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## TURBIDITY CONTROL AND FISH POPULATION RENOVATION ON BLUE MOUNTAIN LAKE, ARKANSAS\*

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### ABSTRACT

Blue Mountain Dam, a flood control project on the Petit Jean River in west central Arkansas, was completed in 1947 impounding a 2,900 acre reservoir.

The reservoir is relatively shallow, receives strong wind action and has a watershed to lake area ratio of over 100:1.

Since four to five years after impoundment, the lake has been plagued with heavy concentrations of colloidal turbidity and a fish population dominated by non-foragable sizes of buffalo, carp, drum and gizzard shad.

Combinations of fall-winter drawdowns, commercial fishing for non-game species, a selective shad kill and the planting of rye grass in the exposed lake bed produced beneficial results in reducing colloidal turbidity and improving the fish population. However, these results were shortlived.

A continuation of these efforts in a more intensive and drastic form was initiated in June, 1965. The lake was dewatered to expose 1,500 to 2,000 acres of lake bed. This area was seeded by airplane with approximately 10 tons of a mixture of Tracy sorghum, *Sorghum sorghum* var. *Tracy*, sweet sudan grass, *Sorghum sorghum* var. *sudanensis*, and a sorghum-sudan grass hybrid. Four months later, almost the entire lake bed was a dense growth of sorghum-type plants six to eight feet tall.

The drawn down lake remained open to both sport and commercial fishing throughout the summer.

In October of the same year, over 95% of the total fish population by weight was removed by treating the lake with 6,000 pounds of 7.6% powdered rotenone.

Restocking, primarily with yearling fish, in the winter of 1965-66, totaled over one and one-third million fish.

Since refilling, the lake has remained relatively clear (visibility 14 to 18 inches) except during high water, and the fish population shows

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rapid expansion, excellent growth and high survival. Game fishes, such as channel catfish, *Ictalurus punctatus*, largemouth bass, *Micropterus salmoides*, white bass, *Roccus chrysops*, and crappie, *Pomoxis sp* are dominant.

Through the first half of 1967, the fishermen's harvest has been excellent with reports that fishing success is similar to that experienced for the first few years after initial impoundment of the lake.

## DESCRIPTION AND HISTORY OF LAKE

Blue Mountain Lake is a flood control project located on the Petit Jean River in Yell and Logan Counties, Arkansas. The project was completed in June, 1947 impounding a 2,900 acre reservoir, which receives drainage from an area of 488 square miles. The reservoir has a relatively shallow average depth, receives strong wind action, and has a watershed to lake area ratio of over 100:1.

The watershed drains shale and sandstone soils with large areas of clay along the flat and bottom lands of the main stream.

Primary land uses in the lake watershed are farming, pasture lands, and timber production.

For four to five years after impoundment there was excellent crappie, channel catfish and black bass fishing on Blue Mountain Lake. By 1953, the lake became very turbid early each summer; this often lasted through the winter (Crawford, 1957). As a result and a further aggravation of the turbidity problem, such fishes as buffalo, *Ictiobus sp*, carp, *Cyprinus carpio*, drum, *Aplodinotus grunniens*, and gizzard shad, *Dorosoma cepedianum* became dominant and game fish production and fishing success was poor (Buck, 1956).

The type of management recommended by the Arkansas Game and Fish Commission to alleviate these problems was a drastic fall-winter drawdown. The purpose of which was (1) to aerate the lake bottom, (2) to allow commercial fishermen to remove large poundages of rough and commercial fishes, (3) to concentrate the forage fishes thereby increasing predation by predator fishes, and (4) to seed the exposed lake bed with rye grass, *Lolium perenne*.

The first of these drawdowns was initiated by the Corps of Engineers in the fall of 1956. Again, the following year, Blue Mountain Lake was drawn down to less than one-third its normal acreage (Wilson, 1959). A third drawdown took place during the fall-winter of 1959-'60 (Screeton, 1960) at which time a selective shad kill was conducted. Some degree of success was realized from these management techniques; however, the effects were shortlived, and by 1963 turbidity was again becoming a problem. Secchi disc readings were often as low as 2 inches. The predator fish population was made up primarily of small, stunted crappie and channel catfish, and the non-predator population was dominated by non-foragable sizes of buffalo, carp, drum, and gizzard shad.

