SEASONAL BIOMASS OF SELECTED CENTRARCHIDS IN DEGRAY LAKE, ARKANSAS, 1977-79

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Abstract: Seasonal biomass estimates of largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), and longear sunfish (*L. megalotis*) were made during 3 growing seasons (1977 - 79) by cove rotenone sampling in May, June, August and September. Substantial mortality of young-of-the-year (YOY) largemouth bass during late summer suggests that this period was critical in determining year-class strength. Overwinter mortality was 88, 87, and 71% for the 1977-, 1978- and 1979-year classes, respectively. Biomass of bluegill increased from May to August and decreased in September, probably as a result of predation. Biomass of longear sunfish was lowest in June and peaked in September in 2 of the 3 growing seasons. Longear sunfish seem to feed more in littoral areas than do bluegills, and are therefore probably more susceptible than bluegills to early summer predation by largemouth bass, and less susceptible than bluegills to late summer predation.

Proc. Ann. Conf. S.E. Assoc. Fish & Wildl. Agencies 35:438-442

Cove-rotenone sampling is an accepted method for establishing standing crop and describing fish populations in southern reservoirs (Chance and Miller 1952, Carter 1958, Chance 1958). The standard method includes 1 or more samples per lake during late summer or early fall. By sampling standing crop several times during the growing season, the additional seasonal data provide a more complete understanding of the annual cycle of fish biomass. These data are also useful in describing interactions between prey and predators during the growing season. With some of the large predator species such as largemouth bass, it is possible to follow the growth of age groups throughout the growing season. Since it is possible to monitor age groups of largemouth bass, we felt that these data would be important in assessing the critical period for determination of year-class strength.

August cove-rotenone sampling in DeGray Lake since 1974 has consistently shown largemouth bass, bluegill and longear sunfish to be the principal components of the centrarchid population. Because the lake has a relatively low production of shad (*Dorosoma* spp.) and high crops of bluegill and longear sunfish, interest was stimulated to study the interaction of largemouth bass and these 2 species of sunfish. Thus, the seasonal biomass data should be useful in describing the seasonal differences in predation by largemouth bass on bluegills and longear sunfish.

METHODS

DeGray Lake, located in the Ouachita mountains of west central Arkansas, was impounded in 1969. The dam is located on the Caddo River, 11.2 km north of Arkadelphia, Arkansas. At normal pool elevation — 124.4 m above mean sea level (msl) — the area of the reservoir is 5,428 ha and maximum and mean depths are 57 m

and 15 m, respectively. The reservoir extends in a west-northwest direction for about 32 km and has a shoreline 207 km long.

Three coves with areas of 1.2, 1.4, and 1.0 ha, respectively, were sampled. All are located in the middle section of the reservoir. Maximum depths were 7.6, 3.7, and 10.0 m, and mean depths were 2.6, 1.5, and 3.0 m. Fish were sampled with rotenone during the 3rd week of May, the 4th week of June, the 1st week of August, and the 3rd week of September each year, 1977 - 79. This allows for approximately equal time intervals between seasonal samples. One cove was treated during each sample period, and the cove used for the May sample was also used for the September sample.

In sampling, each cove was blocked off with a net, treated with rotenone at the rate of 1.0 ppm, and fish were collected for 2 days. The fish were tabulated according to species and 25-mm length groups. Weights were reported for each length group. Length-frequency data from seasonal cove samples and age and growth data collected during spring population estimates (taken in April by electrofishing) were used to define size ranges for YOY and yearling bass.

RESULTS

Largemouth Bass

Young-of-the-year bass were 38 - 60 mm long in May, 38 - 86 mm in June, 38 - 132 mm in August and 38 - 188 mm in September; yearlings were 86 - 239 mm long in May, 86 - 264 mm in June, 190 - 290 mm in August, and 140 - 315 mm in September. Biomass of YOY largemouth bass increased with each successive sampling period in 1977 (Table 1), reaching 10.2 kg/ha in September. The strength of the 1977-year class is shown by the biomass (4.4 kg/ha) of yearling bass in May, 1978, in comparison to 2.0, 2.8, and 2.0 kg/ha for yearling bass in

Table 1. Number and weight (in kilograms) of young-of-the-year and yearling bass per hectare in DeGray Lake, 1977 - 79.

Age and month of collection	Year Class 1977	1978	1979
Young-of-the-year			
May	393 (0.1)	[a]	[a]
June	408 (0.5)	605 (1.0)	213 (0.3)
August	939 (4.9)	1,915 (9.1)	451 (4.6)
September	802 (10.2)	439 (4.4)	114 (2.6)
Yearlings			
May	104 (4.4)	53 (2.8)	34 (2.0)

[a] No young-of-the-year collected.

May, 1977, 1979, and 1980, respectively. In 1978 and 1979, the biomass and number of YOY peaked in August and declined significantly by September (Table 1).

Seasonal biomass trends, including all age groups, varied among the 3 growing seasons (Fig. 1). The minimum standing crop (carrying capacity) in May 1978 was more than double the estimated carrying capacity in May 1977. Jenkins (1974) defined carrying capacity as the minimal standing crop at the most critical period in early spring. However, 35% of the biomass in May 1978 was contributed by 3 fish 519 to 569 mm in length. The estimated carrying capacity in 1979 (16.4 kg/ha) was similar to that in 1978. Peak biomass occurred in September 1977 and in August 1978 and 1979. The high biomass of largemouth bass in August 1978 and 1979 was due to the presence of large numbers of bass from 166 to 442 mm long. Peak biomass occurred in September 1977 because of the high biomass of YOY present (10.2 kg/ha).

