Report of Fisheries Investigations

Notes on the Natural History of Problematical Fish Species

by

Leo D. Lewis
Project Leader

Lonnie J. Peters
Assistant Project Leader

Dingell-Johnson Project F-7-R-7, Job B-15
June 1, 1959 - December 31, 1959

H. D. Dodgen - Executive Secretary

Texas Game and Fish Commission
Austin, Texas

Marion Toole
Coordinator

Kenneth C. Jurgens & William H. Brown
Assistant Coordinators

A B S T R A C T

Laboratory and field work was continued at Lake Diversion to study food and feeding habits, distribution, movements, and reproduction of gizzard shad, carp, carpsuckers, and the buffalo fishes. Selected stations were netted monthly, and 1,435 fish were taken. Shad, carp, carpsucker, and smallmouth buffalo comprised 64.74 percent of the total collection, while game fish totaled 26.20 percent. Seining produced 9,304 forage-size fish, 58.87 percent of which were shad. All data were compiled in such a manner as to obtain as much information as possible. This information will be utilized to organize and plan more detailed natural history studies in the future.

Work during this short segment period has been devoted mostly to the collection of materials for the laboratory study at Midwestern University, in accordance with the inter-agency contract agreement.

Netting stations, as well as other areas, were fathometered and mapped for future studies. Sampling equipment was re-rigged to increase efficiency of fish collections.

Job Completion Report

State of TEXAS

Project No. F-7-R-7 Name: Fisheries Investigations and Surveys of the Waters of Region 1-B.

Job No. B-15 Title: Notes on the Natural History of Problematical Fish Species.

Period Covered: June 1, 1959 through December 31, 1959

OBJECTIVES

To conduct laboratory and field studies on the anatomy, food and feeding habits, distribution, movements, and reproductive habits of problematical species. This work is to be prepatatory to more detailed studies of each species at a future time, with special emphasis on such features of natural histories that may aid in population controls.

TECHNIQUES

Using techniques that were established during the preceding segment, netting and seining collections were made at least twice each month from Lake Diversion in an effort to determine distribution, movements, and general living habits of river carpsuckers, carp, shad, and the buffalo fishes. These data were compiled and tabulated in such a manner as to obtain as much information as possible.

Data for the study of distribution and movements were collected mostly from fifteen regular netting stations. These stations were chosen according to habitat types and were located between the Lake Diversion Dam and the confluence of Cottonwood Creek and the Big Wichita River, the headwater tributary of Lake Diversion. In addition to the regular netting stations, periodic random sets were made to obtain supplementary data. Collections were made with experimental type nylon gill nets ranging in mesh size from one inch to three inch square mesh in 25 foot sections.

In order to obtain digestive tracts that contained freshly eaten food, some of the most productive net sets were usually worked throughout the night. Digestive tracts that were to be used for food studies were removed and placed in cloth bags. These bags are five by seven inches in size and have a tag attached on which length, weight, sex, location, date of capture, and species of fish are recorded. Bags containing digestive tracts were immersed in ten percent formalin for preservation of tissue.

If there was evidence of increased activity of any fish species in a particular area, that area was either check-seined or "boogered" with gill nets. The "boogering" technique was most successful in areas where gill nets could be set across the mouth of a creek or narrow bay, and in areas where mud or stumps made seining impossible.

Notes were made on which direction fish were traveling when caught in gill nets. At times, a majority of fish seemed to be moving in a certain direction. This practice will continue in order to detect distribution patterns and reasons will be sought for such movements.

Monthly seine samples were collected with 20-foot, one-fourth inch mesh minnow seines and preserved for later identification and counting. In order to show distribution of small fish, all seine samples from different locations were placed in separate containers.

Efforts were made to increase efficiency of fish collection equipment. Gill nets were rigged on various bases of fullness and extent of hang. A small bag seine was rigged to sample areas where mud and silt have accumulated. Various types of traps were considered for use in areas where seining was impossible.

A fathometer was employed to map bottom contours at each station, as well as other future collection sites. Plans were made to collect bottom samples, vegetation samples, turbidity recordings and other data necessary to provide complete limnological descriptions of each station. This was not fully accomplished, however, and in view of the fact that changes in sampling methods are contemplated, new plans have been made which will involve the contouring of the entire lake on a large map. Vegetation, stumpy areas, bottom types, and spawning areas will be indicated on this map, which should be most helpful in the planning of future field work.

Stages of gonadal development were recorded each month for the species under study in order to determine major spawning periods. Very little information on spawning was obtained during this segment period, however, because it is a segment of short duration between June 1 through December 31. Most spawning activities were well underway before the segment began and did not begin by the time the segment terminated.

Field notes were taken regarding associations, enemies, preferred habitats, and other features of life histories which might make undesirable species vulnerable to chemical or biological control.

Laboratory studies were conducted on food habits and fecundity of the river carpsucker, carp, gizzard shad and the buffalo fishes. This work was done by the Midwestern University during this period of study through an inter-agency contract agreement. Stomachs and digestive tracts were collected, preserved, and delivered to the college laboratory at least once each month. In addition to preserved materials, live specimens, plankton, and other materials were delivered upon request. Results of this study will be presented in a report to be submitted by the Midwestern University in accordance with the inter-agency contract agreement.

Information obtained in the laboratory and in the field during this segment period will be utilized to organize and plan detailed natural history studies in the future.

FINDINGS

This is a short segment report, covering a period of only seven months between June 1 through December 31, 1959.

Fish Collections

A total of 1,435 fish was collected by gill nets from the fifteen regular netting stations. Carp, carpsucker, shad and smallmouth buffalo comprised 64.74 percent of the total number taken. Game fish totaled 26.20 percent, and the remainder were drum, bullhead catfish, longnose gar, and shortnose gar. The average collection per station was 96.6 fish. The most fish taken at any station was 181 at Rocky Bend, and the least number was 18 at the floating midlake station. Five sets took 747 fish which was 51.16 percent of all fish taken.

Gizzard shad was the most abundant species taken, comprising 28.65 percent of the total. Equal numbers of carpsuckers and smallmouth buffalos were taken. A total of 224 of each species was caught, comprising 15.61 percent for each species. The next most abundant species were white bass and crappie which were also taken in exactly the same number. One hundred and fifty-five of each were caught, which comprised 10.80 percent for each species. Figure 1 presents the number and percent of each species taken. This information is given in the first column of figures to the right of the column of species. The number taken is above and the percent is directly below. This chart may seem confusing at first, but to one who has used it a short time, it is simple and very useful because it condenses a host of information into one reference. It contains the following information:

(1) Total number and number of each species taken from all stations combined.

(2) Percent of the total number of each species taken from all stations combined.

