

Kentucky Fisheries Bulletin No. 29

Bernard Carter, Director

SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF BULLOCK PEN LAKE

Department of Fish and Wildlife Resources

Minor Clark, Commissioner

SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL
CHARACTERISTICS OF BULLOCK PEN LAKE

By

Peter W. Pfeiffer
Senior Fishery Biologist

This Project Was Financed Partially With Federal Aid in Fish Restoration Funds

Kentucky Project F-14-R

1967

ABSTRACT

Physical, chemical, and biological studies were conducted on Bullock Pen Lake from 1958 through 1962.

A bathymetric map of the lake is presented. Other physical data are given which include surface area, shoreline mileage, volume, and mean and maximum depth. Mean monthly temperature profiles are presented. Stratification was evident by mid-May, at which time the thermocline was located between 6 and 19 feet. Autumnal mixing was completed by November when a near homothermic condition was found.

Mean monthly dissolved oxygen profiles show this characteristic to be present in adequate amounts (for fish survival) to a depth of 10 feet during all sampling periods. It became void in the lower depths during June, July, and August. Ranges for alkalinity, total phosphates, pH, and free carbon dioxide are given.

*Aquatic vegetation studies showed that dense beds of the curly pondweed, *Potamogeton crispus* L., were produced and covered 17% of the lake in 1960.*

Population studies indicated an excellent fish population. The average standing crop increased from 115.8 pounds per acre in 1958 to 193.4 pounds per acre in 1962. Ample reproduction of both forage and piscivorous species was noted each year with a very heavy spawn of white crappie occurring in 1958. The channel catfishes reached harvestable size in 1961, five years after the initial stocking.

The creel survey studies showed a decreasing harvest from 1958 to 1961, however, in 1962 the harvest increased 50% over that recorded in the first year. The channel catfish harvest was excellent with increased quality and quantity being recorded each year. Other species generally reflected the strength of their year classes.

Introduction

Bullock Pen Lake is a 142-acre impoundment located in the extreme northern part of Grant County in the Bluegrass Physiographic Region of the state. It was built in 1953 and opened to public fishing in the fall of 1955. This report includes the results of the studies conducted on the lake from 1958 through 1962. The physical and chemical studies were conducted during 1958 and 1959, aquatic vegetation studies in 1959 and 1960, fish population studies from 1958 through 1962, and creel survey studies from 1958 through 1962. The stocking record was as follows:

<u>DATE</u>	<u>SPECIES</u>	<u>SIZE</u>	<u>NUMBER</u>
5/18/54	Largemouth bass	Fry	15,000
7/6/54	Bluegill	Adult	1,566
7/29/54	Bluegill	Adult	1,600
5/8/56	White bass	Adult	35
6/6/56	White bass	Adult	27
6/29/56	Channel catfish	2"	3,300
6/31/56	Kentucky bass	1"	17,000
	and Crappie		
7/20/56	Bullfrogs (tadpoles)		3,000
5/14/57	Bass	Fry	7,000
6/27/57	Bass	3"	12,000
10/15/59	Channel catfish	2 - 6"	10,000
12/20/60	Channel catfish	3 - 6"	3,000
11/8/61	Channel catfish	3 - 4"	1,000
10/11/62	Channel catfish	4"	8,000
10/17/63	Channel catfish	Fingerling	5,000
8/28/64	Channel catfish	3 - 4"	7,100
4/7/65	White bass	Adult	200
8/16/65	Channel catfish	6 - 8"	1,100

METHODS

Physical

The basic outline of the bathymetric map, presented in Figure 1, was made from an aerial photograph provided by the U.S.D.A. The depths and contour intervals were determined using a Raytheon echo sounder.

Temperature profiles were recorded monthly with a Whitney underwater thermometer, near the dam, at the point of greatest depth. Temperatures were taken in one-foot decrements and recorded at every 0.5° F. change.

Chemical

Dissolved oxygen profiles were determined monthly using the modified Winkler method. Samples for this characteristic were collected every 5 feet to a depth of 20 feet, and then every 10 feet to the bottom.

Total alkalinity, pH, free carbon dioxide, and total phosphate determinations were made from monthly samples collected as described above. All sampling was done near the dam at the point of greatest depth. The amount of free CO₂ present was determined by nomograph using known quantities of pH

and alkalinity. The values presented in this report are an average of the results obtained from samples collected at the surface, middle, and near-bottom.

Soil samples were taken from the watershed with a soil auger which sampled to a depth of six inches. These samples were taken in proportion to the amount of specific types of soils present in the watershed. Analyses of these samples were made by the University of Kentucky Soils Laboratory.

Biological

Population studies were conducted each year in pre-selected cove areas. These areas were measured to the nearest tenth of an acre by the plane table method. At approximately 7:00 a.m., a block net measuring 300' x 20' x 1" (bar measure) was placed across the mouth of the cove to be sampled. Emulsifiable rotenone (Chem-Fish Regular) was applied with a venturi-type bailer at the rate of 1 ppm (0.05 ppm actual rotenone). All fish that surfaced in the sample area within 60 hours were picked up, sorted to species, counted, measured to the nearest inch, and weighed.

