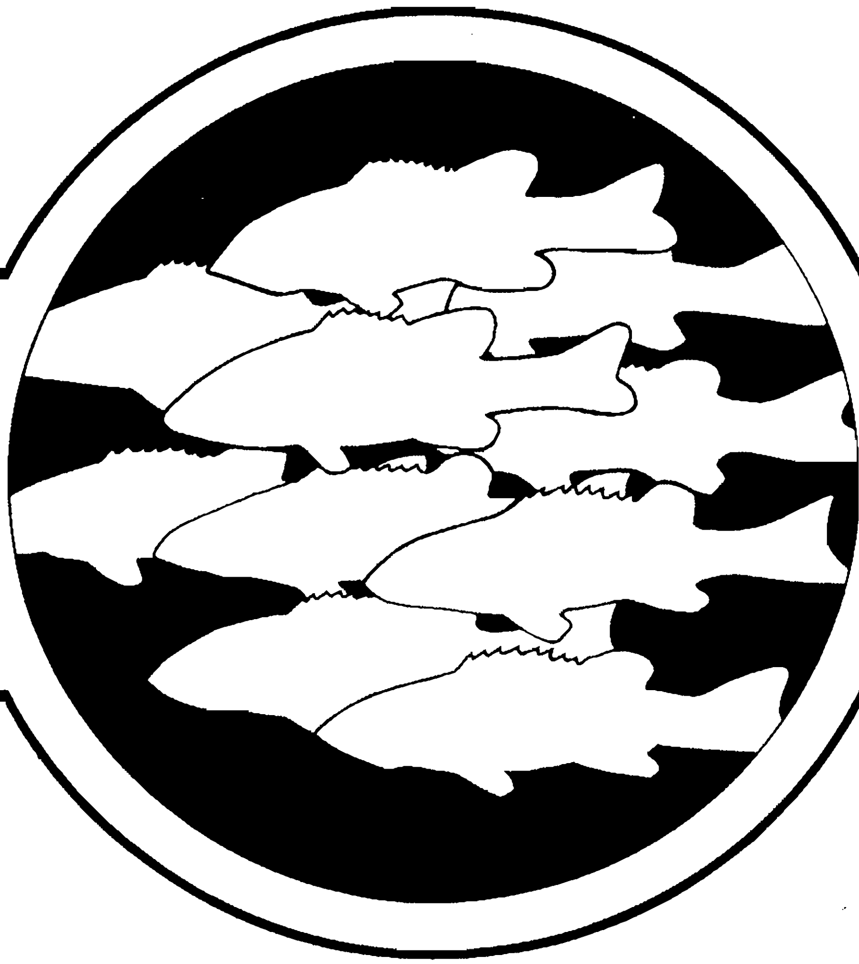

Fisheries Bulletin of the Kentucky Department of Fish and Wildlife Resources

Smallmouth Bass Stocking Evaluation at Herrington Lake

Gerard L. Buynak

Bulletin No. 79

January 1986

Kentucky
Department of Fish and Wildlife Resources
Don R. McCormick, Commissioner

Division of Fisheries
Peter W. Pfeiffer, Director

Smallmouth Bass Stocking Evaluation

at

Herrington Lake

Gerard L. Buynak

This study was financed partially with
Federal Aid in Sport Fish Restoration Funds
Dingell-Johnson Project Number F-40 (2-8)

1986

ABSTRACT

A total of 561,334 smallmouth bass ranging in length from fry to 3.5 inches were stocked into Herrington Lake from 1978-1981 in an attempt at re-establishing smallmouth bass in the lake. For the first 30 years of impoundment, a self-sustaining smallmouth bass fishery existed in the lake. Cove-rotenone data collected from 1948 through 1955 indicated that a viable smallmouth bass population existed during these years. After 1955, only one fingerling-sized (5 inches) smallmouth bass was taken in 1961 and one harvestable-sized (≤10 inch) smallmouth bass was collected in 1976. A selective shad removal program conducted from 1956-1959 was at one time thought to be responsible in part for the elimination of smallmouth bass from Herrington Lake.

