

## Job Completion Report

State of TEXAS

Project No. F-7-R-8

Name: Fisheries Investigations and Surveys  
of the Waters of Region 1-B.

Job No. E-2

Title: Experimental Control of Undesirable  
Fish Species in Lake Diversion.

Period covered:

January 1, 1960 - December 31, 1960

### OBJECTIVES

To determine the practical application and effectiveness of methods developed under Job E-1 (Experimental Control of Undesirable Fish Species). Specifically, objectives of the work covered by this report were to determine the effects of the selective-kill treatment during March, 1957.

### TECHNIQUES

Beginning nine months prior to the selective-kill treatment of Lake Diversion, monthly gill net and seine collections were made. Six netting stations were selected from different areas of the lake, ranging in depth from three to thirty feet. These stations were each netted with approximately 225 feet of gill net ranging in mesh size from one to three inches. All fish taken in these gill nets were weighed, measured, and sexed. Game fish stomachs were opened and inspected for food contents. Seine samples were collected with 20-foot minnow seines and were preserved for laboratory identification and counting. These techniques, which were established in 1956, have been standard throughout the extent of Job E-2.

### BACKGROUND INFORMATION

For background information concerning this report, readers are referred to the following job completion reports:

- F-7-R-4, Job E-2
- F-7-R-5, Jobs E-2 and E-1
- F-7-R-6, Job E-2
- F-7-R-7, Job E-2

The basic inventory and survey of Lake Diversion (June 1953 - May 1954) showed a fish population consisting of 73 percent rough fish. Thirty percent of the population was composed of gizzard shad alone. Freshwater drum, although constituting a small percentage of the gill net catch, were very abundant as evidenced by a rotenone check in a small bay in 1953. This ten acre bay was treated with enough rotenone to effect a total kill, and all fish killed were collected. Of the 4,136 fish killed, 2,601 or 63 percent were freshwater drum.

In July 1956, monthly net and seine collections were begun. Netting stations

were chosen and techniques were established from which comparative data could be collected before and after a selective rotenone kill. In March 1957, the lake was treated with 10,320 pounds of five percent rotenone powder which was distributed by a large unit mounted on a barge, and smaller boat-mounted unit. Immediately following the kill, shoreline counts and estimates of total numbers of fishes killed were made. An estimated minimum of 185 tons of rough fish, consisting mostly of shad and drum, were killed. Since game fish species constituted only a small percentage of the total number killed, the treatment was considered successful. Continued netting and seining since the treatment has shown that shad are capable of rapid increase following a rotenone treatment, and within two to three years, can increase to original numbers.

## FINDINGS

### Fish Collections

Ten gill net collections, made during this segment, produced a total of 1,153 fish. Monthly collections produced an average of 115 fish per trip, and ranged from 44 fish in February to 162 fish in September. During the hot months of July and August and the cold months of October, November, January and February, the catch was less than during the remaining months. Monthly totals of fish taken by gill nets are given in Table 1.

The catch of gizzard shad showed an unexpected decrease of 2.59 percent over last year. Longnose gar, shortnose gar, and carp also decreased, however smallmouth buffalo and river carpsucker increased slightly. The total percentage of rough fish was 81.97 percent, a decrease of 2.75 percent over last year.

Game fish, except for white crappie, all showed from slight to good increases, with white bass having the best gain (5.45 to 7.90 percent). Table 2 gives percentage composition, sex ratios, and average weights by sex.

Percentage composition by weight changed slightly during this segment. Longnose gar, smallmouth buffalo, and carp decreased while gizzard shad, river carpsucker, and freshwater drum increased slightly. Game fish all showed increases in percent of total weight. The total increase for all game fish combined was about four percent above last year's total.

Gizzard shad, redhorse shiners, bullhead minnows, mosquitofish, and bluegills were the five more abundant species taken by seine. Common in seine samples were river carpsuckers, plains shiners, sand shiners, Red River pupfish, Red River shiners, white bass, white crappie, and spotted sunfish. The 22 other species found in our samples were uncommon or rare, and none comprised more than one percent of the total number taken. Table 3 gives the number and percent of each species taken by seine. Table 4 is a checklist and gives the total number of fish taken by both gill nets and seines.

