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by

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ABSTRACT

The affects of various water-level fluctuation rates during the fall drawdown on abundance and harvest of fish in shoreline areas and the overall sportfish harvest were studied in 1974-1981 at Barren River Lake, a 10,000 acre flood control reservoir. Shoreline fish activity increased during either a slow rise or fall in the water level. Black bass occurrence was greatest during a 2-foot decline below summer pool or a 1 to 2-foot rise in water levels during a 15-day period. Sunfish and catfish were more prevalent during stable water levels. Crappie remained relatively unaffected by water level rises, but a rapid decrease from 1 to 2 feet resulted in the number of crappie increasing in the shoreline areas. Maximum fisherman use occurred during stable water-level periods; however, maximum fisherman catch occurred during slow water-level fluctuations. White bass and crappie harvests were highest during stable water levels. Maximum water levels within $\pm$2 foot of summer pool were preferred by fishermen. Total harvests of black bass and sunfish were higher when the water level exceeded summer pool at some time during the fall drawdown period. A slow drawdown of 1-2 feet per 15-day period resulted in the greatest occurrence and harvest of sportfish in shoreline areas. Although greatest fisherman use of the shoreline areas occurred during a very slow drawdown, a more rapid drawdown resulted in a higher catch rate.

Fishermen in Kentucky have long held the opinion that the early fall drawdown of flood-control reservoirs affects their fishing success. They have requested to the U. S. Corps of Engineers (USCE) that water levels be held at summer pool into the later fall periods, primarily through October. The USCE maintains that it need to remove the water as soon as possible in order to prepare for the winter-spring high inflow periods.

The normal water-level regime on Barren River Lake, a 10,000-acre flood-control reservoir, was to maintain summer pool at 552 ft msl until early September when the water level would slowly be lowered by 2 ft by October 15. Thereafter, the rate of drawdown to winter pool (525 ft msl) was controlled by downstream discharge capacities. Downstream farming operations limit the maximum discharges. The water acreages per lake elevation are presented in Table 1. The normal fluctuation of Barren River Lake is from 10,000 surface acres at summer pool to approximately 4,340 surface acres at winter pool. The tailwater temperatures below Barren River Lake are maintained at 70 F or less to provide coldwater habitat for rainbow trout stockings (Table 2).

The effects of drawdown on smaller reservoirs and lakes has been evaluated during the past, with most evaluations being conducted on determining the affects of winter and/or summer drawdowns on fish populations during the following summer. Lance et al. (1964), Pierce et al. (1963), Wegener and Williams (1974), Herman et al. (1969), and numerous other authors related drawdowns and their affects on fish populations and/or aquatic vegetation during the following year or years. Charles (1967) evaluated the affects of winter drawdowns on the

fish movement downstream, but made little correlation to the reservoir fishes until the following summer. There has been little research on the affects of fall drawdown on the fish population and/or fisheries.

This study was designed to measure the affects of a stable water level on the fishery at Barren River Lake during the period of August 15 through October 15 from 1968 through 1981. After this time, the normal drawdown regime was to be resumed. During 1967 and 1977, the water level was to be lowered 2 ft by August 15 and held at that level until October 15. Other agencies and the Game Division of the Kentucky Department of Fish and Wildlife Resources also conducted experiments during this time. Because of the lack of success in these other programs, the 2 ft drawdown was terminated after 1977. In 1978-1981, the lake was to be held at summer pool until October 15.

METHODS

Electrofishing was conducted over the same shoreline areas during August 15 through October 15, 1974 through 1981. Water levels and abundance of fish collected altered the sampling time; however, every effort was made to keep the sampling effort and area sampled as equal as possible for each sample period. The electrofishing unit consisted of a boat mounted, 230-volt alternator with the electrical current controlled by a III-E VVP Coffelt control box. Current was introduced into the bottom of 6-ft electrodes mounted on booms 3 and 9 ft in front to an aluminum boat. Fish most sought by anglers were captured by long handled dip nets and held in a live well until processing. Only harvestable fish were collected. All fish were returned to the water after processing. Gizzard shad were the most

prevalent fish shocked, although they were not collected. Carp were also not collected.

