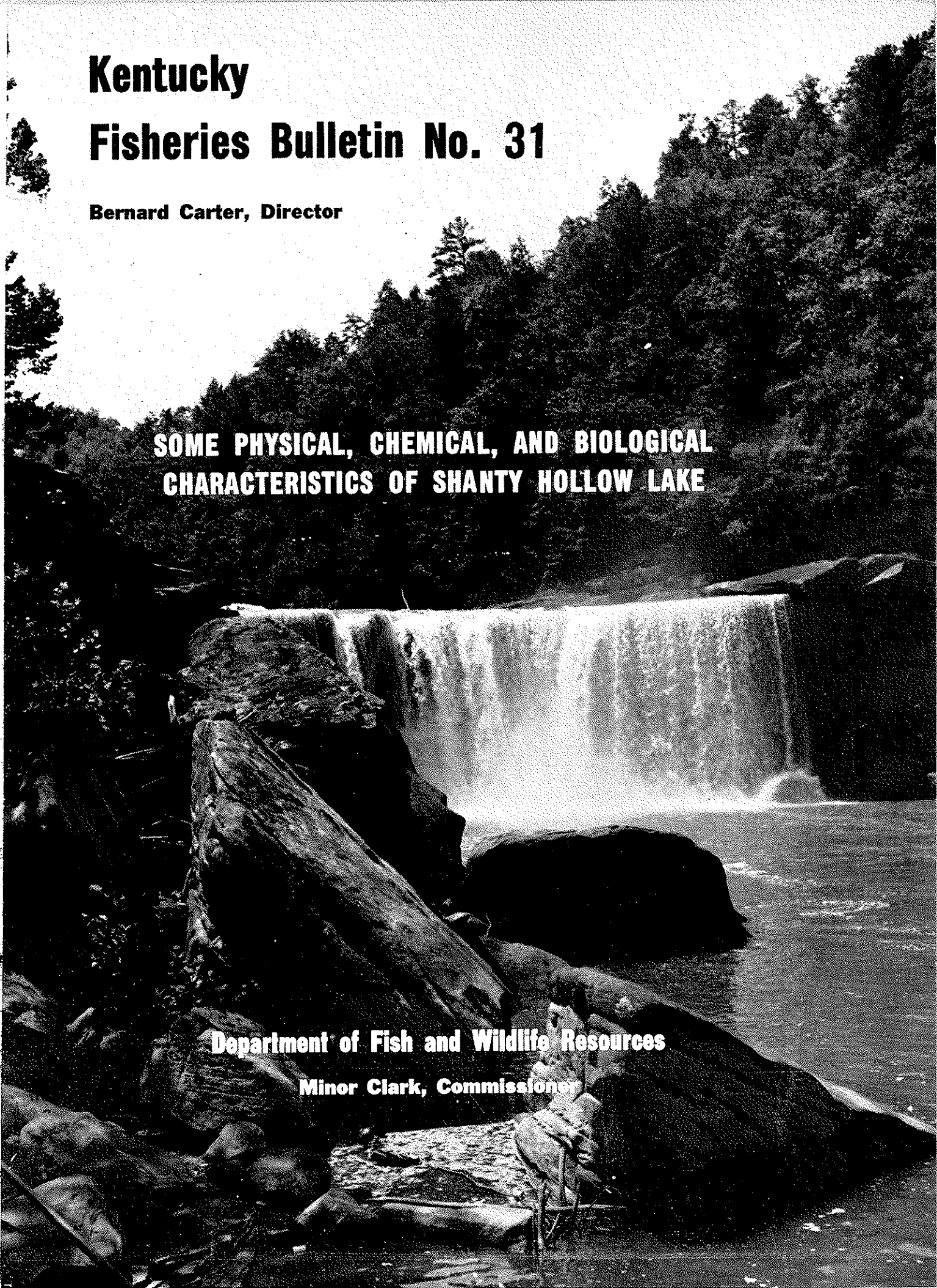
Kentucky Fisheries Bulletin No. 31

Bernard Carter, Director



SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF SHANTY HOLLOW LAKE

Department of Fish and Wildlife Resources

Minor Clark, Commissioner

SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF SHANTY HOLLOW 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

SHANTY HOLLOW LAKE

ABSTRACT

Physical, chemical, and biological studies were conducted at Shanty Hollow Lake from 1958 through 1965.

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 usually evident by the latter part of May, when the thermocline was located between 7 and 11 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 amounts adequate for fish survival (above 5 ppm), to a depth of 10 feet during all sampling periods. It became void in the lower depths during July, August, and September. Annual maximum, mean, and minimum values for total alkalinity, total phosphates, pH, and free carbon dioxide are given.

Population studies indicated a widely fluctuating fish population. The average standing crop varied from 49 pounds per acre in 1959 to 200 pounds per acre in 1961; then it dropped to 67 pounds per acre in 1962 and went back up to 180 pounds per acre in 1965.

The creel survey studies showed an increasing harvest from 1958 to 1964. During 1965 the harvest dropped, however there were approximately three times as many pounds of fish harvested during that year as compared to 1958. From 1961 to 1964 the lake provided some of the best bluegill fishing in Kentucky.

The fertilization studies indicated a substantial increase in the quality and quantity of the fishery during the years (1960 - 1965) when an inorganic fertilizer was applied monthly at the rate of 40 pounds per acre (April - September).

Introduction

Shanty Hollow Lake is a 106-acre impoundment located in Warren County in the Western Coalfield Physiographic Region of the state. It was built by private enterprise in 1951 and opened to fishing the following year. It was purchased by the Kentucky Department of Fish and Wildlife Resources in 1953. This report includes the results of the studies conducted on the lake from 1958 through 1965. The physical and chemical studies were conducted from 1958 through 1963, aquatic vegetation studies during 1958, fish population studies from 1958 through 1964, creel survey studies from 1958 through

1965, and fertilization studies from 1960 through 1964. The stocking record was as follows:

Date	Species	Size	Number
5/7/57	Largemouth bass	Fry	22,000
7/18/57	Largemouth bass	Fingerling	8,500
5/5/58	Walleye	1"	180,000
5/58	Largemouth bass	2"	12,000
6/9/61	Largemouth bass	1"	9,450
11/1/61	Largemouth bass	4 - 5"	3,000
11/15/61	Channel catfish	4"	2,000
10/9/62	Channel catfish	3 - 4"	2,000
4/10/63	Channel catfish	4 - 5"	3,000
8/24/64	Channel catfish	3"	5,350
8/2/65	Channel catfish	6 - 8"	3,200
11/66	Channel catfish	3 - 7"	2,000

Methods

Physical

The basic outline of the bathymetric map, presented in Figure 1, was made from an aerial photograph. The depths and contour intervals were determined using a Raytheon Echo Sounder.

