

JOB COMPLETION REPORT

As required by

FEDERAL AID IN FISHERIES RESTORATION ACT

TEXAS

Federal Aid Project No. F-7-R-9

Fisheries Investigations and Surveys of the Waters of Region 1-A  
(Formerly 1-B)

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

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## ABSTRACT

Laboratory and field work was continued at Lake Diversion to study food and feeding habits, distribution, movements, and reproduction of gizzard shad, carp, carpsuckers and the buffalo fishes.

Techniques and methods were changed to provide additional data. Thirty-nine seining stations were selected and were seined monthly. The data collected were recorded to show distribution of the species collected in this manner.

Netting, done in the same manner as during the later part of the last segment, produced 2,630 fish from which a total of about 800 rough fish digestive tracts was collected for food habits study. These digestive tracts, along with plankton samples, bottom samples and live specimens, were delivered to personnel at Midwestern University who conducted studies of the anatomy, fecundity, and food habits of the species concerned.

Data concerning spawning, predation, distribution and growth rates are presented, and recommendations for further natural history work are suggested.

## JOB COMPLETION REPORT

State of Texas

Project No. F-7-R-9

Name: Fisheries Investigations and Surveys of the Waters of Region 1-A (Formerly 1-B)

Job No. B-15

Title: Notes on the Natural History of Problematical Fish Species

Period Covered: January 1, 1961 - December 31, 1961

### Objectives:

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

### Techniques Used:

Netting techniques were basically the same as were used during the later part of last segment. Thirteen stations were netted monthly with experimental and 3-inch gill nets. Location of the 13 stations, as shown in Figure 1, extended from the dam on the east end of Lake Diversion to Cottonwood Creek on the west end.

Seining techniques were changed to provide more accurate and more extensive data on distribution. Thirty-nine seining stations were selected from all ecological types present. The stations, shown in Figure 2, were seined monthly with a 20-foot one-eight-inch mesh nylon minnow seine. The specimens taken at each station were placed in cloth bags, labeled, and preserved for laboratory identification and counting.

Through an inter-agency contract between the Game and Fish Commission and Midwestern University, the University is conducting studies on the anatomy, food habits, and reproductive habits of problematical fish species including gizzard shad (Dorosoma cepedianum) European carp (Cyprinus carpio), river carpsucker (Carpiodes carpio) and smallmouth buffalo (Ictiobus bubalus). The inter-agency contract allows the use of trained personnel and laboratory facilities which are necessary for the work, and which are not immediately available to the Inland Fisheries Division. The results of this work will be presented in a separate report.

Materials for food habits, anatomical and fecundity studies, including preserved digestive tracts, plankton samples, bottom samples and live and dead specimens of species under study, were delivered to Midwestern University monthly or when requested. Digestive tracts were preserved in cloth bags which were labeled with the length, weight, sex, location and date of capture of the fish. Plankton samples were concentrated, preserved and labeled with the location,

date, and depth of the collection. Bottom samples were collected and washed through a fine mesh screen, and the remaining organisms and debris were preserved and labeled with the location and date of the collection. Live specimens for anatomical study were collected with nets or seines and kept in holding vats until needed.

Findings:

Fish Collections

Water depths at the netting stations ranged from 3 to 4 feet at the Cottonwood Creek and Hackberry Bay stations, to about 20 feet at the Gravel Beach and Dam stations. Bottom types included sand, silt, clay and mud. Vegetation in the vicinity of the stations was for the most part either Chara sp. or Potamogeton sp., but in some places cattails, bulrush and sedges were found along shorelines near which nets were set. Table 1 gives the characteristics of the 13 lake netting stations. Two of the stations which were located in deep water were netted at both the lake surface and bottom.

