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# SIZE SELECTIVITY OF TRAP NETS FOR EIGHT SPECIES OF FISH[1]

By Percy W. Laarman and James R. Ryckman

## Abstract

Size selectivity of trap nets was determined from the ratio of recaptured fish of various lengths to the number of marked fish in the population. The nets operated in Manistee Lake (348 ha) from mid-September to mid-October (1974-1978) were size selective for six of eight species of fish. In general, nets were selective for the larger sizes of bluegills, pumpkinseeds, rock bass, black crappie, and yellow perch. Walleyes about 55 cm long and larger were more catchable than smaller sizes. Significant size selectivity was not evident for smallmouth bass and white suckers.

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

## Introduction

Management of fish populations often requires accurate estimates for the parameters of size and age distribution. Trap nets are species selective (Crowe 1953), 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 summed to obtain a population estimate for a species. On the other hand, samples of fish collected only to determine size frequency and year-class strength will reflect the population structure more accurately if the catch data are adjusted for net selectivity. In this report, size selectivity of trap nets for eight species of fish was investigated.

## Methods

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

Manistee Lake covers an area of 348 ha, 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. Twelve nets were fished each year and four of them were moved daily according to a predetermined random schedule which insured coverage of the entire lake. Nets were operated from mid-September to mid-October each year (1974-1978) for a total of 1,656 net lifts.

Each trap net consisted of a single pot 2.4 m (8 feet) long, 1.5 m (5 feet) wide, and 0.9 m (3 feet) deep with 38.1-mm (1.5-inch) stretched mesh, a heart 3.4 m (11 feet) long with 63.5-mm (2.5-inch) mesh, two wings 2.4 m (8 feet) long with 63.5-mm (2.5-inch) mesh, and a lead 38.1 m (125 feet) long by 1.2 m (4 feet) deep with 63.5-mm (2.5-inch) mesh.

Relative size selectivity was determined by dividing the number of recaptured (R) fish by the number of fin-clipped (M) fish each year for each 2.5-cm length group. The R/M-fish length relationships were determined by polynomial regressions of R/M values against fish lengths. Correction factors, as demonstrated for pumpkinseeds, for each length group were determined by dividing the R/M value of the midpoint of the length group (15.1-17.5 cm) by the R/M values of the midpoints of the other length groups. Application of the correction factors is explained later in the report.

## Results

Total numbers of fish by species marked and recaptured each year are given in Table 1. 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 size groups are given in Figures 1-8. Net selectivity was evident for all species except smallmouth bass and white suckers.

For bluegills an increase in percentage of recaptures occurred up to 20 cm and remained relatively constant for larger fish (Fig. 1). 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 straight-line relationship best described size selectivity for pumpkinseeds (Fig. 2). The coefficient of determination ($R^2$) shows that about 64% of the variability in R/M percentages was due to length. Size selectivity was barely detectable for rock bass (Fig. 3). Although the general trend was an increase with

size, the extreme yearly variation produced 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). Black crappie indicated a general increase in catchability with size with an $R^2$ of 0.45 (Fig. 4). Net selectivity for yellow perch and walleyes was best described by third-degree polynomials (Figs. 5 and 6). Very few yellow perch larger than 30 cm were collected, which may explain the descending part of the curve for the largest fish. Nets were selective for walleyes greater than 55 cm, but a significant difference in catchability was not detectable for smaller fish.

Selectivity due to size was not significant for smallmouth bass and white suckers (Figs. 7 and 8). The low $R^2$ values of 0.18 (smallmouth bass) and 0.12 (white suckers) indicate 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.

The catch of pumpkinseeds from Manistee Lake in 1978 was used as an example to show how catch data are changed when adjusted for net selectivity (Table 2). Absolute numbers in the adjusted catch are not important, but rather the relative proportions of each length group in the total catch. The absolute numbers would vary depending on which length group R/M value was used as the numerator to determine correction factors, but the relative proportions among length groups would remain constant. The length frequency of the sample was considerably changed after adjustment was made for size selectivity of the nets. For example, the empirical catch data showed that about 52% of the fish sampled were 17.6-20.1 cm long, but the adjusted catch indicated only 37% of the population were in that size group.

Some aspect of size-specific fish behavior must be responsible for size selectivity of trap nets, but field observations have not necessarily isolated the controlling factors. Latta (1963) reported that 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 escapement rate of several species of fish from trap nets in Jewett and Lodge lakes. Smaller pumpkinseeds and white suckers escaped more readily than the larger fish, but rate of escapement was not significantly size specific for bluegills.

Undoubtedly fish behavior (and size selectivity) varies seasonally and in different habitats. 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 a New York lake (Forney 1961). Evidence of size or age selectivity should be considered in a study where knowledge of the age structure of a population is important. The data from Manistee Lake included 5 years of netting, with complete coverage of the lake having surface water temperatures ranging from 9° C to 20° C. The size selectivity presented should be representative of relatively shallow lakes during September and October. However, the size-specific R/M values presented for Manistee Lake may not be valid for trap nets used under other environmental conditions.

