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Gerard L. Buynak

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ABSTRACT

Largemouth bass were remedially stocked in three small impoundments in an attempt to improve the population structure of largemouth bass. This study was preformed to determine where remedial stocking has application. Largemouth bass populations in Guist Creek and Fishpond lakes showed improvements as a result of stocking. At Cannon Creek Lake, the stocking of large numbers of advanced fingerlings did little, if anything, to improve the size structure of the bass population.

Stocking of largemouth bass in an infertile (oligotrophic) lake, like at Cannon Creek Lake, does not appear to improve the black bass size structure. In these lakes, the stocking of smallmouth bass may be an appropriate management option if suitable coldwater habitat exists. If the management decision is not to establish a self-sustaining population of smallmouth bass because of lack of habitat or the lake is too small (approximately 100 acres or less), the lake may be fertilized to improve largemouth bass habitat followed by stockings of bass. This approach was effective at Fishpond Lake.

In more fertile (mesotrophic and eutrophic) lakes where largemouth bass habitat is not limited, remedial stocking can improve the bass size structure, as occurred at Guist Creek Lake, if the problem causing the imbalance can not be corrected by methods other than by stocking.

Remedial stocking of largemouth bass is a well-known fish management technique, but very little detailed information can be found in the literature. The best summary on bass stocking was given in a Bass Research Foundation (BRF) Special Report (Laska 1982). This report reviewed available literature on largemouth bass stocking. Lake and reservoir stockings of largemouth bass (northern subspecies) fingerlings (0-4 inches) in various lakes were found not to be feasible. Reasons given were that stocked bass did not appreciably affect the fish populations; increases in the largemouth catch was not in proportion to the number of fish stocked; and, because of low survival of these small fish, they did not contribute much to the creel. Stockings of intermediate-size (5-8 inch) largemouth bass was not considered to be a good management tool because of the expense of producting the larger bass and the low return to the creel. Stockings of 7-9 in bass was also found to be unproductive. One study was cited where 15,000 7-9 in bass (9.1/acre) were stocked in a 1,650-acre impoundment in Missouri. These fish were stocked to supplement a weak year class. The results of this study were that the stocking of the large number of bass failed to stop the downward trend in angler catch. In another study where large bass (0.75 - 1.50 pounds each) were stocked, these fish were harvested too soon after stocking to contribute significantly to the fishery.

The conclusions of the BRF report were: "The only situations in which stocking bass into existing populations is warranted is following pollution or naturally caused heavy die-offs of adults and/or fingerlings, while there still is an adequate forage food supply for the stocked fish. Therefore, while stocking bass appears on the surface to be a valuable management tool, it has a very limited

application."

As can be seen, the great majority of attempts at stocking largemouth bass in lakes with established largemouth bass populations have resulted in little if any improvements in the fisheries. The rising cost as a result of extensive expenditures of hatchery space, manpower, and time needed to produce largemouth bass for remedial stocking of bass requires good justification. It is necessary to determine the situations where this type of stocking has the best chance of success, and what other options could be available to correct population imbalances in lakes. This report will discuss results of remedial stockings of largemouth bass in three small impoundments in Kentucky.

STUDY AREAS

Guist Creek Lake is a 304-acre lake located in Shelby County, 3.0 miles east of Shelbyville, Kentucky. The lake was built in 1961 by the Kentucky Department of Fish and Wildlife Resources (KDFWR) and opened to public fishing in 1963. This lake is used as a domestic water supply for the City of Shelbyville. The lake has a maximum depth of 46.9 feet and a mean depth of 15.4 feet. Land use of the watershed is 85% agriculture, 10% silviculture, and 5% urban. Guist Creek Lake is classified as a eutrophic lake (Division of Water 1984).

Fishpond Lake is a 31.6-acre lake located in Letcher County, 2.0 miles west of Jenkins, Kentucky. This lake was built in 1964 and is owned by Letcher County. The lake has a maximum depth of 78.7 feet and a mean depth of 32.8 feet. Land use of the watershed is 95% silviculture, 3% mining related, and 2% recreation. The lake was classified as being mesotrophic, but the trophic level was influenced

by fertilization of the lake by KDFWR. Without fertilization, this lake would likely be oligotrophic.

Cannon Creek Lake is located in Bell County, 4.7 miles south of Pineville, Kentucky. The lake was built in 1972 and is owned by Bell County Properties Corporation. Cannon Creek Lake has a maximum depth of 95 feet and a mean depth of 46.6 feet. Land use of the watershed is 95% silviculture and 5% mining related. This lake has been classified as being oligotrophic.

METHODS

Fish population surveys were conducted using standard cove-rotenone sampling techniques, as described by Charles (1969), and a boat-equipped electrofishing unit at Guist Creek, Fishpond, and Cannon Creek lakes. In most cases, fish data from electrofishing were recorded as numbers of fish collected per inch group. Data were also expressed in numbers of fish captured per hour.

Proportional Stock Density (PSD), or the percent of the stock that is of quality size (Anderson 1976), was determined for largemouth bass and bluegill from spring electrofishing. Relative weights (Wr) (Weye and Anderson 1978) were calculated for bass from electrofishing data collected in the fall.

Systematic, non-uniform probability, creel surveys were conducted at Fishpond and Cannon Creek lakes in 1983. At Fishpond Lake, a day- and night-time survey were conducted. The day-time survey was scheduled once per week and consisted of one of four 3-hour survey periods from 7 am to 7 pm. Angler counts were made both at the beginning and end of each period, then averaged. This survey was conducted from April 8 through October 30. The night-time survey

consisted of one 3-hour survey conducted from 9 pm to 12 midnight, three nights a week. This survey was conducted from the third week in May through the first day of October. At Cannon Creek Lake, the creel survey was conducted during one of four 3-hour periods from 7 am to 7 pm, one day per week, from 1 April through October. Total counts were made at the beginning of each survey period.

