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RATE OF ESCAPE OF FISH FROM TRAP NETS [1]

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Fishery biologists are well aware that stationary trapping devices usually are selective with respect to species and size of fish they capture and retain. This source of bias can significantly affect catch indices, population estimates, and computations of growth and mortality rates. In this paper I discuss the rate of escape of fish of various species and sizes from trap nets of the kind described by Crowe (1950) and Latta (1959). This experiment was prompted by casual observations that, even though some fish if left in a net overnight were still present the following day, there also were instances when fish escaped during the interval between lifts.

Hansen (1944) tested the ability of certain species to escape fyke nets in Illinois lakes and found that both the bluegill (Lepomis macrochirus) and largemouth bass (Micropterus salmoides) were adept at escapement. One-third of the bluegills and 37% of the bass escaped in a 23-hour period. Over a 2-day period (51 hours) in another lake, 86% of the bluegills and 20% of the bass left the nets. Schupp (1965)[2]

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2 In Minnesota Annual Reports of Fisheries Research Projects, 1965: 1964 Progress Report for Project No. 63-1.

observed a pronounced increase in fish catches when nets were lifted at 2-hour intervals rather than once a day. Latta (1959), seeking an explanation for size selectivity among fish large enough to be retained by the trap nets, speculated that some sort of behavior pattern probably was responsible, and cited several instances where more larger fish were retained than small ones. He further postulated that the "peck order" described by Gerking (1957) might be a factor.

Equipment and methods

The trap nets used in this experiment have a single pot 5 ft. by 3 ft. by 8 ft. with 1 1/2-inch stretched mesh. The heart is 12 1/2 ft. long with 2 1/2-inch mesh and the wings are 10 ft. long with 3-inch mesh. The leads are 140 ft. long by 3 ft. deep with 3-inch mesh.

Two lakes on the Rifle River Recreation Area in northeastern Michigan were used for these tests. The first test was run in April on Jewett Lake; a second test was conducted in August on Lodge Lake. Between April 24 and 29, 1961, two nets were fished in 12.9-acre Jewett Lake. The water temperature was either at or close to 52 F, and a secchi disk was visible all the way to the bottom (13 ft.). Both nets were re-set in different locations after 48 hours at the original sites. However, newly caught unmarked fish were left in the nets. There were four 24-hour captivity periods and two of 48 hours. In 16.8-acre Lodge Lake one trap net was fished during August 1-4, 1961, and two during August 7-11. The weather was clear and warm and the water temperature at 9 AM was about 78 F. A zooplankton bloom

limited visibility of the secchi disk to 4 ft. The captivity periods consisted of 5 for 24 hours, 3 for 48 hours, and 1 for 72 hours.

All fish were fin-clipped, measured to the nearest 0.1 inch, and returned to the nets. Nets were lifted daily and captured fish were measured and examined for fin clips. New fish were marked with a different fin clip each day and all were put back in the nets. The various marks enabled us to determine how long an individual had been in the net after being marked. Obviously, the true period of confinement was somewhat longer than indicated because the fish had to be captured before they were marked. Mortality among the captives was considerably higher in August (38 fish) than in April (3 fish). Dead fish were omitted from the evaluation.

Results

Escapement from the trap nets for both tests is shown by percentages in Table 1. In the 24-hour periods following initial capture and marking, pumpkinseeds (Lepomis gibbosus) were most successful at escapement, followed by hybrid sunfish and brown bullheads (Ictalurus nebulosus). Unlike Hansen's (1944) fyke-net captives, largemouth bass and bluegills were less prone to leave the nets than any other species.[3] In the 48-hour periods, the degree of escapement was greatest among white suckers (Catostomus commersoni), whereas bass again demonstrated a lack of desire (or ability) to leave the nets. About

[3]This statement applies only to species shown in the table. Small numbers (<5) of black crappies (Pomoxis nigromaculatus), yellow perch (Perca flavescens), redear sunfish (Lepomis microlophus), and rock bass (Ambloplites rupestris) also were caught and none escaped.

the same proportion of bluegills escaped as in the 24-hour periods, but loss of bullheads and pumpkinseeds was considerably less. Over a 3-day span, all of the original bass, pumpkinseeds, and hybrids had abandoned the nets. However, all of the bullheads that remained after 48 hours were still present at the end of 72 hours, as well as most of the bluegills and suckers.

