SURVEY REPORT

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

FISH MANAGEMENT SURVEY AND RECOMMENDATIONS

FOR

LAKE KEYSTONE

2022-2023

SURVEY REPORT

State: Oklahoma

Project Title: Oklahoma Fisheries Management Program

Study Title: Surveys and Recommendations-Keystone Reservoir

Period Covered: 1 January 2022 - 31 December 2023

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LAKE KEYSTONE

ABSTRACT

Lake Keystone was sampled by spring electrofishing and fall gillnetting in 2022 to determine fish population trends for Largemouth Bass, Crappie, Channel Catfish, Blue Catfish, White Bass, and Striped Bass. Shad populations were also sampled by fall gill netting to assess the forage base for the sportfish in Keystone Lake. Largemouth Bass populations remain just above the threshold of a quality fishery. Crappie populations dipped below the threshold for a quality fishery. White Bass, Striped Bass, Channel Catfish, and Blue Catfish populations were all well above the threshold for quality fisheries. No major Striped Bass fish kills were observed in 2022 or 2023. Water quality profiles were conducted throughout the months of June through September to monitor conditions that can affect Striped Bass health. Current statewide regulations for all sportfish should remain in effect for Lake Keystone.

INTRODUCTION

Lake Keystone impounds the Arkansas and Cimarron Rivers, 25 km west of Tulsa in Osage, Pawnee and Creek Counties, Oklahoma (Figure 1). Keystone Lake covers 10,530 surface hectares and was constructed in 1964 by the U.S. Army Corps of Engineers. Keystone Lake has a mean depth of 7.7 m and a maximum depth of 23.3 m, a shoreline development ratio of 14.5, and a secchi disc visibility of around 24 inches in the main pool in April; turbidity is primarily from both suspended clay and plankton. Fish habitat consists primarily of extensive lengths of shoreline of either sand or rock. Major fisheries include Channel Catfish, Blue Catfish, White Bass, Striped Bass, Crappie, and Largemouth Bass. Angling pressure appears to be high due to the proximity to the Tulsa metropolitan area. A high water exchange rate (8.4:1), widely fluctuating water levels and high seasonal turbidities have had negative impacts especially on Largemouth Bass and Striped Bass fisheries resulting in low natural recruitment and/or emigration losses. However, Crappie, White Bass, catfish species, and forage fish (primarily gizzard shad) have generally had a trend of high abundance with some cyclic variations.

Since 2014, the Wildlife Department has placed over 80 brush pile habitat structures throughout the lake consisting primarily of cedar trees. Locations for these structures can be found on the ODWC Interactive Fish Attractor Map that can be accessed through the ODWC website, wildlifedepartment.com. Due to the dramatic water fluctuations that can happen at Keystone Lake, no buoys are used for marking habitat locations on the water.

In 2022, the 14-inch minimum rule for Largemouth and Smallmouth Bass was removed and replaced by allowing anglers to keep 6 bass total, but only one fish over 16 inches. This is to allow anglers to harvest the more abundant, smaller fish while preventing the over harvest of larger fish.

A research project completed in 1992 was designed to assess the suitability of Keystone Reservoir for habitat ion by adult striped bass. This project was precipitated by the late summer die-off's of adult striped bass. Based on the findings of this research, the U.S. Army Corps of Engineers has modified procedures for floodwater releases beginning in March 1989, in an attempt to improve water quality, and hence, reduce the frequency of these mortality events. However, the USACE no longer operates the dam in that manner as it caused corrosion and damage to federal property and equipment downstream of the dam. Summer Striped Bass fish kills are still an annual concern. Regional managers regularly monitor water quality within the lake during the summer months to try to predict when a die-off might occur. The Last documented Striped Bass die-off was in August of 2021.

Keystone Reservoir was sampled in 2022 by spring electrofishing to evaluate the status of black bass populations. It was also sampled by fall gill netting to evaluate the status of Striped Bass, White Bass, Channel Catfish, Blue Catfish, and White Crappie fisheries. Water quality surveys were performed in the summer months of 2022 and 2023 to monitor conditions that may affect Striped Bass health and potential die-offs.

RESULTS

Largemouth Bass

1. Largemouth Bass abundance from spring boat electrofishing in 2022 (C/f = 45.63) was down slightly from the previous survey in 2018 but still above the threshold for a quality fishery (Table 1).
2. Relative weights (W_r) were very good for all length groups larger than eight inches and consistent with previous surveys.
3. Recruitment of largemouth Bass is known to fluctuate dramatically between samples, most likely because of the dramatic water fluctuations that occur in Lake Keystone for flood control during the spring spawning season. Bass populations have fluctuated significantly since the earliest sample recorded in 1989.
4. Since favorable habitat for bass is sparse within the reservoir, spring sampling is conducted at fixed sites where bass are most likely to be encountered.
5. Spring electrofishing for Largemouth Bass should continue every two to three years to continue monitoring population trends.

Crappie

1. Crappie abundance from 2022 fall gillnetting (C/f = 1.96) was below the minimum acceptable value for a quality fishery (C/f = 4.8). The total crappie C/f has fluctuated in recent sample years (Table 2).
2. The abundance of all crappie size groups was below satisfactory. The total crappie C/f has been cyclic in recent samples. Random sampling may impact the overall C/f from year to year.
3. Body condition values (W_r) were satisfactory for crappie greater than eight inches (W_r = 96) and excellent for fish greater than 10 inches (W_r = 106), but those less than eight inches were below the acceptable value (W_r = 85). Condition values for all size groups have been generally stable in recent samples.
4. Recruitment of crappie is known to fluctuate dramatically between samples, most likely because of the dramatic water fluctuations that occur in Lake Keystone for flood control during the spring spawning season.
5. Fall gill netting should continue every other year to continue monitoring population trends for White Crappie. Trap netting for White Crappie should be done in 2024 to determine age and growth rates.

White Bass

1. White Bass abundance from 2022 fall gill netting (C/f = 12.58) was well above the minimum acceptable value for a quality fishery (C/f ≥ 4.8). The total White Bass C/f has been cyclic but has generally remained above the acceptable value for a quality fishery in recent sample years (Table 5).

2. The abundance of White Bass in size groups above eight inches was satisfactory, and their abundance has been cyclic in recent samples.
3. Body condition values (W_r) were satisfactory for all size groups. Condition values have been generally stable in recent samples.
4. Abundance, size structure and condition values indicated the presence of a good White Bass fishery in the fall of 2022.
5. Fall gill netting should continue every other year to continue monitoring population trends for White Bass.

Striped Bass

1. The total Striped Bass abundance has remained stable in recent sample years (C/f = 3.48; Table 6).
2. The abundance of Striped Bass less than 12 inches was higher than in recent samples showing better recruitment. Fish 12 – 20 inches were relatively unchanged when compared with recent catch rates while those greater than 20 inches decreased in number.
3. Body condition values (W_r) were unsatisfactory for all length groups in 2022.
4. Although abundance and size structure has improved over the past few years, striped bass numbers continued to be too low to represent a quality fishery. Emigration of fish downstream during high water outflows and occasional thermal related die-offs in the lake proper are probably the controlling factors regulating striped bass abundance in Keystone Lake.
5. Striped bass young-of-year are sampled annually as lake levels allow to assess spawning success. Catch rates in 2022 and 2023 (C/f = 55.37 and C/f = 2.3, respectively) were dramatically lower than the previous samples in 2020 and 2021 showing that spawning success seems to be sporadic and dependent on proper environmental conditions and stream flow (Table 11).
6. Fall gill netting should continue every other year to continue monitoring population trends for Striped Bass.

Channel Catfish

1. Channel Catfish abundance from 2022 gill netting (C/f = 8.41) was well above the minimum acceptable value for a quality fishery (C/f = 4.8). The total Channel Catfish C/f has fluctuated but generally remained above the value for a quality fishery during most sample years (Table 7).
2. The abundance of all Channel Catfish size groups was satisfactory in 2022.
3. Body condition values (Wr) were unsatisfactory for all size groups ≥12 inches. Fish less than 12 inches had acceptable body condition. The previous two samples (2018 and 2020), condition values were acceptable for all size groups of fish.
4. Channel Catfish abundance and size structure data indicated the presence of a sub-quality fishery in 2022.

5. Fall gill netting should continue every other year to continue monitoring population trends for Channel Catfish.

Blue Catfish

1. Blue Catfish abundance from 2022 gillnetting (C/f = 7.86) was well above the minimum acceptable value for a quality fishery (C/f ≥ 2.4).
2. The total Blue Catfish C/f has been increasing in recent sample years (Table 8). The abundance of all Blue Catfish size groups was satisfactory. The abundance of Blue Catfish in all size groups increased substantially in recent samples.
3. Body condition values (Wr) were unsatisfactory for Blue Catfish greater than 12 inches. Condition values for all size groups ≥12 inches have generally been satisfactory and stable in recent samples but declined below acceptable values in 2022.
4. Abundance, size structure and condition values continued to indicate that Blue Catfish is the dominant catfish species in Keystone Lake.
5. Fall gill netting should continue every other year to continue monitoring population trends for Blue Catfish.

Flathead Catfish

1. Flathead catfish abundance from 2022 gillnetting (C/f=0.23) was satisfactory. The total flathead catfish C/f has declined in recent sample years (Table 9).
2. The abundance of all flathead catfish size groups ≥20 inches were not represented in 2022 and have always been rare in samples.
3. Body condition values (Wr) were good to excellent for size groups represented.
4. Flathead catfish abundance, size structure and condition values are difficult to calculate due to the fact they are not sampled well by gill nets.

Gizzard Shad

1. Shad abundance from 2022 fall gill netting (C/f = 19.41) was well above the minimum acceptable value for a quality forage supply (C/f ≥ 4.8). The total shad C/f has fluctuated in recent years but has always well exceeded the C/f for a quality forage base (Table 14).
2. In 2022 fall gill netting, the catch rate of shad< 200 mm was 19.41 and represented about 60% of shad caught (Figure 11). The abundance of shad< 200 mm has remained very high in recent samples showing that Keystone Lake has ample forage for most sportfish.
3. Gizzard Shad populations are known to fluctuate dramatically within reservoirs and are usually not a concern unless there are multiple consecutive samples with below acceptable catch rates.
4. Shad abundance and size structure indicates they were providing an abundant source of prey in 2022.
5. Fall gill netting should continue every other year to continue monitoring population trends for shad.

