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A Trapping Experiment to Estimate the Bluegill Population in a Farm Pond¹

By JOHN M. LAWRENCE

Estimates of fish populations from recapture of marked fish have on several occasions yielded estimates far below the population later shown to be present (Krumholz 1944, Carlander and Lewis 1948, Fredin 1950, Carlander 1952). Fredin (1950) suggested that the recapture of the fish by some method different from that used in the original capture might give less biased results. In the present investigation the bluegill population was estimated by the marking and recovery technique using seines and baited wire traps.

The pond selected for study was on the Bill Blackman farm in Marion County, Iowa (T79N, R19W, Sec. 31) and had a surface area of 0.7 acres. The pond was stocked with bluegill (*Lepomis macrochirus* Raf.), largemouth black bass (*Micropterus salmoides* Lacepede), Black crappie (*Pomoxis nigromaculatus* LeSueur), and black bullheads (*Ameiurus melas* Raf.) in 1944. The pond has contained a "balanced" population since 1947 with both bass and bluegills reproducing annually. Prior to trapping for bluegills, the pond was seined on August 1, 1951 and 153 bluegills ranging in size from 3 to 8 inches total length were marked by clipping the left pectoral fin. The pond was again seined on August 3 and a population estimate of 1759 bluegills was obtained. The 95 per cent confidence limits for this estimate, based upon the binomial distribution (Snedecor 1946) placed the population as between 110 and 3419.

Trapping for bluegills began on August 7 and continued through August 29. The pond was divided into 6 areas, and one wire trap was assigned to each area. The traps were constructed of ½-inch hardware cloth and were 4 feet long and triangular in cross-section with 24 inch sides. A total of 142 trap sets was made during this 4-week period. All traps were baited with soy bean flakes. A total of 533 bluegills (3 to 8 inches total length) was trapped and marked. The fish from each area were given identifying marks by clipping a pectoral or pelvic fin plus one or two dorsal spines. For example, a fish trapped in area 1 had its right pectoral fin and first dorsal

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spine clipped before it was released, while a fish taken in area 2 had its right pectoral fin and first 2 dorsal spines clipped. Thus, for area 3, 4, 5 and 6 a combination clipping of the right or left pelvic fin and the first or first two dorsal spines served to identify the area in which they were marked.

Recaptured fish, taken in the same area in which they were marked had their third dorsal spine clipped, whereas fish recaptured in a different area had the appropriate pectoral or pelvic fin clipped (only the outer half of the fin was removed on recaptures) plus the fourth or fifth dorsal spine. By use of this technique of marking it was possible to determine the movement of the recaptured fish in this pond (Table 1).

One of the assumptions that must be made to give an unbiased estimate of the total fish population is that the marked fish are randomly distributed among the entire population. In an effort to determine if random distribution of marked fish was occurring in this pond, a test of independence was run on the data concerning the area of marking to the area of recapture of the bluegills. A Chi-square value of 8 with 5 d.f. was obtained. Such a value has a tabular probability of 0.15 which is not usually considered significant, but is in the range where some doubt may be cast upon the random distribution assumption in this pond.

Another test of independence was made on the numbers of fish marked in each area and the numbers of fish recaptured from that area by trapping. A Chi-square value of 9.15 with 5 d.f. was obtained. Such a value has a tabular probability of 0.10 which is not significant. However, such a low probability value sheds some doubt on the assumption of equal vulnerability to trapping of all bluegills in this pond.

To test the differential vulnerability of various size classes of bluegills to recapture, a test of independence was run on the numbers of

Table 1
Relation of area of recapture to area of marking;
bluegills, Blackman Pond, 1951

Area Marked	Area Recaptured					
	1	2	3	4	5	6
1	4	4	5	1	4	3
2	2	13	5	6	5	0
3	0	5	6	1	3	1
4	1	2	3	1	5	3
5	2	5	2	5	7	3
6	3	2	5	5	7	12

fish marked in each size group and the numbers of these fish in each group recaptured. A Chi-square value of 37.0 with 4 d.f. was obtained on the seine-marked trap-recapture fish, and a Chi-square value of 32.4 with 4 d.f. was obtained on the fish marked and recaptured by trapping. Both of these values are significant with a probability of less than 0.01. Thus with a high degree of confidence, it is evident that the larger bluegills were more vulnerable to trap recapture than were the smaller bluegills in this pond.

The bluegill population estimates were computed by formulas of both Schnabel (1938) and Schumacher and Eschmeyer (1943) from the following combinations of data: fish marked by seining and then recaptured in traps, and fish marked and recaptured by trapping. During the 4-week period 26 trap samples were taken. Since the estimates by the two formulas were quite similar only the estimates using the Schumacher formula are given in Table 2.

The population estimates based on fish marked and recaptured by trapping fluctuated from 100 to 5300 during the first 10 samples. Following this, these estimates began to steadily decrease from about 3000 to the final estimate of 1532 bluegills by Schnabel's formula and 1361 bluegills by Schumacher's formula. It is believed that this declining estimate is the result of more frequent capture of marked than unmarked fish.

The bluegill population estimates based on fish seine marked and trap recaptured varied considerably throughout the first 9 samples, but then became fairly stable in the neighborhood of 2500 fish for the remaining 17 samples. The final population estimate by Schnabel's formula was 2550 fish and by Schumacher's formula, 2608 fish.

The estimate based upon fish caught for marking by seines and recaptured by traps was higher than either the estimates based upon fish caught and recaptured by seines or that based upon fish caught and recaptured by traps. Apparently both the seines and traps are selective of certain individuals but their selectivity is not the same so that the errors due to selectivity are less when one method is used in marking and the other in recapture.

The average weight of the bluegills (3 inches total length and longer) was computed from the seining samples. The estimated total weight of bluegills, based on this average weight and the population estimates, ranged from 101 to 194 pounds in this 0.7 acre pond.

Table 2
 Estimates of the bluegill population based upon trap recovery of
 marked bluegills, Blackman's Pond, 1951

Sample	Seine marked		Trap marked	
	n ¹	Estimate	n ¹	Estimate
1	153		0	
2	153	6426	35	1715
3	153	7803	83	916
4	153	4666	99	1267
5	153	5699	118	2520
6	153	5171	145	3922
7	153	5386	165	4224
8	153	3277	172	7973
9	153	3578	252	3896
10	153	2923	294	3389
11	153	2671	347	3554
12	153	2730	398	2676
13	153	2709	398	2685
14	153	2606	430	2642
15	153	2517	443	2371
16	153	2448	443	2524
17	153	2556	449	2364
18	153	2579	466	2063
19	153	2550	477	1864
20	153	2452	478	1874
21	153	2479	477	1740
22	153	2585	489	1608
23	153	2605	502	1443
24	153	2646	518	1456
25	153	2590	526	1415
26	153	2608	516	1361

¹n = the accumulated total of marked bluegills in the pond.

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