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# Relative Size Selectivity of Trap Nets for Eight Species of Fish[1]

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## ABSTRACT

**Relative size selectivity of trap nets was determined from the ratio of recaptured fish per 2.5-cm length groups to the number of marked fish of corresponding lengths in the population. The 12 nets were fished in Manistee Lake (348 hectares), Kalkaska County, Michigan, from mid-September to mid-October (1974–1978), and were size selective for six of eight species of fish. In general, nets were selective for the larger sizes of rock bass (*Ambloplites rupestris*), walleye (*Stizostedion vitreum vitreum*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), yellow perch (*Perca flavescens*), and pumpkinseed (*Lepomis gibbosus*). Significant size selectivity was not evident for smallmouth bass (*Micropterus dolomieui*) and white sucker (*Catostomus commersoni*).**

Management of fish populations often requires accurate estimates from samples of size and age structure. Trap nets are species-selective (Crowe 1963; Yeh 1977), and also tend to be size selective (Latta 1959). Small fish are not representatively sampled because of mesh size, but selection for larger sizes is probably due to fish behavior (Watt 1956; Latta 1959).

In the determination of population estimates from trap-net data (mark-and-recapture method), compensation for size selectivity can be made by stratifying the estimates by size groups which can be added to obtain a population estimate for a species. On the other hand, samples of fish collected only to determine length-frequency distribution or year-class strength will reflect the true population structure more accurately if the catch data are adjusted for size selectivity. Relative size selectivity of trap nets for eight species of fish is presented in this report.

## METHODS

Data for population estimates (mark-and-recapture method) collected from Manistee Lake, Kalkaska County, Michigan, were used to determine relative size selectivity of trap nets for smallmouth bass (*Micropterus dolomieui*), white sucker (*Catostomus commersoni*), rock bass (*Ambloplites rupestris*), walleye (*Stizostedion vitreum vitreum*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), yellow perch (*Perca flavescens*), and pumpkinseed (*Lepomis gibbosus*).

Manistee Lake covers an area of 348 hectares, has a maximum depth of 5.5 m, and a mean depth of 2 m. Placement of nets was determined from a numbered grid overlaid on a map of the lake. Numbers were drawn randomly without replacement; consequently, nets were not placed in the same grid more than once. Twelve nets were fished each year with three nets in each quadrant of the lake. One net from each quadrant was moved daily according to the predetermined schedule. This procedure enabled coverage of the entire lake. Nets were fished from mid-September to mid-October (1974–1978) for a total of 1,656 net lifts.

Each net consisted of a single pot 2.4 m long, 1.5 m wide, and 0.9 m deep, with 38.1-mm stretched mesh. The heart, wings and lead consisted of 63.5-mm stretched mesh and the lead was 30.5 m long and 0.9 m deep. All webbing was made from nylon material.

Fish were marked by clipping the upper caudal fin and were added to the population as netting progressed. At the end of each year of netting, the total number of fin-clipped (M) fish in

[1] Contribution from Dingell-Johnson Project F-35-R, Michigan.

**Table 1. Number of marked and recaptured fish caught with trap nets in Manistee Lake, 1974–1978.**

| Species | Length range[a] (cm) | Number | |
|---|---|---|---|
| | | Marked | Recaptured |
| Bluegill | 10.2–22.7 | 13,670 | 486 |
| Pumpkinseed | 10.2–22.7 | 20,105 | 1,125 |
| Rock bass | 10.2–25.2 | 1,830 | 190 |
| Black crappie | 12.7–32.8 | 5,827 | 693 |
| Yellow perch | 12.7–32.8 | 3,775 | 104 |
| Walleye | 25.4–58.2 | 3,063 | 366 |
| Smallmouth bass | 15.2–32.8 | 3,093 | 322 |
| White sucker | 38.1–58.2 | 1,772 | 77 |

[a] Fish outside of the length ranges were captured occasionally, but in low numbers.

the population and the number of recaptured (R) fish were determined. The end result was five R/M ratios (one per year) for each 2.5-cm length group per species. No attempt was made to determine R/M ratios from fish marked in one year and recaptured in later years. Relationships between R/M values and total lengths of fish were determined by polynomial regressions. The R/M values for the mid-point of each 2.5-cm length group represent relative efficiency indices, and the application of these indices is discussed below.