Very few diseased or abnormal fish were taken during this segment. An occasional channel catfish had small leeches around its mouth or fins. Except for white crappie, largemouth bass, and channel catfish being parasitized by body-cavity nematodes, only three other abnormal fish were caught. One longnose gar had no left eye. This fish's "K" factor was normal, so its handicap apparently did not

restrict its feeding. One gizzard shad had a portion of its caudal peduncle missing, and one river carpsucker had a deformed tail. Both of these fish also had normal "K" factors.

#### Food Habits

Food habits data from some of the game fish collected on Job B-15 were included in the compilation of the food habits chart included in this report (Table 5). Thirty different food items were noted, but only four were common. Gizzard shad, unidentifiable fish remains, mayfly nymphs, and grasshoppers were the items most often found. Channel catfish preyed mostly upon fish, mayfly nymphs and grasshoppers. Crayfish, fly larvae, plant material, and grain were also fairly common. Only one flathead catfish had food in its stomach; it had eaten a gizzard shad.

White bass preferred gizzard shad, mayfly nymphs, and unidentifiable fish. The stomach of one white bass examined contained a small rock, and nothing else. Both largemouth bass and white crappie fed mostly upon gizzard shad and other fish. Table 5 gives the food items of each species of game fish, the frequency of occurrence, and the total number identified, as well as the frequency of occurrence and total number identified of each food item from all game fish combined.

#### Coefficient of Condition

In general, "K" factors were very near the same as last year. Male freshwater drum, however, dropped sharply from 2.9 last year to 2.3 this year. The average "K" factor of female drum also dropped, but to a lesser extent (from 2.9 to 2.7). Considering males and females separately, there were nine decreases and seven increases in "K" factors, while ten remained the same as last year. Table 6 gives the distribution of "K" factors by sex for each species. Table 7 gives a comparison of "K" factors by sex from 1956 to 1960.

#### Sexual Development and Spawning Success

Seine samples indicated good spawns of gizzard shad, white bass, carp and river carpsucker. The number of small channel catfish taken in August indicates a fair spawn of this species. Shad began spawning in late May or early June, and by later June, 89.47 percent of the adult females taken had spawned. Buffalo, carpsucker, channel catfish, and white bass also began spawning in late May or early June, but crappie and carp spawned in July and August. Tremendous spawns of longnose gar occurred on the 25th and 27th of May, when hundreds of these fish deposited countless thousands of eggs along two stretches of rocky shoreline on the south side of the lake. It was interesting to note that smallmouth buffalo taken in the spawning area were found to have been feeding on the gar eggs.

All fish taken in gill nets were opened and the stage of gonadal development was recorded. Sub-adult fish were recorded as "UM" or "UF" (undeveloped males or undeveloped females). Fish in which the gonads contained immature eggs were classified as immature - "IM" or "IF". Fish ready to spawn were recorded as ripe - "RM" or "RF", and fish taken shortly after they had spawned were classed as spent - "SM" or "SF".

#### Physical Characteristics

Physical conditions recorded at the time of each collection included water and

air temperatures, wind speed and direction, and weather conditions. Surface water temperatures ranged from a low of 41 on February 26, to a high of 95 on July 27. Air temperatures ranged from 28 to 105 on the same dates. Water clarity at Lake Diversion varied with conditions. Following high winds, the lake was quite turbid, but it usually cleared up within two or three days after the wind subsided. Table 8 gives the physical conditions on collection dates.

## DISCUSSION

When Lake Diversion was treated, the use of rotenone powder as a selective fish toxicant was relatively new. Methods and machinery for the distribution of rotenone powder were not as efficient as they are at present. Bigger machines capable of mixing and dispensing 2000 pounds of powder per hour are now available, and these machines can easily be operated by a crew of three men. They are lightweight, portable, and allow a minimum of contact of crew with the powdered chemical. Efficient treating methods developed since 1957, have cut the cost of treating with powder, and have increased its effectiveness. When considering the results of the Lake Diversion kill, with thoughts of comparing cost with benefit gained, it must be kept in mind that new methods, less expensive chemical, and greater capacity of machines now in use would permit a better and more economical treatment than was accomplished at that time. It must also be remembered that there were two sources of contamination from which shad and drum could get back into the lake. The treatment of these sources would have prolonged the period of time it took shad and drum to increase to their original numbers.