Temperature profiles were recorded with a Whitney 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 CO_2 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.

Three different types of creel surveys were conducted on Shanty Hollow Lake. A two-hour stratified survey was conducted from 1958 through 1965 (excluding 1963). This survey had 2 variations: from 1958 through 1961 the survey had 58 sampling periods, while from 1962 to 1965 it had 49 sampling periods.

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, or 49 days and 7 of each. 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 farthermost 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 interviewed-party data were projected to determine fishing pressure, catch, fishing methods, sex ratio, and numbers of resident and non-resident fishermen.

During 1961, 1962, 1963, and 1964 a complete census was conducted in an attempt to interview every angler visiting the lake. From an analysis of the total fishing pressure data supplied by the complete census and the concurrent two-hour survey, it was determined that approximately 31.3% of the anglers visiting the lake were being missed in the complete survey. As a result this more expensive and less reliable census was dropped in 1965. For that reason the data provided by the complete census will not be presented.

In 1965 a non-uniform probability survey was conducted in conjunction with the two-hour survey to determine if there was a statistically significant difference between the two surveys in terms of fishing pressure (Pfeiffer, 1966).

Shanty Hollow was fertilized each year from 1960 through 1965 with an inorganic fertilizer (20-20-5) at the rate of 40 pounds per acre. Eight

applications were made in the lake each year beginning in April and continuing through September. Double applications were made in April and May. The fertilizer was placed in the lake at three to five different sites (usually on large flat rocks one to three feet under the water). Water temperatures and secchi disc readings were taken once a week by the conservation officer conducting the creel survey. In 1964, the last four applications of 20-20-5 were replaced with triple super phosphate (0-46-0) at the rate of 18 pounds per acre.

Physical Characteristics

A bathymetric map of Shanty Hollow Lake is presented in Figure 1. The lake has a maximum depth of 28.0 feet, a mean depth of 15.6 feet, 4.8 miles of shoreline, and a total volume of 1,652 acre feet. Table 1 gives the volume in gallons and cubic feet, and the percent volume for each five-foot contour.

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

Depth	Volume		Percent Volume
	Gallons	Cubic feet	
0 - 5'	165,166,670	22,078,154	30.7
5' - 10'	141,859,255	18,962,606	26.3
10' - 15'	113,040,012	15,110,281	21.0
15' - 20'	76,364,821	10,207,836	14.2
20' - 25'	33,477,266	4,474,972	6.2
25' - 28'	8,533,809	1,140,731	1.6

Temperature

The values given in Table 2 are a monthly average of temperatures taken once a month for six years (1958-1963). Stratification usually became evident in the latter part of May at which time the thermocline extended from 7 to 11 feet (Table 2). It reached its maximum thickness in July when it extended from 7 to 19 feet. From this point it steadily weakened until early October when it disappeared with the advent of fall

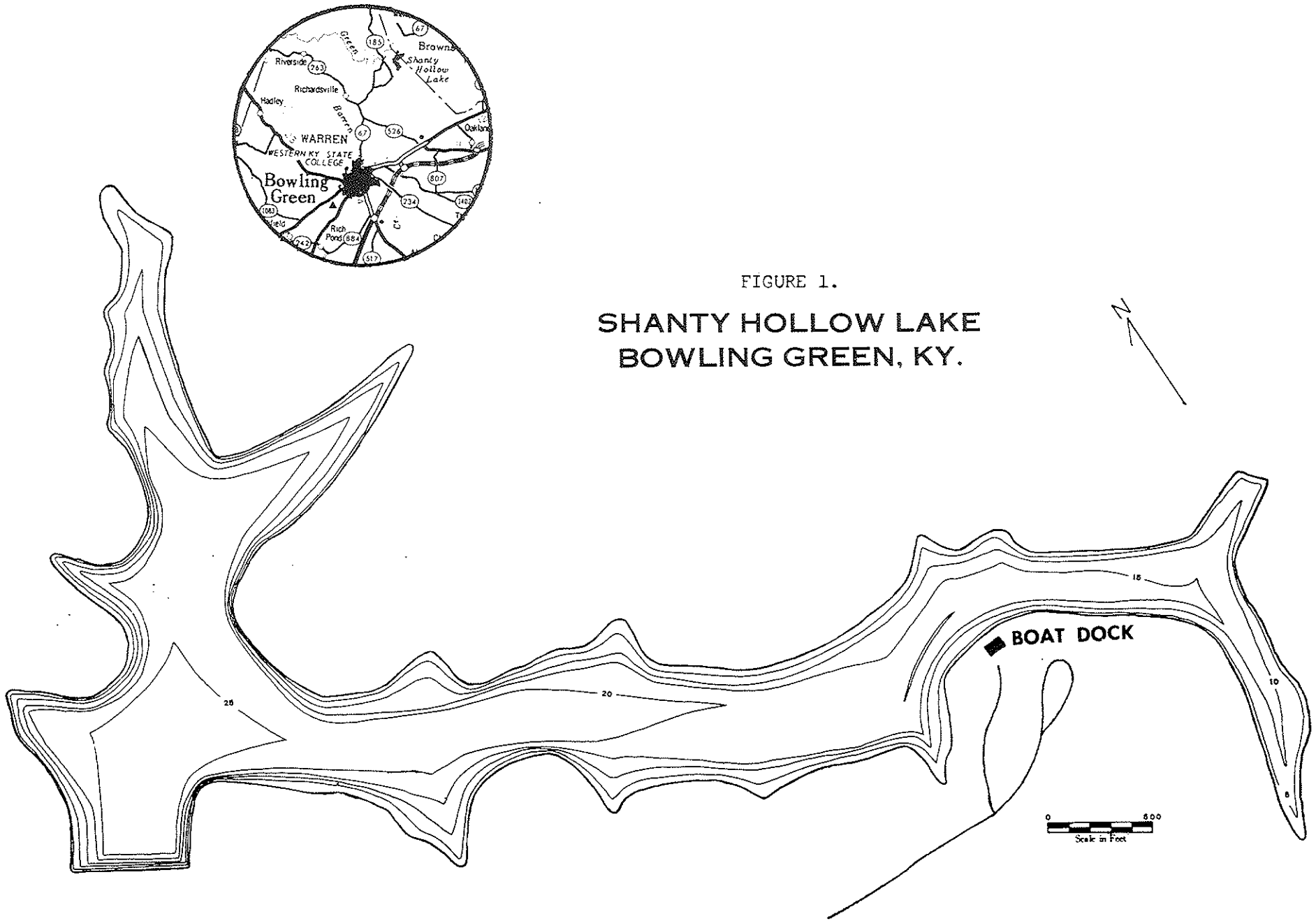


FIGURE 1.

