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May 13, 1959

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Report No. 1570

PROGRESS REPORT ON THE EFFECT OF THE HOAD FISH SHELTER
ON FISHING SUCCESS

by

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Since 1933, the Michigan Department of Conservation has installed brush shelters in numerous lakes and has encouraged sportsmen's clubs to do the same. These shelters were constructed, for the most part, from natural materials available near the site of installation. Descriptions of several kinds of brush shelters can be found in Hubbs and Eschmeyer (1938). Much experimental work on shelters was done by Rodeheffer (1939, 1940, 1941 and 1945) who showed that shelters provide a haven for both small fish and large ones, including several game species. Since large fish tend to concentrate at brush shelters, it has been assumed that anglers could catch fish more readily at brush shelters than elsewhere, but this has not yet been confirmed by research in Michigan. Recent studies on a 145-acre Virginia lake revealed a definite increase in angler success for black crappies in shelter areas over that for the rest of the lake. ¹ The present report deals with a carefully designed fishing experiment made in 1958 to test the effect of a new type of shelter (Hoad shelter) on fishing success; the Hoad shelter is quite different from the conventional brush shelter which has been installed extensively in Michigan lakes, and it should not be assumed that the two types are necessarily similar in their effectiveness in attracting fish.

¹Reported in Bulletin No. 72 of Sport Fishing Institute (November, 1957), page 4.

Description of Hoad shelter

This new type of shelter was devised by Professor W. C. Hoad of the University of Michigan for the Lake and Stream Improvement Section of the Fish Division. It is comparatively easy to build and install. The components of the Hoad shelter (called a "jack" because of its resemblance to the familiar jack in a child's game) are a concrete cylinder, about 6" x 12", perforated with three holes, and three 2" x 2" sticks eight feet long. The three sticks are driven through the holes and nailed together at the center in such a manner that they protrude about four feet from each side of the cylinder, producing a 6-legged jack. The pre-cast concrete cylinders weigh about 35 pounds each; they are made in specially designed forms. The jacks are assembled either on shore or on a flat barge at the site of installation (see Figure 1).

For the present tests, from 12 to 18 jacks were dropped into the water at one point to form a cluster or "shelter." Each shelter was thus a pile of jacks which took the form of a jumbled mass of protruding sticks. The shelters were installed at the drop-off (at depths of 15 to 20 feet), and the protruding sticks prevented the jacks from rolling down the slope into deeper water.

Design of the experiment

Devoe Lake on the Rifle River Area was chosen for the test of Hoad shelters because of its convenient location on a research area, and because it has features typical of Michigan lakes in which shelters are usually installed. It is a marl lake with barren shoals and with abrupt drop-off into deep water (40-50 feet), and has a variety of fish species. So that the installation of shelters would be typical of general procedures, the selection of sites and the installation of shelters were done by personnel of the Lake and Stream



A



B



C

Figure 1.--The installation of part of a Hoad shelter in Devoe Lake (A - unassembled materials; B - assembling a jack; C - dropping the jack into the lake).

Improvement Section. Clark Oliver selected 22 possible shelter sites around the perimeter of the lake from the Institute lake map (Figure 2). These sites were located on barren areas between the 15- and 20-foot depth contours, to conform with general practice.

The 22 sites were then considered as 11 pairs (adjacent sites being paired). One of each of the 11 pairs of shelter sites was selected to receive a shelter, by the random method of tossing a coin; the remaining site of the pair was designated as the control site with no shelter. Distance between adjacent sites was mostly 300 to 400 feet; the minimum was 270 feet between a site with a shelter and a control site.

The shelters of jacks were installed in the lake on April 14 and 15, 1958, by a crew directed by D. Sims of the Lake and Stream Improvement Section. Markers were set on shore and also near the drop-off to indicate shelter locations and their control sites. On July 8 the shelters were examined by H. J. Vondett, using underwater diving gear, and the exact location of each was marked with a float attached to the shelter. Mr. Vondett found that, in general, the grouping of the jacks was good, although at two sites the shelter groups were not very compact. At one site (Number 8) the shelter could not be located despite repeated diving and dragging through the area with an anchor; apparently the jacks reserved for this station were inadvertently dumped at another area; thus, this station and its control site were eliminated from the experiment.