Of a total of 2,630 fish taken by gill nets during this segment, the four species under study comprised 76.54 per cent of this figure. Last year the same four comprised 70.48 per cent of the segment's catch. Compared with last year, shad were down 5.28 per cent, smallmouth buffalo were up 3.61 per cent, carpsuckers were up 7.60 per cent, and carp were up 0.12 per cent. These differences in composition were probably due, in part, to the use of additional 3-inch mesh gill nets this year, which were used for only a short time at the end of last segment. Station composition and species distribution for fish netted are given in Table 2. Netting collections were made monthly from January to August with two collections being made in the month of May. The May 23 collection was the largest with a total of 382 fish, while the July 19 collection was the least with 190 fish. The average catch per month was 292. Total catches per station varied from 73 at the Dam Floating station to 565 at the Fence Line station, and the average per station was 202 fish. Stations' records show that the highest and lowest catch per single set during any month were 99 from the Fence Line in February and none from the Sandy Beach Sinking station in January, and the Dam Floating station in February.

The 39 lake seining stations were selected to give samples from all ecological types noted. Stations' types varied from those barren of vegetation and bottom sediments and with consistently clear water, to those located in areas of thick vegetation with deep bottom sediments of mud and organic debris, and with consistently very turbid water. At the site of each seine collection, the following were recorded: date and time of the collection, temperature of the water at one foot below the surface, vegetation noted in the area, the maximum depth seined, the number of drags necessary to collect the sample, and the relative turbidity of the water.

Seining collections produced a total of 24,931 fish with monthly collections, shown in Table 3, ranging from 1,243 in February to 4,324 in July. The smallest total number taken at any station was 96 at the Duck Bay No. 2 station and the largest number taken at any station was 2,216 at Big Brushy No. 1 station. This was only slightly more than was taken at the Big Boggy No. 1 station where 2,177 fish were collected. The two stations accounted for 17.62 per cent of the total

seine collections. Of the 36 species of fish known to exist in Lake Diversion, only 26 species were represented in the regular seine collections. Only 7 of these comprised over 1 per cent of the total, leaving 19 species which are considered of minor importance. Of the seven most abundant species, the red shiner (Notropis lutrensis), comprised 31.77 per cent, and the bullhead minnow (Pimephales vigilax), comprised 25.79 per cent of the total, which combined accounted for 57.56 per cent of the fish taken by seining. As shown in Table 4, which gives the monthly percentage composition, these two species were the only ones taken in abundance during each of the nine months in which seine collections were made. At times the gizzard shad was noted to be more abundant, but following the month of June when the seine collection consisted of 57.99 per cent shad, they rapidly declined in abundance. During the month of October only 17 shad were taken; while red shiners and bullhead minnows together comprised approximately 75 per cent of the seine catch. The other species of importance in seine samples were the ghost shiner (Notropis buechanani), the spotted sunfish (Lepomis punctatus), the bluegill (Lepomis macrochirus), and the mosquitofish (Gambusia affinis).

During this segment, one species of fish was taken which had not previously been found. This fish, the Mississippi silverside (Menidia audens), went up the Wichita River and Holiday Creek, and entered Lake Wichita following heavy rains in 1957. It has since spread rapidly in Lake Wichita as well as adjacent irrigation canals flowing from Lake Diversion, and it is now established in Lake Diversion. Whether or not this species will flourish remains to be seen, but it has done exceptionally well in Lake Wichita. This species was taken only during random seining and therefore does not appear in the seine collection tables.

Work on the section of the Big Wichita River between Lake Diversion and Lake Kemp included seining and gill netting. It was necessary to confine netting to tributaries of the river, and due to the inconsistent flow of the river, seining stations originally established at the beginning of this segment were either changed or abandoned, thereby causing the river seining data to be incomplete and not comparable. Netting of the river met with more difficulties than expected and data collected by netting is not as extensive as was hoped.

#### Distribution

There seemed to be a preference among shad for the upper portions of the lake. For example, the upper 5 stations took a total of 419 shad which was 67 per cent of all the shad taken, and 213 more than was taken at the 8 other stations located from Rattlesnake Island to the dam. Figure 3 shows the monthly percentage of shad taken in the five upper stations, and that in February and March, 100 per cent and 82 per cent of the shad respectively were taken in the upper area of the lake. In July, however, only 39 per cent were taken from this area which could represent a movement of some shad to the lower area of the lake seeking the coolness of deeper water. A similar occurrence was noted last segment.