SHANTY HOLLOW LAKE
BOWLING GREEN, KY.

Table 2. Mean temperatures and dissolved oxygen concentrations (ppm) for Shanty Hollow Lake.

Depth in Feet	Jan. D.O.-°F	Feb. D.O.-°F	Mar. D.O.-°F	Apr. D.O.-°F	May D.O.-°F	June D.O.-°F	July D.O.-°F	Aug. D.O.-°F	Sept. D.O.-°F	Oct. D.O.-°F	Nov. D.O.-°F	Dec. D.O.-°F
0	10.7-42°	12.2-45°	10.7-49°	10.0-56°	10.3-71°	9.3-81°	9.6-86°	8.3-86°	7.7-81°	8.8-71°	8.9-53°	10.1-45°
5	10.4-41°	12.2-44°	10.5-49°	9.8-55°	10.0-69°	9.7-81°	8.7-83°	8.3-84°	9.0-80°	8.6-70°	9.0-53°	9.5-44°
10	10.3-41°	12.0-44°	10.4-49°	9.8-54°	10.2-65°	8.8-73°	5.4-77°	5.5-80°	6.1-78°	5.6-68°	8.8-53°	9.8-44°
15	9.6-41°	12.0-43°	10.4-49°	9.8-53°	8.0-59°	5.0-65°	1.8-67°	1.2-67°	2.4-68°	2.3-66°	9.0-52°	9.8-44°
20	9.1-41°	11.2-41°	9.8-48°	7.4-49°	5.9-52°	3.2-53°	0.5-55°	0.6-55°	0.1-55°	0.2-59°	6.9-51°	8.5-44°
25	- -41°	- -42°	- -45°	- -46°	- -48°	- -49°	- -49°	- -50°	- -53°	- -52°	- - -	- - -

Thermocline ----------

Oxygen Depletion Zone ——————

circulation. By November the lake was completely mixed, exhibiting a near-homothermic condition. Inverse stratification was never observed.

Chemical Characteristics

The watershed of Shanty Hollow Lake is comprised of woods, pastures, and cultivated fields. An analysis of the soil from the watershed showed it to be moderately acidic (pH 5.8), with moderate amounts of available phosporous (155 pounds per acre), and a very low amount of available potassium (3 pounds per acre).

Oxygen

The mean monthly oxygen profiles are given in Table 2. Dissolved oxygen was present in amounts above 5 ppm, to a depth of 10 feet, during all sampling. During July, August, and September it became inadequate below 15 feet for fish survival (Table 2). Between November and June, oxygen was present all the way to the bottom. Mean surface concentrations fluctuated from a high of 12.2 ppm in February, to a low of 7.7 ppm in November.

Alkalinity

Total alkalinity, expressed as ppm $CaCo_3$, varied from month to month as high as 40 ppm (1959), Table 3. Mean lake concentrations decreased steadily from 41 ppm in 1958 to 31 ppm in 1963.

Phosphates

Mean total phosphate concentrations fluctuated widely from month to month in Shanty Hollow Lake, Table 3. Mean concentrations for 1961-1963 (years fertilized) increased 47% over the 3 years previous to 1961 when the lake was not fertilized. Mean values ranged from a low of 0.03 ppm in 1959 to a high of 0.37 ppm in 1962. Soil samples from the watershed indicated available phosporous to be present in the amount of 155 pounds per acre.

Table 3. The annual maximum, mean, and minimum values (unless otherwise noted) for alkalinity, total phosphates, pH and free CO_2 in Shanty Hollow Lake from 1958 through 1963. Values for alkalinity, free CO_2, and total phosphates are expressed as ppm.

	1958	1959	1960	1961	1962	1963
Alkalinity	45.0 41.0 37.0	68.0 42.0 28.0	42.0 36.0 29.0	45.0 35.0 24.0	48.0 33.0 20.0	45.0 31.0 21.0
Total phosphates	0.23 0.13 0.06	0.09 0.03 0.00	0.81 0.25 0.00	0.77 0.24 0.00	2.38 0.37 0.03	0.50 0.16 0.01
pH	7.2 - 6.8	7.8 - 5.9	8.1 - 6.9	9.1 - 7.1	- - -	- - -
Free CO_2	22.1 19.3 4.0	123.0 5.0* 1.1	12.0 4.8 1.0	6.5 2.7 0.3	- - -	- - -

* - Mode

pH

The monthly pH values ranged from 5.9 in February of 1960 to 9.1 in July of 1962. Mean annual values ranged from a low of 7.1 in 1958 to a high of 7.7 in 1961 (Table 3). Mean lake concentrations decreased steadily from 1958 through 1961.

Free Carbon Dioxide

Mean monthly free CO_2 concentrations ranged from a low of 1.0 ppm in May of 1960, to an extreme high of 123.0 ppm in February of 1959 (Table 3). Mean lake concentrations decreased steadily from 1958 through 1961.

Biological Characteristics

Aquatic Vegetation Studies

In July of 1958 Shanty Hollow Lake developed an aquatic vegetation problem when a dense growth of the pondweed, *Potamogeton* spp., appeared.

The lake was treated with sodium arsenite at the rate of 5 ppm by the Fish Management Section before it could be sampled by project personnel.

Fish Population Studies

In 1958, the cove population studies conducted in Shanty Hollow Lake showed it to be in good condition. An average standing crop of 101.4 pounds of fish per acre was recovered from the 2 studies. This weight was composed of 15.5% game fish, 84.0% panfishes, 0.5% commercial fish, and 0.1% forage fish, Table 4. The population exhibited an F/C ratio of 6.8, and an A_t value of 57. Ample reproduction of the main non-piscivorous (bluegill) and piscivorous (largemouth bass) species was found.