A creel survey was conducted each year during the seven-month period from April through October. The survey was taken during pre-selected two-hour periods between 7:00 a.m. and 7:00 p.m. Each week, one weekday and one weekend day were sampled. The days and time periods sampled were rotated each week until the total time surveyed amounted to 58 days and included 2-hour periods for 6 Mondays, 6 Tuesdays, 6 Wednesdays, 6 Thursdays, 6 Fridays, 14 Saturdays and 14 Sundays. A conservation officer conducted the survey. At the beginning of each survey period the officer boated completely around the lake and made a total count of all fishermen. After making the count he began interviewing fishing parties (a fishing party consists of one or more fishermen), trying first to contact two parties who had completed their trips for the day. After making or failing to make these contacts,

the officer moved around the lake interviewing fishing parties until he had boated completely around the lake, making sure that he stayed within the two-hour period. The survey was then complete for that day.

To insure that interviews were taken in all areas of the lake, the officer, after making the total count, began interviewing at the dam, moving one day to the left and the next to the right. The third and fourth days after making the count, he began interviewing at the farthestmost point from the dam moving one day to the left and the next to the right. The fifth and sixth days he returned to the dam and repeated the procedure.

The data from the parties who were interviewed were projected to determine fishing pressure, catch, fishing methods, sex ratio, and numbers of resident and non-resident fishermen.

Aquatic vegetation studies were conducted to determine the location, extent, and density of all wholly aquatic vegetation and all obnoxious shoreline vegetation. The aquatic plant beds were located and measured. A Peterson dredge was used to take a random number of samples from each bed. These samples, which were approximately one foot square, were washed, weighed, and the number of stems counted. After ten of these samples had been so processed (to establish the average number of stems per pound) the remaining samples were washed and weighed only. These data were then projected to determine the number of stems for the entire weed bed.

Physical Characteristics

A bathymetric map of Bullock Pen Lake is presented in Figure 1. The lake has a maximum depth of 48.0 feet, a mean depth of 21.3 feet, 11.4 miles of shoreline, and a total volume of 3026 acre feet. Table 1 gives the volume in gallons and cubic feet and the percent volume for each five-foot contour.

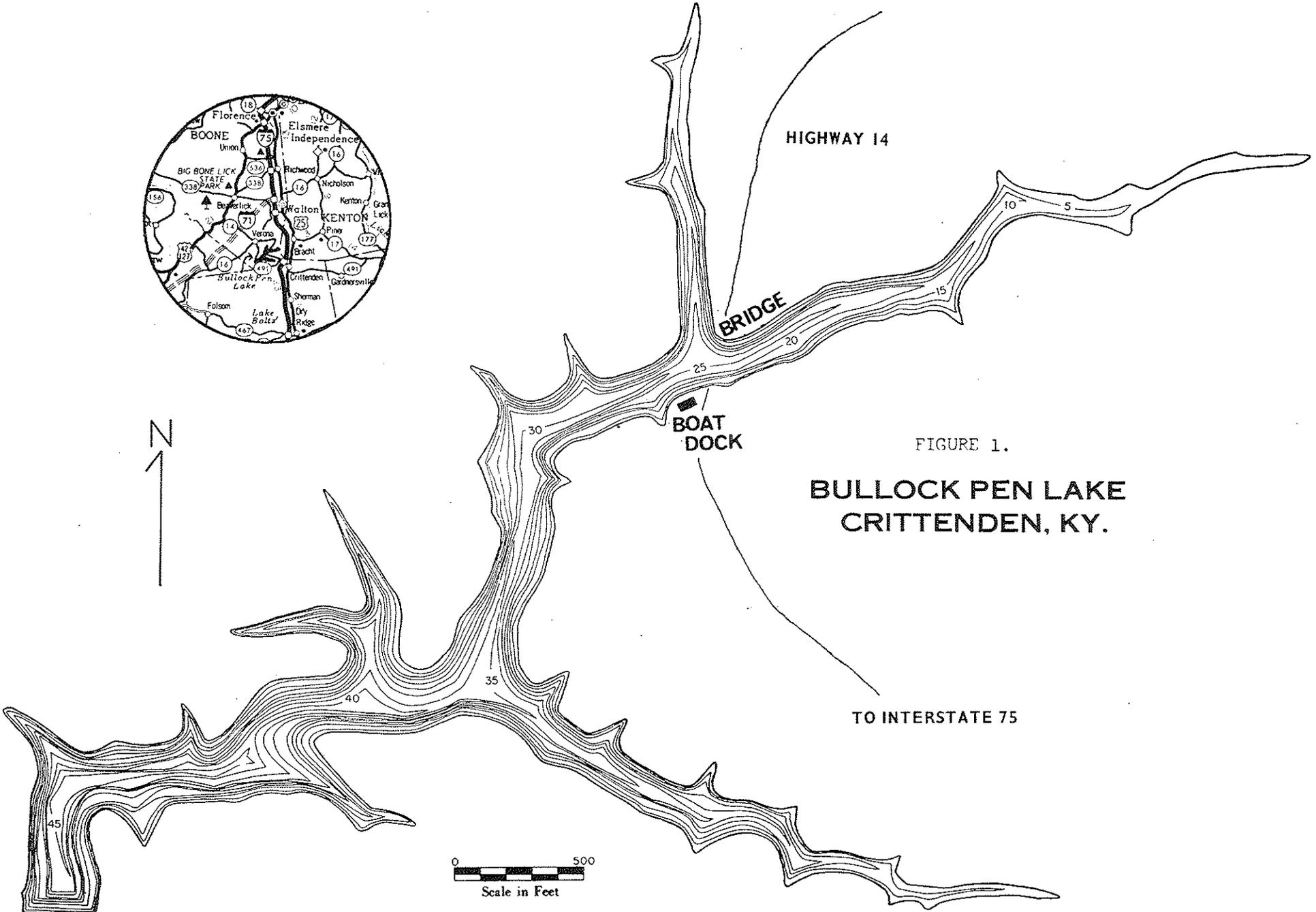
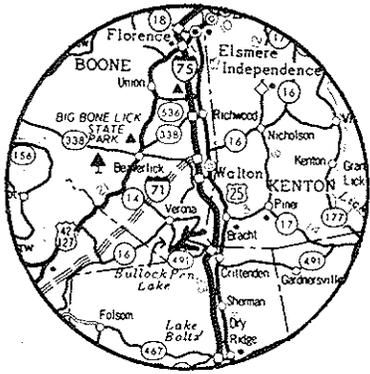


