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PRELIMINARY STUDIES ON THE EFFECT OF DYNAMITING FISH POPULATIONS

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ABSTRACT

During 1963 a series of experiments was conducted to determine the effect of dynamite on fish populations. One set of these experiments consisted of placing various species of fish in cylindrical wire baskets which were suspended vertically in water ranging from six to 15 feet in depth. A dynamite charge, consisting of one stick of 60% ditching dynamite, was placed at a point 10 feet from the nearest line of baskets and was detonated. Nine experiments were conducted using this arrangement of baskets in various depths of water with the dynamite charges ranging in depth from 2.5 feet below the surface to one foot from the bottom.

The results of these experiments indicated the effective killing range of the dynamite charge and the most desirable depth at which to set the charge. From these tests it was found that some fish were killed up to a distance of 50 feet from the charge and that the greatest number of kills occurred when the charge was placed 2.5 feet below the surface.

The second set of tests consisted of applying this technique in farm ponds. Three such ponds were dynamited, and the results are indicated. When rotenone was applied after dynamiting to remove the remainder of the fish population in Pond No. 1, it was observed that 38.7% of the total number of fish and 52.4% of the total weight of fish were eradicated with the dynamite technique. After rotenoning Pond No. 2 it was found that 84.2% of the total number and 73.3% of the total weight of the fish population were killed by the dynamite blast. In Pond No. 3 it was noted after rotenone was applied that the dynamite

blast removed 55.7% of the total number of fish and 25.5% of the total weight.

INTRODUCTION

It has been observed that ordinary 5% rotenone formulation, a chemical fish poison, is not as effective for killing fish at low temperatures as it is at higher temperatures. Thomaston (1962) suggests that this product is largely inconsistent in kiling warm-water fishes in the relatively "soft" waters of the Southeast at temperatures below 70°F. Swingle (1953) recommends that poison be applied when surface water temperatures are above 80°F. Because of this, a project was begun in January, 1963, to determine if dynamite could be used as an efficient and economical means of eradicating fish during the winter months, at which time water temperatures in Georgia fall well below the optimum for rotenone applications.

Johnston (1961) successfully used dynamite for removing concentrations of longnose gar from the coastal streams of North Carolina. Ten-pound charges of Nitromon Primer S were used by J. B. Copeland (1957) in removing longnose and shortnose gar from the Aucilla River in Florida. Arthur W. Dickson (1954) employed dynamite in a rough fish removal program in North Carolina.

The writer has found that little is known concerning the possibilities for the use of dynamite in controlling fish populations on a partial basis or the eradication of entire fish populations in farm ponds. This study was conducted in an effort to establish the feasibility of using dynamite for this purpose.

METHODS

Preliminary Dynamite Studies

Before testing dynamite for the eradication of fish in farm ponds, it was necessary to obtain information concerning the effective killing range and optimum depth placement of the dynamite charge. This information was obtained by conducting a series of experiments in a 1.5-acre cove on Lake Sidney Lanier near Gainesville, Georgia. The depth of the water in this cove ranged from five to 28 feet, and the width of the cove at the mouth measured 190 feet.

Six species of fish were used in the experiments. They were golden shiners *(Notemigonus crysoleucas)*, European carp *(Cyprinus carpio)*, brown bullheads *(Ictalurus nebulosus)*, smallmouth bass *(Micropterus dolomieui)*, channel catfish *(Ictalurus punctatus)*, and black crappie *(Pomoxis nigromaculatus)*.

The fish were placed in baskets made of one-inch mesh wire, 12 inches in length and 18 inches in circumference. These baskets were suspended vertically in the water at 2.5-foot intervals from the water surface to the bottom of the cove. From three to five of these vertical lines of baskets were placed at 10-foot intervals. The number of baskets per line was determined by the depth of the water in which a particular series of tests was to be conducted. The baskets were so arranged that the top basket was 2.5 feet below the water surface, and the bottom basket was no more than 2.5 feet from the lake bottom. Figure 1. indicates the placement of the holding baskets. To suspend the baskets in a stationary position in the water, a one-gallon plastic jug was tied to the top basket as a float; and a heavy weight was tied to the bottom basket. This weight was so connected that it settled firmly to the bottom but did not allow enough slack for the surface wind to drift the line of baskets out of position. A series of such baskets was placed in a straight line at 10-foot intervals in the cove.

