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MOVEMENT OF NATIVE AND STOCKED FISH IN D'ARBONNE LAKE AFTER IMPOUNDMENT[1] [2]

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ABSTRACT

A total of 3,174 native fish of 29 species was tagged and released in Bayou D'Arbonne during the spring and summer of 1963. The distance and direction of movement of captured fish were recorded before inundation and again after the flooding of the 15,000-acre impoundment, D'Arbonne Lake, in January 1964. Of the 57 tagged fish returned before inundation, 54 were recaptured in the same location. One fish moved upstream for a distance of 3.3 miles and two fish moved downstream for an average distance of 6.8 miles. After the lake was filled, the fish exhibited extensive movements and only 11 percent of the returns occurred in release areas. Thirty-three of the 84 fish recaptured in the lake moved toward the headwaters while 35 fish moved toward the spillway. A total of 4.4 percent of the native fish tagged were recovered. Tagged hatchery reared bluegill, *Lepomis macrochirus*; largemouth bass, *Micropterus salmoides*; channel catfish, *Ictalurus punctatus*; and black crappie, *Pomoxis nigromaculatus* numbering 9,173 individuals were stocked in D'Arbonne Lake. The direction and distance of movement of these fish were also recorded. Sixty-one hatchery reared fish (0.7 percent) were recovered from the lake. Largemouth bass

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showed an upstream movement while 50 to 54 percent of the bluegill and channel catfish showed no movement. No tagged black crappie were recovered. A determination of the number of fish release sites necessary for stocking large impoundments was a primary objective.

INTRODUCTION

The movement of native fish after impoundment is an important factor in the planning of subsequent fish stocking. The movement of native fish to more favorable areas or the occupation of new habitats is an important feature. Some species of fish may normally migrate to headwaters for spawning and this migration or lack of migration may indicate the availability of suitable spawning areas in the headwaters, or adequate spawning areas in the lake proper.

A knowledge of the direction and distance of migration routes of stocked fish is important in determining the number of release points necessary for lake stocking or restocking programs. It is hoped that this study will guide future planning of the stocking of new impoundments of this type in Louisiana and surrounding states.

DESCRIPTION OF STUDY AREA

D'Arbonne Lake is a 15,000-acre impoundment located in Northeast Louisiana. This lake was authorized by the Louisiana Legislature through Act Number Nine in 1956 creating the Bayou D'Arbonne Watershed District. This District encompassed parts of the streams and watershed of Bayou D'Arbonne, Corney Bayou, Little Bayou D'Arbonne and Middle Fork Bayou (Figure 1). The purposes outlined for the construction of the lake was for the conservation of soil and water, and the development of the District's natural resources and wealth for sanitary, agricultural and recreational purposes.

D'Arbonne Lake was formed by the construction of a dam and spillway in Sec. 23, T20N, R1E across Bayou D'Arbonne. This dam is located in Union Parish ten air miles southeast of Farmerville, Louisiana. Bayou D'Arbonne is formed by the confluence of Middle Fork Bayou and Little Bayou D'Arbonne eight miles southwest of Farmerville. Corney Bayou, a major tributary of Bayou D'Arbonne, flows into the bayou one mile west of Farmerville. Several other tributaries are present, including Stowe Creek, but are of minor consequence, because of size. The D'Arbonne drainage system, with a watershed of 1,585 square miles, originates in southern Arkansas and terminates in the Ouachita River.

When the lake is at pool stage, 80 feet mean sea level, the average depth is 8.5 feet and the shoreline is 150 miles long. Five thousand, one hundred and eighty acres in the lake were cleared for water sports. Of this cleared area, 963 acres are located in front of the spillway with the remainder of the cleared area occurring along the banks of Bayou D'Arbonne and Corney Bayou. The remainder of the lake surface is of flooded timber consisting of an oak-gum-cypress complex. The surrounding lands are hilly and support a loblolly shortleaf pine and oak-pine forest types.

In July 1963 a check dam was placed across Bayou D'Arbonne to allow the construction of the permanent dam. Heavy rains caused a water rise from 55 feet to 71 feet mean sea level and the check dam was removed. The spillway gates were closed in November 1963 and by January 1964 water flowed over the bayou banks. Pool stage was reached on March 18, 1964. On September 4, 1964 the spillway gates were opened in order to lower the lake five feet for boat ramp construction. This level of 75 feet mean sea level was reached on September 15, 1964. The gates were closed December 1, 1964 and the lake returned to pool stage on January 24, 1965.

REVIEW OF LITERATURE

Literature regarding the movement of native fish within a stream area is abundant. Fajen (1962) worked on two small Ozark streams, Big Buffalo Creek and Little Saline Creek. In Little Saline Creek he tagged 135 smallmouth bass and recaptured 72 percent. Of the 97 tagged bass