Acknowledgments

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Table 1.--Numbers of marked and recaptured fish of designated lengths caught by trap nets in Manistee Lake, 1974-1978.

| Species | Length range (cm) | Year | Numbers | |
|---|---|---|---|---|
| | | | Marked | Recaptured |
| Bluegill | 10.2-22.6 | 1974 | 1,108 | 59 |
| | 10.2-22.6 | 1975 | 3,120 | 58 |
| | 10.2-22.6 | 1976 | 3,347 | 119 |
| | 10.2-22.6 | 1977 | 3,812 | 150 |
| | 10.2-22.6 | 1978 | 2,283 | 100 |
| Pumpkinseed | 10.2-22.6 | 1974 | 1,078 | 96 |
| | 10.2-22.6 | 1975 | 4,806 | 164 |
| | 10.2-22.6 | 1976 | 6,576 | 418 |
| | 10.2-22.6 | 1977 | 5,783 | 355 |
| | 10.2-22.6 | 1978 | 1,862 | 92 |
| Rock bass | 10.2-25.1 | 1974 | 236 | 13 |
| | 10.2-25.1 | 1975 | 254 | 23 |
| | 10.2-25.1 | 1976 | 830 | 123 |
| | 10.2-25.1 | 1977 | 260 | 18 |
| | 10.2-25.1 | 1978 | 250 | 13 |
| Black crappie | 12.7-32.8 | 1974 | 983 | 65 |
| | 12.7-32.8 | 1975 | 1,623 | 164 |
| | 12.7-32.8 | 1976 | 1,415 | 226 |
| | 12.7-32.8 | 1977 | 748 | 64 |
| | 12.7-32.8 | 1978 | 1,058 | 174 |
| Yellow perch | 12.7-32.8 | 1974 | 84 | 2 |
| | 12.7-32.8 | 1975 | 735 | 31 |
| | 12.7-32.8 | 1976 | 770 | 19 |
| | 12.7-32.8 | 1977 | 1,697 | 48 |
| | 12.7-32.8 | 1978 | 489 | 4 |
| Walleye | 25.4-58.2 | 1974 | 295 | 29 |
| | 25.4-58.2 | 1975 | 359 | 55 |
| | 25.4-58.2 | 1976 | 844 | 130 |
| | 25.4-58.2 | 1977 | 733 | 66 |
| | 25.4-58.2 | 1978 | 832 | 86 |

(continued, next page)

Table 1.--concluded.

| Species | Length range (cm) | Year | Numbers | |
|---|---|---|---|---|
| | | | Marked | Recaptured |
| Smallmouth bass | 15.2-32.8 | 1974 | 667 | 34 |
| | 15.2-32.8 | 1975 | 694 | 71 |
| | 15.2-32.8 | 1976 | 1,082 | 137 |
| | 15.2-32.8 | 1977 | 255 | 15 |
| | 15.2-32.8 | 1978 | 395 | 65 |
| White sucker | 38.1-58.2 | 1974 | 626 | 43 |
| | 38.1-58.2 | 1975 | 197 | 0 |
| | 38.1-58.2 | 1976 | 276 | 11 |
| | 38.1-58.2 | 1977 | 291 | 9 |
| | 38.1-58.2 | 1978 | 382 | 14 |

Table 2.--Comparison of empirical catches of pumpkinseeds, by length group with the catch adjusted for trap-net selectivity in Manistee Lake, 1978.

| Length groups (cm) | Midpoint R/M ratio[a] | Correction factor[b] | Empirical catch | Adjusted catch[c] |
|---|---|---|---|---|
| 10.2-12.4 | 0.2 | 31.0 | 5 | 155 |
| 12.5-15.0 | 3.1 | 2.0 | 122 | 244 |
| 15.1-17.5 | 6.2 | 1.0 | 732 | 732 |
| 17.6-20.1 | 9.4 | 0.7 | 962 | 673 |
| 20.2-22.6 | 12.4 | 0.5 | 41 | 20 |

[a] Calculated from Figure 2.

[b] The quotient of 6.2 divided by the R/M ratio of the midpoints of each length group.

[c] The product of the correction factor times the empirical catch for each length group.