Fish used in these experiments were collected by the use of gill nets, nylon fish baskets, electric shocking equipment, and hook and line. Some fish were supplied by Georgia Game and Fish Commission employees from Lake Allatoona and from the Lake Burton Fish Hatchery. In most cases it was necessary to transport the fish over distances ranging from 50 to 100 miles. This transporting may have weakened the fish making them more susceptible to the effects of the dynamite blast. Because of the problems encountered in collecting fish, a wide variety

of species was used; and a systematic method was not worked out whereby the resistance of one species over another could be tested. Fish were placed, one to each basket, on the basis of what species were available at the time.

Six brown bullheads and six channel catfish were placed in 12 baskets and allowed to remain for a period of 72 hours as controls. Of the 12 controls, two channel catfish and one brown bullhead died during this period.

One stick of 60% ditching dynamite was placed at the desired depth in line with, and 10 feet distant from, the nearest line of baskets. The dynamite was suspended at the desired depth by a string connected to a plastic jug on the surface and anchored to the bottom with a weight. As soon as possible after placing the fish in the baskets the dynamite charge was detonated with electric blasting caps. The four-foot blasting cap lead wires were connected to double-strand, insulated wire and were run to the lake bank where the charge was set off with a 6-volt automobile battery.

Five series of tests, consisting of nine dynamite charges, were conducted in water ranging from five to 15 feet in depth using this procedure and setting the charges at 2.5, 5.0, 7.5, and 10.0 feet below the surface, and at one foot from the bottom. All fish used in each series were discarded after detonation, and fresh fish were placed in the baskets before conducting the next series.

Testing of Dynamite in Farm Ponds

Pond No. 1:

In August, 1963, a small farm pond near Colbert, Georgia, was selected to be used for testing the effect of the dynamite technique on an entire fish population. Information gathered the previous winter was used in spacing the distance between charges and the depth at which they should be set.

This pond had an area of slightly over .3 acre and was nearly triangular in shape with the water ranging in depth from 12 to 15 feet near the dam to less than one foot near the opposite end. Approximately one-fourth of the pond area was less than three feet deep. Heavy emergent pond vegetation extended out into the water as far as five to six feet on approximately one-fourth of the pond's shoreline.

At 40-foot intervals, beginning at the dam, wooden stakes were driven on both sides of the pond. Number 2 nylon cord was then tied to adjacent stakes which resulted in six lines being strung across the pond. Number 20 double-strand electric wire was connected to the nylon lines, run to the pond bank and connected to a common wire, thus having the electrical circuit connected in series. The electric wire was stripped at each point where a charge of dynamite was to be set, and a one-gallon plastic jug was tied near each of these points. The plastic jugs were intended to prevent the dynamite charges from sinking lower than the desired 2.5 feet below the surface. Charges located in the shallow end of the pond were suspended only six to 12 inches below the surface of the water. This was done to prevent the entire shock wave from being absorbed by the soft, mud bottom (Johnston 1961).

Electric blasting caps having four-foot lead wires were connected at the stripped points on the Number 20 double-strand wire. The blasting cap lead wires were then connected to the plastic jug so that the dynamite charge would extend down into the water exactly 2.5 feet. A hole, ¼-inch in diameter and 2½ inches long, was placed in one end of the dynamite stick. The electric blasting cap was inserted into this hole, and the lead wire was wrapped one time around the stick of dynamite. One-inch plastic tape was wrapped around the stick of dynamite. When left in water for any length of time, the paper covering around a stick of dynamite will tend to come loose; and the dynamite will crumble. It was necessary for some of these dynamite sticks to remain suspended in the water for up to two hours, and the plastic tape served to keep the dynamite tightly enclosed in the paper covering.

The dynamite charges were placed so that no charge was more than

15 feet from the bank. The intervening charges were placed so that not more than 35 feet separated any two charges. A total of 21 sticks of dynamite was used in this pond.

After all charges were set, the double-strand electric wire was extended approximately 50 feet from the pond bank; and the dynamite charges were detonated simultaneously with a 12-volt automobile battery. The dead fish were picked up during the following four days, and all fish greater in size than one inch were recorded by length and weight. On the fifth day after dynamiting, 5% rotenone was applied to the pond at the rate of 2 ppm. During the next two days all dead fish were again removed and the results recorded in the same manner.

Pond No. 2:

In September, 1963, a 1.2-acre pond near Gainesville, Georgia, was dynamited using the same technique which was used in Pond No. 1. This pond, unlike Pond No. 1, had no emergent vegetation; and the water was not less than four feet deep at any point. A total of 35 sticks of dynamite was used in this pond.

