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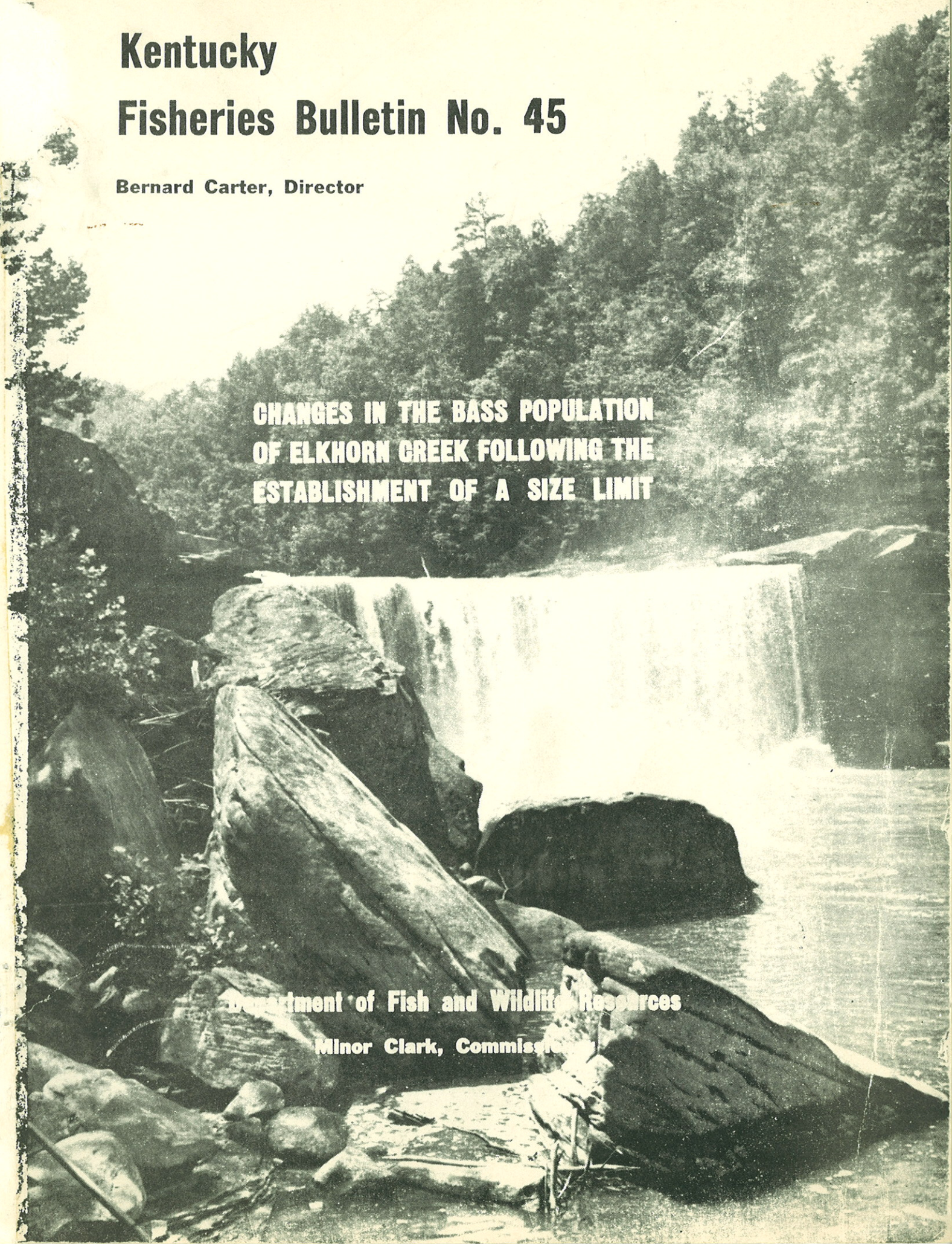

CHANGES IN THE BASS POPULATION OF ELKHORN CREEK FOLLOWING THE ESTABLISHMENT OF A SIZE LIMIT

Department of Fish and Wildlife Resources

Minor Clark, Commissioner

CHANGES IN THE BLACK BASS POPULATION OF ELKHORN CREEK FOLLOWING THE ESTABLISHMENT OF A SIZE LIMIT

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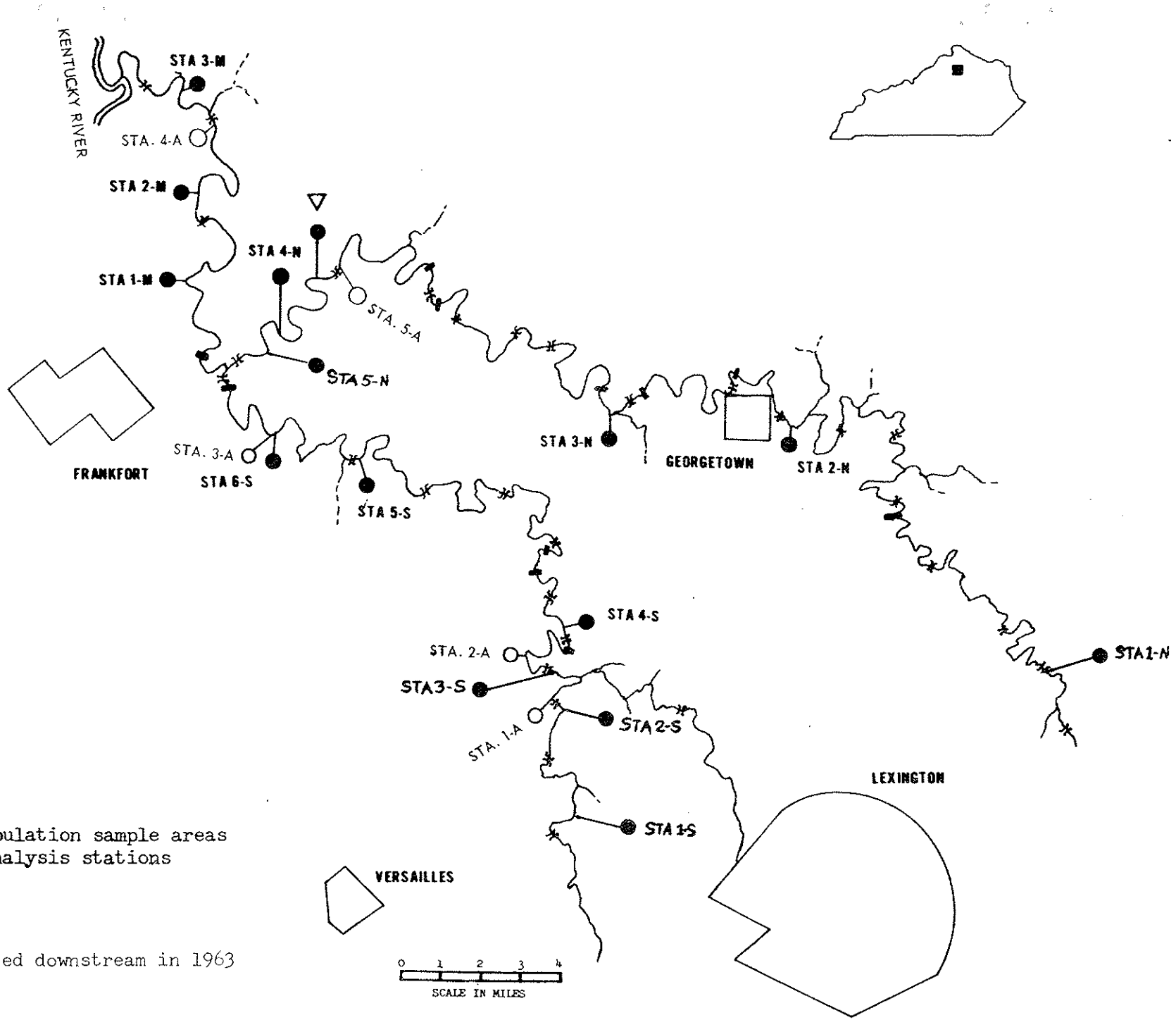

Figure 1. Map of Elkhorn Creek showing sampling stations and inset showing location in Kentucky.