Water Quality

1. Multiple water quality measurements were recorded at two locations within Keystone Lake from June to September in 2022 and 2023 as needed based on weather and lake conditions (Figures 12-16).
2. No major Striped Bass kills were observed during the summer months of 2022 and 2023.
3. Water quality meter malfunctions prevented water quality profiles from being taken between August 2, 2023, until September 21, 2023.
4. Water quality measurements should be conducted multiple times annually as needed during the months of June through September to track environmental conditions that could lead to a Striped Bass die-off.

RECOMMENDATIONS

Fish Attractor Structures

1. Brush pile structures will be added or refurbished with cedar trees in 2024.

Fish Stockings

1. No additional fish stockings are currently recommended.

Fish Surveys

1. A spring electrofishing survey should be conducted in 2024 and every other year after that to continue evaluating black bass populations as part of a long-term monitoring program and to evaluate impacts of 2020 regulation changes.
2. A fall gill netting survey should be conducted in 2024 and every other year after, to evaluate the status of pelagic fish as part of a long-term monitoring program.

Fishing Regulations

1. Current regulations are statewide regulations for all species as defined in Title 800 and the Oklahoma Fishing and Hunting Regulations book.
2. No change in the Striped Bass fishing regulation is recommended since natural losses and not angler harvest is the primary factor regulating abundance.
3. No change in the Largemouth Bass regulation is recommended since the changes that were made in 2020. Electrofishing surveys will be conducted every two to three years, as lake conditions allow, to evaluate the impacts of the 2020 regulation changes.
4. Statewide regulations should remain in place for all other fish species.

Table 1. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **Largemouth Bass** collected by spring electrofishing from Keystone Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r are ≥ 90.

	Total (≥ 40)		< 8 inches (15-45)		8-12 inches (15-30)		≥ 12 inches (≥ 15)		≥ 14 inches (≥ 10)	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r	C/f	W_r
1989	252	22.57	2.74	94	3.99	101	15.8	102	8.9	103
1990	86	49.14	4.67	103	26.24	109	18.23	105	9.65	108
1991	28	18.66	10.00	99	8.00	93	0.67	84		
1996	116	29.12	6.25	101	5.72	102	17.43	98	11.95	97
1998	282	81.69	23.36	106	18.65	109	40.28	103	26.00	103
2003	234	39.00	3.333	96	7.5	103	28.33	103	23.167	103
2011	100	25.00	1.75	81	10.0	94	18.00	101	11.25	102
2015	96	24.00	2.5	97	9.75	104	14.0	102	10.5	101
2018	254	63.5	10.5	90	9.5	103	45.75	101	39.25	101
2022	179	45.63	5.37	88	11.05	99	34.42	109	22.74	110

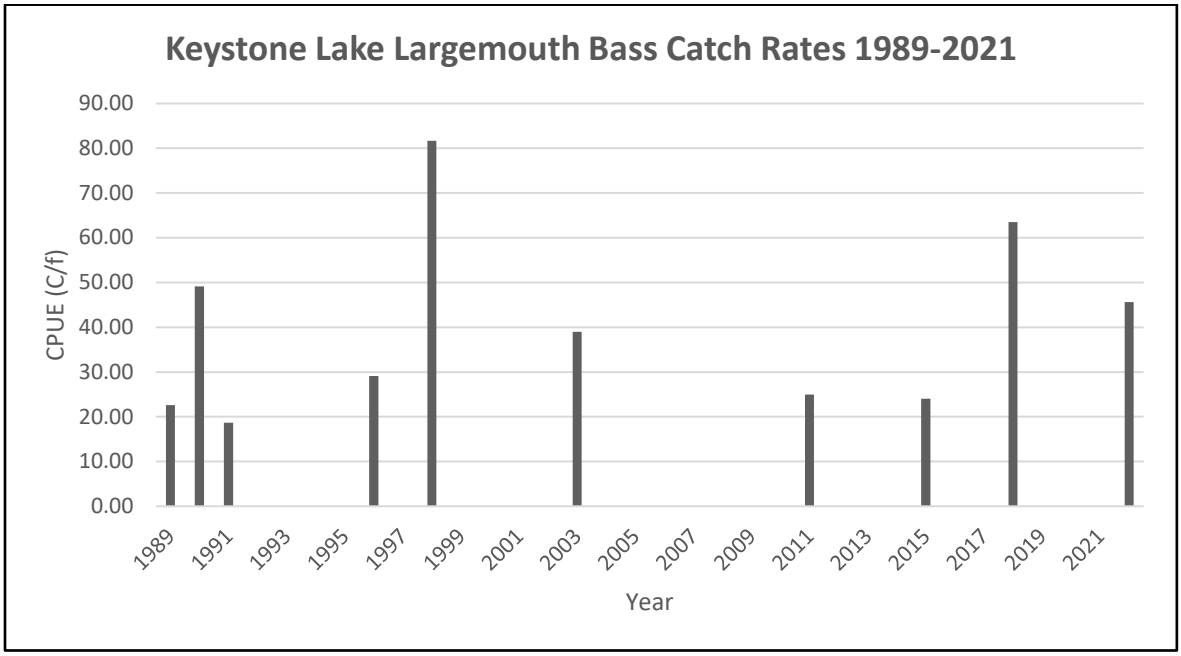


Figure 1. Total catch per unit effort (CPUE; C/f) for **Largemouth Bass** in Keystone Lake from electrofishing surveys from 1989-2021.

Table 2. Total CPUE of **Largemouth Bass** by spring electrofishing 2018 (OFAT analysis).

Species	Mean	Count	RSE	SE	L 95% CI	U 95% CI	N RSE = 12.5 (25% range)	N RSE = 20 (40% range)
Largemouth Bass	63.5	24	12.89	8.19	47.45	79.55	26	10

Table 3. CPUE by size for **Largemouth Bass** by spring electrofishing 2018 (OFAT analysis).

Species	Size Category	Mean	RSE	SE	L 95% CI	U 95% CI	N RSE = 12.5 (25% range)	N RSE = 20 (40% range)
Largemouth Bass	substock	9.5	17.39	1.65	6.26	12.74	46	18
Largemouth Bass	stock	7.25	20.53	1.49	4.33	10.17	65	25
Largemouth Bass	quality	14.25	14.74	2.10	10.13	18.37	33	13
Largemouth Bass	preferred	32	19.60	6.27	19.71	44.29	59	23
Largemouth Bass	memorable	0.5	69.16	0.35	-0.18	1.18	735	287
Largemouth Bass	trophy	0	NA	NA	NA	NA	NA	NA

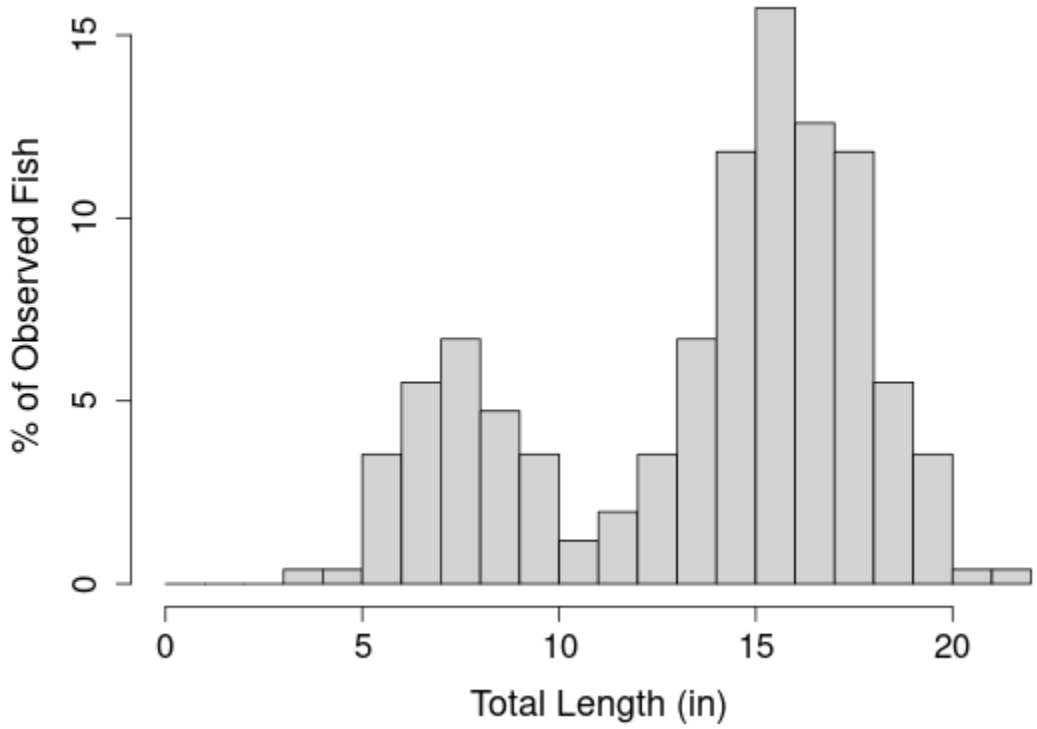


Figure 2. Length frequency plot for **Largemouth Bass** by spring electrofishing 2018 (OFAT analysis).

Table 4. Total CPUE of **Largemouth Bass** by spring electrofishing 2022 (OFAT analysis).

Species	Mean	Count	RSE	SE	L 95% CI	U 95% CI	N RSE = 12.5 (25% range)	N RSE = 20 (40% range)
Largemouth Bass	56.53	19	11.63	6.57	43.64	69.41	16	6

Table 5. CPUE by size for **Largemouth Bass** by spring electrofishing 2022 (OFAT analysis).

