Expansion of the Crappie Population in Ardmore City Lake Following a Drastic Reduction in Numbers[1]

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One of the fishery management tools currently employed in Oklahoma involves the elimination of 50 to 95 percent of the fish in a lake where the populations of desirable species are determined to be slow-growing and overcrowded. The desired result is the creation of conditions conducive to greatly accelerated growth, a phenomenon which is associated with excellent fishing success.

An attempt to drastically reduce the numbers of stunted fishes in Ardmore City Lake, particularly white crappie (*Pomoxis annularis*) and black crappie (*P. nigromaculatus*), was made in September, 1953. The application of 2550 pounds of powdered rotenone to about 80 percent of the lake surface killed large numbers of gizzard shad, crappies, and carp. Largemouth bass, channel catfish, yellow perch, and various sunfishes were killed in lesser numbers. In order to evaluate the effects of the reduction in population on reproduction and growth, sampling with wire traps was carried on at intervals during the following two years (5).

The production of large numbers of crappie by a very limited number of adults was one of the more striking results of the investigation.

DESCRIPTION

Ardmore City Lake is located in Carter County, Oklahoma, 2 miles north and 1 mile west of Ardmore. Impounded in 1902 as a municipal water supply reservoir, the lake has a surface area of 184 acres, a maximum depth of 32 feet, and an average depth of about 18 feet. The drainage area comprises 1600 acres of native tall grass prairie, and the shoreline vegetation is composed of moderately heavy stands of *Polygonum lapathifolium* and *P. americanus*. Lush growths of *Chara* spp. occur in water from 3 to 14 feet deep.

The lake level is fairly stable due to water received through a gravity-flow conduit from Mountain Lake, a 145-acre impoundment located 12 miles northwest in the Arbuckle Mountains. The water is alkaline (pH 7.8-8.2) and hard (methyl orange alkalinity 100-155 ppm.), and the lake is typically thermally stratified during the summer months.

SAMPLING METHODS

Cylindrical traps, 6 feet long and 3 feet in diameter, with funnel throats at each end, were used to capture fish. The framework was made of 3/8-inch reinforced rod, and covered with 1-inch mesh chicken wire.

Trapping was carried on during four separate periods from June, 1954, to June, 1955 (Table I). Fifteen to 25 traps were fished during each period, and were normally lifted every day. Trapped fish were placed in a canvas holding "tub," measured individually, marked by clipping the left or right pectoral fin, and released. During the 1954 trapping periods fish were released at a central point of the lake, but in subsequent operations they were liberated at random (within 50-300 yards of the site of capture) to avoid disrupting the normal behavior pattern of individuals (4). The traps were moved about in the lake, and were placed to afford a high crappie catch. During the winter months, most of the catches were made in

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the northern half of the lake near the dam, and traps were concentrated there. In the summer months they were distributed throughout the lake, and were set within 100 feet of shore in 4 to 15 feet of water.

POPULATION ESTIMATE

The population estimates were calculated by the Schnabel formula (7) and also by the Chapman formula (3). The conditions which must be satisfied if these formulae are to produce valid results (6) were considered to be fulfilled. All fish which were injured in the traps were not released as marked fish. Some regeneration of clipped fins was noted in June, 1955, but could easily be detected by asymmetry and shortness of the fin. Random mixing of marked and unmarked fish was accomplished by constantly shifting the location of the traps and by releasing fish at random. No crappie were removed by fishermen during the period of investigation, so recognition and recording of marked specimens was made entirely by trained personnel. Examination of the length-frequency distribution of the two species (Tables II and III) indicated that some growth did occur in the spring of 1955, but that there was no recruitment.

In 110 trapping days, including 1614 trap-lifts, only 9 adult black crappie and 14 adult white crappie were captured. Two of the black crappie and 7 of the white crappie were recaptured during this period. The estimate of the population existing following rotenone treatment in 1953 is 27 black crappie (95 percent limits, 18-47), 18 of which were over 8 inches in length the following spring, and 23 white crappie (95 percent limits, 18-32), 10 of which exceeded 8 inches. None of the fish exceeded 11 inches, and all were 4 to 6 years of age. Carlander (1) cites various authors who report that female black crappie produce from 11,000 to 188,000 eggs, with an average of about 19,000 eggs in 6-8 inch fish, 30,000 in 8-10 inch fish, and 45,000 in larger females. On this basis, and provided that the number of each sex in the lake was equal, the 13 pairs of black crappie had a maximum potential production of approximately 350,000 fertilized eggs in 1954. Based on a slightly lower fecundity rate (1), the 11 pairs of white crappie could have produced about 240,000 eggs.

