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GIZZARD SHAD REMOVAL IN DEER ISLAND LAKE, FLORIDA

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ABSTRACT

Results of four experiments on 5.5-acre Deer Island Lake demonstrated that selective poisoning was a practical method for reducing the gizzard shad population. Past haul seine efforts had effected only a temporary reduction in this lake.

A concentration of 0.04 p.p.m. of 5 percent emulsified rotenone killed very few gizzard shad. A 0.1 p.p.m. concentration resulted in a conservatively calculated kill of 4,651 pounds or 846 pounds per surface acre. An application of 0.15 p.p.m. concentration killed larger shad as well as a few bass. A subsequent application of 0.1 p.p.m. concentration produced a large unexplained kill of bass.

INTRODUCTION

The earliest experiments with selective poisoning in Florida included a study of Deer Island Lake located on an island in Johns Lake, Orange County, Florida. This lake had a history of gizzard shad and had been the subject of

previous applied work and experiments by personnel of the Game and Fresh Water Fish Commission. Planimeter readings of an aerial photograph established the area of the lake at 5.5 acres; average depth of 6.4 feet was determined by the use of a "White" echo sounder. Following a complete poisoning and restocking in 1951, water from Johns Lake was pumped into Deer Island Lake several times when the owner believed the water level too low. Eight to ten months after stocking 6.5-inch bass were taken. Size was estimated to have increased an inch during the next two or three months. Within two years, ten to thirteen inches was about the average length of numerous bass caught. Catch then gradually declined (personal communication: C. W. Irrgang, Sr.). Seine hauls on June 17, August 25, and October 5 in 1954 exhibited the presence of a large proportion of gizzard shad in the lake (Table I). It is possible these were introduced during pumping operations. The haul of August 25 was considered successful since the lake had been lowered to depths which the net could fish effectively. The other hauls were considered unsuccessful as quantitative samples.

Reductions of gizzard shad and bluegill by these seine hauls did not prevent recoveries of their populations. Yearly stocking with bass fingerlings did not result in noticeable improvement in sport fishing.

Lethal effects of small quantities of rotenone on gizzard shad had been noted by Bowers (1955) and other workers. This study reports attempts in Deer Island Lake to attain a concentration of rotenone effective in destroying gizzard shad without materially damaging game fish.

A concentration of 0.04 p.p.m. of 5 percent emulsified rotenone during the first experiment resulted in a kill of 2,000 shad of small size (2.5-4.0 inches). The second experiment demonstrated that the 0.04 p.p.m. concentration had eliminated few of the smaller and none of the larger shad. However, gizzard shad had been selectively killed.

On January 24, 1955 a concentration of 0.1 p.p.m. was carefully mixed with the waters of the lake in five separate applications of 1.8 pints. The procedure involved use of a large funnel which was attached to a perforated pipe suspended vertically in the water from the side of the boat. Emulsified rotenone diluted with water and poured into the device was distributed at graduated depths by means of gravity flow.

Upon completion of the first application at 11:10 a. m., small shad were seen at the surface. During the fifth application four hours later small shad were observed dead and dying. At 4:30 p. m., dip nets were used to take 75 shad. Several fish were 5.5 to 7.5 inches in length, the others were smaller. On the following day windrows of small dead shad were seen on the east shore of the lake. Fifty to seventy-five medium sized shad were observed living but in some distress. One large shad (13.0 inches) was seen dead. Detailed length-weight and length-frequency analysis of the January 24 kill is presented in Tables II and III.

Enumeration of shad in eight random sample areas, each of an estimated four shoreline feet, were used to approximate the number of dead shad at the shore. Estimates, based on samples from water 2.5 feet in depth or less were made of numbers of dead fish on the bottom. Fish in three randomly selected areas of 16 square feet were counted. In each of two areas nineteen, and in the third eighteen shad were recovered. The average number of fish from these samples was applied to the area of the lake to calculate fishes dead on the bottom.

Total shad mortality by weight was calculated from the estimates of fish dead on the bottom plus the estimates of those on the shore multiplied by 5.8 grams (the average weight of 191 shad collected January 24). The total estimated weight of the kill thus became 4,651 pounds or 846 pounds per surface acre. It was difficult to make an accurate calculation of the kill. Most of the dead fish were on the bottom where sample technique was poorest.

Accurate calculation of kill was difficult to make for several reasons. Principally many fish were on the bottom, numerous gulls and herons were scavenging, and wind action blew many fish to one side of the lake causing them to be unevenly distributed. Calculations were perplexing also because of a differential kill; *i. e.*, small fish died before larger oines, thus samples taken the day of poisoning were not comparable to samples during succeeding days (Tables II and III).