At this time another management program of turbidity control and fish population improvement was proposed. This program was similar to previous operations, but of a more intensive nature. By 1965, the program was accepted by the public and work began to initiate it.

## PROCEDURES

### *Turbidity Control*

In June 1965, the Corps of Engineers began lowering the lake approximately ten feet. This level was maintained until November, 1965 by dewatering the lake after each rain. From 1,500 to 2,000 acres of the lake bed was exposed at the ten-foot drawdown level.

The plan to control colloidal turbidity was to utilize the electrochemical reaction caused by decaying vegetation to flocculate the electrically charged silt and clay particles from the water (Irwin and Stevenson, 1951).

On July 7, 1965, approximately ten tons of seed, composed of 3,300 pounds Tracy sorghum, 6,300 pounds of sweet sudan grass, and 6,300 pounds of green graze (sorghum-sudan grass hybrid), was disseminated by airplane over the majority of the exposed lake bed.

Observations made at various times after the planting were as follows:

- (1) Within one week the planted seed had germinated and also numerous kinds of native grasses and sedges had sprouted.
- (2) By forty days after planting, the seeded crop was 18 to 24 inches tall and was beginning to outgrow and shade out the native plants.
- (3) Sixty-seven (67) days from planting, the lake bed appeared as a green field of sorghum-type plants with only a few native plants visible in the lower, wet areas (Figure 1).
- (4) By October 21, one hundred and four (104) days after planting, the plants were leaning from the weight of the heavy seed tops (Figure 2). Area residents reported that numerous quail and deer were drawn to this area.
- (5) In November, after several hard frosts killed and dried the plants, the tops became broken and bent over; the main stem remained erect.

Frequent observations throughout the entire growth period of the plants showed the best production was from the sorghum-sudan grass hybrid. The poorest survival and the least bulk from the mature plant was from the sudan grass.

#### *Fish Population Renovation*

An attempt was made to remove 95+ % of the total poundage of fish in the lake.

In October, 1965, the lake was lowered an additional two feet leaving approximately 600 surface acres of water. The major part of the total volume of water remaining was confined to the river channel. Only about 100 acres of water, most of it less than two feet deep, was out of the channel at the lower end of the lake.

Fifty-seven hundred pounds (5,700) of 7.6% powdered rotenone was applied to the entire channel area for approximately eleven and one-half miles above the dam. Heavier concentrations were applied at the lower end of the lake to allow for diffusion into the shallow areas. The following day, an additional 300 pounds were applied to a shoal at the upper end of the lake to produce a continuous toxic flow for several hours.

It was estimated that over 95% by weight of the total poundage of fish present was killed. The largest poundage of fish was composed of buffalo too small for commercial harvest with legal tackle (average weight one pound). Next, in order of highest poundage killed was gizzard shad, carp, gar, *Lepisosteus sp.*, crappie, channel catfish, and flat-head catfish, *Pylodictis olivaris*. Game fish probably made up less than 10% of the total population by weight.

An estimated 5 to 10 thousand people came out to dip up the edible species of fish.

#### *Restocking*

Restocking began the latter part of November, 1965, from the three state fish hatcheries. The majority of the fish stocked were yearlings (one growing season old). During the winter of 1965, a total of over 1½ million fish were stocked (Table I).