The catch in 1,213 trap-lifts between December 8, 1954 and June 20, 1955 numbered 13,047 black crappie and 5,150 white crappie of the 1954 year-class (Table I). At the end of the operation (June 20), 11,968 marked black crappie and 4,565 marked white crappie were theoretically at large in the lake. Recaptures included 677 black and 191 white crappie. Injuries and deaths occuring in the traps accounted for 402 black crappie (0.35 percent of the estimated population and 394 white crappie (0.65 percent of the estimated population).

The final estimate on June 20 resulted in 116,200 yearling black crappie by the Schnabel formula, and 136,500 by the Chapman formula (Table IV). (Confidence limits for the Schnabel computation were based on the assumption of Poisson distribution, wherein the variance is equal to the summation of recaptures.) Estimates were much higher during the earlier trapping periods which might be attributable to high natural mortality. However, it is believed that a realistic estimated was not reached until about 7 percent of the population had been marked. The decrease from March 31 to June 20 of 6,100 fish (Table IV, Chapman formula) amounted to 4.3 percent of the total population, and may indicate actual mortality during the spring months. Estimates derived by the Chapman formula did not fluctuate as widely as did those obtained by the Schnabel formula, and are used in further computations.

The final yearling white crappie population estimate was 60,300 using the Schnabel formula, and 64,000 using the Chapman formula. The increase in estimate from March 31 to June 20 (Table IV) might be attributable to higher mortality of marked fish, but is believed to have been due

to more adequate sampling in June of the shallower upper reaches of the lake. This is a habitat which seemed to be preferred by the species, but which had not been productive of catches during the winter months.

There were an estimated 27 black crappie weighing a total of 10.2 pounds, and 23 white crappie weighing 5.4 pounds remaining in 184-acre Ardmore City Lake following rotenone treatment in September, 1953. Their approximate potential combined production in 1954 was 590,000 offspring. Based on lenght-frequenty distributions (Tables II and III) and calculated weights,[1] the yearling black crappie averaged 5.42 inches in total length and 0.067 pounds in weight in June, 1955. Yearling white crappie averaged 5.79 inches and 0.069 pounds. Therefore, there were about 136,500 black crappie (742 per acre) weighing 9,120 pounds (49.6 pounds per acre), and 64,000 white crappie (348 per acre) weighing 4,420 pounds (24.0 pounds per acre), in the lake after one complete year of growth.

First-year growth had increased 2 inches over pre-rotenone rates for both species. However, growth during 1955 to June 20 was below that anticipated, and may have been due to competition from the large yearling carp population present (5). Recovery following rotenone application in 1953 indicated that white crappie outnumbered black crappie approximately 5 to 1 but the survival and reproduction of larger individuals of the latter species had reversed the ratio to 2 to 1 in favor of black crappie in 1955.

Carlander (2) cites average standing crops, in pounds per acre, of white and black crappie in some midwest reservoirs as follows:

White crappie 35.3 pounds / acre

Black crappie 92.1 pounds / acre

White crappie with black crappie present 26.9 pounds / acre

Black crappie with white crappie present 17.1 pounds / acre

Black crappie production in Ardmore City Lake (49.6 pounds per acre) exceeded the average stated in combination with white crappie and was 54 percent of the black crappie alone mean after one year's growth. The standing crop (24.0 pounds per acre) of white crappie after one year's growth was nearly equal to the average stated when black crappie were present and represented 68 percent of the weight of Carlander's average standing crop of white crappie alone.

CONCLUSION

An estimation of the crappie population in Ardmore City Lake revealed that a population of 50 adults with a reproduction potential of about 590,000 produced a population which at one year old numbered 200,500 fish. The study demonstrates the fecundity of these two species, and emphatically underlines the inanity of stocking crappie in lakes where they are already present.

LITERATURE CITED

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[1] Calculated length-weight relationships:
Black crappie 64 fish log w= -4.6855 + 3.1706 log L
White crappie 100 fish log w= -4.1574 + 2.8347 log L

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TABLE I.

