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A PRELIMINARY REPORT OF STANDING CROP AND RATES  
OF HARVEST IN LAKE FORT SMITH, ARKANSAS:  
1957 THROUGH 1958

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INTRODUCTION

Lake Fort Smith is a 525-acre artificial lake in Crawford County, Arkansas. Impounded in 1936 as a water supply reservoir for the city of Fort Smith, this lake is located about 26 miles northeast of the city of Fort Smith on the southern slope of the Boston Mountains and drains into Frog Bayou, a tributary of the Arkansas River. It has been the site of several limnological studies in recent years (Hoffman, 1951; Hoffman and Causey, 1952; and Nelson, unpublished thesis, 1954). There are indications that the lake's sport fishery has markedly declined during the 23-year life of the lake. This has been particularly noticeable to those lake fishermen primarily interested in catching white crappie, Pomoxis annularis, and the largemouth bass, Micropterus salmoides. In hopes that some management practice might be designed to improve fishing in this and other small man-made lakes in northwestern Arkansas, a cooperative fisheries research project between the Arkansas Game and Fish Commission, the Zoology Department of the University of Arkansas and the U. S. Fish and Wildlife Service was established in June, 1957.

The management technique selected for trial has been an experimental introduction of the threadfin shad, Dorosoma petenense (Gunther), and was aimed at improving available forage supplies. The threadfin shad, unlike the gizzard shad, is an ideal forage fish rarely growing longer than 5 to 6 inches under optimum conditions. Thus, presumably, it never becomes too large for utilization as food by the game species in the lake. Although such introductions have already been carried out in many southeastern states as well as in southern part of Arkansas by the Arkansas Game and Fish Commission, little basic information is available concerning the effects of these introductions on the established fish populations. In order to evaluate the

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effect of the shad introduction, a knowledge of the biological conditions which existed in the lake prior to the introduction is an absolute necessity. The Lake Fort Smith program was thus designed to obtain such information. Accordingly, the main early objectives of the project prior to the introduction of the shad were to determine the present population composition, growth rates and condition factors of the game species, the size of harvestable populations, and the current rates of harvesting or utilization of those populations by the sportsman. The rate of harvesting prior to the introduction, has been studied by a creel census, the first eleven months of which are reported upon in a preliminary fashion by this paper; it is hoped at a later date to establish confidence limits upon the estimations of harvest presented herein. A very preliminary attempt to determine standing crop has been made based upon rotenone samples made in early June, 1958. The inaccuracies of this method and the possibility of completely erroneous conclusions based upon determination of standing crop utilizing only rotenone sampling methods are well appreciated by the authors.

### ROTENONE SAMPLING METHODS

Recognizing the shortcomings of the rotenone method for determining standing crop (Krumholz, 1944 and others) but needing some quantitative estimation of standing crop, two sites were sampled by the rotenone method on June 9, 1958. Soundings and plane table mappings of these areas were conducted on June 18, 1958. Project personnel with the guidance of Mr. Raymond Martin and Mr. William Mathis, Fishery Biologists for the Arkansas Game and Fish Commission, poisoned two areas generally typical of the upper area of the lake using 8.2 per cent Powco powdered rotenone in water using a pump-operated spray. The first site, a shallow bay of 4.1 surface acres and 4 feet maximum depth was treated with 9 pounds of rotenone. The second site, a portion of the channel of the old stream bed now having a maximum depth of 12 feet and a surface area of 2.9 acres was treated with 48 pounds of rotenone. Additional information concerning these sites may be found in Cole, Finkelstein and Trenary, 1958.

The fish poisoned in these areas were collected,

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weighed and measured over a two-day period. The shallow bay site was heavily grown with Chara and undoubtedly was not completely cleared of specimens. This bay is poorly joined to the main lake by two shallow mud bars which fairly well prevented any extensive migration in or out of the poisoned zone. The channel site has no such natural limits and was not blocked off by seines being delimited only by two walls of rotenone delivered before general poisoning was started. Every effort was made to count only specimens captured within this area. Unfortunately no means of determining movement in or out of the area subsequent to the poisoning is possible utilizing this technique.