TABLE I

POUNDS OF FISHES TAKEN BY HAUL SEINE AND SELECTIVE POISONING IN DEER ISLAND LAKE
MARCH 29, 1951 THROUGH MARCH 5, 1956

No. of Hauls	*1*	*1*	*1*	*1*	*0*	*2*	*1*	*0*	*1*	*1*
Date	*3/29/51*	*6/17/54*	*8/25/54*	*10/5/54*	*1/24/55*	*2/9/55*	*3/15/55*	*2/12/56*	*2/15/56*	*3/5/56*
Species										
Largemouth Bass	339	6	470	280	..	198	58	189	11	20
Black Crappie	30	..	..	..	..	..	..	..	..	..
Bluegill	65	1	1,893	47	..	38	19	..	4	30
Shellcracker	30	..	8	2	..	..	..	..	..	1
Warmouth	15	1	9	..	..	..	..	..	..	..
Channel Catfish	26	..	..	..	..	..	..	..	..	..
Speckled Bullhead	97	..	4	6	..	..	..	..	..	..
Florida Spotted Gar	40	..	..	..	..	..	..	..	..	..
Gizzard Shad	4,760	70	1,140	186	4,651	121	1	2	..	..
Golden Shiner	20	..	1	..	..	..	..	..	..	..
TOTAL FISH	5,422	78	3,526	521	4,651	355	81	191	15	51
Predatory Turtles	..	..	24	7	..	3	..	..	..	10
Non-Predatory Turtles	75	57	130	66	9	..	..	..	..	13
REMARKS:										
Good Haul	x	..	x	..	..	x	..	..	..	x
Haul Lost	..	x	..	x	..	..	x	..	x	..
Selectively Poisoned	..	..	..	..	x	..	..	x	..	..

TABLE II

LENGTH-WEIGHT OF THE SHAD KILLED DURING SELECTIVE POISONING EXPERIMENTS, DEER ISLAND LAKE, JANUARY 24 AND 25, 1955

Date	*Jan. 24, 1955*		*Jan. 25, 1955*		*Jan. 24 and 25*		
Total Lgth. (Inches)	*No.*	*Weight (Grams)*	*No.*	*Weight (Grams)*	*No.*	*Weight*	*Average Weight*
2.5	13	31	..	..	13	31	2.4
3.0	88	315	..	..	88	315	3.6
3.5	72	299	..	..	72	299	4.2
4.0	10	81	2	21	12	102	8.5
4.5	..	..	..	..	..	..	..
5.0	..	..	..	..	..	..	..
5.5	1	23	..	..	1	23	23.0
6.0	..	..	..	..	..	..	..
6.5	1	42	1	45	2	87	43.5
7.0	5	257	6	330	11	587	53.4
7.5	1	59	17	1,067	18	1,126	62.5
8.0	..	..	12	931	12	931	77.6
8.5	..	..	7	674	7	674	96.3
9.0	..	..	3	358	3	358	119.3
9.5	..	..	2	290	2	290	145.0
13.0	..	..	1	421	1	421	421.0
TOTALS	191	1,107	51	3,716	242	4,823	..
AV. WEIGHT	..	5.8	..	72.9	..	..	19.9

TABLE III

LENGTH-FREQUENCY OF THE SHAD KILLED DURING SELECTIVE POISONING EXPERIMENT, DEER ISLAND LAKE, JANUARY 24 AND 25, 1955

Total Length (Inches)	*Jan. 24, 1955*		*Jan. 25, 1955*		*Total*	
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*
2.5	13	6.8	..	..	13	5.4
3.0	88	46.1	..	..	88	36.4
3.5	72	37.7	..	..	72	29.7
4.0	10	5.2	2	3.9	12	5.0
4.5	..	..	..	..	..	..
5.0	..	..	..	..	..	..
5.5	1	.5	..	..	1	.4
6.0	..	..	..	..	..	..
6.5	1	.5	1	2.0	2	.8
7.0	5	2.6	6	11.8	11	4.5
7.5	1	.5	17	33.3	18	7.4
8.0	..	..	12	23.5	12	5.0
8.5	..	..	7	13.7	7	2.9
9.0	..	..	3	5.9	3	1.2
9.5	..	..	2	3.9	2	.8
13.0	..	..	1	2.0	1	.4
TOTALS	191	..	51	..	242	..