## Results and Discussion

Total numbers of fish marked and recaptured from 1974 to 1978 are given in Table 1 by species. Fish shorter and longer than the indicated lengths were captured occasionally but in very low numbers.

Calculated curves, with 95% confidence limits, showing the relationships between R/M values and total lengths of fish are given in Figs. 1–8. Size selectivity was evident for all species except smallmouth bass and white suckers (Figs. 1 and 2). Low coefficient of determination ($R^2$) values of 0.18 (smallmouth bass) and 0.12 (white sucker) indicated much variation in the data for both species. Latta (1959) reported more variation in R/M percentages for largemouth bass (*Micropterus salmoides*) than for other species in Whitmore and Fife lakes and no general trend in size selectivity. In the same study, however, Latta (1959) reported size-specific catchability for white suckers from Fife Lake.

Size selectivity was barely detectable for rock bass (Fig. 3). Although the general trend was an increase in catchability with size, the extreme yearly variation gave a low $R^2$ value of 0.22. Rock bass from Fife Lake showed a uniformly upward trend, but data from Whitmore and Sugarloaf lakes were more erratic (Latta 1959). Nets were selective for walleyes greater than 55 cm, but a significant difference in catchability was not detectable for smaller fish (Fig. 4).

There was a general increase in catchability

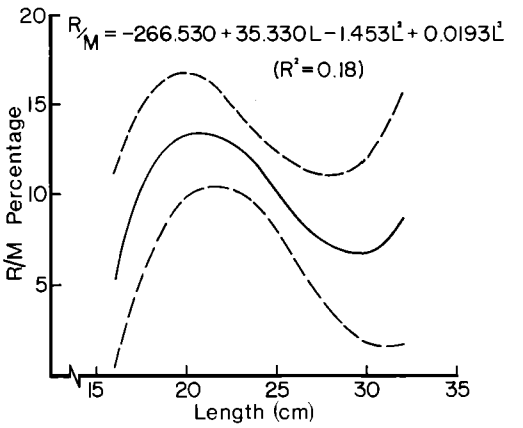


**Figure 1. Relationship between the percentage of recapture of marked smallmouth bass (R/M) and length (L) in Manistee Lake, 1974–1978 (±2 standard errors).**

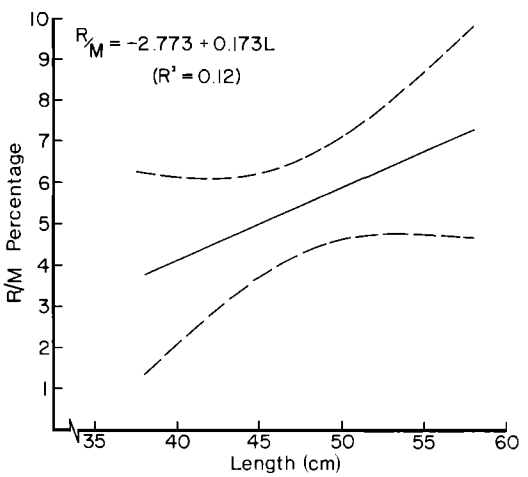


**Figure 2. Relationship between the percentage of recapture of marked white suckers (R/M) and length (L) in Manistee Lake, 1974–1978 (±2 standard errors).**

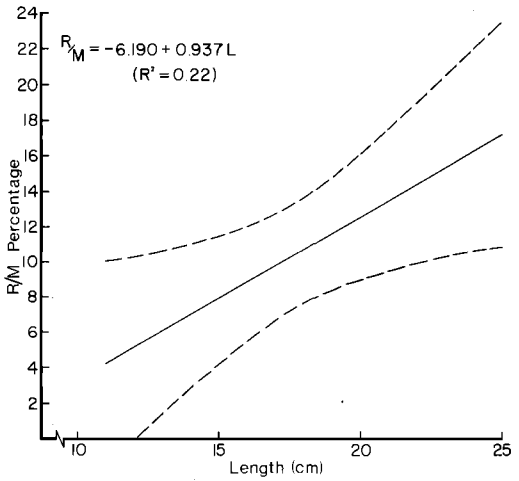


**Figure 3. Relationship between the percentage of recapture of marked rock bass (R/M) and length (L) in Manistee Lake, 1974–1978 (±2 standard errors).**

