IOWA CONSERVATION COMMISSION

FISHERIES SECTION

COMPLETION REPORT

Study No. 402-3 - Dynamics of Predator-Prey Relationship in DeSoto Bend Lake

PERIOD COVERED 1 APRIL, 73-31 MARCH, 76

COMPLETION REPORT

JUN 1978

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COMPLETION REPORT

RESEARCH PROJECT SEGMENT

STATE: Iowa

STUDY NO: 402-3

STUDY TITLE: Dynamics of Predator-Prey Relationship in DeSoto Bend Lake

Period Covered: 1 April, 1973 through 31 March, 1976

ABSTRACT: Major fish species were studied in DeSoto Bend Lake, a 310 ha (770 ac) man-made oxbow, to determine relative abundance and standing stock. Food consumption, forage selectivity and biological characteristics of predators were also studied. Population estimates for largemouth bass were 8,100 ± 1,400 in 1973, 20,987 ± 2,765 in 1974, and 9,463 ± 2,431 in 1975. Population estimates of channel catfish ranged from 7,000 to 10,000 during the three year study. Relative abundance data indicated a winterkill void created in 1974-1975 was filled by carp, carpsucker, bigmouth buffalo, and smallmouth buffalo. Largemouth bass fed almost exclusively on young fish. Gizzard shad were found in a majority of stomachs during 1973 and 1974, while crappie, carp, and bluegill were the main food items in 1975. Channel catfish fed primarily on chironomids; however, fish consumed, changed from gizzard shad in 1973 and 1974 to crappie, carp, and bluegill in 1975. Largemouth bass and channel catfish grew as rapidly in DeSoto Bend as in other Iowa lakes. Standing stock estimates in 1975 for largemouth bass, channel catfish, black crappie, white crappie and bluegill were: 12 ± 3 kg/ha (11 ± 3 lbs/ac), 32 ± 15 kg/ha (29 ± 14 lbs/ac), 45 ± 12 kg/ha (40 ± 11 lbs/ac), 32 ± 15 kg/ha (29 ± 13 lbs/ac) and 14 ± 4 kg/ha (13 ± 4 lbs/ac). Carp standing stock estimate in 1975 was 221 ± 68 kg/ha (197 ± 61 lbs/ac) nearly twice the total biomass of all sport species. Standing stock estimates of sport species acceptable to anglers in 1975 was 94 ± 40 kg/ha (84 ± 36 lbs/ac), while the standing stock in the same year of non-sport species was 335 ± 121 kb/ha (300 ± 105 lbs/ac).

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STUDY OBJECTIVE

To determine the relative abundance and standing stocks of major fish species; the food consumption, forage selectivity and other biological characteristics of major predators and develop a fisheries management strategy for DeSoto Bend Lake.

INTRODUCTION

DeSoto Bend Lake is the most popular oxbow lake in western Iowa because of recreation facilities, public accessibility and its close proximity to metropolitan areas. The lake is unique because it has the greatest potential for providing sport fishing when compared to existing lakes in Iowa's nine western border counties.

The Iowa Conservation Commission, Nebraska Game and Parks Commission, and United States Fish and Wildlife Service jointly manage the fishery in DeSoto Bend Lake. Management emphasis consisted of population inventories, sport fishery surveys, and fish stocking.

Past fishery surveys and inventories conducted in DeSoto Bend Lake rated sport fish populations poor to good. A 1961 survey by the Bureau of Sport Fisheries and Wildlife revealed 11 indigenous fish species with largemouth bass, channel catfish, and black crappie being the most numerous. A survey in 1962 by Iowa revealed 15 fish species with carp, buffalo, gizzard shad, carpsucker, and gar dominating the fish population. An inter-agency inventory in 1963 sampled 23 fish species with bluegill, carp, crappie, largemouth bass, and gizzard shad most prevalent in the catch. A 1965 survey by Iowa indicated the most numerous fish species were gizzard shad, carp, buffalo, largemouth bass, carpsucker, crappie, and bluegill. The Fisheries Division of Nebraska Game and Parks Commission in 1966 stated carp and crappie were the only species of fish caught by fishermen and recommended complete chemical renovation. A 1968 survey revealed large populations of carp and gizzard shad and small numbers of channel catfish and largemouth bass. The three conservation agencies confirmed the density of undesirable fish exceeded an acceptable level and agreed to total chemical renovation in 1970. Channel catfish was the only game fish species occurring in significant numbers and it did not contribute significantly to sport fishery. Lack of coordination among agencies and lack of funds postponed the renovation project. No additional consideration of renovation has been proposed by any member of the management group.

Several supplemental fish plants were placed in DeSoto Bend Lake in an effort to improve sport fish populations. Twenty thousand largemouth bass fingerlings were stocked in 1961 and 160,000 were stocked the following year (Table 1). No additional largemouth bass were stocked until 1965 when 34,500 fingerlings were added.

Greater effort was expended attempting to create a walleye fishery. During 1962, 2 million walleye fry and 44,000 walleye fingerlings were added to DeSoto Bend Lake. Three million walleye fry and 140,000 fingerlings were stocked in 1963, and 4 million fry were stocked in 1964. Walleye were again stocked in 1966 when 750,000 fry and 50,000 fingerlings were added.

Table 1. Fish stocking at DeSoto Bend Lake from 1961-1971.

Species	Development Stage	Number
1961		
Largemouth bass	Fingerling	20,000
1962		
Largemouth bass	Fingerling	160,000
Walleye	Fry	2,000,000
Walleye	Fingerling	44,000
White bass	Adult	1,700
Channel catfish	Fingerling	80,000
1963		
Largemouth bass	Fingerling	139,000
Channel catfish	Fingerling	53,000
Northern pike	Fry	50,000
Walleye	Fry	3,000,000
Walleye	Fingerling	140,000
1964		
Walleye	Fry	4,000,000
1965		
Largemouth bass	Fingerling	34,000
1966		
Walleye	Fry	750,000
Walleye	Fingerling	50,000
1969		
Black bullhead	Adult	9,000
1970		
Black bullhead	Adult	3,500
Yellow perch	Fingerling	20,000
1971		
Black bullhead	Adult	3,500
1972		
Northern pike	Fry	100,000
Northern pike	Fingerling	10,000

Five additional fish species were stocked in DeSoto Bend Lake. Eighty thousand channel catfish fingerlings and 1,700 adult white bass were stocked in 1962. An additional 53,000 channel catfish fingerlings were placed in the lake during 1963. Northern pike were stocked in 1963 and 1972, with 50,000 fry being added in 1963 and 100,000 fry and 10,000 fingerlings stocked in 1972. Nine thousand adult bullheads were introduced in 1969 and 3,500 adult bullheads were stocked in 1970 and again in 1971. One stocking of 20,000 yellow perch fingerlings occurred in 1970.

DESCRIPTION OF DESOTO BEND LAKE

DeSoto Bend Lake is a 310 ha (770 ac) man-made oxbow located 9.7 km (6 mi) west of Missouri Valley, Iowa. The lake is located in DeSoto Bend National Wildlife Refuge, an area managed as a feeding and nesting area for migratory waterfowl. The oxbow was formed in 1959 when a bend of the Missouri River was separated from the main river channel by two earth and rock levees. Inlet and outlet structures connecting the lake with the Missouri River allow partial control of lake water level.

DeSoto Bend Lake is a long, 12.1 km (7.5 mi) narrow horseshoe-shaped lake with a mean width of 247 m (752 ft) and a maximum width of 411 km (1,252 ft). Maximum depth at 301.6 m MSL is 10.6 m (39 ft) and mean depth is 3.6 m (10 ft). Bottom slope ranges from 3.8% to 48.5% with a mean slope of 4.1%. Thermal stratification occurs intermittantly throughout the summer at a depth of 1.2 m (3-6 ft) (Huggins, 1968).

The lake receives surface runoff water from Rand's Ditch, Young's Ditch and Coulthard's Ditch (Figure 1). Surface runoff originates primarily from cultivated land. Sedimentary turbidity was low except for a band of turbid water adjacent to shore. Plankton blooms occur periodically following periods of extreme runoff and result in greater turbidity. Rooted aquatic vegetation was abundant May through June and formed a continuous aquatic macrophyte community along the entire shoreline extending 10-20 m (33-66 ft) outward. The vegetation belt was partially destroyed during summer months by wave action shear forces and from increased wave action turbidity.

Lake water levels fluctuated greatly from year to year. The mean surface area, May through September, 1973, was 315 ha (778 ac), but during the same period in 1974 the mean surface area was 303 ha (748 ac).

METHODS AND PROCEDURES

Fish sampling consisted of four hours electrofishing near the shoreline, 32 frame net days, and 16 seine hauls per week and was conducted at biweekly intervals 15 April to 30 October each year. The frame nets contained 15.24 m (50 ft) leads with .61 x 1.22 m (2 x 4 ft) frames ahead of a hooped net .61 m (2 ft) in diameter and 2.44 m (8 ft) in length. A winged throat was formed by the frames and two additional throats were located in hoop net section. Webbing of 19 mm (3/4 in) bar measure covered the entire net. Frame nets were set at