Scale samples were collected from largemouth bass for age-growth determinations. Scales were taken from the area below the lateral line near the tip of the pectoral fin.

Most of scales were read using a microfiche reader; scales from larger fish were read using a Eberback scale viewer. Distance of annuli from the focus and scale radius were measured to the nearest 0.1 inch. Body-scale relationships were derived by fitting a straight line, by the least squares method, to the length of the fish and the projected scale radius (Ricker 1971). The formula was:

$$Ln - C = \frac{SN}{S}(L-C),$$

where Ln = length of the fish when annulus 'n' (at length 'Ln'), S = total scale radius, and C = the intercept on the length axis. No differentation of sex was made.

RESULTS

Guist Creek Lake

Fish populations in Guist Creek Lake have been imbalanced since 1975. An expanding yellow bass population, poor largemouth bass reproduction, and a generally poor panfish population were among the problems that led to a recommendation for remedial stocking of largemouth bass in the lake.

Electrofishing and cove-rotenone population samples in the early 1970's revealed the establishment of yellow bass in Guist Creek Lake (Table 1). Electrofishing studies conducted in late spring of 1975 showed that the yellow bass population was at a low density, with only 3.0 fish/hour (f/h) collected. Yellow bass were very abundant by 1976, according to results of a cove-rotenone study. In this study, 138 fingerling (0-4 inches), 211 intermediate (5-6 inches), and 36 harvestable-size ($\geq$7 inches) fish/acre (f/a) were collected (Henley 1977). Electrofishing studies conducted from 1979 through 1981 showed an increase in the yellow bass population (Table 1). Numbers increased from 408.0 f/h in 1979 to 480.0 f/h in 1980 and to 885.0 f/h in 1981. Fall electrofishing samples taken in 1982 indicated that the number of yellow bass were declining; 264.0 f/h were collected that year. Numbers continued to decline in subsequent spring electrofishing samples, with 93.8 f/h captured in 1983 and 105.0 f/h in 1984. The cause of this apparent decrease in unknown. However, two possible factors are the introduction of gizzard shad and a vastly improved largemouth bass population.

Establishment of gizzard shad, stocked into Guist Creek Lake from an unknown source, occurred in the late 1970's or early 1980's. Through 1980, no shad were collected in any cove-rotenone study or electrofishing sample (Table 2). In 1981, 36.0 gizzard shad were collected per hour and were in the 7-13 inch groups. In 1983, the catch rate by electrofishing increased to 193.8 f/h. The catch rate in 1984 was 43.0 f/h.

The introduction and expansion of the gizzard shad population corresponds to decreasing numbers of yellow bass (Tables 1 and 2). This decrease may have been caused by competition between the two

species for the available zooplankton which are important items in the diets of both young yellow bass and gizzard shad (Pflieger 1975).

A second reason that possibly contributed to the decline in yellow bass numbers is increased predation from the expanded largemouth bass population. Prior to the yellow bass introduction, the largemouth bass population was doing reasonably well under the 10-inch minimum size limit. Cove-rotenone studies conducted in 1964 showed that the largemouth bass population had a good size structure and density. In that year, 110 fingerling (0-4 inches), 92 intermediate-(5-9 inches), and 11 harvestable-size (10 inch or greater) bass were collected per acre (Pfeiffer 1965). The standing crop of largemouth bass was 213 f/a and 20.3 pounds/acre (lb/a). The PSD value for largemouth bass, calculated from the cove-rotenone data, was 20. In 1975, the PSD for largemouth bass was 24; both PSD values were below the desirable range of 40-60 (Table 3). These low PSD values did not occur as a result of competition by yellow bass since none were in the lake; no yellow bass were collected in cove-rotenone samples in 1964 (Pfeiffer 1965).

The yellow bass population had begun to have an affect on the largemouth bass population by 1976. The PSD value for largemouth bass, calculated from cove-rotenone data, was 37. This value is near the range of a balanced population. The PSD was higher than the 1964 value due to a reduction in the number of intermediate-size largemouth bass. By 1979, the PSD value had risen to 100; there were too many quality-size bass and no fish in the 8-11 inch group (Table 3). Length-frequency data collected in 1979 included very few bass from any inch group, and several inch groups were not represented by any

fish. Largemouth bass stocked from 1975 through 1979 (Table 4) have done very little to improve the black bass population in Guist Creek Lake. This lack of success can be attributed to the expanding yellow bass population during this period and, more importantly, to an inconsistent number and size of bass stocked each year.

Stockings since 1980 have been more consistent and improvements in the size structure of bass have resulted. A great improvement was seen in 1981 when the PSD declined to 55 (Table 3). The PSD values obtained in 1983 and 1984 were 68 and 48, respectively, showing that the stocking had made a dramatic improvement in providing a size structure of bass that had a PSD within or near the desired range on an annual basis.

In 1981 and 1983, numerous inch groups of bass were still absent (Table 3). This was particularly evident in the 2-8 inch group of fish. This can be explained by the stocking of bass within a narrow size range of 3-4 inches and the apparent lack of natural spawning success. By stocking fish in a narrow size range, the natural variation in size has been altered.

The increase in numbers of largemouth bass did not caused any problems in condition or growth rate of largemouth bass. The Wr values obtained in both 1982 and 1983 show that bass were in good condition (Table 5). Largemouth bass became legal size (12.0 inches) at age 3+ (Table 6).

Even with the improved size structure and the increased numbers of sexually mature fish, very little of the naturally spawned largemouth bass survived. This is based on the fact that during age and growth studies in 1983, a hatchery check or false annulus was found on many of the scales of bass less than 8.0 inches. If this check is

considered a true annulus, the back-calculated length at age 1 is 1.6 inches. This corresponds to the time in the hatchery when the bass are removed from the ponds and trained to eat dry foods, or they are stocked into other ponds to feed on natural foods.