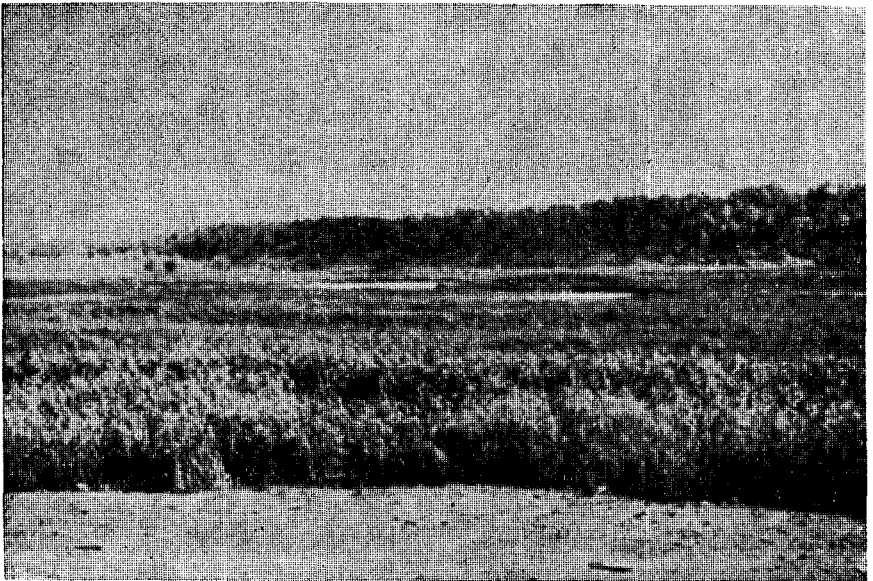
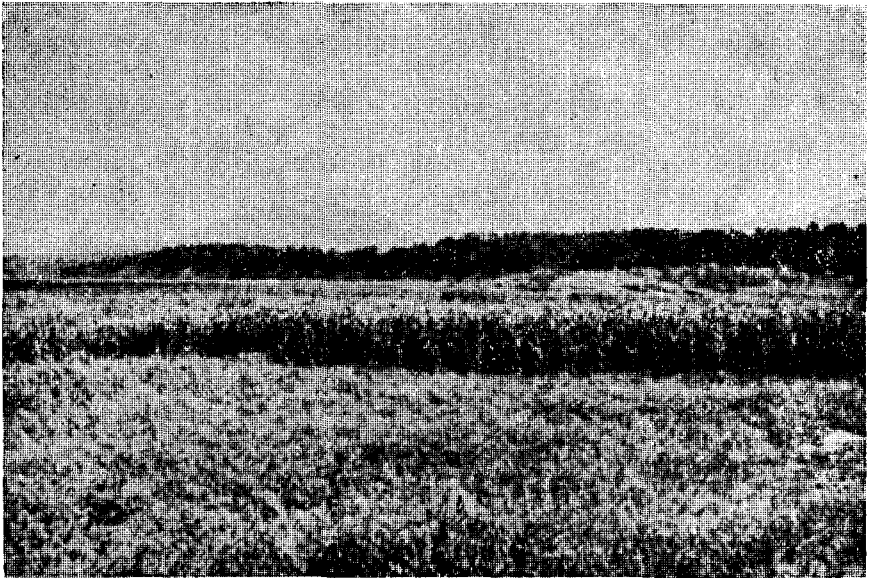


Figure 1. Blue Mountain Lake bed sixty-seven days after seeding with sorghum-type plants.