Pond No. 3:

In an effort to determine the possibilities of using dynamite as a means of partial renovation, a third pond, located near Gainesville, Georgia, was dynamited. This pond had an area of 1.0 acres with very little water less than four feet deep and relatively little emergent vegetation. A total of 22 dynamite charges was placed around the perimeter of this pond 10 feet from the bank. These charges were suspended and spaced in the same manner as in the other two ponds. This pond was dynamited at midday, the time recommended for conducting partial poisonings with rotenone.

RESULTS

Preliminary Dynamite Studies

1. Preliminary Test of Shock Range—water depth 12 feet, charge depth 7.5 feet. Channel catfish were used in this test and placed at 20, 30, 40, and 50 feet from the charge and at every 2.5 feet in depth at each of the stations. Two shots were made under these conditions.

After the first shot all fish on Line No. 1 (the vertical line nearest the dynamite) were dead within 24 hours. After 24 hours the top four fish on Line No. 2, the middle three fish on Line No. 3, and the second fish from the top on Line No. 4 were also dead. No fish on Line No. 5 were killed.

The same results were achieved on the second shot with the exception that the second and third fish on Line No. 5 were dead after 48 hours.

Data from this test was used to determine the distance fish were to be placed for ensuing experiments. It was concluded that dynamite would be effective for killing fish up to a distance of 30 to 40 feet; therefore, on all subsequent tests, 40 feet was the maximum distance that fish were placed from the charge.

2. Series I—5-foot water depth
   1 Stick at 2.5 feet below the surface
   1 Stick at 4.0 feet below the surface (one foot from the bottom).

All fish at all depths to a distance of 30 feet were killed by the shot placed at 2.5 feet below the surface. Only the top fish on Line No. 1 was killed by the charge detonated at four feet below the surface (one foot from the bottom).

3. Series II—10-foot water depth
   1 Stick at 2.5 feet below the surface
   1 Stick at 5.0 feet below the surface
   1 Stick at 9.0 feet below the surface (one foot from the bottom).

The 5-foot charge killed all fish on Line No. 1 and the top two fish on Line No. 2. The 9-foot charge killed only the top two fish on Line No. 1. Results from the 2.5-foot blast in Series I appeared so promising

that it was repeated in Series II. This time not only were all fish up to a distance of 30 feet killed, but the top two fish on the 40-foot line were also killed.

4. Series III—15-foot water depth
   1 Stick at 7.5 feet below the surface.

All fish on Line No. 1 and those at 5.0 and 7.5 feet on Line No. 2 were killed.

5. Series IV—Random placement of fish in water 5 to 15 feet in depth.
   1 Stick at 2.5 feet below the surface.

Twenty-seven brown bullheads were suspended at random in water ranging from 5 to 15 feet in depth. The dynamite charge was placed at a depth of 2.5 feet below the surface in the approximate center of the randomly spaced fish. The nearest line of fish to the dynamite charge was approximately 20 feet, and the furthermost line was approximately 50 feet. Within 24 hours 21 of the 27 fish were dead, for an average mortality of 77.7%.

Results from this series of tests showed that the largest percentage of kills occurred when the charge was detonated at 2.5 feet below the surface. It was also observed on two occasions that some fish were killed at a distance of up to 50 feet from the charge but that most kills were within 30 feet of the charge. It was therefore concluded that the maximum distance of optimum kill was within a radius of 30 feet from the charge when placed at 2.5 feet below the surface.

Testing of Dynamite in Farm Ponds

After dynamiting Pond No. 1 a total of 552 fish weighing 37.6 pounds was recovered. Bluegill bream *(Lepomis macrochirus)*, largemouth bass *(Micropterus salmoides)*, and brown bullheads *(Ictalurus nebulosus)* accounted for 28.3, 5.2, and 4.1 pounds of the total weight, respectively. Pond No. 2 yielded a total of 7,021 fish weighing 138.5 pounds. Bluegill bream accounted for 101.7 pounds, bass 30.0 pounds, catfish 2.0 pounds, and miscellaneous species 4.8 pounds. A total of 2,255 fish weighing 36.3 pounds was recovered from Pond No. 3 with bream accounting for 29.2 pounds, bass 4.9 pounds, catfish 0.9 pounds, and miscellaneous species 1.3 pounds.