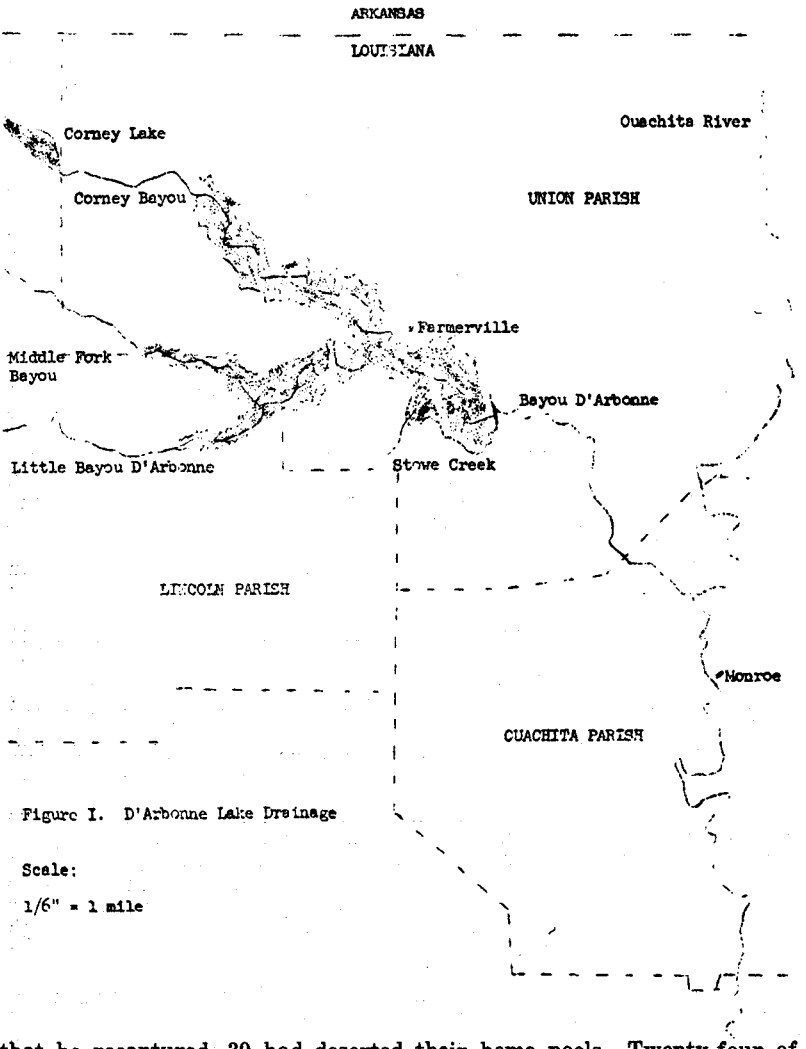

Figure I. D'Arbonne Lake Drainage

that he recaptured, 39 had deserted their home pools. Twenty-four of these were forced to move because their home pools were eliminated by gravel. He concluded that the movement of smallmouth bass in Little Saline Creek was directly correlated with the physical stability of the stream. In Big Buffalo Creek, the bass moved more frequently than the bass in the stable pools of Little Saline Creek although the pools of Big Buffalo Creek were comparatively stable during the study period. Of the 327 tagged bass, 90 were recaptured. Fifteen bass moved from 100 to 2,845 feet to other pools and later returned to home pools. Such voluntary straying and homing behavior had not been reported before for warmwater fishes.

Six hundred and thirty-seven native smallmouth bass and 740 native rock bass were tagged by Brown (1961). Ninety-one percent of the native fish were recaptured within 0.5 mile of the tagging site.

In the Colorado River, 264 channel catfish were trapped and tagged by McCammon (1956). The first year, 20 percent of the fish were recovered. A definite downstream movement of the catfish in the fall was noted.

Muncy (1958) tagged 3,077 channel catfish within a seven-mile area

of the Des Moines River. Seven of the 86 fish recaptured came from outside the seven-mile area; two upstream and five downstream. Electric shocking and netting, on the other hand, indicated that channel catfish do not remain long in the same pool.

From August 1947 through February 1950, 6,011 channel catfish were tagged in the upper Mississippi River (Hubley, 1963). A return of 497 fish (8.3 percent) was noted. Of the fish released at the tagging site, 23.9 percent were captured at the site of release, 45.8 percent were taken in tributaries. One group of fish were tagged and released 110 miles upstream from the area of capture. The transplanted fish as a group did not travel as far as the others released at the capture site, however, a definite upstream movement was noted.

Gerking (1950) marked 540 fish of nine species in a small stream. During the study period a flash flood occurred and the stream rose almost six feet. After the flood waters subsided, 75 percent of the total number of recaptured fish were found in the original location. Two weeks later 70 percent were in the original tagging area. He stated that there was a general tendency for fish to move upstream during the period of high water.

Several studies have also been conducted regarding the movement of native lake fish. Dequine and Hall (1949) tagged 1,616 largemouth bass in six large connected lakes in central Florida. Three hundred and seventy fish (22.9 percent) were recaptured by hook and line. Some movement occurred between the lakes, but no pattern of migration was discernible. More than 84 percent recaptured had not moved more than five miles from the release site. The maximum distance moved was 12.5 miles.

In the Sacramento-San Joaquin Delta during 1952, Pelgen (1954) tagged 3,466 white catfish at six locations. The movement of catfish from point of tagging was sporadic and without apparent direction.

In a later study of the Sacramento-San Joaquin Delta, Pelgen and McCammon (1955) tagged 1,499 white catfish and released them at three locations. During the first year, they had a 15.1 percent return. They found fewer tags were returned from fish under 8.5 inches long. The movement of fish was sporadic and without apparent direction.

Lewis, Summerfelt and Lopinot (1963) released catchable size warmwater fish in a 30-acre lake that had an established fish population. Three stockings of marked fishes were made during the spring of 1960, the spring of 1961 and the fall of 1961. The tag returns were higher from the spring stockings than from the fall stocking. Their explanation for the low return on fall stocked fishes was a possible high winter mortality. They noted an increase in the catch of native fish in the year in which the stockings were made.