The remedial stocking of about 2,500-4,000 largemouth bass, 3-4 inches long, each year in 1980-1983 has resulted in dramatic improvements in the largemouth bass population in Guist Creek Lake. It is recommended that this stocking program continue as a maintenance stocking unless natural reproduction eventually provides adequate recruitment.

Fishpond Lake

Fish samples from electrofishing in 1979 indicated that Fishpond Lake had an imbalanced fish population characterized by a stunted and over-crowded bluegill population and lack of reproductive success by largemouth bass (Crowell 1981 and 1982). The largemouth bass PSD was 100 and the bluegill PSD was 0 (Tables 7 and 8). Remedial stocking of largemouth bass was recommended to alleviate the fish population problems. In July 1979, 675 largemouth bass, 9-12 inches long, and 2,300 largemouth bass, 2.5-3.0 inches long, were stocked.

The stocking of these fish had an immediate and beneficial impact on the fishery. In November 1979, the bass PSD declined to 40, while the PSD for bluegill increased slightly to 2. This indicated that stocked bass had little problem in surviving and that larger fish were beginning to utilize the over-abundant bluegill population in the lake.

Data collected in spring 1980 showed further improvement in the bass population structure as well as the presence of a successful

bass spawn. The numbers of bass collected per hour had risen from 1.0 in 1979 to 16.0 in 1980 (Table 7). The PSD value for bass was 59, indicating that some of the stocked or native bass had recruited into the quality-size range. The bluegill PSD had increased to 8, indicating increased predation by bass. Numbers of bluegill decreased from 242.0 f/h in June 1979 to 137.1 f/h in June 1980. Quality-size bluegill increased in number.

The bass PSD declined to 10 in 1981. This was attributed to angler harvest (Crowell 1982). The PSD value for bluegill decreased slightly to 5. The impact of the fingerling largemouth bass stocking in 1979, along with natural reproduction observed in 1980, resulted in the increased number of bass captured in 1981 - 47.5 f/h (Table 7).

The PSD values for largemouth bass remained below the desirable range in 1982, as the PSD was 18. The positive impact of the 1979 stocking on the bluegill population was further evident, as the PSD value was 30. This represents the first time bluegill PSD values were within the desirable range and provided a good bluegill fishery to the angler. The Wr values obtained for bass in October indicated that they were in relatively poor condition (Table 5).

Age and growth studies conducted in 1983 indicated that largemouth bass reached harvestable size of 12.0 inches at age 4+ (Table 9). The fingerling bass stocked in 1979 were in their fourth year of growth (Age 3+) in 1982. At this age, the mean length was 11.4 inches. These fish were expected to enter the creel in 1983. This speculation held true as the bass PSD increased from 18 in 1982 to 36 in 1983, indicating that the size structure of bass was again back to near a desirable level. These bass continued to have a positive impact

on the bluegill population, as the PSD for bluegill increased to 41. The numbers of bluegill in electrofishing samples decreased sharply from 81.7 f/h in 1982 to only 28.6 f/h in 1983. The greatest declines occurred in the 5-7 inch group fish. These fish were either not along the shoreline at the time of electrofishing or their numbers were reduced by angler harvest.

Bluegill were very abundant in the creel at Fishpond Lake in 1983 (Tables 10 and 11). During the day-time creel, bluegill accounted for 50.8% (167.0 f/a) of the total number and 28.5% (23.8 lb/a) of the total weight of all fish harvested. Total numbers of bluegill harvested during the day- and night-time creel surveys were 176.3 f/a and 24.8 lb/a, respectively. The Wr values collected in 1983, unlike 1982 results, showed that bass were in good condition.

The dramatic turn around in the largemouth bass and bluegill fisheries at Fishpond Lake cannot be attributed entirely to the stocking program. The lake was fertilized from 1980-1983. This has undoubtly contributed to the overall success of the remedial stocking of largemouth bass.

Cannon Creek Lake

Results of electrofishing studies conducted in 1976-1979 at Cannon Creek Lake document the presence of a consistently unbalanced population structure. During this period, largemouth bass PSD values remained at 0; no largemouth bass larger than 12.0 inches were collected (Table 12). PSD values for bluegill during these years ranged from 0-11 (Table 13), indicating the presence of an overcrowded, stunted bluegill population with few quality-size fish available for harvest. As a result, a largemouth bass remedial stocking program was

conducted during 1977-1979. During each year, about 50 advanced (4-inch) largemouth bass fingerlings were stocked per acre (Table 14) in order to improve the size structure of largemouth bass and bluegill.

A 1.65-acre cove-rotenone study was conducted in 1978, following the second year of remedial stocking. The standing crop of fish in this study was low; 3,317 f/a and 41.13 lb/a were collected (Table 15). The standing crop of black bass was 24 f/a and 2.42 lb/a. Largemouth bass was the dominate black bass species by weight with 2.27 lb/a (94%), while spotted bass made up 0.15 lb/a (6%). No harvestable-size fish of either species was collected. The most abundant species was bluegill, composing 80.7% of the total number and 52.3% of the total weight collected. Forage fishes consisted only of minnows that had a standing crop of 61 f/a and 0.13 lb/a.

Electrofishing studies conducted from 1982 through 1984 indicated that the spotted bass population in Cannon Creek Lake had increased. Only one spotted bass was collected by electrofishing during 1976-1979 (Table 16). In 1982, 25.4 spotted bass were collected per hour. These fish were small, with none larger than the 10-inch group. PSD values obtained in 1982 for largemouth bass, spotted bass, and bluegill were 25, 13, and 36, respectively. The value obtained for largemouth bass, however, was determined from a small sample of bass; only eight largemouth bass $\geq$8.0 inches were collected in 2.4 hours of electrofishing. The PSD value for bluegill indicates a good quality fishery exists for bluegill in Cannon Creek Lake. Wr values collected in 1982 indicate that all size groups and species of bass were in relatively poor condition, an indication of crowding and competition for the available forage. The Wr values for largemouth bass could only be obtained for bass less than 8.0 inches long because no larger fish

were collected. The Wr value for these fish was 88. The Wr value obtained for the different size groups of spotted bass were 80 (less than 8.0 inches), 81 (8.0-11.9 inches), and 88 (12.0-14.9 inches).