FIGURE 1.

**BULLOCK PEN LAKE
CRITTENDEN, KY.**



Table 1. Percent volume of Bullock Fen Lake for each five-foot contour in gallons and cubic feet.

	Volume		Percent volume
	Gallons	Cubic feet	
0 - 5'	247,976,033	33,151,876	25.3
5' - 10'	202,548,855	27,078,724	20.5
10' - 15'	162,860,566	21,772,803	16.5
15' - 20'	129,637,630	17,331,234	13.2
20' - 25'	98,245,813	13,134,467	9.9
25' - 30'	68,132,529	9,108,627	6.9
30' - 35'	41,934,929	5,606,274	4.3
35' - 40'	23,524,996	3,145,053	2.4
40' - 45'	9,829,871	1,314,154	0.9
45' - 48'	1,184,540	158,361	0.1

Temperature

The values given in Table 2 are a monthly average of temperature taken once a month for five years (1958 through 1962).

Stratification usually became evident during mid-May, at which time the thermocline extended from 6 to 19 feet (Table 2). It maintained this general position until late September, when water temperatures cooled and autumnal circulation occurred. Just prior to fall overturn it was located between 18 and 25 feet. By November the lake was completely mixed, exhibiting a near-homothermic condition. Inverse stratification was recorded in December, however, it is evident that this condition comes and goes with slight temperature changes and is never more than a temporary condition.

Chemical Characteristics

The watershed of Bullock Fen Lake is comprised of pastureland and cultivated fields. An analysis of the soil from the watershed showed it to be moderately acid, very high in available phosphorous, with a moderate amount of available potassium.

Table 2. Mean temperatures and dissolved oxygen concentrations (ppm) for Bullock Pen Lake.

Depth in Feet	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	D.O.--°F											
0	-	-	12.7-42°	11.1-56°	9.3-75°	8.0-76°	10.0-82°	9.1-83°	7.9-72°	5.5-57°	8.1-48°	12.0-38°
5	-	-	12.7-42°	10.9-56°	9.3-74°	7.9-76°	5.0-77°	9.0-80°	7.9-72°	5.1-57°	8.0-48°	11.7-38°
10	-	-	12.6-41°	10.2-54°	7.5-65°	7.9-74°	4.0-75°	6.9-79°	7.8-71°	5.1-57°	8.1-48°	11.7-38°
15	-	-	12.4-41°	7.9-52°	4.5-57°	3.2-63°	0.9-66°	1.5-69°	4.8-68°	5.1-57°	8.2-48°	11.8-38°
20	-	-	11.9-41°	7.9-50°	0.6-53°	0.6-56°	0.0-59°	0.1-59°	0.6-62°	5.0-56°	7.5-48°	11.7-38°
25	-	-	- -40°	- -49°	- -50°	- -53°	- -52°	- -53°	- -55°	- -56°	- -47°	- -38°
30	-	-	11.9-40°	7.2-48°	1.3-49°	0.2-51°	0.0-52°	0.0-52°	0.0-53°	2.3-56°	6.8-47°	11.3-38°
35	-	-	- -40°	- -48°	- -49°	- -40°	- -50°	- -51°	- -52°	- -51°	- -47°	- -38°
40	-	-	11.2-40°	5.8-47°	1.0-48°	0.2-50°	0.0-50°	0.0-50°	0.0-51°	0.9-50°	5.9-47°	10.9-38°
45	-	-	- -40°	- -47°	- -48°	- -48°	- -48°	- -50°	- -51°	- -50°	- -47°	- -39°

Thermocline -----

Oxygen Depletion Zone -----

Oxygen

The mean monthly dissolved oxygen profiles are given in Table 2 with the mean monthly temperature profiles.

Dissolved oxygen was present in adequate amounts for fish survival (more than 3 ppm) to a depth of 10 feet during all sampling periods. During the months of June, July, and August it became inadequate below 10 feet and limited the survival of fish below that depth. Between November and May, (I assume this held true during January and February since there are no data available for these two months), oxygen was present in adequate amounts all the way to the bottom. Mean surface concentrations fluctuated from a high of 12.7 ppm in August to a low of 5.5 ppm in October.