Ball (1944) studied the movements of bluegill, bullheads and largemouth bass. After being at large from one to two years, 60 percent of the bluegill were taken within 30 yards of the release site. Fifty percent of the bullheads were taken within 30 yards of release site, 39 percent within 15 yards of the release site, and 81 percent within 100 yards of the release site. Of the 52 largemouth bass tagged, seven were returned. These bass exhibited no tendency to remain in one place, but roved over the entire lake.

Home ranges of fish in streams have also made interesting studies. Gerking (1953) working on a small stream in Indiana found that longear sunfish, rock bass, and green sunfish moved about very little, from one year to the next, and some of them remained in one section for as long as four years which is near their life span. The size of the home range of these small sunfish could be estimated at 100 to 200 feet under the conditions of his experiment. The movement of smallmouth bass, spotted bass, golden redhorse and hog suckers was greater than the sunfishes. These species had home ranges of about 200 to 400 feet in the stream.

Working with smallmouth bass in Jordan Creek, it was found that 80 percent of the bass taken the first year and 67 percent taken the following year were in the same section where they were tagged and released. Transplanted bass returned home from both upstream and

downstream locations. Smaller bass (9.0 inches or less) wandered more than the larger ones. Smallmouth bass transferred during low water, remained where released. This was probably due to the difficulties encountered in passing shallow riffles (Larimore, 1952).

Davis (1955), working on Perche Creek in Missouri, recaptured 223 tagged fish of 1759 originally tagged. Eleven percent (26 fish) were recovered at different stations than where they were tagged. No movement was shown by 197 fish. Northern river carpsuckers showed the greatest amount of movement, while carp and white crappie showed the least amount of movement. He noted that fish movement was largely during the spring months even though movement was made possible at other seasons of the year by high water.

MATERIALS AND METHODS

Native Fish

Native fish were collected using hoop nets, wire traps, trammel nets, and electric seine.

The mesh of the hoop nets ranged in size from one inch to three inches. The nets also varied in diameter, length, and number of throats. Hoop nets were fished during the spring of 1963 to capture fish for tagging. During low water flow, these nets were baited with cotton seed cake. After heavy rains with subsequent rapid rise in water level, baiting of the nets was found to be unnecessary. The primary catch of these hoop nets was suckers, catfish and gar.

Wire traps, constructed of one-inch poultry wire, were fished in conjunction with hoop nets. These cylindrical traps were four feet long and had a diameter of 24 inches with a single throat. Baiting was found to be necessary during low flow, but did not increase the catch during a rapid rise of the stream. Cotton seed cake was also used to bait the wire traps. Flathead catfish and sunfish were the predominant species of fish caught using this method.

Trammel nets were fished at sporadic intervals throughout the year of 1963. These nets ranged in size from one-inch square mesh to four-inch square mesh. Quiescent waters and flooded areas were selected to fish these nets. These nets were utilized only during cooler periods since it was difficult to keep the fish alive in the nets during the summer months. The predominant catch of the one-to-two-inch mesh nets was sunfish. Buffalo and carp were the most numerous of the fishes taken in the large mesh nets.

The electric seine used for this study was described by Witt and Campbell (1959). Best results were realized using the seine at night, therefore, some modification had to be made. Visibility was increased by extending lights beneath the water from the bow of the boat. Most of the fish were captured in shallow water near the banks. Brushy areas produced the greatest catches. Sunfish proved to be very susceptible to collection by shocking.

Fish were tagged with number one and number three size monel strap tags and plastic dart tags. The monel strap tags were placed over the lower mandible on most game fishes such as bass, crappie and sunfish and in the operculum on most catfish and suckers.

Some fish of all species were tagged with a plastic double barbed dart tag that had a 2.5-inch plastic streamer. These dart tags were placed in the dorsal musculature of the fish by use of a sharp pointed metal tube. Care had to be exercised to prevent loss of scales and to avoid puncturing the body too deeply with the tag.

A total of 3,174 native fish of 29 species was tagged between May 1963 and November 1963 (Table 1). These fish were released at 11 sampling stations (Figure 2). The common and scientific names of the fishes as accepted by the American Fisheries Society (1960) are as follows:

Esox niger LeSueur, chain pickerel; *Cyprinus carpio* Linnaeus, carp; *Carpiodes carpio* (Rafinesque), river carpsucker; *Ictiobus bubalus* (Rafinesque), smallmouth buffalo; *Ictiobus cyprinellus* (Valenciennes), bigmouth buffalo; *Ictiobus niger* (Rafinesque), black buffalo; *Minytrema melanops* (Rafinesque), spotted sucker; *Moxostoma poecilurum*

Table 1. Native Fish Tagged and Released in Bayou D'Arbonne May 1963 - November 1963