In Pond No. 1 a total of 131 fish weighing 10.7 pounds was recovered immediately after the blast. The remaining 421 fish weighing 26.9 pounds were recovered during the following 72-hour period after they had bloated and had risen to the water surface. Pond No. 2 yielded 1,510 fish weighing 31.0 pounds immediately after the blast and 5,511 fish weighing 107.5 pounds during the following 72 hours. A total of 961 fish weighing 12.5 pounds was recovered from Pond No. 3 immediately after the blast, and 1,294 fish weighing 23.8 pounds were recovered during the following 72 hours.

Table I shows the species, length, number, and weight of fish which were killed by the dynamite blast and those fish which survived the blast in these three ponds.

Figures 2, 3, and 4 show graphically the percentage of each species of fish killed with the dynamite by number of individuals, by weight, and by size class and the percentage of those which survived the dynamiting as shown by the total recovery effected by the heavy rotenone application.

In Pond No. 1 the dynamite blast killed 39.1% of the total number of bream and 61.5% of the total weight of this species. The dynamite killed 42.9% of the total number of bass and 41.6% of the total weight. Of the brown bullheads, 14.8% of the total number and 31.1% of the total weight were killed by the dynamite blast. When all three species are considered together, 38.7% of the total number and 52.4% of the total weight of the fish were killed by the dynamite blast. When the per cent of the number of all three species greater than three inches and the per cent of the total weight of the three species were calculated, it was found that 65.1% and 54.9%, respectively, were

killed by the dynamite blast. Upon breaking this down into individual species, it was found that 67.7% of the total number of bream greater than three inches, 48.0% of the bass greater than six inches, and 30.8% of the brown bullheads greater than six inches were killed. Calculating for the smaller fish, it was found that 15.3% of the total number of bream less than three inches, 36.4% of the bass less than six inches, and none of the brown bullheads less than six inches were killed. (See Figure 2.)

In Pond No. 2 the dynamite blast killed 84.6% of the total number of bream and 88.9% of the total weight of this species. The dynamite killed 36.4% of the total number of bass and 49.1% of the total weight. Of the catfish, 25.9% of the total number and 23.5% of the total weight were killed. When all species are considered together, 84.2% of the total number and 52.4% of the total weight of fish in this pond were killed by the dynamite blast. When the number and the weight of all species greater than three inches were calculated, it was found that 75.3% of the number and 60.2% of the weight were killed by the dynamite blast. Upon breaking this down to individual species, it was found that 80.0% of the bream greater than three inches, 35.7% of the bass greater than six inches, and 33.3% of the catfish greater than six inches were killed. (See Figure 3.)

In Pond No. 3 the dynamite blast killed 55.8% of the number and 55.3% of the weight of the bream population. The dynamite killed 20.0% of the total number of bass and 12.0% of the total weight. Of the catfish, 25.0% of the number and 17.3% of the weight were killed. Calculations showed that the dynamite blast killed 55.7% of the total number and 25.5% of the total weight of all species. When all species greater than three inches were calculated, it was found that 54.4% of the total number and 33.3% of the total weight of fish were killed. Of the bream greater than three inches, 55.1% of the total number was killed. No bass or catfish less than six inches were recovered; therefore, the numbers of these species killed which were greater than six inches are the same as the total numbers killed. (See Figure 4.)

DISCUSSION

It was observed during the preliminary studies on Lake Lanier that, in general, the deeper the dynamite charge was set, the smaller the percentage of fish killed. It is assumed that upon detonation the main force of the shock wave travels upward and downward from the point of detonation in a cone-shaped manner. This is assumed to be the path of least resistance. After detonation of shallowly placed charges in 10 to 15 feet of water, it was observed that in only a couple of seconds after detonation a large amount of mud "boiled" up to the surface of the water. This led to the conclusion that a great part of the effective shock wave is directed straight down. To determine just how strong this shock wave might be, a cement building block was placed on the cove bottom four feet directly below the dynamite charge. After detonation it was found that the cement block had been broken into many fragments.

Some of the fish which were killed by the dynamite blasts were analyzed to determine the extent of internal damage. It was found that the swim bladder had not been ruptured in the catfish; however, there did appear to be some internal bleeding of the spleen and kidneys of these fish. No internal damage could be detected on the scale fish which were killed by the dynamite, but there were areas where the scales had been removed on some of these fish.

In the preliminary tests only those scaled fish very near the point of detonation were killed immediately after the blast, and a period of from 24 to 48 hours elapsed before the catfish died. It was not entirely established whether some mortalities might have occurred because the fish were confined in the small wire baskets; however, it is assumed

that any fish which died within 24 hours of the dynamite blast did so as a result of the blast.