Species	**Size Category**	**Mean**	**RSE**	**SE**	**L 95% CI**	**U 95% CI**	**N RSE = 12.5 (25% range)**	**N RSE = 20 (40% range)**
Largemouth Bass	substock	5.68	27.34	1.55	2.64	8.73	91	36
Largemouth Bass	stock	7.26	22.41	1.63	4.07	10.45	61	24
Largemouth Bass	quality	18.00	15.29	2.75	12.60	23.40	28	11
Largemouth Bass	preferred	24.63	20.98	5.17	14.50	34.76	54	21
Largemouth Bass	memorable	0.95	72.86	0.69	-0.41	2.30	646	252
Largemouth Bass	trophy	0.00	NA	NA	NA	NA	NA	NA

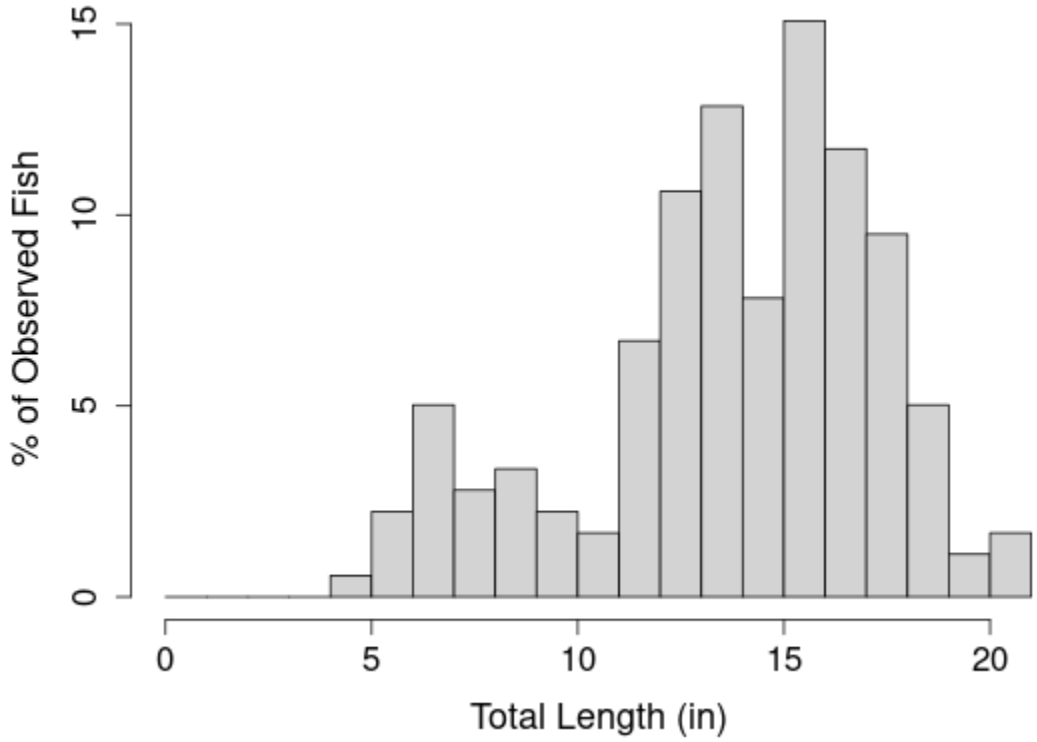


Figure 4. Length frequency plot for **Largemouth Bass** by spring electrofishing 2022 (OFAT analysis).

Table 6. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **White Crappie** collected by fall gill netting from Keystone Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total (≥4.8)		<8 inches (1.2-7.2)		≥8 inches (1.9)		≥ 10 inches (>1.0)	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r
1977	74	4.8	2.4	89	2.64	96	0.96	96
1981	58	4.32	3.12	96	1.2	106	0.72	110
1984	109	7.68	5.04	88	2.64	99	1.2	102
1987	71	4.8	1.2	91	3.6	102	2.64	103
1990	31	2.16	0	101	2.16	111	1.68	110
1993	27	1.68	1.2	97	0.72	106	0.48	108
1995	41	3.36	1.44	88	1.92	101	1.2	103
1999	38	3.84	2.88	87	0.96	94	0.72	94
2004	240	22.08			1.92	102	0.72	100
2005	114	8.64			0.96	90	0.72	100
2008	216	17.76	16.56	101	1.2	87	0.72	82
2010	74	6.0	4.08	104	1.68	101	0.96	98
2012	52	3.89	1.20	99	2.68	89	1.93	94
2014		0.75	0.07	92	0.68	99	0.41	102
2016	59	4.52	1.61	73	2.91	88	1.32	93
2018	35	2.48	0.07	98	2.42	104	2.20	104
2020	97	6.12	0.90	105	5.23	108	2.12	114
2022	26	1.96	0.51	85	1.45	96	0.61	104

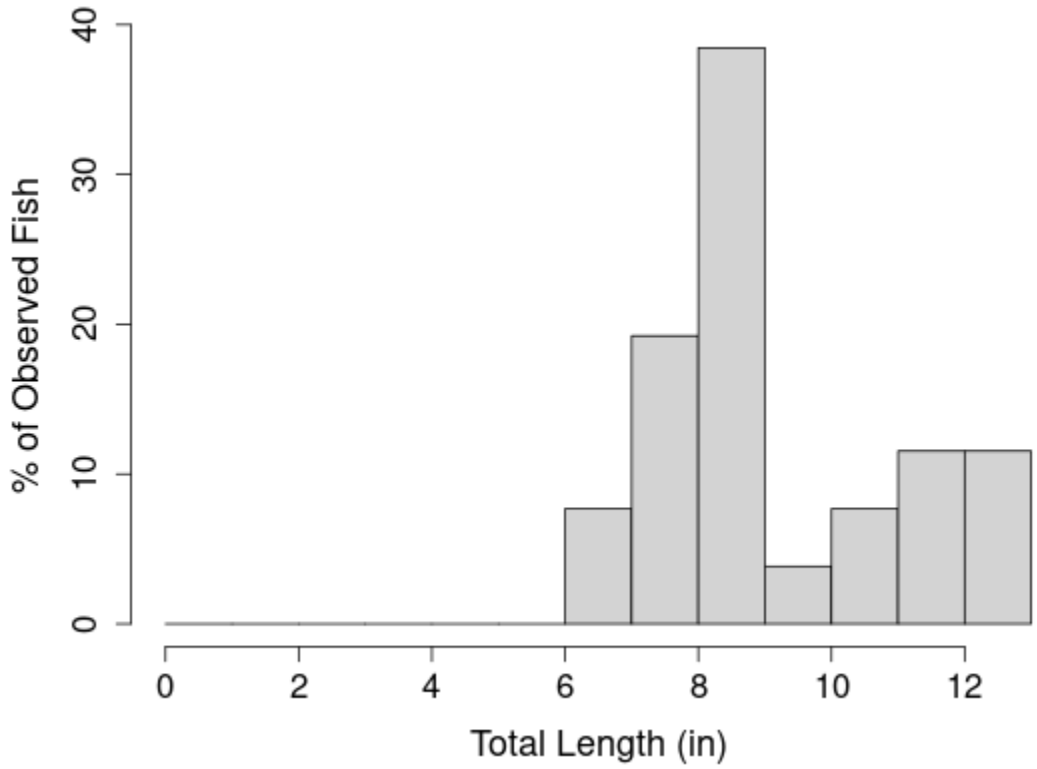


Figure 5. Length frequency plot for **White Crappie** by fall gill netting 2022 (OFAT analysis).

Table 7. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **White Crappie** collected by fall trap netting from Keystone Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total (≥4.8)		<8 inches (1.2-7.2)		≥8 inches (1.9)		≥ 10 inches (>1.0)	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r
2018	213	17.41	9.35	86	8.06	94	3.96	100

Table 8. Mean length at age of **White Crappie** collected from Keystone Lake. Numbers in parentheses represent values for acceptable growth rates.

Year	Age 1 (≥160mm) (6.3 inches)	Age 2 (≥200 mm) (8 inches)	Age 3 (≥225 mm) (9 inches)	Age 4 (≥250 mm) (10 inches)
1993	252	289	308	343
1995	178	255	362	359
1999	186	290	307	343
2018	166	262	257	313

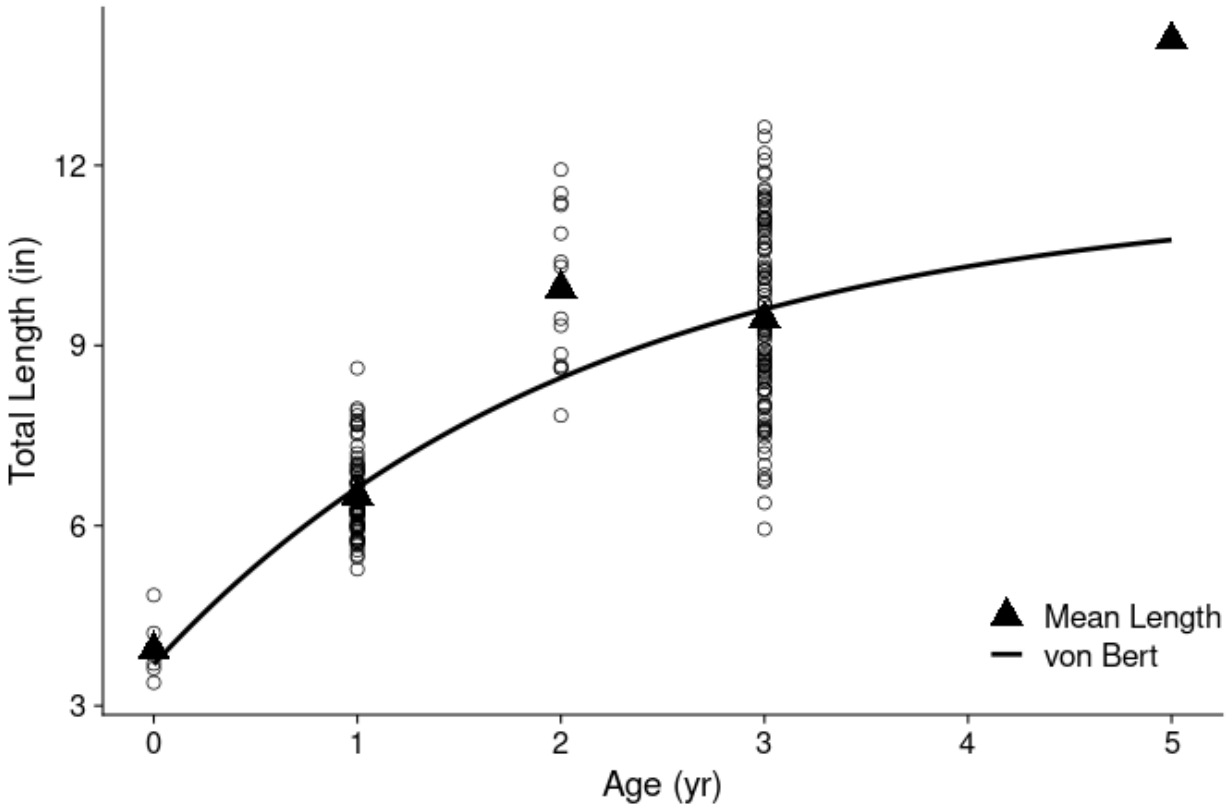


Figure 6. Von Bertalanffy plot for **White Crappie** from 2018 trap netting (OFAT analysis).