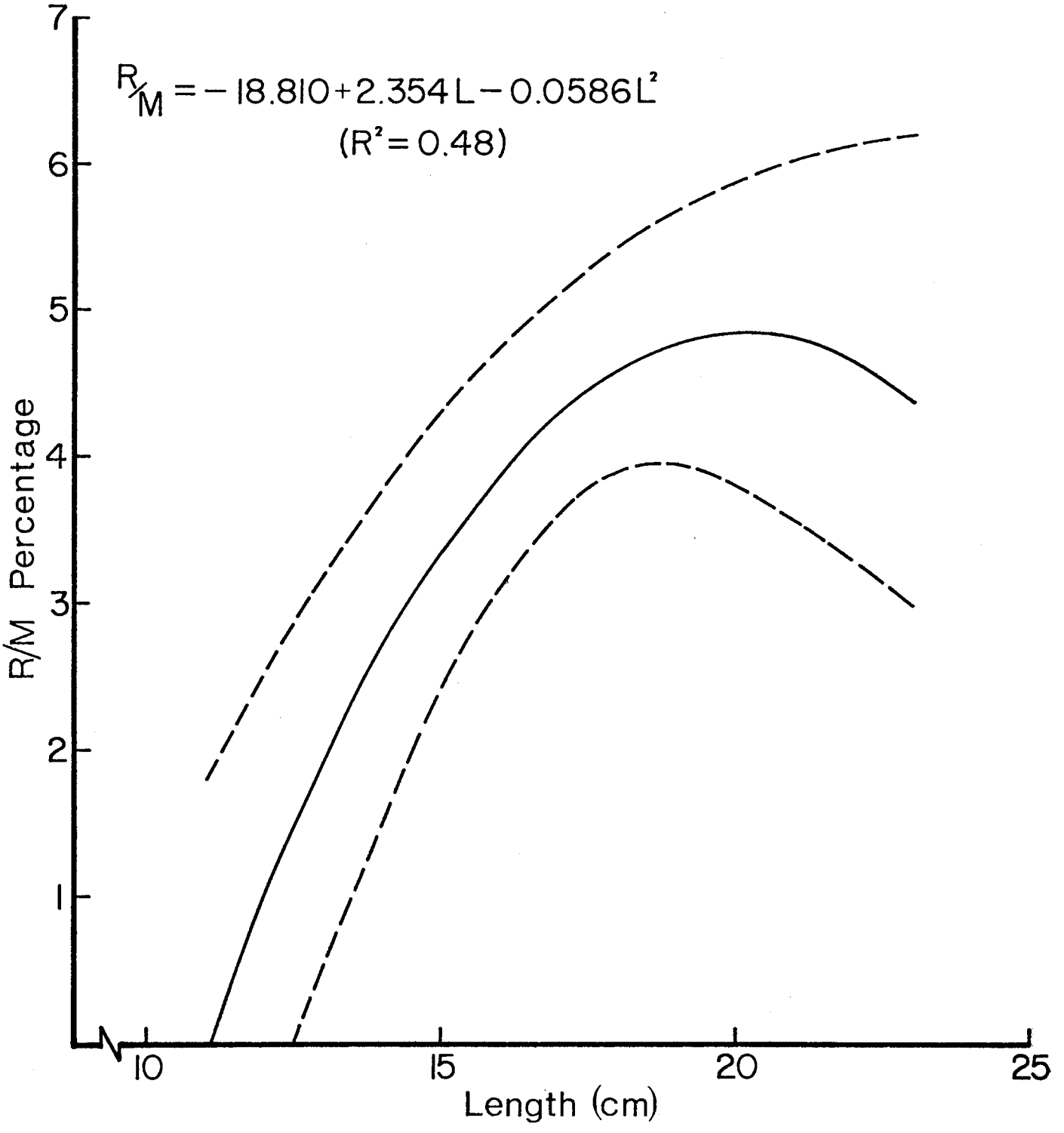




Figure 1.--Relationship between the percentage of recapture of marked bluegills (R/M) and length (L) in Manistee Lake, 1974-1978 (±2 standard errors).