A roving-type creel survey was conducted during a 6-hour period, one day a week, from August 01 to October 31, 1968 through 1978. Days were selected at random as was the time period and counting period. Time periods were from 7 am to 1 pm, or from 1 pm to 7 pm. Counts were conducted during 2 of the 6 hours in each time period. The remaining time was used to interview anglers. The 1979, 1980, and 1981 surveys were access point creel surveys conducted by interviewing fishermen as they left the lake. Aerial counts were conducted to determine fishing pressure. This portion of the survey was conducted in cooperation with the U.S. Fish and Wildlife Service (ECRI). The time period of the survey was changed to September 01 through November 30 because of the survey design.

RESULTS AND DISCUSSION

Response of Fish to Water Level Fluctuations

Water levels during the study period of 1974 to 1981 were affected by major inflow periods and tailwater area repairs (Table 3). The two main fluctuation periods occurred during 1976, when the spilling basin was repaired, and 1979, when a heavy rainfall increased the reservoir water level. The water level during 1976 was reduced from 550 ft to 538 ft msl in order that the tailwater could be repaired; only minimum flow (5 cfs) was maintained during this period. Major repairs were completed at that time. The water level rose during 1979 to 571 ft msl or 19 ft above summer pool. Heavy rains caused the rapid rise in the water level. At 571 ft msl, a major portion of the shoreline is in heavily timbered areas.

Water levels did not remain stable during any year of the study. The most stable period occurred during 1977 when the water level remained close to 1 ft below summer pool for a large proportion of the time. Total fluctuation from August 01 through October 15 varied from 2 to 19 ft per year. Water levels fluctuated from a high of 571 ft msl to a low of 538 ft msl during the 14 years.

Water levels were to be stabilized at 550 ft msl during the 1976 and 1977 study periods. The water levels varied from 552 to 538 ft msl. Water levels were tentatively stabilized at 552 ft msl in 1976 during August 01 to September 01; however, during 1977, they were stabilized at approximately 551 ft msl, only 1 ft below summer pool. The water levels during the 1978 through 1981 study period were to be stabilized at 552 ft msl. The water level was above pool most of the time, except during 1980 and 1981 when a more normal regime was followed - a slow drawdown of 2 ft by October 15.

The affects of fluctuating water levels on the fish population suggests certain species are affected differently. Electrofishing results from shoreline areas tend to support the premise that fluctuating water levels increased activities of certain species in shoreline areas. Black bass were most active in the shoreline areas when the water level was declining at a rate of approximately 2 ft/15 days (Table 4). An additional peak period of activity was also noted when the water level was rising at a rate of 1 ft/15 days; however, it was not as pronounced as during a 1 to 2 ft decline in 15 days. At increases greater than 2 ft/15 days, the number of captured black bass decreased rapidly. Black bass activity during the stable water level period was less than during the fluctuation period, except when the

water level rose over 2 ft/15 days. Part of the decreased activity in the shoreline areas may have been due to the inability to sample during high water levels. Black bass remained relatively active along the shoreline during any decrease in the water level. Black bass numbers declined as the rate of drawdown increased (Figures 1 and 2).

Sunfish became more numerous in the shoreline areas during the 2 ft/15 day drawdown rate; however, unlike the black bass, they remained active during the stable water-level periods. Sunfish were least abundant when water levels rose only 1 ft/15 days or over 2 ft/15 days. Sunfish also became less abundant along the shoreline areas during the decline in water level of more than 2 ft/15 days (Table 4). Crappie numbers remained relatively stable in the shoreline areas until the water levels began to decrease. A high catch rate occurred when the water level was declining 2 ft/15 days but decreased rapidly when it was exceeded.