Table 9. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **White Bass** collected by fall gill netting from Keystone Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total (≥4.8)		<8 inches (1.2-7.2)		8-12 inches (1.2-7.2)		≥ 12 inches (>2.4)	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r
1977	190	12.48	4.32	97	5.52	97	2.4	99
1981	75	5.52	0.72	99	1.92	87	2.88	96
1984	64	4.56	0.24	85	0.96	88	3.12	90
1987	34	2.4	0.48	90	0.24	90	1.44	96
1990	120	8.64	1.2	91	3.12	97	4.56	101
1993	211	13.92	4.08	96	5.04	95	4.8	100
1995	63	5.04	1.2	94	1.2	98	2.64	96
1999	137	13.68	4.56	95	3.84	87	5.28	91
2004	207	18.72	8.88	101	5.04	88	5.04	86
2005	105	8.16	3.12	83	5.04	91	3.12	93
2008	28	2.4	0.48	98	0.72	88	0.96	89
2010	58	4.56	0	109	4.56	94	2.16	95
2012	64	4.79	0.22	70	4.57	87	2.92	87
2014	138	9.67	1.66	87	8.02	91	4.14	93
2016	116	8.70	0.68	72	8.02	90	4.90	94
2018	77	5.42	0.28	91	5.06	89	2.63	89
2020	130	8.39	1.49	98	6.84	102	3.57	104
2022	168	12.58	0.68	93	11.90	90	5.48	91

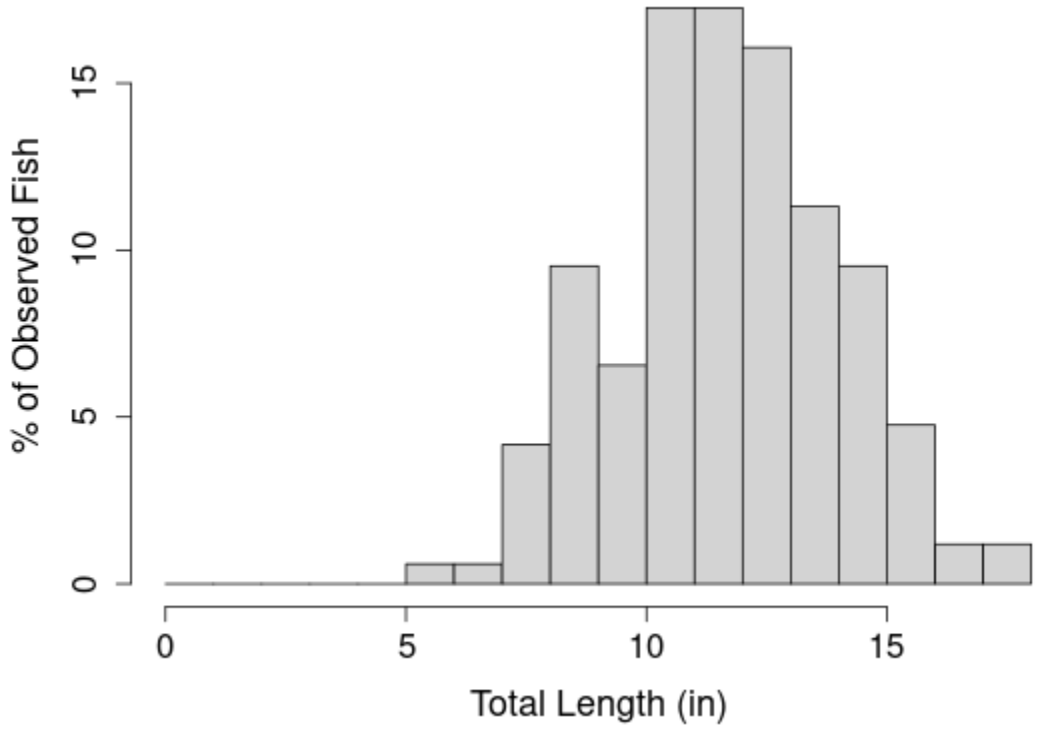


Figure 7. Length frequency plot for **White Bass** by fall gill netting 2022 (OFAT analysis).

Table 10. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **Striped Bass** collected by fall gill netting from Keystone Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total		<12 inches		12-20 inches		≥ 20 inches	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r
1977	69	4.56	1.92	85	2.4	87	0.24	95
1978*		6.24						
1979*		3.12						
1980*		5.76						
1981	140	10.32	6.48	87	2.16	95	1.68	96
1984	18	1.2	0.48	81	0.24	96	0.48	92
1987	27	1.92	0.72	82	1.2	92		
1990	10	0.72		105	0.48	95	0.24	103
1993	33	2.16			1.44	94	0.72	98
1995	25	1.92	0.72	87	0.72	101	0.48	102
1999	16	1.68	0.24	83	0.96	91	0.48	84
2004	34	3.12	1.2	80	1.2	85	0.96	84
2005	28	2.16			1.92	82	0.48	95
2008	17	1.44	0.48		0.72	103	0.72	82
2010	2	0.24	0.072	84	0.072	84	0.072	90
2012	21	1.58	0.07	80	1.28	87	0.30	91
2014	65	4.45	0.57	77	3.60	88	0.85	95
2016	11	0.86	0.24	88	0.48	95	0.38	96
2018	20	1.38	0.14	72	1.24	88	0.14	97
2020	45	2.81	0.94	86	2.05	92	0.76	100
2022	46	3.48	1.50	86	3.48	89	0.08	82

*Data taken from: Combs, David L. 1981 Striped Bass Research Study.

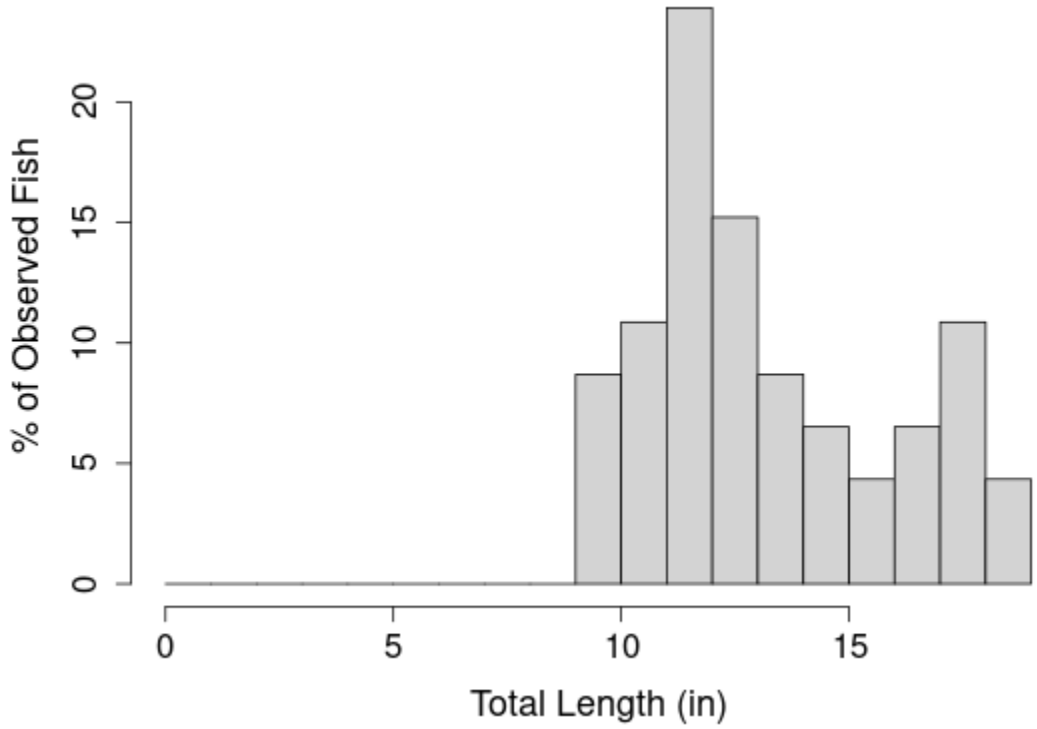


Figure 8. Length frequency plot for **Striped Bass** by fall gill netting 2022 (OFAT analysis).

Table 11. Total number (No.) and catch rates (C/f) of young-of-year **Striped Bass** collected by summer shoreline seining on Keystone Lake, 2010-2023.

Year	No.	C/f	RSE	SE	L 95% CI	U 95% CI	N RSE = 12.5 (25% range)	N RSE = 20 (40% range)
2010	404	77.4	28.85	22.33	33.64	121.17	64	25
2011	270	51.73	38.18	19.75	13.02	90.44	112	44
2012	272	52.11	32.93	17.16	18.48	85.75	83	33
2013	183	35.06	52.4	18.37	-0.95	71.07	211	82
2013	307	58.82	29.01	17.06	25.37	92.26	65	25
2016	1421	272.26	23.61	64.28	146.27	398.24	43	17
2017	648	124.15	30	37.24	51.16	197.15	69	27
2017	648	124.15	18.61	23.11	78.86	169.45	27	10
2018	3	0.57	100	0.57	-0.55	1.7	768	300
2020	2542	487.04	21.48	104.63	281.96	692.11	35	14
2021	2233	427.83	22.85	97.78	236.19	619.48	40	16
2022	289	55.37	26.93	14.91	26.15	84.59	56	22
2023	12	2.3	56.41	1.3	-0.24	4.84	244	95