Station Number	1	2	3	4	5	6	7	8	9	13	14	Total
Chain pickerel	—	—	—	1	1	—	—	—	1	—	—	3
Carp	—	1	—	1	—	—	—	—	—	—	—	2
River carpsucker	—	1	1	—	—	—	1	3	—	—	—	6
Smallmouth buffalo	—	4	1	8	2	—	14	14	—	—	—	43
Bigmouth buffalo	7	12	2	29	1	3	50	9	—	—	—	113
Black buffalo	—	—	2	2	1	—	7	3	—	—	—	15
Spotted sucker	—	—	—	5	1	5	1	—	6	—	—	18
Blacktail redhorse	—	1	—	5	27	31	46	23	44	14	3	194
Blue catfish	—	—	—	—	—	—	—	—	—	1	—	1
Black bullhead	—	5	1	1	4	—	—	—	1	—	—	12
Yellow bullhead	—	6	2	2	—	3	—	—	4	3	—	20
Channel catfish	—	1	12	11	17	10	19	5	2	9	1	87
Flathead catfish	—	10	2	9	6	10	28	5	3	1	—	74
White bass	—	—	—	1	—	—	—	—	—	—	—	1
Flier	—	6	—	2	—	—	—	—	—	3	—	11
Warmouth	—	31	20	39	20	15	11	40	14	12	6	208
Green sunfish	—	1	—	—	—	—	—	2	—	2	—	5
Orangespotted sunfish	—	—	1	—	1	—	—	—	—	—	—	2
Bluegill	1	255	4	228	118	73	57	120	57	34	11	958
Longear sunfish	—	94	4	21	50	80	35	63	94	62	8	511
Redear sunfish	—	8	4	8	1	2	11	3	3	22	1	63
Spotted sunfish	—	—	—	—	1	—	—	—	1	2	—	4
Spotted bass	1	92	1	34	49	39	13	22	83	13	3	350
Largemouth bass	—	49	1	62	40	52	6	18	14	5	8	255
White crappie	—	15	10	17	1	—	—	3	—	4	—	50
Black crappie	1	36	9	17	4	3	14	6	2	3	1	96
Sauger	—	—	—	—	—	—	—	1	—	—	—	1
Freshwater drum	2	9	3	17	5	7	10	3	7	5	1	69
Striped mullet	—	—	—	—	—	—	2	—	—	—	—	2
Total	12	637	79	521	349	334	325	343	336	195	43	3174

(Jordan), blacktail redhorse; *Ictalurus furcatus* (LeSueur), blue catfish; *Ictalurus melas* (Rafinesque), black bullhead, *Ictalurus natalis* (LeSueur), yellow bullhead; *Ictalurus punctatus* (Rafinesque), channel catfish; *Pylodictis olivaris* (Rafinesque), flathead catfish; *Roccus chrysops* (Rafinesque), white bass; *Centrachus macropterus* (Lacepede), flier; *Chaenobryttus gulosus* (Cuvier), warmouth; *Lepomis cyanellus* Rafinesque, green sunfish; *Lepomis humilis* (Girard), orangespotted sunfish; *Lepomis macrochirus* Rafinesque, bluegill; *Lepomis megalotis* (Rafinesque), longear sunfish; *Lepomis microlophus* (Gunther), redear sunfish; *Lepomis punctatus* (Valenciennes), spotted sunfish; *Micropterus punctulatus* (Rafinesque), spotted bass; *Micropterus salmoides* (Lacepede), largemouth bass; *Pomoxis annularis* Rafinesque, white crappie; *Pomoxis nigromaculatus* (LeSueur), black crappie; *Stizostedion*

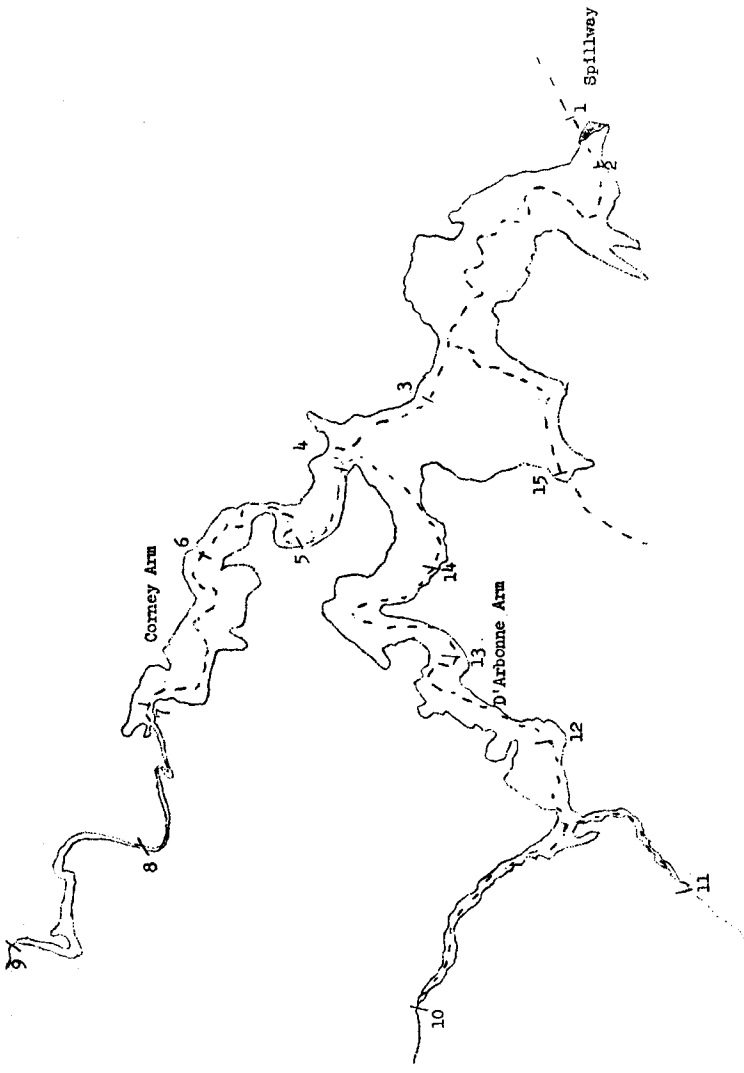

Figure 2 Sampling Stations on Bayou D'Arbonne and D'Arbonne Lake

canadense (Smith), sauger; *Aplodinotus grunniens* Rafinesque, freshwater drum; and *Mugil cephalus* Linnaeus, striped mullet.