The Fence Line station, which accounted for 29.92 per cent of all shad taken, produced the highest percentage of shad during 7 of the 9 collections. Four other stations which produced high percentages of shad were Hackberry Bay with 12 per cent, Sandy Beach Sinking with 11 per cent, Rocky Point with 9 per cent, and Sandy Beach Floating with 9 per cent. Three of these are included in the five upper stations.

Carp sucker were consistently taken in large numbers at three of the stations. The Fence Line station was high with 224, followed by Rock Island with 118, and Cedar Point with 91. Other stations producing above the average were Hackberry Bay with 75 and Cottonwood Creek with 76. The Cottonwood Creek station would have produced more, but on two occasions low water caused the omission of this set. During May and July there was less than four inches of water standing at Fulda Bridge, which prevented passage beyond this point by boat. Nineteen carpsuckers were taken at Cottonwood in June, indicating that the species was active in the river at that time. During the preceding segment, it was noted that ripe male carpsuckers were abundant in the river during the month of May and that spawning took place during the following weeks. It was interesting to note that of the 182 fish taken at the netting stations along the river, 50.55 per cent were carpsuckers. This is considerably higher than the lake average and strengthens the thought that the carpsucker prefers a flowing-water habitat.

An average of 39 smallmouth buffalo per station was taken. Five stations produced more than the average, and one station, Rock Island, produced more than twice the average. Rock Island, which produced 25 per cent and Cedar Point which produced 14 per cent, were followed by Cottonwood Creek with 13 per cent, Rattlesnake Island with 11 per cent and Hackberry Bay with 10 per cent. These 5 together totaled 73 per cent for this segment, and similarly, were the 5 stations producing the largest percentage of buffalo last segment. As noted in Table 1, the characteristics of Hackberry and Cottonwood stations are very similar, as are the characteristics of the other three. Examination of monthly distribution data showed that large numbers of buffalo were taken at the Hackberry and Cottonwood stations only during the period of April through June, which coincides with the spawning period of this species. During the other months, the catch of buffalo at these stations was very low, which indicates that the presence of buffalo in the area of these stations is related to spawning activity. Field observations and random netting have substantiated this. The other three stations where buffalo were abundant are thought to be in areas where buffalo feed throughout most of the year.

The distribution of carp in Lake Diversion is unclear due to the relatively small numbers of carp which were taken. Monthly catches varied from none to 18, and averaged only 10 carp per month. The largest single catches of carp were 7 in April at Rock Island, 6 in June at Little Brushy, and 6 in August at Cottonwood Creek. These figures are hardly large enough to indicate concentrations or preferred areas of carp. The three stations producing the highest percentages of carp were Rock Island, Cedar Point, and Little Brushy. The percentages at each station were very near the same, totaling about 14 per cent at each station.

The distribution of young-of-the-year rough fish was determined from seining data. Locations of high and low catches were noted for each species and the characteristics of these locations, including bottom type, vegetation, water temperature, and turbidity were compared. As a rule, the largest catches of young shad were taken at stations having muddy bottoms, covered with Chara, while the smallest catches were made at stations having firm bottoms of gravel or rock with no vegetation. Temperature appeared to be a significant factor, with stations having slightly higher water temperatures generally producing more shad. Turbidity, maximum depth seined, and time of day did not appear to be significant factors affecting the distribution of any young rough fish. Young-of-the-year of species, other than shad, were taken in numbers too small to be of much value

in determining their distribution. However, the data collected indicate a preference among the other species for muddy bottoms and vegetated areas also.

### Spawning

Spawning of buffalo began between March 14 and April 7 with water temperatures in shallow water ranging from about 53° F. early in the morning to about 62° F. in the afternoon. On the April 7 collection, 16 adult female buffalo were taken, 2 of which were spent. During the following collections, spawning of buffalo was noted to progress rather slowly, but by mid-June approximately 70 per cent of the adult females had spawned, by mid-July 77 per cent had spawned and by August 2 only about 1 out of 10 females still carried eggs. Early spawns of buffalo apparently were not successful because young buffalo did not appear in seine collections until July. Similarly, females that had not spawned before August probably were not successful because some females taken in August were reabsorbing their eggs.