Based on size factors (see Cole et al., 1958), all fishes were classed as young, intermediate or adults after having been sorted to species. Scales and measurements were taken on a number of specimens but no attempt was made to determine sex of those specimens. Table I indicates the estimations of the adults per acre from these two sites and an average figure for the lake expressing our only knowledge about the possible adult population at that time.

Just how typical of the entire lake these sites are is difficult to say. Probably the upper half of the lake is relatively similar; however, the region near the dam and the boat dock is largely over 40 feet in depth. Such habitat was not and probably cannot be effectively sampled by rotenoning for reasons of good public relations and thus an attempt to determine total lake standing crops based upon such biased data is dangerous. However, since no other additional means for estimating standing crop was available at that time, any preliminary statements made based on such information must be clearly labeled as tentative. During the second year of the project, it is planned to develop and use a boat-mounted electric shocker in gathering specimens sufficient for a mark and recapture study. While there are definite increases in time and effort needed by such a program, its accuracy and reliability should be such as to permit a valid statement concerning standing crop and harvest. It is hoped that additional rotenone samples conducted along with the mark and recapture program may give some indication of the reliability of our present effort.

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### CREEL CENSUS METHODS

Based upon personnel and equipment limitations, it was decided that sufficient accuracy could be gained by sampling creels only three of the seven days in the week. Since fishing pressure appeared to be generally highest on the weekends, both Saturdays and Sundays were censused in each week. The third day was chosen in such a fashion as to be sampled one day later each succeeding week. During the period from April through October, this resulted in each of the five weekdays being sampled every five weeks. From early November through the end of March the lake was closed on Fridays, resulting in a sampling of the four weekdays every four weeks. The lake is officially opened for fishing by Mr. Ira Cole, lake manager, from sunrise until about one hour after sunset. Usually the lake opens between 5:30 and 6:00 a.m. during the warmer months and between 6:30 and 7:00 a.m. during the colder months of the year. The creel census clerks are due on the lake site, forty miles south of Fayetteville, by 8:00 a.m. This almost always is in sufficient time to catch the first returning boats. Should any boats be missed at this time, the lake manager can usually supply sufficient catch data. The clerks remain at the lake until the last boat returns, usually after sunset.

The following information is obtained from the returning fishermen by the census clerk: number of fishermen, not always agreeing with the total number of boat occupants; total number of hours spent fishing; type of boat used and how powered; type of bait used; and the name and residence of one member of the party. Each fish caught by the fishermen is weighed and measured. Time permitting, scale samples are taken from each specimen for use in the age and growth phase of the project. At present, only creel census data resulting in estimations of total catch or harvest has been analyzed to date.

### CRITICISM OF CREEL CENSUSING METHODS

Lake Fort Smith is considered nearly an ideal lake for creel censusing. It has only one access road leading to the one dock and launching site, the remaining shoreline being generally inaccessible. About 80 per cent of the fishermen using

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the lake fish from boats and most of them use boats rented by the lake manager. During the period from July 1957 through June 1958, 1539 boats were rented or launched, 1431 of which were rentals. No boats are permitted on the lake with larger than  $7\frac{1}{2}$  HP motors and no swimming or water-skiing is permitted. About 20 per cent of those fishing the lake, fish from the shore and almost all of these fishermen use the access road and come to the dock parking area before leaving the lake. A relatively small number of local residents walk in about one-half mile from a dirt road which passes near the upper end of the lake. These persons are often missed by the census clerk who makes only unscheduled trips from the dock site. The effect of these fishermen upon the total harvest of the lake is unknown.