The Lake Diversion job was primarily experimental, and was completed in order to determine relative changes in the fish population. The effect of the treatment on fishing success has not been studied. Creel censuses have never been made at Lake Diversion, and accurate data concerning changes in fishing success following the kill are not available. However, reports from cabin owners, concessionaires, and fishermen state that the fishing did improve after the rotenone treatment. These reports are in accordance with the data collected during the year following the kill. The removal of thousands of pounds of shad and drum (basic food items of game fish in Diversion) should naturally have made the game fish easier to catch. An unexpected benefit to fishermen was the apparent removal of mayfly nymphs by the rotenone. This left game fish without two of their three most important food items and forced them to spend more time searching for food. Thus, fishing was improved.

Since Job E-2 will be terminated this segment, and this will be the final report on this job, the following discussion will include a brief comparison of data collected during all of the five segments that this job has been in effect. For convenience the discussion will be divided under six headings.

### The Effect of the Selective Rotenone Kill on the Percentage Composition of the Fish Population

The relative abundance of gizzard shad prior to the treatment was 36.6 percent as determined from gill netting during the nine months before the treatment. During the segment following the treatment, the figure was down to 6.8 percent, or approximately an 80 percent reduction of the shad. The following year the shad increased to 22.52 percent, or up to about 60 percent of the original number. In 1959, they increased

an additional 9.12 percent or up to about 85 percent of the original number. In 1960, the percentage of shad dropped to 29.05 percent. Thus, it took about three years for shad to repopulate the lake.

Except for shad and drum, other rough fish were not greatly affected by the selective kill, and while their relative abundance increased, this was largely mathematical and not an actual increase in numbers. The same thing was true of game fish. Their relative abundance increased somewhat, but again this was mostly a mathematical increase rather than an actual increase in numbers. Table 9 gives percentage composition from 1956 to 1960. Table 10 gives the percentage composition by weight from 1956 to 1960.

#### The Effect of the Selective Rotenone Kill on the Physical Condition of the Fish Population

The greatest effect of the kill, other than changing the relative abundance of species, was the effect upon the physical condition of the fish. It would seem that with less food available following the kill, game fish would lose weight, but such was not the case. Following the kill the "K" factors of all species of game fish increased. Increases in "K" factors of white bass, largemouth bass, and crappie were exceptionally greater. Drum and shad which survived the kill also showed increases in "K". Less crowded conditions or changed food habits probably accounted for the increases. As "K" factors increased, average weights increased. Fish were bigger and in better condition and they remained this way until shad began to increase. There was an inverse relationship between "K" factors and average weights and the shad population. Tables 7, 9 and 11 clearly show this relationship. A large shad population is apparently not only detrimental to fishing, due to the abundance of food available, but also the physical condition of game fish.

#### The Recovery Capacity of Shad and the Changes in the Fish Population due to Reinfestation by Shad

Tremendous reproductive potential enables shad to spawn off thousands of fry each summer. Predation on shad is greatest during the period when young shad are schooling in shallow water, but many survive this period and grow large enough to prevent any but the larger predators from eating them. This is evidenced from the increase in shad from 1957 to 1958 when they increased from 7 to 23 percent of the population. Increases in shad during 1958 to 1960 raised the population to about 30 percent. At this point game fish were nearing the conditions, both in numbers and in physical condition that were prevalent before the treatment. The factors which control the shad population are not known, but something causes shad in Lake Diversion to "level off" at about 30 percent. Competition for food and space may be limiting factors. Predation may exert a measure of control on the shad population, however, predation alone cannot be too important, otherwise it would seem that a shad increase from 7 to 30 percent within three years would have been impossible. The sources of recontamination of Diversion (seven miles of river above the lake and 52 miles of main irrigation canal below the lake) probably contributed to this rapid increase of shad. It should be noted that after almost four years have passed since the treatment, and as shad have become abundant again, the game fish population is still in better condition than it was before the selective kill, and the benefits of the kill have not entirely diminished.

#### The Inaccuracy of Gill Netting in Determining the Relative Abundance of Freshwater Drum

Unfortunately, the inability of gill netting to show the relative abundance of drum has left a blank space in our data. Although an estimated 100 tons of drum were killed, the percentage of drum taken in gill nets following the kill did not drop appreciably. However, since not more than 1.50 percent drum were taken by nets during any segment before or after the treatment, gill netting is obviously totally unreliable for establishing the relative abundance of this species using the netting techniques employed on this job. It would have been interesting to compare the changes in the drum population following the treatment with changes in the population of other species, but this was not possible.