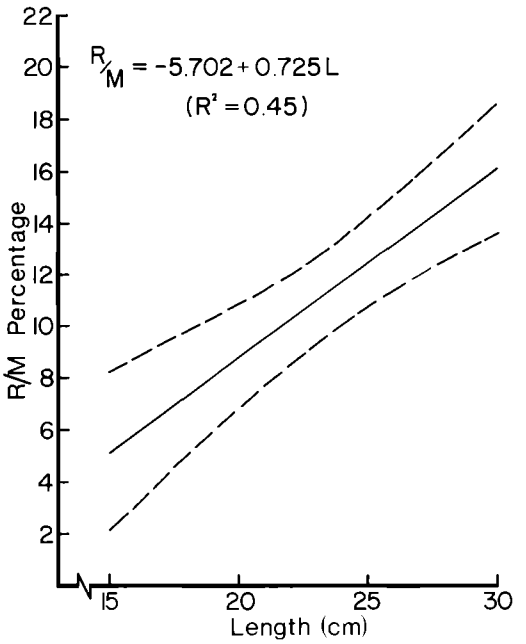


**Figure 5. Relationship between the percentage of recapture of marked black crappies (R/M) and length (L) in Manistee Lake, 1974–1978 (±2 standard errors).**

of black crappie (Fig. 5) with an increase in size ($R^2$ value of 0.45). For bluegills, an increase in percentage of recaptures occurred up to 20 cm and remained relatively constant for larger fish (Fig. 6). In an earlier study in Michigan (Latta 1959), bluegill data from Sugarloaf, Whitmore, and Fife lakes also indicated a general increase in R/M percentages with increases in length.

A linear relationship best described size selectivity for yellow perch and pumpkinseeds (Figs. 7 and 8). The respective $R^2$ values of 0.61

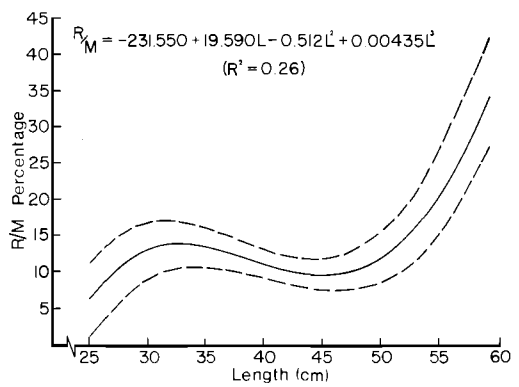


**Figure 4. Relationship between the percentage of recapture of marked walleyes (R/M) and length (L) in Manistee Lake, 1974–1978 (±2 standard errors).**

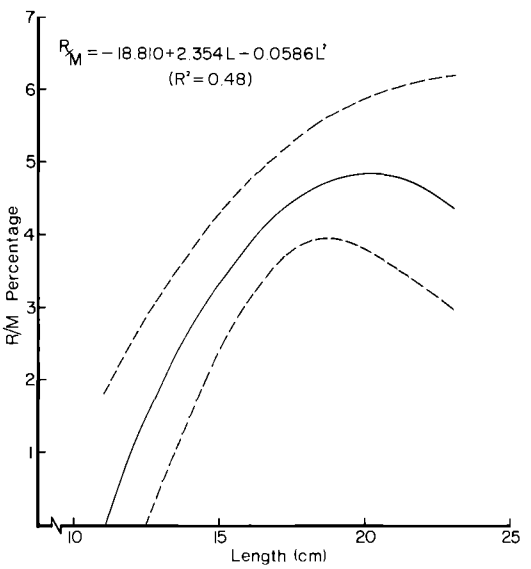


**Figure 6. Relationship between the percentage of recapture of marked bluegills (R/M) and length (L) in Manistee Lake, 1974–1978 (±2 standard errors).**

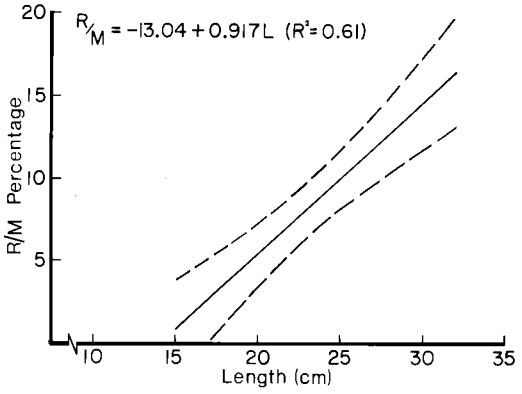


**Figure 7. Relationship between the percentage of recapture of marked yellow perch (R/M) and length (L) in Manistee Lake, 1974–1978 (±2 standard errors).**

and 0.64 for yellow perch and pumpkinseed were the largest of all the species.

