Fish Population Studies on Three Wichita Mountains Wildlife Refuge Lakes[1]

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Studies of impoundments in areas of igneous rocks in Oklahoma are few, and knowledge of fish populations in such areas are needed for a more complete understanding of the relative productivity of waters in the State. Discussion with personnel of the Fish and Wildlife Service at the Wichita Mountains Wildlife Refuge resulted in permission to study three lakes of this mountainous area and an analysis of standing crop, pounds per acre, species composition, and the percentage of desirable and harvestable-size fish was undertaken in June, 1957. Four members of the Fishery Research Laboratory summer survey party were assigned to the project, and field investigations were carried on from June 12 to July 2.

Lost, Burford and Quanah Parker lakes were selected on the basis of accessibility to field equipment, use by fishermen and feasibility of initiating a future fish-management program. To measure the standing crop of fish in these lakes, the short-period simultaneous mark and recapture method of population estimation was employed, using one-inch mesh wire fish traps for a period of 15 lift-days.

Description of watershed. The Wichita Mountains Wildlife Refuge consists of 63,000 acres of igneous rocks, grassland, savanah, and dense woody growth in Comanche County in southwest Oklahoma. The area has an average annual rainfall of about 31 inches. The frost-free period is about 200 days, with a generally moderate southwest prevailing wind. The summers are hot and dry and the winters mild with little precipitation. Evaporation exceeds precipitation which results in considerable fluctuation in ponds and lakes and in the intermittent streams.

The soils are thin and infertile, confined to small deposits of alluvium and colluvium, much of the area being bare granite, prophyry and gabbro and boulders of these rocks. The land-use pattern is notable since it is under the control of the Refuge Division of the Fish and Wildlife Service and is managed for the preservation, protection and production of a variety of wildlife species and longhorn cattle. The human use consists of sightseeing, picnicking, fishing, hiking and camping.

The drainage areas of the three lakes are much alike, the major difference being that Lost Lake has a number of impoundments above it. There are three low-water dams on West Cache Creek directly above the head of the lake, and much larger upstream structures that serve as flood-control and silt-retarding facilities. The drainage areas of Burford and Quanah Parker lakes are more wooded than that of Lost Lake and are without artificial means of flood control; consequently, runoff water has little chance to settle before going into these lakes.

Materials and Methods. In analyzing each lake population, the following data were computed for each species present: number marked, number recaptured, estimated population, number per acre, average weight, pounds per acre, length-frequency, average total length and length range. In order to determine the potential yield and relative condition of "bal-

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ance'" as prescribed by Swingle (1950), the numbers of harvestable-size fish were also determined. Harvestable-size fish are defined by minimum weights for each species as follows: sunfishes, 0.1 pounds; crappies, 0.25 pounds; largemouth bass, 0.4 pounds; bullheads, 0.3 pounds; and channel catfish, 0.5 pounds. All computations were made to the nearest 0.1 pound and rounded to the nearest whole number for presentation. Where appearing in tables, "t" indicates less than 0.5 pounds.

Table I. Area, number of trap-lifts, number of fish marked, and estimated number and weight of total standing crop and harvestable-size fish in Lost, Quanah Parker and Burford lakes, June 12-July 2, 1957.

	Lost Lake	Quanah Parker Lake	Burford Lake
Surface area in acres	9.0	18.2	5.2
Age in years	42	23	35
Average depth in feet	6	12	7
Maximum depth in feet	30	20	18
Average pH	7.6	7.4	7.8
Average MO alkalinity	77	42	82
Number of traps	10	8	8
Number of traplifts	139	120	117
Number of fish marked	826	1,525	777
Estimated total population per acre	1,590	2.200	1,500
Estimated pounds per acre	184	251	180
Pounds of harvestable fish per acre	149	131	118
Number of harvestable-size fish per acre	662	620	733

Table II. Estimated total standing crop and harvestable-size fish in pounds per acre, based on short-period simultaneous mark and recovery in wire traps, in Lost, Quanah Parker and Burford Lakes, June 12-July 2, 1957.

	Standing crop in pounds per acre					
	Lost Lake		Quanah Parker Lake		Burford Lake	
Species	Total	Harvestable-size	Total	Harvestable-size	Total	Harvestable-size
Largemouth bass	28	23	31	16	5	5
Bluegill	113	92	140	52	160	100
Redear sunfish	31	23	49	44	10	9
Black bullhead	7	7	1	1	1	1
White crappie	t	t	11	2		
Black crappie	1		2			
Warmouth	4	4	1	t	2	1
Green sunfish					2	2
Orangespotted sunfish					t	t
Channel catfish			16	16		
Total	184	149	251	131	180	118
Percent Harvestable (A_t)	81		52		66	

During the 15-day period of study, 376 traplifts were made, and a total of 3,128 fish captured and marked in the three lakes (Table I.)

Lost Lake was impounded in 1915, and has an area of 9.0 acres, with an average depth of 6 feet and a maximum depth of 30 feet. The average pH was 7.6 and the average MO alkalinity was 77. The total population estimate derived by the mark and recovery method was 14,320, representing seven species (Table I.) Bluegill dominated the population, with redear and largemouth bass following in order of abundance (Table II.) Largemouth bass were represented by an estimated 14 harvestable-size fish per acre, weighing 23 pounds. Of the high bluegill population, 459 per acre were harvestable size, weighing 92 pounds. Redear sunfish occurred as harvestable size in the magnitude of 164 per acre, weighing 23 pounds. Black bullheads had a density of 4 individuals per acre, weighing 7 pounds. Harvestable-size white crappie represented less than 0.5 pounds per acre, and black crappie occurred in the density of 2 per acre, and had a total weight of one pound. Warmouth were found to occur in a density of 18 per acre, weighing about 4 pounds. All harvestable-size fish combined totalled 5,960, weighing 1,340 pounds.