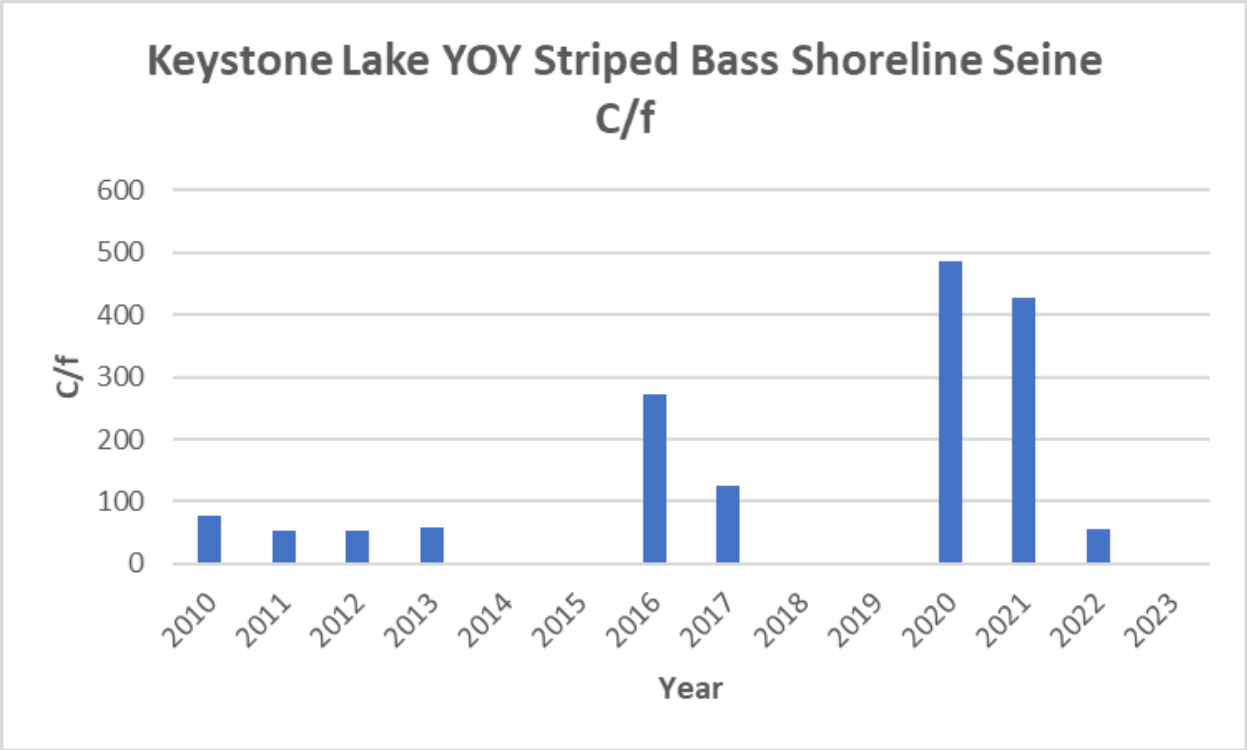


Figure 9. Cath rates (C/f) trends for Striped Bass YOY on Keystone Lake from summer shoreline seining, 2010-2023.

Table 12. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **Channel Catfish** collected by fall gill netting from Keystone Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total (≥4.8)		<12 inches (≥2.4)		≥12 inches (≥2.4)		≥ 16 inches (≥1.2)	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r
1977	102	6.72	5.04	88	1.68	87	0.96	94
1981	133	9.84	7.2	102	2.64	93	1.44	96
1984	115	7.92	6.48	90	1.44	82	0.24	89
1987	79	5.52	3.84	91	1.68	84	0.72	84
1990	131	9.6	8.4	97	1.2	91	0.72	95
1993	52	3.36	2.4	88	0.96	93	0.48	88
1995	77	6	4.8	83	1.44	83	0.72	92
1999	93	9.36	7.68	84	3.6	85	2.4	87
2004	255	22.8	21.84	90	1.2	82	0.24	74
2005	219	16.8	14.88	89	1.92	85	0.96	89
2008	39	3.36	2.4	87	0.96	87	0.48	90
2010	47	3.84	2.64	99	1.2	86	0.96	88
2012	45	3.37	2.31	93	1.06	85	0.53	92
2014	76	5.37	3.51	90	1.86	87	1.22	88
2016	34	2.58	1.53	67	1.05	86	0.22	90
2018	64	4.51	2.34	106	2.16	94	1.12	98
2020	99	6.23	2.68	102	3.54	91	2.22	92
2022	112	8.41	5.05	91	3.36	84	2.43	86

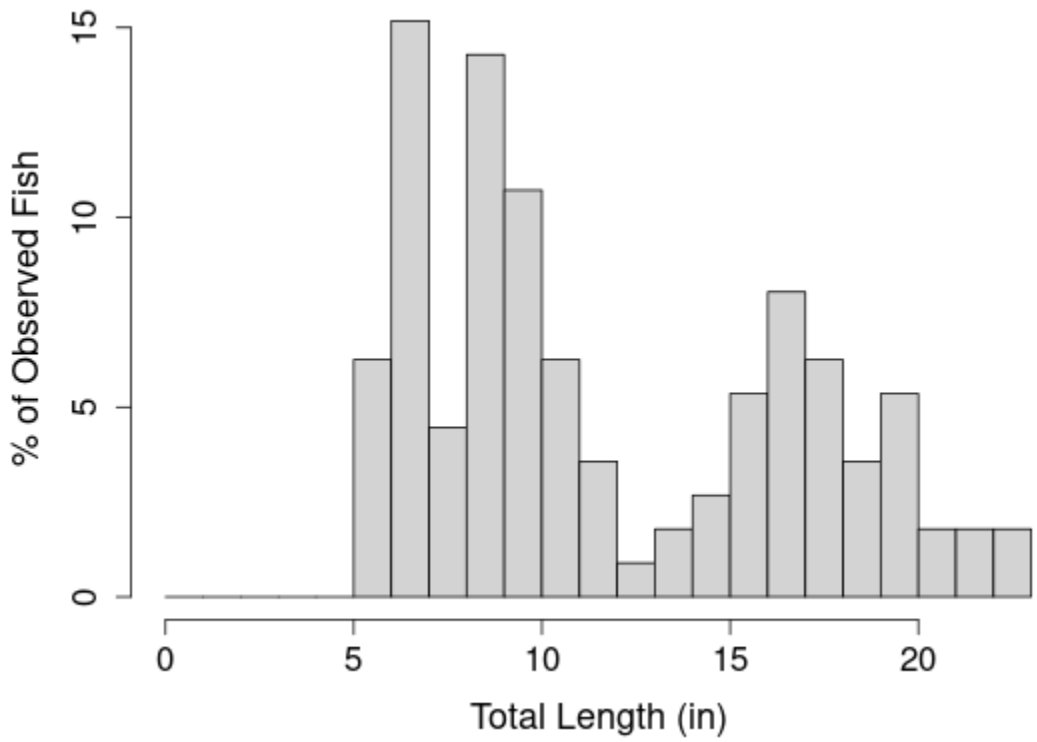


Figure 10. Length frequency plot for **Channel Catfish** by fall gill netting 2022 (OFAT analysis).

Table 13. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **Blue Catfish** collected by fall gill netting from Keystone Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total (≥2.4)		<12 inches (≥1.2)		≥12 inches (≥1.2)		≥ 16 inches (≥0.7)	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r
1977	37	2.4	1.92	106	0.48	105	0	107
1981	100	7.44	4.56	101	2.64	107	2.16	109
1984	82	5.76	4.56	92	1.2	99	0.72	105
1987	68	4.8	2.88	101	1.68	94	1.44	91
1990	106	7.68	5.28	102	2.64	102	1.2	106
1993	96	6.24	1.68	102	4.8	107	4.08	110
1995	94	7.44	4.32	95	3.12	99	2.64	101
1999	79	7.92	4.32	87	3.6	85	2.4	87
2004	75	6.96	4.56	85	2.4	88	1.68	90
2005	61	4.56	3.36	86	1.44	83	0.96	83
2008	126	10.08	7.92	87	2.4	85	1.44	86
2010	61	4.8	2.88	87	1.92	83	1.2	83
2012	89	6.56	3.16	89	3.39	79	2.43	78
2014		4.36	0.80	92	3.56	83	2.88	83
2016	74	5.66	0.60	99	5.05	91	4.81	91
2018	57	4.04	1.26	106	2.78	93	2.36	93
2020	50	3.18	1.89	106	1.29	93	1.10	93
2022	106	7.86	3.14	91	4.72	84	3.41	85

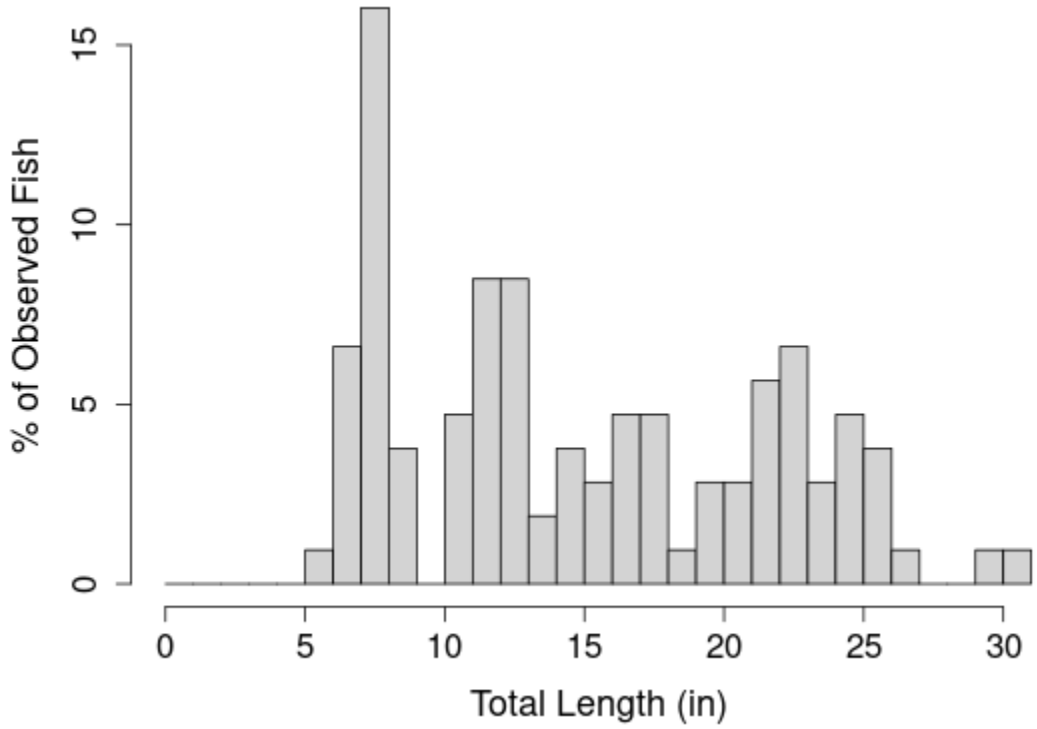


Figure 11. Length frequency plot for **Blue Catfish** by fall gill netting 2022 (OFAT analysis).