(3) Total number and number of each species taken from each station.

(4) Percent of the total number of each species taken at all stations.

(5) Percent of the total of each particular species taken at each station.

(6) Number of males of each species under study at each station.

For example, distribution of smallmouth buffalo (or any other particular species) during this period of study can be determined by referring to Figure 1. A total of 1,435 fish of all species was taken. Two hundred and twenty-four smallmouth buffalos were taken, which comprised 15.61 percent of the total number of all fish taken from all of the stations combined. Sixty-eight of the 224 buffalo taken were collected from the Gravel Beach station, comprising 30.35 percent of the total number of all smallmouth buffalos taken from all stations combined. Considering only the fish taken from the Gravel Beach station, a total of 157 fish was taken, 43.31 percent of which were smallmouth buffalos. Of the 68 smallmouth buffalos taken at this station, 44 were males. During this period of study, 10.94 percent of all fish collected were taken at the Gravel Beach Station.

Figure 1 was compiled from monthly records, shown in Figures 2 through 8. Monthly fish collections are given in Figures 2 through 8.

Seining produced a total of 9,304 forage fish, of which gizzard shad were greatly dominant. Shad comprised 58.87 percent of the total. Also abundant were Notropis lutrensis (12.79 percent) and Pimephales vigilax (13.86 percent). The numbers of forage fish taken by seine collections are given in Figure 9.

Distribution and Movements

Although only fifteen regular netting stations were used during this period of study, they were distributed throughout the lake well enough to indicate distribution and, perhaps, preference of species under study for various types of habitat. Netting locations are plotted on the map at the end of this report. Data obtained from gill nets are supplemented by seining collections.

Carpsucker

Five particular stations produced 75.00 percent of all carpsucker taken. These stations were similar only in water depth. The lake bottom at the Crappie Creek, Rock Island, and Rattlesnake Island stations is moderately to heavily vegetated, while the Hackberry Bay and Cottonwood Creek bottoms are covered with deep mud and are not vegetated. At the Cottonwood Creek set, 21 of the 29 carpsuckers taken were caught in October. Ordinarily, this set does not catch many carpsuckers and their presence at this station in October may have been caused by a rise in the river resulting from an increase in water release from Lake Kemp. The high percentage of carpsuckers taken from the Hackberry station may be attributed to the fact that the nets were set at the entrance to Hackberry Bay which is moderately vegetated with Chara. It is doubtful that carpsuckers fed in the immediate area in which the nets were set. They were probably caught while entering or leaving feeding areas inside the bay. The remaining three stations where high percentages of carpsuckers were taken are believed to be located in feeding areas. Rock Island is at the northeast entrance to Duck Bay which is a large, heavily vegetated bay of somewhat uniform depth. The Crappie Creek Station is in Crappie Creek Bay which is also heavily vegetated, large, and of somewhat uniform depth. The Rattlesnake Island set is in the narrow passageway between Rattlesnake Island and the mainland to the north. This passageway leads to Wildhorse Bay, a smaller bay, but otherwise similar to Crappie Creek Bay and Duck Bay. At Gravel Beach, the only other shallow-water station, the bottom is firm and covered with a thick mat of Chara. This set took only 17 carpsuckers. Figure 10 gives the distribution of carpsuckers during this period of study.

The small catch of carpsuckers during June and July may have been due to their spawning activities up in the river above the point where our netting stopped. Extensive netting and seining in the upper river is planned during the next segment to determine the extent of its utilization by carpsuckers, especially during the spawning season.

Young carpsuckers less than 1½ inches, a scarce item in seine collections, were taken only at Boggy Bay, Sandy Beach, Rocky Bend, Hackberry Bay, and in the river, approximately four miles above Fulda Bridge. All of these places are in the extreme upper end of the lake or in the river, which suggests that carpsuckers probably spawn somewhere in this area.

Gizzard shad

During this period of study, shad were well distributed throughout a large part of the lake except during the spawning season when approximately 80 percent were taken in areas above Sandy Beach. Shad were taken in abundance at many stations almost every month; however, more were taken in the upper part of the lake than in the lower. The five stations located in the upper part of the lake and in the river took 62.31 percent of all shad collected, while sets located in the main part of the lake caught as little as 1.22 percent.

During June, 89.15 percent of all shad were collected in the upper part of the lake and in the river above. Undoubtedly, the shad were spawning in this area at that time. They began leaving the upper lake in July, and by August, only 17.24 percent of the shad collected were taken there. They returned in September, however, and throughout October to December, an average of 61.50 percent of the shad were taken in the upper five sets. Figure 11 gives the distribution of shad during this period of study.

Food studies of shad in Lake Diversion indicate they are demersal type feeders rather than plankton feeders. Their stomachs contain a high percentage of silt and clay particles which could only be taken by fishes with demersal type feeding habits. Therefore, in Lake Diversion, indications are that shad are not open-water pelagic feeders, but rather, like the carpsucker, find most of their food on the bottom in the littoral zone. In addition to bottom feeding, they probably get a portion of their food by sucking algae, protozoans, and bacteria off stumps, rocks and brush.

Shad fry were collected at many places in the lake, but they were more abundant in the shallow areas of Boggy Bay and along the south side of the river near Rocky Bend. Shad fry collected at these locations on June 4, 1959, were from three-fourths to one inch long. They were still present in large numbers on July 8 and were obviously larger, but by July 28, they had practically disappeared from this area. They reappeared early in August, but when the same area was checked on two occasions in September, only four small shad were taken. Very few shad were taken in seine collections at any location from early September to December. This sudden disappearance of small shad from shallow areas where they were previously very abundant suggests that they move out to deeper, open-water areas when they reach a certain size. In spite of heavy predation, it is unlikely that the disappearance of young shad from these seining areas was due to predation alone. It is considered more probable that, after a certain age, shallow water habitat is not suitable, and they must find their food in other areas.

Carp

Although carp are present in Lake Diversion, they are not considered to be overabundant. A total of only 68 carp was taken during this segment, and very seldom were more than two or three taken at any set. For this reason, very little can be said about the movements and distribution of this species. Figure 12 gives the distribution of carp for this segment.

Food studies have revealed that Chara is the principle food item of carp in Lake Diversion. Special efforts will be made in the future to determine if the distribution of carp is influenced by large beds of Chara.

Smallmouth buffalo

Unlike other species under study, most smallmouth buffalo were collected at relatively few places. Two sets in particular caught high percentages of this species. These were the Gravel Beach and the Rock Island sets which took 30.35 and 21.43 percent respectively. These sets are probably located in feeding areas or else in areas through which buffalo pass while going to and from feeding areas.

