First Year Growth and Survival of Stocked Largemouth Bass in a Small Oklahoma Impoundment[1]

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Abstract: Liberty Lake was stocked with fingerling largemouth bass (*Micropterus salmoides*) at 448/ha in July, 1980. Monthly electrofishing samples collected for 1 year following stocking showed 76.4% of the 1980-year-class to have been stocked. A bimodal length distribution of stocked fish appeared in fall, 1980 and continued throughout the sampling period. Decreased survival of the stocked largemouth bass during the winter was noted. Most mortality occurred in the slower-growing fish. However, a decline in the number of fish from both length modes was evident.

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The merits of supplemental stocking of largemouth bass (*Micropterus salmoides*) have been debated by fisheries managers for years. Both positive and negative results from supplemental stocking have been reported. Toole (1947) and Hansen (1966) reported increased fishing success following supplemental stocking with largemouth bass. Most studies on supplemental or maintenance stocking have reported negative results. Studies from Oklahoma, Ohio, Alabama, Virginia, and Missouri reported no increases in angler catches following supplemental stocking (Aldrich 1938, Langlois 1941, Swingle 1945, Rosebery 1951, Patriarche and Campbell 1958). The results of studies in California were also discouraging. Hatchery fingerlings stocked in Millerton Lake and Lake Oroville did not survive the winter, whereas wild largemouth bass survival was good. Overwinter survival of tagged hatchery fingerlings in Lake Shasta was good. However, only 15% of these fish were harvested over a 2-year period (McCammon and von Geldern 1979). Delta Lake, Texas (668 ha) was stocked with 82,100 largemouth bass over a 3-year period. Only

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2 large adults were recovered in subsequent samples (Barron 1966). Over 450 largemouth bass per hectare were stocked in Llano Grande Lake (101 ha) in spring, 1966. Late summer sampling failed to recover any of these fish (Barron 1966).

Due to the existing negative data concerning supplemental and maintenance stocking of largemouth bass, the Oklahoma Department of Wildlife Conservation initiated research to evaluate existing stocking programs. The data discussed here are part of an ongoing research effort to determine if supplemental stocking of largemouth bass fingerlings will increase the standing crop of bass and subsequent angler catch and harvest rates.

Methods

The study was conducted in Liberty Lake, Logan County, Oklahoma. Liberty Lake is a 81.8 ha municipal water supply facility for the city of Guthrie. The lake was impounded on an unnamed tributary of Cottonwood Creek in 1949. It has a maximum depth of 15.1 m and a mean depth of 4.9 m. The watershed drainage area is 4.5 km^2 and is comprised of rangeland and unirrigated pastureland. Sediment loads from the watershed have caused heavy siltation of the upper end of the lake which has led to a decline in available spawning habitat.

Largemouth bass fingerlings, 35-64 mm total length, were marked by excising the left pectoral fin followed by freeze cauterization of the wound with liquid nitrogen. Marking techniques were described by Boxrucker (1982). An estimated 36,646 marked bass (448/ha) were stocked into Liberty Lake in July, 1980.

Monthly electrofishing samples were collected beginning in July, 1980. No sample was taken in August due to equipment malfunction. All largemouth bass collected were measured (total length), weighed, and checked for presence or absence of a fin-clip. All unmarked largemouth bass smaller than the largest marked fish in a given sample were classified as native largemouth bass of the 1980-year-class. Scale samples were aged from 250 largemouth bass collected in April, 1981.

Results

The proportions of stocked largemouth bass from the 1980-year-class in the monthly samples (Table 1) ranged from a low of 68.2% in January to a high of 84.6% in September. The difference in these percentages among months was not significant (Chi-square, $P = 0.05$). Therefore, the ratio of stocked to native largemouth bass in the 1980-year-class remained constant

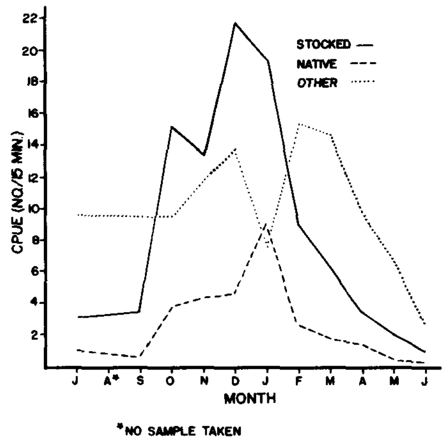

Figure 1. Catch per unit effort of stocked and native bass from the 1980-year-class from the monthly electrofishing samples in Liberty Lake.

throughout the sampling period. The overall proportion of stocked to native largemouth bass in the combined samples was 76.4%.