Number of black and white crappie captured in wire traps in Ardmore City Lake during periods indicated, and number of fish caught per trap-lift in 1954-55.

Trapping period	Number of trap lifts	1954 Year-Class		Older fish		Number of fish per trap-lift	
		Black crappie	White crappie	Black crappie	White crappie	Black crappie	White crappie
9-25 June, 1954	401	....	....	1	7	....	....
8-29 Dec., 1954	285	3180	1528	6	3	11.2	5.4
8 Feb.- 31 Mar., 1955	645	8420	2579	2	9	13.1	4.0
2-20 June, 1955	283	1447	1043	2	2	5.1	3.7
Totals	1614	13047	5150	11	21	10.8	4.3

TABLE II.

Length-frequency distribution of yearling black crappie captured in Ardmore City Lake during various trapping periods.

Total length	Trapping Periods (1954-55) 8-29 Dec.	8-26 Feb.	27 Feb.-10 Mar.	11-21 Mar.	22-31 Mar.	2-20 June
4.0		1				
4.1	2					
4.2	2	4	1			
4.3	12	5				
4.4	23	6	2			
4.5	41	19	10	2	1	
4.6	71	29	11	2		
4.7	106	27	20	3	1	
4.8	150	89	49	29	8	3
4.9	198	145	71	37	28	11
5.0	254	236	137	123	63	37
5.1	370	312	263	336	152	75
5.2	378	328	483	696	308	92
5.3	366	314	530	817	401	190
5.4	224	182	400	614	289	231
5.5	85	97	190	280	85	273
5.6	36	20	40	43	20	174
5.7	9	8	9	15	7	90
5.8		1			1	21
5.9		1	1			6
6.0						1
6.1						
6.2						
6.3						1
6.4						
6.5						
6.6						
Total no. of fish	2327	1824	2217	2997	1364	1205
Average length	5.10	5.14	5.24	5.28	5.27	5.42

TABLE III.

Length-frequency of yearling white crappie captured in Ardmore City Lake during various trapping periods.

Total length	Trapping periods (1954-55)					
	8-29 Dec.	8-26 Feb.	27 Feb.-10 Mar.	11-20 Mar.	22-31 Mar.	2-20 June
4.0						
4.1						
4.2						
4.3						
4.4	1					
4.5						
4.6	1	1				
4.7	3	1	1			
4.8	9	8	1	1		
4.9	18	14	2	1	1	
5.0	45	27	3	4	1	
5.1	68	48	25	9	3	2
5.2	81	105	61	16	9	6
5.3	107	141	79	36	42	27
5.4	144	169	139	66	125	46
5.5	191	174	179	88	155	87
5.6	160	141	110	75	108	111
5.7	166	75	54	44	82	138
5.8	61	28	14	12	37	134
5.9	12	14	7	4	5	146
6.0	2	3	1		1	130
6.1	1	4				63
6.2						32
6.3						13
6.4						6
6.5						1
6.6						3
Total no. of fish	1070	953	676	356	569	945
Average length	5.45	5.42	5.45	5.49	5.53	5.79

TABLE IV.

Estimate of the total population of black and white crappie in Ardmore City Lake at various dates throughout the trapping period calculated by the formulae of Schnabel (7) and Chapman (3), with 95 percent confidence limits denoted in minimum and maximum columns. B/P indicates the percent of marked fish present in the population on dates stated. All estimates are stated to the nearest 100.

Date 1954-55	Method of estimate	Black crappie				White crappie			
		B/P (%)	Minimum	Estimate	Maximum	B/P (%)	Minimum	Estimate	Maximum
29 Dec.	Schnabel	2.5	167,200	242,500	440,900	2.0	45,000	67,700	137,100
	Chapman	2.1		238,500		1.9		43,400	
15 Mar.	Schnabel	6.7	177,800	205,400	243,200	5.0	54,400	66,800	86,300
	Chapman	5.7		206,600		4.7		65,300	
31 Mar.	Schnabel	9.3	113,600	123,600	135,400	6.1	44,300	51,500	61,500
	Chapman	7.9		142,600		5.7		53,500	
20 June	Schnabel	10.3	108,000	116,200	125,600	7.6	52,800	60,300	70,200
	Chapman	8.8	125,200	136,500	147,800	7.1	54,000	64,000	74,000