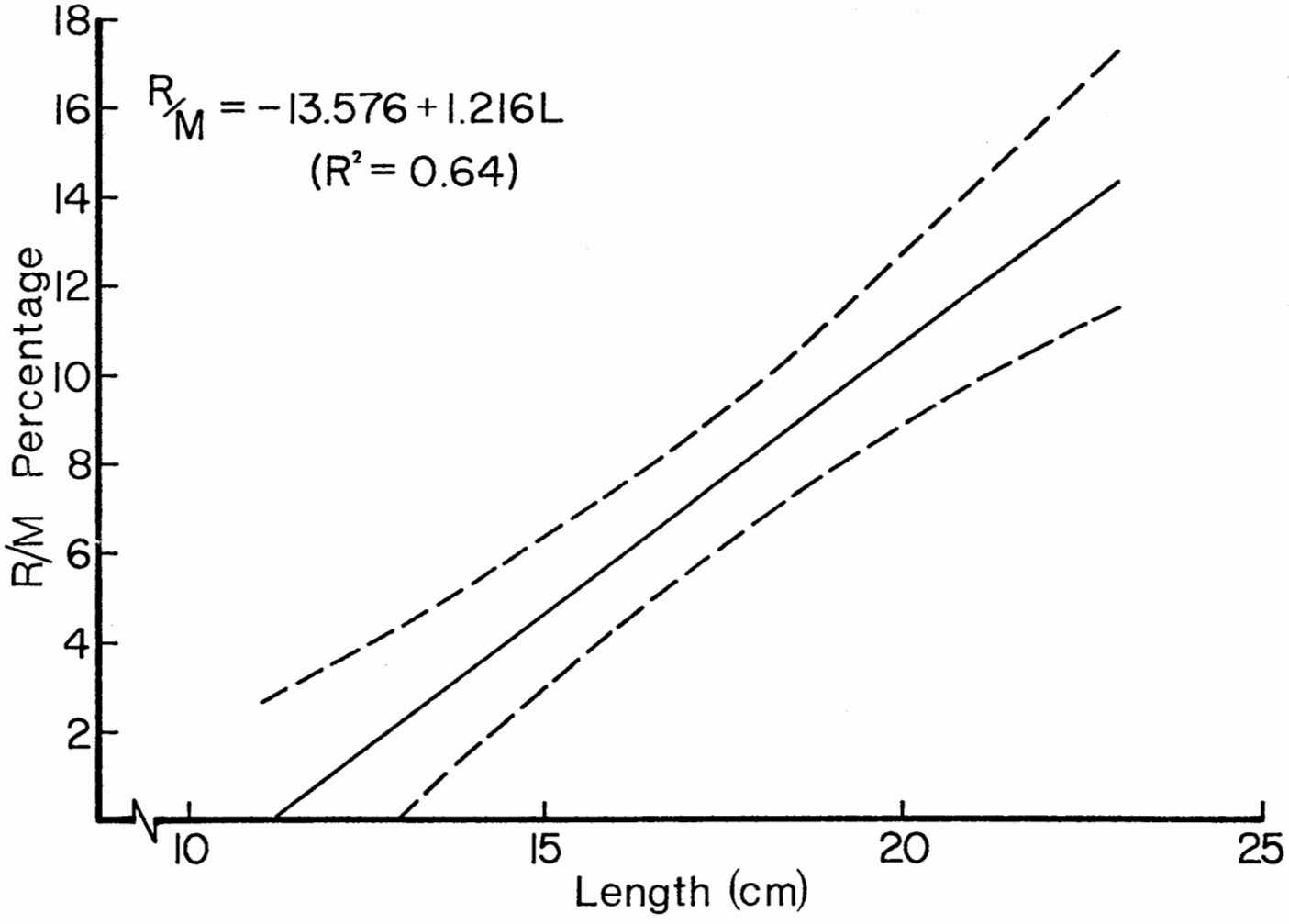


Figure 2.--Relationship between the percentage of recapture of marked pumpkinseeds (R/M) and length (L) in Manistee Lake, 1974-1978 (±2 standard errors).

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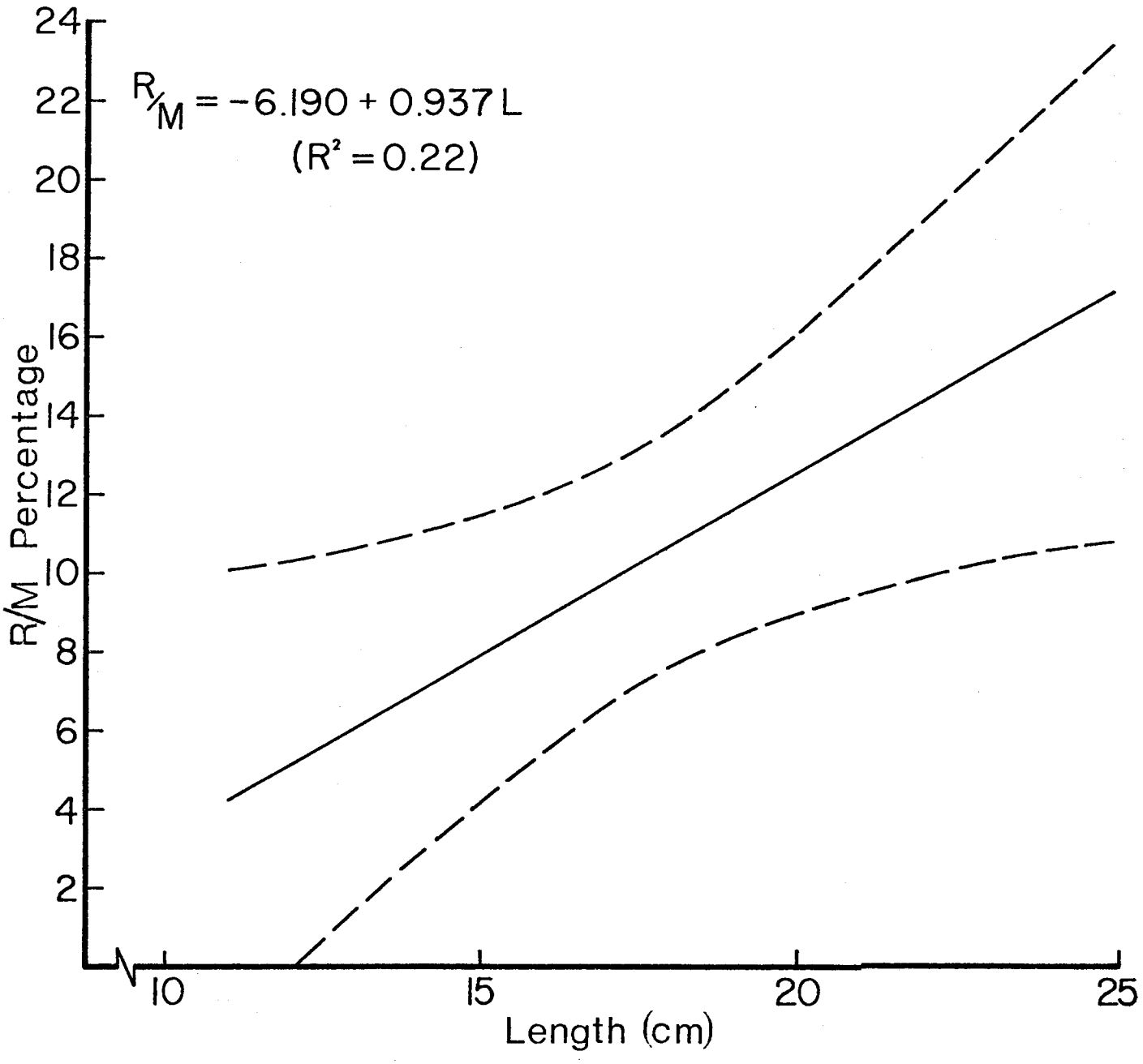