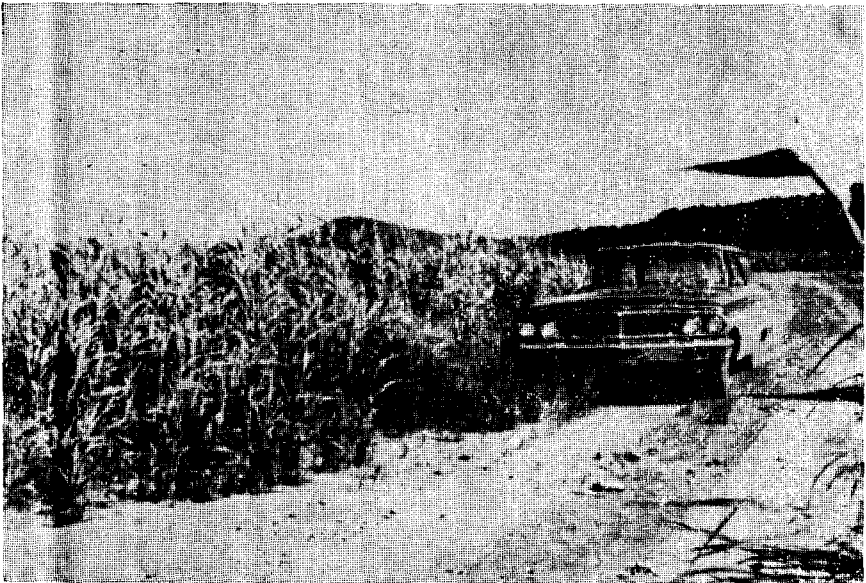


Figure 2. Blue Mountain Lake bed one hundred and four (104) days after seeding. Sorghum-type plants with heavy seed tops.

Table I

A RECORD OF THE FISH THAT WERE STOCKED IN BLUE MOUNTAIN LAKE, LOGAN AND YELL COUNTIES, ARKANSAS, AFTER THE FISH KILL IN THE FALL OF 1965 AS OF APRIL 6, 1966

Date	LARGEMOUTH BASS		CRAPPIE		BREAM <sup>1</sup>		CHANNEL CATFISH		REDEAR BREAM		BROWN BULLHEAD <sup>3</sup>		GREEN SUNFISH <sup>4</sup>	
	Yearlings	Adults	Yearlings	Adults	Yearlings	Adults	Yearlings	Intermediates	Yearlings	Adults	Yearlings	Adults	Yearlings	Adults
12-10-65	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12-11-65	---	---	1,000	---	43,000	---	---	---	---	---	---	---	---	---
12-20-65	---	---	---	---	162,000	---	---	---	---	---	---	---	---	---
12-21-65	---	---	---	---	96,000	---	---	---	---	---	---	---	---	---
1-3-66	2,000	---	---	1,000	---	3,000	---	---	---	---	---	---	---	---
1-15-66	---	---	---	---	---	16,300	---	---	---	---	---	---	---	---
2-7-66	1,440	---	---	---	10,000	---	---	---	---	---	---	---	---	---
3-11-66	---	---	10,500	---	---	---	---	---	---	---	---	---	---	---
3-17-66	---	---	26,000	---	---	---	---	---	---	---	---	---	---	---
3-17-66	---	---	26,000	---	---	---	---	---	---	---	---	---	---	---
3-21-66	---	---	10,400	---	---	---	---	---	---	---	---	---	---	---
SUB TOTAL	3,440	---	73,900	1,000	361,000	3,000	16,300	---	---	100,000	---	---	---	---
(From Joe Hogan Hatchery)	---	---	---	---	---	---	---	---	---	---	---	---	---	---
From the Joe Hogan Fish Hatchery, Lonoke, Arkansas														
12-6-65	---	---	37,000	---	---	---	---	---	---	---	---	---	---	---
12-7-65	15,000	---	---	---	---	---	---	---	---	---	---	---	---	---
12-7-65	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12-9-65	---	---	32,000	---	---	---	---	---	---	---	---	---	---	---
12-29-65	9,600	---	---	---	---	---	---	---	---	---	---	---	---	---
12-30-65	16,000	---	---	---	---	---	---	---	---	---	---	---	---	---
1-4-66	25,000	---	---	---	---	---	---	---	---	---	---	---	---	---
1-17-66	---	---	---	---	---	26,000-(Redear)	---	---	---	---	---	---	---	---
From the Lake Hamilton Fish Hatchery, Hot Springs, Arkansas														
Lake Hamilton Hatchery Continued -														

