FISHERIES SECTION

PRELIMINARY REPORT ON THE EFFECTS OF THE REMOVAL OF ROUGH FISHES ON THE CLEAR LAKE SPORT FISHERY

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INTRODUCTION

Clear Lake, an oxbow lake of approximately 115 acres, is located in northeast Louisiana. Most water in the lake has a depth of 5 to 10 feet. Clear Lake was selected as a study area on which to evaluate experimental fish management practices. Fish population samples taken by rotenoning during 1953 showed that the standing crop of fish consisted of approximately 90 percent, by weight, of gizzard shad. Following the removal of rough fishes by seining, intensive investigations were conducted to determine the effects on the fish population and the sport fishing. This report will concern itself primarily with the changes occurring in the sport fishing over a five-year period, September, 1953 through August, 1958.

REMOVAL OF ROUGH FISHES FROM CLEAR LAKE

The principle rough fish removal operations were carried out during the winter and spring of 1953-54. Rough fishes removed after that period were only incidental to other operations. Table I summarizes the results of the rough fish removal operations.

Fish were removed during the winters and springs of 1953-54 and 1954-55 with a 400-yard haul seine which had a 1-inch square mesh pocket. During October of 1955, the lake was seined with a 300-yard seine of 2-inch square mesh webbing. An 800-yard haul seine with a 1-inch square mesh pocket was used during February and March, 1956.

TABLE I

POUNDS PER ACRE OF ROUGH FISHES REMOVED FROM CLEAR LAKE *

	Gizzard Shad	*Buffalo Fish*	*Garfish*	*Catfish*	*Other Fish*	*Total*
Winter and Spring 1953-54	173.7	24.2	4.1	0.3	0.9	203.0
Jan. 18–Feb. 17, 1954	139.4	17.3	2.6	. .	0.4	159.7
May 14–June 2, 1954	34.3	6.9	1.5	0.3	0.5	43.3
Winter and Spring 1954-55	41.3	1.9	0.7	. .	0.4	44.0
November, 1954 (Fish Kill)†	21.7	. .	. .	. .	. .	21.7
Nov. 16–Dec. 30, 1954	13.8	1.2	0.7	. .	‡	15.7
March 22-30, 1955	5.8	0.7	‡	. .	0.4	6.5
October 25-28, 1955	. . .	10.4	. .	. .	. .	10.4
Feb. 15–March 6, 1956	11.1	0.4	1.1	. .	‡	12.6

* Approximately 2,000 pounds (17 pounds per acre) of gizzard shad were killed during October, 1953 fish population sampling. This would increase the total amount of gizzard shad removed during 1953-54 to 191 pounds per acre and the total amount of all rough fish removed during 1953-54 to 220 pounds per acre. Also, 1,200 pounds (10 pounds per acre) of gizzard and threadfin shad were removed during October, 1956 fish population sampling.

† The cause of the fish kill was unknown. An estimated 2,500 pounds of dead gizzard shad were seen floating on the water—no other species were observed.

‡ Less than 0.05.

CREEL CENSUS METHODS

In order to determine changes occurring in the sport fishery, an intensive creel census was conducted from September, 1953 through August, 1958. The census methods used are described in another report (Lambou and Stern, 1958).

Some night fishing, primarily for bass, occurred during the summer months; however, we believe that this fishing comprised but a very small percent of the total fishing pressure. This night fishing was not sampled and, therefore, estimates of the total harvest of bass from the lake should be considered as minimum.

In conducting the creel census and analyzing the data some grouping of species of fish was necessary (common names and scientific names of fishes mentioned in this report are given in Table II). Species of fish were grouped into the following classes:

Class	*Species of Fish*
Bass	Largemouth bass. (This class includes all the black basses—spotted bass occur in the creel on other bodies of water in La.).
Crappie	Black crappie and white crappie.
Sunfish	Bluegill sunfish, redear sunfish, warmouth sunfish, longear sunfish, and green sunfish. (This class includes all sunfishes occurring in the creel.)
Striped Bass	Yellow bass. (This class also includes white bass which occur in the creel on other bodies of water in Louisiana.)

The reliability of creel census data depends considerably on the sample size. Table III shows the number of half-days the creel census was conducted; Table IV shows the number of fishermen checked, number of fishing parties checked and number of man-hours of fishing checked; Tables V and VI show the number and pounds of fish checked by species. It is believed that the creel census sample was of sufficient size to give significance at a low probability to the majority of the observed differences.

TABLE II

LIST OF COMMON AND SCIENTIFIC NAMES OF FISHES APPEARING IN THIS REPORT

Common Name	*Scientific Name*
Largemouth bass	*Micropterus salmoides*
Spotted bass	*Micropterus punctulatus*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis migromaculatus*
Bluegill sunfish	*Lepomis macrochirus*
Redear sunfish	*Lepomis microlophus*
Warmouth sunfish	*Chaenobryttus coronarius*
Longear sunfish	*Lepomis megalotis*
Green sunfish	*Lepomis cyanellus*
Yellow bass	*Morone interrupta*
White bass	*Roccus chrysops*
Bullheads	Mostly *Ictalurus natalis*
Other catfish	*Ictalurus punctatus, Ictalurus furcatus* and *Pylodictis olivaris*
Shiner	Family Cyprinidae
Garfish	*Lepisosteus* spp.
Bowfin	*Amia calva*
Gizzard shad	*Dorosoma cepedianum*
Threadfin shad	*Signalosa petenensis*
Buffalo fishes	*Ictiobus cyprinellus, Ictiobus niger* and *Ictiobus bubalus*

TABLE III

NUMBER OF HALF-DAYS CLEAR LAKE CREEL CENSUS WAS CONDUCTED

The first figure represents the number of half-days the census was conducted, the figure in parenthesis represents the number of half-days in the month or year and the third figure represents the sample size expressed as percent of total number of half-days.

	Census									
Day of Week	*1953-54*		*1954-55*		*1955-56*		*1956-57*		*1957-58*	
Monday	12 (100)	12.0	13 (100)	13.0	13 (102)	12.7	15 (102)	14.7	13 (102)	12.7
Tuesday	13 (106)	12.3	12 (104)	11.5	15 (104)	14.4	13 (104)	12.5	13 (104)	12.5
Wednesday	12 (102)	11.8	14 (106)	13.2	24 (102)	23.5	27 (104)	26.0	25 (104)	24.0
Thursday	13 (104)	12.5	14 (104)	13.5	26 (106)	24.5	26 (102)	25.5	26 (104)	25.0
Friday	17 (102)	16.7	25 (102)	24.5	14 (104)	13.5	13 (102)	12.7	13 (100)	13.0
Saturday	23 (104)	22.1	52 (104)	50.0	50 (104)	48.1	53 (106)	50.0	52 (104)	50.0
Sunday	15 (102)	14.7	25 (104)	24.0	12 (104)	11.5	16 (104)	15.4	13 (106)	12.3
Holiday	10 (10)	100.0	6 (6)	100.0	6 (6)	100.0	6 (6)	100.0	6 (6)	100.0
TOTAL	115 (730)	15.8	161 (730)	22.1	160 (732)	21.9	169 (730)	23.2	161 (730)	22.1

TABLE IV

NUMBER OF FISHERMEN CHECKED, NUMBER OF FISHING PARTIES CHECKED AND NUMBER OF MAN-HOURS OF FISHING CHECKED ON CLEAR LAKE

	Census Year				
	1953-54	*1954-55*	*1955-56*	*1956-57*	*1957-58*
No. of Fishermen Checked	1,268	3,542	2,232	1,975	1,281
Number of Parties Checked	748	2,023	1,319	1,091	739
Man-Hrs. of Fishing Checked	3,737.75	10,819.25	6,133.00	6,384.50	3,899.00