Results of this evaluation study of the smallmouth bass stocking showed that a self-sustaining fishery did not result from the stocking of large numbers of smallmouth bass into the lake. During the 4 years of stocking, smallmouth bass made up a mean of only 0.9% of the total number and 0.7% of the total weight of bass collected during cove-rotenone studies. No smallmouth bass of any size were collected in rotenone studies from 1982-1985. Creel survey data collected from 1980 through 1984 indicated that some of the stocked smallmouth bass did survive, grow, and contribute to the creel. Stocked smallmouth bass accounted for a mean of 1.3% of the total number and 1.1% of the total weight of bass harvested in these years. For a smallmouth bass stocking program to be considered a success at developing a self-sustaining fishery, this species is expected to contribute about 10% to the black bass biomass and/or 10% of the yield of all bass. Little, if any, reproduction success from the 1982 year class was evident from the 1985 creel survey results to indicate that the stocked fish have developed a viable self-sustaining population.

The apparent reason for both the elimination of smallmouth bass from the lake in the 1950's and the failure at re-establishing the smallmouth bass fishery is a result of eutrification and the gradual reduction and subsequent elimination of coolwater habitat suitable for smallmouth bass in the lake.

INTRODUCTION

The smallmouth bass, commonly known as black bass, brown bass, green bass, or old bronze back, is a very important freshwater fish in North America and other parts of the world. Its geographic distribution was originally restricted to the freshwaters of east-central North America. Its range was expanded beginning in the mid-1800's and can now be found in nearly all parts of the United States and many places in Europe, Russia, and Africa (Scott and Crossman 1973).

As a result of the interest in the smallmouth bass, a great deal of information can be found pertaining to its age and growth, reproduction, food habits, and habitat requirements. The maximum age of this species is said to be about 15 years (Scott and Crossman 1973); however, it was reported that fish older than 7 years are uncommon (Edwards et al. 1983). The present world record is a 27 inch long, 11 pound 15 ounce fish caught in Dale Hollow Lake, Kentucky in 1955.

Nest building and spawning takes place on sandy, gravel, or rocky bottom in lakes usually in 2-20 feet of water near cover such as rocks or logs. The major portion of egg deposition lakes place when water temperatures are 61-65 F (Scott and Crossman 1973). Hubbs and Bailey (1938) described the best smallmouth bass lakes as being clear-water lakes larger than 100 acres, more than 30 feet in depth, and having scanty vegetation and large shoals of rock and gravel. Jenkins (1975, 1976) stated that the better smallmouth bass populations in reservoirs are found in clear, less fertile reservoirs several years after impoundment that have low total dissolved solids. Standing crops of smallmouth bass have been positively correlated with standing crops of rainbow trout, redhorses, and spotted suckers and negatively correlated with standing crops of crappie, longnose gar, spotted bass, largemouth bass, redbreast sunfish, gizzard shad, blue catfish, and flathead catfish (Jenkins 1975).

Habits of the fish vary with respect to time of the year. Scott and Crossman (1973) stated "In the spring, adult fish congregate on the spawning grounds. Later they are usually found in rocky and sandy areas of lakes and rivers in moderately shallow water. In the heat of summer, they usually retreat to greater depths". The preferred field-observed temperatures of the smallmouth bass is given as 68.5-70.3 F (Ferguson 1958).

At Herrington Lake, it has been reported that a self-sustaining smallmouth bass fishery existed in the lake for the first 30 years of impoundment. Cove-rotenone data have been collected at Herrington Lake in one or more coves from 1948 through 1964 and from 1973 through 1985. Smallmouth bass were collected in these studies from 1948 through 1955, with the exception of 1952, indicating a self-sustaining smallmouth bass fishery existed during these years. After 1955, only one fingerling-sized (<5 inches) smallmouth bass was taken in 1961 and one harvestable-sized (≥10 inches) smallmouth bass was collected in 1976. One of the possible reasons given for explaining the elimination of smallmouth bass is the selective shad removal that was conducted annually from 1956-1959 using a diluted rotenone emulsion. The present study was done to evaluate the success of re-establishing a self-sustaining smallmouth bass fishery in Herrington Lake through the stocking of smallmouth bass fingerlings for 4 years.