White bass were most active in the shoreline areas when the water level was declining only 1 ft/15 days; this species was also quite active when the water level was rising at 1 ft/15 days. During other water-level fluctuating periods, white bass became less active. Few white bass were sampled during periods of stable or rapid water-level fluctuations. Catfish preferred a stable water level or a rise in water level of approximately 2 ft/15 days. Catfish were sampled less frequently during the 2 ft/15 day drawdown. The sucker population became more active in shoreline areas during the 2 ft/15 day drawdown period like most other fish.

The overall catch rate of fish at the different water-level fluctuations had two peaks, one occurring at the 2 ft/15 day rise and the second at a drawdown rate of 2 ft/15 days. The number of fish

collected when the rate was declining faster than 2 ft/15 days was approximately the same as when the fluctuation was increasing 1 ft/15 days.

Fishermen Use and Harvest During Fluctuating Water Levels

The greatest fisherman use of the reservoir during the August 1 - October 15 period occurred when the water level fluctuated between 0 and 3 ft (Table 5). An average of 21,422 fisherman days were spent on the reservoir at this time. Anglers fished 77,599 hours and harvested 69,444 fish that weighed 29,256 lb. Fisherman use decreased as the water-level fluctuation increased. An average of 17,728 fisherman days were fished when there was a 4-8 ft fluctuation during the 92-day period. These fishermen fished for an average of 47,164 hours, during which they harvested 52,532 fish that weighed 28,724 lb. During the greatest water-level fluctuation of 9-20 ft, the average number of fisherman days was 18,368. Anglers fished for 54,943 hours, which is more than during the 4-8 ft fluctuation. The harvest, however, was only 42,981 fish that weighed 19,551 lb.

The average number of fish caught per hour of fishing was the highest (1.11) during the 4-8 ft fluctuation. The catch rate during the 0-3 ft fluctuation was 0.89 fish per hour. During the 9-20 ft fluctuation, 0.78 fish were harvested per hour. The greatest number of hours fished per day occurred during the more stable period when an average fisherman day lasted 3.6 hours. The least time spent fishing was when the greatest catch rate was occurring, during the 4-8 ft fluctuation.

The catch rate for black bass was greatest during the

fluctuation rate of 4-8 ft (0.31), followed by 9-20 ft (0.14) and 0-3 ft (0.07)(Table 6). More crappie were harvested during the 0-3 ft fluctuation when they were harvested at a rate of 0.63 fish per hour. The harvest rate was 0.40 during the 9-20 ft fluctuation and 0.31 during the 4-8 fluctuation. Sunfish were harvested during the period of the 4-8 ft fluctuation at a rate of 0.40 fish per hour, followed by 0.20 per hour during the 9-20 ft fluctuation and 0.10 during the 0-3 ft fluctuation.

The maximum water level obtained during the 3-month period was also used to evaluate the fisherman use and catch. Fishermen were relatively selective in their preference. Fishermen preferred to fish the reservoir when the pool level did not exceed 2 ft above or below summer pool (Table 7).

The black bass harvest was greatest when the elevation was above summer pool of 552 ft msl for some portion of the time (Table 8). The sunfish harvest was also highest at that time. Crappie and white bass harvests were highest when the water level did not exceed 2 ft above summer pool. When the water level was so low that it never reached 550 ft msl, harvest of all species declined, except for sunfish.

CONCLUSIONS

Shoreline activity of fish increased during either the slow rise or fall of water levels. Above and below 2 ft/15 day fluctuation, the activity decreased rapidly. Black bass and crappie were more active in the shoreline areas during the 2 ft/15 day drawdown than at any other period. A second most active period occurred for black bass when the water level was rising from 1 to 2 ft/15 days. Sunfish and

catfish were more active in the shoreline area during stable water levels than any other species. Sunfish activity increased during the +2, 0, -1, and -2 ft/15 day fluctuation periods. Little activity occurred when the water level was rising by 1 ft or decreasing by more than 2 ft/15 days.

Fishermen preferred to fish the reservoir when the water level remained fairly constant. Fishing success was greatest when the water level fluctuated from 4-8 ft. Black bass and sunfish had a higher catch rate during the 4-8 ft fluctuation period; however, white bass and crappie had a higher catch rate during the 0-3 ft fluctuation period.