Alkalinity

Total alkalinity expressed as ppm CaCO_3 showed very little month-to-month change during 1958 and 1959. It ranged from a low of 101 ppm during November to a high of 135 ppm during April of 1958 and from a low of 104 ppm in October to a high of 124 ppm in March of 1959.

Phosphates

Mean total phosphate concentrations showed very little month-to-month fluctuation in 1958 and 1959. During 1958 the mean monthly concentration was approximately 0.08 ppm, while during 1959 this dropped to 0.04 ppm. Soil samples from the watershed contained approximately 182 pounds per acre.

pH

The monthly pH value for the lake ranged from 6.8 to 7.4 in 1958 and from 7.1 to 7.7 in 1959. Analysis of the watershed soil samples indicated a pH of 5.9.

Free Carbon Dioxide

Monthly free CO₂ concentrations ranged from 0.0 ppm at the surface, to 102.5 ppm near the bottom in 1958. During 1959 concentrations ranged from 2.1 ppm at the surface to 41.1 near the bottom. Mean concentrations were heaviest during the period from April to October. Concentrations increased with depth during both years.

Biological Characteristics

Aquatic Vegetation Studies

In 1960 the lake supported dense beds of curly pondweed, *Potamogeton crispus* L. Samples of this species were taken on May 25 and 26. The plants were found growing to a depth of five feet. One hundred four samples were taken from a surface area of 1,056,000 square feet, which comprised approximately 17% of the total surface area. An average of 15 stems per square foot of sampled area were found in the lake.

Fish Population Studies

In 1958, the cove population studies conducted in Bullock Pen Lake showed the lake to be in excellent condition. An average standing crop of 115.8 pounds of fish per acre was recovered from the two studies. This weight was composed of 30.5% game fish; 69.1% panfishes; 0.4% commercial; and 0.01% forage fish (Table 3). The population exhibited a F/C ratio of 4.2 and an At value of 58.7. There was a very heavy spawn of white crappie. Ample reproduction of other forage and piscivorous species was also found.

In 1959, an increased average standing crop of 204.4 pounds of fish was recorded, of which game fish comprised 64.8%, food fish 1.8%, panfishes 33.1% and commercial fish 0.36% (Table 4). The shift in the balance between the game fishes and the panfishes resulted from the heavy spawn of white crappie in 1958 which had moved their weight from the fingerling group to the intermediate

group. This good carryover and the resultant heavy concentration of intermediate white crappie increased the F/C ratio to 5.0, but reduced the A_t value to 30.6. Reproduction of the forage species was found to be moderate and the piscivorous species light.

The studies conducted in 1960 yielded a further increased standing crop, of 375.6 pounds of fish per acre. Of this weight, game fish comprised 63.5%, food fish 6.8%, panfishes 28.8%, and commercial fish 0.9% (Table 5). The intermediate white crappie of 1959 still remained in the 5 - 7 inch group, however they had nearly doubled their weight during the year. The channel catfish (food fish) which were stocked in 1956, 1959, and 1960 were represented in all three size groups and were becoming established in the population.

Both the largemouth bass and the bluegill spawned moderately. An F/C ratio of 7.3 and an A_t value of 28.0 were recorded.

In 1961, a decreased standing crop of 203.0 pounds of fish per acre was recorded, of which game fish comprised 31.6%, food fish 18.2%, panfishes 49.1%, and commercial fish 1.2% (Table 6). An F/C ratio of 13.6 was calculated for the population, an increase of 6.4 over 1960. This increased F/C ratio was due mainly to a decrease in the number of largemouth bass (game fish), especially those of harvestable size. It was believed, by the previous project leader, that many of these fish went over the spillway during the unusually heavy rains in the spring.

Although the numbers of harvestable size bass decreased, the numbers of harvestable size crappie increased. (The intermediate crappie of 1959 and 1960 had finally moved into the harvestable size group.) Therefore the A_t value (33.0) remained about the same as in 1960. The largemouth bass reproduction more than doubled the 1960 spawn. It was the opinion in 1960 that the channel catfish were becoming established as a harvestable species in

Table 3. Average weight and number of fish per acre taken from Bullock Pen Lake during 1958 (2 studies).

