RELATIVE SIZE RELATIONSHIP IN PREY SELECTION BY LARGEMOUTH BASS IN WEST POINT LAKE, ALABAMA-GEORGIA

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Abstract: Largemouth bass *(Micropterus salmoides)* are able to feed on relatively large prey. The relative size of prey, calculated as the ratio of prey length (or weight) to predator length (or weight), changed only slightly with increasing size of largemouth bass. Bluegills *(Lepomis macrochirus)*, gizzard shad *(Dorsoma cepedianum)*, and threadfin shad *(D. petenense)* were the most common fishes consumed by largemouth bass in West Point Lake. Bluegills were more often eaten by small largemouth bass (3 to 15 cm TL), while shad were eaten by larger ones (>15 cm TL). Regression equations for the sizes of bluegills and shad that largemouth bass consumed were calculated to predict the average size of prey for different sizes of largemouth bass. Largemouth bass could swallow bluegills at 0.4 times their length or shad at 0.5 times their length. The equations of Lawrence (1958) were corroborated by our study of size - selective predation in largemouth bass from West Point Lake.

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Prey abundance is of no consequence to a predator fish if the prey is too large for the predator to swallow. Factors determining acceptable prey size include: the size of the predator's mouth, the length and volume of the stomach, and the energy expended on searching, seizing, and digesting the prey (Popova 1978). Predators prefer prey of the largest size they can comfortably ingest. Smaller or larger prey are consumed with lower frequency (Ivlev 1961).

Prey selection by largemouth bass is determined by prey availability and vulnerability (Lewis et al. 1961, Lewis and Helms 1964, Snow 1971), as well as the size of the prey. Tarrant (1960) observed that large largemouth bass (630 to 681 g) preferred larger green sunfish *Lepomis cyanellus* than did small largemouth bass (284 to 296 g). Lawrence (1958) calculated regression equations for determining the largest sizes of some common lake and pond fishes that could be swallowed by largemouth bass. He determined that the non-flexible cleithrum bones regulated the size of fish that could pass through the esophagus.

The objectives of this study were to determine the lengths of bluegills, and shad consumed by largemouth bass from West Point Lake, Alabama-Georgia, and to compare these lengths to those calculated by Lawrence (1958). Gizzard shad and threadfin shad were considered together because partly digested shad were only identified to genus. Timmons et al. (1981) discussed other prey and their abundance in stomachs of largemouth bass from West Point Lake.

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METHODS

Largemouth bass were collected by electrofishing and seining from August 1975 through July 1979. A boat-mounted 110 volt, 3400-watt generator with a pulsator unit that

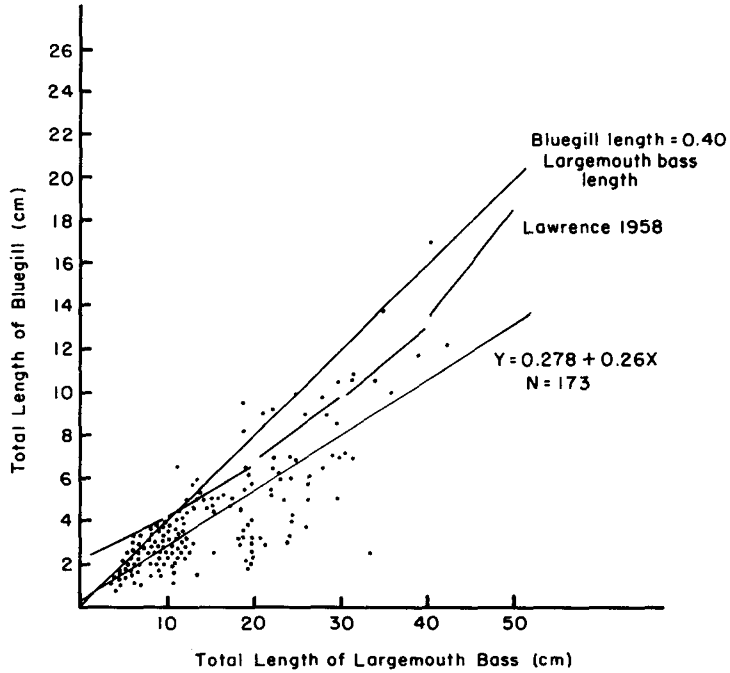

Fig. 1. Total length of bluegills from stomachs of largemouth bass from West Point Lake, 1975-1979. The upper line is an approximation of the maximum size of bluegill consumed by largemouth bass. The middle line is the estimated lengths of bluegill that largemouth bass can swallow based on the average width of the cleithrum bones (Lawrence 1958). The lower line is the linear regression fitted to data points on the graph.