STUDY AREA

Herrington Lake is a 2,940-acre lake located in portions of Mercer, Garrard, and Boyle counties, 2.5 miles northeast of Danville, Kentucky. The lake was impounded in 1925 and is the oldest major reservoir in Kentucky. The lake was formed by the construction of a dam by Kentucky Utilities on the Dix River, a tributary of the Kentucky River. Major inflows into the lake include Dix River, Clarks Run, and Mocks Branch. The lake is one of the deepest lakes in the state, having a mean depth of 78 feet and a maximum depth of 249 feet. The watershed of the lake includes an area of about 280,953 acres. Watershed land usage includes agriculture (71%), silviculture (26%), and urban (3%). Herrington Lake is classified as a eutrophic lake (Anderson and Miller 1984).

METHODS

The success of re-establishing smallmouth bass in Herrington Lake through stocking was evaluated by sampling the fish populations using standard cove-rotenone sampling techniques, as described by Charles (1969), and by using a boat-equipped electrofishing unit. Data collected by electrofishing were recorded as numbers of fish collected per inch group and numbers of fish captured per hour.

Non-uniform probability creel surveys, utilizing a hired creel clerk were conducted at Herrington Lake from March through October in 1980-1985 to evaluate the contribution of the stocked fish and fish from natural reproduction to the creel. The lake was divided into two survey areas, while the work week was stratified into 14 half-day periods. Length of the fishing day was figured for each survey month, and mid-day was adjusted accordingly. Each week, 4 of the possible 14 half-day periods were surveyed. An instantaneous count of anglers was made during a randomly selected 2-hour period during each half-day period surveyed; anglers were interviewed during the remaining portion of the period.

Scale samples were collected from smallmouth bass for age and growth determinations. Scales were taken from the area below the lateral line near the tip of the pectoral fin. Scales were read using a microfiche reading. 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:

$$L_n - c = \frac{S_N}{S}(L-C),$$

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 differentiation of sex was made.

RESULTS AND DISCUSSION

A self-sustaining population of smallmouth bass existed at Herrington Lake until 1955. Cove-rotenone data collected from 1948 through 1955 showed that smallmouth bass formed from 0-5.3% of the total number ($\bar{x}$ = 1.6%) and 0-6.3% of the total weight ($\bar{x}$ = 3.1%) of bass collected. After 1955, only two smallmouth bass were collected prior to the years smallmouth bass were stocked. It was felt at one time that the selective shad poisoning conducted on Herrington Lake from 1956-1959 contributed to their elimination from the lake. An undetermined number of game fish, including smallmouth bass, were killed during the first 2 years of shad eradication.

In order to try to re-establish the smallmouth bass fishery in Herrington lake, smallmouth bass were stocked for 4 years from 1978 through 1981 (Table 1). In these 4 years, a total of 561,334 fish ranging in size from fry to an average length of 3.5 inches were stocked. Cove-rotenone studies conducted from 1978-1985 indicated that the stocking program had relatively little success (Table 2). In 1978, following the first year of stocking, smallmouth bass accounted for 1.5% of the total number and 0.7% of the total weight of black bass collected in the cove-rotenone studies. In 1979 and 1980, smallmouth bass accounted for <1% of the total number and weight of black bass collected. In 1981, the last year of stocking, smallmouth bass accounted for 0.9% of the total number and 1.3% of the total weight of bass collected. During the 4 years of stocking, smallmouth bass made up a mean of only 0.9% of the total number and 0.7% of the total weight of bass collected.

Electrofishing studies conducted in 1982 resulted in the capture of four smallmouth bass (Table 3). No smallmouth bass were collected in 1983 or 1984.

Too few smallmouth bass were obtained to obtain reliable age and growth estimates. Estimates obtained were 5.2, 8.2, 10.5, and 11.9 inches for age 1, 2, 3, and 4 fish, respectively (Table 4).

Creel survey data collected from 1980 through 1984 indicate that the stocked smallmouth bass contributed from 0.5 to 2.8% of the total number ($\bar{x}$ = 1.3%) and 0.6 to 2.0% of the total weight ($\bar{x}$ = 1.1%) of bass harvested (Tables 5 and 6). The best year for smallmouth bass harvest was 1980 when they made up 2.8% of the total number and 2.0% of the total weight of bass harvested. Although the 1985 creel survey has not been completed at the time of writing this report, an examination of the interview cards revealed that several smallmouth bass were harvested in 1985. In addition, several anglers stated that they had caught and released several smallmouth bass <11.0 inches. It is not known if the fish that were caught and released were smallmouth bass, but if they were, it would indicate that a small amount of natural reproduction could be occurring in the lake since no smallmouth bass have been stocked since 1981. This data, however, does not compare favorably with lakes having viable self-sustaining, smallmouth bass fisheries where smallmouth bass have accounted for 11-95% of the bass standing crop (lb) and 13-60% of the black bass harvested (lb) in recent years (Table 7). From this data, a successful stocking of smallmouth bass for establishing a self-sustaining fishery has been defined as a one where smallmouth represent about 10% of the black bass biomass and/or 10% of the bass yield.