ABSTRACT

Fish population studies conducted on the Main Stream and North Fork of Elkhorn Creek each year in the fall, from 1961 through 1965 revealed an increase in the black bass population (mainly smallmouth). The greatest increase was in the number of intermediate-sized bass; from 8.2 fish per acre in 1961 to 18.8 fish per acre in 1965. The number of harvestable-sized black bass increased in number from 2.1 fish per acre in 1961 to 5.7 fish per acre in 1965 while their mean weight decreased from approximately 1 pound to 0.5 pound. The fish population in the South Fork is affected by municipal sewage treatment effluent and has been erratic in both number of fish per acre and species composition throughout this study. There has been a continuous decrease in the fish population since 1962 except at the lowermost section of the stream, the farthest downstream from pollution. Here the intermediate-sized smallmouth bass population increased from 4 fish per acre in the fall of 1962 to 6 fish per acre in 1965, but the harvestable-sized smallmouth bass population decreased.

The fishing pressure on the Main Creek and North Fork decreased from 21,950 fisherman hours in 1960 to 19,131 fisherman hours in 1965. Fishing pressure on South Elkhorn, during 1960, was 846 fisherman hours. The average number of fish harvested per hour from the North Fork and Main Stream of Elkhorn Creek decreased from 0.86 in 1960 to 0.60 in 1965. The rate of harvest from South Elkhorn, in 1960, was 0.87 fish per hour.

Water quality studies at Station 2A, which is located closest to the source of pollution, generally revealed a lower dissolved oxygen concentration than at stations downstream. In 1962, the maximum concentration of oxygen, at Station 2A, was 2.5 ppm. Alkyl benzene sulphonate was considerably higher at Station 2A, where a maximum of 3.80 ppm was recorded on June 30, 1964. At Station 2A concentrations of ammonia nitrogen exceeded 3.50 ppm in 11 of 13 samples taken during 1962 and 1963. The total phosphates, at Station 2A, ranged from 14.80 ppm (recorded July 2, 1963) to less than 0.01 ppm in July of 1965 while at stations above the effluent total phosphates failed to exceed 3.20 ppm. The highest concentration of total alkalinity (255 ppm) was found at Station 3A in 1962. Each year the mean concentration of alkalinity was greatest at Station 2A. The pH varied little.

INTRODUCTION

Before and during the early fifties, Elkhorn Creek was known to central Kentucky anglers as an excellent smallmouth bass stream, however during the fifties fishermen complained about the large numbers of intermediate-sized bass which were being harvested. There were also complaints about the pollution problem on the South Fork of Elkhorn Creek and most of the local fishermen quit fishing on this section of the stream. It was a well known fact that the fishing intensity on the other sections (North Fork and Main Stream) was high.

With these factors in mind it was decided to establish an 11-inch size limit on black basses in Elkhorn Creek in 1960 and a project was initiated to investigate the existing fish population composition; to determine the fishing pressure and fisherman success; and to measure the results of the size limit in terms of changes in the fish population structure and fisherman success. Water quality studies were initiated in 1962, to determine the extent of pollution.

This study was under the leadership of James P. Carter from 1960 through 1964. The author became project leader in January 1965.

LOCATION DESCRIPTION

Headwaters of both North Elkhorn Creek and South Elkhorn Creek are in Fayette County, near Lexington, Kentucky. South Elkhorn flows northwestwardly for approximately 35 miles while North Elkhorn flows northwestwardly for approximately 45 miles and then takes a southwestwardly course for approximately 10 miles before joining the South Fork, at Forks of Elkhorn, Kentucky to form Elkhorn Creek. The stream continues to flow north and west for sixteen miles to join the Kentucky River 10 miles north of Frankfort. The average gradient of both North Elkhorn and South Elkhorn is four to five feet per mile while the gradient of the Main Stream is ten feet per mile.

Elkhorn Creek drains approximately 500 square miles of the inner Bluegrass region of Kentucky. The surface of this area is undulating to gently rolling and the fertile soils are derived from limestone of the Ordovician period.

There are hard surface roads that follow the course of a large part of this stream providing easy access.

I Fish Population Studies

Fish population studies were initiated in 1960 to investigate the fish population and to determine any change in the composition of the population, especially the black basses, of Elkhorn Creek.

The fish population at all stations were sampled with an electric shocker consisting of a Homelite 180 cycle, 230-volt, A.C. - D.C. generator which was mounted on an aluminum boat, and a 65-foot cable, from which electrodes were suspended. Two men operated the shocker, while from two to four additional men recovered stunned fish with dip nets. The number of netters at any given station remained constant throughout the study. Alternating current was used exclusively during sampling. An amperage regulator was especially useful when sampling water of different depths; that is, in deeper waters the amperage could be increased to maintain sampling efficiency and lowered in shallow water to avoid killing fish. All fish were held in portable live nets until they could be identified, measured, weighed and released. Mortality of fishes was considered low; however, occasionally some species of the minnow and sucker families did not recover. Small fishes, not identified in the field, were preserved in 10% formalin at the study site and later identified in the laboratory.

The fish population at three study areas on the Main Stream were sampled from 1960 through 1965. Three permanent stations were established on the North Fork in 1960, however only one Station (2N) was used for sampling from

1961 through 1965 while two other stations were not used for sampling in 1962 and were relocated for studies conducted from 1963 through 1965, Figure 1. The fish population at three stations (1S, 2S and 3S) on the South Fork were sampled in 1960 and/or 1961 but were not sampled from 1962 through 1965 while three other stations (4S, 5S and 6S) were used for sampling the fish population of South Elkhorn Creek from 1960 through 1965.

Fifty-six species of fish were collected during investigations from 1960 through 1965, Table 1.

In the fish population studies conducted from 1960 through 1963 commercial fishes comprised the majority of the total weight of fish taken, Tables 2-A and 2-B. Predatory fishes were taken only from the Main Stream while food fishes were taken from the Main Stream and on one occasion from the South Fork.

The standing crop of black bass as determined by electrofishing from 1960 through 1965 is presented in Tables 1-A through 3-G (Appendix).

Main Stream and North Elkhorn

The three fish sampling areas on the Main Stream encompassed 8.1 surface acres or 0.7 mile of stream while on North Elkhorn three sampling areas encompassed 10.3 surface acres along 1.1 miles of stream. One of these areas, Station 2N, was sampled from 1961 through 1965, while two other areas, Stations 3N and 4N, were sampled from 1963 through 1965.

Studies conducted in the fall on the Main Stream and North Fork of Elkhorn Creek revealed an increase of almost two pounds per acre in the black bass population from 1961, when 4.29 pounds per acre (10.9 fish) were taken to 1965, when 6.15 pounds per acre (24.7 fish) were taken, Table 3. This increase was represented by both the intermediate-sized and harvestable-sized basses. The primary increase was in the intermediate-sized basses, from 8.2 fish per acre in 1961 to 18.8 fish per acre in 1965 and a gain of almost 50%

Table 1. List of fishes collected from Elkhorn Creek from 1960 through 1965.