provided variable half pulsed direct current was used to collect fish in nearshore areas in daylight hours. A seine 4 m long and a 15-m bag seine, both with 6-mm bar mesh and 1.5 m deep were used to collect largemouth bass in shallow water. Small fish were preserved in formalin while large ones were placed on ice until they could be examined. Largemouth bass and identifiable fish from their stomachs were measured to the nearest millimeter (total length). More than 3000 largemouth bass stomachs were examined.

RESULTS AND DISCUSSION

Bluegills and shad were the most common fish in largemouth bass stomachs. Small largemouth bass between 3 and 15 cm in length primarily consumed bluegills (Fig. 1). Largemouth bass longer than 45 cm essentially had stopped feeding on bluegills and fed on shad.

Lawrence (1958) estimated the maximum sizes of prey a largemouth bass could swallow, within 10-cm size groups, using a series of linear equations. These regression lines for bluegills are plotted in Fig. 1 and correspond well to our empirical observations. Although, largemouth bass longer than 10 cm swallowed some bluegills longer than the longest size suggested by Lawrence, those less than 10 cm did not.

The average size of bluegills eaten by largemouth bass of various sizes in West Point Lake was best described by the linear regression of bluegill length ($\underline{Y}$) on largemouth bass

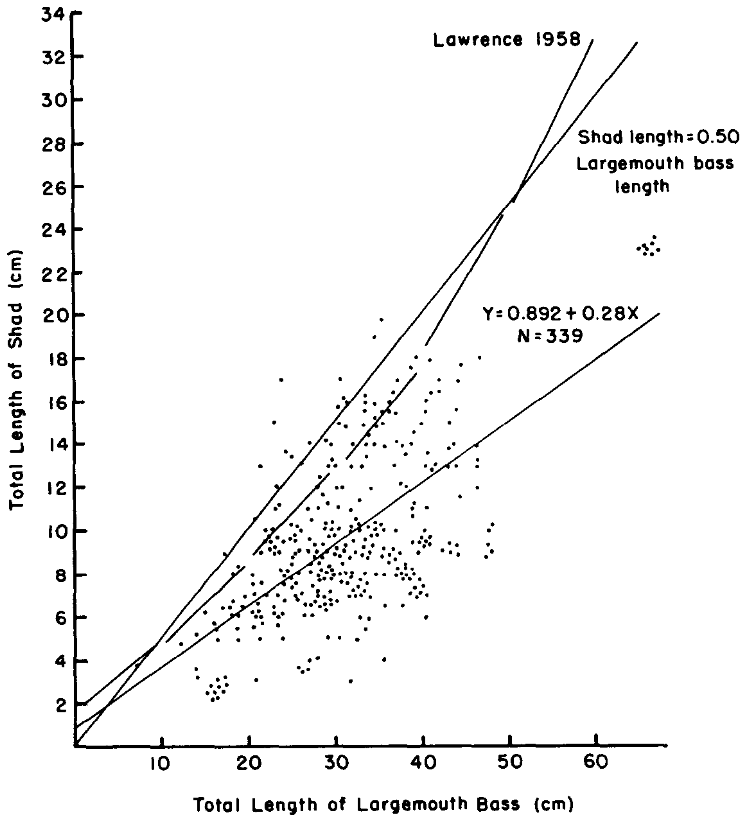

Fig. 2. Total lengths of shad, *Dorosoma* spp. from stomachs of largemouth bass from West Point Lake, 1975-1979. The upper straight line is an approximation of the maximum size of shad consumed by largemouth bass. The middle line is the estimated lengths of shad a largemouth bass can swallow based on the average width of the cleithrum bones (Lawrence 1958). The lower line is the linear regression fitted to data points on the graph.

length ($\bar{X}$) where $\bar{Y} = 2.78 + 0.26\,\bar{X}$ ($r = 0.81$). The relationship is plotted in Fig. 1 as are the lines based on Lawrence (1958) and to a generalized maximal condition. An approximation of the largest size of bluegill consumed by largemouth bass occurs where maximum bluegill length equals 0.40 times largemouth bass length.