Smallmouth buffalos in Lake Diversion feed extensively on organisms which are found on submerged stumps, brush, rocks, and other objects. Bryzoans, for example, are abundant on these submerged objects, and are major food items during certain times of the year. Food studies and the analysis of collection data indicates that distribution of this species may be directly associated with stumps, brush, and rocks. Figure 13 gives distribution of buffalo during this segment.

Bigmouth buffalo

Only two bigmouth buffalos were collected during this period of study. They were taken one at a time at the Rock Island station during the August and September collections. Therefore no distribution data were recorded.

Spawning

The period covered by this report began June 1, 1959. Since the species under study had already begun to spawn by that time, and since crowded work schedules prevented the time necessary for field observations, no pertinent data concerning spawning were collected. Concentrated efforts will be made during the segment beginning January 1, 1960, to learn as much as possible about the spawning habits and requirements of the species under study. Field observations will be made to collect information concerning the following related subjects:

1. Time of spawning. Month and time of day when major spawning occurs.
2. Locations and requirements for spawning of each species.
3. Spawning methods.
4. Relation of water temperatures to spawning.
5. Relation of current and fluctuating water levels to spawning.
6. Identification of eggs and young of each species at various stages of development.
7. Time required and factors influencing incubation.
8. Effects of certain chemicals on eggs and fry.
9. Movements, food, and general living habits of the young-of-the-year from the time they hatch until they grow to a size permitting capture by gill nets.

Food Habits - Fecundity - Anatomy

Detailed laboratory studies have been initiated and are presently being conducted on the comparative anatomy, food habits, and fecundity of the river carpsucker, buffalo fishes, carp and gizzard shad. This work is being conducted by the Midwestern University at Wichita Falls, Texas, for the Texas Game and Fish Commission under an interagency contract. Field-collected specimens and materials are collected, preserved,

and delivered to Midwestern University by F-7-R personnel for this laboratory study. Results of the study will be presented in a separate report by the Department of Biology of the University.

Discussion

Work during this short segment period has been devoted mostly to the collection of materials for the laboratory study at Midwestern University. At the same time, studies continued on movements and distribution of the species under study, collecting gear was modified and future work was planned. Netting stations, as well as other areas, were "fathometered" and mapped for future studies.

One of the more outstanding problems of this study has been the inadequacy of our collecting and sampling methods. It has been quite obvious that gill netting is entirely too selective to produce a truly representative sample of the fish population. Seining methods, too, are limited to areas of shallow water devoid of stumps, rocks, vegetation and other objects that are attractive to fish. In order to obtain maximum benefit from this study, we must develop collecting methods that will acquire data from any or all parts of waters under study. Work on this problem was begun during this segment, and it will continue to receive special attention during future segments.

Efforts will also be directed to determining depth distribution of undesirable species as related to seasons, temperature, barometric pressure, etc. This knowledge would be very useful in determining proper times for selective-kill treatments, For example, there would be no need to postpone a selective-kill treatment until a thermocline existed at 20 feet in the summer time when the fish to be killed may occur only in the upper 10 feet normally and at a time affording more desirable treating conditions.

During this very brief study, we have already encountered a number of tempting and very interesting diversionary aspects of life histories, none of which would be thieves of time when we consider the primary objectives of the study. However, crowded work schedules and other official obligations will not permit sufficient time to devote to the many aspects of a natural history study at this time. Plans are being made to reduce the number of jobs, as well as the work load in general, so that more time can be devoted to this study. Meanwhile, work on this job will be confined primarily to preparations and planning for future work. It is hoped that, during this work, factor-weaknesses in the life histories will be discovered through which each individual species under study can be controlled biologically.

Prepared by Leo D. Lewis
Project Leader

Lonnie J. Peters
Assistant Project Leader

Approved by Marion Toole
Director Inland Fisheries Division

Date June 17, 1960

Natural History
Segment Totals
Species Distribution

			Dam Floating	Dam Sinking	Gravel Beach	Widlake Floating	Widlake Sinking	Crappie Creek	Rock Island	Rocky Point	Little Brushy	Rattlesnake	Sandy Beach Floating	Sandy Beach Sinking	Rocky Bend	Hackberry	Cottonwood	
Long Nose Gar (1) (2)	No	83	1		2	2	1		2	4	4	1	12	7	7	18	22	(3)
			1.20		2.41	2.41	1.20		2.41	4.82	4.82	1.21	14.45	8.44	8.44	21.68	26.51	(4)
	%	5.78	2.17		1.27	11.11	2.77		1.48	4.16	5.00	1.04	10.52	7.07	3.86	13.33	15.82	(5)
																		(6)
Short Nose Gar	No	15					2						3	4	3		3	
							13.33						20.00	26.67	20.00		20.00	
	%	1.04					5.56						2.63	4.04	1.66		2.16	
Shad	No	411	26	11	19	5	5	12	20	37	11	10	52	35	81	35	52	
			6.32	2.68	4.62	1.22	1.21	2.92	4.87	9.00	2.68	2.43	12.65	8.52	19.71	8.51	12.66	
	%	28.65	56.52	39.28	12.10	27.77	13.89	16.00	14.81	38.54	13.75	10.41	45.62	35.35	44.75	25.92	37.41	
Smallmouth Buffalo	No	224	9	3	4	3		3	14	16	4	1	27	15	19	17	21	
			4	7	68	3	7	11	48	12	8	12	3	1	10	16	14	
			1.78	3.13	30.35	1.34	3.13	4.91	21.43	5.35	3.58	5.35	1.34	.45	4.46	7.15	6.25	
	%	15.61	8.70	25.00	43.31	16.67	19.44	14.66	35.56	12.50	10.00	12.50	2.63	1.01	5.53	11.86	10.07	
			2	4	44	2	5	4	23	7	4	6		1	4	8	11	
Big Mouth Buffalo	No	2							2									
									100.00									
	%	0.13							1.48									
									2									
Carpsucker	No	224		3	17		9	32	38	3	8	42	2	5	9	27	29	
				1.33	7.59		4.02	14.29	16.96	1.34	3.57	18.75	.90	2.23	4.02	12.05	12.95	
	%	15.61		10.72	10.83		25.00	42.67	28.15	3.13	10.00	43.75	1.75	5.05	4.97	20.00	20.87	
				2	8		3	19	17	2	5	26	1	1	3	7	14	
Carp	No	68	2	1	7			10	6	6	3	6	2	1	5	16	3	
			2.94	1.47	10.29			14.71	8.82	8.82	4.42	8.82	2.94	1.47	7.35	23.53	4.42	
	%	4.74	4.34	3.57	4.46			13.33	4.44	6.25	3.75	6.25	1.76	1.01	2.76	11.85	2.15	
					2			2	4	2	1	4			4	11	2	
Channel Cat	No	56	1	1	1	2	2	1	2	4	6	4	4	8	14	1	5	
			1.78	1.79	1.78	3.57	3.58	1.78	3.57	7.15	10.71	7.14	7.15	14.28	25.00	1.79	8.93	
	%	3.91	2.18	3.57	0.64	11.11	5.56	1.34	1.48	4.17	7.50	4.17	3.51	8.08	7.74	.74	3.60	
Bullhead	No	1														1		
																100.00		
	%	.07														.74		
Flathead	No																	
	%																	
White Bass	No	155	8		37	4	4	5	6	22	36	9	9	1	9	2	3	
			5.16		23.87	2.58	2.58	3.22	3.88	14.19	23.22	5.81	5.81	.64	5.81	1.29	1.94	
	%	10.80	17.39		23.56	22.22	11.11	6.66	4.45	22.91	45.00	9.38	7.89	1.01	4.97	1.48	2.16	
Black Bass	No	10			3		1		4						1	1		
					30.00		10.00		40.00						10.00	10.00		
	%	.69			1.91		2.78		2.96						0.55	.74		
Crappie	No	155	4	4	3	2	2	4	7	8	4	11	27	26	34	14	5	
			2.58	2.58	1.93	1.29	1.29	2.58	4.52	5.16	2.58	7.10	17.42	16.77	21.94	9.03	3.23	
	%	10.80	8.70	14.28	1.92	11.12	5.55	5.34	5.19	8.34	5.00	11.45	23.69	26.26	18.79	10.37	3.60	
Drum	No	31		1			3					1		11	8	4	3	
				3.22			9.68					3.22		35.49	25.80	12.91	9.68	
	%	2.17		3.58			8.34					1.05		11.12	4.42	2.97	2.16	
	No	1435	46	28	157	18	36	75	135	96	80	96	114	99	181	135	139	
	%	100.00	3.20	1.95	10.94	1.26	2.51	5.22	9.41	6.69	5.57	6.69	7.95	6.90	12.61	9.41	9.69	

