Rotenone Survey of Black Hollow on Lower Spavinaw Lake, November, 1953[1,2]

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Lower Spavinaw Lake has been impounded since 1923, but very little population data are available as to species composition and relative abundance. This study was initiated in order to determine the structure of the existing population, with the possibility of obtaining a better understanding of the inter- and intra-relationships of the various fishes.

Black Hollow was selected as a sample area because it was representative of the various habitats in the lake and was readily accessible. Further, it provided areas for dead fish disposal and was removed from normal activity centers. Fish were picked up over a five day period and buried well back from the water's edge.

Description

Lower Spavinaw Lake, located in Mayes and Delaware Counties in northeastern Oklahoma, provides a supply of water for the city of Tulsa, and is one of the oldest lakes of its size in the state. The spillway of the dam is 55 feet high and impounds 1,637 acres of water. The storage capacity of the reservoir is 30,660 acre-feet at spillway level. The lake drains approximately 400 square miles of the Ozark foothills, 80 percent of which is covered with timber. The major tributary, Spavinaw Creek, arises near Gravette, Arkansas, and meanders in a southwesterly direction for approximately 45 miles to its juncture with Grand River. Lower Spavinaw Dam is located 4 miles above this juncture. In normal years water runs over the spillway continuously. However, very little water has left the lake in this manner since 1951, and the lake has been as low as 8 feet below normal.

The principal vegetation surrounding the lake is water willow (*Dianthera*) with willow being the principal tree near the water's edge. The oak-hickory forest is the most prevalent vegetation type covering the chert-mantled hillslopes and crests (1).

Black Hollow is the easternmost hollow on the south side of the lake, being located approximately 2 miles above the dam. It is fed by springs and runoff from adjoining limestone and chert hills. The area selected constituted approximately 8 acres at the upper end of the hollow. The depth of the water varied from a few inches to 9 feet at the deepest point, and a constant temperature of 57° F. was recorded from top to bottom. The bottom of the lake at the sample site was mud at the extreme southern tip, and along the west side and portions of the east shore. The main portion of the eastern side of the site was gravel, and the deeper areas were gravel with very little siltation. The water was clear, and the air temperature was 57° F. Stumps were present along the western side, and a few were encountered in the middle of the cove.

Equipment and Methods

Gill nets were stretched across the bay below the designated sampling area in an effort to prevent fish from entering or leaving. One hundred and fifty pounds of 5 percent powdered rotenone, furnished by the Oklahoma Game and Fish Department, were used in the sample area. The

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rotenone was applied by dragging bags of rotenone behind boats, and by pressure sprayer in the shallower water.

The age and growth-rates of all species of fish were calculated by standard methods of scale and spine analysis employed at the Oklahoma Fisheries Research Laboratory. A direct proportion between body length and scale and spine radius was assumed, and a nomograph was employed in computation. Growth averages represent the weighted average for each species, and all lengths are expressed in total length in inches.

Results

The 8-acre area in Black Hollow yielded an estimated total of 21,674 fish, weighing 4,326 pounds, over the five day pickup period. This is equivalent to 2,709 fish per acre, weighing 541 pounds. A similar survey on 46,000 acre Grand Lake (4), 5 miles north of Spavinaw Lake, produced 565 pounds per surface acre. Following cove poisoning at 470-acre Claremore City Lake, located 30 miles west of Spavinaw Lake, 236 pounds of fish per acre were recovered (2). In all three studies, gizzard shad comprised more than 50 percent of the total weight of all fish collected. Incomplete recovery, fish movement, and varying susceptability of species to rotenone, render these estimates subject to errors which are not measureable.