LEPISOSTEIDAE	
Lepisosteus osseus (Linnaeus)	Longnose gar
CLUPEIDAE	
Dorosoma cepedianum (LeSueur)	Gizzard shad
HIODONTIDAE	
Hiodon tergisus LeSueur	Mooneye
CYPRINIDAE	
Campostoma anomalum (Rafinesque)	Stoneroller
Cyprinus carpio Linnaeus	Carp
Hybopsis amblops (Rafinesque)	Bigeye chub
Hybopsis biguttata (Kirtland)	Hornyhead chub
Hybopsis micropogon (Cope)	River chub
Notropis ardens (Cope)	Rosefin shiner
Notropis atherinoides Rafinesque	Emerald shiner
Notropis cornutus (Mitchill)	Common shiner
Notropis photogenis (Cope)	Silver shiner
Notropis rubellus (Agassiz)	Rosyface shiner
Notropis spilopterus (Cope)	Spotfin shiner
Notropis volucellus (Cope)	Mimic shiner
Notropis whipplei (Girard)	Steelcolor shiner
Pimephales notatus (Rafinesque)	Bluntnose minnow
Rhinichthys atratulus (Hermann)	Blacknose dace
Semotilus atromaculatus (Mitchill)	Creek chub
CATOSTOMIDAE	
Carpiodes carpio (Rafinesque)	River carpsucker
Carpiodes velifer (Rafinesque)	Highfin carpsucker
Catostomus commersoni (Lacepede)	White sucker
Hypentelium nigricans (LeSueur)	Northern hog sucker
Ictiobus bubalus (Rafinesque)	Smallmouth buffalo
Ictiobus cyprinellus (Valenciennes)	Bigmouth buffalo
Moxostoma breviceps (Cope)	Shorthead redhorse
Moxostoma duquesnei (LeSueur)	Black redhorse
Moxostoma erythrurum (Rafinesque)	Golden redhorse
ICTALURIDAE	
Ictalurus melas (Rafinesque)	Black bullhead
Ictalurus natalis (LeSueur)	Yellow bullhead
Ictalurus punctatus (Rafinesque)	Channel catfish
Noturus flavus Rafinesque	Stonecat
Pylodictis olivaris (Rafinesque)	Flathead catfish
POECILIIDAE	
Gambusia affinis (Baird and Girard)	Mosquitofish
SERRANIDAE	
Roccus chrysops (Rafinesque)	White bass

Table 1. (continued)

CENTRARCHIDAE	
Ambloplites rupestris (Rafinesque)	Rock bass
Chaenobryttus gulosus (Cuvier)	Warmouth
Lepomis cyanellus Rafinesque	Green sunfish
Lepomis macrochirus Rafinesque	Bluegill
Lepomis megalotis (Rafinesque)	Longear sunfish
Lepomis microlophus (Gunther)	Redear sunfish
Lepomis sp. x sp.	Hybrid sunfish
Micropterus dolomieui Lacepede	Smallmouth bass
Micropterus punctulatus (Rafinesque)	Spotted bass
Micropterus salmoides (Lacepede)	Largemouth bass
Pomoxis nigromaculatus (LeSueur)	Black crappie
PERCIDAE	
Etheostoma blennioides Rafinesque	Greenside darter
Etheostoma flabellare Rafinesque	Fantail darter
Etheostoma nigrum Rafinesque	Johnny darter
Etheostoma spectabile (Agassiz)	Orangethroat darter
Percina caprodes (Rafinesque)	Logperch
Percina maculata (Girard)	Blackside darter
Stizostedion canadense (Smith)	Sauger
SCIAENIDAE	
Aplodinotus grunniens Rafinesque	Freshwater drum
COTTIDAE	
Cottus carolinae (Gill)	Banded sculpin
ATHERINIDAE	
Labidesthes sicculus (Cope)	Brook silverside

in weight, Table 2. The harvestable-sized basses also increased, from 2.1 fish per acre in 1961 to 5.7 fish per acre in 1965, while the mean weight of this size class decreased from approximately one pound to 0.5 pound during this period.

South Elkhorn

It has been obvious since the early fifties that the fish fauna of the South Fork has been affected by sewage pollution below Town Branch (effluents from a Lexington, Kentucky sewage treatment plant are discharged into this

Table 2-A. Major fish groups in Elkhorn Creek from 1961 through 1963.

Fish Group	1960				1961				1962				1963			
	No. per acre	% of number	Lbs. per acre	% of weight	No. per acre	% of number	Lbs. per acre	% of weight	No. per acre	% of number	Lbs. per acre	% of weight	No. per acre	% of number	Lbs. per acre	% of weight
Game Fishes	13.1	9.24	4.50	11.48	9.4	3.74	3.98	3.91	7.1	0.70	2.53	5.55	16.5	8.67	5.93	12.77
Food Fishes	3.7	2.61	0.50	1.28	0.3	0.13	0.31	0.30								
Predatory Fishes	0.4	0.28	0.23	0.59	0.5	0.20	0.18	0.17					0.3	0.16	0.23	0.50
Panfishes	23.7	16.73	2.49	6.35	22.5	8.98	2.77	2.72	23.6	23.16	2.96	6.50	38.6	20.29	4.84	10.42
Commercial Fishes	50.1	35.36	29.97	76.47	76.8	30.68	46.98	46.11	58.6	57.55	31.72	69.62	43.8	23.03	27.08	58.30
Forage Fishes	50.7	35.78	1.50	3.83	140.9	56.26	47.66	46.78	18.9	18.59	8.36	18.35	91.0	47.84	8.37	18.02
TOTAL	141.7	100.00	39.19	100.00	250.4	99.99	101.88	99.99	108.2	100.00	45.56	100.02	190.2	99.99	46.45	100.01

Table 2-B. Species in each fish group in Elkhorn Creek.

Game Fishes	- Smallmouth bass, Largemouth bass, Spotted bass, White bass and Sauger
Food Fishes	- Channel catfish and Flathead catfish
Predatory Fishes	- Mooneye and Longnose gar
Panfishes	- Rock bass, Longear sunfish, Bluegill, Green sunfish, warmouth, Redear sunfish and Hybrid sunfish
Commercial Fishes	- Redhorses, Hogsucker, Carpsuckers, White sucker, Buffalofishes, Carp and Bullheads
Forage Fishes	- Cyprinids, Darters, Brook silversides, Gizzard shad and Sculpin

Table 3. Total number and weight per acre of black bass found on North Elkhorn and Main Elkhorn Creek from 1961 through 1965.

Size Group	1961		1962		1963		1964		1965	
	17.21 acres or 1.86 miles		11.60 acres or 1.14 miles		18.41 acres or 1.76 miles		18.41 acres or 1.76 miles		18.41 acres or 1.76 miles	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Fingerling	0.6	0.01	2.4	0.06	2.9	0.12	5.7	0.16	0.2	0.01
Intermediate	8.2	2.22	5.6	1.65	20.6	4.34	22.7	4.65	18.8	3.44
Harvestable	2.1	2.06	1.8	1.80	3.5	4.60	5.4	4.49	5.7	2.66
TOTAL	10.9	4.29	9.8	3.51	27.0	9.06	33.8	9.01	24.7	6.15

tributary). There were a number of fish kills, on this section of the stream, during the fifties and early sixties while an inadequate primary sewage treatment plant was in operation, Figure 2. Conditions improved after secondary sewage treatment facilities became operational in April, 1963.

Fish population studies were initiated on the South Fork in 1960. However, after the first year of investigation it was evident that a size limit

study was not feasible on this section of the stream due to the effects of the pollution on the fish population.

Six sampling areas were used in determining the fish population in this stream. Stations 1S and 2S were located in the headwater section of the stream; station 2S was one mile above Town Branch. The other four stations were located below Town Branch. Station 3S was 0.5 mile and 4S was 5.5 miles below this tributary. Stations 5S and 6S were in the lowermost section of this stream. Stations 1S, 3S, 4S, 5S and 6S were used for sampling the fish population in 1960 while in 1961 Stations 2S, 3S, 4S, 5S and 6S were used. The fish population of South Elkhorn Creek was sampled at Stations 4S, 5S and 6S from 1962 through 1965. The latter three stations constituted 8.6 acres of water.

The fish fauna of the South Fork above Town Branch, which was sampled in 1960 and 1961, more closely resembled that of the lower section of this stream than the area immediately below Town Branch, Table 4.