Figure 3.--Relationship between the percentage of recapture of marked rock bass (R/M) and length (L) in Manistee Lake, 1974-1978 (±2 standard errors).

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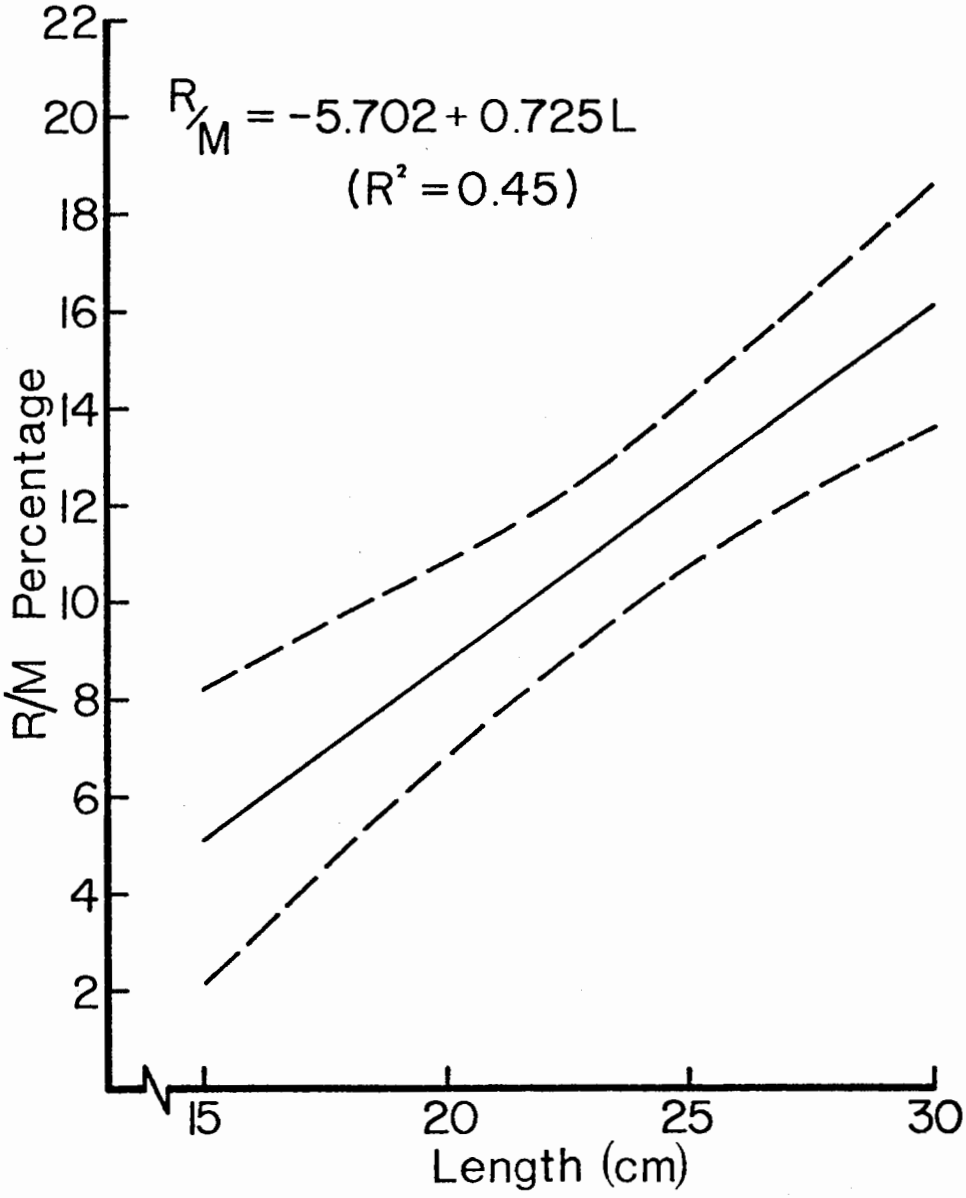


Figure 4.--Relationship between the percentage of recapture of marked black crappies (R/M) and length (L) in Manistee Lake, 1974-1978 (± 2 standard errors).