It is thought that the percentage of total weight and of total numbers of fish killed in Pond No. 1 would have been much higher had it not been for the shallow condition of much of the pond's area and for the emergent pond vegetation which shielded many of the fish from the shock wave. Even after placing the charges just below the surface in the shallow area of the pond, it is reasonable to assume that the shock wave traveled horizontally only a short distance from the point of detonation, thus preventing a maximum kill in this area. This was substantiated to some degree after Pond No. 2 was dynamited. These two ponds were treated in exactly the same manner, but Pond No. 1 had emergent vegetation and very shallow water while Pond No. 2 had no vegetation and relatively deep water throughout. As indicated by Figures 2 and 3, the percentage of kills in Pond No. 2 on all species of fish, with the exception of bass, was consistently higher.

Upon dynamiting Pond No. 1, it was observed that only 23.7% of the total number of fish killed by the blast were killed immediately. In Pond No. 2 approximately 22% of the total number of fish killed were killed immediately, and approximately 43% of those killed in Pond No. 3 were killed immediately.

It was found that in Pond No. 2 the dynamite charges could not be detonated electrically. Upon investigation it was learned that a pasture on the watershed had been heavily treated with agricultural lime, and it was assumed that a high lime content resulting from runoff caused a short in the electrical circuit when voltage was applied. Each electrical connection was then tied to a plastic jug which held it out of contact with the water. After this was done, all charges were detonated successfully in the usual manner.

The cost of the materials used in dynamiting Pond No. 1 was $19.91. This included 21 sticks of 60% ditching dynamite with electric blasting caps, 250 yards of Number 2 nylon cord, and 250 yards of double-strand electric wire. Approximately 11 man-hours were required for the entire dynamiting operation in this pond. The electric wire used in Pond No. 1 was also used in Pond No. 2 and Pond No. 3. This lowered the cost of the operations in these two ponds. The cost of materials used in Pond No. 2, which required 35 sticks of dynamite, was $17.95, and six man-hours were necessary. The dynamiting of Pond No. 3 cost $8.14 and required eight man-hours.

Precautions

Extreme precaution should be used when handling dynamite and electric blasting caps. A printed copy of "Do's and Don'ts" in the use of explosives may be obtained when purchasing dynamite. It is recommended that these instructions be followed very carefully and that inexperienced personnel not attempt to do work with dynamite.

CONCLUSION

From the tests which were conducted it was not established that the dynamite technique will be effective for eradicating entire fish populations; however, they did indicate that this technique may have other practical uses. With further study it may be possible to develop a feasible method of partial renovation for farm ponds. Another possible use of this technique would be for programs of rough fish removal in large reservoirs by baiting and then dynamiting small coves.

It appears that there are several advantages to the dynamite technique. (1) The system is entirely mechanical. (2) There are no temperature limitations. (3) There are no long-term effects as with chemical fish poisons. (4) Limited technical knowledge is required.

Along with these advantages are also several disadvantages. (1) The cost of materials may be somewhat higher than that of established rotenone techniques. (2) Preparations for the application of this

technique may involve many man-hours. (3) There is always a potential danger when using explosives.

In general, the writer wishes to conclude that:

(1) Dynamite is not effective in eradicating entire fish populations in farm ponds.

(2) Emergent vegetation appears to shield some of the fish from the shock wave produced by the blast.

(3) Dynamite blasts are effective over only a short radius in shallow water.

(4) Approximately 70% to 80% of those fish killed by the dynamite blast will settle to the bottom and remain until the following day.

(5) The cost of the dynamite technique will average $.37 per charge, plus the cost of electrical wire and the man-hours required for the operation. It may be noted, however, that the cost of the electrical wire is an initial expense since this wire may be used repeatedly.

(6) All electrical connections must be insulated or kept above the water surface in ponds having a high total hardness.