Gizzard shad dominated the sample from the standpoint of both total numbers and total weight in the Lower Spavinaw Lake collection. They constituted 90 percent of the total number of fish and 78.5 percent of the total weight (Table I). In comparison, shad made up 66 percent of the total weight in the Grand Lake study, and 52 percent in the Claremore City Lake collection. Of the 13,650 individuals collected at Lower Spavinaw, 302 were used for length-frequency data, and 41 were used in the age and growth determination. Young-of-year were scarce and were outnumbered by yearling fish (1952 year-class), a phenomenon also observed in nearby Grand Lake during an extreme drawdown (3). Lower Spavinaw was drawn down about 8 feet during the winter of 1951-52 and raised back to normal in the spring of 1952 during the normal spawning season. With the raising of the water level, conditions similar to that in a new lake were created and the largemouth bass, white bass, and shad spawn in 1952 was extremely high. During the winter of 1952-53 the lake was again lowered because of the impoundment of Upper Spavinaw Lake, and the water remained at a level during that year. Since the 1953 year-class of shad was greatly reduced, intra-year-class competition was reduced. The shad that survived made such rapid growth that they quickly became unavailable as food for the 1952 and 1953 year classes of largemouth and white bass. The introduction of white bass in 1950 and its rapidly expanding population could feasibly have been one of the major factors in the decrease of the available shad population. Shad in Spavinaw Lake are slower growing in the later years of life in comparison to other lakes (Table III). The slow growth of older shad indicates an overpopulated condition, since the 1953 year-class shows accelerated growth when numbers are reduced.

Largemouth bass represented the second most abundant fish in the sample, comprising 2.2 percent of the total number and 1.8 percent of the total weight, as compared to Grand Lake's 3.1 percent of total weight (4). It is unusual for largemouth bass to rank this high in a population. Three hundred thirty-nine largemouth bass (4.8 to 21.7 inches in length) were collected, 224 of which were used for length-frequency data, and 62 for age and growth analysis. Thirty-four percent of the bass were young-of-year, 63.6 percent of the 1952 year-class, 0.4 percent of the 1950 year-class, 1.2 percent of the 1949 year-class, and 0.8 percent of the 1947 year-class. The 1951 and 1948 year-classes were missing from the sample, which suggests that these were poor years for reproduction. Conditions in 1952 were excellent for bass reproduction and the sample indicates a high rate

of survival. Growth in 1952 was good, but it fell off sharply in 1953 following drawdown. Growth is equal to the state average for the first four years of life, and is well above the state average for the next three years of life.

Drum ranked third in the sample, with 306 individuals being taken. The condition of the drum was extremely poor, and many individuals were so thin that vertebral outline was visible. This species typically appears as one of the five most abundant fishes in Mississippi River Valley impoundments.

Spotted suckers are probably the second most numerous fish in Lower Spavinaw Lake, but ranked fourth in the rotenone collection. Gill netting operation for the past five years have indicated that this is the most abundant species, which is probably attributable to net selectivity.

Approximately 750 white bass were introduced into the lake in September, 1950 and in 1953 represented the fifth most abundant species in the sample. The 1951 hatch of white bass was moderate, and in 1952, reproduction was highly successful. The strong 1952 year-classes of white bass and black bass may account for the reduced 1953 year-class of gizzard shad. Growth has slowed since introduction, and fish attained an average length of 7.6 inches at the end of the first year of life, and 9.3 inches at the end of the second year of life in 1953.

Channel catfish were the sixth most abundant species, representing 5.5 percent of the total weight, as compared to 3. 6 percent in the Grand Lake rotenone sample. Growth is excellent, exceeding the state average by a considerable amount. Carp ranked seventh in number and third in weight in the sample. Most of the individuals were three years old (1951 year-class), indicating a dominant year-class. The white crappie sample was much smaller than anticipated, and evidently they had begun to move to deeper water in mid-November. Growth was fair in 1951, good in 1952, and poor in 1953. Growth practically ceased during 1953, suggesting that a prolonged drawdown is not conducive to desirable crappie growth.

Other species which were represented in the sample included bluegill, green sunfish, redear sunfish, longear sunfish, log perch, golden redhorse, river redhorse, spotted bass, flathead catfish, black bullhead, and yellow bullhead. The minnow and small fish population included the bluntnose minnow, horny-head chub, red shiner, stoneroller, brook silversides, topminnows, and *Gambusia*. The numbers of these small fish collected from the sample area were much smaller than expected.

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LITERATURE CITED

1. BLAIR, W. F., and T. H. HUBBELL. 1938. The biotic districts of Oklahoma. Amer. Midland Nat., 20(2): 425-454.

2. JENKINS, ROBERT M. 1951. A fish population study of Claremore City Lake. Proc. Okla. Acad. Sci. 30 (1949): 84-93.

3. ..... 1953. Growth histories of the principal fishes in Grand Lake (O' The Cherokees), Oklahoma, through thirteen years of impoundment. Okla. Fish. Research Lab. Rep. 34: 1-87; multilith.