Burford Lake, impounded in 1922, is 5.2 acres in surface area, with an average depth of 7 feet and a maximum depth of 18 feet. The average pH was 7.8 and the average MO alkalinity was 82. The total estimated population for this lake was 1,506 fish per acre. Bluegill again dominated the population by accounting for 1,433 of this number, with redear sunfish and green sunfish following in order of abundance. The total number of harvestable-size fish in this lake were comparable to those in Lost Lake. Largemouth bass had a density of 4 harvestable individuals per acre, with a total weight of 5 pounds. Bluegill, totaled 664 harvestable fish per acre, having a total weight of 100 pounds and redear sunfish numbered 34 per acre, weighing 9 pounds. Harvestable black bullheads were represented by one individual per acre weighing one pound. Warmouth and green sunfish combined accounted for 14 per acre, weighing 3 pounds. Harvestable-size fish totalled 3,810, weighing 615 pounds.

Table III. Comparison of the estimated total standing crop in 11 small Oklahoma lakes, based on mark and recovery in 1-inch mesh wire traps and total pounds per acre of desirable-size* fish in these lakes.

		Standing crop in pounds per acre		
Name of Lake	Acres	Total	Desirable-size*	Percent desirable-size*
North Rod & Gun	9.0	360	155	43
Hominy City	10.0	421	27	6
Danielson	13.0	148	131	89
Ada City	14.0	90	33	37
Chickasaw Club (A)	22.2	845	788	93
Chickasaw Club (B)	22.2	506	465	92
Sportsman Club	25.0	167	7	4
Lake Dahlgren	25.2	171	78	46
Odom	19.0	125	88	70
Lost	9.0	184	78	42
Quanah Parker	18.2	251	65	26
Burford	5.2	180	82	46
Average	16.0	287	166	50

*Desirable-size fish, minimum weight: sunfishes — 0.15 pounds; crappies — 0.25 pounds; bullheads — 0.30 pounds; largemouth bass, channel catfish — 0.50 pounds.

Quanah Parker Lake, the youngest and the largest of the lakes, was 18.2 acres at the time of study. The average pH was 7.4 and the MO alkalinity, 42. Bluegill dominated the population, accounting for 74.8 percent of the total catch in the wire traps. Redear sunfish constituted 11 percent of the catch, white crappie 8.3 percent, and the remaining 5.9 percent of the catch including small numbers of black crappie, largemouth bass, warmouth, black bullhead, golden redhorse, channel catfish and golden shiner.

The estimated numbers of harvestable-size fish per acre in this body of water were as follows: Largemouth bass, 5 per acre weighing 16 pounds; bluegill, 371 individuals weighing 52 pounds per acre; redear sunfish, 229 weighing 44 pounds per acre; black bullhead, 1 per acre weighing 1 pound; white crappie, 3 per acre with a weight of 2 pounds; channel catfish, 9 per acre weighing 16 pounds. All harvestable-size fish combined totalled 11,280, weighing 2,385 pounds.

So that an index to the relative level of production of the three lakes could be gauged, nine lakes from other areas in the State were selected for comparison. An examination of Table III shows the percentage by weight of desirable-size fish per acre for the nine lakes as 62.5 compared to 37 in the three Wichita Lakes. None of the other nine lakes are in areas of igneous rocks and since the productivity of the two groups of lakes is markedly different, it is concluded that the non-igneous areas have waters of greater natural fertility.

In preparing the tables in which harvestable-size fish (A_t) are involved, the sizes established by Swingle (1950) serve as a means of measurement of relative availability and the term desirable-size fish is similarly employed as an availability measure by the Fishery Research Laboratory wherein minimum sizes are somewhat greater (Jenkins, 1957) than the sizes employed by Swingle. Both measures are arbitrary and need more careful study and definition.

The one-inch mesh wire traps used in the study are selective for fish over 4 inches long; that segment of the population less than 4 inches long was not sampled. It is considered that the A_t figures for the 3 lakes are somewhat higher than actual. A more accurate total standing crop estimate would be a value about 15 percent higher than the figures presented, since the smaller fish are not included in the totals.

Management Analysis. Since the three lakes are so similar in population composition, with bluegill as the dominant species, it is recommended that Lake Burford be selected for experimental population manipulation because of its small size and freedom from upstream contamination of unwanted fishes. It is suggested that all fish be eliminated from this lake, and it be restocked with redear sunfish, largemouth bass and channel catfish. This experiment could be used as an index to a possible management plan for all small lakes in the Wichita Mountain area.

Quanah Parker Lake, which is presently under a program of aquatic vegetation control by the manipulation of water levels, could be drawn down and all fishes removed. This step, followed by restocking with largemouth bass, channel catfish and redear sunfish should result in better fishing within two years.

Under present conditions, the harvestable pounds of fish in Lost Lake should afford about 520 successful fisherman-days annually at an average catch-rate of 2.6 pounds per day. Quanah Parker Lake should furnish 845 fisherman-days per annum, and Burford Lake should have a use of 260 days in the same length of time. These lakes theoretically afford 1,625 fisherman-days, or a total of 260 fisherman-hours per acre per year.

These 1,625 fisherman-days are considered at present to represent a potential annual fisherman expenditure of about $11,000. It is probable that these lakes are currently receiving much greater angler use.

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