SPECIES	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE			TOTAL		% OF TOTAL	
	Range	No.	Wt.	Range	No.	Wt.	Min. in.	No.	Wt.	No.	Wt.	No.	Wt.
<u>GAME FISH</u>													
Largemouth bass	0-4	599	7.68	5-9	18	3.06	10	11	10.93	628	21.67	6.56	18.71
White crappie	0-4	7760	8.16	5-7	27	3.50	8	8	1.93	7795	13.59	81.41	11.74
TOTAL		8359	15.84		45	6.56		19	12.86	8423	35.26	87.97	30.45
<u>PANFISHES</u>													
Bluegill	0-2	299	1.60	3-5	416	21.90	6	367	55.19	1082	78.69	11.29	67.96
Green sunfish	0-2	34	0.29	3-5	21	0.82	6	-	-	55	1.11	0.57	0.96
Longear sunfish	0-2	6	0.07	3-5	5	0.17	6	-	-	11	0.24	0.12	0.21
TOTAL		339	1.96		442	22.89		367	55.19	1148	80.04	11.98	69.13
<u>COMMERCIAL FISH</u>													
Bullhead	0-4	1	0.04	5-8	1	0.44	9	-	-	2	0.48	0.03	0.41
TOTAL		1	0.04		1	0.44		-	-	2	0.48	0.03	0.41
<u>ABOVE FORAGE SIZE</u>													
<u>FORAGE FISH</u>													
Fathead minnow	0-3	2	0.01	4-7	-	-	8	-	-	2	0.01	0.02	0.01
TOTAL		2	0.01		-	-		-	-	2	0.01	0.02	0.01
GRAND TOTAL		8701	17.85		488	29.89		386	68.05	9575	115.79	100.00	100.00
% OF TOTAL		90.87	15.42		5.09	25.81		4.04	58.77	100.00	100.00		

Table 4. Average weight and number of fish per acre taken from Bullock Pen Lake during 1959 (2 studies).

SPECIES	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE			TOTAL		% OF TOTAL	
	Range	No.	Wt.	Range	No.	Wt.	Min. in.	No.	Wt.	No.	Wt.	No.	Wt.
<u>GAME FISH</u>													
Largemouth bass	0-4	19	0.14	5-9	81	7.52	10	13	22.11	113	29.77	3.63	14.56
White bass	0-4	-	-	5-8	2	1.17	9	4	1.82	6	2.99	0.19	1.46
White crappie	0-4	7	0.23	5-7	1624	96.65	8	8	2.71	1639	99.59	52.48	48.73
TOTAL		26	0.37		1707	105.34		25	26.64	1758	132.35	56.30	64.75
<u>FOOD FISH</u>													
Channel catfish	0-4	-	-	5-9	-	-	10	1	3.67	1	3.67	0.02	1.80
TOTAL		-	-		-	-		1	3.67	1	3.67	0.02	1.80
<u>PANFISHES</u>													
Bluegill	0-2	437	1.31	3-5	613	32.11	6	209	31.21	1259	64.63	40.31	31.61
Green sunfish	0-2	14	0.11	3-5	80	2.69	6	1	0.12	95	2.92	3.03	1.47
Redear sunfish	0-2	-	-	3-5	-	-	6	1	0.09	1	0.09	0.02	0.01
TOTAL		451	1.42		693	34.80		211	31.42	1355	67.64	43.36	33.09
<u>COMMERCIAL FISH</u>													
Bullhead	0-4	5	0.06	5-8	5	0.69	9	-	-	10	0.75	0.32	0.36
TOTAL		5	0.06		5	0.69		-	-	10	0.75	0.32	0.36
GRAND TOTAL		482	1.85		2405	140.83		237	61.73	3124	204.41	100.00	100.00
% OF TOTAL		15.41	0.91		77.03	68.89		7.56	30.20	100.00	100.00		

Table 5. Average weight and number of fish per acre taken from Bullock Pen Lake during 1960 (2 studies).

SPECIES	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE			TOTAL		% OF TOTAL	
	Range	No.	Wt.	Range	No.	Wt.	Min. in.	No.	Wt.	No.	Wt.	No.	Wt.
<u>GAME FISH</u>													
White bass	0-4	-	-	5-8	-	-	9	4	3.80	4	3.80	0.08	1.01
Largemouth bass	0-4	170	0.59	5-9	66	8.50	10	21	33.30	257	42.39	4.59	11.29
White crappie	0-4	9	0.03	5-7	2029	192.14	8	-	-	2038	192.17	36.43	51.16
TOTAL		179	0.62		2095	200.64		25	37.10	2299	238.36	41.10	63.46
<u>FOOD FISH</u>													
Channel catfish	0-4	1	0.02	5-9	132	18.13	10	20	7.43	153	25.58	2.74	6.81
TOTAL		1	0.02		132	18.13		20	7.43	153	25.58	2.74	6.81
<u>PANFISHES</u>													
Bluegill	0-2	1434	7.69	3-5	1084	47.10	6	256	41.57	2774	96.36	49.59	25.66
Green sunfish	0-2	129	1.11	3-5	195	7.99	6	6	0.81	330	9.91	5.90	2.64
Redear sunfish	0-2	-	-	3-5	-	-	6	6	1.98	6	1.98	0.11	0.52
TOTAL		1563	8.80		1279	55.09		268	44.36	3110	108.25	55.60	28.82
<u>COMMERCIAL FISH</u>													
White sucker	0-4	-	-	5-11	-	-	12	1	1.02	1	1.02	0.01	0.28
Bullhead	0-4	19	0.36	5-8	12	2.02	9	-	-	31	2.38	0.55	0.63
TOTAL		19	0.36		12	2.02		1	1.02	32	3.40	0.56	0.91
GRAND TOTAL		1762	9.80		3518	275.88		314	89.91	5594	375.59	100.00	100.00
% OF TOTAL		31.50	2.61		62.89	73.45		5.61	23.94	100.00	100.00		

Table 6. Average weight and number of fish per acre taken from Bullock Pen Lake during 1961 (2 studies).