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TABLE 1
Data on Fish Which Were Killed and Fish Which Survived Dynamiting in Three Farm Ponds

Species	Length in Inches	Pond No. 1 Killed No.	Pond No. 1 Killed Lbs.	Pond No. 1 Survived No.	Pond No. 1 Survived Lbs.	Pond No. 2 Killed No.	Pond No. 2 Killed Lbs.	Pond No. 2 Survived No.	Pond No. 2 Survived Lbs.	Pond No. 3 Killed No.	Pond No. 3 Killed Lbs.	Pond No. 3 Survived No.	Pond No. 3 Survived Lbs.
Bluegill Bream	2-3	113	0.9	625	3.9	6,621	64.0	1,186	3.4	1,499	3.9	1,171	1.5
	4-5	390	24.5	181	11.9	231	15.4	40	2.2	666	20.4	471	10.9
	6-7	25	2.8	17	1.9	135	22.3	44	7.1	57	4.9	111	7.5
	>7	...	...	...	...	...	...	...	...	...	...	7	3.7
	Total	528	28.3	823	17.7	6,987	101.7	1,270	12.7	2,222	29.2	1,760	23.6
Largemouth Bass	<6	8	0.3	14	0.3	6	0.4	10	0.5	...	...	...	...
	8-22	12	4.9	13	7.0	10	29.6	18	30.6	3	4.9	12	35.9
	Total	20	5.2	27	7.3	16	30.0	28	31.1	3	4.9	12	35.9
Catfish (Ictalurus sp)	<6	...	...	14	trace	...	...	6	0.5	...	...	...	...
	7-13	4	4.1	9	9.1	7	2.0	14	6.0	4	0.9	12	4.3
	Total	4	4.1	23	9.1	7	2.0	20	6.5	4	0.9	12	4.3
Other	<6	...	...	...	...	1	0.1	1	0.2	21	0.6	2	trace
	7-16	...	...	...	...	10	4.7	...	...	5	0.7	5	1.3
	Total	...	...	...	...	11	4.8	1	0.2	26	1.3	7	1.3
Grand Total		552	37.6	873	34.1	7,021	138.5	1,319	50.5	2,255	36.3	1,791	65.1

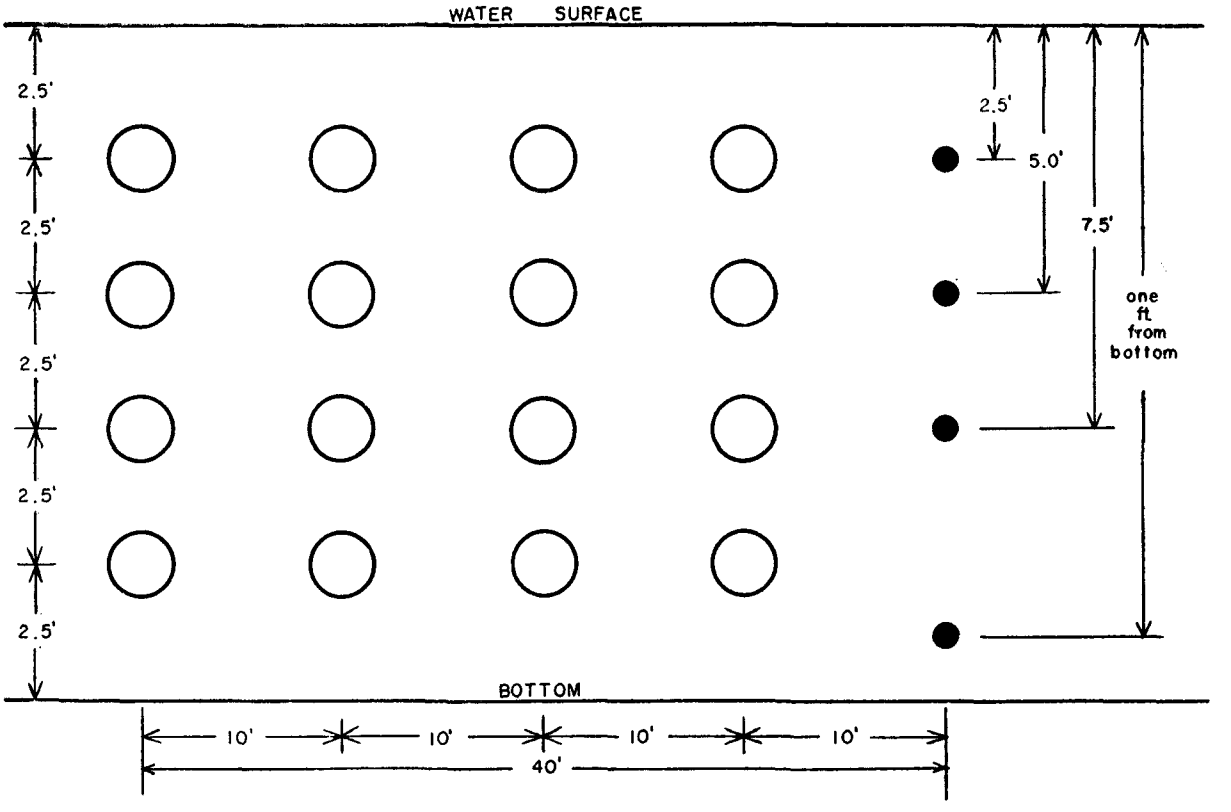

Figure 1. Generalized placement of holding baskets and depths at which dynamite charges were placed during each series of tests. Open circles represent holding baskets. Solid circles represent dynamite charges.