Hatchery Fish

The stocked fish released in D'Arbonne Lake were raised in the Monroe Fish Hatchery at Monroe, Louisiana and the Beechwood Fish Hatchery near Alexandria, Louisiana. A portion of hatchery-reared fishes were tagged before their release into the lake. The fish tagged were channel catfish, bluegill, largemouth bass and black crappie.

Number one and number three monel strap tags were used to tag hatchery fish. The catfish were tagged in the operculum while the centrarchids were tagged in the lower mandible. At the time of release, the bluegill and black crappie averaged 0.1 pound, the bass averaged 0.5 pound and the channel catfish weighed 0.25 pound. A total of 9,173 tagged fish were stocked at 11 release sites during the months of December 1963 and January 1964 (Table 2).

Tagged fish were recovered using hoop nets, trammel nets, and

Table 2. Hatchery Fish Tagged and Released in Lake D'Arbonne December 1963-January 1964

Station Number	2	3	4	5	6	7	8	11	12	13	14	Total
Channel catfish	—	—	298	—	—	—	—	—	—	—	—	298
Bluegill	473	125	345	121	100	250	23	—	325	75	250	2087
Largemouth bass	624	710	997	728	500	500	492	499	492	498	498	6538
Black crappie	50	31	50	50	—	—	19	—	50	—	—	250
Total	1147	866	1690	899	600	750	534	499	867	573	748	9173

the electric seine. Both the sport and commercial fishermen of the area aided the study by reporting tagged fishes caught. No rewards were offered for tag returns.

Release Stations Before Inundation

Station 1

The area immediately below the lake spillway was the site of station 1 located in Sec.23, T20N, R1E. The banks were steep with a drop of 20 feet to the water level. Depths ranged from six inches in the riffle areas to 12 feet in the pools. The bottom was comprised of silt. During the rise of water levels due to backwater, sampling was done over the bank. The water in this flooded area was adequate for trammel nets and electric seine.

Station 2

Station 2 was in Sec.23, T20N, R1E. It included the bayou immediately in front of the dam and Kings Lake, a low banked cut-off adjacent to the area. Kings Lake varied in depth from two to four feet while the bayou had depths up to 15 feet. A hard clay bottom predominated in the bayou with limestone rock located in the riffle areas. Widths of the bayou averaged 80 feet in most of this area. Kings Lake had a silt bottom with low shrubs growing throughout the lake. This lake provided an excellent area to fish trammel nets.

Station 3

This area was located in Sec.6, T20N, R1E. Due to clearing operations the waters of this area remained turbid throughout the tagging study. There was a drop of eight feet from the bank to the water level. The bottom was silty and water depths ranged from six to 12 feet. The electric seine was not effective in this area.

Station 4

Station 4 was located in Sec.36, T21N, R1W. The north banks were relatively flat and the south banks quite steep. Corney Bayou, a relatively clear stream, flowed into the turbid Bayou D'Arbonne at this point. Bayou D'Arbonne had depths up to 14 feet while the depths in Corney Bayou ranged from six inches to five feet. The bottom types ranged from silt in Bayou D'Arbonne to sand in Corney Bayou.

Station 5

Corney Bayou at the Highway 2 bridge crossing was the location of station 5 and was located in Sec.27, T21N, R1W. The banks were steep and depths were up to 12 feet in the pool areas. Bottom types consisted of clay and silt.

Station 6

This station was located in Sec.16, T21N, R1W on Corney Bayou. The bayou meandered extensively at this station. Banks were steep with a 30-foot drop to water level. Several riffle areas with rock bottoms were present and pool areas were relatively shallow.

Station 7

Station 7 was on Corney Bayou in Sec. 7, T21N, R1W. Pool areas were the dominant type of habitat with a single riffle area located at the lower end. Depths averaged eight feet and steep banks were present.

Station 8

This area located in Sec.11, T21N, R2W, had a large pool area with no riffles present. The bayou averaged 150 feet in width and had depths up to 20 feet. Banks were relatively flat. Trammel nets were fished successfully in this area.

Station 9

The headwaters of Corney Bayou in Sec.33, T22N, R2W, was the location of station 9. The land was flat and the water was quite shallow. It was comprised mostly of riffle areas. Hoop nets were used extensively.

Station 10

This station was on Middle Fork Bayou in Sec.26, T20N, R2W. Turbid water due to riffle areas followed by areas of silty bottoms characterized this station. The banks were low and the surrounding land relatively flat.

Station 11

This area located in Sec.26, T20N, R2W was on Little Bayou D'Arbonne. The banks were steep with a drop of 40 feet to the water level. Hard clay and sand comprised the bottom type in this area. Shallow riffles made this area unsuitable for netting, therefore, all sampling was done with the electric seine.

Station 12

Station 12 was located in the upper end of Bayou D'Arbonne in Sec.18, T20N, R1W. Depths ranged from four to six feet with several mud bars in the area. The bottom was very silty.