Date	LARGEMOUTH BASS		CRAPPIE		BREAM <sup>1</sup>		CHANNEL CATFISH		ROCKBASS		GREEN BULLHEAD <sup>3</sup>		COWPOND <sup>4</sup>	
	Yearlings	Adults	Yearlings	Adults	Yearlings	Adults	Yearlings	Intermediates	Yearlings	Intermediates	Yearlings	Intermediates	Yearlings	Intermediates
1-17-66	---	---	---	---	52,000-(Bluegill)	---	---	---	---	---	---	---	---	---
1-19-66	---	---	---	---	---	---	---	---	---	---	---	19,000	---	---
2-15-66	---	---	---	---	---	---	---	---	---	---	---	17,000	---	---
2-17-66	---	---	---	---	---	---	---	---	---	---	---	21,000	---	---
3-22-66	5,000	---	---	---	---	---	---	---	---	---	---	5,000	---	---
3-8-66	---	400	1,220	---	---	---	---	---	---	---	---	---	---	---
3-9-66	---	---	225	---	---	---	---	---	---	---	---	---	---	---
SUB TOTAL	71,600	400	105,220	225	79,000	---	---	---	---	---	---	66,000	---	---
(From Lake Hamilton Hatchery)														
From the Centerton Fish Hatchery, Centerton, Arkansas														
11-26-65	---	---	---	---	---	---	---	---	---	---	---	---	---	---
11-30-65	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12-2-65	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12-10-65	---	136	---	45	42,600	---	---	---	---	---	---	---	---	---
12-22-65	---	---	9,500	---	22,000	---	---	223	---	---	---	---	---	---
1-5-66	---	---	10,000	---	49,000	---	---	---	---	---	---	---	---	---
1-7-66	---	---	---	---	210,000	---	---	---	---	---	---	---	---	---
2-12-66	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-15-66	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-16-66	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-17-66	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-18-66	4,000	---	3,000	---	---	---	---	---	---	---	---	---	---	---
2-24-66	2,500	---	1,670	---	---	---	---	---	---	---	---	---	---	---
2-23-66	4,500	---	2,000	---	---	---	---	---	---	---	---	---	---	---
SUB TOTAL	11,000	136	26,170	45	323,600	---	---	---	---	---	---	---	---	21,000
(From Centerton Hatchery)														
GRAND TOTAL (All Hatcheries)	85,040	536	205,290	1,270	762,600	3,000	147,939	223	100,000	66,000	21,000	---	---	---
TOTAL FISH STOCKED - 1,392,000														
1 <u>Lepomis sp</u>			2 <u>Lepomis microlophus</u>			3 <u>Ictalurus nebulosus</u>			4 <u>Lepomis cyanellus</u>					

The following spring, after shoreline seining revealed a tremendous number of shad fry in the lake, an additional 144,000 fingerling bass were released into the lake (Table II).

TABLE II—RECORD OF SUPPLEMENTAL STOCKING OF BLUE MOUNTAIN LAKE.

Date	White Bass Adults	Largemouth Bass Fingerlings
<b>From the Upper White River in Northwest Arkansas</b>		
3-22-66	104	....
3-24-66	70	....
3-25-66	94	....
3-27-66	41	....
<b>From the Joe Hogan Hatchery, Lonoke, Arkansas</b>		
6-22-66	....	18,000
<b>From the Lake Hamilton Hatchery, Hot Springs, Arkansas</b>		
6-22-66	....	30,000
6-23-66	....	20,000
6-30-66	....	25,000
7-2-66	....	25,000
7-13-66	....	26,000
Total	309 Adult White Bass and	144,000 Largemouth Bass Fingerling

## DISCUSSION AND RESULTS

Blue Mountain Lake did not refill until after the first of the year 1966. However, spring rains caused water levels to rise into the flood pool of the reservoir.

In late summer there were still dense mats of decaying vegetation on the bottom of the lake, and small areas of American Lotus, *Nelumbo lotus*, were growing in 2 to 3 feet of water in some areas of the reservoir. The water had a rich, greenish-brown color throughout the summer of 1966.

Through the spring of 1967, the water has remained relatively clear (visibility 12-14 inches) except during flood periods.

The first year following the kill, the fish in the lake produced the typical pattern of a rapidly expanding and fast growing population. Rotenone samples in the summer of 1966 showed tremendous growth and high survival of channel catfish, largemouth bass, and crappie (Table III). Of particular interest, was the large number of young-of-the-year white bass collected. The majority of these fish were in the 7 to 9 inch class.