The maximum water level had some effect on fisherman use of the shoreline areas. Fishermen preferred the water level to be within ±2 ft of summer pool at least sometime within the drawdown period. When the water level exceeded or never achieved these levels, fisherman use declined. A greater harvest of black bass and sunfish occurred when the water level had exceeded summer pool. Crappie and white bass harvests were highest when the fluctuation was only 2 ft above to 2 ft below summer pool.

Fishing effort decreased as the rate of water level fluctuation increased. The greatest fisherman use occurred during relatively stable water levels and decreased as water level fluctuation increased. Although fishing pressure declined during fluctuating water levels in the fall, this study suggests that the declining water levels may in fact increase the chance of harvesting fish. Catch rate during periods of relatively slow drawdown, 4-8 ft during the 92-day period, was higher than during either a slower or

faster rate of drawdown. Fishing activity increased as water-level fluctuations decreased to less than 2 ft/15 days. Black bass occurrence and catch rate were greatest during the years when this rate of drawdown occurred.

Water-level management during fall periods may be an effective management tool to be used during certain conditions. Rapid water-level fluctuations of over 2 ft/15 day period will likely decrease the harvest of all species. However, stable water levels would be expected to increase the harvest of crappie, sunfish, catfish, and white bass, while decreasing the harvest of black bass. A slow controlled drawdown of 1-2 ft/15 day period should result in the greatest harvest of fish.

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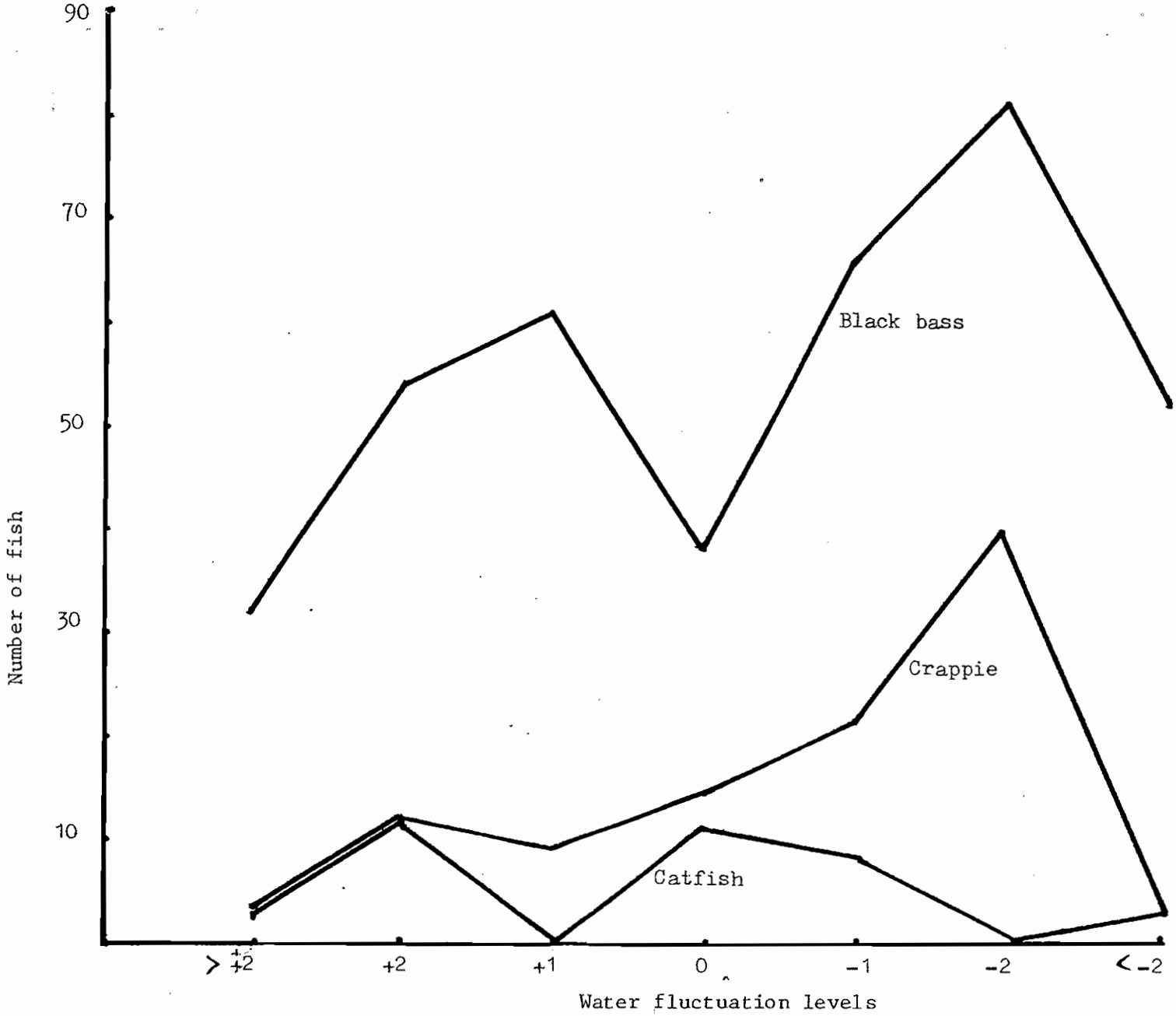

