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cc: Mr. Ruhl

Dr. Pirnie

Mr. Shetter

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RESULTS FROM TAGGING OPERATIONS ON WINTERGREEN LAKE,
KELLOGG BIRD SANCTUARY, KALAMAZOO COUNTY, MICHIGAN

In connection with other studies on Wintergreen Lake, several hundred of the various species of fish native to the lake have been tagged in an attempt to learn more of their respective habits and growth rates. The results of this work are encouraging, though in no sense complete or far reaching. Due to the method of controlled fishing practiced on this lake, the author feels that future tagging experiments will build up a set of extremely interesting data.

The initial group of fish were tagged on May 3, 1935, by the author, and since that time any fish that were tagged have been tagged by D. L. Allen, or by Frank Lyman. The recoveries and measurements have also been recorded by them. Fish were tagged by encircling the maxillary or the mandible with a very light metal strap tag, each of which carried a serial number. All fish were measured at time of tagging and at time of recovery, and locations of both tagging and recovery were recorded. No fish were tagged after August 3, 1935.

The following table gives a tabular summary of the number of fish tagged and recovered during the past year from Wintergreen Lake:

Table 1

General Summary Table Showing Number of Fish Tagged and Recovered at Wintergreen Lake by Species

Species	No. of Fish Tagged	No. of Tagged Fish Recovered	% of Recovery
<i>Aplites salmoides</i>	284	36	12.6
<i>Eupomotis gibbosus</i>	158	11	7.0-
<i>Helioperca macrochira</i>	214	30	14.0+
<i>Perca flavescens</i>	20	..	...
<i>E. gibbosus</i> x <i>H. machro.</i>	4	..	...
<i>Amia calva</i>	2	..	...
Totals	682	77	11.2

All fish tagged between 5/3/35 and 8/3/35.

All Recoveries listed were recovered between 5/3/35 and 4/30/36.

For the time period between August 8, 1935 to April 30, 1936, complete records of the great majority of catches by hook and line in the lake were kept. At least 95% of the catches were measured. Mr. Lyman's tables for the total catch is shown below, and also includes the catch per acre for the winter fishing:

Table 2

Total fish caught during winter of 1935-1936
Wintergreen Lake, Kellogg Bird Sanctuary

Species	No. of fish caught ice fishing during winter of '35-'36 including tagged fish	Catch per acre
<i>Helioperca macrochira</i>	1079	54
<i>Aplites salmoides</i>	5	0.25
<i>Perca flavescens</i>	428	22.4
<i>Eupomotis gibbosus</i>	92	4.6
Totals	1604	80.

✓ Based on acreage of 20 acres as shown by Lyman's survey.

As will be seen from Table 2, approximately two-thirds of last winter's catch was comprised of bluegills. With the exception of one tagged largemouth black bass which showed up in the winter's fishing, all the tagged fish caught were bluegills, some 14 tagged bluegills being taken. Therefore this species will be discussed somewhat in detail.

Although 30 bluegills bearing tags have been recovered (14 by ice-fishing, 16 by seine, trap, fly), only 21 have been used in attempting to determine the growth rate. Nine recoveries have shown a negative growth, some as much as 10 mm. This is no reflection on the parties who took the data, since it is very possible there is considerable shrinkage due to rigor mortis. This would have every chance to take place in ice fishing, where the fish are often exposed to the elements over long periods of bitter cold weather. It has recently been found that brook and brown trout shrink in length with the onset of rigor mortis after removal from the water¹. It would therefore seem wise to measure all fish as soon as they are taken from the water, inasmuch as the original measurements on tagged fish are made on live fish. Those fish which showed negative growth, however, have not been included in the following tables.

Table 3

Size Range of Tagged Bluegills Recovered Since
 Aug. 3, 1935-April 30, 1936
 By Ice Fishing

Tag Number	Size at Tagging in mm.	Increase in mm.	Days Out	Age
26223	240	5	244	VII
26614	232	3	236	V
26156	235	...	242	...
26181	230	1	247	V
26089	234	2	255	V
26112	236	4	248	...
23185	233	6	273	VI
26603	240	1	236	VI
26129	245	1	246	...
26207	240	1	253	VI
Totals 10	2365	24	2480	
Averages	236.5	2.4	248	

Table 4

Bluegills Recovered between May 3-Aug. 3, 1936
 by Seine, Trap, Hook and Line

(Table 4 given on following page)

¹ Shetter, David S. - 1936. Shrinkage of Trout at Death and on Preservation. Copeia, 1936, No. 1, May 10, pp. 60-61.

Table 4

Bluegills Recovered between May 3-Aug. 3, 1936
by Seine, Trap, Hook and Line

Tag Number	Size at Tagging in mm.	Increase in mm.	Days Out	Age
26254	234	...	8	
26065	240	...	20	
26243	235	...	2	
26245	249	...	2	
26247	227	...	2	
26251	234	...	2	
26253	237	...	2	
26134	241	...	9	
26248	243	...	2	
26075	223	...	17	IV
26070	235	...	19	
<u>11</u>	<u>2618</u>	<u>0</u>	<u>87</u>	
Averages	238	0	8	

As can be seen from Table 4, there was no growth over the relatively short period of time during which the earlier recaptures were made. The recoveries effected during the winter ice fishing showed only a very slight growth for the relatively long period of time which these fish were free. This growth was approximately 1 millimeter per 100 days. The age of these recovered bluegills ran from five to seven years, close to the maximum age for bluegills in Michigan waters, which possibly explains the very small growth of these particular fish.