In order to take advantage of the coolwater habitat available in Cannon Creek Lake, a smallmouth bass stocking program was started in 1982 and ended in 1984. Each year, smallmouth bass (Dale Hollow form) were stocked at the rate of about 40 f/a. The poor condition of largemouth and spotted bass in 1982 plus the attempt at establishing an additional predator (smallmouth bass) led to the decision to stock 350 adult gizzard shad on 19 April 1983. Shad were stocked to provide an additional source of forage for black bass.

The standing crop of spotted bass increased from 16 f/a (0.15 lb/a) in 1978 to 36 f/a (1.98 lb/a) in 1983 (Table 17). Spotted bass was the most abundant black bass collected in 1983, with 1.98 lb/a (54%) collected compared to 1.43 lb/a (39%) for largemouth bass and 0.23 lb/a (6%) for smallmouth bass. No harvestable-size bass of any species was taken. Electrofishing studies were conducted in 1983, but not enough bass were collected to determine PSD. After 2 years of stocking, the smallmouth bass already accounted for 6% of the total standing crop of black bass in the lake. Gizzard shad were successful in spawning and accounted for 21 f/a and 0.27 lb/a.

Age and growth data collected in 1982 and 1983 showed that largemouth reached harvestable size of 12.0 inches at age 4+ (Table 18). Largemouth bass stocked in 1977-1979 were age 6+, 5+, and 4+, respectively, in 1983. No harvestable-size largemouth bass were collected in the cove-rotenone study in 1983 and only two fish were collected in 2.4 hours of electrofishing in 1982. This indicates that

the stocking of 37,944 advanced fingerlings (about 50 f/a) over a 3-year period did little if anything to improve the size structure of the largemouth bass population in Cannon Creek Lake.

Black bass in the 1984 cove-rotenone study accounted for 5.49 lb/a (Table 19). Of these, 2.98 lb/a (54%), 1.23 lb/a (22%), and 1.28 lb/a (23%) were largemouth, smallmouth, and spotted bass, respectively. Only one harvestable-size bass was collected per acre. Much of the increase in largemouth bass from 1982 to 1983 occurred in the intermediate-size bass, particularly the 5- and 6-inch group fish. The smallmouth bass population continued to increase after 3 years of stocking, as this species increased from making up 6% of the standing crop of black bass in 1983 to 22% in 1984.

A potentially good fishery existed for bluegill in Cannon Creek Lake in 1983 as in 1982. The PSD value for bluegill was 35. In 1978 (Table 15), only 9 harvestable-size bluegill were collected per acre while, in 1983 (Table 17) and 1984 (Table 19), harvestable fish accounted for 21 and 20 f/a in the respective years. The cause of this turn around in the bluegill population is not known. It is felt, however, that the expanding spotted bass population from 1978 to 1983 may have contributed. Creel survey data collected in 1983 (Tables 20 and 21) showed that bluegill was the most harvested species by number (67.8%) and weight (36.7%). Largemouth bass accounted for only 4.3% of the total number of fish harvested (1.2 f/a) and 13.8% of the total weight (1.3 lb/a).

DISCUSSION

Largemouth bass were stocked in the three study lakes in an attempt to correct population imbalances as indicated by poor reproductive success and/or an undesirable PSD for bass. The goals for

stocking each lake were initially the same. Each lake, however, had a distinct set of conditions that required a different approach as was realized near conclusion of this study. Several alternatives to black bass management developed after determining the success of remedial stocking in these small impoundments.

The stocking of largemouth bass in an oligotrophic lake, such as Cannon Creek Lake, is not recommended. Cannon Creek Lake is infertile, providing limited warmwater habitat for largemouth bass. The stocking of smallmouth bass should be considered in oligotrophic lakes with suitable coolwater habitat and a minimum size of about 100 acres (Belding 1926). The establishment of a self-sustaining smallmouth bass population would result in utilization of habitat that is most favorable for this species and provide needed improvements in the black bass fishery in respect to harvest and diversity. For a lake to have enough coolwater habitat for smallmouth bass in Kentucky, it must be no less than about 100 acres and have at least 4.0 ppm dissolved oxygen at water temperatures of 68.5 to 74.3 F from July-September. Lakes in Kentucky that have coolwater habitat are either oligotrophic or mesotrophic and have the following characteristics: silviculture $\geq$55% of watershed, mean depth of $\geq$26 feet, retention time of $\geq$0.28 year, morpho-edaphic index of $\leq$20, and thermocline depth of $\geq$15 feet. The form of smallmouth bass used as broodstock should be obtained from a lake such as Dale Hollow Lake where the species has demonstrated very good lake-spawning and growth characteristics. Smallmouth bass should be stocked for 3 or 4 years to develop consecutive year classes prior to spawning by the first stocking at age 3 or 4.

If the oligotrophic lake is too small or smallmouth bass habitat is not present, the approach used at Fishpond Lake can be a viable option. Fishpond Lake is much less than 100 acres, although it has coolwater habitat. This lake was fertilized to increase fertility and provide more suitable habitat for remedially stocked largemouth bass. Fishpond Lake was fertilized at half the recommended rate in order to prevent the loss of coldwater habitat for rainbow trout that are stocked each year. Before a similar management approach is chosen at a lake to correct a poorly structured bass population, several considerations must first be taken into account. Fertilization of an oligotrophic lake can reduce or eliminate coolwater and coldwater habitat. If the retention time in the lake is not long enough, fertilization will not be effective. The cost/benefit ratio must also be considered.