Station 13

Station 13 located in Sec.5, T20N, R1W on Bayou D'Arbonne, proved to be the most difficult to sample. The deepest water was four feet deep with the majority of the water less than one foot. Numerous cypress stumps were present. All sampling had to be done in the small pool areas.

Station 14

This station was located in Sec.4, T20N, R1W on Bayou D'Arbonne. Riffles and pools of six feet or less alternated. The bottom was silty and the water was turbid. Banks were steep with a drop of 30 feet to the water level.

Station 15

This station was located on Stowe Creek in Sec.18, T20N, R1E. Stowe Creek was one of the major tributaries of Bayou D'Arbonne. The bottom was sandy and the water was very shallow. Due to the flat surrounding lands, this area flooded rapidly during heavy rains. Stowe Creek ran into the bayou immediately below station 3.

Description of Stations After Inundation

After inundation stations 2, 3, 4, and 15 were in the major portion of the lake (Figure 2). Widths in this part of the lake varied from ½ mile to two miles and depths ranged up to 40 feet in the old stream bed with an average depth of 15 feet. Approximately 20 percent of the water in this area was less than five feet deep.

The stations located on the Corney Bayou arm of D'Arbonne Lake (5, 6, 7, 8 and 9) varied in width from 60 feet to one mile (Figure 2). The average depth in this portion of the lake was eight feet.

Middle Fork Bayou and Little Bayou D'Arbonne are located in the headwaters of Bayou D'Arbonne (Figure 2). The water at these stations, 10 and 11, respectively, rose six feet and remained in the channel. Widths in this area averaged 80 feet.

The Bayou D'Arbonne stations (12, 13, and 14) ranged in width from ¼ mile to one mile (Figure 2). The average depth was 10 feet.

RESULTS

Native Fish

Of the 3,174 native fish tagged, a total of 141 fish (4.4 percent) were recaptured. Fifty-seven of these fish were taken before the lake

was filled (Table 3). The majority of the native fish recaptured before inundation of D'Arbonne Lake apparently exhibited little or no movement. Appreciable movement was shown by only three fish with one moving upstream and two moving downstream.

An adult blacktail redhorse which exhibited an upstream movement was at large for four days before recapture (Table 4). A distance of 3.3 miles was recorded during this time. One channel catfish moved a distance of 2.6 miles downstream in 58 days. An adult bluegill which was free for 15 days traveled a distance of 11.1 miles downstream.

Eighty-four of the 141 native fish returned were taken after D'Arbonne Lake was filled (Table 5.) The greater percentage of the fish ((81 percent) exhibited some movement. Sixteen fish were

Table 3. Direction of Movement and Number of Returns of Native Fish Before Inundation of D'Arbonne Lake

	Total No. Returned	No Movement	Upstream Movement	Downstream Movement
Carp	1	1	—	—
Bigmouth buffalo	9	9	—	—
Black buffalo	2	2	—	—
Blacktail redhorse	10	9	1	—
Channel catfish	4	3	—	1
Flathead catfish	3	3	—	—
Bluegill	14	13	—	1
Longear sunfish	3	3	—	—
Spotted bass	4	4	—	—
Largemouth bass	3	3	—	—
White crappie	1	1	—	—
Black crappie	2	2	—	—
Freshwater drum	1	1	—	—
TOTAL	57	54	1	2

recaptured where released. The greater percentage of the buffalos moved toward the spillway area. The other species of fish recaptured generally moved in both directions. Over one half of the bluegill which migrated to the headwaters moved into Corney Lake which is a small impoundment 15 miles upstream from station 9. A washout had occurred beside the Corney Lake spillway and this was apparently the route taken by the bluegill. Only one other tagged fish, a smallmouth buffalo, was recaptured from this lake.

Two fish made complex moves; that is, they moved down Corney Bayou and then moved upstream in Bayou D'Arbonne. These fish, a black buffalo and a bigmouth buffalo, were tagged at the same location within two days of each other. They were recaptured ten months later on the same day and within 5.1 miles of each other. No other fish recaptured exhibited this type of movement.

Three multiple returns were recorded during this study period. Two blacktail redhorse were tagged at the same station on the same day and were recaptured four months later in different locations but again on the same day. One blacktail redhorse had moved a distance of 17 miles toward the spillway while the other one had moved 3.5 miles in the same direction. Five days later the latter fish was recaptured at the 17-mile downstream location where the former fish had earlier been recaptured. In the interim the former fish had moved 3.5 miles further downstream in two days. A spotted bass was recaptured six months after tagging and had moved two miles toward the headwaters. It was recaptured again nine months later and had moved a mile further in the same direction.

Three spotted bass, one bluegill, one blacktail redhorse and one bigmouth buffalo were tagged in the bayou before the spillway gates were closed. These fish were recovered within one mile below the dam after the lake had reached spillway level. It was assumed that these fish had moved through the gates before they were closed. Two other

fish, one smallmouth buffalo and one bigmouth buffalo that had been tagged before the gates were closed were recovered in the bayou after the drawdown of D'Arbonne Lake. The smallmouth buffalo was recovered two miles below the dam in D'Arbonne while the bigmouth buffalo was recovered 41 miles below the dam in the Ouachita River. These fish could have come through the spillway gates either before the filling of the lake or during the drawdown operations.