Aside from a slight decrease in November, CPUE for stocked largemouth bass increased through December, followed by a steady decline through June (Fig. 1). CPUE for natives followed a similar pattern, increasing through January and declining thereafter. CPUE for natives of the 1980-year-class was consistently lower than stocked largemouth bass. The combined CPUE for stocked and native largemouth bass of the 1980-year-class was greater than the CPUE for the remaining largemouth bass in the sample

Table 1. Proportion of Stocked Largemouth Bass from the 1980-Year-Class and Older Year-Classes in the Monthly Electrofishing Samples from Liberty Lake

Month	No. Stocked	No. Native	% Stocked
July, 1980	15	5	75.0
September	33	6	84.6
October	76	19	80.0
November	67	22	75.3
December	65	14	82.3
January, 1981	58	27	68.2
February	27	8	77.1
March	25	7	78.1
April	63	25	71.6
May	32	8	80.0
June	14	6	70.0
Total	475	147	76.4

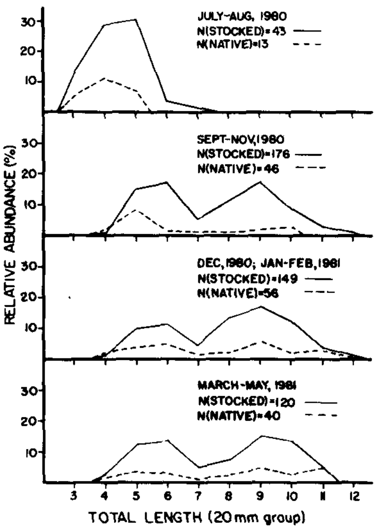

Figure 2. Seasonal length-frequency of stocked and native bass from the 1980-year-class in Liberty Lake.

from October through January. Beginning in late winter and early spring, the CPUE's for the 3 groups of bass in the samples declined steadily. However, beginning in February the combined CPUE of largemouth bass from the 1980-year-class was less than the CPUE for the remaining largemouth bass in the sample.

Assuming that supplemental stocking does not affect the survival of the native largemouth bass of that year-class, the number of bass from the 1980-year-class in the combined monthly electrofishing samples was increased by 223% following stocking at the rate of 448/ha. The relative abundance of the 1980-year-class in the combined samples increased from 16.4% to 34.6% by stocking the marked largemouth bass. However, it is not known if competition from the addition of the stocked largemouth bass decreased the survival of the native 1980-year-class.

Thirty-six largemouth bass collected in seine samples were included in the July-August length-frequency data (Fig. 2). A bimodal length distribution of the stocked largemouth bass appeared in the fall, 1980 and continued throughout the sampling period. The first mode was at 81-140 mm and remained relatively static through the winter and spring samples. Fish in this mode appeared to be in poor condition and exhibited little or no growth. The second mode was from 161-240 mm. The length of the second mode did not increase with time, however the distribution changed during the winter and spring with more fish growing into the 200 mm + length groups. Bimodality in the length distribution of the native 1980-year-class was not as evident. This may be due in part to the smaller sample size. Scale analysis from the April, 1981 sample indicated a 20% error in the classification of the native 1980-year-class. Five Age II fish were included in the 25 bass classified as native 1980-year-class. The smallest incorrectly classified bass was 176 mm, indicating that too many fish were included in the larger length groups of the native length-frequency distribution. The inclusion of some Age II largemouth bass in the native category resulted in the percentage of stocked fish in the 1980-year-class being underestimated.

The condition of the fish in the second mode was good as evidenced by the relative weights (W_r) (Fig. 3). With the exception of largemouth bass in the 160-240 mm length groups in the spring, 1981 samples, the relative weights for fish > 160 mm were consistently within the 95-100% range which is considered satisfactory (Wege and Anderson 1978). Relative weights were not used for fish < 160 mm in length due to the high percentage of error associated with weighing small fish in the field. The proportional stock density (PSD) of largemouth bass from the spring, 1981 samples was 57.6%. This is within the recommended range of balanced bass populations where shad are the primary forage (Anderson and Weithman 1978).

No numerical estimates of survival of stocked fish could be made. However, some observations on overwinter survival were possible. By comparing the proportions of stocked bass in the electrofishing samples from fall, 1980 to spring, 1981, a decline in the numbers of stocked bass was indicated. The fall samples contained 42.8% stocked bass (176 stocked bass out of a sample of 411 bass), whereas 31.3% (120 stocked bass out of a sample of 383 bass) of the spring sample consisted of stocked bass. This represents a

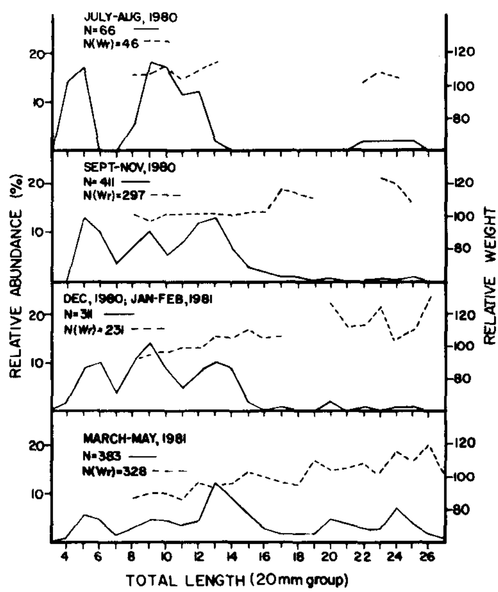

Figure 3. Seasonal length-frequency and relative weights of bass from the monthly electrofishing samples on Liberty Lake.