Figure 1. Catch of black bass, crappie, and catfish at various water-level fluctuations during a 15-day period.

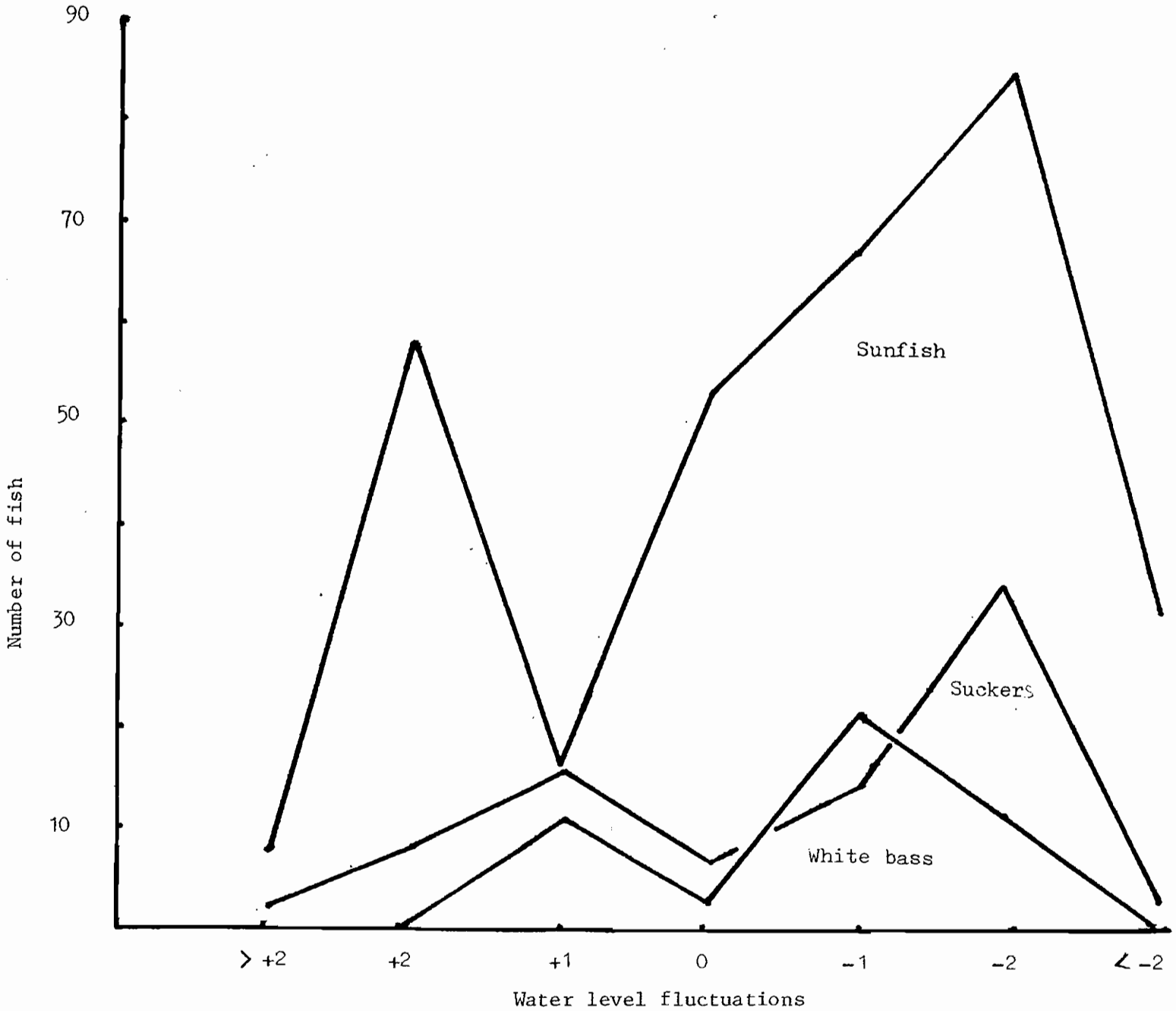

Figure 2. Catch of sunfish, suckers, and white bass at various water-level fluctuations during a 15-day period.

Table 1. Water levels and surface acreage at Barren River Lake.

Elevation (ft/msl)	Acres	
524	4,180	
525	4,340	(Winter pool)
538	6,860	
540	7,340	
542	7,760	
544	8,200	
546	8,620	
548	9,100	
550	9,560	
552	10,000	(Summer pool)
554	10,460	
556	10,920	
558	11,420	
560	11,900	
562	12,380	
564	12,840	
566	13,320	
568	13,800	
570	14,300	
572	14,800	

Table 2. Checklist of Kentucky fishes captured in Barren River Lake during the drawdown study from 1968 through 1981.

LEPISOSTEIDAE - Gars	
Lepisosteus osseus (Linnaeus)	longnose gar
CLUPEIDAE - Herrings	
Dorosoma cepedianum (Lesueur)	gizzard shad
SALMONIDAE - Trouts	
Salmo gairdneri Richardson	rainbow trout
CYPRINIDAE - Minnows and Carps	
Carassius auratus (Linnaeus)	goldfish
Cyprinus carpio Linnaeus	carp
CASTOMIDAE - Suckers	
Minytrema melanops (Rafinesque)	spotted sucker
Moxostoma carinatum (Cope)	river redhorse