Due to special conditions occurring in the upper reaches of Lake Diversion last summer, large numbers of drum were taken on two Job B-15 gill net collections. On the basis of these two occasions, it is believed that drum are again abundant in Lake Diversion.

#### The Effect of the Selective Kill on Water Quality and Aquatic Organisms

Lake Diversion is ordinarily moderately clear, but the rotenone treatment resulted in increased clarity, especially in shallow areas. This "clearing up" of the water was a normal occurrence that usually follows with the removal of shad, drum, carp, and other bottom-feeding species. It is also possible that many zooplankters were killed which could have contributed to the increased water clarity. As previously stated, the rotenone affected the bottom fauna. Mayfly nymphs were apparently greatly reduced, and bottom sampling would probably have shown that other bottom organisms such as damselfly larvae, dragonfly larvae, and chironomid larvae were also affected.

#### The Length of Time that the Benefits of the Rotenone Treatment Lasted

The extent that fishing was improved by the selective kill, and how long good fishing continued cannot be accurately stated because a creel census was not made, however, fishing did improve for a while. Continued good fishing could probably be attained only by repeated treatments at intervals of two or three years depending on conditions. This would periodically eliminate most of the young shad, and create more space for game fish. Treatment of lakes as early in the fall as conditions would permit should give the best results, because the small shad spawned during the previous summer which are the only shad small enough to be eaten by the average sized game fish, and the ones most susceptible to the effects of rotenone would be eliminated. Assuming that a kill could be done in October, it would remove small shad for a period of at least seven months, or until surviving shad spawned during the next summer. Spring treatment, on the other hand, would eliminate small shad for a period of only three to four months (from the treatment date until about June), and after June, shad would again be present as an abundant source of food for game species.

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Table 1. Monthly gill net collections, Lake Diversion, 1960

Species	January		February		March		April		May		June	
	Fish	Percent of total	Fish	Percent of total	Fish	Percent of total	Fish	Percent of total	Fish	Percent of total	Fish	Percent of total
Longnose gar	0	0	0	0	1	0.70	4	2.75	No collection made during this month.	5	3.12	
Shortnose gar	0	0	0	0	0	0	1	0.69		3	1.88	
Gizzard shad	18	21.42	12	27.27	39	27.46	34	23.45		65	40.62	
Smallmouth buffalo	11	13.10	6	13.63	43	30.29	29	20.00		36	22.50	
Bigmouth buffalo	0	0	0	0	1	0.70	0	0		1	0.63	
River carpsucker	26	30.95	13	29.55	25	17.61	52	35.86		21	13.12	
Channel catfish	2	2.38	2	4.55	4	2.82	1	0.69		5	3.12	
Black bullhead	0	0	0	0	0	0	0	0		0	0	
Flathead catfish	0	0	0	0	0	0	4	2.76		1	0.63	
White bass	18	21.43	9	20.45	11	7.74	3	2.07		5	3.12	
Largemouth bass	3	3.57	0	0	0	0	0	0		1	0.63	
White crappie	2	2.39	0	0	5	3.53	5	3.45		12	7.50	
Freshwater drum	0	0	2	4.55	0	0	1	0.69		0	0	
Carp	4	4.76	0	0	13	9.15	11	7.59	5	3.13		
Totals	84	100.00	44	100.00	142	100.00	145	100.00		160	100.00	