TABLE V

NUMBER OF FISH, BY SPECIES, CHECKED ON CLEAR LAKE

	Census Year				
	1953-54	*1954-55*	*1955-56*	*1956-57*	*1957-58*
Largemouth Bass	52	171	280	353	598
White Crappie	465	1,511	438	787	240
Black Crappie	37	116	50	77	36
Bluegill Sunfish	4,028	14,031	7,722	5,638	2,198
Redear Sunfish	32	143	150	558	633
Warmouth Sunfish	72	90	180	249	273
Longear Sunfish	215	275	351	438	267
Green Sunfish	67	...	...	1	...
Yellow Bass	58	573	440	431	364
Bullhead	5	21	28	42	55
Other Catfish	1	3	4	14	33
Shiner	10	...	...	...	...
Garfish	1	...	...	...	...
Bowfin	...	...	4	...	...
TOTAL NUMBER	5,043	16,934	9,647	8,588	4,697

TABLE VI

POUNDS OF FISH, BY SPECIES, CHECKED ON CLEAR LAKE

	Census Year				
	1953-54	*1954-55*	*1955-56*	*1956-57*	*1957-58*
Largemouth Bass	66.5	270.1	424.0	565.8	796.3
White Crappie	341.5	703.7	245.5	619.3	235.4
Black Crappie	26.7	77.5	25.0	48.1	25.8
Bluegill Sunfish	855.5	2,568.5	1,091.8	718.1	326.4
Redear Sunfish	10.6	45.4	16.3	94.1	103.3
Warmouth Sunfish	11.3	12.7	20.6	17.9	25.5
Longear Sunfish	44.7	37.2	23.5	27.4	11.1
Green Sunfish	10.2	...	...	*	...
Yellow Bass	19.5	173.5	126.6	105.2	135.4
Bullhead	8.8	16.6	9.1	24.8	25.1
Other Catfish	0.6	1.6	1.0	3.1	22.2
Shiner	0.5	...	...	...	...
Garfish	7.0	...	...	...	...
Bowfin	...	...	7.6	...	...
TOTAL POUNDS	1,403.4	3,906.8	1,991.0	2,223.8	1,706.5

* Less than 0.05.

CHANGES OCCURRING IN THE SPORT FISHERY

Relative Importance of the Various Kinds of Fishing. Practically all of the sport fishing on Clear Lake was for bass, crappie and sunfish (Table VII). Sport fishing for striped bass (yellow bass) occurred only during the second and third census years—it amounted to less than one percent of the total man-hours. Some striped bass were caught during other years by fishermen fishing for other kinds of fish.

There was relatively little fishing for bass during the first census year (3.7 percent of the total man-hours); however, the importance of bass fishing in-

creased each succeeding year and during the fifth year it comprised 30.2 percent of the total man-hours of fishing.

The percent crappie fishing comprised of the total man-hours of fishing ranged from 16.6 during the third year to 31.3 during the fourth year. Crappie fishing made up 27.6 percent of the total man-hours of fishing during both the first and fifth years.

During the first and second years sunfish fishing comprised 68.7 and 76.6 percent of the total man-hours of fishing respectively. Each succeeding year the importance of sunfish fishing declined and during the fifth year it comprised only 42.2 percent of the total man-hours of fishing.

Composition of the Catch. There were extensive changes in the relative composition of the sport fish catch. The importance of bass from both a numerical and weight standpoint increased considerably during the five census years. Bass comprised 1.0 percent of the total number and 4.3 percent of the total pounds of fish caught during the first year, while they comprised 12.8 percent of the total number and 47.0 percent of the total pounds during the fifth year (Tables VIII and IX).

TABLE VII

PERCENT OF TOTAL ESTIMATED MAN-HOURS FISHED FOR EACH KIND OF FISH

	Census Year				
	1953-54	*1954-55*	*1955-56*	*1956-57*	*1957-58*
Bass	3.7	3.9	10.4	15.5	30.2
Crappie	27.6	19.3	16.6	31.3	27.6
Sunfish	68.7	76.6	72.3	53.1	42.2
Striped Bass	. . .	0.3	0.7	. . .	. . .
Other	. . .	. . .	. . .	*	. . .
TOTAL MAN-HOURS	22,161	46,723	24,714	24,537	16,354

* Less than 0.05.

TABLE VIII

RELATIVE COMPOSITION OF TOTAL ESTIMATED CATCH OF FISH, BY KINDS OF FISH, EXPRESSED AS PERCENT OF TOTAL NUMBER

	Census Year				
	1953-54	*1954-55*	*1955-56*	*1956-57*	*1957-58*
Bass	1.0	1.0	2.5	4.2	12.8
Crappie	11.3	9.9	4.9	9.6	5.6
Sunfish	86.2	85.4	88.0	80.7	72.0
Striped Bass	1.3	3.6	4.1	4.8	7.4
Other	0.3	0.1	0.4	0.6	2.1
TOTAL NUMBER	28,902	72,757	40,066	33,019	20,466

TABLE IX

RELATIVE COMPOSITION OF TOTAL ESTIMATED CATCH OF FISH, BY KINDS OF FISH, EXPRESSED AS PERCENT OF TOTAL POUNDS

	Census Year				
	1953-54	*1954-55*	*1955-56*	*1956-57*	*1957-58*
Bass	4.3	6.5	19.4	27.0	47.0
Crappie	29.2	20.4	13.5	28.0	15.1
Sunfish	63.7	67.8	60.3	39.3	27.4
Striped Bass	1.5	4.7	5.9	4.5	7.5
Other	1.3	0.5	0.9	1.2	3.0
TOTAL POUNDS	8,218.7	16,802.3	7,974.7	8,556.7	7,225.9

The importance of crappie from a numerical standpoint ranged from 4.9 percent of the total number of fish caught during the fourth year to 11.3 percent during the first year. The percent crappie comprised of the total pounds of fish caught ranged from 13.5 during the third year to 29.2 during the first year.

The percent sunfish made up of the total number of fish caught ranged from 72.0 during the fifth year to 88.0 during the third year. Sunfish comprised from

60.3 to 67.8 percent of the total pounds of fish caught during the first three years. There was considerable decrease in the importance of sunfish during the last two years when they comprised 39.3 and 27.4 percent of the total pounds of fish caught respectively.

Striped bass made up from 1.3 percent of the total number of fish caught during the first year to 7.4 percent during the fifth year. The percent striped bass comprised of the total pounds of fish caught ranged from 1.5 during the first year to 7.5 during the fifth year.

The principal species of fish occurring in the catch, from both a numerical and weight standpoint, were the largemouth bass, white crappie, bluegill sunfish, redear sunfish, warmouth sunfish, longear sunfish and yellow bass (Tables X and XI).

Crappie Fishing. During the first and second census years, crappie were caught at the rate of 0.5 and 0.8 fish per man-hour of effort respectively (Fig. 1). The rate of catch decreased to 0.4 fish per man-hour of effort for the next two years and 0.3 fish for the fifth year. The average weights of crappie caught ranged from 0.5 to 0.9 pounds (Table XII).

During the first year there were 6,114 man-hours of fishing for crappie (Fig. 2). The crappie fishing effort increased to 9,013 man-hours during the second year; however, the effort decreased to 4,098 man-hours during the third year. The crappie fishing effort then increased to 7,684 man-hours for the fourth year and decreased to 4,515 man-hours for the fifth year.