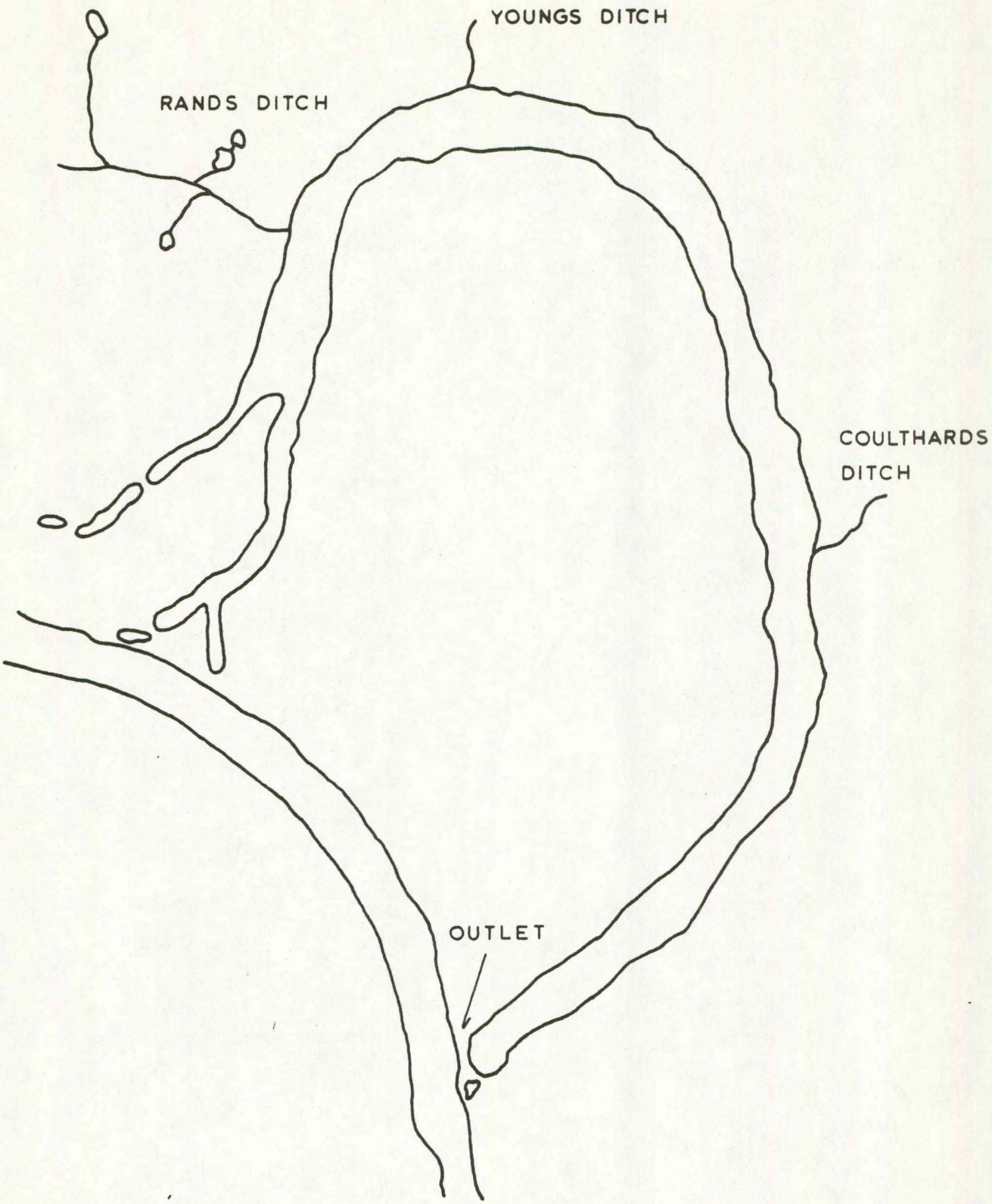

Figure 1. Outline map of DeSoto Bend showing 3 water ditches and outlet channel.

Plate 1. Aerial view of DeSoto Bend Study Area.

permanent sampling sites with leads perpendicular to shore in water depth sufficient to cover the entire net. The electroshocker consisted of a boat outfitted with a 240 volt alternating current generator and three cylindircal electrodes suspended 2.44 m (8 ft) at the front of the boat. The electrodes, 13 mm (1/2 in) in diameter and 1.83 m (6 ft) in length, were located in a row at 1.60 m (5.5 ft) intervals. The boat was driven slowly parallel to shoreline while one person retrieved all stunned fish sufficinetly large to stay in a dip net containing 19 mm (3/4 in) bar measure webbing. A seine composed of 63. m (1/4 in) bar measure web and measuring 15.24 m (50 ft) long by 1.22 m (4 ft) deep was used for all seine hauls. Each seine haul consisted of pulling the seine parallel to shoreline for 15.24 m (50 ft). Seine hauls were taken from four individual permanent sampling stations. All contents were preserved in 10% formalin for later enumeration.

All fish collected age I and older were measured and fin clipped to differentiate between years. A sample of all fish was weighed to determine mean weight of each species.

Population estimates were conducted simultaneously with other study portions using the Peterson equation

$$\hat{N} = \frac{MC}{R}$$

where,

$\hat{N}$ = estimated number in the population
M = total number of fish marked in the sampling period
C = total number of fish captured in the sampling period
R = total number of fish recaptured in the sampling period

Confidence intervals set at the 95% level from the sample standard error with replacement using the fraction:

$$\left(\hat{N} \sqrt{\frac{(\hat{N} - M \quad N - C)}{MC \quad (N - 1)}} \right)$$

where the equation components were the same as before.

Largemouth bass and channel catfish were collected for stomach content analysis from randomly chosen samples collected during each sampling season. Only fish collected with the electroshocker were used for stomach analysis. All fish collected for stomach content analysis were immediately refrigerated for later laboratory examination. Volumetric measurements of stomach contents were made immediately upon removal and individual diet items were identified. If the contents contained fish remains, body length measurements were recorded.

Food preference was determined by the Ivlev procedure:

$$E = \frac{r_i - p_i}{r_i + p_i}$$

where,

r_i = percent occurrence of the i^{th} food item in the stomach

p_i = percent occurrence of the same food item in the seine sample

E = electivity index

Values of food electivity ranged from -1.0 to +1.0 where +1.0 indicated absolute selection for the food item and a -1.0 indicated the food item was ingested, but not selected.

Relative abundance were determined simultaneously with other aspects of the study and estimated directly from catch effort data using fyke net, electro-shocker and seine catches. Standing stocks of major species were calculated annually by multiplying the population estimate of each species by its mean weight.

Age and growth of largemouth bass and channel catfish were determined from scale and spine samples and body length and weight measurements collected monthly. Length-weight regression, body condition factors, and back calculation of body length at each year of life were calculated using conventional procedures in a complete age and growth computer program (Mayhew, 1973).

FINDINGS

RELATIVE ABUNDANCE

Thirty-one fish species inhabited DeSoto Bend Lake, the majority of which are indigenous to the Missouri River. Carp, carpsucker, gizzard shad, and several species of centrachids are the most abundant species of fish. The next most abundant species are leargemouth bass, channel catfish, shortnose gar, smallmouth buffalo, and bigmouth buffalo.

A partial winterkill of fish occurred in DeSoto Bend Lake during the winter of 1974-1975. Estimates of dead fish in March, 1975, revealed gizzard shad, carpsucker and freshwater drum comprised most of the biomass killed. Fifty thousand gizzard shad were lost and their biomass was estimated to be 48.3 kg/ha (43 lbs/ac) (Table 2). Winterkilled freshwater drum and carpsucker totaled 8,000 and 6,000, respectively. Large paddlefish and flathead catfish also winter-killed and their combined biomass was estimated to be 11.2 kg (10 lbs/ac). Total fish biomass killed by the winterkill was estimated to be 91 kg/ha (81 lbs/ac).

Relative abundance of fish species age I and older, was determined directly from catch effort statistics calculated from biweekly samples collected April to October of each study year. Largemouth bass captured by electrofishing were most numerous in 1974 when fish were caught at a rate of 28.6 F/HR (fish/hour); however, during the same year catch rates were highest for channel catfish, bluegill, shortnose gar, carp, carpsucker, and gizzard shad (Table 3). Black and white crappie were captured by electrofishing with greatest success in 1975, as were smallmouth buffalo. The species most abundant in fyke nets were black crappie, white crappie, carp, carpsucker, and shortnose gar (Table 3). Black crappie and white crappie were more abundant in fyke nets during 1975 than during the previous study year. Largemouth bass and gizzard shad were much less vulnerable to netting than electrofishing.

Table 2. Estimated numbers and biomass of fish species killed during 1974-1975 winterkill in DeSoto Bend.

Species	Number	Biomass	
		kg/ha	(lbs/ac)
Paddlefish	70	6.0	5.5
Flathead catfish	120	5.2	4.6
Gizzard shad	50,000	48.3	43.3
Carpsucker	6,000	17.4	15.5
Carp	1,000	5.0	4.5
Channel catfish	900	1.7	1.5
Freshwater drum	8,000	7.8	6.9
Total		91.4	81.8

Table 3. Mean catch rate of fish sampled from DeSoto Bend Lake, April through November.

	1973		1974		1975	
	F/HR*	F/ND**	F/HR	F/ND	F/HR	F/ND
Largemouth bass	19.0	.1	28.6	.2	6.3	.1
Channel catfish	1.0	.2	3.1	.3	.59	.2
Black crappie	4.7	3.0	4.2	1.2	6.3	2.1
White crappie	4.4	3.0	1.9	.8	4.2	2.6
Bluegill	18.6	3.8	26.7	2.1	7.1	1.4
Shortnose gar	.5	1.7	2.4	1.1	.3	.2
Carp	8.0	1.8	11.1	.5	10.3	.4
Carpsucker	6.1	1.5	7.5	.6	5.3	.4
Gizzard shad	7.0	.3	26.3	.2	0	0
Bigmouth buffalo	1.3	.3	.6	.1	1.2	.2
Smallmouth buffalo	.7	.1	.7	.1	1.2	.3

*Fish per hour of electrofishing.

**Fish per net day.

Seine haul data were used to determine relative abundance of forage fish species. Eleven fish species were identified from the 95,380 fish sampled by seineing. Bluegill were the most abundant age 0 sport species in all study years and was collected at a mean rate of 66.3, 28.7, and 7.3 fish per seine haul (F/SH) (Table 4). Largemouth bass were the second most abundant sport fish sampled during all study years although catch rates were only 2.1 F/SH in 1974. The highest channel catfish age 0 relative abundance was 4.3 F/SH and was attained in 1973, but catch declined to 0 F/SH in 1975. Black crappie catch rates ranged from .08 F/SH in 1973 to .4 F/SH in 1975. White crappie catch rates increased from .1 F/SH during the first study year to 4.2 F/SH in 1975.

Table 4. Relative abundance of age 0 fish in DeSoto Bend Lake.

Species	Mean number/seine haul 1973	1974	1975
Bluegill	66.3	28.7	7.3
Largemouth bass	29.0	2.1	10.3
Channel catfish	4.3	1.0	0
Black crappie	.08	.15	.4
White crappie	.1	.8	4.2
Gizzard shad	94.7	78.7	0
Carp	12.5	5.8	10.3
Bigmouth buffalo	11.1	54.8	36.0
Smallmouth buffalo	0	3.0	14.3
Carpsucker	1.93	6.7	10.8
Drum	.6	1.4	1.62

Seine haul catch rates were determined for six major non-sport species. Gizzard shad were most abundant age 0 fish collected during the first two study years, but none were collected in 1975. Mean catch of gizzard shad was 94.7 F/SH in 1973 and 78.7 F/SH in 1974.

Relative abundance of age 0 carp was greatest in 1973 while the 1975 year class appeared to be double that established in 1974. Bigmouth buffalo reproductive success was best in 1974 when age 0 fish were collected at a mean rate of 54.8 F/SH. This species was the third most numerous non-sport fish in 1973 seine hauls, but the most numerous in 1975 by two and one-half times other non-sport species. Smallmouth buffalo were more abundant in seine hauls during 1975 than preceding study years; however, density of 0 age bigmouth buffalo was consistently greater. Carpsucker young-of-the-year were sampled each study year and increased in density as study progressed. Freshwater drum were the least abundant non-sport species found in seine hauls, but were collected at low densities in all study years.