A pre-arranged fishing schedule of dates and time of day (Table 1) was drawn up, using a table of random numbers, to include 200 hours of still-fishing. Two dates, June 21 and July 4, were withheld from the drawing in anticipation of the usual greater influx of visitors and anglers to the Area on those days (the bass season opened on June 21, 1958). Seasonal fishing

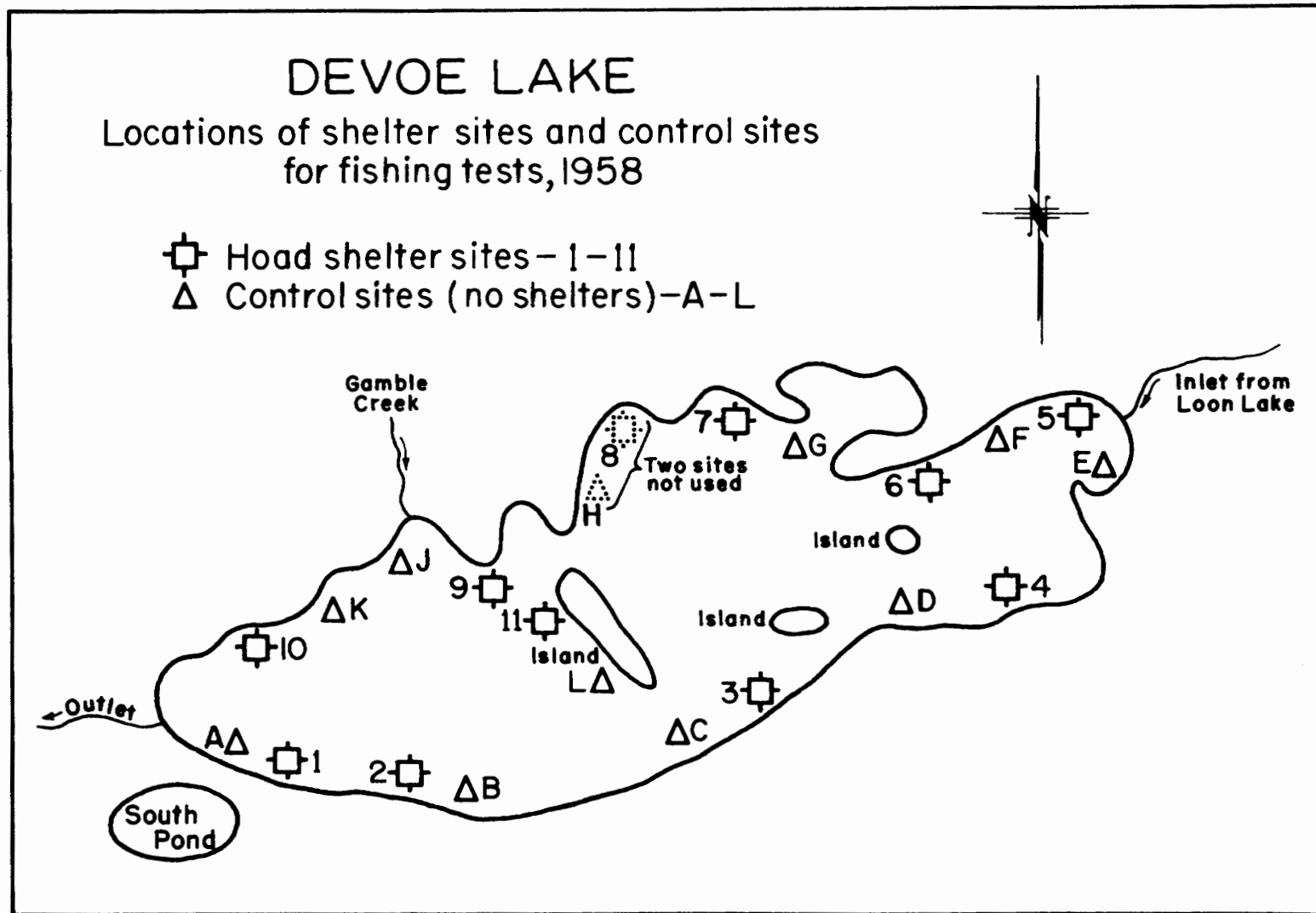


Figure 2

Table 1.--The fishing schedule used to test the effectiveness of Hoard shelters in Devoe Lake, 1958