TABLE X

RELATIVE SPECIES COMPOSITION OF TOTAL ESTIMATED CATCH EXPRESSED AS PERCENT OF TOTAL NUMBER

	Census Year				
	1953-54	*1954-55*	*1955-56*	*1956-57*	*1957-58*
Largemouth Bass	1.0	1.0	2.5	4.2	12.8
White Crappie	10.3	9.2	4.4	8.8	4.9
Black Crappie	1.0	0.7	0.5	0.9	0.7
Bluegill Sunfish	75.9	82.4	80.5	66.0	46.3
Redear Sunfish	0.9	0.9	1.8	6.2	13.8
Warmouth Sunfish	1.7	0.5	2.0	2.9	6.1
Longear Sunfish	5.7	1.6	3.8	5.5	5.9
Green Sunfish	2.1	. .	. .	*	. .
Yellow Bass	1.3	3.6	4.1	4.8	7.4
Bullhead	0.1	0.1	0.3	0.5	1.3
Other Catfish	*	*	*	0.2	0.8
Shiner	0.1	. .	. .	. .	. .
Garfish	*	. .	. .	. .	. .
Bowfin	. .	. .	*	. .	. .
TOTAL NUMBER	28,902	72,757	40,066	33,019	20,466

* Less than 0.05.

TABLE XI

RELATIVE SPECIES COMPOSITION OF TOTAL ESTIMATED CATCH EXPRESSED AS PERCENT OF TOTAL POUNDS

Largemouth Bass	4.3	6.5	19.4	27.0	47.0
White Crappie	26.7	18.3	12.2	26.0	13.6
Black Crappie	2.5	2.1	1.2	2.1	1.5
Bluegill Sunfish	56.8	65.4	57.0	33.0	19.0
Redear Sunfish	1.1	1.2	1.0	4.0	6.1
Warmouth Sunfish	0.9	0.3	1.1	0.9	1.6
Longear Sunfish	3.9	0.9	1.3	1.4	0.7
Green Sunfish	1.1	. .	. .	*	. .
Yellow Bass	1.5	4.7	5.9	4.5	7.5
Bullhead	0.7	0.5	0.5	1.1	1.6
Other Catfish	*	*	0.1	0.2	1.4
Shiner	*	. .	. .	. .	. .
Garfish	0.5	. .	. .	. .	. .
Bowfin	. .	. .	0.4	. .	. .
TOTAL POUNDS	8,218.7	16,802.3	7,974.7	8,556.7	7,225.9

* Less than 0.05.

Figure 1. - Number of crappie caught per man-hour of effort while fishing for crappie, September, 1953 through August, 1958.

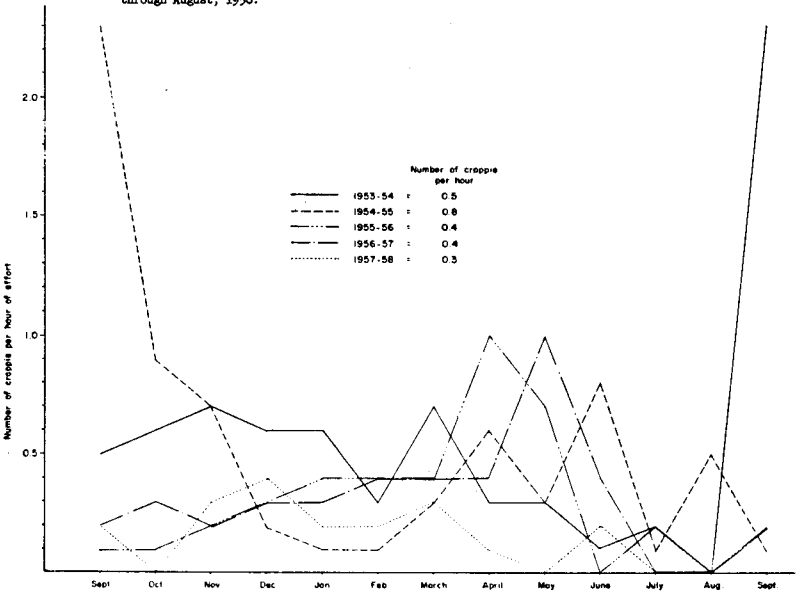
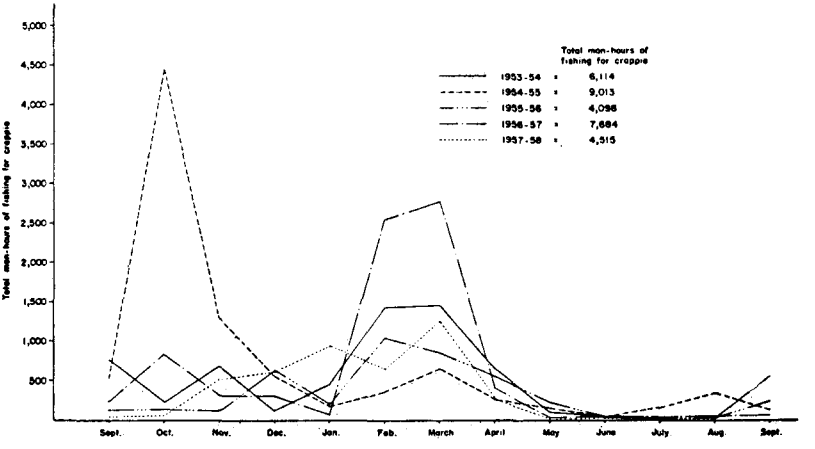


TABLE XII

AVERAGE WEIGHT, IN POUNDS, OF CRAPPIE CAUGHT WHILE FISHING FOR CRAPPIE, SEPTEMBER, 1953 THROUGH AUGUST, 1958
(The Figure in Parenthesis Represents the Number of Specimens)

	Time of Year											
	Sept.	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Total*
1953-54....	0.7(126)	0.7(15)	0.9(71)	0.8(9)	0.7(61)	0.7(47)	0.8(121)	0.3(19)	0.9(4)	0.6(2)	0.3(2)	.....	0.7(477)
1954-55....	0.5(331)	0.5(815)	0.4(208)	0.6(17)	0.6(5)	0.8(7)	0.7(39)	0.4(38)	0.1(8)	0.2(8)	0.3(6)	0.3(29)	0.5(1511)
1955-56....	0.2(3)	0.3(5)	0.3(8)	0.6(35)	0.5(21)	0.7(103)	0.6(105)	0.4(119)	0.7(36)	.....	0.6(1)	.....	0.5(436)
1956-57....	0.6(20)	0.6(65)	0.5(20)	0.6(21)	0.9(7)	0.9(295)	0.9(290)	0.7(48)	0.7(11)	0.4(6)	.....	.....	0.8(783)
1957-58....	1.0(2)	.....	0.8(29)	1.0(54)	1.0(41)	1.0(41)	0.9(74)	0.6(7)	.....	0.6(1)	.....	.....	0.9(249)

Figure 2. - Estimated man-hours of fishing for crappie, September, 1953 through August, 1958.



The total pounds of crappie harvested from the lake followed approximately the same trend as the fishing pressure. A total of 2,397 pounds of crappie was harvested during the first year (Fig. 3). An increase to 3,432 pounds was noted during the second year; however, the next year's harvest decreased to 1,074 pounds. The harvest then increased to 2,394 pounds during the fourth year and decreased to 1,091 pounds for the fifth year.

Figure 3. - Estimated total pounds of crappie caught by sport fishing, September, 1953 through August, 1958.