SPECIES	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE			TOTAL		% OF TOTAL	
	Range	No.	Wt.	Range	No.	Wt.	Min. in.	No.	Wt.	No.	Wt.	No.	Wt.
<u>GAME FISH</u>													
Largemouth bass	0-4	47	0.38	5-9	30	4.08	10	8	9.84	85	14.30	1.34	7.03
White crappie	0-4	5	0.02	5-7	236	33.11	8	88	16.70	329	49.83	5.17	24.55
TOTAL		52	0.40		266	37.19		96	26.54	414	64.13	6.51	31.58
<u>FOOD FISH</u>													
Channel catfish	0-4	1	0.05	5-9	1	0.06	10	54	36.78	56	36.89	0.88	18.17
TOTAL		1	0.05		1	0.06		54	36.78	56	36.89	0.88	18.17
<u>PANFISHES</u>													
Bluegill	0-2	3344	10.88	3-5	2236	62.28	6	112	17.50	5692	90.66	89.44	44.66
Green sunfish	0-2	34	0.19	3-5	107	3.50	6	4	0.57	145	4.26	2.28	2.10
Longear sunfish	0-2	-	-	3-5	1	0.06	6	-	-	1	0.06	0.01	0.03
Redear sunfish	0-2	-	-	3-5	18	1.35	6	19	3.26	37	4.61	0.59	2.27
TOTAL		3378	11.07		2362	67.19		135	21.33	5875	99.59	92.32	49.06
<u>COMMERCIAL FISH</u>													
White sucker	0-4	-	-	5-11	-	-	12	1	0.72	1	0.72	0.01	0.35
Bullhead	0-4	7	0.14	5-8	9	0.96	9	1	0.56	17	1.66	0.27	0.82
TOTAL		7	0.14		9	0.96		2	1.28	18	2.38	0.28	1.17
<u>ABOVE FORAGE SIZE</u>													
<u>FORAGE FISH</u>													
Misc. cyprinids	0-3	-	-	4-7	1	0.02	8	-	-	1	0.02	0.01	0.02
TOTAL		-	-		1	0.02		-	-	1	0.02	0.01	0.02
GRAND TOTAL		3438	11.66		2639	105.42		287	85.93	6364	203.01	100.00	100.00
% OF TOTAL		54.02	5.74		41.47	51.93		4.51	42.33	100.00	100.00		

Table 7. Average weight and number of fish per acre taken from Bullock Pen Lake during 1962 (2 studies).

SPECIES	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE			TOTAL		% OF TOTAL	
	Range	No.	Wt.	Range	No.	Wt.	Min. in.	No.	Wt.	No.	Wt.	No.	Wt.
<u>GAME FISH</u>													
Largemouth bass	0-4	314	1.92	5-9	38	5.68	10	10	13.98	362	21.58	9.52	11.16
White crappie	0-4	31	0.16	5-7	94	7.46	8	84	19.88	209	27.50	5.50	14.22
TOTAL		345	2.08		132	13.14		94	33.86	571	49.08	15.02	25.38
<u>FOOD FISH</u>													
Channel catfish	0-4	2	0.05	5-9	33	1.21	10	25	41.51	60	42.77	1.58	22.11
TOTAL		2	0.05		33	1.21		25	41.51	60	42.77	1.58	22.11
<u>PANFISHES</u>													
Bluegill	0-2	1561	7.69	3-5	1195	46.75	6	185	30.01	2941	84.45	77.37	43.66
Green sunfish	0-2	25	0.21	3-5	111	3.60	6	2	0.36	138	4.17	3.63	2.16
Redear sunfish	0-2	-	-	3-5	22	1.48	6	16	3.67	38	5.15	1.00	2.66
TOTAL		1586	7.90		1328	51.83		203	34.04	3117	93.77	82.00	48.48
<u>COMMERCIAL FISH</u>													
White sucker	0-4	-	-	5-11	1	0.06	12	5	5.29	6	5.35	0.15	2.77
Bullhead	0-4	33	0.14	5-8	12	1.15	9	2	1.15	47	2.44	1.25	1.26
TOTAL		33	0.14		13	1.21		7	6.44	53	7.79	1.40	4.03
GRAND TOTAL		1966	10.17		1506	67.39		329	115.85	3801	193.41	100.00	100.00
% OF TOTAL		51.72	5.26		39.62	34.84		8.66	59.90	100.00	100.00		

the population. This was further substantiated by a 42% increase in their standing crop in 1961.

The studies conducted in 1962 (final year of work on Bullock Pen) indicated a standing crop of 193.4 pounds of fish per acre which was almost identical to that recorded in 1961. This weight was composed of 25.4% game fish, 22.1% food fish, 48.5% panfishes, and 4.0% commercial fish (Table 7). The F/C ratio dropped from 13.6 in 1961 to 4.2 in 1962. This lowered ratio was due to an increase in the weight of harvestable largemouth bass and white crappie. It also helped raise the A_t value from 37.0 to 51.8.

Reproduction for both the piscivorous and forage species was moderate. The channel catfish population remained in approximately the same proportion as recorded in 1961 at 43.0 pounds per acre.