If a small impoundment is not oligotrophic and lacks year-round coolwater habitat, the stocking of largemouth bass should be considered. This option may work if there is poor survival of reproduction, as occurred at Guist Creek Lake, or poor recruitment of young-of-year bass to age 1. The cause of poor survival must first be identified. Proper action should then be taken to eliminate or control the cause. Public opinion should be identified and incorporated into the decision-making process. The size of the body of water must also be considered, since the remedial stocking of large numbers of largemouth bass needed in a large lake might be cost prohibitive. If overharvest is the main problem, a change in the size-limit regulation may be the best decision.

These studies have indicated that the remedial stocking of largemouth bass in a small impoundment can be beneficial if the habitat

is suitable for largemouth bass and the problems associated with the population imbalance can be corrected by stocking. Although the remedial stocking of largemouth bass has worked in a few small impoundments under certain conditions, its use in large reservoirs is highly questionable due to little, if any, impact expected on the population and the cost of stocking.

The results of this study have shown that several management alternatives, in addition to remedial stocking, should be kept in mind when responding to population imbalances of largemouth bass in small impoundments. Remedial stocking of largemouth bass should only be considered if conditions favor its success and all other management options have been explored. A summary of the management recommendations obtained from this study are given below:

(1) Remedial stocking of largemouth bass is not recommended in oligotrophic lakes where there is enough coolwater habitat to establish a smallmouth bass fishery.

(2) If the oligotrophic lake has no suitable habitat for smallmouth bass, or is much less than 100 acres, fertilization should be initiated to improve largemouth bass habitat followed by remedial stocking. However, if either the retention time is too short or the lake is too large for fertilization to be economical, then this approach is not feasible. Also, if year-round coldwater habitat for trout is present, fertilization should not be applied at a rate that would sacrifice the trout fishery.

(3) If the small impoundment is too eutrophic to either consider stocking of smallmouth bass or fertilization, then the only option is to remedially stock largemouth bass unless overharvest is a

problem. In this case, the harvest regulation on black bass should be modified.

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Table 1. Relative abundance of yellow bass collected by electrofishing at Guist Creek Lake.

Year	Inch group 3	4	5	6	7	8	Total	No./hour
1975			2				2	3.0
1979		40	27	136		1	204	408.0
1980	2	47	72	102	14	3	240	480.0
1981		239	361	64			664	885.0
1983		16	9	20			45	93.8
1984	3	22	41	26	12	1	105	105.0

Table 2. Relative abundance of gizzard shad collected by electrofishing at Guist Creek Lake.

Year	Inch group 4	5	6	7	8	9	10	11	12	13	Total	No./hour
1975											0	0
1979											0	0
1980											0	0
1981				1	5	4	9	3	1	1	27	36.0
1983	1	16	54	19	3						93	193.8
1984	1	11	11	7	12	1					43	43.0

Table 3. PSD values and relative abundance of largemouth bass collected by electrofishing at Guist Creek Lake.

Year	Inch group																					Total	No./ hour	PSD
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			
1975	3	1	8	10	1	1	4	8		1	2	1	1									41	61.5	24
1979		5	4			1					1	1			1		3	1	1			18	36.0	100
1980		1		3	2				1		4	3	1	3	1		2		1		1	23	46.0	94
1981			4	5			5	5		3	4	3		5	4							38	50.7	55
1983			1	2	1			2	5	4	4	5	5	3	4	2		1	2		1	42	26.9	68
1984			1	1	3	1	4	18	17	7		4	4	6	9	8	4	5	1			93	93.0	48

Table 4. Largemouth bass stocking record for Guist Creek Lake.

Year	Size of bass stocked (in)	Number of bass stocked
1975	2	935
	7	378
1976	1	5,500
	4	4,350
	7	256
1977	1 (fry)	92,000
1978		none
1979	6	774
1980	4	4,272
1981	3	2,500
1982	4	4,000
1983	4	3,650
	3-4	2,375

Table 5. Relative weights (Wr) for each size group of largemouth bass collected at Guist Creek Lake and Fishpond Lake in 1982 and 1983.

		Length range			
Lake	Year	<8.0	8.0-11.9	12.0-14.9	≥15.0
Guist Creek	1982	96	93	85	103
	1983	107	101	100	105
Fishpond	1982	79	80	79	
	1983	107	96	92	106

Table 6. Mean back-calculated lengths (in) at each annulus for largemouth bass collected from Guist Creek Lake in 1983, including the range of length at each age and the 95% confidence interval for each age group.

Age	No.	Range		Mean	Standard error	95% C.I.	
		Low	High			Low	High
1	50	4.13	9.05	6.11	0.15	5.80	6.42
2	47	6.38	11.30	8.73	0.17	8.39	9.07
3	42	8.29	12.41	10.49	0.14	10.21	10.78
4	29	11.10	14.59	12.61	0.18	12.23	12.98
5	24	12.20	15.81	14.17	0.20	13.74	14.60
6	14	14.78	17.47	16.06	0.18	15.67	16.45
7	11	15.86	18.50	17.20	0.24	16.67	17.73
8	6	17.55	19.21	18.28	0.23	17.71	18.84
9	4	18.51	20.03	19.12	0.32	18.22	20.02
10	3	19.60	20.72	20.00	0.35	18.86	21.15
11	1	21.00	21.00				

Table 7. PSD values and relative abundance of largemouth bass collected by electrofishing at Fishpond Lake.

Date	Inch group																					Total	No./ hour	PSD
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
Jun 1979																	1				1	2	1.0	100
Nov 1979		5	2							3	2	2	2									16	16.0	40
Jun 1980	1	1	7	2					1	2	4	5	6	3	1							33	18.9	59
Jun 1981	1			7	16	17	17	7	5	7					1			1				69	47.5	10
May 1982				2	23	12	4	2	15	8	3	1	1	1			1	2	1			76	42.5	18
May 1983				2	11	10		1	2	5	4	4	4	4		1				1		49	37.7	36

Table 8. PSD values and relative abundance of bluegill collected by electrofishing at Fishpond Lake.