Fish population data indicates a lack of reproductive success of the stocked smallmouth bass, since no young-of-year smallmouth bass have been collected after the stocking program ended in 1981 (Tables 2 and 3). As a result, the attempt at re-establishing a viable self-sustaining smallmouth bass fishery in Herrington Lake has evidently failed. The reason for the stocking failure and the elimination of a viable self-sustaining smallmouth bass fishery from Herrington Lake in the 1950's may be one and the same reason. The shad eradication may have hastened the demise of the smallmouth bass in Herrington Lake but was not totally or directly responsible for it. The main reason for the elimination of smallmouth bass from Herrington Lake in the 1950's was the gradual reduction and eventual elimination of coolwater habitat in the lake during the critical period of July-September as a result of eutrophication. The critical period refers to the time of thermal stratification when oxygen levels become depleted in the deeper cooler water located below the thermocline. The critical period usually extends from July through September and is usually most critical in September, just prior to when the lake destratifies. A discussion of the importance of this as it relates to smallmouth bass abundance and harvest will be covered in a forthcoming report. It is sufficient to state here that one of the factors found necessary for a lake to support a viable and sufficient smallmouth bass fishery in Kentucky is the presence of deep, oxygenated water at or near the field-observed preferred temperatures of 68.5-70.3 F (Ferguson 1958) during the critical months of July-September.

Dissolved oxygen-temperature profiles that were taken from 1948 through 1983, although somewhat limited, illustrate the gradual elimination of coolwater habitat from Herrington Lake during the critical period of July-September (Fig. 1). Data collected in 1948 at Gerrie's Cove, located in the lower one-third of the lake, showed oxygen levels greater than 4.0 mg/l to a depth of 27.7 feet. During that year, oxygen was available in deeper, cooler water thought to be necessary for smallmouth bass. In that year, smallmouth bass accounted for 5.3% of the total number and 4.5% of the total weight of bass collected in the cove studies. In 1957, the depth at which oxygen became less than 4.0 mg/l was 24.5 feet; in 1973 and 1983, the depth was 18.2 feet and 15.7 feet, respectively. During these years, oxygen was not available at the preferred field-observed temperatures for smallmouth bass during the critical time and, as the years went by, the available habitat became even more limited. From 1956 to 1977, only two smallmouth bass were collected prior to the beginning of the stocking program. Dissolved oxygen-temperature profiles collected in 1948, 1957, 1964, 1973, and 1983 show the elimination of coolwater habitat from Herrington lake, thus resulting in the loss of smallmouth bass.

Data collected by the U.S. Environmental Protection Agency in 1973 showed the lake to be eutrophic, with a yearly mean Carlson TSI value of 52 (Anderson and Miller 1984). Carlson TSI values for eutrophic lakes range from 51-69. In 1983, the yearly mean TSI value was 56 (Anderson and Miller 1984), showing that the lake was eutrophic from at least 1973 to the present. The trophic state of Herrington Lake prior to this is not known; however, the temperature-dissolved oxygen profiles taken in 1948 that showed oxygen levels at $\geq$4.0 mg/l to a depth of 27.7 feet during the critical period are not characteristic of a eutrophic lake. Of the 29 eutrophic lakes in Kentucky where water quality data was available (Anderson and Miller 1984), the depth at which oxygen became less than 4.0 mg/l was always less than about 16 feet during the most critical time. These data indicate that Herrington Lake in all liklihood was not eutrophic but mesotrophic or possibly slightly oligotrophic in 1948 when oxygen $\geq$4.0 mg/l was available down to nearly 28 feet.

In conclusion, the results of this study have shown that stocked smallmouth bass were not capable of providing a self-sustaining fishery in an eutrophic lake, even though some of the stocked fish did survive, grow, and contribute to the creel. It is felt that the loss of the once self-sustaining smallmouth bass fishery in Herrington Lake prior to 1955 resulted from eutrification and the eventual elimination of year-round coolwater habitat from the lake.

