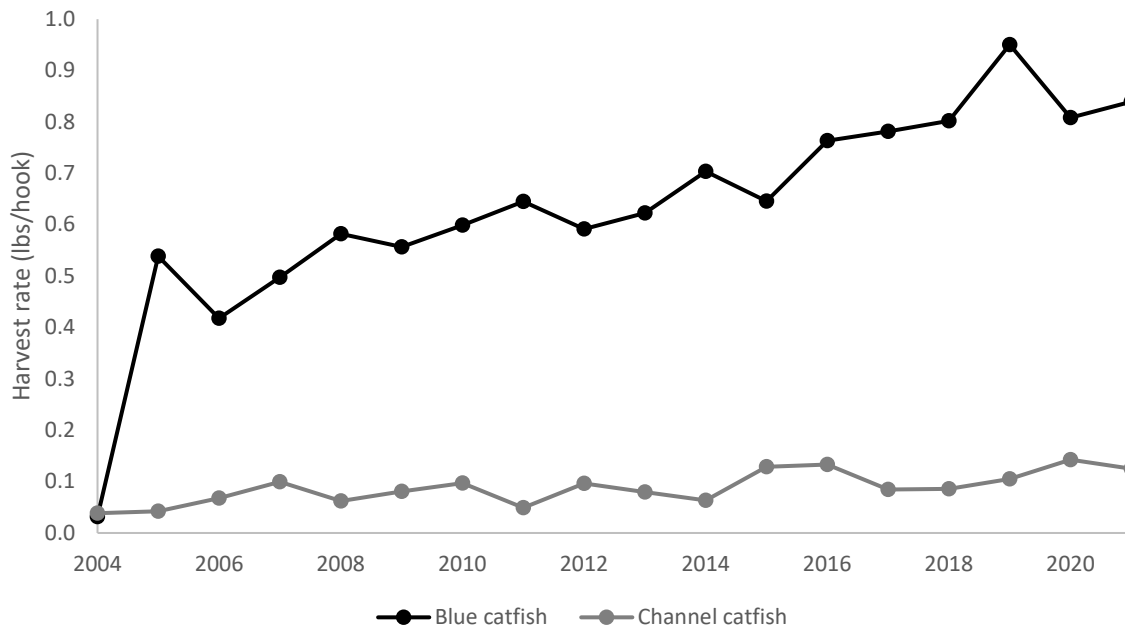


Figure 2. Harvest rate (lbs/hook) of blue catfish and channel catfish harvested with trotlines by commercial fishermen from the Ohio River from 2004 – 2021.

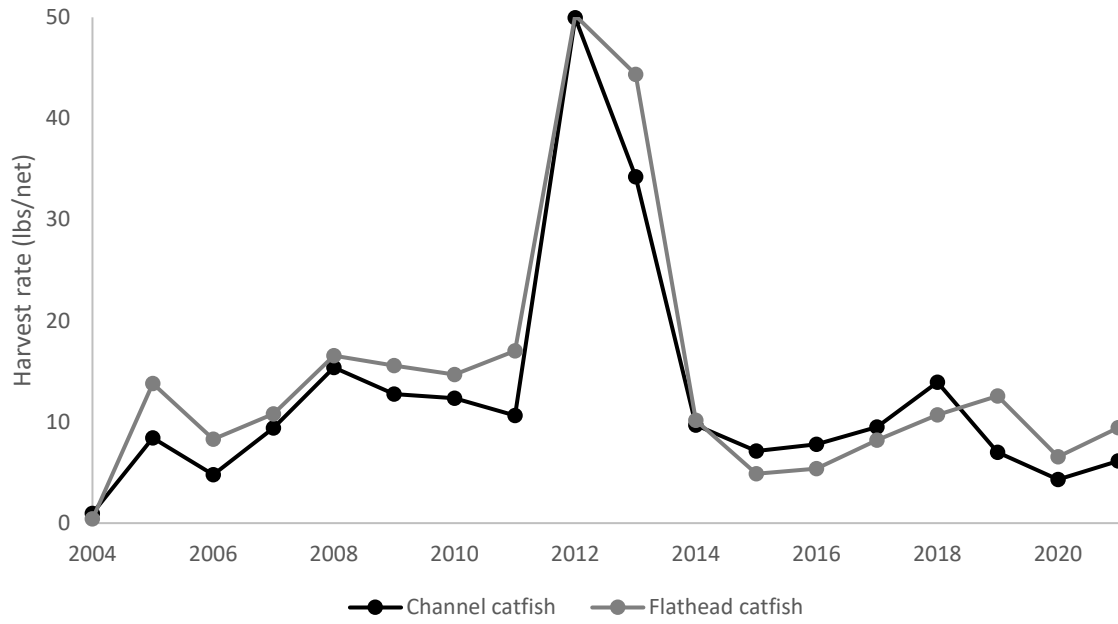


Figure 3. Harvest rate (lbs/net) of channel catfish and flathead catfish harvested with hoop nets by commercial fishermen from the Ohio River from 2004 – 2021.