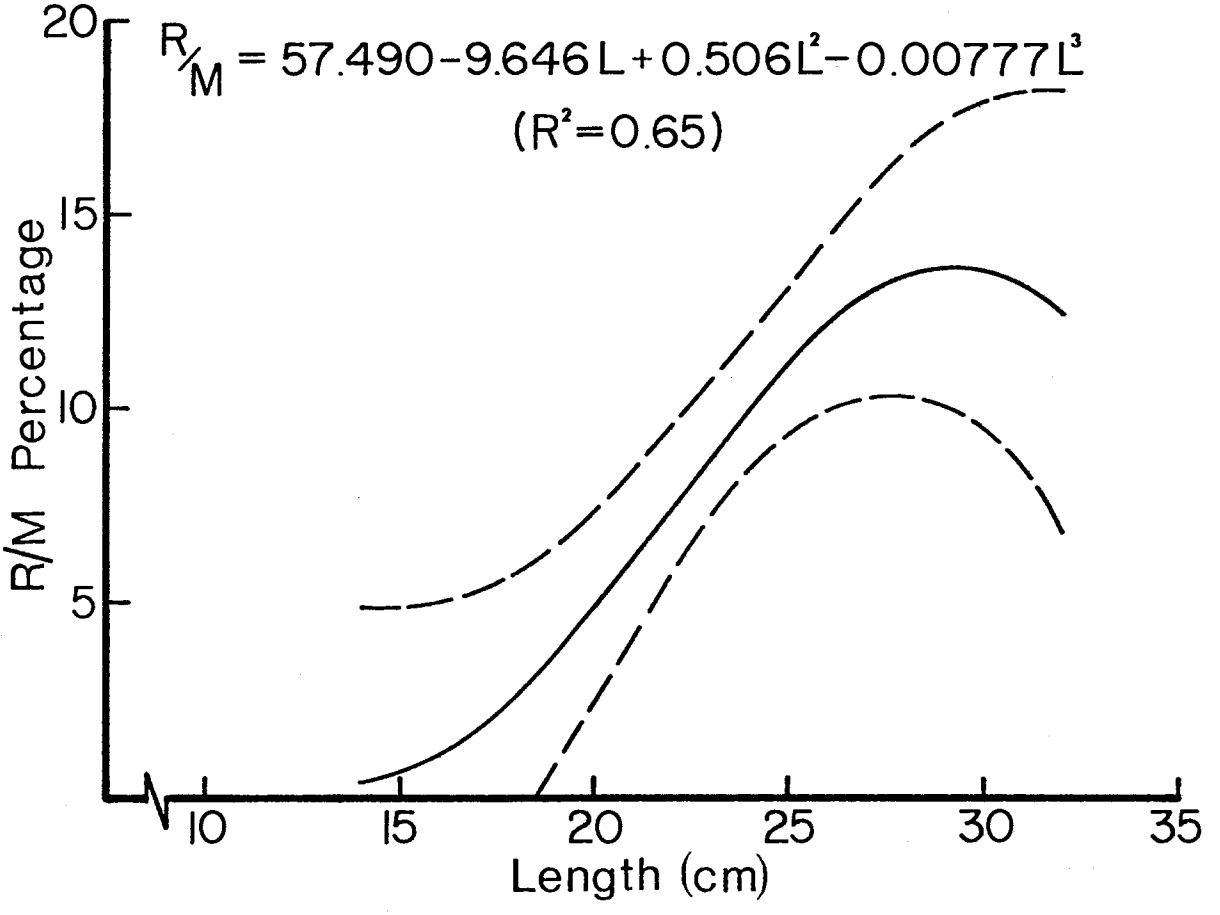


Figure 5.--Relationship between the percentage of recapture of marked yellow perch (R/M) and length (L) in Manistee Lake, 1974-1978 (± 2 standard errors).