4. THOMPSON, WILLIAM H. 1950. Investigation of the fisheries resources of Grand Lake. Okla. Fish. Research Lab. Rep. 18. 46 pp. mimeograph.
5. TURNER, W. R. 1953. The age and growth of the gizzard shad, *Dorosoma cepedianum* (LeSueur), in Herrington Lake, Ky. Ky. Dept. Fish and Wildl. Resources, 15 pp., mimeograph.

TABLE I.

Number and weight of fishes collected following rotenone application in Black Hollow, Lower Spavinaw Lake, 5-10 November, 1953.

SPECIES	Total Number	% of Total Count	Total Length Range (Inches)	Total Weight	% of Total Weight
Gizzard shad	13,650	89.957	5.7-13.0	3,395.0	78.4
Largemouth bass	339	2.234	4.8-21.7	76.0	1.7
Drum	306	2.017	5.4-14.2	137.0	3.1
Spotted sucker	242	1.595	8.3-15.6	147.0	3.3
White bass	199	1.311	7.2-10.2	41.0	0.9
Channel catfish	110	0.724	4.9-30.7	236.0	5.4
Carp	72	0.474	9.2-32.0	221.0	5.1
Bluegill	49	0.323	3.7- 7.7	8.0	0.1
White crappie	39	0.257	7.5- 8.8	8.0	0.1
Log perch	36	0.237	4.1- 5.0	1.3	0.0
Redhorse (spp.)	18	0.119	14.8-23.0	41.0	0.9
Black crappie	9	0.059	6.5-12.4	2.0	0.0
Redear sunfish	9	0.059	6.7- 8.6	2.0	0.0
Spotted bass	6	0.040	5.5- 9.0	1.0	0.0
Longear sunfish	4	0.026	3.9- 4.2	0.1	0.0
Green sunfish	2	0.013	5.5- 5.9	0.2	0.0
Flathead catfish	1	0.007	16.3	1.1	0.0
Black bullhead	1	0.007	8.5	0.2	0.0
Yellow bullhead	1	0.007	6.0	0.0	0.0
Miscellaneous sunfishes	81	0.534	.....	7.3	0.1
Miscellaneous minnows, etc., estimated	6,500		.....	.....	.....
Totals	21,674	100.000		4,325.9	100.0

TABLE II.

Average growth-rate of fishes collected in Lower Spavinaw Lake following retononing November 5, 1953.

SPECIES	Number of fish	Calculated total length in inches at end of year								
		1	2	3	4	5	6	7	8	9
Gizzard shad	41	5.5	7.7	9.0	10.4	11.6				
Largemouth bass	62	5.4	8.4	12.7	15.0	17.3	20.4	21.6		
Drum	30	5.2	7.8	10.4	12.0	12.9				
Spotted sucker	45	4.2	9.2	11.1	12.6	14.5				
White bass	39	7.6	9.3							
Channel catfish	63	4.6	8.8	12.2	14.9	17.4	19.6	22.0	24.2	26.6
Carp	22	6.7	13.2	16.8	20.3	25.8	27.4	29.2	30.9	32.0
Bluegill	30	3.5	5.0	5.9	6.7	7.2				
White crappie	27	2.0	7.0	8.0						
Log perch	6	1.7	3.2	4.2	4.9					
Green sunfish	2	2.0	4.2	4.9	5.7					
Redear sunfish	6	3.3	5.1	7.1	8.0	8.4				
Longear sunfish	3	1.7	3.5	4.1						
Golden redhorse	8	3.4	10.3	15.1	17.1	18.6	20.8	23.0		
River redhorse	1	2.5	10.0	14.8						
Flathead catfish	1	3.4	9.7	14.0	16.3					
Spotted bass	4	6.1	8.9							

TABLE III.

Comparison of average calculated lengths of gizzard shad in Lower Spavinaw Lake, Grand Lake (3), *and Herrington Lake, Kentucky* (5), *at the end of various years of life.*

LAKE	Calculated length in inches at end of year				
	1	2	3	4	5
Spavinaw Lake	5.5	7.7	9.0	10.4	11.6
Grand Lake	4.0	8.1	10.4	12.7	14.0
Herrington Lake	4.4	7.8	10.4	12.4	13.4