Reasons exist for the belief calculated kill was conservative rather than exaggerated. The average weight of fish (5.8 grams) was obtained from fish recovered on January 24, 1955. Discrepancy from true average weight is conservative since many medium and large fish did not die or float to the surface until days after the rotenone application. Moreover, the average of 19 dead fish per 16 square feet of bottom is not considered excessive since the kill continued for two days following the time of estimation of fish on the bottom. Therefore, the total kill appeared to be higher than calculated kill based on the sample used. A less conservative estimate placed the kill at 1,000 pounds per acre or a total of 5,500 pounds. Results of catch with a haul seine in 1951

demonstrated the lake was capable of such a productivity. Not one fish of any species other than gizzard shad were observed during exacting observations conducted through January 31, 1955.

Two seine hauls on February 9, 1955 (Table IV) which were judged successful except for possible losses of fish from deeper areas indicated that smaller gizzard shad of the population had been severely reduced.

TABLE IV

LENGTH–FREQUENCY OF THE GIZZARD SHAD TAKEN IN TWO HAULS WITH A 220-YARD HAUL SEINE OF 3-INCH STRETCHED MESH IN DEER ISLAND LAKE, FEBRUARY 9, 1955

Total Length (Inches)	*Number*	*Percentages*
7.0	1	0.5
7.5	10	4.8
8.0	17	8.1
8.5	33	15.7
9.0	32	15.2
9.5	29	13.8
10.0	22	10.5
10.5	9	4.3
11.0	5	2.4
11.5	..	..
12.0	1	0.5
12.5	..	..
13.0	4	1.9
13.5	7	3.3
14.0	12	5.7
14.5	8	3.8
15.0	5	2.4
15.5	6	2.9
16.0	7	3.3
16.5	..	..
17.0	1	0.5
17.5	..	..
18.0	1	0.5
TOTALS	210	..

A third experiment on March 9, 1955 to determine if a concentration of rotenone higher than 0.10 p.p.m. could be used to destroy larger shad without causing damage to other fish populations was executed. The vertical distribution device was again employed to distribute a total of 13.5 pints of poison in the water (0.15 p.p.m.) during six applications. The first of the six applications consisted of 5.4 pints and was put out at 1:30 p. m. at a surface water temperature of 73° F. Subsequent applications of 1.8 pints each, except the last, were completed at 4:55 p. m. Following the third application (2:40 p. m) some fish were affected. Increased activity of distressed fish occurred.

However, few fish were collected during the operation. A total of eleven shad were found dead. Of these eight were large (10-15 inches), three were medium-sized, and one was small. In addition fifteen dead or dying bass, ranging from 5 to 14 inches in length, were taken. Efforts were made to recover fish through March 14, 1955. Following that date no fish were apparent. Sampling results indicated large shad were not destroyed without harm to bass.

Three seine haul samples following the 0.15 p.p.m. concentration experiment of March 9, 1955 (Table I) caught four shad of large size. Although the hauls were not considered entirely successful they did indicate the effect of the poisonings had caused an extreme reduction of all shad except the largest.

Concurrent to the selective poisoning studies a stocking program was conducted to determine if sport fishing (particularly for bass) could be improved and maintained during the seinings and poisonings. Minnow seine samples

obtained on July 13, 1955 established reproduction of game species had occurred. Over 15,000 bluegill and 32 bass were taken in six minnow seine hauls. No shad were taken. The lake owner considered sport fishing very good.

A fourth selective poisoning effort was conducted to further determine if shad had escaped from the previous nettings and poisonings. On February 12, 9 pints (0.10 p.p.m.) of rotenone were used. The poison was applied by pouring the diluted mixture on the water surface and mixing with an outboard motor. Applications were started at 1:00 p. m. and completed by 2:30 p. m. A surface water temperature of 68° F. was recorded. No fish activity was noted after the applications and it was thought at the time a kill had not occurred. On subsequent days it was apparent largemouth bass had been strongly affected. Two hundred and thirty-three dead bass were recovered from the time of poisoning through February 16. They weighed a total of 189 pounds and ranged from 5.5 to 25.0 inches in length. It was estimated that at least 100 pounds of bluegill were also destroyed. Measurements of 26 indicated a size range from 1.0 to 4.0 inches. One shad approximately 2.0 pounds was killed. Results of the fourth treatment were unusual compared to results of other selective poisonings conducted in Deer Island Lake or elsewhere in Florida. If the chemical composition of the poison was constant (5 percent emulsified rotenone, etc., as stated by manufacturer) the reason for this kill could be in chemical composition of the water at time of application, related physical factors, method of application, length of time for the application to be made, or, perhaps, to a secondary kill.