Date		Time of day	Shelter number	Control site [↓]
May	8	3-5 PM	6	F
"	12	1-3 PM	1	A
"	16	7-9 AM	5	E
"	27	5-7 PM	3	C
June	9	3-5 PM	9	J
"	10	9-11 AM	7	G
"	11	1-3 PM	11	L
"	16	11 AM-1 PM	2	B
"	24	1-3, 3-5 PM	4, 10	D, K
"	26	1-3, 7-9 PM	2, 9	B, J
"	29	9-11 AM, 1-3 PM	11, 10	L, K
July	3	9-11 AM, 1-3 PM	5, 6	E, F
"	7	7-9 AM, 3-5 PM	1, 7	A, G
"	12	11 AM-1 PM, 5-7 PM	4, 3	D, C
"	15	11 AM-1 PM, 7-9 PM	9, 1	J, A
"	25	9-11 AM, 3-5 PM	7, 9	G, J
"	30	9-11 AM, 11 AM-1 PM	5, 7	E, G
"	31	1-3, 5-7 PM	2, 6	B, F
August	6	11 AM-1 PM, 3-5 PM	3, 4	C, D
"	8	11 AM-1 PM, 3-5 PM	11, 10	L, K
"	9	7-9 AM, 7-9 PM	2, 10	B, K
"	12	9-11 AM, 5-7 PM	4, 7	D, G
"	18	11 AM-1 PM, 5-7 PM	9, 1	J, A
"	22	1-3, 5-7 PM	5, 3	E, C
"	25	7-9 AM, 9-11 AM	1, 11	A, L
"	29	5-7, 7-9 PM	6, 10	F, K
September	10	7-9 PM	5	E
"	14	1-3 PM	9	J
"	17	3-5 PM	6	F
"	23	5-7 PM	10	K
"	28	11 AM-1 PM	1	A
October	14	9-11 AM	4	D

[↓]Control sites are lettered A to L (letter I not used) and are paired in consecutive series with shelter sites 1 to 11. Sites 8 and H were omitted from the experiment (see text).

pressure for these tests was apportioned on the basis of the 1957 Devoe Lake creel census records. As a result, 8 trips (32 hours) were scheduled for spring, 36 trips (144 hours) for summer, and 6 trips (24 hours) for fall. Only one fishing trip was scheduled per day in the spring and fall. During the summer (June 21-September 1) two periods of fishing were scheduled for each fishing day, to make more efficient use of employees' time in this and other work. Practically all recorded public fishing on Devoe Lake in 1957 was done between 7:00 A.M. and 9:00 P.M.; hence the schedule of hours for test fishing was confined to that time interval. The sites to be fished experimentally on any one day were also selected by recourse to a table of random numbers.

The experimental fishing was done as follows: Two persons fished simultaneously and as a pair; one person fished at a shelter site while the second fished at the control site. They fished for one hour, and then reversed their positions (exchanged sites) and resumed fishing for another hour. This procedure was adopted to minimize any bias caused by differential angler skill, change in weather, or fish movement. Fishing at shelter sites and control sites was in the same depth of water. Either worms or minnows were used as bait, depending upon their availability. Worms were used for 150 hours of fishing; minnows for 50 hours. Each angler used the same size of hook and same type of bait during the course of each 2-hour fishing trip. All fishing was done either by research personnel at the Rifle River Area, or in the presence of one of them. In the event a trip had to be postponed it was re-scheduled for the following day. All fish caught were counted, measured, and removed from the lake, with the exception of a few sub-legal bass which were fin-clipped and released. A sample of the fish were weighed and scale-sampled.