Other errors are also present in the censusing technique. During the census day, the census clerk is expected to examine gill nets, wire traps, trot lines or other gear which may be in the water. He is expected to accomplish this at the most opportune time and occasionally parties may return to the dock in his absence. Persons undoubtedly are also missed who visit the lake during unauthorized times. Night fishing by boat is prohibited, but several illegal boats probably used for night fishing or running illegal gear were confiscated during the reporting period. It is known too that unauthorized shore fishing takes place at night as well as during the closed Fridays in the winter. The total effects of these errors upon the estimation of total harvest are unknown and while inherent in any creel census, may actually be of more than minor importance in the total harvest from a lake so lightly harvested. On occasion, several parties as well may arrive at the dock at one time during sudden showers, or at night closing times and the single clerk may not be able to obtain all the information desired. Usually, however, the clerk is able to get enough information for basic catch and effort estimations. Although these errors are common to many creel censusing operations, they may show a greater total effect at Lake Fort Smith because of the very light fishing pressure. Nonetheless, it is felt that the data presented represents a reasonably accurate measure of the total fishing effort for the eleven-month period from August 1, 1957 through June 30, 1958.

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## DISCUSSION

The data resulting from the creel census program were expanded for Tables II and III in the following manner to develop an estimation of total harvest and total fishing pressure per acre per year. One weekday a week was sampled and used as the best estimate of fishing for that four- or five-day period. To this expanded estimate for the four- or five-day period was added the total fishing data gathered from the Saturday and Sunday census for the estimation of total fishing effort and pressure for the week. In addition, the three main summer holidays, Memorial Day, Fourth of July, and Labor Day were treated as special days and were separately censused. There seems to be good evidence, unfortunately, that the precision of our estimate would have been greatly enhanced had an extra census day per week been added during the more heavily fished summer months (Jessen, in Carlander et al., 1956).

During certain weeks of the year, "lost" data occurred. If for some reason the clerk was unable to be on the lake on a scheduled weekday, the creel census data from the weekday of the previous week and for the day of the week immediately following were averaged and that average used as the best estimate for the "lost" day and substituted for it in the expansion. If weather conditions prevented travel to the lake and if it could subsequently be determined that the lake was not fished that day, that day was treated as if the census taker had been present on the lake.

## RESULTS

Preliminary evaluation of the first year's creel census information indicates that Lake Fort Smith is relatively lightly fished. It has a relatively low rate of harvest for unit effort as well which may be related to its poorer than average standing crop as estimated by the rotenone sampling. The two June 1958 rotenone samplings indicated a standing crop of less than 60 pounds of all species and sizes of fishes per acre. These samples indicated approximately 17 adult largemouth bass, 39 white crappie and 32 bluegill adults per surface acre plus other assorted sunfishes and catfishes bringing the estimation of the average acre's crop to about 120 game fish of a size acceptable to the

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TABLE II

 EXPANDED TOTAL HARVEST AND FISHING PRESSURE  
 DATA, LAKE FORT SMITH, 1957-58

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Estimated total number of fishermen	2,910 2,910
Estimated total number of trips	1,431
Estimated total number of fishermen hours	13,160
Estimated total number of fish harvested	4,905
Estimated weight of fish harvested	1,646.4 lbs.
Estimated pounds of harvested game fish/acre/year	3.14 lbs.
Estimated number of harvested game fishes/acre/year	9.33
Estimated man hours of angling/acres/year	25.04 hrs.

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TABLE III

EXPANDED TOTAL HARVEST BY KIND, PERCENTAGE  
OF TOTAL CATCH IN POUNDS AND NUMBERS  
LAKE FORT SMITH, 1957-58

Common Name	Total Number	% of Total	Total Weight (Lbs.)	% of Total
Largemouth bass	836	17.0	679.4	41.3
White crappie	2,222	45.3	479.6	29.1
Black crappie	193	3.9	74.2	4.5
Longear sunfish	54	1.1	5.5	0.3
Bluegill sunfish	1,320	26.9	292.9	17.8
Spotted bass	45	0.9	24.8	1.5
Smallmouth bass*	4	0.1	3.8	0.2
Green sunfish	80	1.6	15.3	0.9
Warmouth	122	2.5	38.3	2.3
Channel catfish	16	0.3	26.3	1.6
Flathead catfish	13	0.3	6.3	0.4
<b>TOTALS</b>	<b>4,905</b>	<b>99.9</b>	<b>1,646.4</b>	<b>99.9</b>

\*Probably are misidentified spotted bass.