Date	Inch group								Total	No./ hour	PSD
	1	2	3	4	5	6	7	8			
Jun 1979	22	48	369	39	6				484	242.0	0
Nov 1979		3	117	142	44	6	1		313	313.0	2
Jun 1980	6	33	164	17	4	14	2		240	137.1	8
Jun 1981	2	40	80	113	40	10	4	2	291	200.7	5
May 1982		4	4	14	62	50	19	2	155	86.6	30
May 1983	2	2	3	5	4	1	3		20	28.6	41

Table 9. Mean back-calculated lengths (in) at each annulus for largemouth bass collected from Fishpond Lake in 1983, including the range of lengths at each age and the 95% confidence interval for each age group.

Age	No.	Range		Mean	Standard error	95% C.I.	
		Low	High			Low	High
1	55	3.75	7.23	5.21	0.1	5.00	5.41
2	35	6.13	11.53	8.81	0.2	8.38	9.22
3	17	8.85	13.41	11.36	0.26	10.79	11.93
4	7	12.57	15.31	13.75	0.37	12.86	14.64
5	4	13.90	15.99	15.20	0.45	13.95	16.46
6	3	15.60	16.68	16.22	0.32	15.19	17.25
7	1	17.74	17.74	17.74			
8	1	18.93	18.93	18.93			
9	1	19.46	19.46	19.46			
10	1	19.99	19.99	19.99			

Total number of fish used in the analysis = 55.

Intercept from regression = 1.5595.

Table 10. Fishery statistics derived from separate day and night creel surveys at Fishpond Lake (32 a) during 8 April through 30 October 1983 (daytime) and 17 May through 1 October 1983 (night-time).

	Daytime	Night time	Total
Anglers			
Number of fishing trips	12,723	1,126	13,849
(per acre)	(397.6)	(35.2)	(432.8)
Percent successful	30.6	34.5	
Fishing pressure			
Total man-hours (m-h)	23,159	3,300	26,459
M-h/acre	723.7	103.1	826.8
Harvest			
Number of fish	10,526	1,078	11,604
Pounds of fish	2,673	270	2,943
Harvest rate			
Fish/hr	0.45	0.33	
Lb/hr	0.12	0.08	
Fish/acre	328.9	33.7	362.6
Lb/acre	83.5	8.4	91.9
Miscellaneous characteristics (%)			
Male	91	93	
Female	9	7	
Resident	99	100	
Non-resident	1	t	
Method (%)			
Still-fishing	94	95	
Casting	5	5	
Trolling	1	0	
Other	t	0	
Mode (%)			
Boat	13	38	
Bank	87	62	

Table 11. Sport fish harvest at Fishpond Lake (32 a) derived from day and night creel surveys from April through October 1983.

	Rainbow trout		Largemouth bass		Crappie		Bluegill		Channel catfish		Anything*	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Number harvested (per acre)	3,351 (104.7)	284 (8.9)	278 (8.7)	17 (0.5)	314 (9.8)	205 (6.4)	5,343 (167.0)	297 (9.3)	1,240 (38.8)	275 (8.6)		
Percent of total no. harvested	31.8	26.3	2.6	1.6	3.0	19.0	50.8	27.6	11.8	25.5		
Pounds harvested (per acre)	1,030 (32.2)	108 (3.4)	370 (11.6)	23 (0.7)	29 (0.9)	18 (0.6)	761 (23.8)	33 (1.0)	482 (15.1)	88 (2.8)		
Percent of total lb harvested	38.5	40.0	13.8	8.5	1.1	6.6	28.5	12.2	18.0	32.6		
Mean length (in)	9.5	10.1	13.9	14.0	6.1	6.1	5.4	5.2	11.0	10.9		
Mean weight (lb)	0.31	0.38	1.33	1.36	0.09	0.09	0.14	0.11	0.39	0.32		
Number of fishing trips for	2,909	161	548	77	66	49	1,714	39	209	249	7,275	551
Percent of all trips	22.9	14.3	4.3	6.8	0.5	4.4	13.5	3.5	1.6	22.1	57.2	48.9
Hours fished for (per acre)	4,728 (147.8)	437 (13.6)	1,048 (32.8)	206 (6.4)	276 (8.6)	142 (4.4)	3,307 (103.3)	150 (4.7)	949 (29.7)	749 (23.4)	12,850 (401.6)	1,616 (50.5)
Number caught fishing for	2,261	220	91	7	254	105	2,728	137	942	194	4,060	330
Pounds caught fishing for	672	73	170	11	24	10	407	12	373	60	967	82
Number per hour caught fishing for	0.48	0.50	0.09	0.04	0.92	0.74	0.83	0.91	0.99	0.26	0.32	0.20
Percent of success fishing for	35.7	49.4	16.5	4.9	t	59.5	56.1	77.9	58.9	34.8	22.1	23.2

Table 12. PSD values and relative abundance of largemouth bass collected by electrofishing at Cannon Creek Lake.

Date	Inch group										Total	No./ hour	PSD
	2	5	6	7	8	9	10	11	13	18			
Jun 1976	1					1	2					4.0	
Sept 1977												0.0	0
Jul 1978				1								1.0	0
Jul 1979				2								2.0	0
May 1982		1	4	3	1		2	3	1	1	16	6.7	25
May 1983		2	2	1							5	3.3	0
May 1984			1			1	2				4	3.1	

Table 13. PSD values and relative abundance of bluegill collected by electrofishing at Cannon Creek Lake.