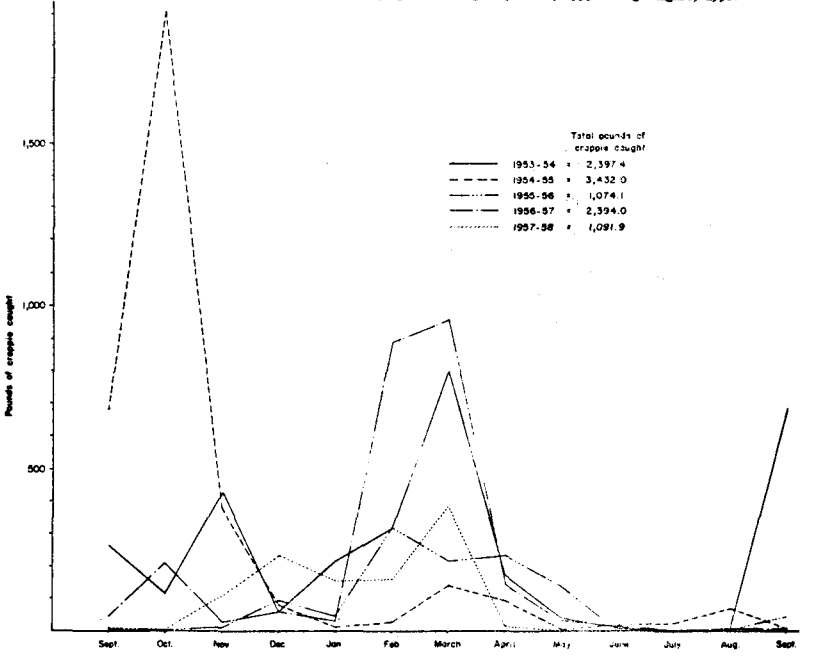
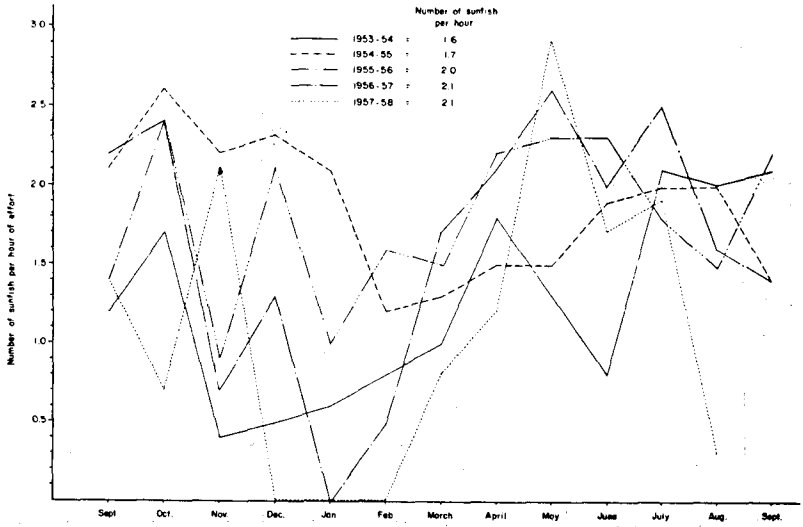


Figure 4. - Number of sunfish caught per man-hour of effort while fishing for sunfish, September, 1953 through August, 1958.



In general, the total harvest, the rate of catch and the fishing pressure for crappie temporarily increased for a short period of time after the removal of rough fishes. For the most part, they then decreased (with some fluctuations among the census years and months) until the last year when they were considerably less than the first year. The average weights of the crappie caught was an exception to the trend summarized above. The average weight of crappie was higher during the fifth year than during the first.

Sunfish Fishing. Sunfish were caught at the rate of 1.6 fish per man-hour of effort during the first census year (Fig. 4). The rate of catch increased during the following years to a maximum of 2.1 fish per man-hour of effort during the last two years. If this was the only measure available, it could be assumed that the quality of the sunfish fishing had improved; however, the pounds of sunfish caught per man-hour of effort show the opposite trend (Figs. 5 and 6). During the first year sunfish were caught at the rate of 0.4 pounds per man-hour of effort. This decreased to 0.3 pounds per man-hour of effort during the next two years and then to 0.2 pounds per man-hour of effort during the following year. There was a slight increase in the rate during the fifth year—0.3 pounds of sunfish per man-hour of effort. During the first two years sunfish averaged 0.2 of a pound in weight; however, they averaged 0.1 of a pound in weight during the last three years (Table XIII). Bluegill sunfish comprised most of the sunfish catch. Their average weights followed almost exactly the same trend as that of all sunfish (Table XIV).

Figure 5. - Pounds of sunfish caught per man-hour of effort while fishing for sunfish, September, 1953 through August, 1958

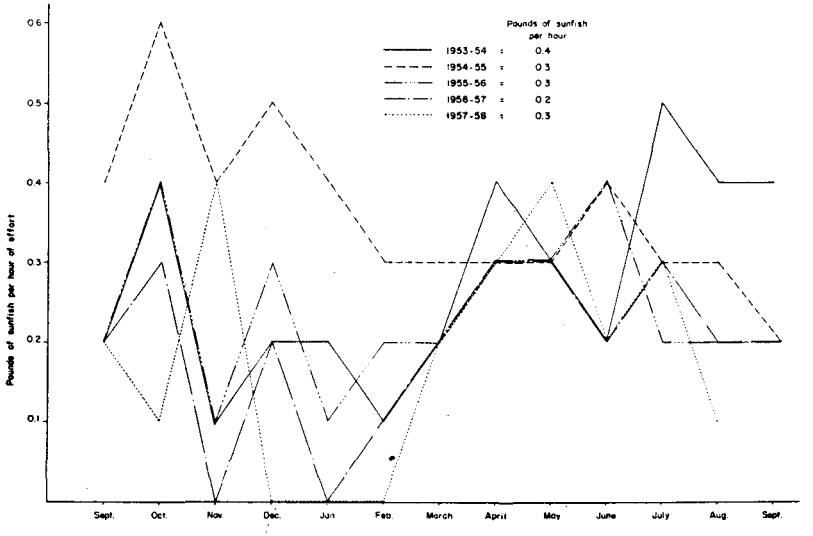
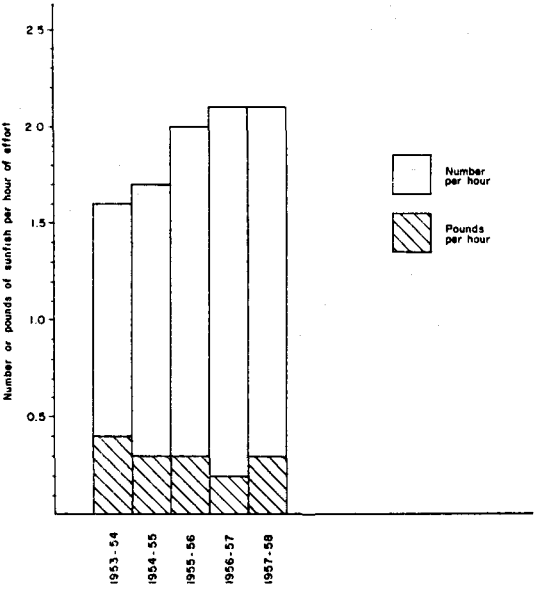


Figure 6. - Comparison of number with pounds of sunfish caught per man-hour of effort while fishing for sunfish, September, 1953 through August, 1958.