Creel Survey Studies

During the first year of study (1958) a harvest of 110.6 pounds (507 fish) per acre was cropped from Bullock Pen Lake (Table 8). Fishermen were successful in harvesting fish at the rate of 1.7 fish per hour or 4.7 fish per trip. Sunfish (bluegill, green sunfish, and redear) dominated the creel by accounting for 76% by weight. No channel catfish were harvested in 1958 (Table 9).

There was a total of 17,670 fisherman trips to the lake. Of that number, 87% were still fishermen, while 15% were using the casting method. Ninety-two percent were residents and 79% were males.

During the seven-month survey in 1959 fish were harvested at the rate of 1.1 fish per hour or 3.1 fish per trip (Table 8). The total harvest for 1959 was 89.9 pounds per surface acre (Table 9). This represents a decrease of approximately 11 pounds per acre from the 1958 catch. The quality of the fish harvested increased, however, as each fish caught averaged one-third heavier in 1959 and the channel catfish entered into the creel for the first time.

Although the total number of fisherman trips decreased by approximately 3000 trips in 1959, the fishing methods used, resident to non-resident fisherman, and sex ratio remained in about the same proportion as recorded in 1958 (Table 10).

During the 1960 survey period anglers harvested 3.6 fish per hour (0.6 pounds) or 7.3 fish per trip (1.2 pounds). A total of 64.3 pounds of fish per acre was harvested. This represents a 25 pound per acre decrease in the harvest under 1959 (Table 9). Concurrently, there was a decrease in the fishing pressure by 140 hours per acre. Therefore, a smaller number of fishermen caught fewer fish than in 1959, but the number of fish caught by each fisherman was higher (approximately 4.2 more fish per trip in 1960), Table 8.

The strong year class of intermediate white crappie (Tables 4 and 5) began entering the fisherman's creel in 1960. Approximately three times as many of these fish were caught in 1960 as in 1959. The channel catfish also showed up in larger numbers.

There was a 17% increase in the use of bait casting in 1960. The other categories remained in approximately the same proportion as recorded in 1959 (Table 10).

A further decrease in the fishing pressure was noted in 1961. Approximately 100 hours of fishing pressure per acre were exerted on Bullock Pen in 1961. This was a decrease of 108 hours per acre under 1960 (Table 8). There was also a further decrease in the harvest (pounds) and an increase in the numbers of fish, thus the quality of the fishery was lower.

The only encouraging information revealed by the creel survey in 1961 was the increase in quality of the channel catfishes. Seventeen channel catfish were caught per acre and these fish averaged almost one pound apiece (Table 9).

There was a slight increase in non-resident fishermen at Bullock Pen Lake in 1961 (6%), but the other categories remained in approximately the same proportions as recorded previously (Table 10).

During the survey period in 1962 (final year of study) a total of 148.4 pounds (54.5 fish) of fish was harvested from the lake. This was 88 pounds per acre more than in 1961. There were increases in all species taken, however there were approximately twice as many white crappie harvested and they weighed more than two times as much as those harvested in 1961. There was also further improvement in the quality of the channel catfishes caught and each fish averaged 1.5 pounds.

Fishermen exerted an increased pressure of 256 hours per acre and harvested fish at the rate of 2.0 fish per hour (0.54 pounds) or 8.0 fish per trip (2.2 pounds), Table 8. There was a 13% reduction in the number of bait casters. The rest of the categories remained in the same proportions (Table 10).

ACKNOWLEDGEMENTS

I would like to express my gratitude to John F. Hall (former Assistant Director, Division of Fisheries) who headed the State-owned Lakes Investigations project from its inception in 1958 to 1963 when the present author assumed these duties. Special thanks are extended to Luther R. Renaker, Billy F. Ellis, and Jim R. Ruark, Jr., my full time assistants and Richard C. Pfeiffer, my summer assistant, for their excellent work in all phases of the project. I would also like to thank Mrs. Patsy Peavler for typing the manuscript.

I am grateful to Bernard T. Carter, Director, Division of Fisheries, who planned this project, designed the field methods and the original creel survey, and assisted with the manuscript. I also appreciate the help given by the staff of fishery biologists who were available at all times for advice

Table 8. Catch statistics from Bullock Pen Lake for 1958 - 1962.

Year surveyed	Acres	Avg. no. fisherman hrs./acre	Avg. no. fisherman trips/acre	Avg. no. fish/hour	Avg. wt. fish/hour	Avg. no. fish/trip	Avg. wt. fish/trip
1958	142	424	106	1.7	-	4.7	-
1959	142	348	87	1.1	-	3.1	-
1960	142	208	52	3.6	0.60	7.3	1.21
1961	142	100	25	3.0	0.60	11.9	2.40
1962	142	256	64	2.0	0.54	8.0	2.16