The number of days from release to recapture and the miles traveled by the native fish are presented in Table 6. There is no apparent correlation between the number of days at large and the distance traveled by native fish. A channel catfish was at large for 702 days before recapture and was taken only 2.5 miles from the release point.

A bigmouth buffalo traveled the greatest distance downstream

Table 4. Direction and Distance of Movement of Native Fish and Number of Days Free Before Inundation

	No Movement		Upstream Movement				Downstream Movement			
	Avg. Days	Range	Avg. Days	Range	Avg. Miles	Range	Avg. Days	Range	Avg. Miles	Range
Carp	68.0	—	—	—	—	—	—	—	—	—
Bigmouth buffalo	50.1	2-136	—	—	—	—	—	—	—	—
Black buffalo	71.5	14-129	—	—	—	—	—	—	—	—
Blacktail redhorse	13.7	3-32	4.0	—	3.3	—	—	—	—	—
Channel catfish	7.0	3-14	—	—	—	—	58.0	—	2.6	—
Flathead catfish	10.0	7-13	—	—	—	—	—	—	—	—
Bluegill	7.9	1-51	—	—	—	—	15.0	—	11.1	—
Longear sunfish	3.0	—	—	—	—	—	—	—	—	—
Spotted bass	16.0	1-53	—	—	—	—	—	—	—	—
Largemouth bass	23.0	1-67	—	—	—	—	—	—	—	—
White crappie	1.0	—	—	—	—	—	—	—	—	—
Black crappie	1.5	1-2	—	—	—	—	—	—	—	—
Freshwater drum	3.0	—	—	—	—	—	—	—	—	—

Table 5. Direction of Movement and Number of Returns of Native Fish After Inundation of D'Arbonne Lake

	Total No. Returned	No Movement	Moved Toward Headquarters	Moved Toward Spillway
Smallmouth buffalo	5	1	1	3
Bigmouth buffalo	7	—	—	7
Black buffalo	1	—	—	1
Blacktail redhorse	8	—	5	3
Yellow bullhead	1	1	—	—
Channel catfish	3	1	1	1
Flathead catfish	5	1	2	2
Orangespotted sunfish	1	—	—	1
Bluegill	23	6	10	7
Longear sunfish	4	—	4	—
Redear sunfish	2	1	—	1
Spotted bass	18	5	7	6
Largemouth bass	3	—	1	2
Black crappie	2	—	2	—
Freshwater drum	1	—	—	1
TOTAL	84	16	33	35

(56.3 miles). This fish was tagged and released in Corney Bayou and was recovered 418 days later in the Ouachita River near Monroe. A bluegill was recovered 37 miles upstream for the greatest distance traveled toward the headwaters. This fish was free for 231 days.

Hatchery Fish

Sixty-one hatchery-reared fish were recovered from the lake (Table 7). This was a return of 0.7 percent. No tagged black crappie were recovered from the lake. Several fish were captured which appeared to have had a tag in the lower jaw. Another tagging procedure might have provided better results for this species.

The largest percent return, 8.1, was exhibited by the channel catfish. Over one-half of these catfish were recaptured near release points and the greatest distances recorded (16 miles) were toward the headwaters (Table 8). An average of 4.3 miles was recorded by those channel catfish moving toward the spillway. The channel catfish were at large longer than the other two species. Bluegill sunfish also had a tendency to remain near the release site. Seven bluegill were captured at release sites, indicating no movement while five moved toward the spillway area and two moved toward the headwaters. Bluegill were at large the fewest number of days. There was so significant difference in number of miles traveled by the bluegill moving toward the headwaters and those going toward the spillway. Forty-eight percent of the largemouth bass recaptured had moved toward the headwaters. The remaining 52 percent was evenly divided between those apparently remaining near the release site and those moving toward the spillway.

DISCUSSION

The tagged native fish in the bayou exhibited very little movement before the inundation of D'Arbonne Lake. After the lake started to fill, the majority of the recaptured fish were taken from areas other than where they were originally captured. In most cases the difference in the number of fish moving toward the headwaters and those moving toward the spillway was not significant. Apparently desirable habitat situations were encountered upstream as well as downstream.

It was hypothesized that some fish would prefer the more shallow areas of the headwaters for spawning. However, no significant difference was noted in the direction of movement of fish by season of the year. Suitable spawning areas apparently were found and utilized near the newly established home range.

Most of the native stream fish were found in the pool area in the lake proper although stream habitat similar to the areas before flooding

Table 6. Direction and Distance of Movement of Native Fish and Number of Days Free After Inundation