POPULATION ESTIMATES

Validity of fish population estimates rely upon six assumptions listed by Ricker (1958). The only assumption not met in this study dealt with recruitment. Recruitment was minimized by fin clipping only fish age I and older. All fish captured were immediately placed in a live tank, body measurements taken, fin clipped and released. Marked fish did not appear to suffer increased mortality compared with unmarked fish.

Largemouth bass achieved their greatest density in 1974 (Table 5), and were the fourth most numerous sport fish in DeSoto Bend during all study years.

Table 5. Population estimates (N) and 95% confidence intervals for major fish species inhabiting DeSoto Bend Lake, 1973 to 1975.

Species	1973		1974		1975	
	N	95% confidence interval	N	95% confidence interval	N	95% confidence interval
Largemouth bass	8,100	± 1,400	20,987	± 2,765	9,463	± 2,431
Channel catfish	7,200	± 3,400	10,243	± 3,520	8,395	± 4,105
Black crappie	86,000	± 45,000	70,347	± 28,000	106,734	± 29,277
White crappie	81,000	± 31,462	35,834	± 16,000	94,376	± 28,630
Bluegill	23,494	± 13,200	95,832	± 16,292	51,774	± 13,133
Shortnose gar	24,024	± 13,717	17,200	± 4,463	3,645[a]	± 2,517
Carp	35,000	± 15,142	58,705	± 23,482	48,632	± 15,124
Bigmouth buffalo	2,256	± 1,080	No recapture		10,137[b]	± 10,036
Smallmouth buffalo	2,480	± 1,172	No recapture		18,090	± 8,910
Carpsucker	37,000	± 18,380	20,152	± 4,481	15,639	± 4,820
Gizzard shad	38,416[b]	± 18,960	175,350	± 4,463	0	0
Freshwater drum	18,600	± 4,500	13,247	± 5,809	0	0

[a]Underestimated 20%.

[b]Underestimated 37%.

Channel catfish were the least numerous sport fish in DeSoto Bend. The catfish population peaked in 1974 and numbers declined in 1975. Black crappie was the most abundant sport species sampled in 1973 and 1975, but was second in numbers during 1974. The white crappie population density was less than that of the black crappie population during all study years. Estimates of the white crappie population peaked in 1975 but was lowest in 1974. During the last study year, the population estimate of white crappie was 94,376 fish. Bluegill was the most

numerous sport species in 1974, but was third most numerous during the other two study years. The bluegill population was estimated at 51,774 fish in 1975.

Gizzard shad was the most numerous species in DeSoto Bend prior to a winterkill which reduced the population sufficiently to eliminate shad from the sampling gear. The gizzard shad population was estimated at 175,350 fish in 1975. Freshwater drum was another species substantially reduced in numbers by the winterkill. The 1974 population estimate was 13,247, however, no drum were sampled in 1975. Carpsucker were the second most numerous non-sport species sampled in 1973, but were third most numerous when collections ceased. Carp was the most numerous non-sport species in 1975, when their population estimate was 48,632 declining from 58,705 in 1974. No recaptures were collected in 1974 for either bigmouth buffalo or smallmouth buffalo. The bigmouth buffalo population was estimated to be 10,137 fish in 1975 which is underestimated by 37% according to Robson and Regier (1964). Smallmouth buffalo maintained a population density similar to bigmouth buffalo throughout the study. Shortnose gar was the least abundant non-sport species in 1975.

FOOD CONSUMPTION AND SELECTIVITY

Eight species of fish were identified in largemouth bass stomachs during the study (Table 6). Gizzard shad was the most commonly eaten species in 1973 and 1974 but none were consumed in 1975. Silvery minnow was the second most common food item in 1973 and 1974, but none were found in bass stomachs during the last study year. Bluegill were the third most common bass forage in 1973 and 1974 and remained so in 1975 when no young shad were present. Crappie young were not found in bass stomachs during 1973 but were the most frequently consumed food organism in 1975. Carp were not found in bass stomachs prior to 1975, but became the second most abundant item consumed during the period. Buffalo fish young were not identified in stomach samples until 1975 when they were the fourth most frequently consumed fish species.

Table 6. Frequency of occurrence of food items found in largemouth bass collected from DeSoto Bend Lake.

Food item	1973 %	1974 %	1975 %
Gizzard shad	60.0	47.3	0
Silvery minnow	15.9	5.0	0
Bluegill	1.6	3.5	8.6
Red shiner	0	5.0	2.3
Crappie	0	1.6	12.8
Drum	0	.7	2.3
Carp	0	0	9.5
Buffalo	0	0	4.1

Largemouth bass food preferences in 1973, based on Ivlev's electivity index, showed gizzard shad was the most selected food (Table 7). Crappie and drum were preferred food items of largemouth bass in 1974. Largemouth bass were selecting gizzard shad slightly in 1973 and 1974, and were strongly selecting crappie and drum in 1974. Bluegill, crappie and drum were positively selected in 1975.

Table 7. Electivity index of largemouth bass sampled from DeSoto Bend Lake.

Species	Electivity index 1973	1974	1975
Gizzard shad	.07	.05	0
Bluegill	-.89	-.66	.98
Crappie	.0	.93	.99
Drum	.0	.97	.99
Carp	-1.0	-1.0	-.06
Buffalo	-1.0	-1.0	-.85

Ten different food items were identified in channel catfish stomachs during the study. Five different food items were found in 1973, seven in 1974, and six in 1975 (Table 8). Chironomid larvae were the most frequently ingested food in 1973 and 1974; however, fish contributed most to the total volume of food consumed. In 1974, chironomids were the most important food item, but algae and gizzard shad were found in fewer stomachs. Largemouth bass were found in 2.3% of channel catfish stomachs. Bluegill, carp, and crappie became the most important food items of channel catfish in 1975, the year after the winterkill.

Food selectivity based on Ivlev's electivity index showed no fish species were selected in 1973 (Table 9). Gizzard shad, bluegill, largemouth bass, carp, and crappie had negative indexes ranging from -.73 to -1. Nearly the same results occurred in 1974 with indexes ranging from -.58 to -1. Bluegill, crappie and carp were selected food items in 1975.

Table 8. Frequency of occurrence of food items found in channel catfish sampled from DeSoto Bend Lake.

Food item	1973 %	1974 %	1975 %
Chironomids	10.0	17.3	9.1
Algae	8.8	5.4	5.5
Gizzard shad	6.6	3.7	0
Bluegill	2.5	4.1	7.5
Tricoptera	2.2	1.2	0
Largemouth bass	0	2.3	0
Crayfish	0	1.6	0
Carp	0	0	12.5
Crappie	0	0	7.6
Red shiner	0	0	3.3

Table 9. Electivity index of channel catfish sampled from DeSoto Bend Lake.

Species	Electivity index 1973	1974	1975
Gizzard shad	- .73	- .84	0
Bluegill	- .84	- .58	.97
Largemouth bass	-1.0	- .91	-1.0
Carp	-1.0	-1.0	.07
Crappie	-1.0	-1.0	.97

AGE AND GROWTH OF LARGEMOUTH BASS

Several aspects of the age and growth of largemouth bass in DeSoto Bend Lake were studied. Length-weight relationship, length at each annulus, and condition factors were determined from scale samples and body measurements. Sixty-eight scale samples were collected from bass in 1973, 74 in 1974, and 60 in 1975. Scales were removed from a location three rows above the lateral line at the anterior of the dorsal fin.

Length-weight relationship

Largemouth bass length-weight relationship was computed independently for three years using the transformed linear regression model:

$$\text{Log}_{10}W = \log_{10} a + b \log_{10}TL$$

where W is weight in grams and TL is total length in millimeters. Data were grouped in 25 mm (1 in) intervals ranging from 114 mm (4.5 in) to 560 mm (22 in) in 1973, 105 mm (4.1 in) to 510 mm (20.1 in) in 1974, and 137 mm (5.4 in) to 314 mm (12.4 in) in 1975.

The following constants were computed from paired length and weight observations.

1973 $\text{Log}_{10}W = -4.768 + 2.989 \text{ Log}_{10}TL$

1974 $\text{Log}_{10}W = -4.930 + 3.067 \text{ Log}_{10}TL$

1975 $\text{Log}_{10}W = -5.655 + 3.353 \text{ Log}_{10}TL$

with correlation coefficients (r) of .999 for 1973 and 1974 and .994 for 1975.

Condition factor

Mean condition factor (K) was compared for fish captured during each year of the study (Table 10). In 1973 (K) values ranged from 1.21 to 1.75 and mean (K) was 1.60. Values of (K) ranged from 1.54 to 2.00 during 1974 when mean (K) was 1.74. Values of (K) were lower during the last study year, ranging from 1.13 to 1.84, and mean K value was 1.54. Larger fish, generally, had higher K values than the smaller fish sampled during the same year.

Table 10. Condition factors for largemouth bass sampled from DeSoto Bend Lake.

1973		1974		1975	
Class range (mm)	K	Class range (mm)	K	Class range (mm)	K
88-113	1.70	105-130	1.75	110-125	1.36
113-138	1.55	130-155	1.76	125-140	1.13
138-163	1.83	155-180	1.68	140-155	1.37
163-188	1.33	180-205	1.57	155-170	1.24
213-238	1.75	205-230	1.66	170-185	1.51
238-263	1.72	230-255	1.59	215-230	1.54
263-288	1.59	255-280	1.75	230-245	1.61
288-313	1.49	280-305	1.61	245-260	1.82
313-338	1.63	305-330	1.84	260-275	1.84
338-363	1.57	330-355	1.81	275-290	1.64
388-413	1.65	355-380	1.54	290-305	1.50
413-438	1.61	380-405	1.82	305-320	1.81
488-513	1.85	405-430	1.81	320-335	1.79
513-538	1.64	455-480	1.76	350-365	1.42
538-563	1.21	480-505	2.00		
		505-530	1.96		
Mean	1.60		1.74		1.54

Body growth in length

Estimated total length of largemouth bass at each annulus was combined by year class and the grand average total length was computed (Table 11). Mean total length for the first six years of life was estimated at 109 mm (4.3 in), 223 mm (8.8 in), 304 mm (12 in), 359 mm (14.1 in), 366 mm (14.4 in), and 382 mm (15 in). Total length by successive summations of mean increments at age 1 through 5 were 75 mm (3 in), 187 mm (7.4 in), 260 mm (10.2 in), 312 mm (12.3 in), and 355 mm (14 in). Growth was most rapid for the first two years and declined as age increased.

Table 11. Estimated total body length in mm (in) for largemouth bass in DeSoto Bend Lake.