Figure 1

Distribution of Fish Species in Lake Diversion, June 1 through December 31, 1959
(See explanation under Distribution and Movements)

Natural History
June 26, 1959
Distribution

			Dam Floating	Dam Sinking	Gravel Beach	Midlake	Crappie Creek	Rock Island	Rocky Point	Little Brushy	Rattlesnake Island	Sandy Beach Floating	Sandy Beach Sinking	Rocky Bend	Hackberry Bay	Cottonwood Cove	
Long Nose Car	No	9						2		1					5	1	No. Taken
								22.22		11.11					55.55	11.11	% of Species
	%	4.63						16.66		11.11					19.23	2.50	% of Set
																	No. Males
Short Nose Car	No	2												1		1	
														50.00		50.00	
	%	1.04												3.22		2.50	
Shad	No	83	2	2	2				1	1	1	21	7	19	9	18	
			2.40	2.41	2.41				1.21	1.20	1.21	25.30	8.43	22.89	10.85	21.69	
	%	42.78	100.00	40.00	28.57				20.00	11.11	10.00	84.00	50.00	61.29	34.61	45.00	
			1									8	1	12	4	6	
Smallmouth Buffalo	No	36			4		3	6	2	2	2			3	6	8	
					11.11		8.33	16.67	5.55	5.56	5.55			8.34	16.66	22.23	
	%	18.56			57.14		42.85	50.00	40.00	22.22	20.00			9.68	23.08	20.00	
					3			1		1	1			1	3	7	
Big Mouth Buffalo	No																
	%																
Carpsucker	No	9									2		1	1	2	3	
											22.22		11.11	11.11	22.22	33.33	
	%	4.63									20.00		7.14	3.22	7.69	7.50	
											1				1	1	
Carp	No	20		1	1		3	3	1	2	3	1	1		1	3	
				5.00	5.00		15.00	15.00	5.00	10.00	15.00	5.00	5.00		5.00	15.00	
	%	10.31		20.00	14.28		42.86	25.00	20.00	22.22	30.00	4.00	7.14		3.85	7.50	
							1	1		1	3					2	
Channel Cat	No	10							1	2			1	3		3	
									10.00	20.00			10.00	30.00		30.00	
	%	5.16							20.00	22.22			7.14	9.68		7.50	
Bullhead	No																
	%																
Flathead	No																
	%																
White Bass	No	1								1							
										100.00							
	%	.51								11.11							
Black Bass	No	1						1									
								100.00									
	%	.52						8.34									
Crappie	No	12		2		1	1				1	3	1	3			
				16.66		8.34	8.33				8.33	25.00	8.34	25.00			
	%	6.18		40.00		100.00	14.29				10.00	12.00	7.15	9.68			
Drum	No	11									1		3	1	3	3	
											9.09		27.27	9.09	27.27	27.28	
	%	5.68									10.00		21.43	3.23	11.54	7.50	
Total for Set	No	194	2	5	7	1	7	12	5	9	10	25	14	31	26	40	
	%	100.00	1.03	2.57	3.61	.52	3.61	6.18	2.58	4.64	5.15	12.89	7.22	15.97	13.41	20.62	