TABQE XIII

AVERAGE WEIGHT, IN POUNDS, OF SUNFISH CAUGHT WHILE FISHING FOR SUNFISH, SEPTEMBER, 1953 THROUGH AUGUST, 1958
(The Figure in Parenthesis Represents the Number of Specimens)

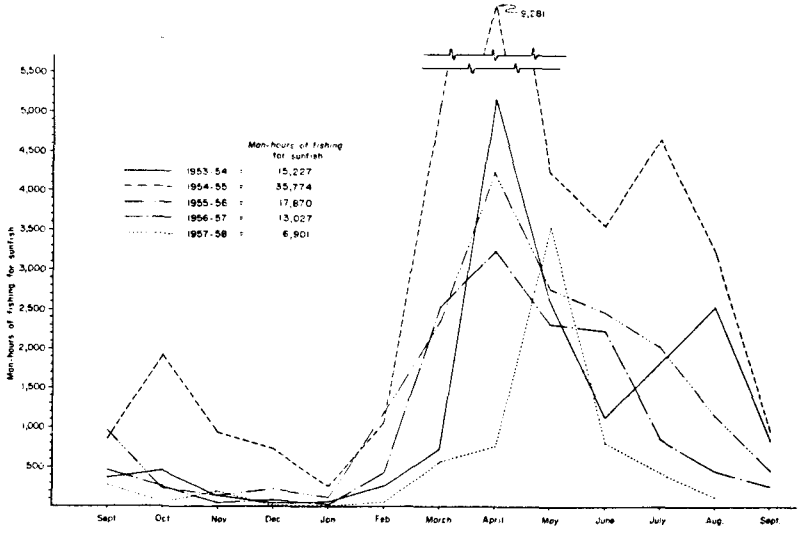
	Time of Year												
	Sept.	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Total*
1953-54....	0.2(154)	0.2(74)	0.2(7)	0.4(1)	0.3(6)	0.2(22)	0.2(85)	0.2(1030)	0.2(427)	0.2(195)	0.2(1302)	0.2(1102)	0.2(4405)
1954-55....	0.2(455)	0.2(1037)	0.2(483)	0.2(263)	0.2(163)	0.2(273)	0.2(1633)	0.2(3386)	0.2(1375)	0.2(1355)	0.2(2841)	0.1(1191)	0.2(14455)
1955-56....	0.2(472)	0.2(162)	0.1(38)	0.1(88)	0.1(25)	0.1(450)	0.1(1159)	0.1(1995)	0.1(1477)	0.2(1066)	0.1(981)	0.1(378)	0.1(8291)
1956-57....	0.1(328)	0.1(139)	0.1(9)	0.1(26)	.....	0.1(58)	0.1(1074)	0.1(1951)	0.1(1491)	0.1(826)	0.1(816)	0.1(150)	0.1(6868)
1957-58....	0.1(114)	0.1(9)	0.2(93)	.....	.....	.....	0.2(101)	0.2(245)	0.1(2273)	0.1(219)	0.2(304)	0.2(9)	0.1(3367)

TABLE XIV

AVERAGE WEIGHT, IN POUNDS, OF ALL BLUEGILL SUNFISH CAUGHT BY SPORT FISHING, SEPTEMBER, 1953 THROUGH AUGUST, 1958
(The Figure in Parenthesis Represents the Number of Specimens)

	Time of Year												
	Sept.	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Total*
1953-54....	0.1(117)	0.3(8)	0.4(1)	.....	.....	.....	0.3(7)	0.2(946)	0.2(405)	0.2(198)	0.2(1281)	0.2(1065)	0.2(4028)
1954-55....	0.2(445)	0.2(1020)	0.2(484)	0.2(253)	0.2(162)	0.2(370)	0.2(1576)	0.2(3230)	0.2(1293)	0.2(1335)	0.2(2791)	0.2(1172)	0.2(14031)
1955-56....	0.2(460)	0.2(161)	0.1(37)	0.1(90)	0.1(25)	0.1(463)	0.1(1161)	0.1(1851)	0.1(1344)	0.2(945)	0.1(851)	0.1(334)	0.1(7722)
1956-57....	0.1(268)	0.1(122)	0.1(9)	0.1(23)	.....	0.1(24)	0.1(836)	0.1(1520)	0.1(1313)	0.1(669)	0.1(733)	0.1(121)	0.1(5638)
1957-58....	0.1(63)	0.1(7)	0.2(40)	.....	.....	.....	0.2(58)	0.2(121)	0.1(1492)	0.1(123)	0.2(286)	0.2(8)	0.1(2198)

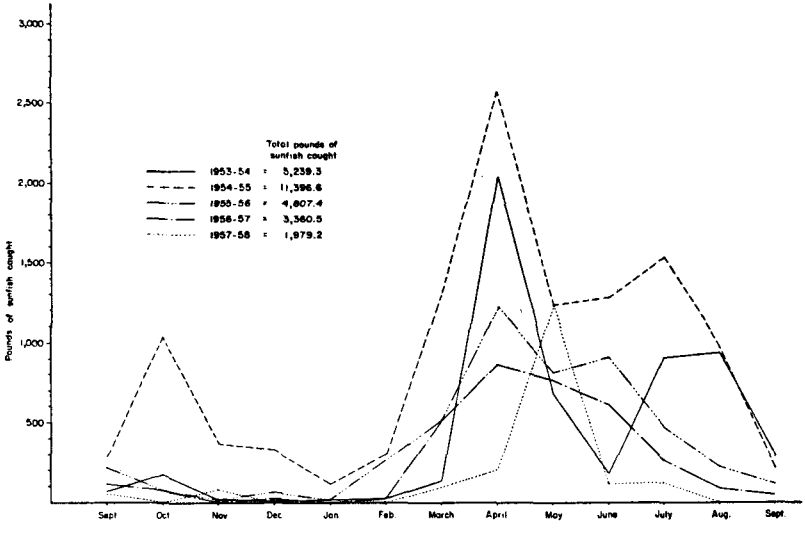
Figure 7. - Estimated man-hours of fishing for sunfish, September, 1953 through August, 1958.



A total of 15,227 man-hours of fishing occurred for sunfish during the first year (Fig. 7). There was a considerable increase in the man-hours of sunfish fishing during the second year (35,774 man-hours); however, during the succeeding years, the fishing effort decreased considerably and only 6,901 man-hours of fishing occurred during the fifth year.

The total pounds of sunfish caught followed essentially the same trend as that of the fishing pressure (Fig. 8). A total of 5,239 pounds of sunfish were

Figure 8. - Estimated total pounds of sunfish caught by sport fishing, September, 1953 through August, 1958.



harvested from the lake during the first year. The harvest increased to 11,396 pounds during the second year and then decreased through the fifth year when 1,979 pounds of sunfish were harvested.

In general, the number of sunfish caught per man-hour of effort increased during the five years. The pounds of sunfish caught per man-hour of effort and the average weights of the sunfish decreased during the five years. The man-hours of fishing and the total pounds of sunfish harvested increased considerably during the second year and then decreased. During the fifth year the man-hours of fishing and the total pounds harvested were considerably less than during the first year.

Bass Fishing. Only 0.1 of a bass was caught per man-hour of effort during the first year (Fig. 9). Bass were caught at the rate of 0.3 of a fish per man-hour of effort during the next three years and increased to 0.5 of a fish per man-hour of effort during the fifth year. During the first year the bass caught averaged 2.1 pounds (Table XV). The average weight of bass decreased each succeeding year and they averaged 1.4 pounds during the fifth year.

Only 825 man-hours of bass fishing occurred on the lake during the first year (Fig. 10); however, the fishing pressure increased each succeeding year and during the fifth year there were 4,941 man-hours of bass fishing.

Figure 9. - Number of bass caught per man-hour of effort while fishing for bass, September, 1953 through August, 1958.