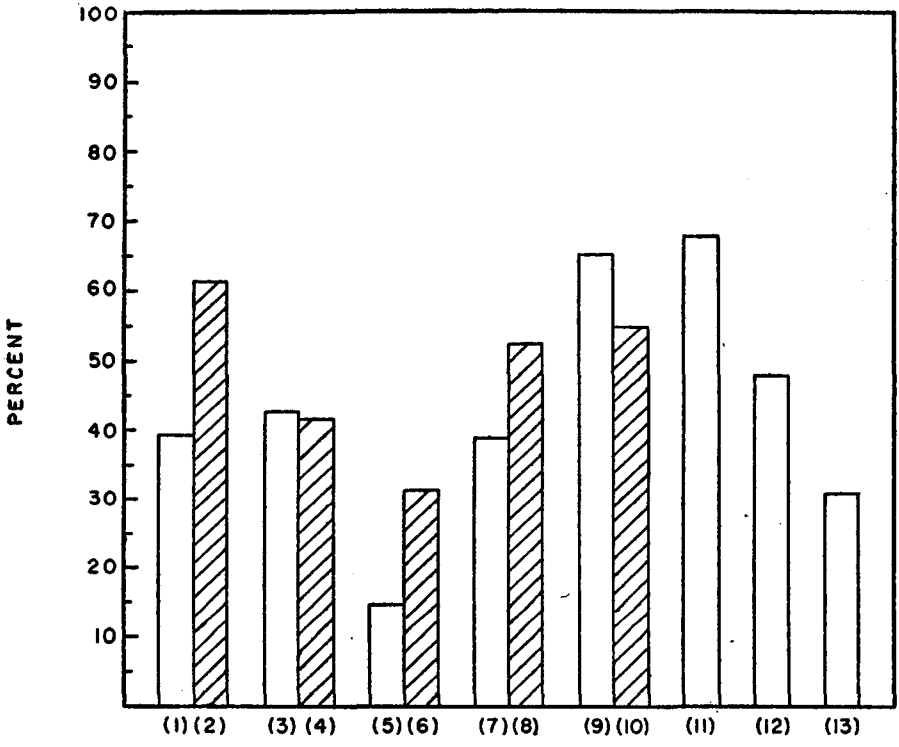

Figure 2. Total number and total weight of fish killed upon dynamiting Pond # 1. Results are expressed in percent.