Moxostoma duquesnei (Leseur)	black redhorse
Moxostoma erythrurum (Rafinesque)	golden redhorse
Moxostoma macrolepidotum (Leseur)	shorthead redhorse
ICTALURIDAE - Bullhead catfishes	
Ictalurus melas (Rafinesque)	black bullhead
Ictalurus natalis (Lesueur)	yellow bullhead
Ictalurus punctatus (Rafinesque)	channel catfish
Pylodictis olivaris (Rafinesque)	flathead catfish
PERCICHTYIDAE - Temperate basses	
Morone chrysops (Rafinesque)	white bass
Morone saxatilis (Walbaum)	striped bass
Morone sp.	hybrid striped bass
CENTRARCHIDAE - Sunfishes	
Lepomis cyanellus Rafinesque	green sunfish
Lepomis gulosus (Cuvier)	warmouth
Lepomis macrochirus Rafinesque	bluegill
Lepomis megalotis (Rafinesque)	longear sunfish
Micropterus dolomieui Lacepède	smallmouth bass
Micropterus punctulatus (Rafinesque)	spotted bass
Micropterus salmoides (Lacepède)	largemouth bass
Pomoxis annularis Rafinesque	white crappie
Pomoxis nigromaculatus (Lesueur)	black crappie
PERCIDAE - Perches	
Stizostedion vitreum vitreum (Mitchill)	walleye

Table 3. Barren River Lake water level fluctuations above and below summer pool of 552 ft msl during 01 August through 31 October 1968 through 1981.