The studies conducted in 1959 indicated a decrease in the standing crop of 52 pounds per acre. This loss was accounted for by a 46-pound-per-acre reduction of the intermediate- and harvestable-sized panfishes (largely bluegill), Table 5. This drop in the non-piscivorous weight lowered the F/C ratio to 3.9, as compared to 6.8 in 1958. The A_t value of 52, however, remained approximately the same as recorded in 1958. Reproduction of the non-piscivorous species was found to be heavy, and of the piscivorous species, moderate.

In 1960 (the first year of artificial fertilization) a four-fold increase in the standing crop was recorded. It increased from 48.8 pounds per acre in 1959 to 198.1 pounds per acre in 1960. This was due to the extremely heavy spawn of bluegill, and the successful carryover of the 1959 largemouth bass and bluegill fingerlings into the intermediate range, Table 6. An F/C ratio of 4.1 indicated the population to be in good shape. A low A_t value of 21.1 was due mainly to the high reproduction and survival of all species, especially the bluegill, Table 6. Brook silverside were taken in the study areas for the first time.

The 1961 studies indicated a standing crop of 184.3 pounds per acre, which was approximately the same as that recorded in 1960. There were, however, two evident changes in the structure of the population in 1961. First, there was tremendous reduction in the reproduction and survival of all species present, Table 7. This evidently was the result of the suppressive influence of the sheer numbers and weight of the intermediate and harvestable panfishes. Secondly, there was a shift in the weight distribution of the panfishes, and the result was a diminished fingerling group, an unchanged intermediate group, and a much improved harvestable group. This redistribution of the weight was reflected in a 27% increase in the A_t value over that recorded in 1960. The F/C ratio remained approximately the same at 5.1.

In 1962, the third year the lake had been fertilized, a standing crop of 66.7 pounds per acre was recorded, Table 8. This represents a decrease of approximately 131 pounds per acre, or 66% from that recorded in 1960 and in 1961. This loss was accounted for by a decrease in the number and weight of the panfishes. Approximately 150 pounds of panfishes per acre were taken in 1961, contrasted to 28 pounds per acre in 1962. The F/C ratio dropped from 5.1 (1961) to 1.5 as a result of the smaller number of panfishes. The A_t value increased again in 1962 to 67.0. Largemouth bass reproduced moderately, while the forage species spawned heavily.

In 1963, the standing crop increased 22 pounds per acre. This was due to an increase in the number and weight of intermediate-sized bass and sunfishes. This was consequently reflected in a 21% reduction of the A_t value. The reproduction of all species was moderate. Channel catfish, which were stocked initially in the lake in 1961, appeared in the cove sample for the first time, Table 9.

The studies conducted in 1964 produced a standing crop of 187.7 pounds of fish per acre (Table 10). This was an increase of approximately 99 pounds

per acre over 1963 and reflected a 20% increase in the A_t value. Substantial numbers of harvestable-size largemouth bass and bluegill were cropped during 1963. This thinning of the population produced the necessary stimulus, and resulted in a 75% heavier bluegill spawn, and an 85% heavier bass spawn during 1964. Recruitment from the 1963 intermediate size group to the 1964 harvestable size group was successful at 75%, and was reflected by the A_t value of 67. A heavy spawn of brook silverside occurred during the first part of August. It was hoped that this valuable forage species would be able to maintain its numbers and weight in the population.

In 1965, (final year of work on Shanty Hollow), the lake supported a standing crop of 179.5 pounds per acre. This was almost identical to the standing crop recorded in 1964. There was, however, a definite change within the structure of the population. The bluegill population, which in past years had provided some of the best bluegill fishing in Kentucky, was producing another strong year class, Table 11. The growth and survival of its spawn in 1964 carried over well, and increased the intermediate size group by 31 pounds per acre in 1965. The largemouth bass population was in excellent shape and continued to hold the F/C ratio down at 1.7. The drop in the A_t value (from 67 to 48) was due to the increased weight of the intermediate fishes, Table 11.

Creel Survey Studies

During the first year of study (1958) a harvest of 18.3 pounds per acre (70 fish) was cropped from Shanty Hollow Lake, Table 13. Fishermen were successful in harvesting fish at the rate of 0.6 fish per hour or 2.4 fish per trip. Bluegill, bass, and crappies shared almost equally in the creel (Table 13). No channel catfish were harvested in 1958.

Table 4. Average weight and number of fish per acre taken from Shanty Hollow 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.
GAME FISH													
Largemouth bass	0-4	162	0.64	5-9	51	9.53	10	3	1.79	216	11.96	2.78	11.79
Black crappie	0-4	63	0.24	5-7	1	0.11	8	8	3.38	72	3.73	0.93	3.68
TOTAL		225	0.88		52	9.64		11	5.18	288	15.69	3.71	15.47
PANFISHES													
Bluegill	0-2	5821	8.77	3-5	289	10.14	6	179	35.43	6289	54.34	81.00	53.58
Longear sunfish	0-2	99	0.69	3-5	232	8.32	6	9	1.14	340	10.15	4.38	10.01
Redear sunfish	0-2	44	0.13	3-5	11	0.46	6	31	7.83	86	8.42	1.11	8.30
Warmouth	0-2	506	2.60	3-5	217	6.39	6	22	3.24	745	12.23	9.60	12.07
TOTAL		6470	12.19		749	25.31		241	47.64	7460	85.14	96.09	83.96
COMMERCIAL FISH													
Bullhead	0-4	1	0.02	5-8	3	0.21	9	1	0.26	5	0.49	0.06	0.48
TOTAL		1	0.02		3	0.21		1	0.26	5	0.49	0.06	0.48
							ABOVE FORAGE SIZE						
FORAGE FISH													
Misc. cyprinids	0-3	11	0.09	4-7	-	-	8	-	-	11	0.09	0.14	0.09
TOTAL		11	0.09		-	-		-	-	11	0.09	0.14	0.09
GRAND TOTAL		6704	13.18		804	35.15		254	53.08	7764	101.41	100.00	100.00
% OF TOTAL		86.35	13.00		10.37	34.66		3.28	52.34	100.00	100.00		