Seasonal differences in rates of escape were examined for most of the species involved because both environmental and physiological conditions differ between April and August and could affect behavior of fish in the nets (Table 2). The proportion of bass and pumpkinseeds which escaped in midsummer (Lodge Lake) was much greater than in the spring (Jewett Lake) for both periods of confinement. Bluegills were more inclined to vacate the nets in the spring. The behavior of hybrids and bullheads was inconsistent.

The 24-hour data also were examined for evidence of the peck order phenomenon. Comparisons were made, by mean lengths, among Lodge Lake bluegills, pumpkinseeds and suckers (also bluegills from Jewett Lake) that stayed in the nets and the fish that escaped. The measurements are shown below:

	Hold-overs	Escapees
White sucker	12.1 (41)	11.3 (9)
Pumpkinseed	5.2 (14)	4.9 (15)
Bluegill (Lodge)	6.3 (31)	6.2 (7)
Bluegill (Jewett)	6.1 (39)	6.0 (8)

The consistently longer mean lengths of the hold-over fish led to analysis of significance by the t test of the differences. The differences between bluegills were not significant, but those for suckers ($P<0.05$) and pumpkinseeds ($P<0.01$) were significant. Thus, there is some evidence that larger fish are retained and perhaps a peck order is involved. This behavior appeared to be quite pronounced in pumpkinseeds. Significant numbers of this species escaped during the 24-hour period, and the influence of aggression is strongly suggested by the size of the escapees. Mesh size was not a factor since the pot webbing was capable of holding 4.0-inch pumpkinseeds, and these captured fish were 4.3 to 5.7 inches long. Predation by bass also was unlikely.

None of the six pumpkinseeds captured in Jewett Lake escaped (Table 2). These fish (7.0-9.3 inches) were much larger than those netted in Lodge Lake, and the water was considerably cooler. Either large pumpkinseeds do not dominate each other, or else these fish were not so inclined because of cooler temperatures.

It was postulated, too, that the presence of large numbers of fish in a net either may lull the captives into a feeling of security and indifference towards confinement or there might be increased hostility. However, there was no apparent correlation between the size of the catches and the number of escapements.

A strong tendency of some species to escape confinement can bias the collection of representative samples necessary for good estimates of fish population parameters. This source of systematic error can be

serious if nets or traps are examined infrequently. Fortunately, the usual daily examination of trapping devices tends to minimize the degree of error.

Literature cited

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INSTITUTE FOR FISHERIES RESEARCH

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Table 1.--Escapement of fish from trap nets set in Jewett and Lodge lakes, expressed as percentages of fish present at the beginning of the various periods [1]

Species	Length of period (hours)		
	0-24	24-48	48-72
Largemouth bass	7 (43)	3 (29)	100 (2)
Bluegill	14 (92)	16 (45)	20 (5)
Pumpkinseed	39 (36)	8 (12)	100 (1)
Brown bullhead	26 (23)	8 (13)	0 (6)
Bluegill x pumpkinseed	33 (9)	20 (4)	100 (2)
White sucker	19 (48)	28 (25)	14 (7)

[1] Total number of fish available for each captivity period shown in parentheses.

Table 2.--Percentages of various species that escaped from trap nets set in April (Jewett Lake) and August (Lodge Lake) during 24- and 48-hour intervals after marking [1]

Species	Capture interval and month			
	0-24 hours		24-48 hours	
	April	August	April	August
Largemouth bass	4 (26)	12 (17)	0 (13)	6 (16)
Bluegill	17 (47)	11 (45)	18 (28)	12 (17)
Pumpkinseed	0 (8)	50 (28)	0 (6)	17 (6)
Brown bullhead	14 (7)	31 (16)	33 (3)	0 (10)
Bluegill x pumpkinseed	33 (3)	33 (6)	0 (1)	33 (3)

[1] Total number of fish available for each captivity period shown in parentheses.