During 1960 and 1961, a combined total of 15 fish were taken at Station 3S. All fish population samples taken since 1961 have consistently revealed a much smaller standing crop of fishes at Station 4S than at Stations 5S and 6S, which are located farther downstream. Since the inception of these investigations in 1960 the fish population at Station 4S has been erratic in both number of fish per acre and species composition. The largest number of fish (147 per acre) was collected in the 1960 study when the standing crop consisted of the following: golden redhorse, 58 per cent; bluegill, green sunfish and longear sunfish, 36 per cent; creek chub and common shiner, 4.5 per cent and largemouth bass, 0.5 per cent. In 1961, no fish were taken from this station. In 1965, white suckers constituted 70 per cent of the 13 fish per acre taken in the study and the remaining 30 per cent consisted of three carp, ten creek chub and one rosefin shiner. Panfish have been taken in five of the seven

Table 4. Total number per acre of each species of fish collected on South Elkhorn Creek during 1960 and 1961.

Species	Above Town Branch				Below Town Branch							
	Station 1-S		Station 2-S		Station 3-S		Station 4-S		Station 5-S		Station 6-S	
	1960	1961	1960	1961	1960	1961	1960	1961	1960	1961	1960	1961
Largemouth bass			2.7				0.4					
Smallmouth bass			0.7						2.7	0.4	2.6	6.8
Redear sunfish			4.0				0.4					0.9
Longear sunfish	66.0		11.0				30.4		6.9	7.3	8.3	13.1
Bluegill	14.0		4.0			2.1	56.0			2.0		4.0
Green sunfish			1.3				5.6					0.3
Hybrid sunfish			0.7									
Rock bass	14.0		12.0				0.4		3.1	7.3	1.4	10.8
White crappie										0.4		
Golden redhorse							38.8		8.8	5.0	7.7	
Black redhorse	14.0		5.4		3.6							13.7
Northern hogsucker									3.5	2.3		4.3
White sucker										4.6		7.8
Creek chub			20.7				0.8			0.8		
Bluntnose minnow						4.2						
Emerald shiner												0.6
Common shiner	104.0		150.1			6.4	12.8		30.8	40.4	15.1	22.0
Steelcolor shiner										3.1	1.7	
Hornyhead chub									4.6	16.2	2.3	8.6
Bigeye chub												6.6
Stoneroller						8.5				4.2		0.3
TOTAL	212.0		212.6		3.6	21.2	145.6		60.4	94.0	39.1	99.8

studies conducted since 1960. No game fish have been taken from this station since 1960 when one intermediate-sized largemouth bass was recovered.

There has been a continuous decrease in the extant fish population at Station 5S since 1962 when 584 fish per acre were recorded. In 1965, there were only 102 fish per acre taken here, a decrease of 166 fish per acre when compared with the 1964 study. This decrease included all but one of the species, the stoneroller, which increased from 16 fish per acre in 1964 to 30 fish per acre in 1965. Smallmouth bass, not present in 1964, were taken in 1965 for the first time since 1961.

The fish population studies at Station 6S revealed a steady increase in the standing crop of all species from 1960 (9.7 pounds per acre) to 1963 (52.1 pounds per acre). However, in 1964 the standing crop decreased to 25.7 pounds per acre showing a reduction in every species of fish with the exception of harvestable-size smallmouth bass, which increased from 0.9 fish per acre in the fall of 1963 to 1.7 fish per acre in 1964, Table 5. The 1965 fish population samples revealed a continuation of the decrease in the standing crop (11.6 pounds per acre) although there was an increase, when compared with the 1964 study, in the number of species represented. Intermediate-sized smallmouth bass increased from 3.7 fish per acre in the fall of 1962 to 5.9 fish per acre during the 1965 investigation while the harvestable-sized smallmouth bass population decreased from 3.1 fish per acre to 1.1 fish per acre. Fingerling-sized black basses were taken in only three of the seven studies conducted from 1960 through 1965.

The relative abundance of each species of fish collected during the South Fork investigations from 1960 through 1965 are presented in Tables 6A and 6B. The largest number of species were collected at Station 6S each year except during 1964 when a larger number of species was recorded at Station 5S.

Table 5. Total number and weight per acre of black bass found at Station 6S on South Elkhorn from 1960 through 1965.

Species	1960*		1961**		1962**		1963*		1963**		1964**		1965**	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Fingerling size														
Smallmouth					2.6	0.90	1.0	0.02			2.6	0.05		
Largemouth														
Spotted														
Total					2.6	0.90	1.0	0.02			2.6	0.05		
Intermediate size														
Smallmouth	2.6	1.70	3.7	1.26	0.9	0.04	6.0	0.39	8.6	1.67	3.1	0.58	5.9	0.91
Largemouth									0.6	0.04				
Spotted														
Total	2.6	1.70	3.7	1.26	0.9	0.04	6.0	0.39	9.2	1.71	3.1	0.58	5.9	0.91
Harvestable size														
Smallmouth			3.1	3.27	0.6	0.57	2.3	2.09	0.9	0.96	1.7	1.40	1.1	0.69
Largemouth														
Spotted														
Total			3.1	3.27	0.6	0.57	2.3	2.09	0.9	0.96	1.7	1.40	1.1	0.69
GRAND TOTAL	2.6	1.70	6.8	4.53	4.1	1.51	9.3	2.50	10.1	2.67	7.4	2.03	7.0	1.60

* Studies conducted in the spring.
** Studies conducted in the fall.

Table 6-A. Total number per acre of each species of fish collected on South Elkhorn Creek during 1960 and 1961.

Species	Station 1-S		Station 2-S		Station 3-S		Station 4-S		Station 5-S		Station 6-S	
	1960	1961*	1960*	1961	1960	1961	1960	1961	1960	1961	1960	1961
Largemouth bass				2.7				0.4		0.4		
Rock bass	14.0			12.0				0.4	3.1	7.3	1.4	10.8
Bluegill	14.0			4.0		2.1		56.0		2.0		4.0
Green sunfish				1.3				5.6				0.3
Longear sunfish	66.0			110.0				30.4	6.9	7.3	8.3	13.1
Redear sunfish				4.0				0.4				0.9
Golden redhorse								38.8	8.8		7.7	
Misc. cyprinids	358.0			170.7		25.5		15.6	35.4	64.6	19.1	18.4
Black redhorse				5.4	3.6					5.0		13.7
Smallmouth bass				1.4					2.7		2.6	6.8
Hogsucker									3.5	2.3		4.3
Hybrid sunfish				0.7								
White sucker										4.6		
White crappie										0.4		

* No studies were conducted.

Table 6-B. Total number per acre of each species of fish collected on the South Fork of Elkhorn Creek from 1962 through 1965.

Species	Station 4-S					Station 5-S					Station 6-S				
	1962[2]	1963[1]	1963[2]	1964[2]	1965[2]	1962[2]	1963[1]	1963[2]	1964[2]	1965[2]	1962[2]	1963[1]	1963[2]	1964[2]	1965[2]
Stoneroller		0.4		1.5		44.2	36.5	5.0	15.8	30.4	9.4	8.0	67.4		
Bigeye chub	0.4					21.5			1.9		5.4		27.1		
Hornyhead chub									2.3				0.3		0.3
River chub			2.0			97.3	41.9	15.0			29.7		23.7		
Golden shiner		0.8													
Rosefin shiner					0.4	12.3			5.0		3.7		15.1		2.6
Common shiner	0.8	1.6				303.8	264.6	250.4	181.2	24.6	107.4	109.1	156.8	80.6	54.9
Rosyface shiner						25.0			15.0	8.8	5.4		3.7		
Spotfin shiner	0.8								3.5	3.1			0.6		0.6
Mimic shiner						4.6					1.1		1.7		
Bluntnose minnow	5.2					8.8	15.8		15.4	13.5	16.6		8.8		31.4
Blacknose dace	0.4					0.4									
Creek chub	13.6		0.4	2.1	2.4	5.0	7.7	15.8	26.2	13.8	1.1	3.7	4.8		1.4
White sucker	0.8	30.0		27.6	9.2	0.8	13.5	26.1	4.2	3.9		18.3	46.6	41.9	17.4
Carp					1.2										
Northern hogsucker						1.9	1.5				11.1	5.7	5.1	0.6	
Black redhorse	6.4					17.3					26.5	2.8	3.1		
Golden redhorse						0.8	0.4		0.4		10.8	2.6	0.8	1.4	0.9
Yellow bullhead											1.4	0.3	0.3	0.6	
Black bullhead	0.8	0.4	0.4												
Channel catfish											0.3				
Mosquitofish	0.4														
Rock bass						8.8	11.2	7.7	1.5	0.8	15.4	14.8	21.4	13.4	4.6
Warmouth												0.3			
Green sunfish	4.0	12.0	1.6	0.4			1.2					0.6	2.3	0.3	
Bluegill		9.2		23.6		1.5	1.5	1.5	2.2		3.7	7.1	6.3	9.7	1.2
Longear sunfish	2.8	1.6				28.8	41.9	60.0	3.5	1.5	18.3	27.4	28.3	8.3	4.6
Redear sunfish	0.8														
Smallmouth bass										0.3	4.0	9.1	9.4	7.4	7.0
Largemouth bass													0.6		