Spent female carpsuckers were also taken as early as April 7, when 10 of the 55 adult females were spent. Between April 7 and May 3, no increase in the percentage of spent female carpsuckers was noted, but between May 3 and July 19, the percentage increased from 17 to 87 per cent, and by August 2, 94 per cent had spawned. Major spawning of this species took place after shallow water temperatures had reached 70° F. As no young carpsuckers appeared in the seine collections until June, the April spawning probably was unsuccessful. Table 5 shows monthly increases in spent females of the four species under study, and the lake temperature taken in open water at one foot below the surface.

Carp, as has been noted in the past, were sporadic in their spawning. Spent carp were taken on May 3, but by July 19 only one-half of the females had spawned, and the August collection showed a decrease in the per cent spawned. Last year when similar figures were obtained, 25 per cent of the female carp were spent in May, 40 per cent were spent in July, and 41 per cent were spent in August. Immature female carp were noted as late as the month of November 1960.

Gizzard shad, the last of the four species to begin spawning, began between May 3 and May 23, with water temperatures in shallow areas of about 70° F. Of the 91 females collected on May 23, 56 per cent were spent. This is very similar to the spawning data of shad collected last year, when spawning began between May 11 and May 25, and 67 per cent of the May 25 collection of 76 females were spent. It is interesting to note that data for July collections, both this year and last year, showed decreases in the per cent of spent female shad compared to the previous months. The significance of this is probably a decrease in activity or widespread movements of those females who have completed their spawning. It is possible that this decrease in percentage of spent female shad is a reflection of a decrease in numbers of spent females due to widespread mortality immediately following spawning. However, this possibility has not been studied. The large spawn of shad in May is reflected in the big increase in the number of fish taken in the June seine sample (Table 3), and in the percentage composition of the June seine sample (Table 4), which shows an increase from no shad in May to 57.99 per cent in June. As previously mentioned, however, this "bloom" of shad fry persisted for a short time only.

### Growth Rates

The growth rates of the four species of rough fish under study were compared with the growth rates of predaceous species. Table 6 gives the number of measurements made, and the maximum, minimum and average lengths of each species of rough and predaceous fish taken from May through October. These figures are for young-of-the-year only. It can be seen that among the predaceous fishes, the longnose gar (Lepisosteus osseus), has the most rapid growth rate. Young of this species were taken on June 13, June 28 and July 18 and on these dates averaged 64 mm, 69 mm and 163 mm, respectively. The average lengths of other species taken on these dates were only one-half to one-third as much as that of the young gar. White bass (Roccus chrysops) were noted to be slightly larger than black bass (Micropterus salmoides) taken on the same dates; however, both were considerably larger than the average shad. The October 6 collection showed average lengths of 88 mm, 78 mm, and 53 mm for young white bass, black bass and shad, respectively. The difference in length between the smallest shad and the largest white bass ranged from 12 mm in May to 30 mm in June to 40 mm in July, and up to 77 mm in October. This illustrates that early spawns of white bass are capable of feeding on the smaller individuals of shad throughout the summer, fall and possibly the entire year.

Smallmouth buffalo and carpsucker showed approximately 10 mm per cent increase in length. Buffalo had 28 mm, 38 mm, 48 mm, and 63 mm as average lengths in the months of June, July, August, and October. Average lengths of carpsucker went from 27 mm to 39 mm to 46 mm during the months of June through August. During the same months, carp grew more rapidly, increasing from 16 mm to 42 mm to 62 mm.

Only a small amount of growth rate data for drum (Aplodinotus gunniens), and white crappie (Poxomis annularis) was obtained; however, the growth rate for crappie appeared to be about the same as for shad and the rate for drum was about the same as for white bass.

Young shortnose gar were taken only during the June 28 collection and at that time the average length was 88 mm, indicating a very rapid growth rate for this species, similar to that of the longnose gar.