Species	July		August		September		October		November		Totals	
	Fish	Percent of total	Fish	Percent of total	Fish	Percent of total	Fish	Percent of total	Fish	Percent of total	Fish	Percent of total
Longnose gar	3	2.41	6	5.94	0	0	1	0.98	0	0	20	1.73
Shortnose gar	1	0.81	1	0.99	0	0	0	0	0	0	6	0.52
Gizzard shad	41	33.07	20	19.80	45	27.77	36	35.29	25	28.08	335	29.05
Smallmouth buffalo	20	16.12	29	28.71	40	24.69	15	14.71	27	30.34	256	22.21
Bigmouth buffalo	0	0	0	0	0	0	1	0.98	2	2.25	5	0.43
River carpsucker	22	17.75	18	17.82	43	26.55	17	16.66	18	20.22	255	22.12
Channel catfish	3	2.42	5	4.95	6	3.71	1	0.98	1	1.12	30	2.60
Black bullhead	0	0	0	0	0	0	1	0.98	0	0	1	0.09
Flathead catfish	0	0	0	0	2	1.23	0	0	0	0	7	0.60
White bass	9	7.26	12	11.88	9	5.56	8	7.85	7	7.87	91	7.90
Largemouth bass	1	0.80	0	0	2	1.23	1	0.98	0	0	8	0.69
White crappie	13	10.49	7	6.94	9	5.56	12	11.76	7	7.87	72	6.24
Freshwater drum	3	2.42	0	0	1	0.62	5	4.91	0	0	12	1.05
Carp	8	6.45	3	2.97	5	3.08	4	3.92	2	2.25	25	2.21
Totals	124	100.00	101	100.00	162	100.00	102	100.00	89	100.00	1153	100.00

Table 2. Results of gill netting, Lake Diversion, 1960.

Species	Fish collected		Weights of fish collected			Males				Females			
	Number	Percent of total	Weights in pounds	Percent of total weight	Mean weight (pounds)	Numbers		Weights		Numbers		Weights	
						Fish	Percent males	Pounds	Average in pounds	Fish	Percent females	Pounds	Average in pounds
Longnose gar	20	1.73	104.08	5.59	5.20	10	50.00	48.81	4.88	10	50.00	55.27	5.53
Shortnose gar	6	0.52	12.18	0.65	2.03	1	16.67	2.31	2.31	5	83.33	9.87	1.98
Gizzard shad	335	29.05	226.92	12.20	0.68	141	42.09	82.01	0.58	194	57.91	144.91	0.74
Smallmouth buffalo	256	22.21	698.37	37.53	2.73	130	50.78	330.64	2.54	126	49.22	367.73	2.92
Bigmouth buffalo	5	0.43	23.12	1.24	4.63	3	60.00	13.92	4.64	2	40.00	9.20	4.60
River carpsucker	255	22.12	370.91	19.94	1.45	128	50.20	179.19	1.40	127	49.80	191.72	1.51
Carp	55	4.71	172.97	9.29	3.14	25	45.45	56.05	2.24	30	54.55	116.92	3.90
Channel catfish	30	2.60	72.28	3.89	2.41	17	56.67	41.76	2.46	13	43.33	30.52	2.35
Black bullhead	1	0.09	1.43	0.07	1.43	1	100.00	1.43	1.43	-	-	-	-
Flathead catfish	7	0.60	32.04	1.73	4.58	3	42.86	17.24	5.75	4	57.14	14.80	3.70
White bass	91	7.90	68.98	3.70	0.76	38	41.76	24.41	0.64	53	58.24	44.57	0.84
Largemouth bass	8	0.69	14.00	0.76	1.75	3	37.50	2.64	0.88	5	62.50	11.36	2.27
White crappie	72	6.24	37.81	2.03	0.53	18	25.00	8.13	0.45	54	75.00	29.68	0.55
Freshwater drum	12	1.05	25.63	1.38	2.14	5	41.67	2.71	0.54	7	58.33	22.92	3.27
Totals	1153	100.00	1860.72	100.00		523		811.25		630		1049.47	

Table 3. Results of seining, Lake Diversion, 1960.

Species	Number seined	Percent of total
Shortnose gar	3	.01
Longnose gar	2	.01
Gizzard shad	5,727	30.51
Smallmouth buffalo	55	.29
River carpsucker	254	1.35
Carp	12	.07
Golden shiner	3	.01
Suckermouth minnow	109	.58
Plains shiner	209	1.12
Sharpnose shiner	110	.58
Red River shiner	189	1.01
Arkansas River shiner	56	.30
Redhorse shiner	3,488	18.58
Sand shiner	258	1.38
Mimic shiner	42	.23
Ghost shiner	7	.04
Silvery minnow	1	.01
Plains minnow	51	.28
Bullhead minnow	1,813	9.66
Channel catfish	42	.22
Black bullhead	30	.16
Plains killifish	10	.05
Red River pupfish	244	1.30
Mosquito fish	2,591	13.81
White bass	494	2.63
Black bass	95	.51
Green sunfish	23	.12
Spotted sunfish	471	2.51
Redear sunfish	91	.48
Bluegill sunfish	1,614	8.60
Orangespotted sunfish	166	.89
Longear sunfish	33	.17
White crappie	222	1.19
Logperch	89	.47
Freshwater drum	164	.87
Totals	18,768	100.00