Year class	Year of life						
	1	2	3	4	5	6	7
1969	70 (2.8)						
1970	86 (3.4)	179 (7.0)					
1971	82 (3.2)	184 (7.2)	250 (9.8)				
1972	120 (4.7)	285 (11.2)	385 (15.2)	435 (17.1)			
1973	125 (4.9)	227 (8.9)	305 (12.0)	347 (13.7)	375 (14.8)		
1974	210 (8.3)	280 (11.0)	320 (12.6)	345 (13.6)	370 (14.6)	380 (15.0)	
1975	75 (3.0)	187 (7.4)	260 (10.2)	312 (12.3)	355 (14.0)	385 (15.2)	405 (15.9)
$\bar{X}$ total length	109 (4.3)	223 (8.8)	304 (12.0)	359 (14.1)	366 (14.4)	382 (15.0)	405 (15.9)
$\bar{X}$ increment	109 (4.3)	114 (4.5)	81 (3.2)	55 (2.2)	7 (.3)	16 (.6)	23 (.9)

AGE AND GROWTH OF CHANNEL CATFISH

Aspects of age and growth were determined from channel catfish from 1973 to 1975. Length-weight relationship, length at each annulus and condition factors were determined from pectoral spine samples and body measurements. Sixty-six samples were collected in 1973, 70 in 1974, and 52 in 1975.

Length-weight relationships were computed independently for the three study years using the same transformed linear regression model as used for largemouth bass. Data were grouped in 25 mm (1 in) intervals ranging from 382 (15 in) to 582 mm (22.9 in) in study year one, 430 to 710 mm (16.9 to 27.9 in) in 1974, and 300 to 520 mm (11.8 to 20.5 in) for the last year.

The following constants were computed from paired length and weight observations.

1973 $\text{Log}_{10}W = -5.965 + 3.345 \log_{10}TL$

1974 $\text{Log}_{10}W = -5.600 + 3.207 \log_{10}TL$

1975 $\text{Log}_{10}W = -4.660 \quad 2.853 \log_{10}TL$

Correlation coefficients (r) for each successive yearly regressions were .883, .931, and .948.

Condition factor

Mean condition factor (K) was compared for channel catfish captured during three samples years (Table 12). Values of (K) for channel catfish ranged from .87 to 1.14 during the first study year. In 1974, (K) values ranged from .86 to 1.20, while in the third study year values ranged from .73 to 1.11. Mean (K) values of channel catfish were .98, .96, .91 for 1973, 1974, and 1975, respectively. Small catfish generally were in better body condition than larger individuals.

Table 12. Condition factors by length intervals for channel catfish sampled from DeSoto Bend Lake.

1973		1974		1975	
Class range (mm)	K	Class range (mm)	K	Class range (mm)	K
382-407	1.12	390-415	1.20	290-315	1.11
407-432	.90	415-440	.89	315-340	.92
432-457	.87	440-465	.86	340-365	.92
457-482	.89	465-490	.90	365-390	.73
482-507	.91	490-515	.89	390-415	.99
507-532	1.04	515-540	1.07	415-440	.90
532-557	.97	540-565	.90	440-465	.83
557-582	1.14	615-640	1.03	465-490	.88
		640-665	1.03	490-515	.87
		690-715	.87	515-565	1.04
				540-565	.87
Mean	.98		.96		.91

Body growth in length

Estimated total length at each annulus was combined by year class and the grand average total length was computed (Table 13). Mean total length for the first four years of life was estimated to be 60, 147, 224, and 301 mm (2.4, 5.8, 8.8 and 11.8 in). Total length by successive summations of mean increments was 64, 151, 236 and 297 mm (2.5, 5.9, 9.3 and 11.7 in) for the first four years of life. Mean increment of growth decreased as the fish age increased. Mean growth increment was 64 mm (2.5 in) as age 0 and decreased to 46 mm (1.8 in) in the seventh year of life.

Table 13. Estimated total body length in mm (in) for channel catfish in DeSoto Bend Lake.

Year class	Year of life							
	1	2	3	4	5	6	7	8
1971	71 (2.8)	157 (6.2)	236 (9.3)	309 (12.2)	363 (14.3)			
1972	70 (2.8)	158 (6.2)	242 (9.5)	298 (11.7)	363 (14.3)	407 (16.0)		
1973	61 (2.4)	148 (5.8)	233 (9.2)	390 (11.4)	345 (13.6)	405 (15.9)	473 (18.6)	
1974	60 (2.4)	146 (5.7)	223 (9.2)	288 (11.3)	355 (14.0)	413 (16.3)	466 (18.3)	522 (20.6)
1975	60 (2.4)	147 (5.8)	245 (9.6)	301 (11.9)	349 (13.7)	418 (16.6)	480 (18.9)	532 (20.9)
$\bar{X}$ total length	64 (2.5)	151 (5.9)	236 (9.3)	297 (11.7)	353 (13.9)	413 (16.3)	473 (18.6)	527 (20.7)
$\bar{X}$ increment	64 (2.5)	87 (3.4)	84 (3.3)	61 (2.4)	58 (2.3)	63 (2.5)	56 (2.2)	46 (1.9)

STANDING STOCK OF SPORT SPECIES

Total standing stock of five sport species in DeSoto Bend Lake ranged from 100 kg/ha (89 lbs/ac) in 1973 to 135 kg/ha (120 lbs/ac) during the last study year. Largemouth bass standing stock estimates were highest in 1974 while 1973 and 1975 biomass was similar (Table 14). Standing stock in the first and last study year was 11 ± 2 kg/ha (10 ± 2 lbs/ac) and 12 ± 3 kg/ha (11 ± 3 lbs/ac), respectively. Channel catfish standing stock in 1973 was similar to the bass stock but increased during the study. In 1974, catfish standing stock was 27 ± 9 kg/ha (24 ± 8 lbs/ac) and increased to 32 ± 15 kg/ha (29 ± 14 lbs/ac) in 1975. Black crappie had the highest standing stock of any sport fish in DeSoto Bend during all study years. Black crappie standing stock ranged from 32 ± 13 kg/ha (29 ± 12 lbs/ac) in 1974 to 45 ± 12 kg/ha (40 ± 11 lbs/ac) in 1975. White crappie were the second most abundant sport species in terms of biomass. White crappie standing stock increased from 20 ± 8 kg/ha (18 ± 8 lbs/ac) in 1974 to 32 ± 15 kg/ha (29 ± 14 lbs/ac) during the last study year. Bluegill biomass was the least of all sport species in 1973 and 1974, but was slightly higher than bass biomass in 1975. Bluegill standing stock reached 21 kg/ha (19 lbs/ac) in 1974 but dropped nearly 40% in 1975 when the standing stock totaled 14 ± 4 kg/ha (13 ± 3 lbs/ac).

Although Age 1 and older bluegill and crappie biomass in 1975 was estimated at 99 kg/ha (89 lbs/ac), not all fish are acceptable to anglers. Only seventeen percent of the black crappie exceeded 200 mm (8 in) (Table 15). Biomass of black crappie over 200 mm (8 in) was 25 kg/ha (22 lbs/ac) in 1975.

Table 14. Standing stock of major sport fish species in DeSoto Bend Lake.

Species	Standing stock 1973 kg/ha	1973 lbs/ac	1974 kg/ha	1974 lbs/ac	1975 kg/ha	1975 lbs/ac
Largemouth bass	11 ± 2	10 ± 2	26 ± 3	23 ± 3	12 ± 3	11 ± 3
Channel catfish	10 ± 5	9 ± 4	27 ± 9	24 ± 8	32 ± 15	29 ± 13
Black crappie	41 ± 21	37 ± 19	32 ± 13	29 ± 12	45 ± 12	40 ± 11
White crappie	31 ± 19	28 ± 17	20 ± 8	18 ± 7	32 ± 15	29 ± 13
Bluegill	7 ± 4	6 ± 4	21 ± 4	19 ± 4	14 ± 4	13 ± 4
Total	100 ± 51	90 ± 43	126 ± 37	113 ± 34	135 ± 49	121 ± 44

Table 15. Percent by number and weight of black crappie in DeSoto Bend during 1975.

Class range (mm)	Number	Weight
125-150	44	19
150-175	24	21
175-200	15	16
200-225	3	5
225-250	11	28
250-275	3	11

White crappie larger than 200 mm (8 in) in 1975 was 18%, but the percent of the biomass was 44% (Table 16). Total biomass in 1975, of black and white over 200 mm (8 in) was 34 ± 12 kg/ha (30 ± 11 lbs/ac). Thirty-six percent of the bluegills were over 150 mm (6 in), while bluegill biomass contained in fish over 150 mm (6 in) was 50% or 8 kg/ha (7 lbs/ac) in 1975 (Table 17).

Table 16. Percent by number and weight of white crappie in DeSoto Bend, 1975.

Class range (mm)	Number	Weight
125-150	42	18
150-175	17	15
175-200	22	23
200-225	3	4
225-250	5	10
250-275	10	25
275-300	1	5

Table 17. Percent by number and weight of bluegill in DeSoto Bend, 1975.

Class range (mm)	Number	Weight
100-125	34	15
125-150	29	25
150-175	16	20
175-200	13	23
200	7	17

STANDING STOCKS OF NON-SPORT FISH SPECIES

Total biomass of non-sport species in DeSoto Bend ranged from 487 ± 177 kg/ha (434 ± 157 lbs/ac) in 1974 to 335 ± 121 kg/ha (299 ± 108 lbs/ac) in 1975 (Table 18). Carp standing stock steadily increased during the study and contributed more biomass than any species. Carp biomass was greater than the combined sport fish biomass by nearly 50%. In 1975, carp standing stock was estimated at 221 ± 68 kg/ha (197 ± 61 lbs/ac).

Carpsucker standing stock decreased during the study as did the biomass of shortnose gar and freshwater drum. Gizzard shad had the second highest biomass in 1974 at 174 ± 70 kg/ha (156 ± 63 lbs/ac) but were virtually eliminated during the winterkill. Standing crop of both species of buffalo increased from 14 kg/ha (13 lbs/ac) in 1973 to 45 kg/ha (40 lbs/ac) in 1975.

Table 18. Standing stocks of major non-sport fish species in DeSoto Bend Lake.

Species	Standing stock					
	1973		1974		1975	
	kg/ha	lbs/ac	kg/ha	lbs/ac	kg/ha	lbs/ac
Shortnose gar	44 ± 25	39 ± 22	36 ± 9	32 ± 8	9[a] ± 6	8 ± 5
Carp	147 ± 63	132 ± 56	187 ± 75	168 ± 67	221 ± 68	197 ± 61
Bigmouth buffalo	8 ± 2	7 ± 2	No estimate		22[b] ± 21	20 ± 19
Smallmouth buffalo	6 ± 2	6 ± 2	No estimate		23 ± 11	21 ± 10
Carpsucker	121 ± 58	109 ± 52	74 ± 16	66 ± 15	60 ± 15	54 ± 14
Freshwater drum	24 ± 6	22 ± 6	16 ± 7	15 ± 6	No estimate	
Gizzard shad	72[b] ± 37	64 ± 33	174 ± 70	156 ± 63	No estimate	
Total	422 ±193	379 ±173	487 ±177	437 ±159	335 ±121	300 ±109

[a]Underestimated by 20%.