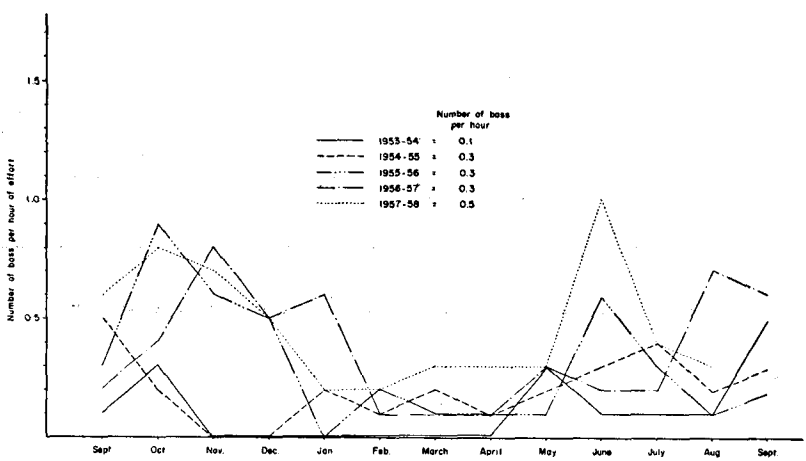
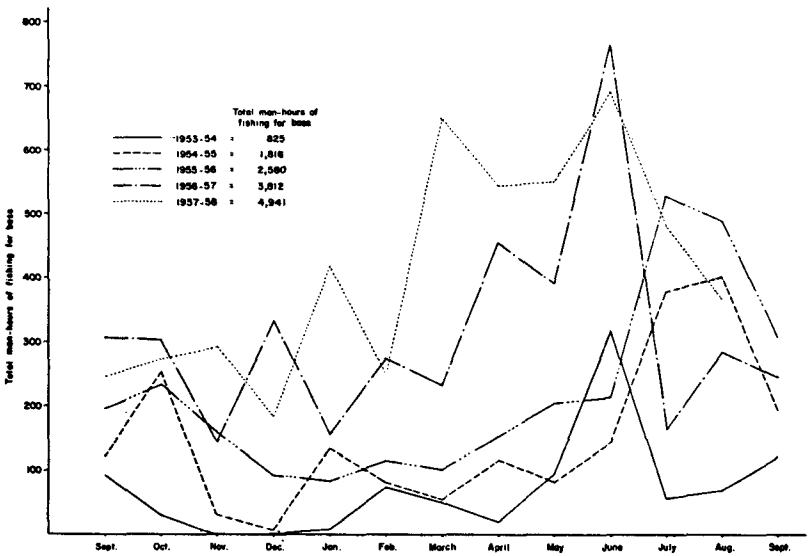


TABLE XV

AVERAGE WEIGHT, IN POUNDS, OF BASS CAUGHT WHILE FISHING FOR BASS, SEPTEMBER, 1953 THROUGH AUGUST, 1958
(The Figure in Parenthesis Represents the Number of Specimens)

	Time of Year												
	Sept.	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Total*
1953-54	0.6(3)	1.2(1)	.....	.....	.....	.....	.....	.....	1.6(4)	2.5(10)	3.0(2)	1.7(2)	2.1(22)
1954-55	1.8(18)	2.2(13)	.....	.....	3.2(7)	1.5(2)	3.6(3)	1.7(2)	1.7(4)	2.0(8)	1.5(43)	1.9(14)	1.9(114)
1955-56	1.0(21)	1.7(73)	1.8(33)	1.7(9)	.....	1.8(5)	2.3(5)	1.5(2)	1.4(7)	1.4(23)	1.8(45)	2.0(12)	1.7(235)
1956-57	1.7(24)	1.7(28)	1.6(42)	2.4(34)	1.9(23)	1.8(10)	2.0(3)	2.1(18)	2.2(32)	1.5(28)	1.5(14)	1.5(37)	1.8(293)
1957-58	1.8(41)	1.3(53)	1.0(46)	1.3(22)	1.3(24)	1.0(17)	2.0(48)	1.5(42)	1.5(35)	1.3(111)	1.5(73)	1.8(21)	1.4(533)

Figure 10. - Estimated man-hours of fishing for bass, September, 1953 through August, 1958.



The harvest of bass followed the same general trend as that of the fishing pressure. Only 353 pounds of bass were harvested from the lake during the first year (Fig. 11); however, the harvest increased each succeeding year and the catch was 3,395 pounds for the fifth year.

In general, the number of bass caught per man-hour of effort, the man-hours of bass fishing and the total harvest increased during the five years and were considerably higher during the fifth year than during the first. The average weights of the bass caught decreased somewhat during the five years, however, the average weights were considered satisfactory throughout the study.

Total Fishing. A total of 1.3 fish were caught per man-hour of effort during the first year (Fig. 12). The rate of catch increased during the next two years to 1.5 and 1.6 fish per man-hour of effort respectively. During the last two years, the rate of catch decreased to 1.3 fish per man-hour of effort. The average weights of all fish caught varied between 0.2 and 0.4 pounds during the five census years (Table XVI).

During the first year 22,161 man-hours of fishing occurred on the lake (Fig. 13). The fishing pressure increased considerably during the second year (46,723 man-hours). The fishing pressure decreased to 24,500 man-hours for the next two years and to 16,354 man-hours for the fifth year.

A total of 8,218 pounds of fish were harvested from the lake during the first year and the catch increased to 16,802 pounds for the second year (Fig. 14). During the last three years the total harvest ranged between 7,225 pounds and 8,556 pounds. The pounds of fish harvested were less during the last year (7,225 pounds) than during the first.

Figure 11. - Estimated total pounds of bass caught by sport fishing, September, 1953 through August, 1958.

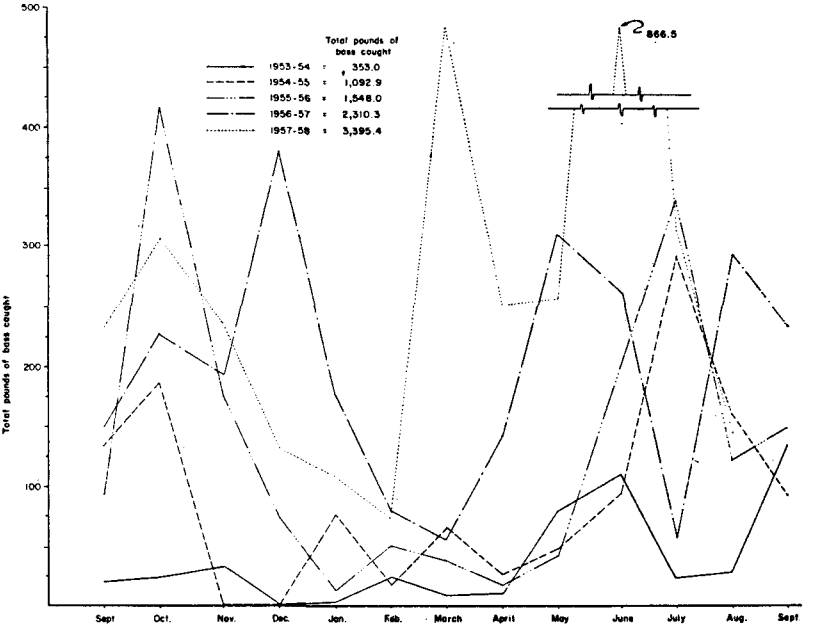


Figure 12. - Total number of fish caught per man-hour of effort, September, 1953 through August, 1958.