### Predation

Food items of white bass, black bass, crappie, and channel catfish (Ictalurus punctatus) were recorded under the general categories of "shad", "other fish", "mayfly larvae", "insects" and "miscellaneous". Tables 7 to 10 give the frequency of occurrence of these items. Black bass were noted to have fed on shad and other fish entirely. Shad were important in the diet of white bass and crappie, but were not found in the stomachs of channel catfish. Other fish, which included "unidentifiable fish remains" were abundant in the diet of white bass and crappie and, to a lesser extent, in the diet of channel catfish. Mayfly larvae were important, except in black bass, during every month. Insects, including, for the most part, beetles, grasshoppers, and various insect larvae other than mayfly larvae, were important food items beginning in the month of May.

White bass fingerlings taken in June, ranging from 29 mm to 44 mm in length, were examined for stomach contents. Out of 7 examined, 1 had eaten numerous backswimmers 2 to 3 mm in length, and the remaining 6 contained only fish fry, some of which could be identified as shad.

Seven black bass fingerlings ranging from 33 mm to 47 mm were also examined. Three contained small insects, 3 contained fish fry, and 1 contained small crustaceans.

Small crappie were found to contain only zooplankton, while fingerling drum contained only diptera larvae. Fingerling gar contained only fish fry, which appeared to be a mixture of minnows and shad.

#### Discussion:

Job B-15 was initiated as a preliminary study of techniques to provide basic information on distribution, movements, spawning and food habits of the four species of rough fish generally considered to be the underlying cause of the decline in good sport fishing as new reservoirs attain maturity. The processes involved when good fishing lakes gradually, but inevitably, decline in game fish production are not thoroughly understood. The chemical, physical, and biological changes, which occur relatively fast in man-made reservoirs, in some manner bring about the conditions which are more conducive to the production of rough fish species than game species. Siltation, diminishing fertility, fishing pressures, and increase in rough species are possible factors in this process.

When examining such problems, one finds that there has been very little research on the ecology and life histories of the problematical species in artificial impoundments in this area. Such impoundments include practically all of the standing water of this state. There has also been very little basic limnological work on these impoundments. In order to meet increased fishing pressures, the trend in rough fish control over the past several years has been mostly towards the use of toxicants for total or partial eradication of fish populations. Experimental chemical control work along these lines has resulted in the development of fairly effective methods for the selective control of some species. However, this type of control has been shown to be effective for only a few years and justification of the expense of some of these treatments has been questioned. Total eradications have been attempted in some lakes where selective controls were not practical, but these projects have met with varying success, and as a rule they were partial or total failures. An example was the failure to obtain a total kill at Buffalo Springs Lake at Lubbock, even though excessive amounts of toxicants were used. Another example was the failure to obtain a total kill at Buffalo Lake at Umbarger, which also was heavily treated. These failures may have been due, in part, to chemical or biological action on the toxicants which reduced their potency, to inadequate coverage or distribution of the toxicant, or to dilution by incoming fresh water. The exact cause or causes are not known for certain.

Many problems concerning chemical control have already been solved, and others, such as those pertaining to the relationship of water quality to chemical potency, will be solved in the future. The possibilities in chemical control are rapidly increasing with the development and use of new insecticides and herbicides. With the discovery of better toxicants it may eventually be possible to have chemicals with special selectiveness for each species. Chemicals which, once applied to an area, would remain effective in that area for long periods of time, and chemicals which will sterilize certain species, or kill the eggs, are not unforeseeable. If such chemicals are now available, our present lack of

knowledge of the basic habits of the rough fish species would not permit their most beneficial and practical utilization. Even with great improvements in the field of chemical control, there will always remain the need for repeated treatments, and the need for basic data on the life histories and habits of the fish species being controlled. Complete life histories of these species could be very valuable in the planning and scheduling of future control work, and in reducing the costs of this work.

Increased knowledge of ecology and life histories will augment control of undesirable species by inexpensive local or spot treatments, controls through biological means, lake drawdown, or mechanical methods. The use of electrical currents as killing agents has not been attempted in this state, but could conceivably be useful in areas of concentrations of spawning rough fish, or rough fish fry, as well as in population surveys.

Studies of natural history and the development of chemical controls should be closely coordinated so that both will progress somewhat equally towards the common goal of better fishing through control of undesirable species.