[b]Underestimated by 38%.

DISCUSSION OF FINDINGS

Numerous attempts to develop a suitable sports fishery in DeSoto Bend Lake have occurred; the major efforts were maintenance stockings of walleye, northern pike, white bass, largemouth bass, and channel catfish. These past management efforts have failed to maintain an acceptable sport fishery.

Relative abundance data revealed gizzard shad were eliminated by a winterkill; but, carp, carpsucker, and buffalo fish catch efforts remained at the same level as those preceeding the winterkill or were higher, indicating these population levels didn't decrease.

Age 0 sport fish relative abundance data indicated a decline in bluegill and channel catfish reproduction but better largemouth bass reproduction. All non-sport species reproductive success, except bigmouth buffalo, was better in 1975 than during the preceeding year. This data indicated the void created by the winterkill was filled by carp, both fuffalo fish species, carpsucker and drum.

First food of largemouth bass were small zooplankton and, as body size increased, insects became more important in the diet and later in life bass consumed small fishes. Fish are important in the diet of adult largemouth bass and constitute as much as 60% of the total stomach content vlume (Couey, 1935). Crayfish are important food and make up a substantial part of the diet. A wide variety of foods are consumed by bass and in some areas gizzard shad is an important food source (Dendy, 1946).

Largemouth bass stomach analysis data showed a switch from gizzard shad as the dominant prey in 1973 and 1974 to crappie, bluegill, and carp as the main forage in 1976. Channel catfish also changed from gizzard shad to bluegill, carp, and crappie. The electivity index indicated crappie, bluegill, and carp were being selected as food items in 1975, but during 1973 and 1974 no selection occurred for the same species.

Paragamian (1977) calculated a length-weight regression for largemouth bass in Big Creek Lake for:

$$1973 = \log_{10}W = -4.58 + 2.90 \log_{10}TL$$
$$1974 = \log_{10}W = -5.95 + 3.45 \log_{10}TL$$
$$1975 = \log_{10}W = -5.44 + 3.23 \log_{10}TL$$

where W = weight in grams and TL in total length in millimeters.

Using the 1973, 1974, and 1975 length-weight regressions from this study, a 250 mm (10 in) fish would weight 250 gr (.55 lbs) in 1973, 264 gr (.58 lbs) in 1974, and 241 gr (.53 lbs) in 1975; and the same fish in Paragamian's study would weigh about 235 gr (.52 lbs) in 1973, 210 gr (.46 lbs) in 1974, and 200 gr (.44 lbs) in 1975. Largemouth bass in DeSoto Bend Lake were significantly heavier at all lengths than Big Creek Lake largemouth bass.

Mitzner (1977) found length-weight regressions for largemouth bass in Bobwhite Lake to be:

$$1973 = \log_{10}W = -5.237 + 3.164 \log_{10}TL$$
$$1974 = \log_{10}W = -5.319 + 3.190 \log_{10}TL$$
$$1975 = \log_{10}W = -5.438 + 3.225 \log_{10}TL$$

where body measurements were in grams and millimeters. The same size fish, 250 mm (10 in), in Bobwhite Lake would weight 219 gr (.48 lbs) in 1973, 212 gr (.47 lbs) in 1974, and 196 gr (.43 lbs) in 1975.

Paragamian (1977) found largemouth bass in Big Creek Lake attained mean lengths of 140 mm (5.5 in), 220 mm (8.7 in), 310 mm (12.2 in) and 350 mm (13.8 in) for Ages I, II, III, and IV. Mitzner (1977) found largemouth bass in Red Haw Lake attained mean lengths of 100 mm (4 in), 150 mm (6 in), 220 mm (8.7 in) and 300 mm (12 in) for Ages I through IV. Bass in DeSoto Bend grew as rapidly as those in Big Creek Lake, a new impoundment and considerable faster than those in Red Haw Lake.

In this study, a 450 mm (17.7 in) channel catfish would weight 812 gr (1.8 lbs) in 1973, 810 gr (1.8 lbs) in 1974, and 811 gr (1.8 lbs) in 1975. Muncy (1959) calculated the following regressions for channel catfish in the Des Moines River:

$$\text{Log}_{10}W = -5.401 + 3.133 \log_{10}TL$$

A 450 mm (17.7 in) fish in the Des Moines River would weigh slightly more than catfish of identical lengths in DeSoto Bend. Appelget and Smith (1951) calculated the following regression for channel catfish in the Mississippi River.

$$\text{Log}_{10}W = -6.789 + 3.66 \log_{10}TL$$

Catfish in the Mississippi River which were 450 mm (17.7 in) in length would weigh 894 gr (1.96 lbs), about 80 gr (.18 lbs) heavier than a similar fish in DeSoto Bend.

Channel catfish (K) values observed in DeSoto Bend are similar to those calculated for catfish sampled from nearby waters. Muncy (1959) calculated a mean (K) of .83 for catfish in the Des Moines River and Birkenholy and Fritz (1956) determined a mean (K) of .97 for catfish in Little Wall Lake. Fogle (1961) found the mean (K) value for catfish in Oahe Lake to be .97.

A decline in channel catfish body condition was observed in DeSoto Bend as mean K values decreased from .98 in 1973 to .91 in 1975. The decrease noted in 1975 is partially explained by the lack of gizzard shad which were preyed on in 1973 and 1974.

Helms (1965) found catfish in Coralville Lake to attain 84, 157, 211, 267 and 330 mm (3.3, 6.2, 8.3, 10.5 and 11.8 in) during the first five years of life. Harrison (1957) recorded similar growth from catfish in the Mississippi River. His growth recordings were 66, 150, 211, 254 and 315 mm (2.6, 6, 8.3, 10 and 12.4 in) for the first five years of life. Iowa Conservation Commission (1961) calculated catfish growth in DeSoto Bend Lake to be 61, 145, 239, 275 and 330 mm (2.4, 5.7, 9.4, 11, and 12.9 in) for the first five years. DeSoto Bend catfish grew at nearly the same rate in this study as they did in 1961 and only slight growth differences occurred at different locations in Iowa.

Largemouth bass and channel catfish in DeSoto Bend grew as rapidly as other populations in the state and the length-weight relationships compared favorably to others in the state indicating these two species are not experiencing sufficient interspecific competition to result in poor growth or condition factors.

Standing data revealed high biomasses indicating a productive lake, but 75% of the biomass was in non-sport fish species. In 1975, the standing stock of five sport species totaled 135 kg/ha (120 lbs/ac), but biomass of carp alone was nearly twice that of all five sport species. Black and white crappie standing stock in 1975 totaled 77 kg/ha (69 lbs/ac) while bluegill biomass was 14 kg/ha (12 lbs/ac). Assuming a 200 mm (8 in) and a 150 mm (6 in) bluegill are the minimum accepted size for these species the biomass and numbers would be significantly lower. Crappie biomass, acceptable to anglers, is 34 kg/ha (30 lbs/ac) while 50% of the bluegill biomass is angler accepted.

Assuming most anglers will accept a 200 mm (8 in) bass and a 250 mm (10 in) catfish, most of the bass and catfish biomass were angler acceptable. The total sport species standing crop that was sufficiently large for angling was 81 ± 32 kg/ha (74 ± 29 lbs/ac). Non-sport species standing crop total 335 ± 121 kg/ha (300 ± 105 lbs/ac) following a winterkill that eliminated 174 kg/ha (155 lbs/ac) of gizzard shad.

Present conditions are not suitable for an acceptable sport fishery nor do conditions warrent more fish plants. With twenty-three fish species inhabiting DeSoto Bend Lake, most niches are filled and considerable intraspecific competition exists. Seine haul data indicates the winterkill void is being filled by carp, carpsucker and two species of buffalo. Non-sport species standing stock is 335 kg/ha (300 lbs/ac) while sports species standing stock acceptable to anglers is 81 kg/ha (74 lbs/ac). The future of DeSoto Bend Lake as a sports fishery is bleak, if fish management continues to be fish stockings and fish surveys.

A sound management program would increase fishing pressure from 20,000 angler hours to nearly 100,000 angler hours. Catch rates will increase from the present .15 to 1.75 fish/hr. Total number of fish harvested will increase from the present 3,000/year to nearly 175,000 fish/yr. DeSoto Bend could maintain an annual harvest of 120,000 lbs without overexploitation (Joe Schwartz, personal communication).

RECOMMENDATIONS

The present large standing stock of non-sport fish and the poor control over entrance of non-sport species from the Missouri River renders successful fish management impossible.

1. A successful sports fishery program can only be initiated with any degree of success if adequate control structures are constructed to manipulate lake water levels without allowing passage of river species into the lake.

2. With adequate control structures in place the lake should be renovated with a selective piscicide to remove all scaled species. Fish plants to establish the following species will be necessary: bluegill, crappie, largemouth bass, walleye, and tiger muskelunge. Supplemental stockings of channel catfish will also be necessary to maintain their numbers.

3. With adequate control structures in place DeSoto Bend Lake should be completely renovated and stocked with the above species in addition to channel catfish.

4. If control structures are not constructed the lake should be renovated with a selective piscicide and restocked with the above species, but the inlet and outlet tubes should not be opened for a minimum of 2 years after stockings to enable a sport fishery to develop. This alternative would supply a sport fishery for a minimum of 6 years, but a long-term sports fishery would be jeopardized.

5. An alternative to recommendation 4 is to completely renovate the fish populations and re-establish the above species plus channel catfish.

6. Night fishing should be permitted to better utilize the channel catfish population.

7. Better fishing access could be provided on the north and east sides of DeSoto Bend Lake to benefit shore anglers.

8. Fish habitat structures should be constructed to concentrate fish and marked to encouarge angler use.

9. Ice fishing season lengths should be liberalized to develop a better winter fishery.

LITERATURE CITED

Appelget, J. and L. Smith, Jr. 1951. The determination of age and rate of growth from vertebrae of the channel catfish, *Ictaluris lacustris punctatus*. Trans. Amer. Fish. Soc. 80:119-39.

Bailey, R. and H. Harrison. 1948. Food habits of the southern channel catfish, *Ictalurus lacustric punctatus*, in the Des Moines River, Iowa. Trans. Amer. Fish. Soc. 75:133.