Table 6-B. (continued)

Species	Station 4-S					Station 5-S					Station 6-S				
	1962[2]	1963[1]	1963[2]	1964[2]	1965[2]	1962[2]	1963[1]	1963[2]	1964[2]	1965[2]	1962[2]	1963[1]	1963[2]	1964[2]	1965[2]
Black crappie				0.4								0.6			
Fantail darter						0.8									
Greenside darter										1.?	1.7		1.7		
Banded sculpin						0.4					0.3				
TOTAL NUMBER PER ACRE	37.2	56.0	4.4	55.6	13.2	584.0	437.7	381.5	278.1	101.9	273.3	210.4	435.9	164.2	126.9

[1] Studies conducted in the spring
[2] Studies conducted in the fall

II Creel Survey

Creel surveys were conducted during 1960, 1961, 1962 and 1965 on the Main Stream and North Fork but due to the lack of fishing pressure on the South Fork the survey was discontinued on this section of the stream after 1960.

The primary purpose of the creel census is to detect changes in the quality of Elkhorn Creek fishing. Quality of fishing is measured in terms of the number of fish caught per man-hour of effort. The same measure can be applied to black basses or other groups or species to determine specific changes within the overall catch.

Creel survey data were collected in the field by conservation officers. Each officer drove a survey route and followed a survey schedule which was designed by the project leader. The starting times and days of the survey were systematically selected so as to obtain a stratified sample of fishermen for each hour of the day and each day of the week. The survey for each year from 1960 through 1962 was conducted on 56 days during the period from April 1 to October 31, whereas in 1965 the survey was conducted on 49 days. Projections for the total survey period (214 days) were made by employing the mean count method (Lambou, 1961).

The fishing pressure on the Main Stream and North Fork of Elkhorn Creek gradually decreased from 31,950 fisherman hours in 1960 to 23,000 fisherman hours in 1962. In 1965, there were 19,131 fisherman hours spent on these two sections of Elkhorn Creek. Fishing pressure on South Elkhorn during 1960 was 846 fisherman hours, Table 7.

During 1960, the average number and weight of fish harvested per hour on the North Fork and Main Stream of Elkhorn Creek, was 0.86 and 0.29 respectively while on South Elkhorn Creek the average number and weight of fish taken was 0.87 and 0.24 respectively. In 1965, the average number and weight of fish

taken from North and Main Elkhorn Creeks was 0.60 fish per hour and 0.13 pound of fish per hour.

In 1960, the total number of fish harvested per mile was 473 on the North Fork and Main Stream while from the South Fork only 22 fish per mile were taken. In 1965, the total number of fish harvested per mile from the North Fork and Main Stream was 171.

The number of black bass harvested per hour, from the North Fork and Main Stream, decreased from 0.05 in 1960 to 0.02 in 1965. The mean weight of black bass harvested from North and Main Elkhorn Creeks increased from 0.87 pound in 1960 to 1.12 pounds in 1961 then decreased to 1.02 pounds and 0.95 pound in 1962 and 1965, respectively.

Panfish, excluding rock bass, dominated the creel on the North Fork and Main Stream of Elkhorn Creek from 1960 (50.7%) through 1962 (69%) and in 1965 (61.9%), Table 8. Rock bass decreased from 27.6 per cent of the total number of fish taken by anglers in 1960 to 15.1 per cent in 1965. Black bass decreased from 6.6 per cent of the total number of fish taken in 1960 to 3.9 per cent in 1965.

III Water Quality

In order to determine the water quality of South Elkhorn Creek, three sampling stations were established in 1962 and two additional stations were sampled in 1963.

Water samples were taken one foot under the surface at midstream, with a Kemmerer sampler. Total alkalinity and pH determinations were made at the collection site, the former by titration with 0.02N sulfuric acid, with methyl orange as indicator; the latter colormetrically with a portable photo-electric Hach kit. Dissolved oxygen was measured by the modified Winkler method; these samples were chemically fixed in the field and titrations were made in the lab the same day of collection. Alkyl benzene sulphonate

Table 7. Fishing pressure, success and methods used on Elkhorn Creek in 1960, 1961, 1962 and 1965.

	Main Stream and North Fork of Elkhorn Creek				South Fork of Elkhorn Creek
	1960	1961	1962	1965	1960
Stream miles	67	67	67	67	33
Total fisherman hours	21,950	23,764	23,000	19,131	846
Average number fish harvested per hour	0.86	0.78	0.84	0.60	0.87
Average weight fish harvested per hour (lbs.)	0.29	0.33	0.20	0.13	0.24
Total number fish harvested per mile	473	307	332	171	22
Total weight fish harvested per mile	144	117	72	37	6
Percent of total number fishermen casting	9.3	8.4	12.4	8.4	20.8
Average number black bass harvested per hour	0.05	0.04	0.05	0.02	0.09
Mean weight of black bass harvested	0.87	1.12	1.02	0.95	1.81

Table 8. Percentage composition of anglers creel on North Fork and Main Stream of Elkhorn Creek for 1960, 1961, 1962 and 1965.

Species	1960		1961		1962		1965	
	% total number	% total weight	% total number	% total weight	% total number	% total weight	% total number	% total weight
Black bass	6.6	17.1	4.7	12.4	6.5	27.8	3.9	17.2
White bass	1.6	1.7					1.3	0.6
Crappie	2.2	2.2	2.3	1.8	1.6	1.5	4.6	4.6
Rock bass	27.6	39.7	23.7	18.7	11.1	8.3	15.1	12.1
Panfish	50.7	10.5	54.7	9.7	69.1	16.7	61.9	31.1
Catfish	3.6	7.2	3.2	3.6	5.2	12.7	8.4	11.5
Drum	3.0	5.7	1.5	1.3	2.3	6.8	0.9	3.5
Suckers	2.7	2.6	6.8	6.6	2.3	7.9	3.1	13.1
Carp	2.0	13.4	2.7	43.3	2.0	18.4	0.8	6.3
Buffalo			0.2	2.1				
Trout			0.2	0.5				
Total	100.0	100.1	100.0	100.0	100.1	100.1	100.0	100.0

(detergents), ammonia nitrogen and total phosphate determinations were made in the lab, the former two were made colormetrically with a portable photoelectric Hach kit and the latter spectrophotometrically.

Location of the five sampling stations are shown in Figure 1. Station 1A is located on the South Fork 0.5 mile above the mouth of Town Branch, the tributary stream which receives the effluents of the Lexington sewage treatment plant. Station 2A is located 11.0 miles below the mouth of Town Branch; Station 3A is located in the lowermost section of the South Fork, 41.3 miles below the effluent. Each of these stations on the South Fork were sampled from 1962 through 1965. Stations 4A (located on the Main Stream 56.8 miles below the mouth of Town Branch) and 5A (located on the North Fork 7.0 miles above the Forks of Elkhorn) were sampled in 1963, 1964, and 1965.

The water quality for three stations on Elkhorn Creek in 1962 and for five stations from 1963 through 1965 is presented in Tables 9A - 9D.