Table 5. Average weight and number of fish per acre taken from Shanty Hollow 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.
GAME FISH													
Largemouth bass	0-4	209	1.60	5-9	50	8.03	10	1	0.40	260	10.03	2.99	20.57
Black crappie	0-4	9	0.12	5-7	-	-	8	-	-	9	0.12	0.10	0.25
TOTAL		218	1.72		50	8.03		1	0.40	269	10.15	3.09	20.82
FOOD FISH													
Channel catfish	0-4	1	0.01	5-9	-	-	10	-	-	1	0.01	0.01	0.01
TOTAL		1	0.01		-	-		-	-	1	0.01	0.01	0.01
PANFISHES													
Bluegill	0-2	8125	10.72	3-5	57	2.78	6	72	16.58	8254	30.08	94.83	61.69
Longear sunfish	0-2	1	0.01	3-5	25	0.84	6	2	0.17	28	1.02	0.32	2.09
Redear sunfish	0-2	-	-	3-5	1	0.02	6	9	2.69	10	2.71	0.11	5.56
Warmouth	0-2	24	0.18	3-5	84	2.41	6	11	1.90	119	4.49	1.37	9.21
TOTAL		8150	10.91		167	6.05		94	21.34	8411	38.30	96.63	78.55
COMMERCIAL FISH													
Bullhead	0-4	14	0.09	5-8	-	-	9	1	0.18	15	0.27	0.17	0.56
TOTAL		14	0.09		-	-		1	0.18	15	0.27	0.17	0.56
							ABOVE FORAGE SIZE						
FORAGE FISH													
Misc. cyprinids	0-3	8	0.03	4-7	-	-	8	-	-	8	0.03	0.10	0.06
TOTAL		8	0.03		-	-		-	-	8	0.03	0.10	0.06
GRAND TOTAL		8391	12.76		217	14.08		96	21.92	8704	48.76	100.00	100.00
% OF TOTAL		96.40	26.17		2.49	28.88		1.11	44.95	100.00	100.00		

Table 6. Average weight and number of fish per acre taken from Shanty Hollow 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.
GAME FISH													
Largemouth bass	0-4	96	1.31	5-9	145	23.32	10	32	17.25	273	41.88	1.28	21.14
Black crappie	0-4	47	0.16	5-7	11	1.79	8	6	2.04	64	3.99	0.29	2.01
TOTAL		143	1.47		156	25.11		38	19.29	337	45.87	1.57	23.15
PANFISHES													
Bluegill	0-2	17,051	43.36	3-5	1,925	42.38	6	46	8.67	19,022	94.41	88.84	47.66
Longear sunfish	0-2	70	0.54	3-5	201	7.79	6	3	0.62	274	8.95	1.28	4.52
Redear sunfish	0-2	24	0.17	3-5	179	7.36	6	14	4.04	217	11.57	1.01	5.84
Warmouth	0-2	186	1.23	3-5	580	20.36	6	47	6.87	813	28.46	3.80	14.37
TOTAL		17,331	45.30		2,885	77.89		110	20.20	20,326	143.39	94.93	72.39
COMMERCIAL FISH													
Bullhead	0-4	10	0.21	5-8	21	2.68	9	4	1.96	35	4.85	0.17	2.45
TOTAL		10	0.21		21	2.68		4	1.96	35	4.85	0.17	2.45
							ABOVE FORAGE SIZE						
FORAGE FISH													
Misc. cyprinids	0-3	4	0.03	4-7	-	-	8	-	-	4	0.03	0.02	0.01
Brook silversides	0-3	709	3.96	4-7	-	-	8	-	-	709	3.96	3.31	2.00
TOTAL		713	3.99		-	-		-	-	713	3.99	3.33	2.01
GRAND TOTAL		18,197	50.97		3,062	105.68		152	41.45	21,411	198.10	100.00	100.00
% OF TOTAL		84.99	25.73		14.30	53.35		0.71	20.92	100.00	100.00		

Table 7. Average weight and number of fish per acre taken from Shanty Hollow 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.
GAME FISH													
Largemouth bass	0-4	10	0.10	5-9	106	18.00	10	12	12.20	128	30.30	6.39	16.44
Black crappie	0-4	-	-	5-7	2	0.39	8	2	0.72	4	1.11	0.20	0.60
TOTAL		10	0.10		108	18.39		14	12.92	132	31.41	6.59	17.04
PANFISHES													
Bluegill	0-2	371	0.88	3-5	774	55.36	6	249	49.50	1394	105.74	69.56	57.36
Longear sunfish	0-2	-	-	3-5	167	13.10	6	32	4.56	199	17.66	9.93	9.58
Redear sunfish	0-2	-	-	3-5	13	1.08	6	61	12.70	74	13.78	3.69	7.48
Warmouth	0-2	30	0.26	3-5	131	8.30	6	29	5.74	190	14.30	9.48	7.76
TOTAL		401	1.14		1085	77.84		371	72.50	1857	151.48	92.66	82.18
COMMERCIAL FISH													
Bullhead	0-4	3	0.08	5-8	2	0.30	9	4	1.04	9	1.42	0.45	0.77
TOTAL		3	0.08		2	0.30		4	1.04	9	1.42	0.45	0.77
							ABOVE FORAGE SIZE						
FORAGE FISH													
Brook silverside	0-3	5	0.01	4-7	1	0.01	8	-	-	6	0.02	0.30	0.01
TOTAL		5	0.01		1	0.01		-	-	6	0.02	0.30	0.01
GRAND TOTAL		419	1.33		1196	96.54		389	86.46	2004	184.33	100.00	100.00
% OF TOTAL		20.91	0.72		59.68	52.37		19.41	46.91	100.00	100.00		