Table 4. A checklist and total number of fishes taken by gill nets and seines from January 1, 1960 - December 31, 1960

Common name	Scientific Name	Number
Shortnose gar	<u>Lepisosteus platostomus</u>	9
Longnose gar	<u>L. osseus</u>	22
Gizzard shad	<u>Dorosoma cepedianum</u>	6,062
Bigmouth buffalo	<u>Ictiobus cyprinellus</u>	5
Smallmouth buffalo	<u>I. bubalus</u>	311
River carpsucker	<u>Carpiodes carpio</u>	509
Carp	<u>Cyprinus carpio</u>	67
Golden shiner	<u>Notemigonus crysoleucas</u>	3
Suckermouth minnow	<u>Phenacobius mirabilis</u>	109
Plains shiner	<u>Notropis percobromus</u>	209
Sharpnose shiner	<u>N. oxyrhynchus</u>	110
Red River shiner	<u>N. bairdi</u>	189
Arkansas River shiner	<u>N. girardi</u>	56
Redhorse shiner	<u>N. lutrensis</u>	3,488
Sand shiner	<u>N. stramineus</u>	258
Mimic shiner	<u>N. volucellus</u>	42
Ghost shiner	<u>N. buchanani</u>	7
Silvery minnow	<u>Hybognathus nuchalis</u>	1
Plains minnow	<u>H. placita</u>	51
Bullhead minnow	<u>Pimephales vigilax</u>	1,813
Channel catfish	<u>Ictalurus punctatus</u>	72
Black bullhead	<u>I. melas</u>	31
Flathead catfish	<u>Pylodictus olivaris</u>	7
Plains killifish	<u>Fundulus kansae</u>	10
Red River pupfish	<u>Cyprinodon rubrofluviatilis</u>	244
Mosquito fish	<u>Gambusia affinis</u>	2,591
White bass	<u>Roccus chrysops</u>	585
Largemouth bass	<u>Micropterus salmoides</u>	103
Green sunfish	<u>Lepomis cyanellus</u>	23
Spotted sunfish	<u>L. punctatus</u>	471
Redear sunfish	<u>L. microlophus</u>	91
Bluegill sunfish	<u>L. macrochirus</u>	1,614
Orangespotted sunfish	<u>L. humilis</u>	166
Longear sunfish	<u>L. megalotis</u>	33
White crappie	<u>Pomoxis annularis</u>	294
Logperch	<u>Percina caprodes</u>	89
Freshwater drum	<u>Aplodinotus grunniens</u>	176
Totals		19,921

Table 5. Food of game fish, Lake Diversion, 1960

Food item	Game fish species										Total Frequency of occurrence
	Channel catfish		Flathead catfish		White bass		Largemouth bass		White crappie		
	Frequency of occurrence	Number iden- tified									
Gizzard shad	1	1	1	1	23	64	2	3	33	49	60
Sunfish					2	2			1	1	3
Minnows					1	3					1
Freshwater drum					1	1	1	2			2
Fish remains	12	-			9	-	2	-	24	-	47
Mayflies					2	63			1	6	3
Mayfly nymphs	12	241			11	174			3	95	26
Dragon fly larvae	2	4					1	1			3
Diptera larvae	5	910									5
Other insect larvae									4	-	4
Flys					2	2					2
Dragon flies					1	1					1
Beetles	1	4			1	1					2
Grasshoppers	15	24			3	16					18
Small hymenopterans	2	500			1	500					3
Field crickets	1	1									1
Cicada	1	1									1
Hemipterans	1	1									1
Other insects					1	1					1
Grass shrimp	1	1			2	59	1	1			4
Plant material	4	-							1	-	5
Freshwater mussels	2	2									2
Snails	1	1									1
Crawfish	4	12									4
Bird remains	3	3									3
Small grain	4	-									4
Otolith Bone of Drum									1	1	1
Rock					1	1					1
Bristle worms	1	2									1
Algae	1	-									1

Table 6. Distribution of "K" factors of fishes taken from Lake Diversion, January 1, 1960 - December 31, 1960.