Much of the data collected on Job B-15 will be of little value until more involved studies of particular species have been completed. This job has involved three years of field collections and observations, food habits and other related studies. A large amount of data on distribution, movements, and spawning of the four rough fish under study has been collected and recorded. However, these data point up no particular trends or solutions, and thus are of no immediate value because of the lack of comparable data, basic limnological data from the waters involved, and reference material concerning life histories of the fish being studied.

During the first year of study, field methods for handling of digestive tracts and for recording certain data were cumbersome and time consuming. Netting stations, while adequate in number, were found to be improperly located or fished with improper gear.

During the second year of study, labeled cloth containers were used for each digestive tract, eliminating the necessity of attaching labels with thread or string. This allowed more rapid processing by the field crew and the personnel at Midwestern University, who were using the tracts in food habits research. Netting stations were changed and different types of nets were used. Additional 3-inch webbing was used at the end of the second year after it was realized that the larger fish were not being taken in sufficient numbers.

During this segment, still further changes were necessary. Some netting stations were added or dropped, extensive seining stations were set up, monthly collections of plankton and bottom samples were made, and monthly records were expanded to include the distribution of species taken by seining. Factors influencing the distribution of rough fish fry were studied, and growth rates and predation were more closely examined.

In reviewing the work on this job, it is evident that not only has a study of rough fish been included, but also study and development of methods and techniques. While all phases of the work accomplished thus far are considered adequate to fulfill the objectives of this job, future natural history work should be more detailed, and limited primarily to a single species. To obtain

valuable natural history information concerning each individual species, greatly expanded data concerning spawning areas, general requirements for spawning, distribution of advanced fingerlings, growth rates, and competition will be required. Yearly trends in the rough fish populations and general population dynamics should also be studied.

Better insight into the problem of population dynamics would come from analyses of the general features existing in lakes having greater and lesser populations of a particular species. Such analyses and comparisons might reveal that there are particular features which, when present, would either promote or suppress the expansion of the population of that particular species. There must be explanations as to why lakes with similar features support populations of entirely different composition. It has been noted that there are two lakes (Kemp and Diversion) having the same water quality, yet they have very different populations of a particular species. This species is affected neither by sport fishing nor commercial fishing, so difference in the populations must be due to ecological or environmental differences in the two lakes.

The extensive food habits study now being completed may give the answers to similar questions concerning population dynamics, provided that the food habits data can be interpreted in such a way as to show the relationship of food availability to population trends. Before any relationships or limiting factors can be detected, it may be necessary to complete further studies of the food availability in different lakes, and to correlate the food availability and food habits with the existing populations in these lakes.

Regardless of the immediate value of the work done and the accomplishment toward the control of rough fish, the important fact is that the end of a beginning has been attained. Some basic facts have been obtained from which our natural history work can be continued in a more closely directed and better-planned project. The work on this job will have at least provided some valuable experience and some useful background data.

One important result to be desired from a natural history study would be the ability to predict when, and where, concentrations of rough fish could be found, so that controls could be applied at the right time and place to accomplish an effective reduction of the species with relatively little time and expense involved. To accomplish this end will require much work, much knowledge of rough fish habits, familiarity with the habitats of the lakes concerned, and many test predictions and evaluations. This type of control will not be possible for several years at best, and only then if natural history work is greatly increased and skillfully executed.

#### Recommendations:

It is recommended that future natural history work under any one job be limited to one species at a time, and that the scope of the work include comparisons of populations in different lakes having different chemical, physical, and biological features. Detailed distribution studies should begin with the development or acquisition of collecting gear capable of getting samples of smaller fish from deep or fast flowing water. Trawls or electric gear, or a combination of electric gear with trawls or seines seems to be the best

possibilities for this purpose. Age and growth studies should begin with evaluation of methods for determining age and an intensive rough fish tagging program. Practically all recoveries of tagged rough fish should be made by personnel working on the project, thus eliminating unreliable data often furnished by fishermen. Studies of spawning and development should employ the use of hatchery ponds or experimental ponds where conditions can be controlled and observations can be made at any time without having to locate spawning activity. The necessity of this is evidenced by the lack of good spawning data collected on this job, because spawning activity could seldom be located and properly observed in the large area covered by Lake Diversion.