Results

A total of 606 fish were caught during the 200 hours of test fishing-- 344 at shelters and 262 at control sites (Table 2). Ninety percent of the fish caught were yellow perch. Only 55 fish (9 percent of the total catch) were of a size acceptable to anglers. Fish regarded as acceptable to anglers included those of the following minimum sizes or larger: bass, 10.0 inches; perch, 7.0 inches; and the sunfishes, 5.0 inches. The one northern pike which was caught was 25 inches long and weighed 3 lbs. 10 1/2 ounces. Small perch dominated the catch. Seventy percent of the perch caught were less than six inches long. Only 5.5 percent (17 fish) of the perch caught at the shelters and 4.6 percent (11 fish) captured at the control sites were at least seven inches long. There was no significant difference between the proportion of the species caught at the shelters and controls (chi square = 0.38 with 4 d.f.).

More fish were taken at the shelter than at the control site in 6 of the 10 pairs, equal numbers at one pair, with more fish at the control for the remaining 3 pairs (Table 3). Thus, although the total number of fish taken at shelters exceeded the total catch at the control sites, the differences were not consistent among the pairs of sites which formed the experimental basis of the trial.

Whether any consistent improvement was found in the catch at shelters over that at comparable areas without shelters was the question being studied here. Therefore an analysis of variance (Snedecor, 1956) was used to test whether the apparent slight improvement in catch at the shelters was greater than one might expect from chance of sampling (i.e., whether the difference was statistically significant). Because counts of fish caught, like those in Table 3, are unsuitable for the analysis of variance, a logarithmic

Table 2.--Fish caught at shelter sites and control sites during
200 hours of still-fishing on Devoe Lake

Species	Shelter sites	Control sites	Totals
Yellow perch	306	240	546
Smallmouth bass	14	9	23
Rock bass	10	6	16
Bluegill	7	5	12
Pumpkinseed	5	1	6
Black crappie	2	...	2
Northern pike	...	1	1
Totals	344	262	606

Table 3.--Numbers of fish caught on separate fishing trips to paired sites, Devoe Lake. Shelter sites are listed by number and control sites by letter. Totals and mean differences are given at the bottom of the table.

	1	A	2	B	3	C	4	D	5	E	6	F	7	G	9	J	10	K	11	L
	10	0	29	3	1	1	0	7	0	0	4	1	8	11	10	19	7	12	3	0
	24	11	23	0	8	3	3	7	4	2	2	6	13	15	1	7	5	0	1	4
	9	4	1	0	0	1	5	2	4	1	0	5	9	1	5	15	0	0	2	0
	11	2	18	12	24	0	6	4	0	2	1	3	6	9	4	22	0	0	5	0
	7	0					1	2	0	1	0	0	4	2	54	27	3	2		
	1	2													4	29	4	5		
Total	62	19	71	15	33	5	15	22	8	6	7	15	40	38	78	119	19	19	11	4
Mean difference	7.2		14.0		7.0		-1.4		0.4		-1.6		0.4		-6.8		0.0		1.7	

transformation was used. The decimal point was moved one place to the right, 1.0 was added to allow use of the zero catch data, and the logarithm obtained. The difference in the transformed (logarithmic) values for one fishing trip formed the unit of the analysis. The purpose of this manipulation was to allow use of the analysis of variance; the effect was to compare catches as logarithms of ratios rather than as differences. The relative values of the data remain the same.

A summary of the analysis of variance follows:

Source of variability	Degrees of freedom	Sum of squares	Mean square	F
Difference from zero	1	1.731	1.731	0.96
Between pairs	9	16.179	1.798	2.47*
Within pairs	40	29.172	0.729	

*Significant at 5 percent level.

The shelter effect, tested as the single degree of freedom called "difference from zero," was not significant (to be significant at the 5% level, the "F" value with 1 and 9 degrees of freedom, would need to be at least 5.12). Thus during this first year of installation the experiment provides no support for the belief that the presence of Hoad shelters affected fishing success.