Species	"K" Factor Frequencies																								Average "K" factors																					
	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6		2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1						
Longnose gar																																														
males	4	5	0	1																								.4																		
females	3	7	0	0																								.4																		
Shortnose gar																																														
males	1	0	0																								.4																			
females	0	4	1																								.5																			
Gizzard shad																																														
males												1	0	2	8	17	35	37	26	5	1	4	1	2	0	1	0	0	0											2.0						
females												1	0	3	16	28	48	42	24	15	7	3	5	1	1	0	0	0	0											2.0						
Smallmouth buffalo																																														
males																		0	1	0	5	14	17	17	24	25	16	5	1	1	2	0	1	0											3.2	
females																		1	2	2	7	9	17	23	15	21	11	7	7	1	3	0	0	0	0											3.2
Big mouth buffalo																																														
males																									2	0	1											3.5								
females																									1	1	0											3.5								
River carpsucker																																														
males																		4									2.7																			
females																		0	4	9	12	18	29	20	12	10	6	3	1											2.8						
Carp																																														
males																		0	0	2	1	6	6	2	1	4	0	1	0	2	0	0											2.7			
females																		1	1	1	1	3	2	3	6	4	2	0	4	1	1	0											2.8			
Channel catfish																																														
males												1	1	2	5	3	2	0	2	1	0														1.7											
females												0	0	2	4	3	2	0	0	0	1														1.7											
Flathead catfish																																														
males																2	0	0	0	0	1														1.9											
females																0	0	3	0	0	1														2.0											
Black bullhead																																														
males																									1											2.9										
females																									0											-										
White bass																																														
males																		0	0	0	0	2	6	7	8	4	4	2	2	2	0	0	0											2.7		
females																		0	0	0	1	5	6	5	9	8	8	4	5	1	0	0	1											2.8		
Largemouth bass																																														
males																		0	2	0	1	0	0	0	0	0	0	0											2.5							
females																		1	0	2	0	0	1	0	0	0	0	0	1											2.7						
White crappie																																														
males																		0	0	0	2	2	1	4	1	2	3	1	0	1	1	0											2.7			
females																		1	0	1	2	3	6	5	6	10	6	9	1	2	1	1											2.8			
Freshwater drum																																														
males												1	0	0	0	0	0	0	1	3	0	0	0														2.3									
females												0	0	0	0	0	0	0	0	1	3	1	2														2.7									



Table 7. Comparison of average "K" factors of fish taken from Lake Diversion, 1956 - 1960.

Species	1956	1957	1958	1959	1960
Longnose gar					
male	.4	.4	.4	.4	.4
female	.4	.4	.4	.4	.4
Shortnose gar					
male	.5	-	.5	.5	.4
female	.6	.6	.5	.5	.5
Gizzard shad					
male	1.9	2.2	2.1	1.9	2.0
female	1.9	2.3	2.2	2.1	2.0
Bigmouth buffalo					
male	-	-	3.5	3.4	3.5
female	-	-	3.4	3.4	3.5
Smallmouth buffalo					
male	3.1	3.2	3.2	3.2	3.2
female	3.1	3.2	3.2	3.2	3.2
Carp sucker					
male	2.6	2.7	2.7	2.8	2.7
female	2.7	2.7	2.8	2.8	2.8
Carp					
male	2.5	2.6	2.8	2.8	2.7
female	2.6	2.7	2.8	2.8	2.8
Channel catfish					
male	1.7	1.8	1.7	1.8	1.7
female	1.6	1.8	1.7	1.7	1.7
Flathead catfish					
male	-	-	-	1.7	1.9
female	1.5	1.8	1.7	2.2	2.0
Bullhead catfish					
male	-	-	-	-	2.9
female	-	-	-	-	-
White bass					
male	2.4	3.0	2.8	2.6	2.7
female	2.6	3.0	2.7	2.7	2.8
Largemouth bass					
male	2.4	2.7	2.5	-	2.5
female	2.4	2.7	2.7	2.4	2.7
White crappie					
male	2.5	3.0	2.9	2.8	2.7
female	2.5	2.9	2.8	2.8	2.8
Freshwater drum					
male	2.2	2.8	2.9	2.9	2.3
female	2.2	2.9	3.0	2.9	2.7

Table 8. Lake Diversion water and weather conditions on 1960 fish collection dates.