Table 14. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **Flathead Catfish** collected by fall gill netting from Keystone Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total		<12 inches		≥12 inches		≥20 inches		≥24 inches		≥28 inches	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r	C/f	W_r	C/f	W_r
1977	15	0.96			0.96	110	0.96	108	0.72	109	0.24	
1981	14	0.96			0.96	108	0.72	111	0.48	108	0	
1984	11	0.72			0.72	102	0.48	106	0.24	116	0	
1987	14	0.96			0.96	88	0.72		0.48		0.24	
1990	23	1.68			1.68	107	1.44	109	0.96	108	0.48	
1993	17	1.2			1.2	107	1.2	107	0.96	108	0.24	
1995	25	1.92	0.24	111	1.92	112	1.68	111	1.2	113	0.24	
1999	9	0.96			0.96	95	0.72	99	0.48	99	0.24	106
2004	8	0.72			0.72	89	0.48	91	0.24	87		
2005	8	0.72			0.72	97	0.48	97	0.24	100		
2008	3	0.24			0.24	86	0.24	86	0.72	100		
2010	4	0.24	0	98	0.24	93	0.24	93				
2013	5	0.37			0.37	94	0.29	89				
2014	0	0										
2016	2	0.15			0.15	94	0.15	90	0.07	90	0.07	90
2018	6	0.42			0.42	103	0.35	91				
2020	4	0.26			0.26	92	0.13	90	0.07	94		
2022	3	0.23			0.23	91	0.15	101				

Table 15. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **Gizzard Shad** collected by fall gill netting from Keystone Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total (≥.20)		<6 inches (>0.10)		>6 inches	
Year	No.	C/f	C/f	W_r	C/f	W_r
1977		9.6	8.4	82		
1981		11.76	9.12	89		
1984		27.6	17.04	86		
1987		46.08	32.4	85		
1990		38.64	30.48	84		
1993		22.8	20.4	91		
1995		31.92	23.76	82		
1999		93.12	85.92	82		
2004		45.36	0			
2005		36.24	18.24		18.24	
2008	465	86.16	72		14.16	
2010	443	108.48	104.64		4.08	
2012		10.98	10.97			
2014		12.09				
2016		6.56				
2018		31.35			0.07	
2020	260	16.89	6.45		9.80	
2022	225	19.41	11.45		5.93	

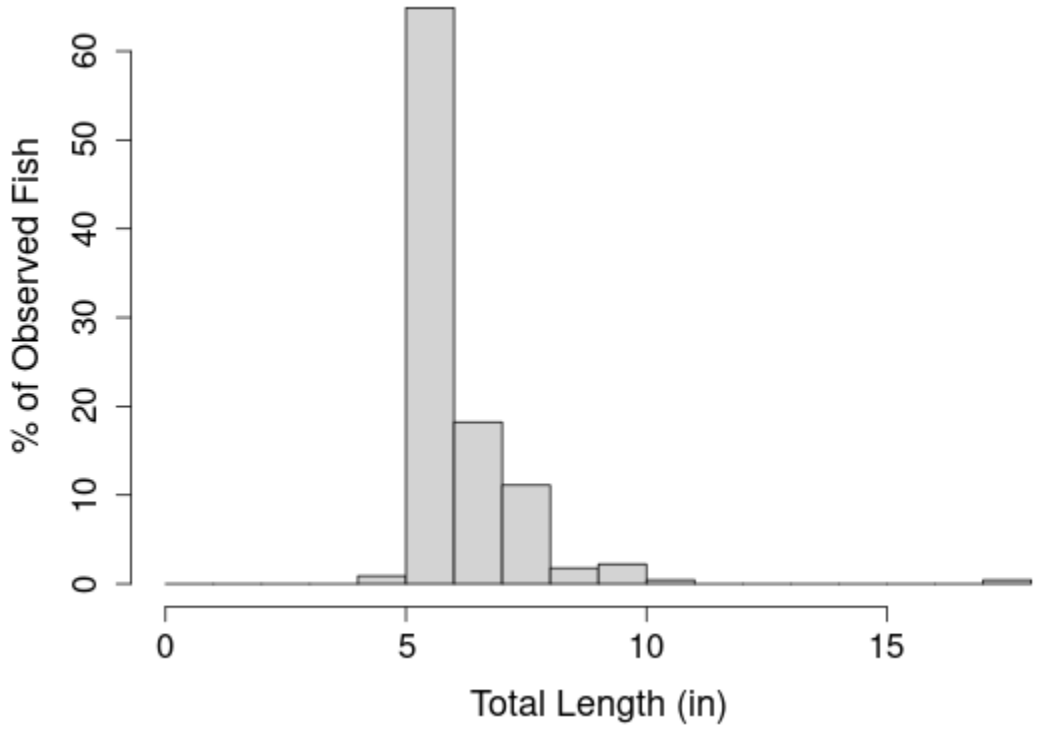
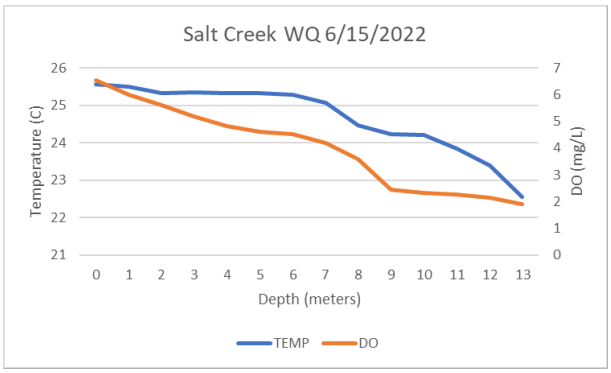
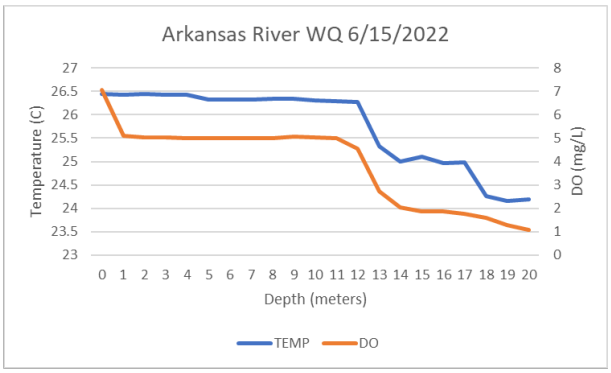


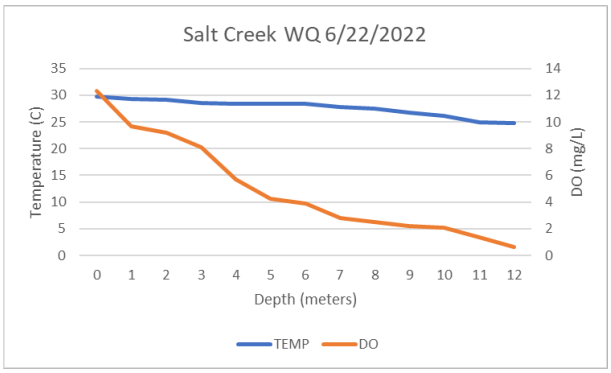
Figure 12. Length frequency plot for Gizzard Shad by fall gill netting 2022 (OFAT analysis).

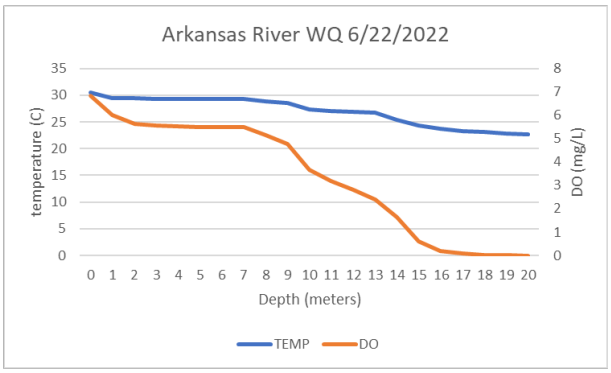
Table 16. Species, number, and size of fish stocked in Keystone Lake since 1981.

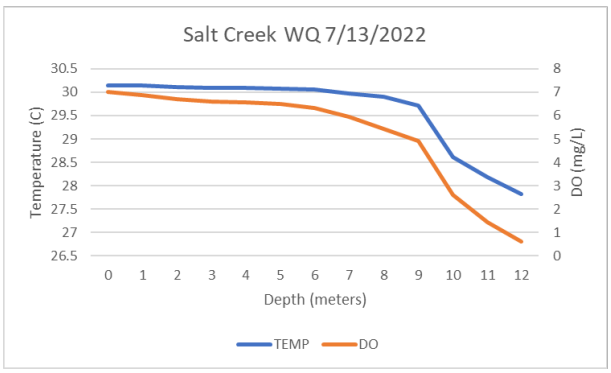
Date	Species	Number	Size (mm)
1981	Largemouth Bass	35,055	90
1982	Largemouth Bass	8,000	102
1983	Largemouth Bass	15,000	147
1984	Largemouth Bass	2,500	140
1985	Largemouth Bass	20,000	89
1987	Largemouth Bass	6,000	114
1988	Largemouth Bass	10,000	64
1989	Largemouth Bass	5,500	102
1990	Smallmouth Bass	36,932	38-64
1991	Smallmouth Bass	118,780	19-52
1994	Walleye	500,000	Fry
1995	Walleye	500,000	Fry
1996	Walleye	2,600,000	Fry
1997	Walleye	1,000,000	41
1998	Walleye	1,000,000	Fry
1999	Walleye	1,000,000	Fry
1999	Smallmouth Bass	28,810	70-76