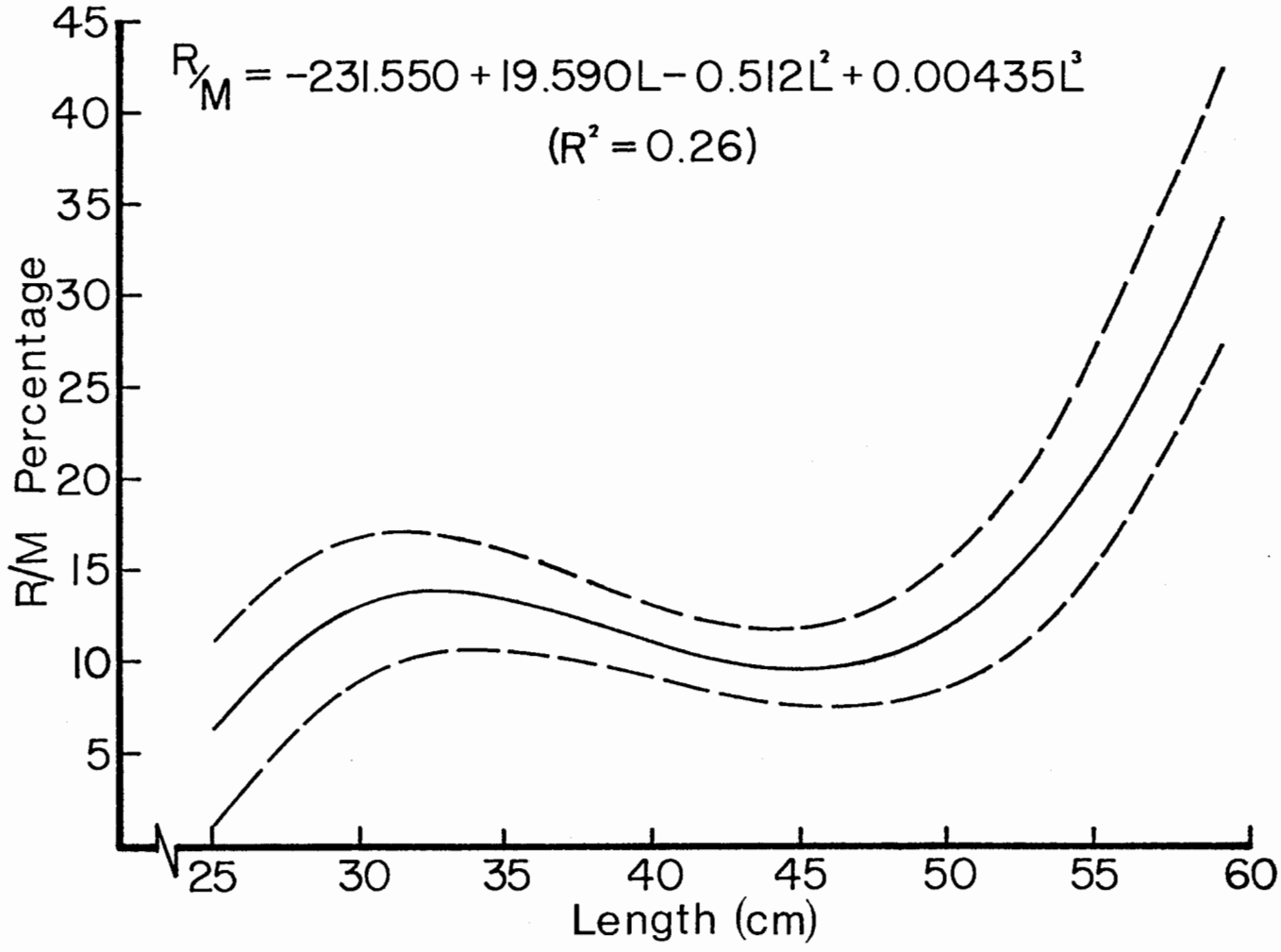


Figure 6.--Relationship between the percentage of recapture of marked walleyes (R/M) and length (L) in Manistee Lake, 1974-1978 (±2 standard errors).

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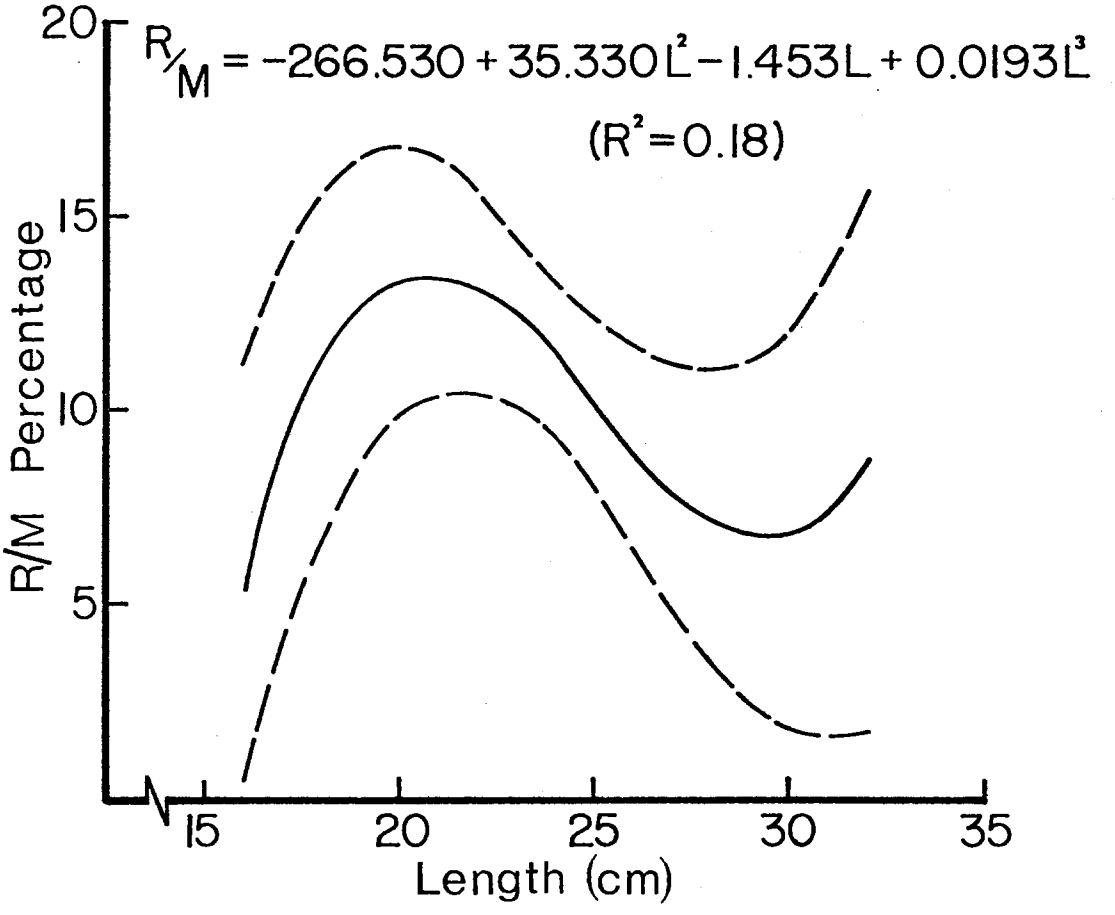