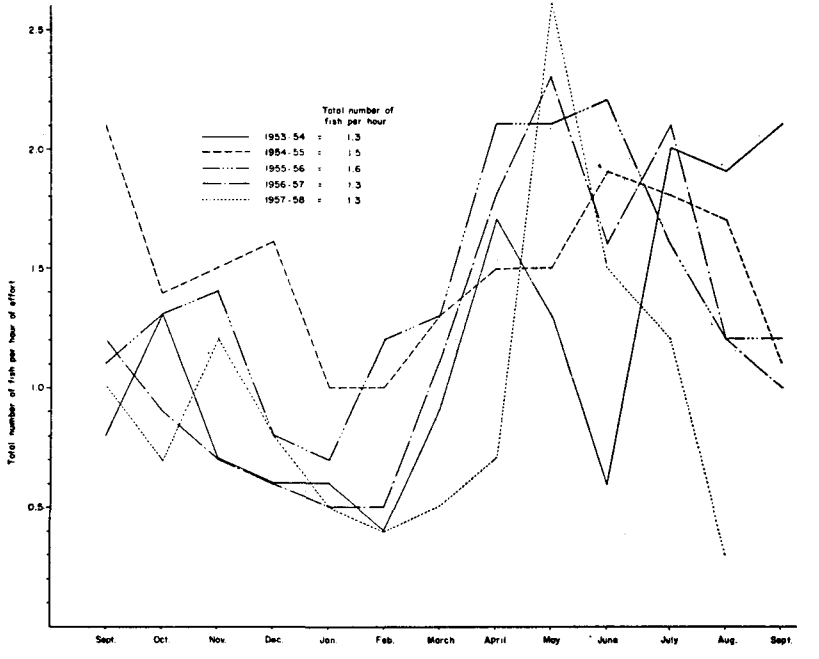


TABLE XVI

AVERAGE WEIGHT, IN POUNDS, OF ALL FISH CAUGHT BY SPORT FISHING, SEPTEMBER, 1953 THROUGH AUGUST, 1958
(The Figure in Parenthesis Represents the Number of Specimens)

	Time of Year												
	Sept.	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Total*
1953-54	0.4(327)	0.3(91)	1.0(85)	0.8(10)	0.7(72)	0.5(78)	0.5(224)	0.2(1082)	0.2(446)	0.3(213)	0.2(1309)	0.2(1106)	0.3(5043)
1954-55	0.4(815)	0.4(1973)	0.3(860)	0.3(324)	0.3(183)	0.2(323)	0.2(1841)	0.2(3519)	0.2(1439)	0.2(1443)	0.2(2940)	0.2(1274)	0.2(16934)
1955-56	0.2(513)	0.6(266)	0.5(215)	0.4(186)	0.3(68)	0.3(658)	0.2(1372)	0.2(2198)	0.2(1586)	0.2(1121)	0.2(1054)	0.2(410)	0.2(9647)
1956-57	0.2(396)	0.4(297)	0.7(130)	1.0(103)	1.7(30)	0.7(432)	0.3(1590)	0.2(2134)	0.2(1556)	0.2(889)	0.2(843)	0.4(188)	0.3(8588)
1957-58	0.6(163)	1.1(70)	0.5(262)	0.7(156)	0.7(178)	0.8(100)	0.7(284)	0.4(304)	0.2(2389)	0.5(367)	0.4(393)	1.3(31)	0.4(4697)

Figure 13. - Estimated total man-hours of sport fishing, September, 1953 through August, 1958.

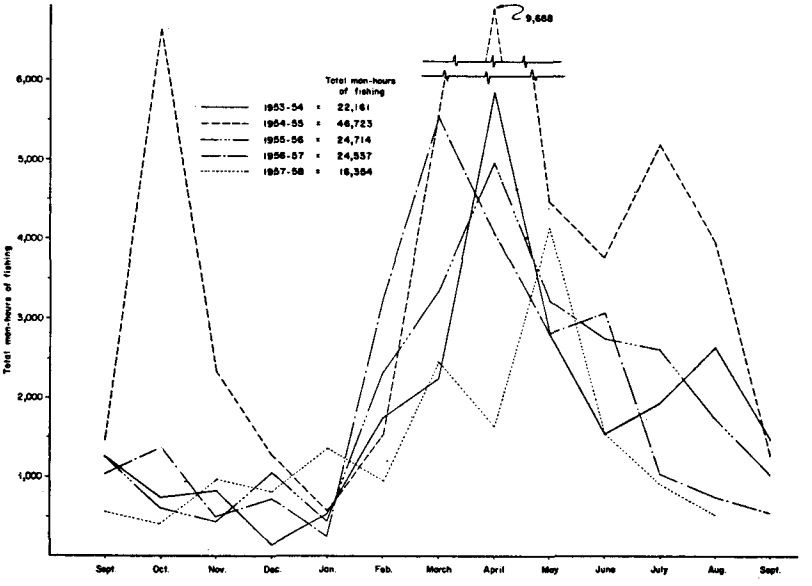
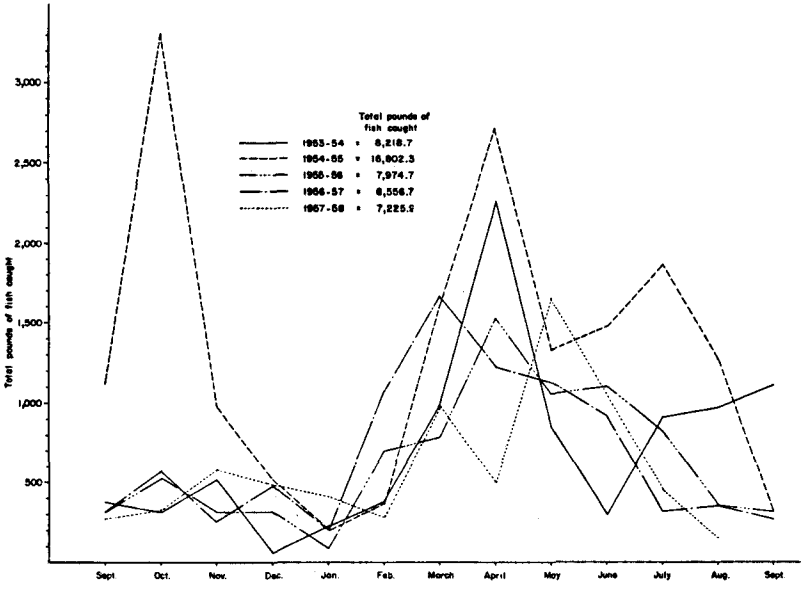


Figure 14. - Estimated total pounds of fish caught by sport fishing, September, 1953 through August, 1958.



In general, the total number of fish caught per man-hour of effort, the total man-hours of fishing and the total harvest increased considerably during the second year of the census and then decreased during the succeeding years. During the last year the total man-hours of fishing and the total pounds of fish harvested were less than during the first year. The average weights of all fish caught ranged between 0.2 and 0.4 of a pound.

EVALUATION OF THE CHANGES OCCURRING IN THE SPORT FISHERY

Factors Affecting Changes. Certainly all changes occurring in the sport fishery cannot be attributed to the removal of rough fishes. Sport fisheries and the fish populations on which they are dependent are not static, and they change even where no attempts at management have been made. There are many variables which affect sport fisheries and fish populations, *e. g.,* the weather, composition of the fishermen population, land use, economic conditions in the surrounding areas, changes occurring in the sport fisheries on near-by waters and many others. Some of these variables we could not measure and others were unknown. However, many of the observed changes occurring in the sport fishery were of such magnitude that we believe they were influenced to some extent by the removal of rough fishes.

Some of the changes occurring in the sport fishery can be readily correlated with changes occurring in the fish population; however, others are not readily explained. The effects of the removal of rough fishes on the fish population will be reported in detail in subsequent reports.

Immediate Effects of the Removal of Rough Fishes. On the whole, the immediate effects of the removal of rough fishes on the sport fishery were very desirable. The number of fish caught per man-hour of effort, the fishing pressure and the total pounds of fish caught increased considerably during the second census year for all types of fishing; however, the pounds of sunfish caught per man-hour of effort decreased somewhat during the second year. (The changes occurring in the pounds of bass and crappie caught per man-hour of effort are not presented in this report, but they follow generally the same trends as that of the number of bass or crappie caught per man-hour of effort.)