At Station 1A, the dissolved oxygen fluctuated from a minimum of 0.8 ppm in September of 1964, when the water was dark and extremely low, to a maximum of 7.8 ppm in June of both 1964 and 1965.

At Station 2A, no dissolved oxygen was recorded during the first four samples taken in 1962, and the maximum value (2.5 ppm) was recorded in October while at Station 3A the dissolved oxygen fluctuated from a minimum of 3.5 ppm in July to a maximum of 6.5 ppm in August. In 1965, the dissolved oxygen, at Station 2A, fluctuated from 2.2 ppm in June to 1.2 ppm in July while at the same time at Station 3A the dissolved oxygen was 5.2 ppm and 5.8 ppm. The concentrations of dissolved oxygen consistently increased downstream from Station 2A.

Concentrations of alkyl benzene sulphonate (detergents) were considerably lower above Town Branch than at and below Station 2A. The maximum at Station 1A (1.40 ppm) was recorded in August 1963 while at Station 5A a maximum of 0.80 ppm was recorded June 1, 1964. At Station 2A a maximum of 3.80 ppm was

Table 9-A. Water quality at three stations on Elkhorn Creek - 1962.

	June 21	July 12	July 24	Aug. 13	Sept. 6	Oct. 1	Oct. 15	Mean
ABOVE EFFLUENT								
Station 1-A								
Temperature (°F)	72	74	75	71	68	60	58	68
Dissolved oxygen (ppm)	4.0	3.7	3.4	4.7	5.3	5.8	5.7	4.7
ABS (detergent) (ppm)	0.17	0.03	0.03	0.01	0.04	0.03	0.05	0.05
Ammonia nitrogen (ppm)	tr.	0.48	tr.	0.02	tr.	0.25	0.03	0.11
Total phosphates (ppm)	1.90	1.60	1.80	1.20	1.80	0.71	0.61	1.37
Total alkalinity (ppm)	170	165	170	153	153	170	145	161
pH	8.1	7.9	8.0	7.5	7.4	7.9	8.0	7.8
BELOW EFFLUENT								
Station 2-A								
Temperature (°F)	72	74	75	73	69	60	58	69
Dissolved oxygen (ppm)	0.0	0.0	0.0	0.0	0.5	1.5	2.5	0.6
ABS (detergent) (ppm)	0.45	0.42	0.36	0.30	0.34	0.35	0.36	0.37
Ammonia nitrogen (ppm)	14.00	8.00	9.50	14.00	3.50	12.00	7.00	9.71
Total phosphates (ppm)	4.50	4.00	6.20	4.80	2.40	3.00	4.00	4.13
Total alkalinity (ppm)	204	200	208	238	146	195	205	199
pH	7.6	7.5	7.5	7.4	7.6	7.6	7.7	7.6
Station 3-A								
Temperature (°F)	72	74	75	73	70	62	58	69
Dissolved oxygen (ppm)	3.8	3.5	6.4	6.5	5.0	4.7	6.2	5.2
ABS (detergent) (ppm)	0.17	0.17	0.19	0.60	0.56	0.50	0.20	0.34
Ammonia nitrogen (ppm)	1.50	tr.	tr.	1.30	4.00	2.80	tr.	1.37
Total phosphates (ppm)	1.90	2.00	2.60	3.40	6.70	7.40	2.30	3.76
Total alkalinity (ppm)	187	175	170	189	171	170	255	188
pH	8.9	8.5	8.1	6.5	7.6	7.7	7.4	7.8

Table 9-B. Water quality at five stations on Elkhorn Creek - 1963.

	June 6	July 2	July 23	Aug. 14	Sept. 22	Nov. 12	Mean
ABOVE EFFLUENT							
Station 1-A							
Temperature (°F)	69	-	72	-	65	44	63
Dissolved oxygen (ppm)	3.7	2.4	5.3	5.7	3.0	7.4	4.6
ABS (detergent) (ppm)	-	0.50	0.02	1.40	-	-	0.64
Ammonia nitrogen (ppm)	0.50	0.45	0.10	0.50	0.10	0.01	0.28
Total phosphates (ppm)	1.60	2.20	1.60	-	0.21	2.90	1.70
Total alkalinity (ppm)	144	183	170	170	220	250	190
pH	7.9	7.7	7.8	7.8	7.8	8.4	7.9
Station 5-A							
Temperature (°F)	69	72	72	-	69	48	66
Dissolved oxygen (ppm)	3.5	3.8	4.7	-	3.6	5.8	4.3
ABS (detergent) (ppm)	-	0.04	0.12	0.03	-	-	0.06
Ammonia nitrogen (ppm)	0.10	0.50	0.50	0.50	0.30	0.03	0.32
Total phosphates (ppm)	0.92	1.40	1.80	0.79	0.20	0.92	1.01
Total alkalinity (ppm)	143	160	118	165	162	190	156
pH	7.8	8.1	7.7	7.9	8.5	7.7	8.0
BELOW EFFLUENT							
Station 2-A							
Temperature (°F)	69	-	72	-	71	48	65
Dissolved oxygen (ppm)	0.3	0.0	4.1	-	3.2	4.8	3.1
ABS (detergent) (ppm)	-	0.36	0.16	0.15	-	-	0.22
Ammonia nitrogen (ppm)	5.50	37.50	1.00	4.50	12.50	0.04	10.17
Total phosphates (ppm)	7.40	14.80	1.60	4.20	2.70	4.20	5.82
Total alkalinity (ppm)	167	237	187	120	230	221	194
pH	7.4	7.7	7.6	7.4	8.5	8.5	7.9
Station 3-A							
Temperature (°F)	69	72	72	-	64	48	65
Dissolved oxygen (ppm)	-	3.5	-	3.9	3.2	6.4	4.3
ABS (detergent) (ppm)	-	0.35	-	0.25	-	-	0.30
Ammonia nitrogen (ppm)	1.10	1.00	-	6.20	0.00	0.02	1.66
Total phosphates (ppm)	3.50	2.00	2.80	-	0.11	6.20	2.92
Total alkalinity (ppm)	165	182	161	177	175	-	172
pH	7.7	7.9	7.7	7.6	7.5	8.5	7.8
Station 4-A							
Temperature (°F)	69	72	72	-	72	48	67
Dissolved oxygen (ppm)	6.3	6.7	4.7	-	6.1	7.8	6.3
ABS (detergent) (ppm)	-	0.21	0.07	0.10	-	0.70	0.27
Ammonia nitrogen (ppm)	0.30	-	0.20	0.25	0.20	0.02	0.19
Total phosphates (ppm)	2.10	5.40	1.32	2.30	0.20	5.00	2.72
Total alkalinity (ppm)	145	155	148	170	182	174	162
pH	8.3	8.3	7.8	8.3	8.5	8.0	8.2

Table 9-C. Water quality at five stations on Elkhorn Creek - 1964.

	June 1	June 30	Aug. 30	Sept. 11	Mean
ABOVE EFFLUENT					
Station 1-A					
Temperature (°F)	59	72	78	73	71
Dissolved oxygen (ppm)	7.8	3.8	3.8	0.8	4.1
ABS (detergent) (ppm)	0.03	0.04	0.06	0.04	0.04
Ammonia nitrogen (ppm)	0.01	-	0.08	0.01	0.03
Total phosphates (ppm)	1.12	1.06	3.20	-	1.79
Total alkalinity (ppm)	133	180	197	250	190
Station 5-A					
Temperature (°F)	66	76	80	70	73
Dissolved oxygen (ppm)	8.8	9.8	6.6	6.0	7.8
ABS (detergent) (ppm)	0.80	0.09	0.06	0.06	0.25
Ammonia nitrogen (ppm)	0.25	-	0.20	0.01	0.15
Total phosphates (ppm)	0.71	0.87	0.53	-	0.70
Total alkalinity (ppm)	147	168	146	137	150
BELOW EFFLUENT					
Station 2-A					
Temperature (°F)	62	74	80	72	72
Dissolved oxygen (ppm)	2.0	2.2	4.6	2.2	2.8
ABS (detergent) (ppm)	3.60	3.80	N.D.*	0.45	2.62
Ammonia nitrogen (ppm)	0.20	-	0.10	12.50	4.26
Total phosphates (ppm)	6.20	N.D.*	5.25	-	5.73
Total alkalinity (ppm)	180	193	197	185	189
Station 3-A					
Temperature (°F)	62	74	80	71	72
Dissolved oxygen (ppm)	5.0	6.0	5.6	8.4	6.3
ABS (detergent) (ppm)	0.60	3.50	0.70	0.47	1.32
Ammonia nitrogen (ppm)	0.20	-	0.25	0.02	0.16
Total phosphates (ppm)	N.D.*	3.50	5.40	-	4.45
Total alkalinity (ppm)	175	155	149	132	153
Station 4-A					
Temperature (°F)	64	80	84	72	75
Dissolved oxygen (ppm)	10.0	8.0	6.6	4.2	7.2
ABS (detergent) (ppm)	0.80	3.03	0.22	0.28	1.08
Ammonia nitrogen (ppm)	0.20	-	0.30	0.01	0.17
Total phosphates (ppm)	4.50	2.90	2.50	-	3.30
Total alkalinity (ppm)	166	153	144	153	154