Figure 2

Distribution of Fish Species in Lake Diversion, June 1959

Natural History
July 29, 1959
Distribution

			Dam Floating	Dam Sinking	Gravel Beach	Midlake Floating	Midlake Sinking	Crappie Creek	Rock Island	Rocky Point	Little Brushy	Rattlesnake	Sandy Beach Floating	Sandy Beach Sinking	Rocky Bend	Hackberry	Cottonwood	
Long Nose Gar	No	31	1			1	1			1	1	1	5	2	1	6	11	No. Taken
			3.22			3.23	3.22			3.23	3.22	3.23	16.13	6.45	3.23	19.35	35.49	% of Species
	%	15.12	5.88			25.00	10.00			7.14	20.00	10.00	22.72	11.11	6.66	20.68	47.82	% of Set
																		No. Males
Short Nose Gar	No	4													2		2	
															50.00		50.00	
	%	1.95													13.34		8.70	
Shad	No	64	12	4	3	3	1	2		6	2	1	9	4	7	8	2	
			18.75	6.25	4.68	4.69	1.56	3.13		9.37	3.13	1.56	14.06	6.25	10.94	12.50	3.13	
	%	31.22	70.59	80.00	20.00	75.00	10.00	28.57		42.86	40.00	10.00	40.91	22.22	46.66	27.59	8.69	
			4		1	2		1		3	1		7	2	4	5	1	
Smallmouth Buffalo	No	35		1	11		3	1	9	1	2	2				2	3	
				2.85	31.43		8.57	2.86	25.71	2.86	5.72	5.71				5.71	8.58	
	%	17.07		20.00	73.33		30.00	14.29	81.81	7.14	40.00	20.00				6.90	13.05	
					5		2		6	1	1	1				1	2	
Big Mouth Buffalo	No																	
	%																	
Carpsucker	No	17					2	2				4		2	1	6		
							11.76	11.76				23.53		11.77	5.88	35.30		
	%	8 29					20.00	28.57				40.00		11.11	6.67	20.69		
												1				1		
Carp	No	11			1			2	1	2		1	1			3		
					9.09			18.18	9.09	18.18		9.09	9.09			27.28		
	%	5.37			6.67			28.57	9.09	14.28		10.00	4.55			10.34		
								1	1	1						2		
Channel Cat	No	5	1				1		1						1		1	
			20.00				20.00		20.00						20.00		20.00	
	%	2.44	5.88				10.00		9.10						6.67		4.34	
Bullhead	No																	
	%																	
Flathead	No																	
	%																	
White Bass	No	15	3				1			4		1	3				3	
			20.00				6.66			26.67		6.67	20.00				20.00	
	%	7.32	17.64				10.00			28.58		10.00	13.63				13.05	
Black Bass	No																	
	%																	
Crappie	No	16											4	5	2	4	1	
													25.00	31.25	12.50	25.00	6.25	
	%	7.80											18.18	27.78	13.33	13.80	4.35	
Drum	No	7					1							5	1			
							14.28							71.43	14.29			
	%	3.42					10.00							27.78	6.67			
Total for Set		205	17	5	15	4	10	7	11	14	5	10	22	18	15	29	23	

Figure 3

Distribution of Fish Species in Lake Diversion, July 1, 1959

...ural History
...st 25, 1959
...cribution

			Dam Floating	Dam Sinking	Gravel Beach	Midlake Floating	Midlake Sinking	Crappie Creek	Rock Island	Rocky Point	Little Brushy	Rattlesnake	Sandy Beach Floating	Sandy Beach Sinking	Rocky Bend	Hackberry	Cottonwood	
Long Nose Gar	No	21				1				2	1		3	2	3	1	8	Number Taken
	%	11.73				4.76				9.52	4.76		14.29	9.52	14.29	4.76	38.10	% of Species
						16.67				10.00	7.14		27.27	13.33	37.50	10.00	80.00	% of Set
										1			3	1	1	1	5	No. Males
Short Nose Gar	No	1					1											
	%	.56					100.00											
							9.09											
Shad	No	29		2	9	2	2	2		5	2		2	2	1			
	%	16.20		6.89	31.04	6.89	6.90	6.90		17.24	6.89		6.90	6.90	3.45			
				40.00	31.03	33.33	18.18	16.66		25.00	14.28		18.18	13.33	12.50			
				1	3	1				2	1		1	1				
Smallmouth Buffalo	No	25		1	10	2	1	3	3	1	1	1			1	1		
	%	13.96		4.00	40.00	8.00	4.00	12.00	12.00	4.00	4.00	4.00			4.00	4.00		
				20.00	34.48	33.33	9.09	25.00	23.07	5.00	7.15	7.69			12.50	10.00		
					7	2		2	1	1		1			1			
Big Mouth Buffalo	No	1							1									
	%	.56							100.00									
									7.69									
									1									
Carpsucker	No	26			1		4	6	6			7	1		1			
	%	14.53			3.84		15.39	23.07	23.08			26.92	3.85		3.85			
					3.45		36.36	50.00	46.16			53.84	9.09		12.50			
							1	4	3			4						
Carp	No	14	2		1			1		2		2			1	5		
	%	7.82	14.28		7.14			7.15		14.28		14.29			7.14	35.72		
			100.00		3.45			8.34		10.00		15.39			12.50	50.00		
												1			1	*4		*Ripe 8
Channel Cat	No	10							1	1	2	2	1	2		1		
	%	5.58							10.00	10.00	20.00	20.00	10.00	20.00		10.00		
									7.69	5.00	14.28	15.38	9.09	13.34		10.00		
...lhead	No																	
	%																	
Flathead	No																	
	%																	
White Bass	No	28			7		1		2	8	8	1				1		
	%	15.65			25.00		3.57		7.14	28.57	28.57	3.57				3.57		
					24.14		9.09		15.39	40.00	57.15	7.70				10.00		
Black Bass	No																	
	%																	
Crappie	No	20		1	1	1	1			1			4	8		1	2	
	%	11.17		5.00	5.00	5.00	5.00			5.00			20.00	40.00		5.00	10.00	
				20.00	3.45	16.67	9.09			5.00			36.37	53.33		10.00	20.00	
Drum	No	4		1			1							1	1			
	%	2.24		25.00			25.00							25.00	25.00			
				20.00			9.10							6.67	12.50			
Total for Set		179	2	5	29	6	11	12	13	20	14	13	11	15	8	10	10	

Figure 4

Distribution of Fish Species in Lake Diversion, August, 1959

Natural History
September 15, 1959
Distribution

			Dam Floating	Dam Sinking	Gravel Beach	Midlake Floating	Midlake Sinking	Crappie Creek	Rock Island	Rocky Point	Little Brushy	Rattlesnake	Sandy Beach Floating	Sandy Beach Sinking	Rocky Bend	Hackberry	Cottonwood	
Long Nose Gar	No	5											1		2		2	No. Taken
	%	3.18											20.00		40.00		40.00	% of Species
													7.14		7.40		33.33	% of Set
															2		1	No. Males
Short Nose Gar	No																	
	%																	
Shad	No	22	2	2						1	2		4	6	4	1		
	%	14.01	9.09	9.09						4.54	9.09		18.19	27.27	18.18	4.55		
			40.00	40.00						6.25	11.11		28.57	85.71	14.82	8.33		
			1	1									2	2	1	1		
Smallmouth Buffalo	No	37	1	2	11	1	2		7	5		1			2	5		
	%	23.57	2.70	5.40	29.73	2.71	5.40		18.92	13.51		2.71			5.40	13.52		
			20.00	40.00	78.57	33.33	40.00		50.00	31.25		16.67			7.40	41.67		
				1	7		2		5	4					2	2		
Big Mouth Buffalo	No	1							1									
	%	.64							100.00									
									7.14									
									1									
Carpsucker	No	28		1	1		2	3	5	1	2	4			3	3	3	
	%	17.83		3.57	3.57		7.14	10.72	17.85	3.57	7.15	14.28			10.72	10.71	10.72	
				20.00	7.14		40.00	60.00	35.71	6.25	11.11	66.66			11.12	25.00	50.00	
				1			1	2	1	1	1	3			2	1	1	
Carp	No	11			2			1		1	1				4	2		
	%	7.01			18.18			9.09		9.09	9.09				36.36	18.19		
					14.29			20.00		6.25	5.55				14.81	16.66		
					1					1					3	2		
Channel Cat	No	14				2				2	2	1	3		3		1	
	%	8.91				14.28				14.29	14.28	7.15	21.42		21.43		7.15	
						66.67				12.50	11.11	16.67	21.43		11.11		16.67	
Bullhead	No																	
	%																	
Flathead	No																	
	%																	
White Bass	No	23	2					1	1	4	10		2	1	2			
	%	14.65	8.69					4.35	4.35	17.39	43.48		8.69	4.35	8.70			
			40.00					20.00	7.15	25.00	55.56		14.28	14.29	7.41			
Black Bass	No																	
	%																	
Crappie	No	14								2	1		4		6	1		
	%	8.92								14.28	7.14		28.58		42.85	7.15		
										12.50	5.56		28.58		22.22	8.34		
Drum	No	2					1								1			
	%	1.28					50.00								50.00			
							20.00								3.71			
Total for Set		157	5	5	14	3	5	5	14	16	18	6	14	7	27	12	6	