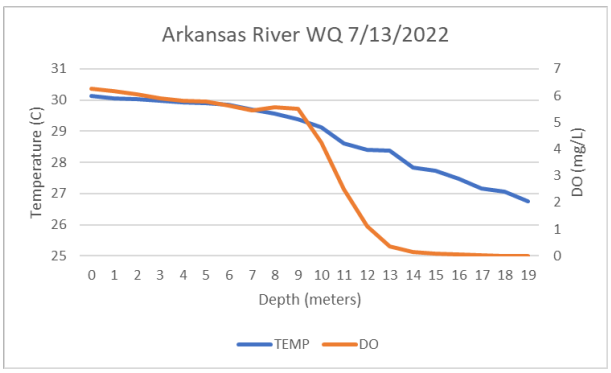


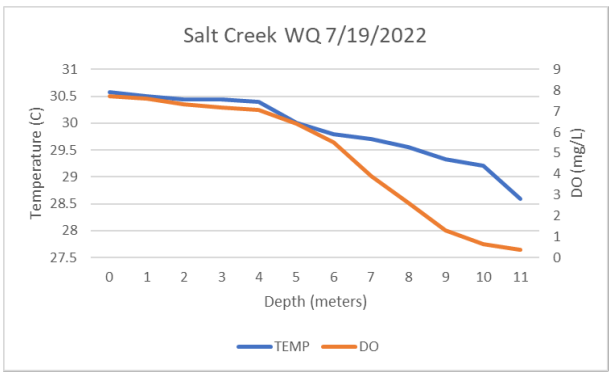












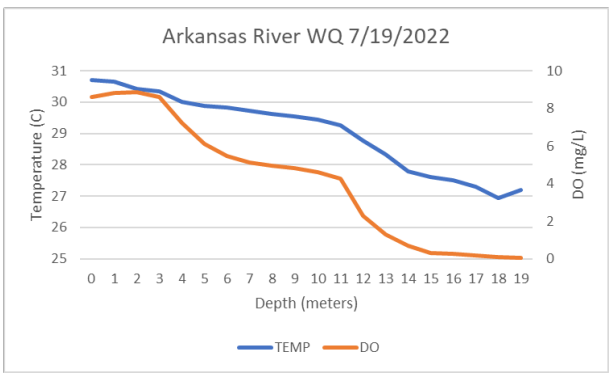
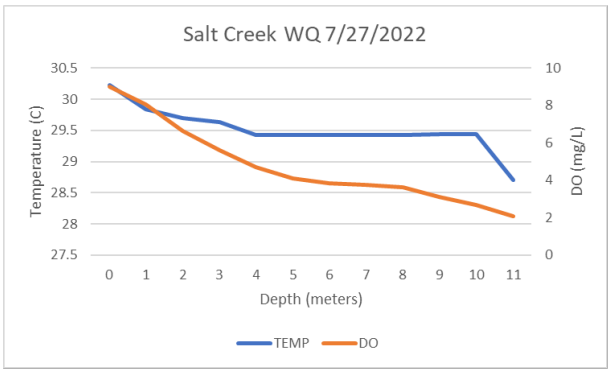
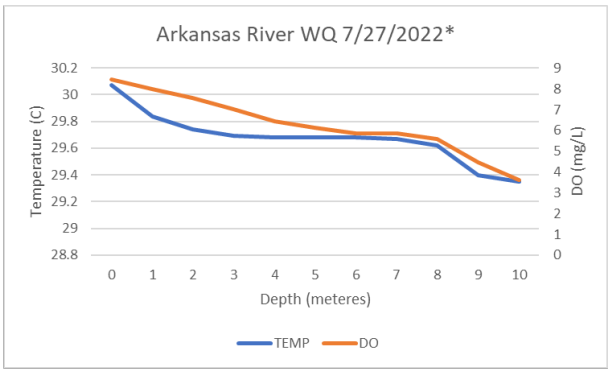
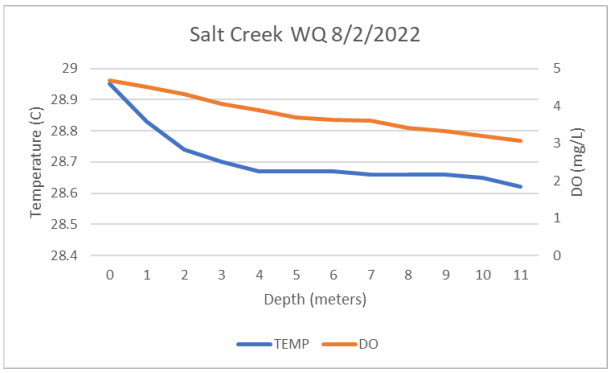
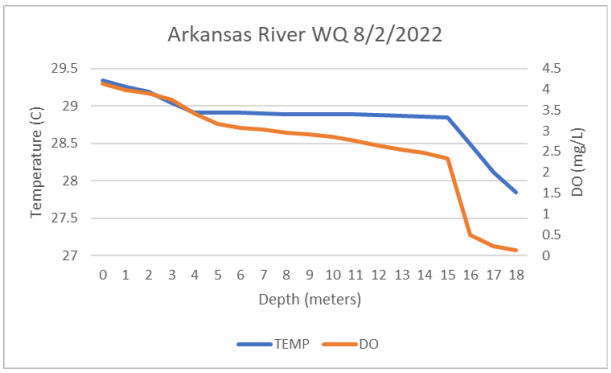


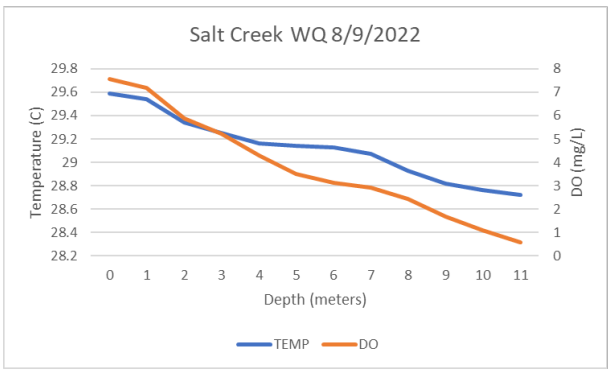
Figure 13. Daily water quality readings for Keystone Lake, June 15 through July 19, 2022.

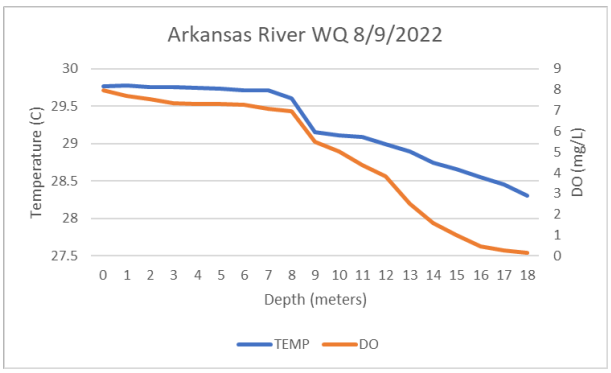


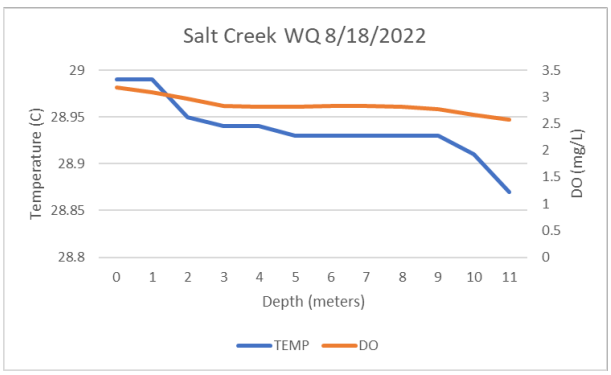












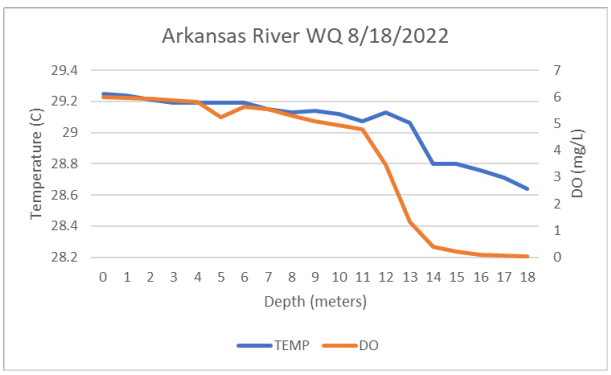
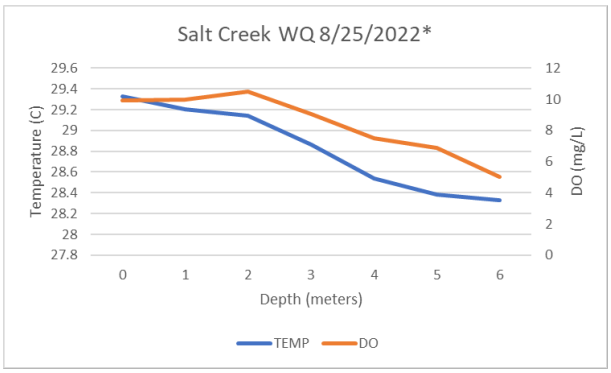
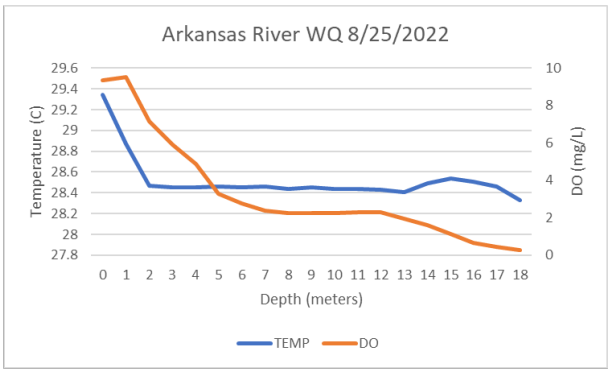
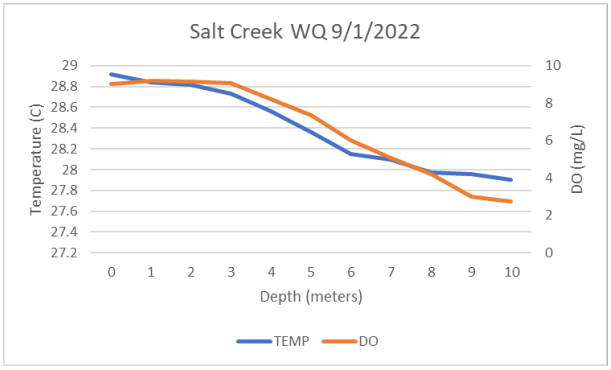


Figure 14. Daily water quality readings for Keystone Lake, July 27 through August 18, 2022.