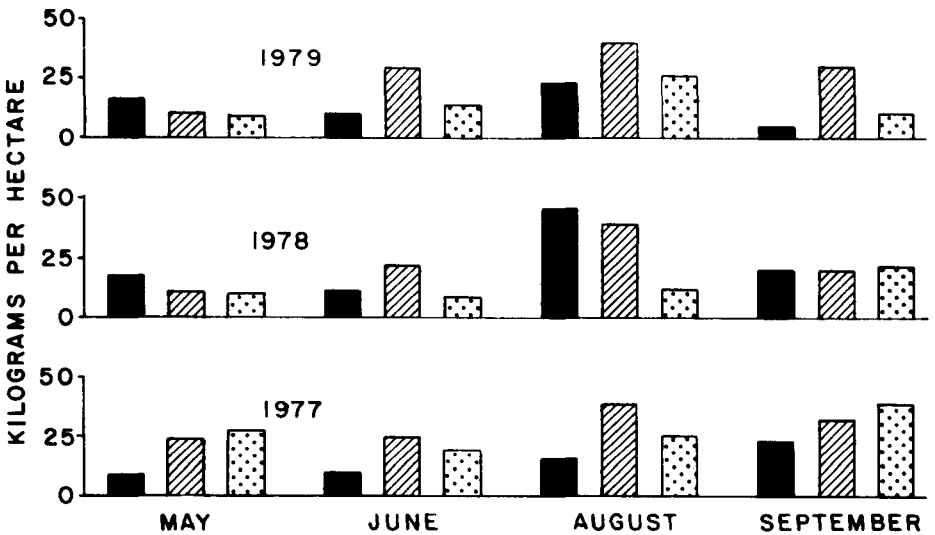

Fig. 1. Seasonal biomass estimates (kg/ha) of largemouth bass (solid bars) bluegills (diagonal lines) and longear sunfish (dots), in DeGray Lake, 1977 - 79.

Bluegill

Biomass of bluegills increased from May to August each year, and then decreased in September (Fig. 1). Carrying capacity was almost identical each May, except 1977. Biomass estimates in August were similar in all 3 years (25.2, 22.3 and 29.6 kg/ha).

Because of the extended spawning period of sunfishes, we could not delineate year class based on length-frequency data. Growth studies from reservoirs at similar latitudes have shown that by September most bluegills less than 50 mm in length are YOY (Jenkins et al. 1955, Trenary 1958). In DeGray Lake, the biomass of YOY declined significantly from August to September each year.

Longear Sunfish

Unlike the trends in seasonal biomass of bluegills, biomass of longear sunfish was lowest in June (instead of May) each year except 1979 (Fig. 1).

Much of this decline in biomass was due to reduction in biomass of fish less than 85 mm long. Biomass estimates were highest in September 1977 and 1978 (39.2 and 22.3 kg/ha, respectively).

DISCUSSION

The mortality of YOY bass that occurred each year between August and September indicated that the late-summer of the 1st year of life is critical in determining year-class strength of largemouth bass in DeGray Lake. This finding contrasts with reports of many investigators that the critical period for determination of year-class strength in reservoirs and natural lakes occurs during the 1st few weeks after egg deposition (Kramer and Smith 1962; Hanson 1965; Miller and Kramer 1971; Von Geldern 1971; Summerfelt 1975; Von Geldern and Mitchell 1975).

Possible causes for mortality during the late summer include predation, competition for food (starvation), and disease. The late summer mortality was higher in 1978 and 1979 than in 1977. Significantly less prey was available to predators 136 to 315 mm long in August 1978 and 1979 than in 1977 (Multi-Outlet Reservoir Studies, unpubl. data). This difference would have made the YOY bass more susceptible to predation in 1978 and 1979. Young-of-the-year bass probably experienced more predation from yearling bass in 1978 and 1979 than in 1977, inasmuch as the biomass of yearling bass in August 1978 and 1979 was much greater than in 1977 (4.1, 9.4 and 10.3 kg/ha in 1977, 1978 and 1979, respectively).

Competition also may have been a factor in the mortality of YOY bass from August to September. Timmons and Shelton (1980) postulated that small yearling largemouth bass may compete with YOY bass for food. If yearling bass were present in large numbers, a shortage of available prey could occur and decrease YOY survival. There was no evidence noted in this study that disease could have been a factor in the last summer mortality of YOY bass.

The seasonal sampling of standing crop permitted an assessment of first-winter mortality of a year-class of largemouth bass. Although the numbers of YOY present in September 1977, 1978, and 1979 varied substantially (802, 439, and 114/ha, respectively), mortality from September to the following May was similar (87, 88, and 71% for the 1977, 1978, and 1979 year-classes). Overwinter mortality appeared to be density independent.

The seasonal biomass levels of bluegills and longear sunfish may be related to variation in predation by largemouth bass. Bryant and Moen (1981), in studying food habits of longear sunfish and bluegills in DeGray Lake during 1976, found that longear sunfish fed mainly on organisms associated with littoral areas, whereas bluegills fed mainly on organisms associated with limnetic areas. They postulated that longear sunfish were therefore more abundant in littoral areas and bluegills more abundant in limnetic areas. Such littoral distribution of longear sunfish would make them more susceptible to predation by largemouth bass feeding in littoral areas during spring and early summer, and may explain the lower biomass of

longear sunfish in June than in May in 1977 and 1978. Biomass of bluegills declined from August to September. Because of higher summer water temperatures, bass would more likely be found offshore during this period. This could partially explain the decline in biomass of bluegills from August to September each year.

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