We regret that creel census data are not available for several years prior to September, 1953. The removal operations were initiated during January of 1954; and therefore, this could have had considerable effects on the sport fishery during a portion of the first census year. We have concluded—from talking to sport fishermen familiar with the lake, people residing in the immediate vicinity of the lake, the boat rental operator and interested sportsmen—that probably the sport fishing for all types of fish was much poorer for at least several years prior to the first census year. In fact, due to complaints from sportsmen relative to the poor quality of the sport fishing, the Richland Parish Police Jury passed a resolution during 1953 requesting that the Louisiana Wild Life and Fisheries Commission close the lake to all commercial fishing and stated that the need of such action was of an emergency nature. At that time, the sportsmen were of the opinion that commercial fishing was detrimental to the sport fishery—wrongly so in our opinion.

Long Term Effects of the Removal of Rough Fishes. Some of the long term effects of the removal of rough fishes were desirable; however, others were undesirable

Swingle (1956) explains how various factors can affect reproduction of bluegill sunfish and largemouth bass. Among others, he lists the following factors: (1) food available during the period of egg formation, (2) crowding, (3) egg-eating habit of bluegill sunfish and (4) the repressive factor. We believe these factors were operative in controlling the number of young bass, crappie and sunfishes produced in Clear Lake. During the first two summers following the initial removal of rough fishes, the removal decreased the adverse effects of the previously mentioned factors, resulting in a much greater than normal production of young bass, crappie and sunfishes.

The most desirable effect of the removal of rough fishes was the improvement in the bass fishing. The young bass apparently had an excellent survival rate resulting in an expansion of the population and improvement in the bass fishing.

There was a decrease in the crappie fishing during the last three census years; however, to what extent this was influenced by the removal of rough fishes is not quite clear. In any case, the removal of rough fishes did not improve the crappie fishing.

The long term effects of the removal of rough fishes on the sunfish fishing were not desirable. Large numbers of young sunfishes were produced during the first two summers and possibly due to lack of adequate predation on them, the

sunfish population became overcrowded. This resulted in a decrease in the average weight of the sunfish occurring in the creel. Even though the number of sunfish caught per man-hour of effort increased during the last three census years, the pounds of sunfish caught per man-hour of effort, the man-hours of fishing for sunfish and the total pounds of sunfish harvested decreased considerably.

The possibility that other factors were the cause or contributed to the overcrowding of this sunfish population should not be dismissed. Overcrowded populations of sunfishes do develop in bodies of water where no removal of rough fishes has been attempted. Some of the changes occurring in the sunfish fishery are puzzling. We think that possibly there were relationships among the rate of catch, average weight of the fish caught and the composition of the fishermen population. We are now in the process of analyzing the creel census data to determine if such relationships occurred.

It is probable that the expanding bass population—it is expanding as evident by the creel census and fish population sampling data—has and will continue to increase its predatory pressure on the sunfish population. If this is true, it is possible that increased predation will reduce the number of individuals in the population, allowing the sunfish to attain a larger average size. It will be necessary to continue our investigations several more years to determine if this will occur.

An evaluation of the overall success of the removal operation would depend on what was considered the primary objective of the program. If the main objective of the program was to improve the bass fishing, it would be considered very successful; however, if the objective was to improve the sunfish fishing, the program would be considered unsuccessful. If the objective was to furnish the maximum amount of sport fishing and the maximum harvest of fish, we would have to conclude (based on the data obtained during the five census years) that the fish management program was not successful. The main reason for the decrease in the total fishing pressure and harvest was the deterioration of the sunfish fishery.

If the primary objective of management is to furnish the maximum amount of sport fishing and harvest on a lake, primary consideration must be given to the sunfish fishery—at least in most instances in Louisiana. Most Louisiana lakes support larger standing crops of sunfishes than predaceous game fishes such as bass; therefore, they have the capacity to support a larger sunfish fishery.

THE REMOVAL OF ROUGH FISHES AS A MANAGEMENT TOOL

Rough fish removal, especially the removal of gizzard shad by selective poisoning, has become very much in style in the Southeast. Many sportsmen are selling it as a cure-all. We definitely are of the opinion that it is not a cure-all in fishery management, and in some instances it may be detrimental—for instance: if the removal of gizzard shad induces an overcrowded sunfish population in a large lake, how are we going to correct this problem?

Undoubtedly under many conditions, the removal of rough fishes is a useful management tool; however, our knowledge of how and when to use this tool is fragmentary. We need much more information than currently available to be able to predict with any degree of accuracy the outcome of rough fish removal operations under varying conditions.

There are many factors which could influence the results obtained from rough fish removal—for example: (1) the physical characteristics of the lake—size, depth, etc., (2) the make-up of the fish population at the initiation of rough fish removal operations and (3) how the rough fish are removed—for example: selective poisoning vs. seining; removal over a period of years vs. removal during one year. Clear Lake differs from many lakes in the Southeast; and therefore, the results obtained do not necessarily hold true for Southeastern lakes in general. Many lakes on which rough fish removal is being carried out are larger than Clear Lake. Most of the removals of gizzard shad are now being accomplished through selective poisoning which removes all size classes of fish. Gizzard shad were removed from Clear Lake by seining, which is selective for the larger size fish.

Actually there is considerable need for much more detailed research on the effects of the removal of rough fishes under various conditions and over extended

periods of time. It would be especially valuable if such intensive studies could be carried out on lakes where the history of the fish population and sport fishery were known for at least several years prior to the initiation of the removal operations. It is also necessary that such studies be carried out over an extended period of time as results obtained from one or two years of study can be misleading.

ACKNOWLEDGMENTS

We wish to thank Dr. Leslie Glasgow and Dr. Bryant A. Bateman, Louisiana State University, for their criticisms and suggestions on an earlier draft of the manuscript.

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THE EVALUATION OF CHEMICAL AQUATIC WEED CONTROL IN GEORGIA FARM PONDS *

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ABSTRACT

Aquatic weed control has in recent years developed into one of the most important phases of farm pond management in Georgia.

Properly constructed ponds with adequate fertilization which were chemically treated four years ago show no reinfestation at this time. On the other hand, in experimental ponds which were not properly fertilized the results of chemical weed control were of extremely short duration.

The more frequently used herbicides, Sodium arsenite, 2,4-D (ester and amines), 2,4-D-2,4,5-T combinations, and Copper sulphate are considered with regard to methods of application, cost of treatments, effectiveness on different plant species and duration of successful weed elimination.

Sodium arsenite was found universally effective in the control of most submerged aquatic plant species. However, its toxicity to warm blooded animals and the caution necessary in its application and handling restrict its use to experienced technicians. Careless handling of this material in Georgia has resulted in injury to personnel as well as the loss of livestock in one instance. Growth regulating 2,4-D and 2,4,5-T compounds were effective in the control of most broad leafed emergent aquatics. The use of both oil and water carriers was evaluated. To achieve complete control, more than one application was usually required. Copper sulphate was found to be the most economical and effective algicide.

Some of the newer aquatic herbicides, Dowpon, Pelletized 2,4-D, Kuron, Novon and Delrad are discussed in relation to their effectiveness. Particular emphasis was placed on the control of Manna grass *(Glyceria sp.)* with these chemicals. Those showing promise are further evaluated as to effectiveness on a large variety of plants.

Dowpon appeared very promising in the control of aquatic grasses. Pelletized 2,4-D and Kuron, formulated for use on submerged aquatic species, gave ex-

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