Birkenholy, D. and A. Fritz. 1956. Fishes of Little Wall Lake, Iowa. Ia. St. Univ. Coop. Fish. Unit. 21 p.

Couey, F. 1935. Fish food studies of a number of northeastern Wisconsin lakes. Trans. Wisc. Acad. Sci. Arts and Lett. 29:131-172.

Dendy, J. 1946. Food of several species of fish, Norris Reservoir, Tennessee. J. Tenn. Acad. Sci. 21(1):105-127.

Fogle, N. 1961. Report of fisheries investigations during the third year of impoundment of Oahe Reservoir, South Dakota, 1960. S.D. Dept. Game, Fish and Parks D-J Proj., F-1-R-10 (Job 9-12). 57 p.

Harrison, H. 1957. Growth of the channel catfish, *Ictaluris punctatus* (Rafinesque), in some Iowa waters. Proc. Ia. Acad. Sci. 64:257-66.

Helms, D. 1965. Age and growth of the channel catfish in the Coralville Reservoir. Ia. Cons. Comm. Quart. Biol. Rep. 17(2):6-12.

Huggins, D. 1968. Limnology of DeSoto Bend Lake. MS Thesis, Iowa State Univ. Press. Ames. 96 pp.

Iowa Conservation Commission. 1961. Calculated total lengths at each annulus for various species of fish taken from DeSoto Bend, September 25-29, 1961. Biology Section. 13 pp.

Mitzner, L. 1975. Life history and dynamics of largemouth bass in three man-made lakes. Ia. Cons. Comm D-J proj. F-88-R-2, Study No. 503-4. 17 p.

Muncy, R. 1959. Age and growth of channel catfish from the Des Moines River, Boone County, Iowa, 1955 and 1956. Ia. St. J. Sci. 34(2):127-37.

Paragamian, V. 1977. Evaluation of the 14-inch length limit largemouth bass at Big Creek Lake. Ia Cons. Comm. D-J Proj., F-88-R, Study No. 601. 36 p.

Ricker, W. 1968. Handbook of computations for biological statistics of fish populations. Fish. Res. Bd. Canada, Bull. No. 119, 300 p.

Robson, D. and H. Regier. 1964. Sample size in Peterson mark-recapture experiments. Trans. Amer. Fish. Soc. 93:216.