Shad were the major food item of largemouth bass longer than 20 cm, and several bass 65 to 68 cm long had eaten gizzard shad 23 cm long. Lawrence's (1958) regression lines for the estimated sizes of gizzard shad consumed by largemouth bass are shown in Fig. 2. Lawrence indicated, however, that he could not establish the absolute maximum sizes of fish a largemouth bass could swallow due to variation in the condition of prey and its body depth.

A line where shad length equals 0.50 times largemouth bass length could be used to estimate the maximum length of shad consumed in West Point Lake (Fig. 2). The average size was best described by the linear equation $\bar{Y} = 8.92 + 0.28\,\bar{X}$, where $\bar{Y}$ = shad length, $\bar{X}$ = largemouth bass length, and $r = 0.66$.

Modes for length distributions of shad changed each year after impoundment in early 1975. By August, the modal length of gizzard shad was 10 cm in 1975, 15 cm in 1976, 7.5 cm in 1977, 17.5 cm in 1978, and 15 cm in 1979. Modal lengths of threadfin shad were between 5 and 10 cm each year. The average size of shad consumed by largemouth bass was determined yearly by linear regression for the 5-year period. There was no significant differences among the lines for the years 1975 (14 shad consumed), 1976 (78 shad), 1977 (91 shad), 1978 (95 shad), and 1979 (61 shad) as determined by analysis of covariance.

Relative prey size is related to mouth size and largemouth bass appear to be able to feed on large prey as adults. Relative prey size, calculated as the ratio of prey length to predator length, changed only slightly with increasing length for the largest prey. The relative size for bluegills reached 50 percent for largemouth bass at 5 cm in length, 40 percent for those at 10 cm, 48 percent for those at 20 cm, 35 percent for those at 30 cm, and 42 percent for those at 40 cm long. The relative size for shad reached 51 percent for largemouth bass at 8 cm long, 45 percent for those at 10 cm, 50 percent for those at 20 cm, 52 percent for those at 30 cm, 45 percent for those at 40 cm, 38 percent for those at 48 cm, and 34 percent for those at 68 cm long. Werner (1979) suggested that maximum prey size for largemouth bass was a constant fraction of body weight across different size classes (i.e., maximum prey weight/largemouth bass weight = 0.06). Observations of maximum prey sizes for largemouth bass in West Point Lake would indicate values greater than 0.06. They ranged from 0.07 to 0.13 for shad and 0.07 to 0.09 for bluegill as calculated using our generalized maximal equations (shad length = 0.50 X largemouth bass length, or bluegill length = 0.40 X largemouth bass length for largemouth bass (10 to 50 cm) and using average weights for Alabama fishes (Swingle 1972).

The relationship of the size of prey consumed by a predator is important for evaluating and managing a fishery. When a survey indicates an abundance of prey, fishery managers need to know whether it is available to the predators. Lawrence's (1958) relationships calculated from largemouth bass from ponds and large lakes, are corroborated by our empirical observations, and as such, are valid for calculating the ratios of Swingle (1950) concerning balance of Alabama farm ponds. Recently, Jenkins and Morais (1978) used the relationship reported by Lawrence (1958) and similar relationships for other predators to develop the available prey/predator (AP/P) ratio for reservoirs. We have determined that an approximation of the largest prey size a largemouth bass will swallow is 40 percent and 50 percent of largemouth bass length for bluegills and shad, respectively. Regression equations based on actual sizes of bluegill and shad that largemouth bass consume can be used for predicting an average size of prey for different sizes of largemouth bass. These values may be more important than maximum values because largemouth bass also feed on many small prey fishes.

Data from other reservoirs are needed to determine the relationship in systems with different predator-prey structures.

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