The comparative measurements of fishing success, which are the basic units of this study, were so variable that the test was of rather low precision. Using the information from the analysis of variance, and methods explained by Snedecor (1956, p. 275) we find that the present test would have been fairly sure of detecting a significant difference in fishing quality

due to shelters, if they had improved the rate of catch to 3.4 times that at the control sites (Type I error 5 percent, Type II error 25 percent). Thus a respectable increase in fishing quality associated with shelters could have occurred here without being detected in the present test, simply because the test was of low precision. To restate the results of the statistical analysis, while the difference observed was not statistically significant, there would be a 25 percent chance with the test used, that a real difference of 3.4 times would not appear as a statistically significant difference. Further, on the basis of this experience, we may also estimate that to be able to detect a real difference of 2 times, should shelters improve the fishing this much, we will need to devote about twice the amount of fishing time to a test, fishing at each of 33 pairs of sites three times, instead of fishing at 10 pairs of sites five times as averaged here. These experimental demands exceed the capacity of Devoe Lake alone, for the fishing sites should not be placed too close together.

Extreme values occurred at paired sites 2B and 9J (Table 3). During the course of fishing it was discovered that shelter site Number 2 contained a submerged weed bed that may have had a bearing on the wide margin of difference between the catches there and at control site B. The paired sites 9J were different from the others in that they were situated in the richest part of the lake near the mouth of Gamble Creek and had an abundant growth of underwater vegetation. It would not be logical to ignore the two extreme values in the present study on the premise that the two pairs of sites were atypical of shelter sites, for unusual sites no doubt are included occasionally in brush shelter installations in general practice.

Catches of fish of acceptable size at the shelters were compared with those of the general public who fished Devoe Lake in a similar manner during the same period of time (Table 4) for evidence as to whether or not certain

Table 4.--Summary of catch of fish of acceptable sizes¹ by test fishing at Hoad shelters and by public fishing in Devoe Lake, May 8-October 14, 1958

Species	Fishing at shelters (100 hours)		Public angling (612 hours)	
	Number	Percentage	Number	Percentage
Yellow perch	17	46	52	37
Rock bass	6	16	29	21
Bluegill	3	8	22	16
Smallmouth bass	8	22	21	15
Black crappie	2	5	13	9
Pumpkinseed	1	3	...	...
Longear sunfish	...	...	1	1
Bullhead	...	...	1	1
Totals	37	100	139	100

¹Bass at least 10 inches in length, perch and bullheads at least 7 inches, and sunfishes at least 5 inches.

species were concentrated at the shelters. No significant difference in species composition was noted (chi square = 3.65 with 4 d.f.). In the test fishing no significant difference was found between catches on minnows and those on worms.

Discussion

This experiment was designed to determine if fishing success could be improved by the installation of Hoad shelters. No significant improvement in the catch was observed during the first fishing season after the shelters were installed. However, it is possible that the effectiveness of the shelters might improve with age if a considerable accumulation of algae, detritus and rooted vegetation takes place on and around the shelters. Thus, the tests might be repeated over the same shelters in Devoe Lake after the lapse of a year or two.

The present test is probably applicable only for the yellow perch. For other species, too few fish were caught to reveal possible significant differences. Had the Hoad shelters been located in shallower water, certain species such as black crappies, smallmouth bass, and rock bass might have been attracted (and caught) in greater numbers. The shelters were installed between the 15-foot and 20-foot contours because that has been the practice of the Lake and Stream Improvement Section. Therefore fishing at the control sites also was done at this depth. Small perch dominated the catches and possibly this depth is too great to attract many fish other than small perch. Rodeheffer (1945) concluded that perch were the most common fish in shelters lying in deep water (15 feet).

Acknowledgments

D. W. Hayne and G. P. Cooper assisted in the planning of the experiment and Dr. Hayne gave valuable assistance in the statistical analysis of the data. Several individuals in addition to the writer participated in the experimental fishing--particularly A. W. DeClaire and H. Gowing. Other anglers were C. J. Kohn, D. S. Shetter, George Smith, Jr., Keith Sammons, Arthur Schiffman, Charles Becker and Dean Gordon. Photographs used in Figure 1 were taken by A. W. DeClaire.

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