APPENDIX

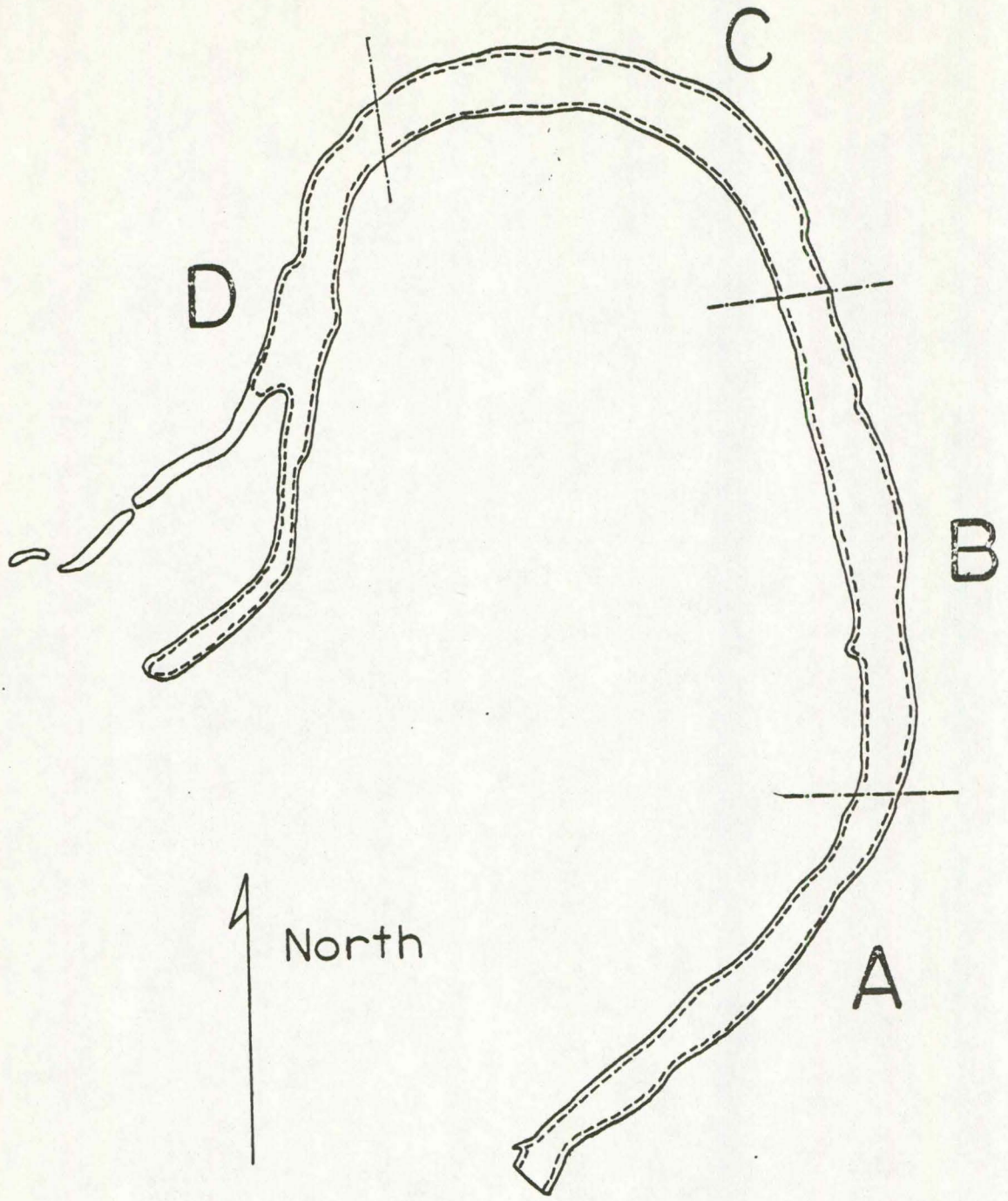

Figure A. Electrofishing routes used in DeSoto Bend Lake

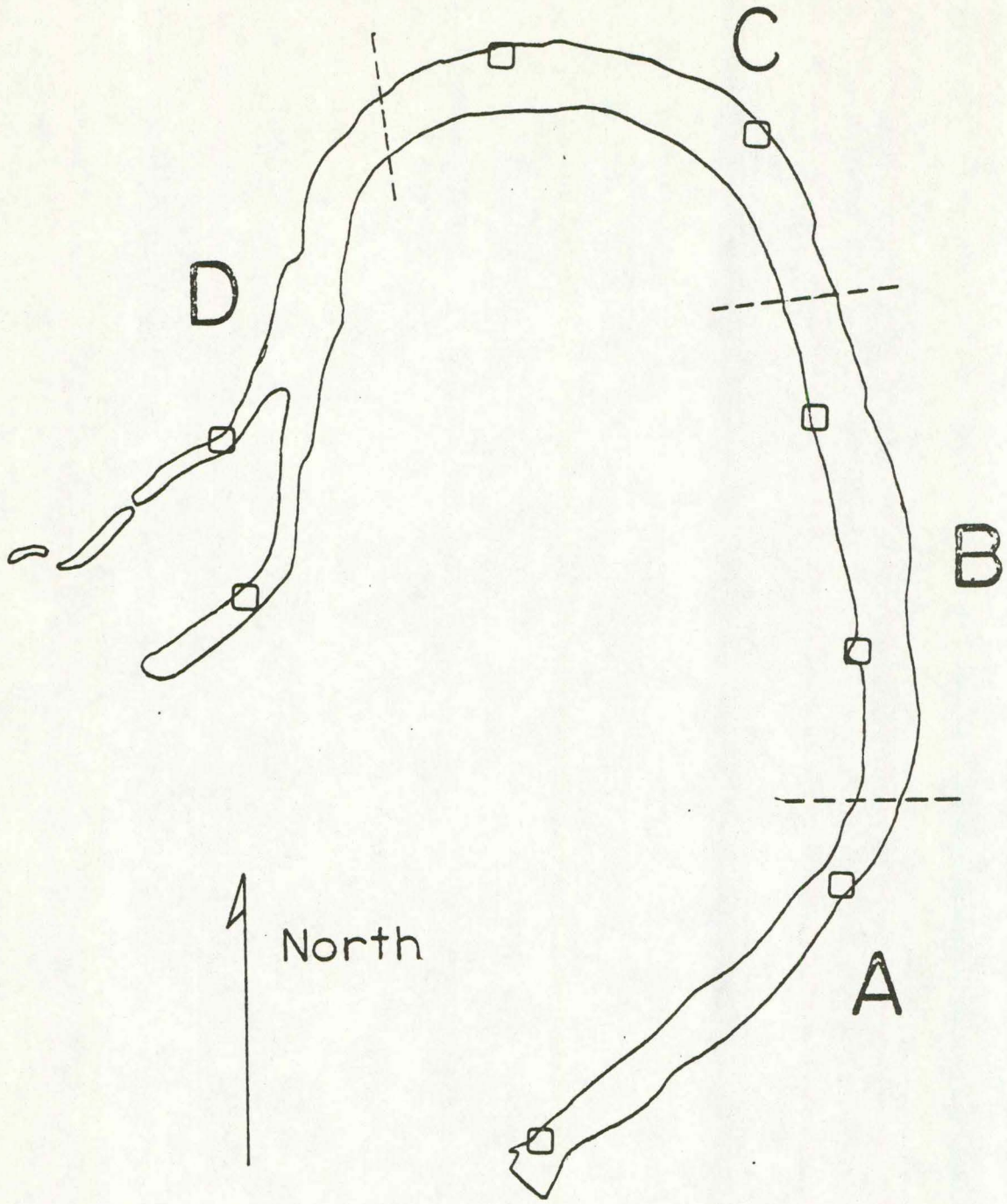

Figure B. Fyke net sampling locations used in DeSoto Bend Lake

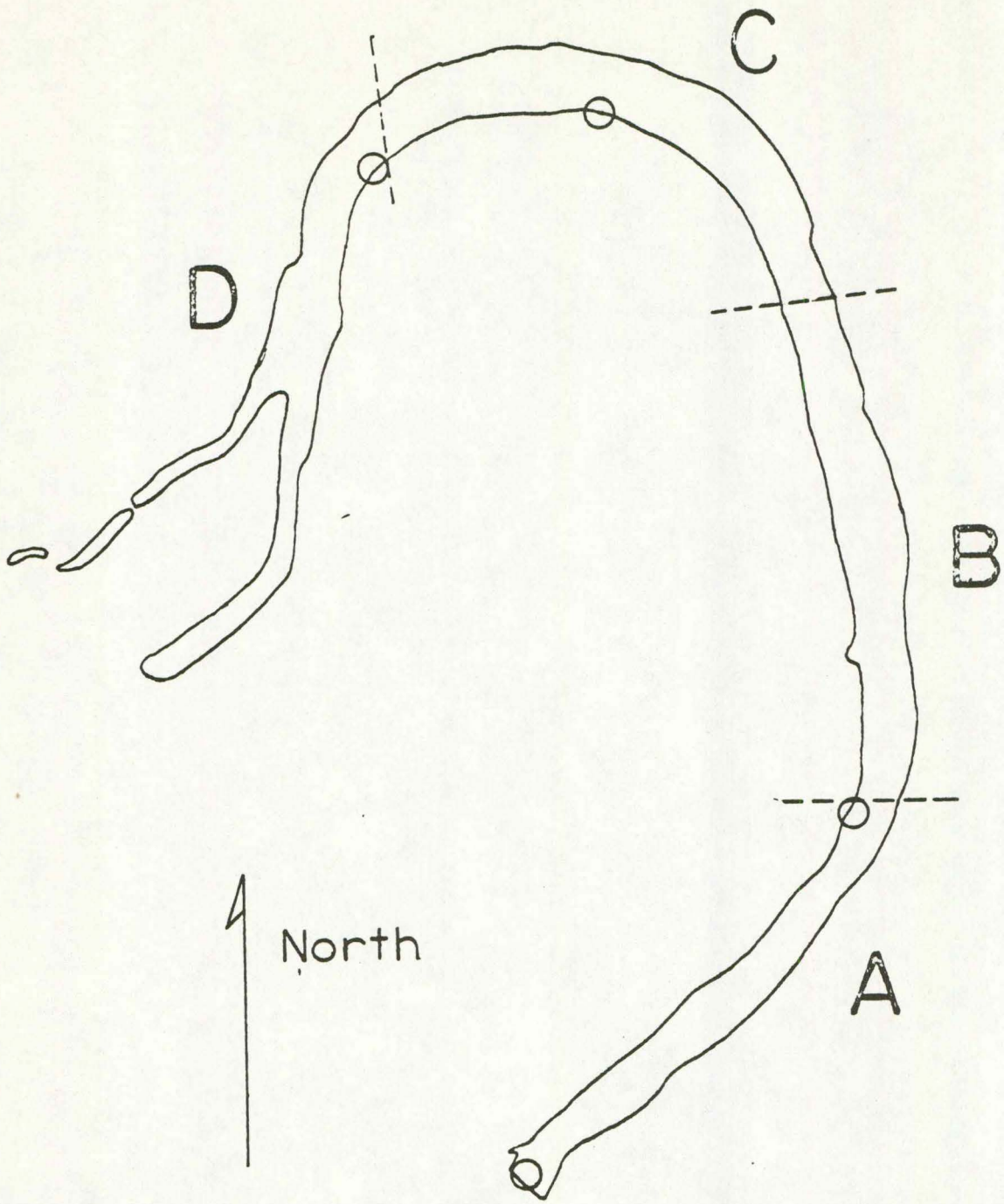

Figure C. Seine haul sampling locations used in DeSoto Bend Lake.

Table A. Mean electrofishing catch rates (F/HR) in DeSoto Bend from July to September 1973.

Species	Sampling Week						
	7-2	7-16	7-29	8-13	8-27	9-10	9-25
Am eel	0	0	0	0	0	0	.25
Lm bass	10.75	14.0	16.0	17.25	33.75	18.0	25.50
W bass	0	0	0	.5	.25	0	0
Bluegill	11.5	12.0	11.0	34.5	35.25	7.75	5.75
Bm buffalo	.5	4.0	0	0	2.75	.5	.25
Sm buffalo	2.5	0	.25	.25	.5	.5	.75
B bullhead	0	0	0	0	0	0	0
Carp	4.0	9.0	16.75	8.0	9.75	.75	.5
Carpsucker	5.5	3.0	6.25	7.5	9.75	5.0	2.0
C catfish	.25	0	.5	0	2.75	2.75	1.0
Fl catfish	1.0	0	0	0	0	0	0
B crappie	.75	1.0	2.0	4.5	19.75	.5	1.0
W crappie	.75	0	2.0	8.5	13.0	2.5	1.5
F drum	10.5	73.0	21.0	4.5	11.0	20.25	0
Blue sucker	0	0	0	0	0	0	0
G sunfish	1.25	0	0	1.75	1.0	0	0
Sn gar	.5	1.0	1.5	0	3.25	.25	0
Ln gar	0	0	.25	0	0	0	0
Y perch	.25	10.0	.75	.25	4.75	2.25	0
G shad	31.5	8.0	2.25	0	.75	0	.75
N pike	.25	0	0	.25	.5	0	0
Walleye	0	0	0	0	.25	.25	0
Sn redhorse	0	0	0	0	0	0	0

Table B. Mean fyke net catch rates F/ND in DeSoto Bend from July to September 1973.

Species	Sampling Week						
	7-2	7-16	7-29	8-13	8-27	9-10	9-25
Am eel	0	0	0	0	0	0	0
Lm bass	.18	1.34	.75	.41	0	0	0
W bass	0	0	.03	.09	0	0	0
Bluegill	2.18	5.69	4.34	3.13	0	2.12	1.76
Bm buffalo	.03	.19	.72	.41	.31	.11	.02
Sm buffalo	.16	.16	.19	.12	.11	.08	.15
B bullhead	.06	0	0	0	0	0	0
Carp	.37	2.06	2.16	2.47	2.34	2.13	1.87
Carpsucker	.87	.31	2.34	2.66	2.50	.31	.98
C catfish	1.22	.5	0	2.75	0	0	0
Fl catfish	.09	0	.15	.09	0	0	0
B crappie	.72	2.0	2.0	7.6	2.	.84	2.0
W crappie	.87	.31	1.91	7.8	.41	.87	1.83
F drum	1.81	2.34	.41	1.06	1.83	.57	1.33
Blue sucker	.03	0	0	0	0	0	0
G sunfish	.16	.91	.19	.03	.01	.01	.11
Sn gar	2.28	1.1	1.56	1.91	1.45	1.27	1.1
Ln gar	.22	.16	.06	.25	0	0	0
Y perch	1.09	.53	.37	.94	0	0	0
G shad	.41	.69	.16	.25	.23	.16	.11
N pike	.25	.03	0	.06	0	0	0
Walleye	.03	0	.03	.06	0	0	0
Sn redhorse	0	0	0	0	0	0	0

Table C. Mean seine catch rates (F/HL) in DeSoto Bend from May to October 1973.

Species	Sampling Week										
	5-1	5-15	6-1	6-15	7-2	7-29	8-13	8-27	9-10	9-25	10-10
Red shiner	8.3	4.3	2.9	1.6	.8	0	1.3	.8	.8	0	0
Sand shiner	0	1.0	0	.6	2.2	0	1.7	.6	0	0	0
Bm buffalo	10.2	27.3	30.8	10.3	.8	.7	.1	0	0	0	0
B crappie	0	0	0	0	.08	0	0	0	0	0	0
W crappie	0	0	0	.1	0	0	0	0	0	0	0
Carpsucker	0	.6	3.2	4.3	2.7	2.0	2.1	1.8	1.8	1.6	.2
Y perch	0	0	.8	1.6	.3	.1	0	0	0	0	0
Carp	0	0	0	0	10.3	28.4	15.1	7.2	1.6	0	0
Fw drum	0	0	0	.1	.7	1.0	0	0	0	0	0
G shad	0	0	0	3.5	107.3	185.0	387.6	99.3	25.9	87.2	47.2
Bluegill	0	0	0	0	21.3	305.2	107.3	11.2	8.4	6.3	4.8
Lm bass	0	0	0	98.6	54.3	37.2	12.4	11.8	10.3	6.3	1.2
C catfish	0	0	0	0	1.2	8.4	6.0	5.2	.8		

Table D. Mean electrofishing catch rates (F/HR) in DeSoto Bend from May to October 1974.

	Sampling Week									
Species	5-20	6-3	6-17	7-1	7-15	7-29	8-12	8-26	9-9	10-7
Am eel	.25	.25	0	0	0	0	0	0	0	0
Lm bass	12.5	5.25	1.0	2.0	8.5	31.75	47.25	42.5	54.5	106.5
W bass	0	0	0	0	.25	0	0	0	.25	.5
Bluegill	25.5	5.5	1.5	2.0	14.25	52.75	40.5	56.5	56.75	39.0
Bm buffalo	.25	0	0	0	.75	0	0	0	0	4.5
Sm buffalo	.50	.25	0	.25	.25	.5	.75	.75	.25	3.0
B bullhead	0	0	0	0	0	0	0	.5	.25	0
Carp	20.25	4.75	5.0	8.25	15.5	9.0	15.25	14.5	5.0	2.5
Carpsucker	6.75	5.25	6.25	5.5	7.25	11.5	10.0	7.0	4.75	3.5
C catfish	4.75	2.75	0	.75	1.5	1.0	2.0	3.75	9.25	2.0
Fl catfish	0	0	0	0	0	.25	0	0	0	0
B crappie	.5	0	0	.25	1.5	17.5	3.25	8.0	5.5	1.5
W crappie	3.25	.25	.25	0	0	5.25	1.0	2.5	4.75	0
F drum	2.25	2.0	1.5	2.5	5.5	10.5	9.5	6.5	1.5	1.5
Blue sucker	0	0	0	0	0	0	0	.5	0	0
G sunfish	4.5	2.0	.5	2.0	2.0	7.25	7.0	4.75	8.0	.5
Sn gar	7.5	1.25	.5	2.25	3.25	.25	4.25	1.0	1.25	0
Ln gar	0	.25	0	.25	0	0	0	0	0	0
Y perch	.25	1.75	0	0	.75	1.0	1.5	.75	.25	0
G shad	30.75	87.5	32.75	42.0	20.75	12.0	3.5	6.75	1.0	0
N pike	0	.25	0	0	0	.5	.25	0	.25	0
Walleye	0	.25	0	0	0	1.75	1.0	.5	.25	.5
Sn redhorse	0	0	0	0	0	.25	0	0	0	0

Table E. Mean fyke net catch rates (F/ND) in DeSoto Bend from April to October 1974.