Even though this study shows that the attempt at re-establishing smallmouth bass was a failure, information gained as a result of this study have led to a better understanding of the habitat requirements of smallmouth bass as it confirms to what we now understand them to be. The information gained is being used to determine what lakes in Kentucky might be suitable for developing self-sustaining populations of smallmouth bass in the future. For example, at Cannon Creek Lake, where smallmouth bass were stocked for 3 years in 1982-1984, a good year class of smallmouth bass was produced through natural reproduction in 1985. Before stocking programs are initiated to re-establish or expand the range of a fish, detailed evaluations of habitat requirements of a species and available habitat in a body of water should be done before beginning a stocking program. With this kept in mind, we will greatly increase the chances of stocking success to establish a self-sustaining population.

ACKNOWLEDGEMENTS

Thanks go to Biologists Ted Crowell, Benjy Kinman, Jim Henley, and numerous other people responsible for assisting with data collecting. Thanks also go to Jim Axon who provided helpful suggestions and encouragement during the time I worked on this study in addition to editing the final report. Technicians Charlie Gorham, Shane Peck, Rip Rhorer, and Bill Mitchell also deserve thanks for their assistance with data collection and tabulation, as does secretary Karen Hukill for typing this report.

LITERATURE CITED

Anderson, T.P., and L.G. Miller. 1984. Trophic state and restoration assessments of Kentucky lakes. Kentucky Natural Resources and Environmental Protection Cabinet, Department of Environmental Protection, Division of Water, Frankfort, Kentucky, USA.

Charles, J.R. 1969. Reservoir discharge investigations. Kentucky Department of Fish and Wildlife Resources. D-J Project F-34-1, Job I-C, Project Progress Report, Frankfort, Kentucky, USA.

Edwards, E.A., G. Gebhart, and O.E. Maughan. 1983. Habitat suitability information: smallmouth bass. U.S. Department of the Interior, Fish and Wildlife Service, FWS/OBS-82/10.36.

Ferguson, R.G. 1958. The preferred temperature of fish and their midsummer distribution in temperate lakes and streams. Journal of the Fisheries Research Board of Canada 15(4)607-624.

Hubbs, C.L. , and R.M. Barley. 1938. The smallmouth bass. Cranbrook Inst. Science Bulletin Number 10.

Jenkins, R.M. 1975. Black bass crops and species associations in reservoirs. Pages 114-124 in H. Clepper, editor. Black bass biology and management. Sport Fishing Institute, Washington, D.C., USA.

Jenkins, R.M. 1976. Predictions of fish productions in Oklahoma reservoirs on the basis of environmental variables. Annual of the Oklahoma Academy of Science 1976(5)11-20.

Ricker, W.E. 1971. Methods of assessment of fish production in freshwaters. IBP Handbook Number 3, 2nd edition. Blackwell Scientific Publications, Oxford and Edinburgh, England.

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes in Canada. Fisheries Research Board of Canada Bulletin 184.