Although some white bass may have remained in the Petit Jean River above the area treated with rotenone, it is believed that the major part of the repopulation of this fish in Blue Mountain Lake was from the offspring of 309 ripe adult white bass which were taken in gill nets from the Upper White River in northwest Arkansas and transported to the lake in the spring of 1966 (Table II).

Very large numbers of young crappie were also found in this sample. Numerous young of such native fishes as buffalo, drum, and gizzard shad were collected. This sample was primarily qualitative since no block-off net was used and many fish, particularly shad and white bass, moved into the area after the treatment was made.



TABLE III—FISH POPULATION SAMPLE, BLUE MOUNTAIN LAKE—LOGAN COUNTY, AUGUST 30, 31, 1966.

Species	Number		Weight Pounds	Percent of Total	
	Of Fish	In Group		Number	Weight
Channel Catfish, Adult	1		1.9		
Channel Catfish, Int.	164		32.9		
Channel Catfish, Young	5		0.2		
Largemouth Bass, Adult	13		8.2		
Largemouth Bass, Int.	251		30.6		
Largemouth Bass, Young	108		1.8		
Spotted Bass, Int.	2		0.1		
Spotted Bass, Young	6		0.1		
White Bass, Young	943		153.4		
White Crappie, Adult	20		14.3		
Black Crappie, Adult	52		14.3		
Black Crappie, Int.	21		3.5		
Mixed Crappie, Young	2,510		11.3		
Spotted Gar, Adult	25		33.3		
Spotted Gar, Int.	2		0.3		
PREDATOR POPULATION					
		4,123	306.2	13.6	33.8
Bluegill, Adult	31		10.4		
Bluegill, Int.	615		23.6		
Bluegill, Young	Present				
Redear, Adult	3		0.3		
Green Sunfish, Adult	31		2.9		
Green Sunfish, Int.	272		10.1		
Longear, Int.	13		0.4		
Warmouth, Adult	3		0.3		
Warmouth, Int.	29		0.3		
Orange spotted Sunfish, Int.	143		3.0		
Brown Bullhead, Adult	4		1.1		
Brown Bullhead, Int.	4		0.8		
Yellow Bullhead, Int.	2		0.2		
Smallmouth Buffalo, Adult	3		8.8		
Mixed Buffalo, Young	290		16.8		
Spotted Sucker, Young	143		4.7		
Carp, Adult	3		12.0		
Carp, Int.	28		17.5		
Drum, Adult	26		24.8		
Drum, Int.	7		2.1		
Drum, Young	283		15.3		
EDIBLE FORAGE POPULATION					
		2,040	158.0	6.8	17.5
Gizzard Shad, Adult	5		2.0		
Gizzard Shad, Young	23,510		435.9		
Misc. (Minnows, darters, etc.)	650		3.1		
NON-EDIBLE FORAGE POPULATION					
		24,165	441.0	79.6	48.7
NON-PREDATOR POPULATION					
		26,205	599.0	86.4	66.2
TOTAL POPULATION					
		30,328	905.2	100.0	100.0

During the early spring of 1967, the fishing was excellent on Blue Mountain Lake. It was expressed by many of the local people that fishing was as good then as it was during the first few years after impoundment. Limits of crappie were the rule rather than the exception, and numerous small largemouth and white bass were caught.

After heavy rains in the early summer of 1967, the lake rose twelve feet into the flood pool, and periodic rains throughout most of the summer kept the lake from three to five feet above normal.

During the latter part of July 1967, another population sample was made in the same area sampled the previous year. A block-off net was

used and a more accurate quantitative as well as qualitative sample was obtained. The lake was only slightly above normal elevation; water was dingy (visibility 8 to 10 inches).

The 1967 sample shows a continuous population expansion in numbers of crappie, channel catfish, drum, and shad. Also, such fishes as crappie, white bass, buffalo, carp, drum, and shad show significant growth to adult and intermediate size groups from young size groups in 1966 (Table IV).