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sportsman. The data from this pair of rotenone samplings are given in Table I. Based only upon this information, it is possible to make only a very hazardous guess that the adult game fish population in the lake in June 1958 included about 20,500 white crappie, 16,700 bluegill and 9,100 largemouth bass, and 17,000 additional sunfishes and catfishes of an acceptable size. Assuming that recruitment has been balancing natural mortality up to the time that the rotenone samplings were conducted, a very rough approximation of percentage of total harvest of the total yearly adult population can be made. Such an approximation has been reached in Table I. The column labeled estimation of total population existing in the lake from July 1957 through June 1958 is the sum of the population in June based on the rotenone samples plus the estimated yearly harvest. Utilizing these figures, it is possible to compute the percentage of adult game fish harvested by fishermen during this period. This is included as Column 9 in Table I which may be compared with Column 7 (per cent of total harvest) of the same table. These figures, of limited accuracy, appear to indicate rates of harvest of about 10 per cent for three of the four predominant game species as determined by the rotenone samplings. Such a rate of harvest must be considered very light. A further examination of the proportions of adults harvested versus the proportions of adults present in the lake indicates a close relationship for the largemouth bass, bluegill and white crappie. The warmouth apparently is the third most common fish in the lake according to the rotenone samples and represents about 20 per cent of the total adults but it is relatively unimportant in the creel representing only 2 per cent of the catch. A similar situation is felt to exist regarding the green sunfish which is not included in Table I since adults were not taken by the rotenone sampling technique and also for the longear sunfish which are much more common in the lake than is indicated by the rotenone data. Undoubtedly the poor representation of these three species in the creels of the average fisherman is related to their relative undesirability and small size. Additionally, fishermen in Lake Fort Smith do not utilize fishing methods designed to catch these species. This is essentially similar to the problem pointed out regarding the black crappie in

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Shoe Lake by Ricker, 1942. This may be further noted by an examination of Table VI, which considers the composition of the fisherman's catch by quarters during 1957 and 1958. It is interesting to note that largemouth bass and bluegill are generally present in about equal numbers in the creel except in the late winter period when the largemouth bass is about the only species taken. The white crappie on the other hand fluctuated from being absent in the late winter creels to being the most commonly taken fish during the spring period.

A summary of the expanded total harvest and fishing pressure data from Lake Fort Smith during the 1957-1958 season is included as Tables II and III. A figure of 9.33 game fishes harvested per acre per year during this period roughly corresponds with the level of fishing pressure computed in the previous paragraph. Estimated harvest of pounds of game fish per acre is in the order of 3.14 pounds per acre per year. In order that a comparison of fishermen use of the lake, rates of success, total numbers of days censused and other such data can be presented by quarters, Table IV is presented.

Since this paper and its companion paper by Dr. James Stevenson and Clinton Richards represent the initial reports for creel census in the State of Arkansas, data have been gathered from similar creel censuses outside the state and presented in Table V for comparative purposes.