Bream (1) number killed
(2) weight killed

Bass (3) number killed
(4) weight killed

Bullhead (5) number killed
(6) weight killed

All Species (7) number killed
(8) weight killed

All Species > 3 inches (9) number killed
(10) weight killed

Bream > 3 inches (11) number killed

Bass > 6 inches (12) number killed

Bullhead > 6 inches (13) number killed

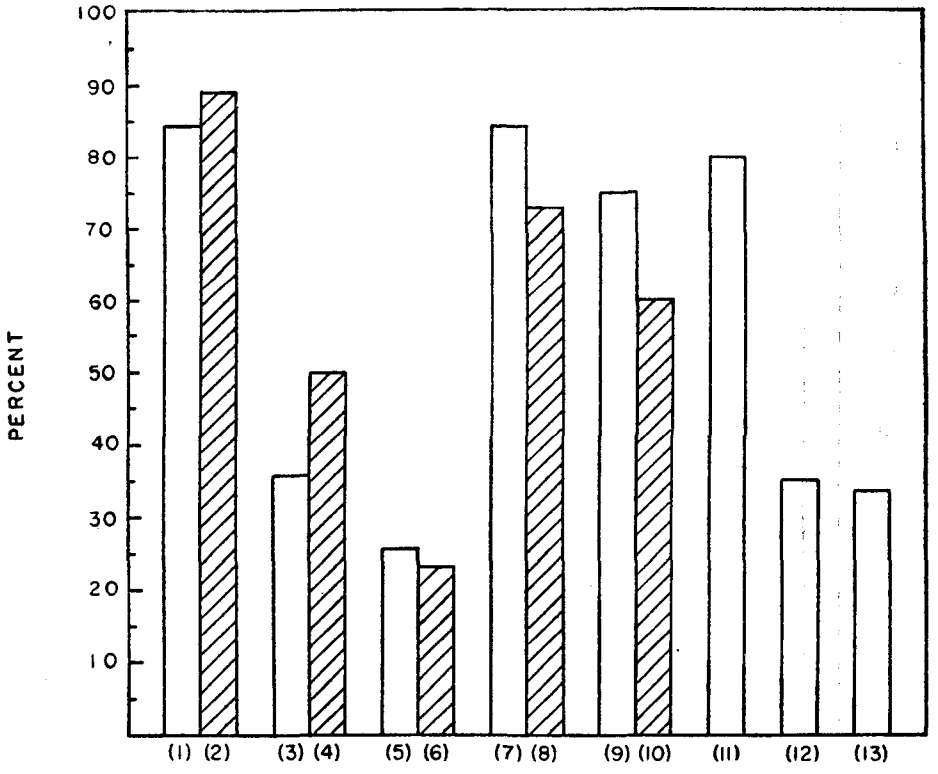

Figure 3. Total number and total weight of fish killed upon dynamiting Pond # 2. Results are expressed in percent.

Bream (1) number killed
(2) weight killed

Bass (3) number killed
(4) weight killed

Catfish (5) number killed
(6) weight killed

All Species (7) number killed
(8) weight killed

All Species > 3 inches (9) number killed
(10) weight killed

Bream > 3 inches (11) number killed

Bass > 6 inches (12) number killed

Catfish > 6 inches (13) number killed

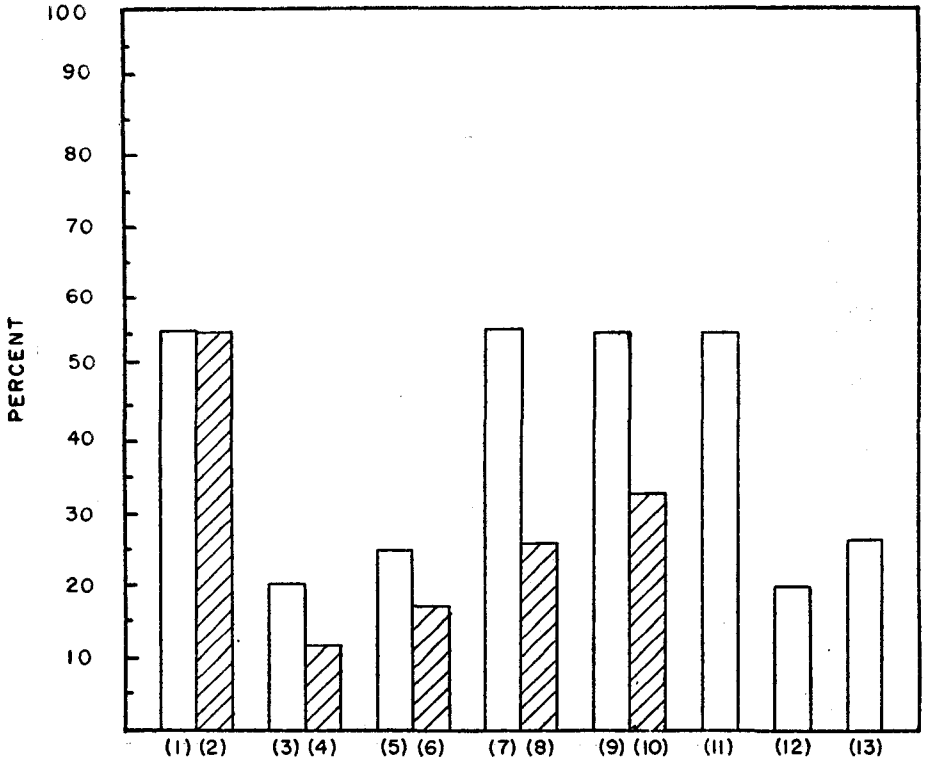

Figure 4. Total number and total weight of fish killed upon dynamiting Pond # 3. Results are expressed in percent.

Bream (1) number killed
(2) weight killed

Bass (3) number killed
(4) weight killed

Catfish (5) number killed
(6) weight killed

All Species (7) number killed
(8) weight killed

All Species > 3 inches (9) number killed
(10) weight killed

Bream > 3 inches (11) number killed

Bass > 6 inches (12) number killed

Catfish > 6 inches (13) number killed