Year	Aug 01	Aug 15	Sept 01	Sept 15	Oct 01	Oct 15	Oct 31	Fluctuation (ft/msl)	Fluctuation during Aug 01-Oct 15 (ft)
1968	0+	0+	1-	1-	1-	2-	9-	552-543	2
1969	7+	0+	0+	0-	1-	2-	9-	559-543	9
1970	1+	1+	1+	2+	0-	2-	5-	553-547	4
1971	2+	3+	0	0	0	2-	7-	555-545	5
1972	1+	0	0	0	1-	2-	9-	553-543	3
1973	0	0	0	1-	2-	3-	8-	552-544	3
1974	0-	0	2+	11+	7+	0	10-	563-542	11
1975	0	0	0	0	1-	3-	2-	552-549	3
1976	2-	2-	2-	6-	14-	13-	13-	550-538	12
1977	1-	1-	1-	0	1-	1-	7-	552-546	1
1978	0+	2+	1+	0+	0+	0+	6-	554-546	2
1979	2+	0+	2+	9+	19+	14+	10+	571-552	19
1980	0+	0+	0+	0-	1-	2-	8-	552-544	2
1981	1+	1+	1+	1+	0+	1-	7-	553-545	2

Table 4. Electrofishing results (fish no.) during water level fluctuations during approximately 15 day periods. Samples were taken during 15 August through 15 October 1974 through 1981.

	Water level fluctuations (ft)						
	>+2	+2	+1	0	-1	-2	>-2
Black bass	32	54	61	38	66	82	53
White bass	0	0	11	3	22	12	2
Crappie	2	12	9	14	22	40	6
Sunfish	8	58	15	53	67	85	32
Catfish	2	12	0	12	9	0	4
Suckers	2	8	15	7	14	34	5
Total	46	144	112	133	205	265	110

Table 5. Mean fall creel-survey data in relation to different water-level fluctuations at Barren River Lake.

Fluctuation (ft)	Fishing trips	Man-hours	Number of fish	Weight (lb)	Fish per hour	Hours fished
0-3	21,422	77,599	69,444	29,256	0.89	3.6
4-8	17,728	47,164	52,532	28,724	1.11	2.7
9-20	18,368	54,943	42,981	19,551	0.78	3.0

Table 6. Mean sportfish harvest (no.) and fish per hour (in parentheses) in the fall at Barren River Lake during different water level fluctuations.

Fluctuation (ft)	Black bass	Crappie	Sunfish	White bass	Catfish	Carp
0-3	5,816 (0.07)	48,591 (0.63)	7,954 (0.10)	6,052 (0.08)	822 (0.01)	203 (t)
4-8	14,412 (0.31)	14,519 (0.31)	18,814 (0.40)	3,380 (0.07)	215 (t)	1,193 (0.03)
9-20	7,889 (0.14)	21,782 (0.40)	10,864 (0.20)	1,521 (0.03)	753 (0.01)	153 (t)

t <0.005.

Table 7. Mean creel data during the maximum water level recorded during the fall creel-survey period.

Maximum water level (ft msl)	Fishing days	Hours	Number of fish	Weight (lb)	Hours fished per day
Above 554	18,753	53,023	48,304	23,240	2.8
552-554	20,986	81,220	72,079	34,133	3.9
550-552	20,216	52,298	52,634	18,622	2.6
Below 550	17,085	56,910	34,776	10,318	3.3

Table 8. Sportfish harvest (no.) at Barren River Lake during the maximum water level recorded during the survey period.

Water level (ft msl)	Black bass	Crappie	Sunfish	White bass	Catfish	Carp
Above 554	9,760	21,545	14,339	1,424	648	574
552-554	8,513	46,142	8,592	7,995	557	277
550-552	4,967	36,253	8,473	1,534	1,239	156
Below 550	3,732	18,318	11,547	424	518	223