Figure 7.--Relationship between the percentage of recapture of marked smallmouth bass (R/M) and length (L) in Manistee Lake, 1974-1978 (± 2 standard errors).

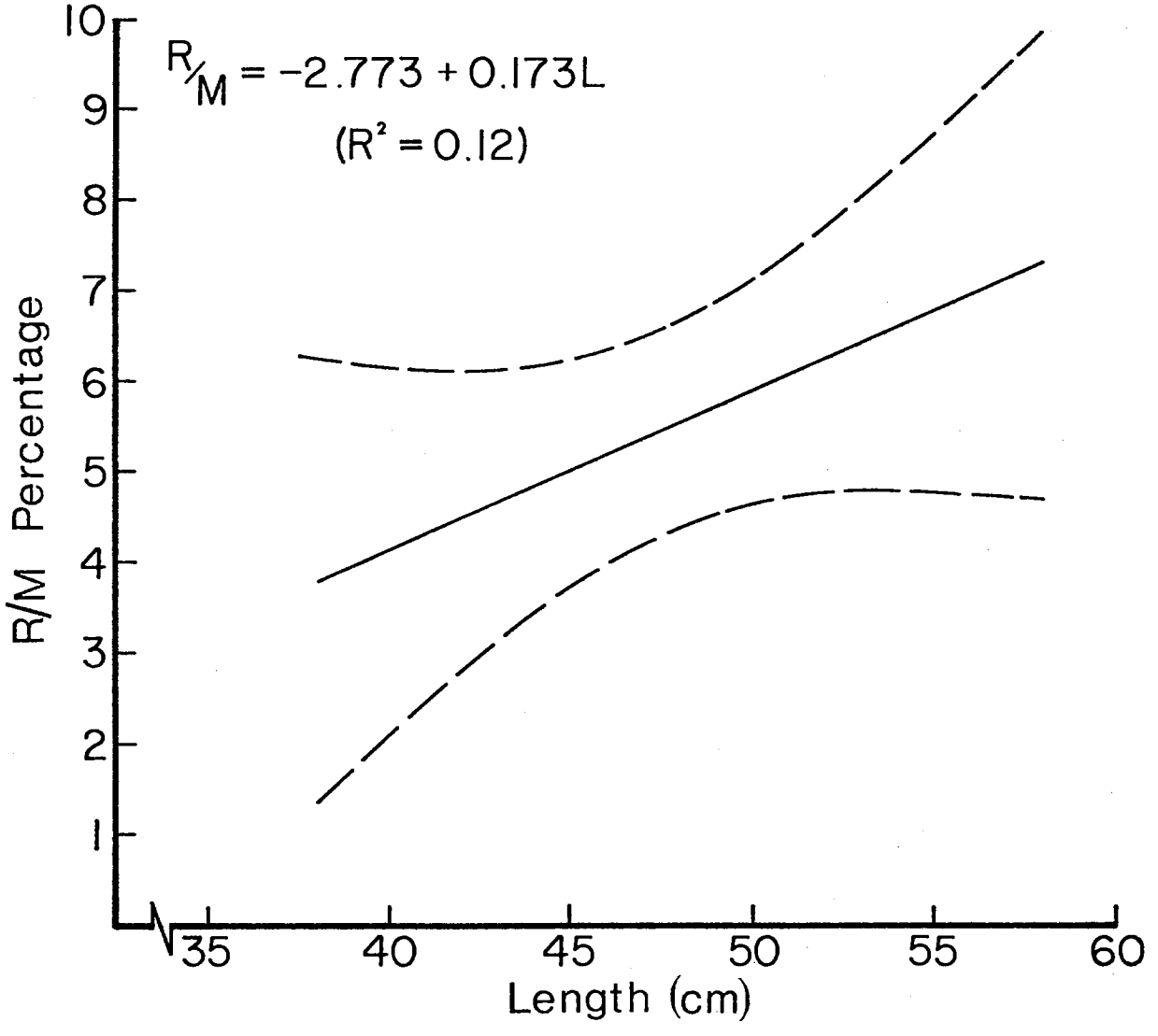


Figure 8.--Relationship between the percentage of recapture of marked white suckers (R/M) and length (L) in Manistee Lake, 1974-1978 (±2 standard errors).

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