Table 8. Average weight and number of fish per acre taken from Shanty Hollow 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.
GAME FISH													
Largemouth bass	0-4	208	1.78	5-9	115	9.56	10	28	16.47	351	27.81	7.20	41.71
TOTAL		208	1.78		115	9.56		28	16.47	351	27.81	7.20	41.71
PANFISHES													
Bluegill	0-2	3457	8.03	3-5	87	1.92	6	90	14.94	3634	24.89	74.59	37.34
Longear sunfish	0-2	3	0.12	3-5	23	1.61	6	3	0.38	29	2.11	0.60	3.17
Redear sunfish	0-2	-	-	3-5	1	0.03	6	6	2.37	7	2.40	0.14	3.60
Warmouth	0-2	175	0.36	3-5	43	1.61	6	26	5.07	244	7.04	5.01	10.56
TOTAL		3635	8.51		154	5.17		125	22.76	3914	36.34	80.34	54.67
COMMERCIAL FISH													
Bullhead	0-4	46	0.09	5-8	-	-	9	1	0.75	47	0.84	0.97	1.26
TOTAL		46	0.09		-	-		1	0.75	47	0.84	0.97	1.26
							ABOVE FORAGE SIZE						
FORAGE FISH													
Topminnows	0-3	2	0.01	4-7	-	-	8	-	-	2	0.01	0.04	0.02
Brook silverside	0-3	558	1.56	4-7	-	-	8	-	-	558	1.56	11.45	2.34
TOTAL		560	1.57		-	-		-	-	560	1.57	11.49	2.36
GRAND TOTAL		4449	11.95		269	14.73		154	39.98	4872	66.66	100.00	100.00
% OF TOTAL		91.32	17.92		5.52	22.10		3.16	59.98	100.00	100.00		

Table 9. Average weight and number of fish per acre taken from Shanty Hollow Lake during 1963 (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.
GAME FISH													
Grass pickerel	0-4	1	0.01	5-9	1	0.04	10	-	-	2	0.05	0.08	0.06
Sauger	0-4	-	-	5-11	-	-	12	1	0.17	1	0.17	0.04	0.19
Largemouth bass	0-4	186	1.90	5-9	85	20.30	10	24	14.69	295	36.89	11.39	41.62
TOTAL		187	1.91		86	20.34		25	14.86	298	37.11	11.51	41.87
FOOD FISH													
Channel catfish	0-4	-	-	5-9	-	-	10	1	0.57	1	0.57	0.04	0.64
TOTAL		-	-		-	-		1	0.57	1	0.57	0.04	0.64
PANFISHES													
Bluegill	0-2	1765	7.20	3-5	311	12.93	6	68	19.85	2144	39.98	82.78	45.10
Longear sunfish	0-2	2	0.01	3-5	60	3.70	6	21	3.35	83	7.06	3.20	7.96
Redear sunfish	0-2	-	-	3-5	2	0.17	6	3	1.59	5	1.76	0.19	1.99
Warmouth	0-2	1	0.01	3-5	15	0.74	6	4	0.74	20	1.49	0.78	1.69
TOTAL		1768	7.22		388	17.54		96	25.53	2252	50.29	86.95	56.74
COMMERCIAL FISH													
Bullhead	0-4	14	0.03	5-8	1	0.06	9	1	0.35	16	0.44	0.62	0.50
TOTAL		14	0.03		1	0.06		1	0.35	16	0.44	0.62	0.50
							ABOVE FORAGE SIZE						
FORAGE FISH													
Brook silverside	0-3	22	0.22	4-7	1	0.01	8	-	-	23	0.23	0.88	0.25
TOTAL		22	0.22		1	0.01		-	-	23	0.23	0.88	0.25
GRAND TOTAL		1991	9.38		476	37.95		123	41.31	2590	88.64	100.00	100.00
% OF TOTAL		76.87	10.58		18.38	42.81		4.75	46.61	100.00	100.00		

Table 10. Average weight and number of fish per acre taken from Shanty Hollow Lake during 1964 (4 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.
GAME FISH													
Largemouth bass	0-4	1,386	5.54	5-9	106	22.09	10	103	61.16	1,595	88.79	14.28	47.30
Black crappie	0-4	20	tr.	5-7	-	-	8	-	-	20	tr.	0.18	tr.
TOTAL		1,406	5.54		106	22.09		103	61.16	1,615	88.79	14.46	47.30
FOOD FISH													
Channel catfish	0-4	-	-	5-9	-	-	10	2	6.86	2	6.86	0.02	3.65
TOTAL		-	-		-	-		2	6.86	2	6.86	0.02	3.65
PANFISHES													
Bluegill	0-2	6,482	12.32	3-5	226	5.36	6	160	49.94	6,868	67.62	61.50	36.02
Longear sunfish	0-2	8	tr.	3-5	180	11.28	6	18	2.94	206	14.22	0.40	7.58
Redear sunfish	0-2	-	-	3-5	7	tr.	6	5	3.16	12	3.16	tr.	1.68
Warmouth	0-2	5	tr.	3-5	12	0.75	6	5	1.21	22	1.96	0.20	1.04
TOTAL		6,495	12.32		425	17.39		188	57.25	7,108	86.96	62.20	46.32
COMMERCIAL FISH													
Bullhead	0-4	19	tr.	5-8	1	tr.	9	tr.	tr.	20	tr.	0.18	tr.
TOTAL		19	tr.		1	tr.		tr.	tr.	20	tr.	0.18	tr.
							ABOVE FORAGE SIZE						
FORAGE FISH													
Brook silverside	0-3	2,584	5.11	4-7	-	-	8	-	-	2,584	5.11	23.14	2.72
TOTAL		2,584	5.11		-	-		-	-	2,584	5.11	23.14	2.72
GRAND TOTAL		10,504	22.97		532	39.48		293	125.27	11,329	187.72	100.00	100.00
% OF TOTAL		94.06	12.24		3.31	21.03		2.62	66.73	100.00	100.00		