The following table shows the distribution of the size ranges of the bluegills caught since last August, the distribution of the size ranges of bluegills tagged, and the distribution of the size ranges of the tagged fish recovered during the winter fishing period.

Table 5

Class in mm.	Size Range of Bluegills caught 8/3/35 to 4/30/36 in Win- tergreen Lake	Size Range of Bluegills tagged in Win- tergreen Lake 1935	Size Range of Tagged Bluegills recovered
>150	6	7 . . . . .	...
150-159	...	1	...
160-169	...	...	...
170-179	11	1	...
180-189	24	...	...
190-199	36	4	...
200-209	72	4	...
210-219	165	3	1
220-229	164	21	1
230-239	315	89	7
240-249	231	75	5
250-259	20	9	...
260-269	...	...	...
270-279	...	...	...
280-289	...	...	...
290-299	...	...	...
300-309	2	...	...
	<u>1046</u>	<u>214</u>	<u>14</u>

From Table 5, it will be seen that about 85% of the bluegills caught during the winter were 210 mm. ($8\frac{1}{4}$ inches) or over, and that about 95% of the fish tagged during 1935 were in the same size ranges. All of the recovered fish were in this particular size range, which is the most likely expectation.

Having at hand the total number of bluegills caught, the total number of recoveries, knowing and the number of tagged fish in the lake after August 8, an attempt was made to calculate the bluegill (legal size) population of the lake. By August 8, according to records furnished me, there had been tagged 214 bluegills; of these 5 had been caught off or had died; the seven undersized fish were also eliminated from the computation, as no tagged undersized bluegills were recorded in later catches (only six untagged undersized bluegills were taken according to Lyman's records) during winter fishing. This left 202 tagged bluegills in the lake. The following equation was then set up:

$$\begin{aligned}
 1065:14 &= x:202 \\
 14x &= 215,130 \\
 x &= 15,366 = \text{population of bluegills of} \\
 &\quad \text{legal size in Wintergreen Lake.}
 \end{aligned}$$

From Mr. Lyman's map, which shows the area of Wintergreen Lake to be approximately 20 acres, this gives a population of approximately 768 legal bluegills per acre.

For a comparison of bluegill populations of other Michigan lakes, I have computed bluegill populations in two lakes in the Waterloo area which were studied by Mr. Gerald Cooper in connection with the recent winter-killing which took place on several lakes in southern Michigan during the winter of 1935-36.

In arriving at figures presented², Mr. Cooper counted all the dead fish observed in sample plots along the shoreline of the lake, and multiplied this by the amount of shoreline covered by fish. I divided these figures by the acreage of each lake as determined by Mr. Coburn, who is connected with the Waterloo Project.

For Mud Lake, Jackson County, an approximate population of 700 legal bluegills to the acre was found. For Green (Staffer's) Lake, Jackson County, an approximate bluegill population of 650 bluegills to the acre was determined. These figures are minimum estimates, since only those bluegills which came to shore were used in arriving at the original figures, as there was no way in which those lying dead in deeper water could be counted.

Although a larger number of bass than bluegills were tagged, there was an extreme difference in the number caught during the winter fishing, only five largemouth being taken on hook and line. The one tagged large-mouth bass which was recovered showed a loss of 3 mm. (373 to 370) since being tagged in May, which again may have been due to shrinkage incurred with rigor mortis.

35 large-mouth recoveries shortly after tagging indicate no measurable growth during the early summer (May and June, 1 August recovery). These fish averaged 300 mm. in size at time of tagging.

Of 158 common sunfish tagged, 11 have thus far been recovered, all within 30 days after the date of tagging. These, like the large-mouth bass, showed no measurable growth over their free period, which was early May and part of June.

² Eschmeyer, R. W. - 1936. Winter Fishing on the Waterloo Area, Winter of 1935, 1936. Report No. 357, Institute for Fisheries Research.

No conclusions can be drawn concerning the migrations of the tagged fishes in the lake outside of the fairly evident facts that they are in water deeper (for the most part) than eight feet during the winter months when ice is on the lake. During the warmer months of late spring and early summer they will be found in the shallower waters till they have completed their spawning. This is fairly adequately demonstrated by our ability to seine them in water not greater than four feet deep during our past two visits during the spring of the year. Before anything more definite than this can be said on the migration question, more returns are needed over all periods of the year, especially returns which have all details recorded, both for the tagging locality, and for the recovery locality.

Conclusions

1. From the number of winter returns, it appears fairly evident that the tags are holding well.
2. If the population estimate approaches the correct number of bluegills, the winter fishing is removing only a small portion of the population of sexually mature bluegills, in fact only 7%. If this estimate is correct only a small proportion of the possible annual crop of bluegills is being taken by the controlled fishing in force at present.
3. The growth of these larger and older fish (as determined by tag returns) is very slight.

Suggestions for Future Work

1. Continue to record each fisherman's catch.
2. If possible, provide each fisherman with a rule, and have him measure the fish as soon as they are caught.
3. Have each fisherman record the exact location where he fished.

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By: David S. Shetter