26.9% reduction in the percentages of stocked bass between the fall and spring samples. However, despite this reduction approximately one-third of the spring electrofishing sample was comprised of stocked fish.

One might expect the majority of the overwinter decline in stocked largemouth bass to consist of a decrease in the number of slow-growing fish from the first length mode. By comparing the proportion of fish from the smaller length mode to all largemouth bass collected from the fall sample to the same proportion from the spring samples and making the same comparisons for fish from the larger length mode, the existence of any differential mortality between the 2 length modes should be demonstrated. The proportions of stocked largemouth bass in the first length mode to all largemouth bass collected from the fall and spring samples were 20.9% (86 stocked bass out of a sample of 411) and 14.1% (54 stocked bass out of a sample of 383), respectively. This represents a 32.5% decline in the percentages of fish in the first length mode from the fall, 1980 to spring, 1981. The proportions of stocked largemouth bass in the second length mode from the fall and spring samples were 21.9% (90 stocked bass out of a sample of 411) and 17.2% (66 stocked bass out of a sample of 383), respectively. This represents a 21.5% decline in the percentages of stocked largemouth bass in the second length mode between the fall and spring samples. Even though there was a greater overwinter decline in the numbers of fish in the first mode than the decline in the second mode, both groups contributed substantially to the overall decline in the number of stocked fish between fall, 1980 and spring, 1981.

Discussion

The strength of a given year-class of largemouth bass is determined within a few weeks after the eggs are deposited (Kramer and Smith 1962, Eipper 1975). Clady (1970) observed a 99% rate of mortality from the time the eggs were deposited to the number of fingerlings in the fall in a small lake in Upper Michigan. It is generally felt that by stocking fingerling fish, those mortality factors operating on the early life stages will be bypassed.

The relative abundance of largemouth bass of the 1980-year-class in the electrofishing samples on Liberty Lake was more than doubled by stocking at the rate of 448/ha. However, there is evidence that the survival of the stocked largemouth bass has decreased with time. There was approximately a 25% reduction in the numbers of stocked largemouth bass of the spring, 1981 samples from the previous fall collections. The CPUE data also point to a reduction of stocked largemouth bass with time. The ascending portion of the line is indicative of the increased vulnerability to the sampling gear as the small fish increase in length. From October through January, CPUE for stocked largemouth bass was greater than that for native 1980-year-class and for all other largemouth bass sampled. Beginning in late winter CPUE's for all 3 groups of fish declined and in February CPUE for bass not of the 1980-year-class was greatest and remained so for the remaining samples. The decline in CPUE's may be explained in part by a loss of available habitat due to a drought in the summer of 1980 and an increased demand by the city of Guthrie for water from Liberty Lake. The resulting drop in the lake level left little habitat in which to concentrate fish, thereby making sampling difficult. However, the decline in CPUE for the stocked largemouth bass in late winter and spring was greater than that for bass other than the 1980-year-class. This suggests that a decrease in survival in combination with loss of suitable habitat resulted in the decrease in CPUE of stocked largemouth bass.

Multimodal length distributions of a single year-class have been discussed by several authors. Summerfelt (1975) correlated growth variations to disruptive spawning caused by the passage of frontal systems. This clearly was not the case in this study because all of the stocked fish were of similar size when stocked. Aggus and Elliot (1975) reported that certain individuals within a largemouth bass population become piscivorous earlier than others. While this tendency is not initially size related, it results in a growth advantage. Certain individuals among the stocked fish may have become piscivorous sooner than others and the resulting growth advantages were manifested in the bimodal length distribution observed. Shelton et al. (1979) related the growth disparity observed in the initial year-class of bass on West Point Reservoir to the limited availability of suitable-size prey for bass spawned late in the season. However, no data on prey availability were collected; therefore, one can only suggest this as being the cause of the observed results.

While the survival of fish from both length modes decreased from fall, 1980 to the following spring, survival of fish from the smaller mode was approximately 11% less than that of bass from the larger mode. Shelton et al. (1979) stated that small largemouth bass from the first length mode disappeared from the population by the fall of the second growing season, while larger fish in the second mode were recruited into the fishery as early as the fall of the first growing season.

The ultimate test of any stocking program is to what extent are the stocked fish seen in the anglers' creel. An ongoing creel survey is being conducted to collect these data.

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