Date	Temperatures (°F)		Wind and weather		
	Water	Air	Direction	Velocity (mph)	Sky
January 28	42	45	SE	12	Cloudy
February 26	41	28	NE	7	Cloudy
March 24	56	45	NE	15	Cloudy
April 27	68	57	NE	3	Partly cloudy
June 29	71	86	SW	12-15	Clear
July 27	95	75-105	-	Calm	Clear
August 24	86	78	S	9	Clear
September 28	72	68- 84	-	Calm	Clear
October 27	70	50- 70	SW	6	Cloudy
November 30	55	51		Calm	Clear

Table 9. Comparison of percentage compositions of net catches, 1956 - 1960.

Species	1956	1957	1958	1959	1960
Longnose gar	2.9	6.6	4.92	4.62	1.73
Shortnose gar	0.3	0.3	.80	1.18	.52
Gizzard shad	36.6	6.8	22.52	31.64	29.05
Smallmouth buffalo	13.6	26.6	21.07	19.78	22.21
Bigmouth buffalo	0.0	0.0	0.15	0.36	.43
Carp	28.6	36.1	25.78	19.55	22.12
Carp	2.4	2.6	4.63	6.40	4.77
Channel catfish*	3.0	5.5	5.14	2.25	2.60
Black bullheads	0.0	0.2	0.00	0.00	.09
Flathead catfish*	0.2	0.2	0.51	0.35	.60
White bass*	5.9	7.1	8.76	5.45	7.90
Largemouth bass*	0.5	1.0	1.23	0.24	.69
White crappie*	5.3	6.4	3.99	6.99	6.24
Freshwater drum	0.7	0.6	0.50	1.19	1.05
Game fish	14.9	20.2	19.63	15.28	18.03
Rough fish	85.1	79.8	80.37	84.72	81.97

\*Indicates game fish species

Table 10. Comparison of percentage composition by weight of net catches, 1956-1960.

Species	1956	1957	1958	1959	1960
Longnose gar	9.4	18.0	12.48	8.71	5.59
Shortnose gar	0.8	0.2	0.42	1.14	0.65
Gizzard shad	19.0	4.2	11.96	10.57	12.20
Smallmouth buffalo	26.8	39.3	35.17	40.36	37.53
Bigmouth buffalo	0.0	0.0	0.19	0.95	1.24
Carp sucker	27.2	20.3	19.23	18.06	19.94
Carp	7.3	4.5	5.11	11.34	9.29
Channel catfish	3.5	5.4	7.15	3.21	3.89
Black bullheads	0.0	0.1	0.00	0.00	0.07
Flathead catfish	0.2	0.3	1.37	0.99	1.73
White bass	3.1	4.2	3.92	2.31	3.70
Largemouth bass	0.6	1.1	1.30	0.12	0.76
White crappie	1.7	2.0	1.36	1.89	2.03
Freshwater drum	0.4	0.3	0.34	0.35	1.38

Table 11. Comparison of average weights, 1956 - 1960.

Species	1956	1957	1958	1959	1960
Longnose gar	4.50	6.03	4.65	2.90	5.20
Shortnose gar	3.45	1.54	.98	1.47	2.03
Gizzard shad	0.71	1.43	.97	.51	.68
Smallmouth buffalo	2.70	3.10	3.06	3.13	2.73
Bigmouth buffalo	0.00	0.00	2.34	4.10	4.63
Carp sucker	1.30	1.37	1.37	1.42	1.45
Carp	4.15	3.80	2.02	2.72	3.14
Channel catfish	1.60	2.04	2.55	2.19	2.41
Black bullheads	0.00	1.19	0.00	0.00	1.43
Flathead catfish	1.40	4.10	4.96	4.29	4.58
White bass	0.72	1.26	.82	.65	.76
Largemouth bass	1.50	2.16	1.93	.73	1.75
White crappie	0.44	.66	.63	.42	.53
Freshwater drum	0.85	.96	.25	.46	2.14