Table 11. Average weight and number of fish per acre taken from Shanty Hollow Lake during 1965 (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.
GAME FISH													
Largemouth bass	0-4	38	0.46	5-9	191	31.32	10	42	34.26	271	66.04	10.56	36.80
Black crappie	0-4	-	-	5-7	9	1.73	8	23	6.66	32	8.39	1.23	4.67
TOTAL		38	0.46		200	33.05		65	40.92	303	74.43	11.79	41.47
FOOD FISH													
Channel catfish	0-4	-	-	5-9	4	0.98	10	26	8.82	30	9.80	1.18	5.46
TOTAL		-	-		4	0.98		26	8.82	30	9.80	1.18	5.46
PANFISHES													
Bluegill	0-2	525	1.35	3-5	663	31.94	5	132	26.40	1320	59.69	51.38	33.26
Longear sunfish	0-2	-	-	3-5	204	12.27	6	25	3.78	229	16.05	8.91	8.94
Redear sunfish	0-2	-	-	3-5	37	1.81	6	27	7.59	64	9.40	2.49	5.24
Warmouth	0-2	44	0.19	3-5	85	2.44	6	30	5.72	159	8.35	6.20	4.65
TOTAL		569	1.54		989	48.46		214	43.49	1772	93.49	68.98	52.09
COMMERCIAL FISH													
Bullhead	0-4	1	0.03	5-8	-	-	9	-	-	1	0.03	0.05	0.02
TOTAL		1	0.03		-	-		-	-	1	0.03	0.05	0.02
							ABOVE FORAGE SIZE						
FORAGE FISH													
Brook silverside	0-3	462	1.73	4-7	-	-	8	-	-	462	1.73	18.00	0.96
TOTAL		462	1.73		-	-		-	-	462	1.73	18.00	0.96
GRAND TOTAL		1070	3.76		1193	82.49		305	93.23	2568	179.48	100.00	100.00
% OF TOTAL		41.68	2.10		46.44	45.96		11.88	51.94	100.00	100.00		

There was a total of 4,204 fisherman trips to the lake (Table 14). Of that number, 74% were still fishermen, while 26% used the casting method. Ninety-seven percent were residents, and 90% males.

The 7-month survey in 1959 indicated a harvest of 39.2 pounds per acre. This represents an increase of 21 pounds per acre over 1958, Table 13. Both the quality and quantity of the bass and bluegill taken in 1959 increased. Fishermen were successful in harvesting fish at the rate of 0.6 fish per hour or 2.4 fish per trip. The rate remained the same as 1958 due to an increase in the fisherman-pressure.

There was a total of 5,900 fisherman trips to the lake in 1959. This was a 38% increase over 1958, Table 12. The fishing methods, sex ratio, and residency status remained in approximately the same proportion as recorded in 1958.

During the 1960 survey period anglers harvested 0.8 fish per hour (0.29 pound) or 3.2 fish per trip (1.16 pounds). A total of 65.5 pounds of fish per acre was harvested. This represents a 67% increase over that harvested in 1959. The largest portion of this increase was accounted for by a substantial rise in the harvest of largemouth bass (Table 13). The fishing pressure remained the same as recorded in 1959 (6,010 fisherman trips). There were approximately 6,042 trips made to the lake. There was a 12% increase in the use of the casting method in 1960. The other categories remained the same as previously recorded.

In 1961 a harvest of 47.5 pounds of fish per acre was creeled from the lake (Table 13). This was a decrease of 18 pounds per acre under 1960, and was largely due to a decrease in the number and weight of the largemouth bass harvested (Table 13). A portion of this loss was taken up by an increased catch of bluegill. Fishermen were successful in harvesting fish at the rate of 1.0 per hour or 4.2 per trip.

The fishing pressure also decreased during 1961. There were approximately 1,000 fewer fisherman trips made to the lake in 1961. The number of fishermen using the bait casting method decreased to the level recorded in 1959. This coincided with the drop in the harvest of largemouth bass (Table 13). The other categories remained unchanged (Table 14).

In 1962, 98.2 pounds of fish per acre were harvested from the lake, Table 13. This represents an increase of 51 pounds per acre over 1961. This was accounted for by an increased catch of largemouth bass and bluegill, Table 13. Fishermen were successful in harvesting fish at the rate of 1.1 per hour or 4.4 per trip, Table 12.

A total of 8,433 fisherman trips was made to Shanty Hollow during 1962. This was an increase of 3,352 trips over 1961, and accounted for the unchanged rate of harvest, Table 12. The methods used and sex ratio did not significantly change. However, there were no non-resident fisherman trips made to the lake in 1962, Table 14.

In 1964, a harvest of 111.2 pounds per acre represented an increase of 12 pounds per acre over 1962. Fishermen were successful in catching fish at the rate of 0.7 fish per hour or 3.7 fish per trip. This was a lower rate than was recorded in 1962, but the average weight of each fish caught had almost doubled, indicating a catch of better quality, Table 12. The increased harvest was accounted for by an increased catch of bluegill.

There was a total of 7,644 trips made to the lake in 1964. The categories presented in Table 14 showed no significant change from 1962.

The final year of creel survey studies was conducted on Shanty Hollow Lake in 1965. During the survey period in 1965 there was a total of 56.8 pounds of fish per acre harvested, or 54.4 pounds per acre less than in 1964. This drop was accounted for by a large decrease in the catch of bluegill (from 96.3 pounds per acre in 1964 to 28.4 pounds per acre in 1965)

Table 12. Catch statistics from Shanty Hollow Lake for 1958 - 1965.*

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	106	160	40	0.6	-	2.4	-
1959	106	224	56	0.6	-	2.4	-
1960	106	228	57	0.8	0.29	3.2	1.16
1961	106	192	48	1.0	0.25	4.2	1.00
1962	106	318	80	1.1	0.30	4.4	1.20
1964	106	361	72	0.7	0.55	3.7	2.20
1965	106	302	76	0.4	0.19	1.7	0.75

Table 13. Average catch per surface acre at Shanty Hollow Lake, 1958 - 1965.*

Year Surveyed	Acres	Largemouth bass		Sunfish		Crappie		Channel catfish		Totals	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
1958	106	11	5.6	53	9.0	7	3.7	0	0.0	70	18.3
1959	106	22	15.0	73	20.6	6	3.5	3	0.6	102	39.2
1960	106	51	34.7	115	28.5	5	2.3	0	0.0	171	65.5
1961	106	11	7.1	188	39.6	1	0.6	tr.	0.2	200	47.5
1962	106	17	19.9	303	77.3	5	0.8	1	0.2	324	98.2
1964	106	14	14.9	250	96.3	2	0.1	0	0.0	264	111.2
1965	106	22	23.8	89	28.4	14	2.6	3	2.0	128	56.8

* The two hour survey was not conducted in 1963.

Table 14. Creel survey statistics, Shanty Hollow Lake, 1958 - 1965.*

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	4204	3111	74	1093	26	4057	97	147	3	3792	90	412	10
1959	5900	4643	79	1257	21	5766	98	134	2	5042	85	858	15
1960	6010	4041	67	1969	33	5842	97	168	3	5412	90	598	10
1961	5081	4009	79	1072	21	5047	99	34	1	4625	91	458	9
1962	8433	6264	74	2169	26	8433	100	0	0	7474	89	759	11
1964	7644	6053	79	1591	21	7581	99	53	1	6647	87	997	13
1965	8003	4902	62	2906	36	7918	99	85	1	6885	83	1118	17

* The two-hour survey was not conducted in 1963.