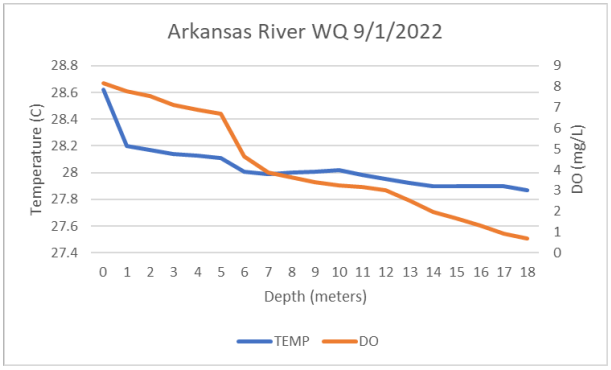
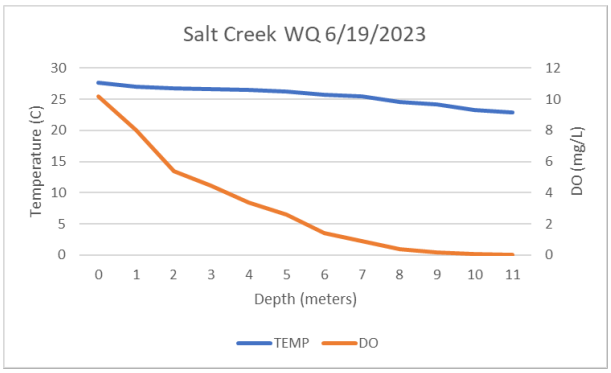
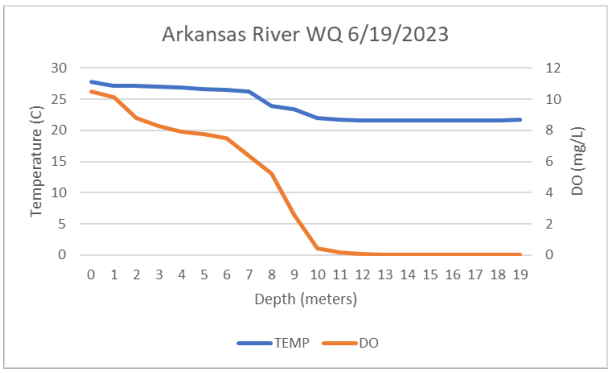
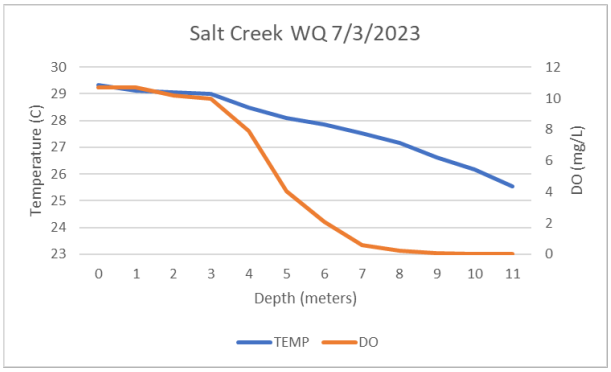
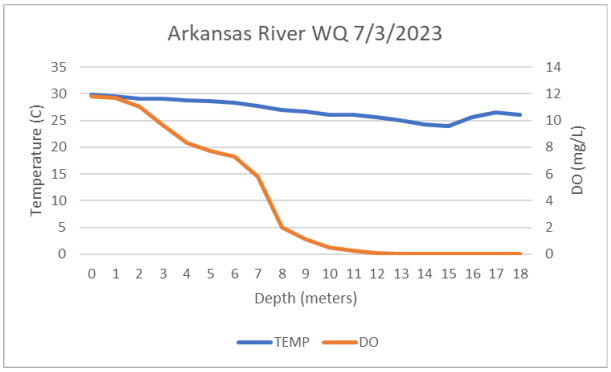


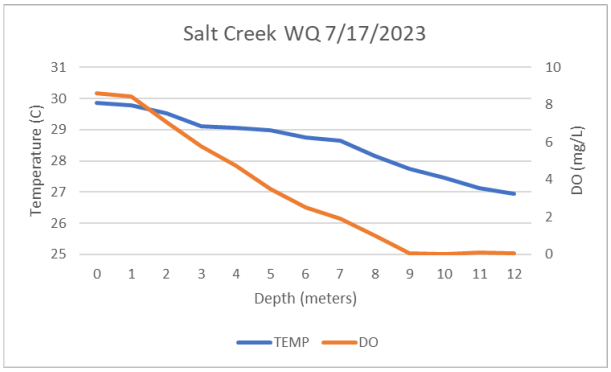
Figure 15. Daily water quality readings for Keystone Lake, August 25 through September 1, 2022.

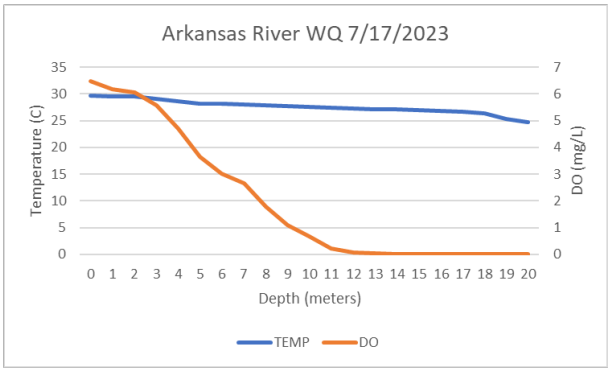


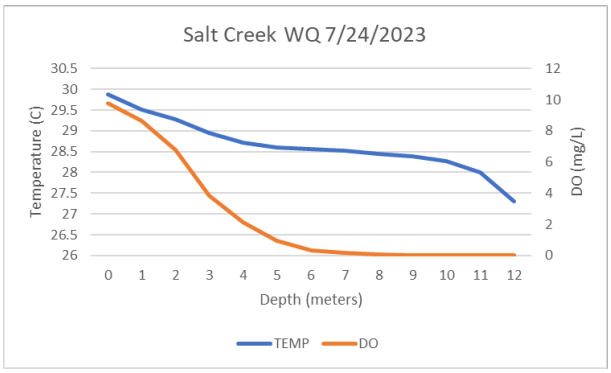












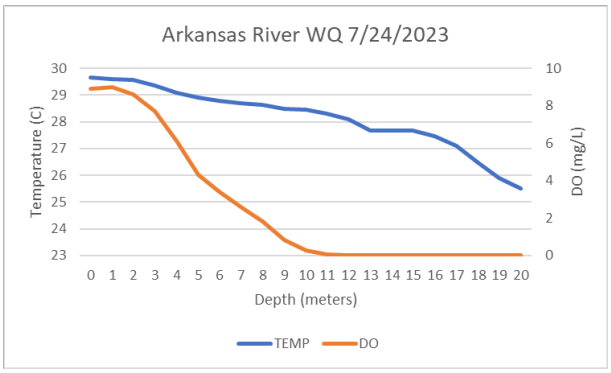
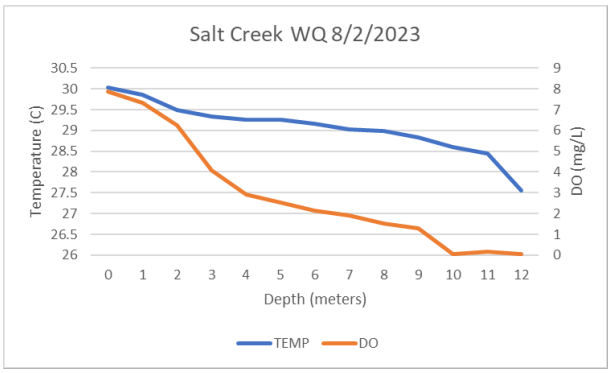
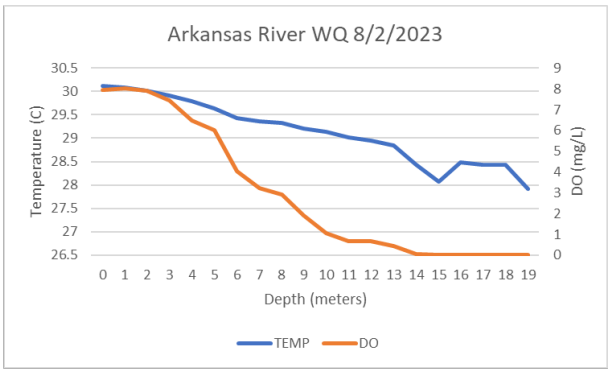
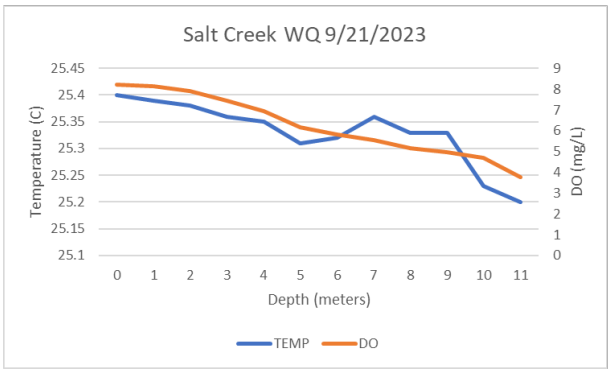


Figure 16. Daily water quality readings for Keystone Lake, June 19 through July 24, 2023.







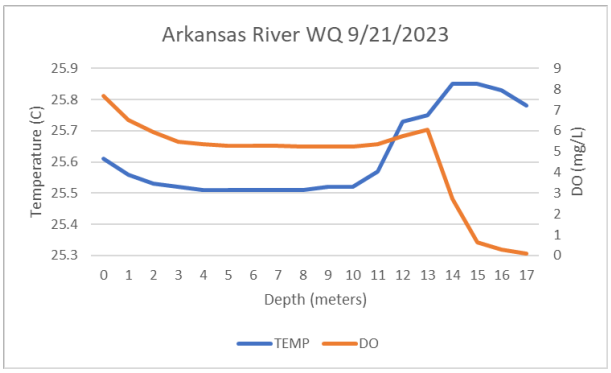


Figure 17. Daily water quality readings for Keystone Lake, August 2 through September 21, 2023.