Figure 5

Distribution of Fish Species in Lake Diversion, September 1959

Natural History
October 15, 1959
Distribution

			Dam Floating	Dam Sinking	Gravel Beach	Midlake Floating	Midlake Sinking	Crappie Creek	Rock Island	Rocky Point	Little Brushy	Rattlesnake Island	Sandy Beach Floating	Sandy Beach Sinking	Rocky Bend	Hackberry Bay	Cottonwood
Long Nose Gar	No	4			1									2		1	
	%	1.91			25.00									50.00		25.00	
					2.00									28.57		8.33	
Short Nose Gar	No																
	%																
Shad	No	56	2		2		1	3	6	2	1	1	5	3	15	6	9
	%	26.79	3.57		3.57		1.78	5.36	10.72	3.57	1.78	1.79	8.93	5.35	26.79	10.71	16.08
			28.57		4.00		33.33	21.42	19.35	33.34	20.00	33.34	83.33	42.86	55.55	50.00	25.71
									2	1			4	2	4	1	4
Smallmouth Buffalo	No	30	3		10			3	8		1				2		3
	%	14.36	10.00		33.33			10.00	26.67		3.33				6.67		10.00
			42.85		20.00			21.43	25.81		20.00				7.41		8.57
			2		6			1	4		1						2
Big Mouth Buffalo	No																
	%																
Carpsucker	No	53		1	7		1	6	11		1	2	1			2	21
	%	25.36		1.88	13.21		1.89	11.32	20.75		1.89	3.77	1.89			3.77	39.63
				100.00	14.00		33.33	42.86	35.48		20.00	66.66	16.67			16.67	60.00
				1	2		1	5	6		1	2	1				12
Carp	No	4			1			2	1								
	%	1.91			25.00			50.00	25.00								
					2.00			14.29	3.23								
					1				1								
Channel Cat	No	1													1		
	%	.48													100.00		
															3.70		
[illegible]head	No																
	%																
Flathead	No																
	%																
White Bass	No	37			29	2			1	1	1				2	1	
	%	17.70			78.37	5.41			2.70	2.70	2.71				5.40	2.71	
					58.00	100.00			3.22	16.66	20.00				7.41	8.33	
Black Bass	No	2					1									1	
	%	.96					50.00									50.00	
							33.33									8.33	
Crappie	No	21	2						4	3	1			2	6	1	2
	%	10.05	9.52						19.05	14.28	4.76			9.53	28.57	4.76	9.53
			28.58						12.91	50.00	20.00			28.57	22.22	8.34	5.72
Drum	No	1													1		
	%	.48													100.00		
															3.71		
Total for Set		209	7	1	50	2	3	14	31	6	5	3	6	7	27	12	35

No. Taken
% of Species
% of Set
No. Males

Figure 6

Distribution of Fish Species in Lake Diversion, October 1959

Natural History
November 3, 1959
Distribution

			Dam Floating	Dam Sinking	Gravel Beach	Midlake Floating	Midlake Sinking	Crappie Creek	Rock Island	Rocky Point	Little Brushy	Rattlesnake Island	Sandy Beach Floating	Sandy Beach Sinking	Rocky Bend	Hackberry Bay	Cottonwood *
Long Nose Gar	No	8			1					1	1		3			2	
	%	2.40			12.50					12.50	12.50		37.50			25.00	
					2.85					4.00	3.84		9.67			8.00	
Short Nose Gar	No	8					1						3	4			
	%	2.41					12.50						37.50	50.00			
							25.00						9.68	12.50			
Shad	No	106	8	1	3		1	1	11	16	3	2	11	13	32	4	
	%	31.93	7.54	.95	2.83		.94	.94	10.38	15.09	2.83	1.89	10.38	12.26	30.19	3.78	
			72.72	20.00	8.57		25.00	10.00	29.72	64.00	11.54	7.69	35.48	40.62	49.23	16.00	
Smallmouth Buffalo	No	50	3	1					7	8	2		5	7	14	1	
	%	15.06		2	18		1		11	3	2	5	3	1	2	2	
				4.00	36.00		2.00		22.00	6.00	4.00	10.00	6.00	2.00	4.00	4.00	
				40.00	51.43		25.00		29.73	12.00	7.69	19.23	9.68	3.13	3.07	8.00	
				2	13		1		4	1	1	3		1		2	
Big Mouth Buffalo	No																
	%																
Carpsucker	No	55		1	7			6	13	2	5	12		1		8	
	%	16.57		1.81	12.73			10.91	23.64	3.63	9.09	21.82		1.82		14.55	
				20.00	20.00			60.00	35.14	8.00	19.23	46.15		3.12		32.00	
					5			3	5	1	3	9		1		3	
Carp	No	4			1			1	1							1	
	%	1.20			25.00			25.00	25.00							25.00	
					2.86			10.00	2.70							4.00	
									1							1	
Channel Cat	No	7						1						1	5		
	%	2.11						14.28						14.29	71.42		
								10.00						3.13	7.70		
Bullhead	No																
	%																
Flathead	No																
	%																
White Bass	No	27	3		1			1		2	14	1			5		
	%	8.13	11.11		3.70			3.70		7.41	51.85	3.71			18.52		
			27.28		2.86			10.00		8.00	53.85	3.85			7.69		
Black Bass	No	3			2										1		
	%	.91			66.66										33.34		
					5.71										1.54		
Crappie	No	58		1	2		1		1	1	1	6	11	10	17	7	
	%	17.47		1.72	3.45		1.72		1.73	1.72	1.72	10.35	18.96	17.25	29.31	12.07	
				20.00	5.72		25.00		2.71	4.00	3.85	23.08	35.49	31.25	26.15	28.00	
Drum	No	6												2	3	1	
	%	1.81												33.33	50.00	16.67	
														6.25	4.62	4.00	
Total for Set		332	11	5	35		4	10	37	25	26	26	31	32	65	25	