Date	Inch group								Total	No./ hour	PSD
	1	2	3	4	5	6	7	8			
Jun 1976		48	20	2	5					75.0	0
Sept 1977	58	36	8	14	8	2					6
Jul 1978	36	108	73	26	9	3	2				4
Jul 1979	10	52	24	16	2	4	1				11
May 1982		2	26	8	16	26	11	17	106	44.2	36
May 1983			10	2	3	3	2	3	23	23.0	35
May 1984			3	2	5	2	2	2	16	12.4	38

Table 14. Largemouth bass stocking record for Cannon Creek Lake.

Year	Size of bass stocked (in)	Number of bass stocked
1977	3.5 - 5.0	12,196
1978	3.0 - 4.7	12,048
1979	3.0 - 5.0	13,700

Table 15. Fish standing crop summary as derived from a 1.65-acre cove-rotenone sample that was conducted at Cannon Creek Lake in August 1978.

GROUP/species	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total population	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Biomass
GAME FISHES										
Largemouth bass	3	0.05	5	2.22	–	–	8	2.27	0.24	5.52
Spotted bass	16	0.15	–	–	–	–	16	0.15	0.48	0.36
Black crappie	–	–	1	0.09	–	–	1	0.09	0.03	0.22
White crappie	95	0.68	42	3.54	3	0.67	140	4.89	4.23	11.89
Total	114	0.88	48	5.85	3	0.67	165	7.40	4.98	17.99
FOOD FISHES										
Channel catfish	1	t	3	0.39	10	5.66	14	6.05	0.42	14.71
Total	1	t	3	0.39	10	5.66	14	6.05	0.42	14.71
PISCIVOROUS TOTAL	115	0.88	51	6.24	13	6.33	179	13.45	5.40	32.70
PANFISHES										
Rock bass	–	–	1	0.04	2	0.38	3	0.42	0.09	1.02
Bluegill	1,773	6.84	896	13.45	9	1.20	2,678	21.49	80.74	52.26
Hybrid sunfish	8	0.02	2	0.01	–	–	10	0.03	0.30	0.07
Longear sunfish	–	–	1	0.02	–	–	1	0.02	0.03	0.05
Warmouth	325	1.34	41	0.56	3	0.52	369	2.42	11.12	5.89
Total	2,106	8.20	941	14.08	14	2.10	3,061	24.38	92.28	59.29
COMMERCIAL FISHES										
Carp	–	–	1	0.33	1	1.73	2	2.06	0.06	5.01
Bullheads	4	0.06	10	1.05	–	–	14	1.11	0.42	2.70
Total	4	0.06	11	1.38	1	0.73	16	3.17	0.48	7.71

Table 15 continued....

GROUP/species	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total population	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Biomass
FORAGE FISHES										
Notropis sp.	3	0.06	-	-	-	-	3	0.06	0.09	0.15
Bluntnose minnow	58	0.07	-	-	-	-	58	0.07	1.75	0.17
Total	61	0.13	-	-	-	-	61	0.13	1.84	0.32
NON-PISCIVOROUS TOTAL	2,171	8.39	952	15.46	15	3.83	3,138	27.68	94.60	67.30
GRAND TOTAL	2,286	9.27	1,003	21.70	28	10.16	3,317	41.13	100.00	100.00

t < 0.01 lb/acre.

Table 16. Relative abundance of spotted bass collected by electrofishing at Cannon Creek Lake.

Date	Inch group								Total	No./hour
	3	4	5	6	7	8	9	10		
June 1976										0.0
Sept 1977										0.0
Jul 1978	1									1.0
Jul 1979										0.0
May 1982	3	19	19	9	5		2	4	61	25.4
May 1983		4	1		4	13	4	1	27	18.0
May 1984		1			1	3			5	3.9

Table 17. Species composition and relative abundance of fishes as determined from a 1.97-acre cove-rotenone sample in Cannon Creek Lake in August 1983.

Group/species	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total population	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
GAME FISHES										
White bass					1	0.57	1	0.57	0.1	1.1
Largemouth bass	1	0.01	7	1.42			8	1.43	0.6	2.7
Smallmouth bass	8	0.11	1	0.12			9	0.23	0.7	0.4
Spotted bass	27	0.06	9	1.92			36	1.98	2.8	3.7
White crappie	47	0.20	22	1.63	7	1.33	76	3.16	5.9	5.9
TOTAL	83	0.38	39	5.09	8	1.90	130	7.37	10.0	13.7
FOOD FISHES										
Channel catfish	3	t	4	0.63	18	9.25	25	9.88	1.9	18.3
TOTAL	3	t	4	0.63	18	9.25	25	9.88	1.9	18.3
PISCIVOROUS TOTAL	86	0.38	43	5.72	26	11.15	155	17.25	12.0	32.0
PANFISHES										
Bluegill	708	1.47	196	5.37	21	4.08	925	10.92	71.4	20.3
Warmouth	21	0.09	86	2.29	1	0.16	108	2.54	8.3	4.7
TOTAL	729	1.56	282	7.66	22	4.24	1033	13.46	79.8	25.0
COMMERCIAL FISHES										
Goldfish					1	1.45	1	1.45	0.1	2.7
Carp			1	0.59	19	21.29	20	21.88	1.5	40.6
Yellow bullhead	4	0.05	4	0.31	1	0.30	9	0.66	0.7	1.2
Black bullhead	2	0.06	1	0.05			3	0.11	0.2	0.2
TOTAL	6	0.11	6	0.95	21	21.59	33	22.65	2.5	42.0
FORAGE FISHES										
Gizzard shad	13	0.13	8	0.14			21	0.27	1.6	0.5
Gambusia	4	t					4	t	0.3	t
Spotfin shiner	14	0.10	6	0.08			20	0.18	1.5	0.3
Bluntnose minnow	29	0.06					29	0.06	2.2	0.1
TOTAL	60	0.29	14	0.22			74	0.51	5.7	0.9

Group/species	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total population	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
NON-PISCIVOROUS TOTAL	795	1.96	302	8.83	43	25.83	1140	36.62	88.0	68.0
GRAND TOTAL	881	2.34	345	14.55	69	36.98	1295	55.87	100.00	100.0

t <0.5 f/a, 0.005 lb/a, or 0.05%.