* Correct reading was not determined.

Table 9-D. Water quality at five stations on Elkhorn Creek - 1965.

	June	July	Mean
ABOVE EFFLUENT			
Station 1-A			
Temperature (°F)	66	67	67
Dissolved oxygen (ppm)	7.2	3.2	5.2
ABS (detergent) (ppm)	0.04	-**	0.04
Total phosphates (ppm)	0.03	0.01	0.02
Total alkalinity (ppm)	154	185	170
pH	7.1	7.5	7.3
Station 5-A			
Temperature (°F)	66	72	69
Dissolved oxygen (ppm)	7.8	2.6	5.2
ABS (detergent) (ppm)	0.06	-	0.06
Total phosphates (ppm)	0.28	0.00	0.14
Total alkalinity (ppm)	133	165	149
pH	7.3	7.3	7.3
BELOW EFFLUENT			
Station 2-A			
Temperature (°F)	66	72	69
Dissolved oxygen (ppm)	2.2	1.2	1.7
ABS (detergent) (ppm)	0.70	-	0.70
Total phosphates (ppm)	0.02	tr.	0.01
Total alkalinity (ppm)	194	180	187
pH	7.2	7.2	7.2
Station 3-A			
Temperature (°F)	66	68	67
Dissolved oxygen (ppm)	5.2	5.8	5.5
ABS (detergent) (ppm)	0.30	-	0.30
Total phosphates (ppm)	N.D.	0.51	0.51
Total alkalinity (ppm)	135	136	136
pH	7.2	7.3	7.2
Station 4-A			
Temperature (°F)	76	73	75
Dissolved oxygen (ppm)	9.2	4.4	6.8
ABS (detergent) (ppm)	0.01	-	0.01
Total phosphates (ppm)	0.66	0.01	0.34
Total alkalinity (ppm)	138	140	139
pH	7.2	7.3	7.3

* Located on North Fork not affected by effluent
** Was not analyzed

recorded on June 30, 1964 while the mean value for 1964 was 2.92 ppm. The minimum for this station (0.15 ppm) was recorded in August 1963. At other stations below Town Branch concentrations ranged from 3.50 ppm (recorded at Station 3A June 30, 1964) to 0.01 ppm recorded at Station 4A in June of 1965.

Concentrations of ammonia nitrogen at stations above the effluent failed to exceed 0.50 ppm while at Station 2A concentrations exceeded 3.50 ppm in 11 of 13 samples taken during 1962 and 1963. The maximum concentration (37.50 ppm) was taken at Station 2A July 2, 1963 while a minimum concentration of 0.04 ppm was recorded November 12, 1963. Once, in 1964, ammonia nitrogen at Station 2A, was recorded in amounts exceeding those considered lethal to fish, this being in September, when a maximum of 12.50 ppm was present. At Station 3A, concentrations ranged from 6.20 ppm (recorded in August 1963) to less than 0.01 ppm, while at Station 4A, the concentrations of ammonia nitrogen failed to exceed 0.30 ppm during 1963 and 1964.

Total phosphates, at Station 2A, ranged from 14.80 ppm (recorded July 2, 1963) to less than 0.01 ppm in July of 1965. At other stations below the effluent total phosphates ranged from 7.40 ppm, at Station 3A, in October 1962, to 0.01 ppm, at Station 4A, in July 1965. At stations above the effluent total phosphates failed to exceed 3.20 ppm.

The highest concentration of total alkalinity (255 ppm) was found at Station 3A in October 1962 while the lowest concentration of alkalinity (118 ppm) was found at Station 5A in July 1963. Each year the mean alkalinity was greatest at Station 2A.

The pH of Elkhorn Creek varied little. A maximum pH value of 8.9 was recorded at Station 3A in June 1962 while the minimum value of 7.1 was recorded at Station 1A in June 1965.

DISCUSSION

Fish population studies on the North Fork and Main Stream of Elkhorn Creek have revealed an increase in the black bass population during a five year period following a size limit regulation on these fishes.

There are other factors besides a size limit that may affect the changes in a fish population which we should consider. One of these factors is the number of brood fish available. The fish population studies revealed an increase in this size group. Other limiting factors include: temperature changes, stream flow conditions, predation and availability of food. The two latter conditions apparently changed little during the course of these studies.

Brown (1960) found in his studies on the Little Miami River that the variations in production of smallmouth bass fry was affected particularly by water temperature and stream flow.

We have no water temperature records of Elkhorn Creek during the years of the study. However, we do have stream flow records (U.S.G.S. - 1959 through 1964) which show a sudden increase in the rate of discharge occurred during the spawning season of 1961. The stream flow on Main Elkhorn Creek increased from approximately 500 cfs on the fifth of May to above 15,000 cfs on the eighth of May. It is interesting to note that the number of intermediate-sized black basses decreased in 1962 following this flood.

We do not know what part all of the factors mentioned, plus perhaps others, played in the increase of the black bass population of Elkhorn Creek. However, we do know there was an increase in this population during the five years immediately following the establishment of an 11-inch size limit.

During the course of these studies, the water quality of the South Fork continued to be affected by low dissolved oxygen, high concentrations of ABS alkyl benzene sulphonate (detergents), ammonia nitrogen and phosphates.

The South Fork waters are continuously affecting the water quality of the Main Stream. This affect was reflected by the excessive growth of filamentous algae noted by the investigator during the spring and summer and by the dark brown color of the water in the fall.

The waters of the North Fork are virtually unpolluted; however, the flow is being reduced, during the summer, by the withdrawal of water for irrigation by farmers along the course of the stream.

SUMMARY

In an attempt to improve the quality of bass fishing in Elkhorn Creek, an 11-inch size limit was established for the black basses in this stream in 1960. In 1960, studies were initiated to investigate the existing fish population composition and to measure the results of the size limit in terms of black bass population structure and fisherman success. In order to determine the extent of the pollution on the South Fork and compare the water quality to the unpolluted North Fork water quality studies were initiated in 1962.

The black bass population on the Main Stream and North Fork of Elkhorn Creek increased from 10.9 fish per acre in 1961 to 24.7 fish per acre in 1965. The greatest increase was in the intermediate-sized smallmouth bass. Harvestable-sized basses also increased in number while their mean weight decreased.

The water quality of the South Fork, which is characterized by low dissolved oxygen, high concentrations of ammonia nitrogen, alkyl benzene sulphonates (detergents) and phosphates, has drastically affected the fish fauna of this section of the stream. No smallmouth bass have been taken from Station 4S (5.5 miles below the tributary which received the effluent from a sewage disposal plant for the city of Lexington, Kentucky) since the inception of this project in 1960, while at the lowermost station a few smallmouth bass have been taken each year. The standing crop and total number of species generally increased downstream.