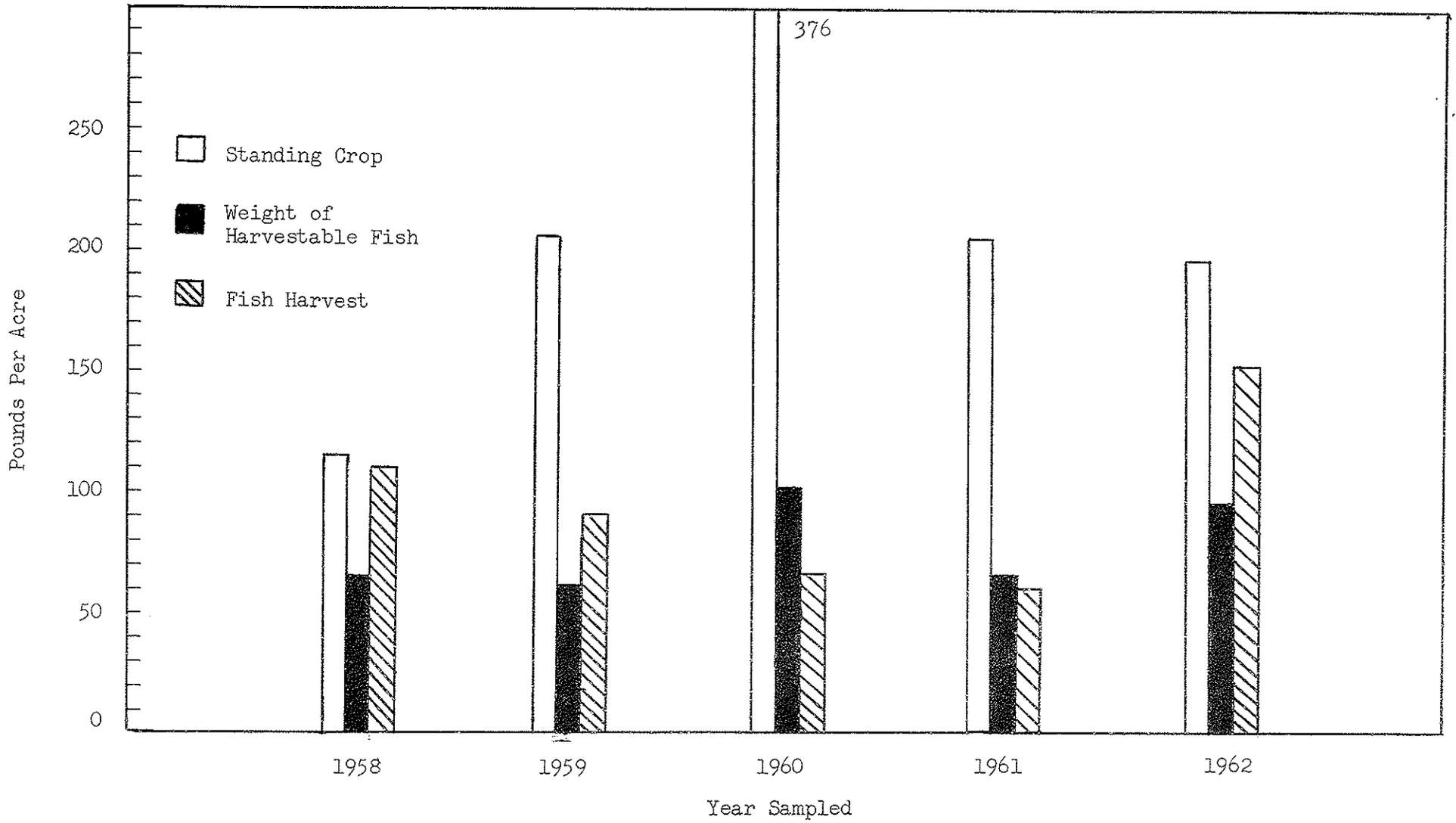
Table 9. Average catch per surface acre at Bullock Pen Lake 1958 - 1962.

Year surveyed	Acres	Largemouth bass		Sunfish		Crappie		Channel catfish		Totals	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
1958	142	33	15.8	449	84.2	25	10.4	-	-	507	110.6
1959	142	33	21.1	193	55.9	42	12.6	2	0.3	270	89.9
1960	142	14	22.4	216	25.9	134	13.4	14	1.7	379	64.3
1961	142	6	9.2	158	19.0	119	15.5	17	16.0	301	59.8
1962	142	10	18.4	297	35.9	222	68.8	15	24.8	545	148.4

Table 10. Creel survey statistics, Bullock Pen Lake, 1958 - 1962.

Year surveyed	Total no. fisherman trips	No. still fishing	% of total	No. casting	% of total	No. residents	% of total	No. non-residents	% of total	No. males	% of total	No. females	% of total
1958	17,670	15,338	87	2,332	13	16,310	92	1,360	8	13,917	79	3,753	21
1959	14,684	13,432	91	1,252	9	13,120	89	1,564	11	11,660	79	3,024	21
1960	7,394	5,483	74	1,911	26	6,455	87	939	13	6,024	84	1,190	16
1961	3,590	2,862	80	728	20	2,911	81	679	19	2,833	79	757	21
1962	9,071	8,466	93	605	7	7,960	85	1,381	15	7,181	79	1,890	21

Figure 2. Standing Crop, Weight of Harvestable Fish, and Fish Harvest in Bullock Pen Lake From 1958-1962.



and discussion of the problems that arose during the course of the project. I am grateful to James R. Charles, Principal Fishery Biologist, who also reviewed the manuscript and made many helpful criticisms.

Thanks are also extended to Jim Ruark, Sr., Grant County Conservation Officer, for conducting the creel surveys.