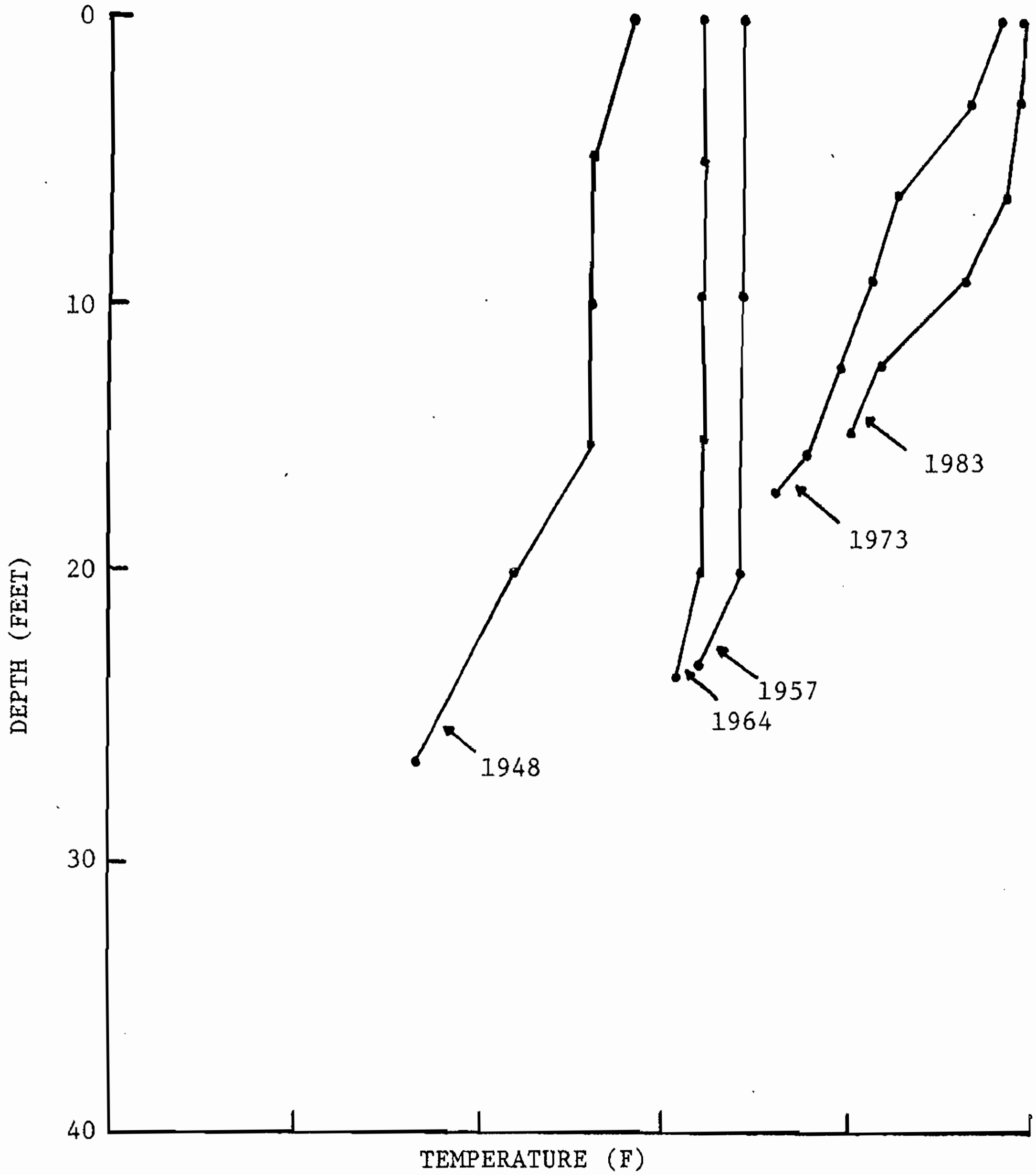

Figure 1. Temperature profiles; solid lines indicate temperature and depth at which oxygen levels fall below 4.0 mg/l for each year. Data collected on 20 September 1948, 10 September 1957, 14 September 1964, 30 August 1973, and 23 August 1983.

Table 1. Smallmouth bass stocking record at Herrington Lake.

Date	Number	Size (in)
1 Jun 1978	46,500 74,000	2 1.25
8 Jun 1979	92,356	1.25-2.50
6 Jun 1980	238,000	fry
29 Aug 1980	12,178	3.5
13 May 1981	98,300	fry

Table 2. Black bass standing crop as determined from cove-rotenone data collected from Herrington Lake from 1978 through 1985.