The fishing pressure on the Main Stream and North Fork of Elkhorn Creek decreased from 31,950 fisherman hours in 1960 to 19,131 fisherman hours in 1965. The rate of harvest decreased from 0.86 fish per hour in 1960 to 0.60 fish per hour in 1965. The average number of black bass harvested per hour decreased from 0.05 in 1960 to 0.02 in 1965, however the mean weight of the black bass taken increased from 0.87 pound in 1960 to 0.95 pound in 1965.

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Bernard T. Carter, Director of the Division of Fisheries, Department of Fish and Wildlife Resources, planned and directed the project throughout.

Conservation Officers Lewis Baker, George Roberts, Bruce Bemis and Norman Rodgers conducted the creel survey during this study.

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A P P E N D I X

Tables 1-A through 3-G

Table 1-A. Average black bass population of Main Elkhorn Creek - 1960.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	-	-	5-10	2.1	0.77	11	0.6	0.48
Smallmouth bass	0-4	-	-	5-10	15.3	2.04	11	2.6	3.25
TOTAL		-	-		17.4	2.81		3.2	3.73

Table 1-B. Average black bass population of Main Elkhorn Creek - 1961.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	-	-	5-10	0.1	0.08	11	0.1	0.15
Smallmouth bass	0-4	0.9	0.01	5-10	8.6	2.65	11	2.1	2.60
Spotted bass	0-4	-	-	5-10	1.2	0.37	11	0.5	0.39
TOTAL		0.9	0.01		9.9	3.10		2.7	3.14

Table 1-C. Average black bass population of Main Elkhorn Creek - 1962.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	0.1	+	5-10	0.9	0.25	11	0.3	0.23
Smallmouth bass	0-4	3.7	0.09	5-10	8.4	2.44	11	3.0	3.14
Spotted bass	0-4	-	-	5-10	0.1	0.01	11	-	-
TOTAL		3.8	0.09		9.4	2.70		3.3	3.37

Table 1-D. Average black bass population of Main Elkhorn Creek - 1963.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	0.1	+	5-10	0.6	0.19	11	0.7	0.75
Smallmouth bass	0-4	3.2	0.13	5-10	6.8	1.82	11	3.0	3.40
TOTAL		3.3	0.13		7.4	2.01		3.7	4.15

Table 1-E. Average black bass population of Main Elkhorn Creek - September, 1963.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	-	-	5-10	1.5	0.51	11	0.5	0.51
Smallmouth bass	0-4	3.2	0.07	5-10	25.2	5.06	11	1.7	2.11
Spotted bass	0-4	0.4	+	5-10	0.1	0.30	11	-	-
TOTAL		3.6	0.07		26.8	5.87		2.2	2.62

Table 1-F. Average black bass population of Main Elkhorn Creek - 1964.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	0.2	+	5-10	7.2	1.21	11	-	-
Smallmouth bass	0-4	5.1	0.22	5-10	24.8	6.04	11	4.2	3.32
Spotted bass	0-4	0.1	+	5-10	-	-	11	-	-
TOTAL		5.4	0.22		32.0	7.25		4.2	3.32

Table 1-G. Average black bass population of Main Elkhorn Creek - 1965.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	-	-	5-10	1.0	0.20	11	-	-
Smallmouth bass	0-4	0.1	+	5-10	11.4	1.87	11	2.4	1.83
Spotted bass	0-4	-	-	5-10	0.1	0.02	11	-	-
TOTAL		0.1	+		12.5	2.09		2.4	1.83

Table 2-A. Average black bass population of North Elkhorn Creek - 1960.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	-	-	5-10	1.1	0.27	11	-	-
Smallmouth bass	0-4	-	-	5-10	11.8	3.04	11	1.3	1.65
Spotted bass	0-4	-	-	5-10	0.8	0.31	11	-	-
TOTAL		-	-		13.7	3.62		1.3	1.65

Table 2-B. Average black bass population of North Elkhorn Creek - 1961.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	0.2	+	5-9	2.2	0.63	10	0.4	0.36
Smallmouth bass	0-4	0.9	0.02	5-9	6.1	1.48	10	1.2	1.18
TOTAL		1.1	0.02		8.3	2.11		1.6	1.54

Table 2-C. Average black bass population of North Elkhorn Creek, at Station 2-N, fall, 1962.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Smallmouth bass	0-4	1.1	0.02	5-10	1.7	0.60	11	0.3	0.22
TOTAL		1.1	0.02		1.7	0.60		0.3	0.22

Table 2-D. Average black bass population of North Elkhorn Creek - May, 1963.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	0.4	0.01	5-10	0.8	0.24	11	0.9	1.40
Smallmouth bass	0-4	1.5	0.03	5-10	7.4	3.57	11	3.9	3.85
TOTAL		1.9	0.04		8.2	3.81		4.8	5.25

Table 2-E. Average black bass population of North Elkhorn Creek - September, 1963.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	1.6	0.03	5-10	4.0	0.93	11	1.4	1.87
Smallmouth bass	0-4	3.6	0.08	4-10	14.5	3.10	11	2.3	3.02
TOTAL		5.2	0.11		18.5	4.03		3.7	4.89

Table 2-F. Average black bass population of North Elkhorn Creek - October, 1964.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	1.2	0.03	5-10	2.0	0.44	11	0.4	0.26
Smallmouth bass	0-4	3.7	0.08	5-10	14.3	2.93	11	4.4	3.26
Spotted bass	0-4	0.2	0.01	5-10	0.2	0.04	11	-	-
TOTAL		5.1	0.12		16.5	3.41		4.8	3.52

Table 2-G. Average black bass population of North Elkhorn Creek, fall, 1965.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	0.1	+	5-10	4.8	0.87	11	0.4	0.42
Smallmouth bass	0-4	0.1	+	5-10	14.5	3.70	11	1.6	1.30
Spotted bass	0-4	0.1	+	5-10	0.1	0.01	11	-	-
TOTAL		0.3	0.01		19.4	4.58		2.0	1.72

Table 3-A. Average black bass population of South Fork Elkhorn Creek - 1960.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	-	-	5-9	0.1	0.02	10	-	-
Smallmouth bass	0-4	-	-	5-9	1.2	0.79	10	0.4	0.38
TOTAL		-	-		1.3	0.81		0.4	0.38

Table 3-B. Average black bass population of South Fork Elkhorn Creek - 1961.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	-	-	5-9	0.4	0.05	10	-	-
Smallmouth bass	0-4	-	-	5-9	1.3	0.44	10	1.2	1.34
TOTAL		-	-		1.7	0.49		1.2	1.34

Table 3-C. Average black bass population of South Fork Elkhorn Creek, 1962.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Smallmouth bass	0-4	1.0	0.33	5-9	0.4	0.02	10	0.2	0.23
TOTAL		1.0	0.33		0.4	0.02		0.2	0.23

Table 3-D. Average black bass population of South Fork Elkhorn Creek - May, 1963.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Smallmouth bass	0-4	0.4	0.01	5-9	2.3	0.16	10	0.9	0.85
TOTAL		0.4	0.01		2.3	0.16		0.9	0.85

Table 3-E. Average black bass population of South Fork Elkhorn Creek - September, 1963.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Largemouth bass	0-4	-	-	5-10	0.2	0.01	11	-	-
Smallmouth bass	0-4	-	-	5-10	3.5	0.68	11	0.3	0.39
TOTAL		-	-		3.7	0.69		0.3	0.39

Table 3-F. Average black bass population of South Fork Elkhorn Creek - October, 1964.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Smallmouth bass	0-4	1.0	0.02	5-10	1.3	0.24	11	0.7	0.57
TOTAL		1.0	0.02		1.3	0.24		0.7	0.57

Table 3-G. Average black bass population of South Elkhorn Creek - 1965.

BLACK BASS	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE		
	Range	Number per acre	Pounds per acre	Range	Number per acre	Pounds per acre	Minimum inch group	Number per acre	Pounds per acre
Smallmouth bass	0-4	-	-	5-10	2.6	0.40	11	0.5	0.28
TOTAL		-	-		2.6	0.40		0.5	0.28