TABLE IV — FISH POPULATION SAMPLE, BLUE MOUNTAIN LAKE—LOGAN COUNTY, JULY 19, 20, 1967

Species	Number		Weight Pounds	Percent of Total	
	Of Fish	In Group		Number	Weight
Channel Catfish, Adult	2		5.4		
Channel Catfish, Int.	99		19.4		
Channel Catfish, Young	65		0.3		
Largemouth Bass, Adult	21		11.5		
Largemouth Bass, Int.	89		16.6		
Largemouth Bass, Young	135		1.6		
White Bass, Adult*	1		0.7		
White Bass, Int.	7		2.2		
White Bass, Young	10		0.2		
Black Crappie, Adult	12		4.2		
Black Crappie, Int.	62		3.4		
White Crappie, Adult	16		14.4		
White Crappie, Int.	308		16.2		
Mixed Crappie, Young	1,749		8.5		
Spotted Gar, Adult	16		42.8		
Spotted Gar, Int.	16		11.5		
Spotted Gar, Young	1		0.1		
<b>TOTAL PREDATOR POPULATION</b>		<b>2,627</b>	<b>159.0</b>	<b>17.4</b>	<b>20.2</b>
Bluegill, Adult	231		26.2		
Bluegill, Int.	782		30.5		
Redear, Adult	14		2.2		
Warmouth, Adult	4		1.0		
Warmouth, Int.	22		1.1		
Green Sunfish, Adult	39		4.3		
Green Sunfish, Int.	78		2.0		
Longear, Adult	1		0.2		
Longear, Int.	48		1.6		
Orangespotted Sunfish, Int.	353		4.0		
Brown Bullhead, Adult	3		1.6		
Yellow Bullhead, Adult	1		0.5		
Yellow Bullhead, Young	2		..		
Black Buffalo, Adult	5		14.3		
Smallmouth Buffalo, Adult	4		10.5		
Mixed Buffalo, Int.	394		119.1		
German Carp, Adult	47		123.7		
Drum, Adult	12		17.1		
Drum, Int.	418		89.7		
Drum, Young	259		4.1		
Spotted Sucker, Int.	25		2.5		
<b>EDIBLE FORAGE POPULATION</b>		<b>2,511</b>	<b>430.0</b>	<b>16.9</b>	<b>40.2</b>
Gizzard Shad, Int.	2,102		149.7		
Gizzard Shad, Young	7,298		46.6		
Misc. Minnows, etc.)	596		3.1		
<b>NON-EDIBLE FORAGE TOTAL FORAGE POPULATION</b>		<b>9,996</b>	<b>199.4</b>	<b>65.7</b>	<b>39.6</b>
<b>TOTAL POPULATION</b>		<b>12,507</b>	<b>629.4</b>	<b>82.6</b>	<b>79.8</b>
<b>Predator: Non-Predator Ratio by Weight 1:3.96</b>		<b>15,134</b>	<b>788.4</b>	<b>100.0</b>	<b>100.0</b>

\* Several killed outside sample area.

## COST OF PROJECT

A rough cost estimation of the entire project, to include costs of seed, seeding, rotenone, salaries, expenses, etc., would be approximately \$10,000. Therefore, virtually a new lake from a sport fishing and fish population standpoint of almost 3,000 acres was produced at a cost of approximately \$3.33 per acre or less than the price of one resident fishing license per acre of water. Cost (value) of fish used for restocking not included in above determination.

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## EVALUATION OF VARIOUS TAGGING METHODS ON SEVERAL FRESHWATER FISHES AND ESTUARINE FISHES OF LOUISIANA<sup>1</sup>

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### ABSTRACT

The retention rates of Atkins, dart, Petersen, spaghetti and strap tags were compared on largemouth bass, bluegill and Atlantic croaker. Antiseptics used in tagging operations were evaluated for their usefulness in promoting tag retention.

Petersen and spaghetti tags were found to be the most suitable of the tags tested for bluegills in short-term studies of three months.

Petersen, spaghetti and Atkins tags were found suitable for short-term tagging (3½ months) with largemouth bass. None of the tags were found suitable for long-term studies with the bass. Low retention rates were shown for all tags tested at the end of seven months.

Almost no retention after a five-month period was realized from Atlantic croakers.

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