Year	Species	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total black bass	
		Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
1978	Largemouth	216	1.00	46	5.13	5	6.97	267	13.10	52.3	66.2
	Spotted	214	0.87	20	3.70	2	1.98	236	6.55	46.2	33.1
	Smallmouth	7	0.12	1	0.03			8	0.15	1.5	0.7
1979	Largemouth	101	0.80	39	6.64	2	2.90	142	10.33	75.5	81.6
	Spotted	34	0.34	11	1.58	t	0.22	45	2.13	23.9	16.8
	Smallmouth			1	0.20			1	0.20	0.6	0.6
1980	Largemouth	46	0.22	34	5.36	8	13.76	88	19.34	49.4	87.4
	Spotted	80	0.37	8	1.58	1	0.82	89	2.77	50.0	12.5
	Smallmouth	1	0.02					1	0.02	0.6	0.1
1981	Largemouth	198	1.40	49	11.96	5	9.69	252	23.05	54.7	74.6
	Spotted	177	0.96	27	5.04	1	1.43	205	7.43	44.5	24.1
	Smallmouth	2	0.02	2	0.19	t	0.19	4	0.40	0.9	1.3
1982	Largemouth	226	3.82	9	3.28	3	5.00	238	12.10	98.8	98.4
	Spotted	3	0.02	t	0.18			3	0.20	0.2	1.6
	Smallmouth									0.0	0.0
1983	Largemouth	72	0.46	26	5.24	8	10.10	106	15.80	91.4	89.8
	Spotted	2	0.02	8	1.61	t	0.16	10	1.79	8.6	10.2
	Smallmouth									0.0	0.0
1984	Largemouth	14	0.13	28	11.80	8	8.68	50	20.61	58.5	80.7
	Spotted	22	0.10	10	2.57	1	2.25	35	4.92	41.5	19.3
	Smallmouth									0.0	0.0
1985	Largemouth	627	2.60	16	4.91	8	12.48	651	19.99	87.5	92.8
	Spotted	86	0.40	7	1.15			93	1.55	12.5	7.2
	Smallmouth									0.0	0.0

t = $<$0.5 fish.

Table 3. Relative abundance of black bass collected by electrofishing in 0.75 hour of electrofishing in 1982, 3.2 hours in 1984, and 0.75 hour in 1985 at Herrington Lake.

Year	Species	Inch group																		Total no.	No./hour
		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
1982	Largemouth	2	6	2	3	3	3	3	8	5	4	8	1	3	2	3				56	74.7
	Spotted								1											1	1.3
	Smallmouth		1			3														4	5.3
1984	Largemouth	1	11	25	16	3	18	52	112	87	38	28	14	5	1	2	4	2	1	420	131.3
	Spotted			1	14	11	6	4	4	6	4	1								51	15.9
	Smallmouth																			0	0.0
1985	Largemouth	1		1	2			5	12	13	12	11	2	1		1				61	81.3
	Spotted							8	6		3									17	22.6
	Smallmouth																			0	0.0

Table 4. Mean back-calculated lengths (in) at each annulus for smallmouth bass collected from Herrington Lake, 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	14	4.07	7.87	5.42	0.30	4.77	6.08
2	8	6.65	11.00	8.19	0.49	7.04	9.34
3	5	8.49	12.20	10.51	0.61	8.93	12.09
4	4	10.20	13.20	11.95	0.67	10.07	13.82

Total number of fish used in the analysis was 15.
Intercept from the regression analysis was 2.208426.

Table 5. A summary of black bass harvest data (number of fish) collected during creel surveys conducted on Herrington Lake from 1980 through 1984.

Year	Total number of bass harvested	Largemouth bass		Spotted bass		Smallmouth bass	
		No. harvested	% total	No. harvested	% total	No. harvested	% total
1980	11,254	9,306	82.7	1,637	14.2	312	2.8
1981	15,422	13,893	90.1	1,423	9.2	105	0.7
1982	27,531	27,107	98.3	343	1.2	136	0.5
1983	20,689	20,128	97.3	223	1.1	338	1.6
1984	12,981	12,637	97.4	242	1.9	100	0.8

Table 6. A summary of black bass harvest data (pounds) collected during creel surveys conducted on Herrington Lake from 1980 through 1984.

Year	Total number of bass harvested	Largemouth bass		Spotted bass		Smallmouth bass	
		Lb. harvested	% total	Lb. harvested	% total	Lb. harvested	% total
1980	13,716	12,117	88.3	1,327	9.7	272	2.0
1981	17,953	16,690	93.0	1,155	6.4	108	0.6
1982	35,302	34,773	98.5	330	0.9	199	0.6
1983	23,020	22,402	97.3	239	1.1	378	1.6
1984	14,758	14,456	98.0	217	1.5	85	0.6

Table 7. Relative abundance of black bass in five lakes as determined from cove-rotenone data and their contribution to the creel.

Lake	% of standing crop (lb/a)			% of black bass (lb) harvested		
	Largemouth	Smallmouth	Spotted	Largemouth	Smallmouth	Spotted
Dale Hollow	43	41	16	31	60	9
Cumberland	54	11	35	73	14	13
Carr Fork	17	73	0	44	56	0
Green River	58	13	29	79	13	8
Herrington	84	<1	16	95	1	4