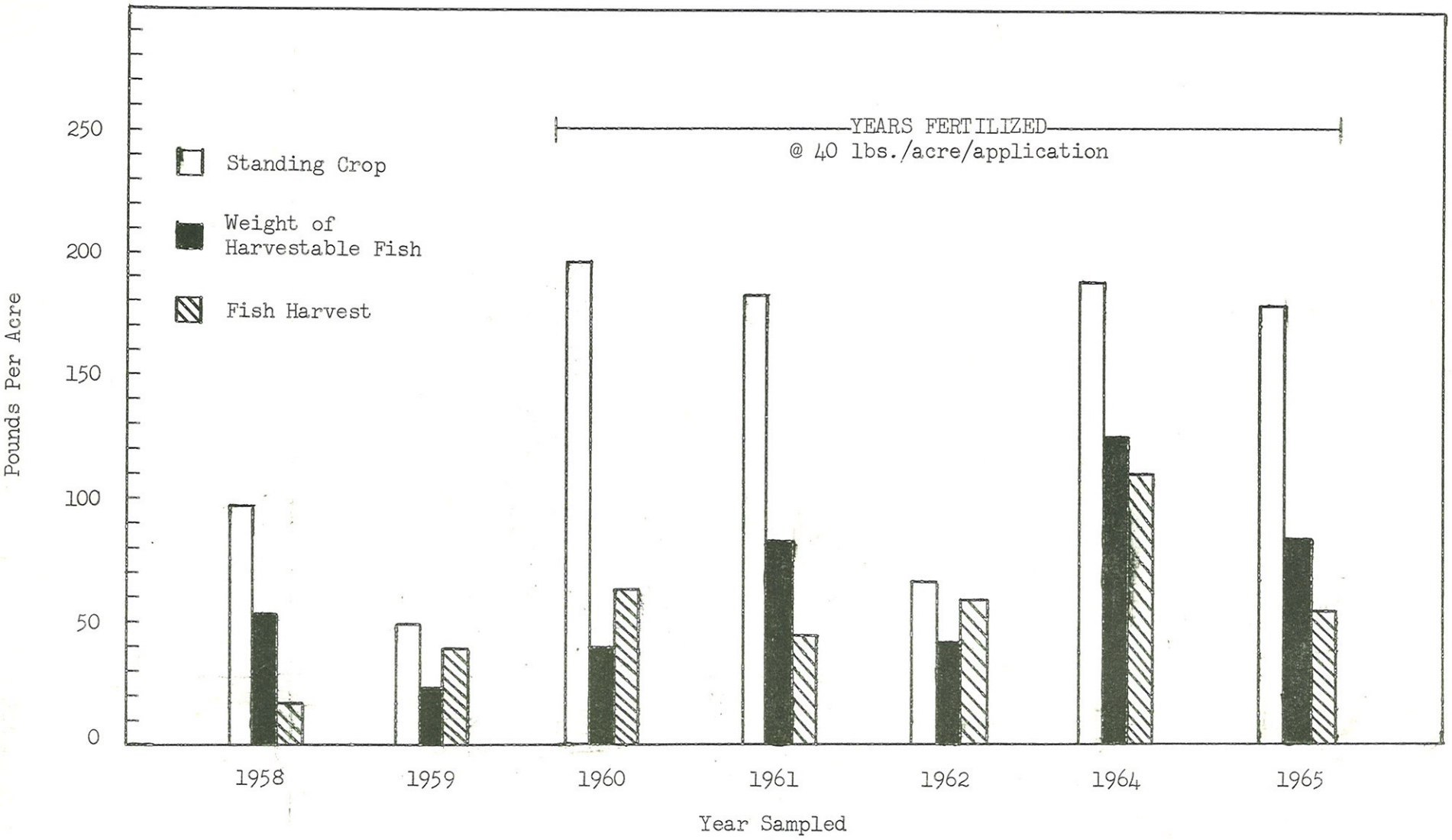
even though there were increased catches of largemouth bass, crappie, and channel catfish, Table 13. Fishermen were successful in harvesting these fish at 0.4 per hour or 1.7 per trip.

The fishing pressure remained relatively unchanged in 1965. However, there were approximately 15% more bait casters, Table 12. This increase can be related to the increased catch of largemouth bass. The other categories did not significantly change.

Fertilization Studies

Figure 2 shows a comparison of the standing crop, weight of harvestable fish (A_t), and fish harvest from 1958 through 1965. During the 2 years previous to fertilization (1958 and 1959) the standing crop averaged 75 pounds per acre, the A_t averaged 42 pounds per acre, and the fish harvest averaged 33 pounds per acre. After the lake had been fertilized for a period of two years the average standing crop increased to 193 pounds per acre, the A_t increased to 63 pounds per acre, and the fish harvest increased to 57 pounds per acre. After four years of fertilization the average standing crop dropped (but was still higher than the years fertilizer was not used), and was recorded at 135 pounds per acre. The A_t value was recorded at 54 pounds per acre and the fish harvest at 61 pounds per acre. After six years of fertilization the average increased again and was recorded at 151 pounds per acre for the standing crop, 70 pounds per acre for the A_t, and 68 pounds per acre for the fish harvest. This represents a substantial increase in the quality and quantity of the fishery at Shanty Hollow Lake during the years when an inorganic fertilizer was applied at the rate of 40 pounds per acre per application .

Figure 2. Standing Crop, Weight of Harvestable Fish, and Fish Harvest in Shanty Hollow Lake from 1958-1965.



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 James 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, available at all times for advice and discussion of the problems that arose during the course of the project. Special thanks are extended to James R. Charles, Principal Fishery Biologist, who also reviewed the manuscript and made many helpful criticisms.

I would also like to thank Mr. Henry Browning and Mr. Barney Miller who ably conducted the creel surveys.

LITERATURE CITED

Pfeiffer, Peter W., 1966. The Results of a Non-uniform Probability Creel Survey on a Small State-owned Lake. Proc. Twentieth Annual Conference, S.E. Association of Game and Fish Commissioners.