No. Taken
% of Species
% of Set
No. Males

* No Fish

Figure 7

Distribution of Fish Species in Lake Diversion, November 1959

Natural History
December 3-4, 1959
Distribution

			Dam Floating	Dam Sinking	Gravel Beach	Midlake Floating	Midlake Sinking	Crappie Creek	Rock Island	Rocky Point	Little Brushy	Rattlesnake Island	Sandy Beach Floating	Sandy Beach Sinking	Rocky Bend	Hackberry Bay	Cottonwood
Long Nose Gar	No	5												1	1	3	
	%	3.14												20.00	20.00	60.00	
														16.66	12.50	14.28	
Short Nose Gar	No																
	%																
Shad	No	51						4	3	6		5			3	7	23
	%	32.08						7.84	5.88	11.77		9.80			5.88	13.73	45.10
								20.00	17.64	60.00		17.85			37.50	33.33	92.00
								2	2	2		1			2	5	10
Smallmouth Buffalo	No	11		1	4			1	4			1					
	%	6.91		9.09	36.36			9.09	36.36			9.10					
				50.00	57.14			5.00	23.53			3.57					
				1	3			1	2								
Big Mouth Buffalo	No																
	%																
Carpsucker	No	36			1			9	3			11		1	3	6	2
	%	22.64			2.77			25.00	8.34			30.55		2.78	8.33	16.67	5.56
					14.28			45.00	17.65			39.29		16.67	37.50	28.58	8.00
					1			5	2			6			1	3	
																4	
Carp	No	4														100.00	
	%	2.52														19.04	
																2	
Channel Cat	No	9		1	1		1					1		4	1		
	%	5.66		11.11	11.11		11.11					11.11		44.44	11.12		
				50.00	14.29		33.33					3.57		66.67	12.50		
lhead	No	1														1	
	%	.63														100.00	
																4.77	
Flathead	No																
	%																
White Bass	No	24				2	2	3	2	3	2	6	4				
	%	15.09				8.33	8.33	12.50	8.34	12.50	8.33	25.00	16.67				
						100.00	66.67	15.00	11.76	30.00	66.67	21.43	80.00				
Black Bass	No	4			1				3								
	%	2.52			25.00				75.00								
					14.28				17.65								
Crappie	No	14	2					3	2	1	1	4	1				
	%	8.81	14.28					21.43	14.29	7.14	7.14	28.57	7.15				
			100.00					15.00	11.76	10.00	33.33	14.29	20.00				
Drum	No																
	%																
Total for Set		159	2	2	7	2	3	20	17	10	3	28	5	6	8	21	25

No. Taken
% of Species
% of Set
No. Males

Figure 8

Distribution of Fish Species in Lake Diversion, December 1959

Figure 9. Total Number of Forage Fish Taken from Lake Diversion, June 1, 1959 - December 31, 1959

Name	Number	Percent
Dorosoma cepedianum	5,478	58.87
Ictiobus bubalus	32	0.35
Carpiodes carpio	25	0.27
Phenacobius mirabilis	4	0.04
Notropis brazosensis	2	0.02
Notropis bairdi	13	0.14
Notropis girardi	2	0.02
Notropis lutrensis	1,190	12.79
Notropis deliciosus	18	0.19
Hybognathus placita	2	0.02
Pimephales vigilax	1,289	13.86
Pimephales promelas	1	0.01
Ictalurus punctatus	2	0.02
Gambusia affinis	176	1.89
Roccus chrysops	127	1.37
Micropterus punctulatus	1	0.01
Micropterus salmoides	54	0.58
Lepomis cyanellus	15	0.16
Lepomis punctatus	126	1.36
Lepomis microlophus	18	0.19
Lepomis macrochirus	281	3.02
Lepomis humilis	285	3.06
Lepomis megalotis	7	0.08
Pomoxis annularis	8	0.08
Percina caprodes	139	1.50
Aplodinotus grunniens	9	0.10
Total	9,304	100.00

Figure 10. Distribution of Carpsucker in Lake Diversion. June 1 through December 31, 1959.

Percent	Total No.	Station	CARPSUCKER June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
		Dam Floating								
1.33	3	Dam Sinking				1	1	1		
7.59	17	Gravel Beach			1	1	7	7	1	
		Midlake Floating								
4.02	9	Midlake Sinking		2	4	2	1			
14.29	32	Crappie Creek		2	6	3	6	6	9	
16.96	38	Rock Island			6	5	11	13	3	
1.34	3	Rocky Point				1		2		
3.57	8	Little Brushy				2	1	5		
18.75	42	Rattlesnake Island	2	4	7	4	2	12	11	
.90	2	Sandy Beach Floating			1		1			
2.23	5	Sandy Beach Sinking	1	2				1	1	
4.02	9	Rocky Bend	1	1	1	3			3	
12.05	27	Hackberry Bay	2	6		3	2	8	6	
12.95	29	Cottonwood Cove	3			3	21		2	
100.00	224		4.02	7.59	11.61	12.50	23.66	24.55	16.07	Percent
			9	17	26	28	53	55	36	Number

Figure 11. Distribution of Gizzard Shad in Lake Diversion. June 1 through December 31, 1959.