Species	Sampling Week										
	4-22	5-6	5-20	6-3	6-17	7-1	7-15	7-29	8-12	8-26	9-13
Am eel	0	0	0	0	0	0	0	0	0	0	0
Lm bass	.09	0	0	0	.06	0	.34	.09	.06	.72	0
W bass	0	0	0	0	0	0	.03	0	0	0	.06
Bluegill	3.81	1.44	1.97	1.06	4.25	1.66	3.28	2.62	.69	2.37	.56
Bm buffalo	0	0	0	0	0	.06	.03	.03	.03	0	0
Sm buffalo	0	0	0	0	0	0	0	.03	.15	.06	.09
B bullhead	.22	.03	0	0	0	0	0	0	0	.03	0
Carp	.19	0	.25	.09	1.6	.60	.44	.28	.81	.41	.41
Carpsucker	1.19	0	0	.06	.34	.37	.37	.47	.91	1.44	1.28
C catfish	.72	0	.44	.91	.25	.03	.22	.12	.44	.22	.22
Fl catfish	0	.03	0	.03	.19	.06	.12	.06	.09	0	.06
B crappie	1.81	.22	1.22	.16	.25	.47	.78	3.53	.37	1.81	1.09
W crappie	2.03	.28	.31	.19	.44	.50	.59	1.69	.44	.59	.84
F drum	.06	0	.03	.03	.06	.37	.97	.31	.31	0	.69
Blue sucker	0	0	0	0	0	0	0	0	.02	0	0
G sunfish	.19	.22	.06	.06	.16	.25	.12	0	0	0	.03
Sn gar	0	.09	2.53	.75	.41	.87	.87	1.34	1.12	2.72	.31
Ln gar	0	0	0	.25	0	.25	0	0	0	0	0
Y perch	1	.12	.03	.09	.03	.12	.19	.25	.25	.25	.19
G shad	.34	.5	.25	0	0	.09	.06	.5	0	.03	0
N pike	.06	0	0	0		.09	.09	.09	.09	.16	.12
Walleye	.06	0	.03	0		0	.03	.09	.06	0	.09
Sn redhorse	0	0	0	0		0	0	0	0	0	0

Table F. Mean seine catch rates (F/HL) in DeSoto Bend Lake from May to October 1974.

Species	Sampling Week									
	5-6	5-20	6-3	6-17	7-1	7-15	7-29	8-12	8-26	9-13
Red shiner	0	0	0	2.2	.3	.50	1.4	2.6	1.25	.6
Sand shiner	0	0	0	.45	.6	1.3	2.1	1.75	4.1	.4
Bm buffalo	20.4	40.6	0	145.6	70.2	.9	5.33	.6	0	0
Sm buffalo	0	0	0	0	0	.5	9.4	11.95	.65	1.45
B crappie	0	0	0	0	.1	.25	0	0	0	0
W crappie	0	0	0	0	.1	.25	2.66	.2	0	0
Carpsucker	0	2.4	0	17.7	21.75	8.5	12.1	3.8	2.85	.65
Y perch	0	0	0	.25	.7	2.2	.47	0	0	0
Carp	0	0	0	13.6	29.0	2.7	9.2	.4	0	0
Fw drum	0	0	0	0	1.5	.2	3.93	.05	0	0
G shad	0	0	0	0	99.8	166.2	302.7	96.4	7.90	43.25
Bluegill	0	0	0	0	9.1	203.9	13.24	1.4	.75	.65
Lm bass	0	0	0	0	2.7	2.3	4.9	1.85	1.95	1.0
C catfish	0	0	0	0	0	0	1.0	0	0	0

Table G. Mean electrofishing catch rates (F/HR) in DeSoto Bend Lake from April to October 1975.

	Sampling Week									
Species	4-22	5-6	5-21	6-4	6-17	7-1	7-15	7-29	8-12	8-26
Am eel	0	0	0	0	0	0	0	0	0	0
Lm bass	3.25	3.5	2.50	1.25	1.0	.25	1.50	2.5	16.5	6.25
W bass	0	0	0	0	0	0	0	0	0	0
Bluegill	.75	4.0	4.0	3.0	3.0	4.0	2.5	3.25	8.25	32.75
Bm buffalo	.25	10.0	0	0	0	.25	.75	1.0	.25	1.0
Sm buffalo	.25	.25	1.25	6.0	2.0	.75	1.75	2.0	6.75	3.50
B bullhead	.25	0	0	0	0	0	0	0	0	0
Carp	9.25	24.75	4.25	27.75	12.5	11.5	4.75	5.75	7.50	6.0
Carpsucker	11.25	11.75	5.0	6.75	6.5	6.75	3.0	4.25	7.50	2.50
C catfish	.50	0	0	1.25	0	.25	0	0	0	.5
Fl catfish	0	0	0	0	0	0	0	0	0	0
B crappie	0	3.5	.50	2.25	.5	1.0	0	.5	3.25	17.25
W crappie	1.5	1.25	.25	0	2.5	.5	2.0	2.0	1.50	7.25
F drum	.5	.5	.50	3.0	.75	1.0	1.75	.5	2.25	1.25
Blue sucker	0	0	0	0	0	0	0	0	0	0
G sunfish	.25	1.5	4.0	1.25	1.25	3.75	.5	0	0	15.5
Sn gar	0	.75	2.0	.50	0	1.25	0	.75	0	0
Ln gar	0	0	0	.25	0	0	0	0	0	0
Y perch	.25	0	0	0	.75	2.75	.25	.25	.25	2.0
G shad	0	0	0	0	0	0	0	0	0	0
N pike	.25	.5	.25	0	.5	0	.25	0	0	0
Walleye	.75	0	.50	0	.75	0	0	0	.25	.25
Sn redhorse	0	0	0	0	0	0	0	0	0	0

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Table G. Continued

Species	Sampling Week 9-9	9-24	10-6	10-22
Am eel	0	0	0	0
Lm bass	6.0	9.0	12.33	22.50
W bass	0	0	0	0
Bluegill	5.0	8.50	10.33	10.5
Bm buffalo	.66	0	0	4.5
Sm buffalo	1.0	0	1.33	2.0
B bullhead	0	0	0	0
Carp	6.66	4.25	10.0	10.50
Carpsucker	3.0	1.75	2.33	2.75
C catfish	0	0	.33	.75
Fl catfish	0	0	0	0
B crappie	25.66	2.75	16.66	5.75
W crappie	18.66	5.0	10.33	4.0
F drum	2.0	.75	1.0	1.75
Blue sucker	0	0	0	0
G sunfish	0	2.50	5.66	.50
Sn gar	0	.25	0	.25
Ln gar	0	0	0	0
Y perch	9.0	1.75	.66	.25
G shad	0	0	0	.75
N pike	0	0	0	0
Walleye	0	0	0	.25
Sn redhorse	0	0	0	0

Table H. Mean fyke net catch rate (F/ND) in DeSoto Bend from April to October 1975.

	Sampling Week									
Species	4-22	5-6	5-21	6-4	6-17	7-1	7-15	7-29	8-12	8-26
Am eel	0	0	0	0	0	0	0	0	0	0
Lm bass	0	0	0	0	0	0	0	0	.12	0
W bass	0	0	0	0	0	0	0	0	0	0
Bluegill	0	1.37	2.9	1.8	.5	.81	1.17	1.50	.90	1.50
Bm buffalo	0	.75	0	0	0	0	.12	.08	.32	.32
Sm buffalo	0	0	.16	0	0	.12	.18	.18	.56	.32
B bullhead	0	0	.16	0	0	0	0	0	.06	0
Carp	0	.5	.33	.43	.18	.06	.43	.50	.43	.50
Carpsucker	0	0	.42	.01	.18	.31	.37	.40	.28	.28
C catfish	0	1.37	.45	.68	.06	.12	0	0	.06	0
B crappie	0	1.0	.29	.43	1.15	.25	3.5	.75	4.75	4.5
W crappie	0	3.25	0	1.25	.75	.31	.75	.75	5.34	5.20
F drum	0	.06	.08	.01	.25	.28	.43	.02	.34	.18
Blue sucker	0	0	0	0	0	0	0	0	0	0
G sunfish	0	0	.54	.75	.31	.15	0	0	0	0
Sn gar	0	.12	1.16	.04	.08	.09	.03	0	.28	.31
Ln gar	0	0	0	0	0		0	0	0	0
Y perch	0	.18	.08	.01	0	1.18	0	.01	1.20	.18
G shad	0	0	0	0	0		0	0	0	0
N pike	0	0	0	0	0	.06	0	0	.06	0
Walleye	0	0	0	0	.08		0	0	0	0
Sn redhorse	0	0	0	0	0	.03	.06	0	.06	0

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Table H. Continued

Species	Sampling Week 9-9	9-24	10-6	10-22
Am eel	0	0	0	0
Lm bass	0	.15	0	0
W bass	0	0	0	0
Bluegill	1.90	1.90	.45	1.09
Bm buffalo	.08	.03	0	.75
Sm buffalo	.58	1.18	.30	.28
B bullhead	0	0	0	.06
Carp	.53	.53	.35	.46
Carpsucker	.73	1.53	.80	.18
C catfish	0	0	0	.06
B crappie	3.5	3.0	1.70	3.46
W crappie	4.31	1.81	4.90	2.96
F drum	.06	.06	.65	.12
Blue sucker	0	0	0	0
G sunfish	0	0	0	.50
Sn gar	0	0	0	0
Ln gar	0	0	0	0
Y perch	.48	.78	.65	.43
G shad	0	0	0	0
N pike	0	0	0	0
Walleye	0	0	0	.06
Sn redhorse	.12	0	0	0

Table I. Mean seine catch rate (F/HL) in DeSoto Bend from May to September 1975.

	Sampling Week										
Species	5-6	5-21	6-4	6-17	7-1	7-15	7-29	8-12	8-26	9-9	9-24
Red shiner	6.9	3.9	1.6	2.9	0	.7	0	0	2.7	1.0	0
Sand shiner	0	.8	0	.9	2.2	1.6	.5	0	.6	0	0
Bm buffalo	2.4	2.0	100.	36.0	76.5	0	0	.1	0	0	0
Sm buffalo	0	0	0	45.0	26.1	.25	1.2	.4	0	0	0
B crappie	0	0	0	0	0	0	0	0	0	0	.4
W crappie	0	0	0	7.0	0	1.7	0	0	4.1	0	0
Carpsucker	1.6	.	14.5	.	43.0	1.6	2.5	1.9	0	0	0
Y perch	0	0	5.9	1.9	0	0	0	0	0	0	0
Carp	0	0	8.0	17.0	31.6	9.5	4.5	1.3	.25	0	0
Fw drum	0	0	0	5.6	3.7	.16	0	0	0	.1	0
G shad	0	0	0	0	0	0	0	0	0	0	0
Bluegill	0	0	0	0	4.6	0	3.2	3.3	7.9	23.6	.25
Lm bass	0	0	0	64.8	.8	3.6	3.2	4.8	3.6	1.8	.5
C catfish	0	0	0	0	0	0	0	0	0	0	0
G sunfish	0	0	0	0	0	2	1.7	.8	2.3	.4	0