Table 18. Mean back calculated lengths (in) at each annulus for largemouth bass collected from Cannon Creek Lake in 1982 and 1983, including the range of length at each age and the 95% confidence interval for each age group.

Age	No.	Range		Mean	Standard error	95% C.I.	
		Low	High			Low	High
1	27	3.51	6.10	4.52	0.13	4.25	4.79
2	15	5.40	8.08	6.84	0.20	6.39	7.29
3	7	7.79	10.09	9.06	0.34	8.25	9.87
4	6	9.46	12.63	10.79	0.50	9.54	12.03
5	4	10.96	15.17	12.70	1.01	9.88	15.53
6	2	15.90	17.29	16.59	0.69	13.61	19.58
7	2	16.57	19.83	18.20	1.63	11.18	25.22
8	2	17.90	20.68	19.29	1.39	13.30	25.27
9	1	21.95	21.95	21.95			
10	1	22.80	22.80	22.80			

Total number of fish used in the analysis = 27.

Intercept from regression = 1.62.

Table 19. Species composition and relative abundance of fishes from a cove-rotenone sample in Cannon Creek Lake in August 1984.

	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total population	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
GAME FISHES										
Largemouth bass	11	0.20	31	2.37	1	0.41	43	2.98	3.0	5.0
Smallmouth bass	9	0.10	6	1.13			15	1.23	1.1	2.1
Spotted bass	17	0.16	3	1.12			20	1.28	1.4	2.2
White crappie	131	0.92	4	0.44	13	4.31	148	5.67	10.4	9.6
TOTAL	168	1.38	44	5.06	14	4.72	226	11.16	15.9	18.9
FOOD FISHES										
Channel catfish	7	0.03	7	0.82	10	4.12	24	4.97	1.7	8.4
TOTAL	7	0.03	7	0.82	10	4.12	24	4.97	1.7	8.4
PISCIVOROUS TOTAL	175	1.41	51	5.88	24	8.84	250	16.13	17.6	27.3
PANFISHES										
Bluegill	688	2.12	163	3.93	20	4.09	871	10.14	61.3	17.2
Warmouth	108	0.40	59	1.18	2	0.21	169	1.79	11.9	3.0
TOTAL	796	2.52	222	5.11	22	4.30	1,040	11.93	73.2	20.2
COMMERCIAL FISHES										
Carp			1	0.68	20	23.66	21	24.34	1.5	41.2
Yellow bullhead	9	0.08	1	0.11			10	0.19	0.7	0.3
TOTAL	9	0.08	2	0.79	20	23.66	31	24.53	2.2	41.5
FORAGE FISHES										
Gizzard shad	39	0.26	3	0.12	20	5.80	62	6.18	4.4	10.5
Bluntnose minnow	21	0.09					21	0.09	1.5	0.2
Spotfin shiner	7	0.08	3	0.06			10	0.14	0.7	0.2
Gambusia	7	t					7	t	0.5	t
TOTAL	74	0.43	6	0.18	20	5.80	100	6.41	7.0	10.9
NON-PISCIVOROUS TOTAL	879	3.03	230	6.08	62	33.76	1,171	42.87	82.4	72.6
GRAND TOTAL	1,054	4.44	281	11.96	86	42.63	1,421	59.03	100.0	100.0

Table 20. Fishery statistics derived from a creel survey at Cannon Creek Lake (248 a) between April 5 and October 23, 1983.

Anglers	
Number fishing trips (per acre)	25,108
Percent successful	7.9
Fishing pressure	
Total man-hours (m-h)	18,765
M-h/acre	77.2
Harvest	
Number of fish	6,910
Pounds of fish	2,222
Harvest rate	
Fish/hr	0.37
Pounds/hr	0.12
Fish/acre	28
Pounds/acre	9.1
Miscellaneous characteristics (%)	
Male	76
Female	24
Resident	99
Non-resident	1
Method	
Still fishing	91
Casting	8
Trolling	1
Fly fishing	0
Other	0
Mode	
Boat	22
Bank	78

Table 21. Harvest of fish at Cannon Creek Lake (248 acres) between April 5 and October 23, 1983.

	Trout	Largemouth bass	Spotted bass	Sunfish	Crappie	White bass	Drum	Channel catfish	Anything
Number harvested (per acre)	1,030 (4.2)	294 (1.2)	94 (0.4)	4,688 (19.3)	6 (t)	60 (0.2)	10 (t)	729 (3.0)	
Percent of total harvest	14.9	4.3	1.4	67.8	0.1	0.9	0.1	10.5	
Pounds harvested (per acre)	634 (2.6)	307 (1.3)	75 (0.3)	815 (3.3)	0.35 (t)	10 (t)	4 (t)	376 (1.5)	
Percent of total pounds harvested	28.5	13.8	3.4	36.7	t	0.5	0.2	16.9	
Mean lengths (in)	11.7	12.8	12.0	6.1	5.0	7.0	10.0	12.1	
Mean weight (lb)	0.62	1.04	0.80	0.17	0.06	0.17	0.40	0.52	
Number of fishing trips for that species	2,201	915	0	1,282	101	0	0	81	20,528
Percent of all trips	8.8	3.6	0	5.1	0.4	0	0	0.3	81.8
Hours fished for that species (per acre)	770 (3.1)	2,663 (10.7)	0 (0)	2,805 (11.3)	75 (0.30)	0 (0)	0 (0)	128 (51.6)	12,323 (49.7)
Number caught fishing for that species	182	150	0	2,557	0	0	0	31	3,059
Pounds caught fishing for that species	102	159	0	456	0	0	0	39	917
Number/hour caught for that species	0.24	0.06	0	0.91	0	0	0	0.24	0.25
Percent success fishing for that species	4.8	16.4	0	58.3	0	0	0	19.1	4.4