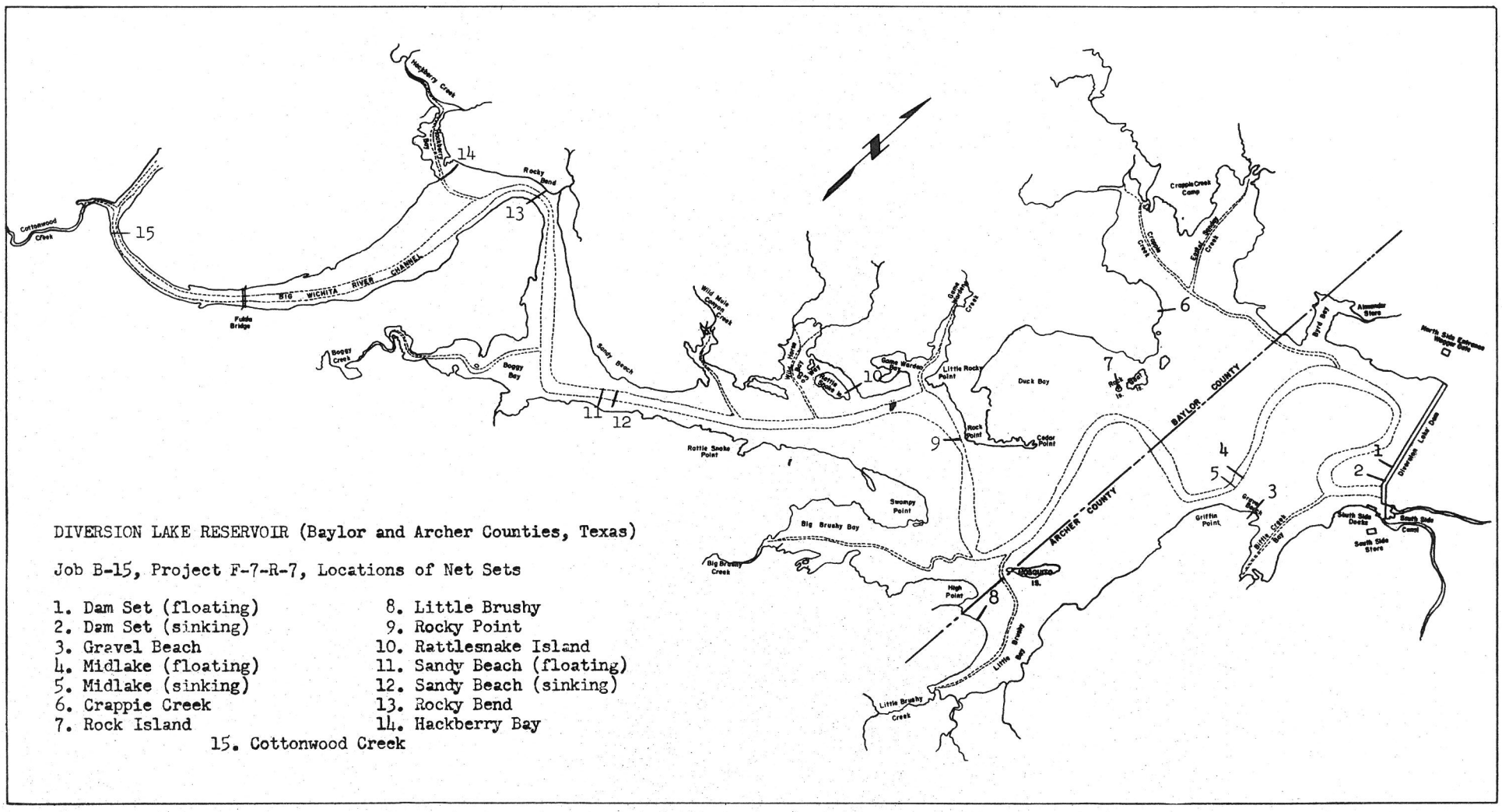
Percent	Total No.	Station	GIZZARD SHAD June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
6.32	26	Dam Floating	2	12		2	2	8		
2.68	11	Dam Sinking	2	4	2	2		1		
4.61	19	Gravel Beach	2	3	9		2	3		
1.22	5	Midlake Floating		3	2					
1.22	5	Midlake Sinking		1	2		1	1		
2.92	12	Crappie Creek		2	2		3	1	4	
4.87	20	Rock Island					6	11	3	
9.00	37	Rocky Point	1	6	5	1	2	16	6	
2.68	11	Little Brushy	1	2	2	2	1	3		
2.43	10	Rattlesnake Island	1	1			1	2	5	
12.65	52	Sandy Beach Floating	21	9	2	4	5	11		
8.52	35	Sandy Beach Sinking	7	4	2	6	3	13		
19.71	81	Rocky Bend	19	7	1	4	15	32	3	
8.51	35	Hackberry Bay	9	8		1	6	4	7	
12.66	52	Cottonwood Cove	18	2			9		23	
100.00	411		20.20	15.57	7.06	5.35	13.63	25.79	12.40	Percent
			83	64	29	22	56	106	51	Number

Figure 12. Distribution of Carp in Lake Diversion.
June 1 through December 31, 1959.

Percent	Total No.	Station	CARP June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
2.94	2	Dam Floating			2					
1.47	1	Dam Sinking	1							
10.29	7	Gravel Beach	1	1	1	2	1	1		
		Midlake Floating								
		Midlake Sinking								
14.71	10	Crappie Creek	3	2	1	1	2	1		
8.82	6	Rock Island	3	1			1	1		
8.82	6	Rocky Point	1	2	2	1				
4.42	3	Little Brushy	2			1				
8.82	6	Rattlesnake Island	3	1	2					
2.94	2	Sandy Beach Floating	1	1						
1.47	1	Sandy Beach Sinking	1							
7.35	5	Rocky Bend			1	4				
23.53	16	Hackberry Bay	1	3	5	2		1	4	
4.42	3	Cottonwood Cove	3							
100.00	68		29.42	16.17	20.59	16.18	5.88	5.88	5.88	Percent
			20	11	14	11	4	4	4	Number

Figure 13. Distribution of Smallmouth Buffalo in Lake Diversion. June 1 through December 31, 1959.

Percent	Total No.	Station	SMALLMOUTH BUFFALO June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1.78	4	Dam Floating				1	3			
3.13	7	Dam Sinking		1	1	2		2	1	
30.35	68	Gravel Beach	4	11	10	11	10	18	4	
1.34	3	Midlake Floating			2	1				
3.13	7	Midlake Sinking		3	1	2		1		
4.91	11	Crappie Creek	3	1	3		3		1	
21.43	48	Rock Island	6	9	3	7	8	11	4	
5.35	12	Rocky Point	2	1	1	5		3		
3.58	8	Little Brushy	2	2	1		1	2		
5.35	12	Rattlesnake Island	2	2	1	1		5	1	
1.34	3	Sandy Beach Floating						3		
.45	1	Sandy Beach Sinking						1		
4.46	10	Rocky Bend	3		1	2	2	2		
7.15	16	Hackberry Bay	6	2	1	5		2		
6.25	14	Cottonwood Cove	8	3			3			
100.00	224		16.08	15.62	11.16	16.52	13.39	22.32	4.91	Percent
			36	35	25	37	30	50	11	Number



DIVERSION LAKE RESERVOIR (Baylor and Archer Counties, Texas)

Job B-15, Project F-7-R-7, Locations of Net Sets

1. Dam Set (floating)
2. Dam Set (sinking)
3. Gravel Beach
4. Midlake (floating)
5. Midlake (sinking)
6. Crappie Creek
7. Rock Island
8. Little Brushy
9. Rocky Point
10. Rattlesnake Island
11. Sandy Beach (floating)
12. Sandy Beach (sinking)
13. Rocky Bend
14. Hackberry Bay
15. Cottonwood Creek