	No Movement		Moved Toward Headwaters				Moved Toward Spillway			
	Avg. Days	Range	Avg. Days	Range	Avg. Miles	Range	Avg. Days	Range	Avg. Miles	Range
Smallmouth buffalo	251.0	— —	354.0	— —	22.7	— —	326.3	177-565	11.5	8.3-17.3
Bigmouth buffalo	— —	— —	— —	— —	— —	— —	333.4	217-604	18.5	5.2-56.3
Black buffalo	— —	— —	— —	— —	— —	— —	312.0	— —	20.0	— —
Blacktail redhorse	— —	— —	149.6	90-187	8.5	1.0-27.7	129.0	112-139	15.3	10.8-19.2
Yellow bullhead	228.0	— —	— —	— —	— —	— —	— —	— —	— —	— —
Channel catfish	334.0	— —	239.0	— —	3.3	— —	702.0	— —	2.5	— —
Flathead catfish	218.0	— —	376.5	230-523	7.3	6.8-7.7	667.0	661-673	5.7	2.0-9.3
Orangespotted sunfish	— —	— —	— —	— —	— —	— —	296.0	— —	6.5	— —
Bluegill	290.2	181-545	231.8	175-310	19.6	1.5-37.0	194.6	114-245	7.7	1.0-14.8
Longear sunfish	— —	— —	323.8	222-527	4.4	2.0-11.6	— —	— —	— —	— —
Redear sunfish	287.0	— —	— —	— —	— —	— —	216.0	— —	7.1	— —
Spotted bass	257.6	173-378	343.0	269-367	8.2	2.0-13.7	225.3	102-386	7.5	1.0-12.8
Largemouth bass	— —	— —	374.0	— —	7.1	— —	155.5	132-179	14.4	11.8-17.0
Black crappie	— —	— —	196.0	159-233	13.0	1.0-25.0	— —	— —	— —	— —
Freshwater drum	— —	— —	— —	— —	— —	— —	420.0	— —	1.5	— —

Table 7. Direction of Movement and Number of Returns From Hatchery-Reared Fish

	Total No. Returned	No Movement	Moved Toward Headwaters	Moved Toward Spillway	Percent Return
Channel catfish	24	13	5	6	8.1
Bluegill	14	7	2	5	0.7
Largemouth bass	23	6	11	6	0.4
Black crappie	0	0	0	0	0
TOTAL	61	26	18	17	0.7

Table 8. Direction and Distance of Movement of Hatchery-Reared Fish and Number of Days Free

	No Movement		Moved Toward Headwaters				Moved Toward Spillway			
	Avg. Days	Range	Avg. Days	Range	Avg. Miles	Range	Avg. Days	Range	Avg. Miles	Range
Channel catfish	102.3	41-439	223.6	113-525	16.0	12.1-24.0	348.3	125-471	4.3	1.0-6.0
Bluegill	97.5	46-139	107.0	76-138	4.4	2.0-6.8	104.8	95-112	4.3	1.0-9.1
Largemouth bass	340.2	223-480	217.3	125-443	3.9	1.2-18.2	219.7	154-282	5.7	1.5-9.0

were present in the headwaters above the lake. Apparently the lake habitat was suitable to most native species.

Forty-three percent of the hatchery-reared fish were recaptured near release sites, but the remainder of the fish recaptured moved an average of 4.5 miles in both directions from the release site. The majority of the stocked fish appeared to have found suitable habitats at the release location or within this distance. If these fish had been stocked at one location, the distances traveled would probably not have been sufficient to populate the whole lake within one year, however, population pressure would most certainly have hastened dispersal. It is generally accepted that fish will eventually become more or less evenly distributed throughout an area if suitable habitats exist. One of the objectives of this study was to determine the distances between the release sites necessary for an adequate distribution in the shortest period of time. Since the average distance of movement was 4.5 miles it is surmised by the authors that a distance of no more than 10 miles between release sites should suffice to obtain an adequate distribution within one year, in a similar impoundment in a similar geographic location. Some of the fish moved farther than the average of 4.5 miles which would tend to provide sufficent overlapping to stock fringe areas.

A higher percentage return of native fish than stocked fish was recorded. Several factors may have attributed to this difference. The native fish were catchable size when tagged while the stocked fish were young-of-the-year and therefore, too small to be caught immediately. Since the native fish were larger, tags could be better adapted to them than to the smaller fish.

The lake drawdown had no apparent effect on the movements of the fish. Little if any movement was attributed to this fluctuation. The lake was drawn down five feet, but most of the newly inundated area was still flooded. The fact that the water did not recede to the bayou banks may explain this lack of fish movement during the drawdown.

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EFFECTS OF IMPOUNDMENT ON THE BENTHIC POPULATION OF BAYOU D'ARBONNE, LOUISIANA

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INTRODUCTION

This study was initiated in 1957 in an effort to determine the effect of impoundment on stream dwelling benthos (Davis, 1960). Bayou D'Arbonne and Corney Bayou were chosen due to the proposal to construct a 15,000-acre lake on the area. A later objective was to determine the effect on benthic organisms of a water level fluctuation program.

DESCRIPTION OF STUDY AREA

Bayou D'Arbonne was formed by the confluence of Middle Fork Bayou and Little Bayou D'Arbonne eight miles southwest of Farmerville, Louisiana. Corney Bayou was a major tributary of Bayou D'Arbonne and flowed into the bayou one mile west of Farmerville. The combined drainage systems of these two bayous exceeds 1,400 square miles. They originate in south central Arkansas and Bayou D'Arbonne empties into the Ouachita River 12 miles northwest of Monroe, Louisiana.

Station 1 was located 0.5 miles below the proposed dam site (Figure 1). The banks in this area were quite steep with a drop of up to 20 feet to the water level. The area is a mixture of riffles and deep pools. Bottom types in the pools ranged from silt to sandy loam. During the actual construction of the dam this station received heavy silt deposits. At this station and at all other stations, two samples were taken on each sampling date.

One mile above the dam was the location of Station 2. This station was just below a rocky outcropping. The water was two feet deep during normal stream flow. The bottom was generally mucky with numerous sticks and leaves.

A long pool which varied up to 14 feet in depth characterized Station 3. The bottom was mucky with many partially decayed leaves and twigs. Depths of the samples were two feet to ten feet.

In an effort to determine the effect of mixing the water of the two

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