Chemical determinations of February 12 (Table V) were: O_2, 6.6 p.p.m.; CO_2, O; water surface temperature, 68° F.; Methyl Orange alkalinity, 33 p.p.m. and phenolphthalein alkalinity, 10 p.p.m. Not enough chemical data were taken prior to the last application to relate the kill to changes which might have occurred. Temperature variations (taken at surface) were not likely to have been the cause of the bass kill since no bass were recovered during the 0.10 p.p.m. concentration experiment of January 24, with a temperature of 60° F. whereas a slight bass kill was obtained with 0.15 p.p.m. at a temperature of 73° F. and the heavy kill at 68° F. again with a 0.10 p.p.m. concentration.

TABLE V

CHEMICAL ANALYSES OF THE WATER OF DEER ISLAND LAKE DECEMBER, 1954 THROUGH FEBRUARY, 1956

Date	*Time*	*O_2 p.p.m.*	*CO_2 p.p.m.*	*pH*	*Water Temp.*	*Air Temp.*	*Carbonates p.p.m.*	*Bicarbonates p.p.m.*	*Total Alkalinity*
12/30/54	11:30 a. m.	. . .	. . .	. . .	69°F.	78°F.	..	..	..
1/24/55	11:00 a. m.	. . .	. . .	. . .	60°F.	..	..	..	..
2/ 9/55	2:00 p. m.	13.0	0	8.0	63°F.	78°F.	..	..	..
3/ 9/55	11:30 a. m.	. . .	. . .	. . .	73°F.	..	..	..	..
2/ 2/56	12:45 p. m.	11.4	0	10.0	68°F.	76°F.	30	2	32
2/12/56	1:00 p. m.	6.6	0	8.0	68°F.	66°F.	10	23	33

Kills attributed to causes other than the direct result of rotenone upon fish have not been observed in selective poison studies. A decrease in amount of plankton at Deer Island Lake following poison applications was noted by gross observations but further studies of quantitative and qualitative plankton are needed before conclusions regarding plankton depletion can be drawn. Experience suggests if the rapidity and manner of distribution of the poison on February 12 had been the cause of the kill of game fish they would have died sooner. As it was the action of the fish did not show a similarity to those of spot or partially poisoned waters.

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Mr. Harold Moody's contribution to the work included supervising seine crews, obtaining much of the data and numerous suggestions during preparation of the mandscript. Some of the seining and all of the poison experiments were conducted under the auspices of Dingell-Johnson Federal Aid to State Fisheries programs.

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AGE AND GROWTH OF THE GIZZARD SHAD (Dorosoma lacepedi) (Lesueur), IN LAKE NEWNAN, FLORIDA

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Fish population sampling in many Florida lakes by the Florida Game and Fresh Water Fish Commission had indicated a very high concentration of gizzard shad, *Dorosoma lacepedi* (Lesueur).† The use of control measures for this species was suggested by the implications that the gizzard shad was successfully competing for space and other essential factors with species of game fish and was absorbing a large amount of the potential productivity in the lakes concerned into a non-utilizable biomass. The Florida Commission began an investigatory program of haul seining of Lake Newnan, Florida, in October, 1953, that incidentally furnished a source of specimens for an age and growth study of the gizzard shad.

Lagler and Applegate (1942), working with gizzard shad from two ponds in Indiana, were the first to determine the age of this species by the structure of their scales. Lagler and Van Meter (1951) determined the growth rate of gizzard shad from Beaver Dam, Illinois, by scale analysis. Turner (1953) furnished similar information from Herrington Lake, Kentucky. Warner (1940) described the eggs, hatching, and early larvae of the shad. Since completion of the present work, Bodola (1955) has written a very inclusive life history study of the gizzard shad.

Interpretation of scale structure of fish from warm Florida waters was first successfully treated by Huish (1954), working with the black crappie, *Pomoxis nigromaculatus* (Lesueur), in Lake George, Florida. Caldwell and others (1957) commented upon the scale structure of the stumpknocker, *Lepomis punctatus punctatus* (Valenciennes), and the Florida largemouth bass, *Micropterus salmoides floridanus* (Lesueur), from Silver Springs, Florida.

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METHODS

Gizzard shad were taken for study by haul seine, bag seine, otter trawl, dip net, and rotenone. Body lengths were recorded to the nearest millimeter. Standard length (S.L.) was measured from the tip of the snout to the caudal base (the end of the hypural bones). Total length (T.L.) was measured from the tip of the snout to the tip of the caudal fin with the caudal lobes pressed together.

Scale samples were taken from the area under the tip of the pectoral fin with the fin pressed in normal position against the body. Usually 6 to 20 scales were sampled. The high percentage of regenerated and misshapen scales that were encountered (due to the extreme deciduousness of the scales of smaller shad)

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† The use of this specific name, rather than *D. cepedianum* as constructed by Lesueur, concurrs with the Copenhagen Decisions on Zoological Nomenclature that specific names based on modern surnames that do not consist of the exact surname must be corrected.