### ACKNOWLEDGMENTS

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TABLE IV

SUMMARY CREEL CENSUS BY QUARTERS - JULY, 1957 THROUGH JUNE, 1958

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total
No. of days checked	26	35	33	33	127
Number of hours checked	272	188	197	247	904
No. of fishermen contacted	742	92	116	895	1,845
No. of trips	317	47	56	391	811
Total fishermen hours censused	3,142.0	340.25	413.25	4,055.50	7,951.00
No. of successful trips censused	159	16	11	181	367
Ave. No. of hours in successful trip	11.95	9.67	9.80	12.52	*10.99
No. of unsuccessful trips	158	31	45	210	444
Ave. No. of hours in unsuccess- ful trip	7.99	5.98	6.78	8.52	*7.32
Total No. of fish caught	978	84	23	1,686	2,771
Ave. No. of fish caught/trip	3.08	1.79	0.41	4.31	3.42
Ave. No. of fish caught/hour	0.32	0.27	0.06	0.41	0.35
Total weight of fish caught	418.9	30.5	20.9	626.4	1,096.7
Wt. of fish caught/trip	1.31	0.65	0.91	1.60	1.35
Ave. Wt. of fish caught/hour	0.13	0.09	0.37	0.15	0.14
No. of fishermen on shore	80	23	28	62	193
Per cent of fishermen on shore	10.7	25.0	24.1	6.9	10.5
No. of fishermen in paddleboats	49	5	4	29	87
Per cent of fishermen in paddleboats	6.60	5.43	3.44	3.24	4.7
No of fishermen in motorboats	613	64	84	804	1,565
Per cent of fishermen in motorboats	82.6	69.6	72.41	89.8	84.8

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\*Not weighted.

TABLE V  
COMPARATIVE FISHING RESULTS, LAKE FORT SMITH, 1957-58 WITH  
OTHER WARM-WATER LAKES

	1957-58 Ft. Smith	1956-57 Spavinaw <sup>1</sup>	Clear Lake <sup>2</sup>	Fort Gibson <sup>3</sup>	Fort Gibson <sup>4</sup>
Pounds harvest/A./Yr.	3.14	11.2	24.13	62.0	74.6
Man hours angling/A./Yr.	25.04	12.40	55.11	-----	-----
Ave. hours successful trip	10.99	-----	-----	-----	-----
Ave. no. caught/hour	0.35	0.9	1.22	-----	-----
Ave. wt. caught/hour (Lbs.)	0.14	0.75	0.44	-----	-----
No. game fish harvest/A./Yr.	9.33	11.16	67.03	101.0	155.2

<sup>1</sup>Jackson, 1958.

<sup>2</sup>Represents only harvest from June 21 through August 31. Author estimates that total annual harvest approaches 60 pounds per acre, with 150 man hours recreation (fishing only) per acre. (Di Costanzo and Ridenhour, 1957)

<sup>3</sup>Fort Gibson Reservoir data from Houser, 1958. Data from December, 1954 through September, 1955.

<sup>4</sup>Fort Gibson Reservoir data from Houser, 1958. Data from September, 1955 through August, 1956.

TABLE VI

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## COMPOSITION OF FISHERMAN'S CATCH BY QUARTERS, 1957-58

FISH SPECIES	July-Sept.		Oct.-Dec.		Jan.-Mar.		April-June		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%
Largemouth bass	289	29.55	18	21.4	16	69.6	299	17.7	622	22.4
Smallmouth bass	5	0.5	0	0.0	0	0.0	0	0.0	5	0.2
Spotted bass	0	0.0	0	0.0	1	4.3	26	1.5	27	1.0
Warmouth	22	2.2	3	3.6	0	0.0	61	3.6	86	3.1
White crappie	197	20.1	28	33.3	0	0.0	862	51.1	1087	39.2
Black crappie	34	3.47	4	4.8	0	0.0	64	3.8	102	3.7
Bluegill	371	37.9	25	29.8	6	26.1	336	19.9	738	26.6
Longear sunfish	25	2.6	1	1.2	0	0.0	15	0.9	41	1.5
Green sunfish	25	2.6	4	4.8	0	0.0	21	1.2	50	1.8
Channel catfish	6	0.6	0	0.0	0	0.0	1	0.1	7	0.3
Flathead catfish	4	0.4	1	1.2	0	0.0	1	0.1	6	0.2
TOTAL	978		84		23		1686		2771	
FISHERMAN HOURS SAMPLED	3142		340.25		413.25		4055.5		7951.0	
DAYS CHECKED	26		35		33		33		127	
NO. OF FISH CAUGHT PER HOUR	0.311		0.247		0.056		0.416		0.349	

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