Catch of pumpkinseeds from Manistee Lake in 1977 was used as an example to show how catch data are changed when adjusted for net selectivity (Table 2). The R/M ratio for each fish length is a relative efficiency index of size selectivity of trap nets. Adjusted catch was determined by dividing the empirical catch for each length group by the R/M ratio of the midpoint of corresponding length groups. Since extended periods of netting would change the absolute R/M values, the absolute numbers in the adjusted catch are not important. However, the proportion of the adjusted catch per length group to the total catch should remain constant. The length frequency of the sample was considerably changed after adjustment was made for size selectivity of trap nets. For example, the empirical catch data indicated that about 45% of the pumpkinseed population were 15.2–17.6 cm long, but the adjusted catch showed only 14.7% of the population were in that size group. The greatest difference in length frequency was evident in the 10.2–12.5 cm group; 6.7% in the empirical catch compared to 67.3% in the adjusted catch.

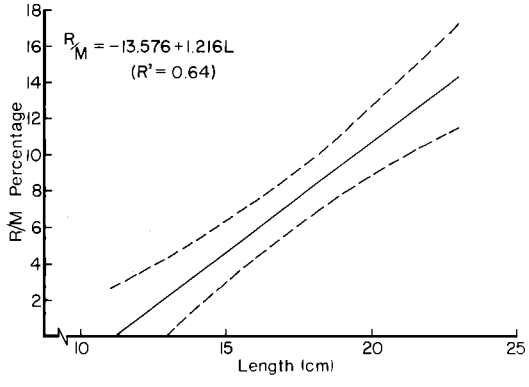


**Figure 8. Relationship between the percentage of recapture of marked pumpkinseeds (R/M) and length (L) in Manistee Lake, 1974–1978 (±2 standard errors).**

**Table 2. Comparison between empirical catch and adjusted catch of pumpkinseeds in Manistee Lake, 1977.**

| Length groups (cm) | Midpoint[a] R/M ratio | Empirical catch | Percent of total | Adjusted[b] catch | Percent of total |
|---|---|---|---|---|---|
| 10.2–12.5 | 0.2 | 349 | 6.7 | 1,745 | 67.3 |
| 12.6–15.1 | 3.1 | 944 | 18.2 | 305 | 11.8 |
| 15.2–17.6 | 6.2 | 2,355 | 45.4 | 380 | 14.7 |
| 17.7–20.2 | 9.4 | 1,488 | 28.7 | 158 | 6.0 |
| 20.3–22.7 | 12.4 | 54 | 1.0 | 4 | 0.2 |
| Totals | | 5,190 | 100 | 2,592 | 100 |

[a] Calculated from Fig. 8.
[b] The empirical catch divided by the R/M ratio for each length group.

Some aspect of size-specific fish behavior must be responsible for size selectivity of trap nets, but field observations have not isolated the controlling factors. Latta (1963) reported that the larger, tagged smallmouth bass at Waugoshance Point, Lake Michigan, traveled farther than smaller bass and thus were captured more frequently in trap nets, but size selectivity for that species was not evident in Manistee Lake.

If rate of escapement of fish from trap nets was size selective, the R/M values per size group could be affected. Patriarche (1968) investigated the rate of escapement of several species of fish from trap nets in two small Michigan lakes and concluded that smaller pumpkinseeds and white suckers escaped more readily than larger fish, but the rate of escapement was not significantly size specific for bluegills.

Undoubtedly fish behavior and, consequently, size selectivity varies seasonally and in different habitats. Forney (1961) reported that trap nets were selective for older age groups of walleyes

in the fall but, during the spring spawning run, size selectivity was not apparent in Oneida Lake, New York. The data from Manistee Lake included 5 years of netting when surface water temperatures ranged from 9 C to 20 C and, therefore should be representative of relatively shallow lakes during September and October. However, the relative efficiency indices presented for trap nets in Manistee Lake may not be valid for other times of year or in lakes with different environmental conditions.

## Acknowledgments

W. C. Latta reviewed the manuscript and Alan D. Sutton drafted the figures.

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