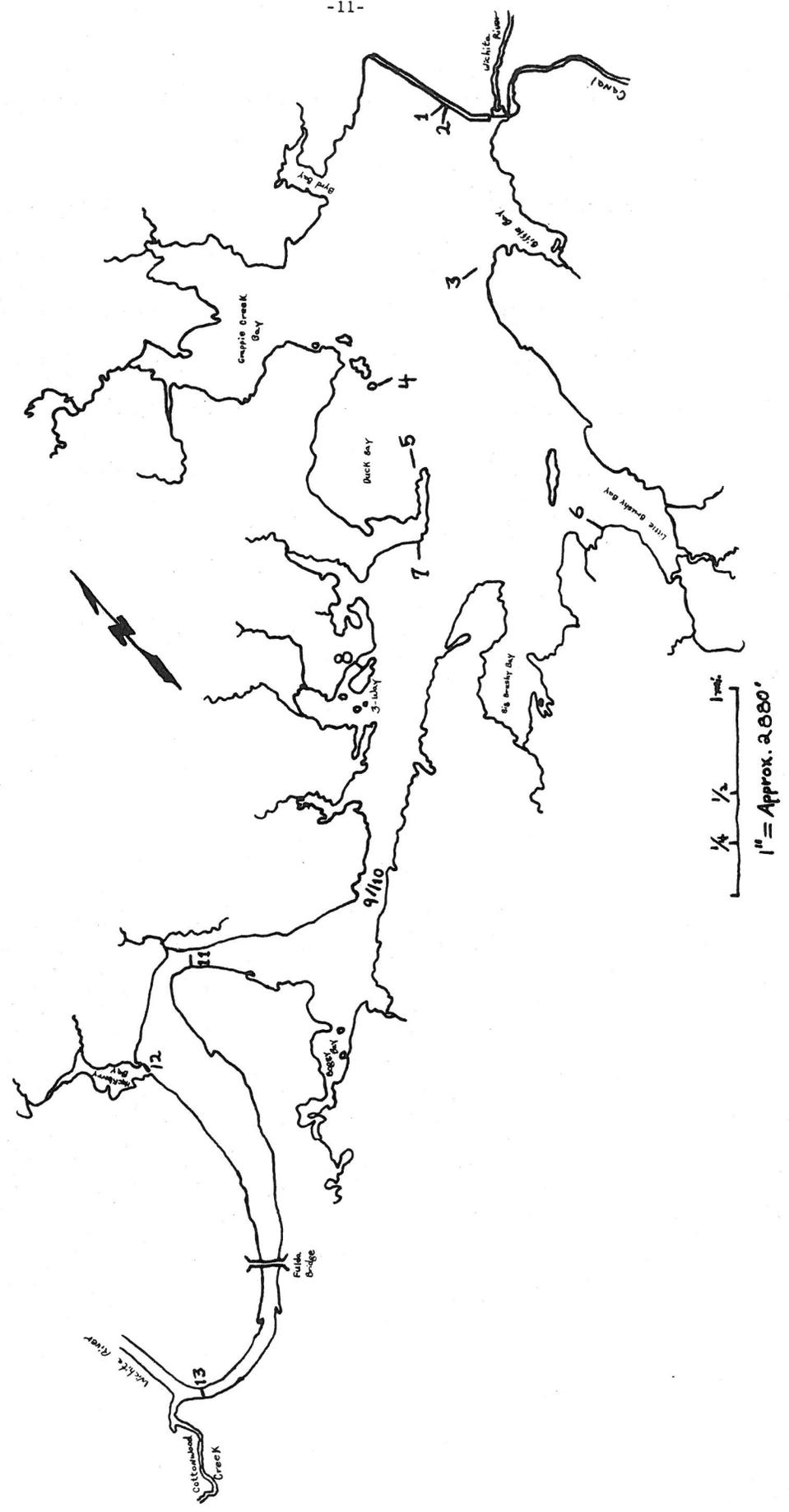
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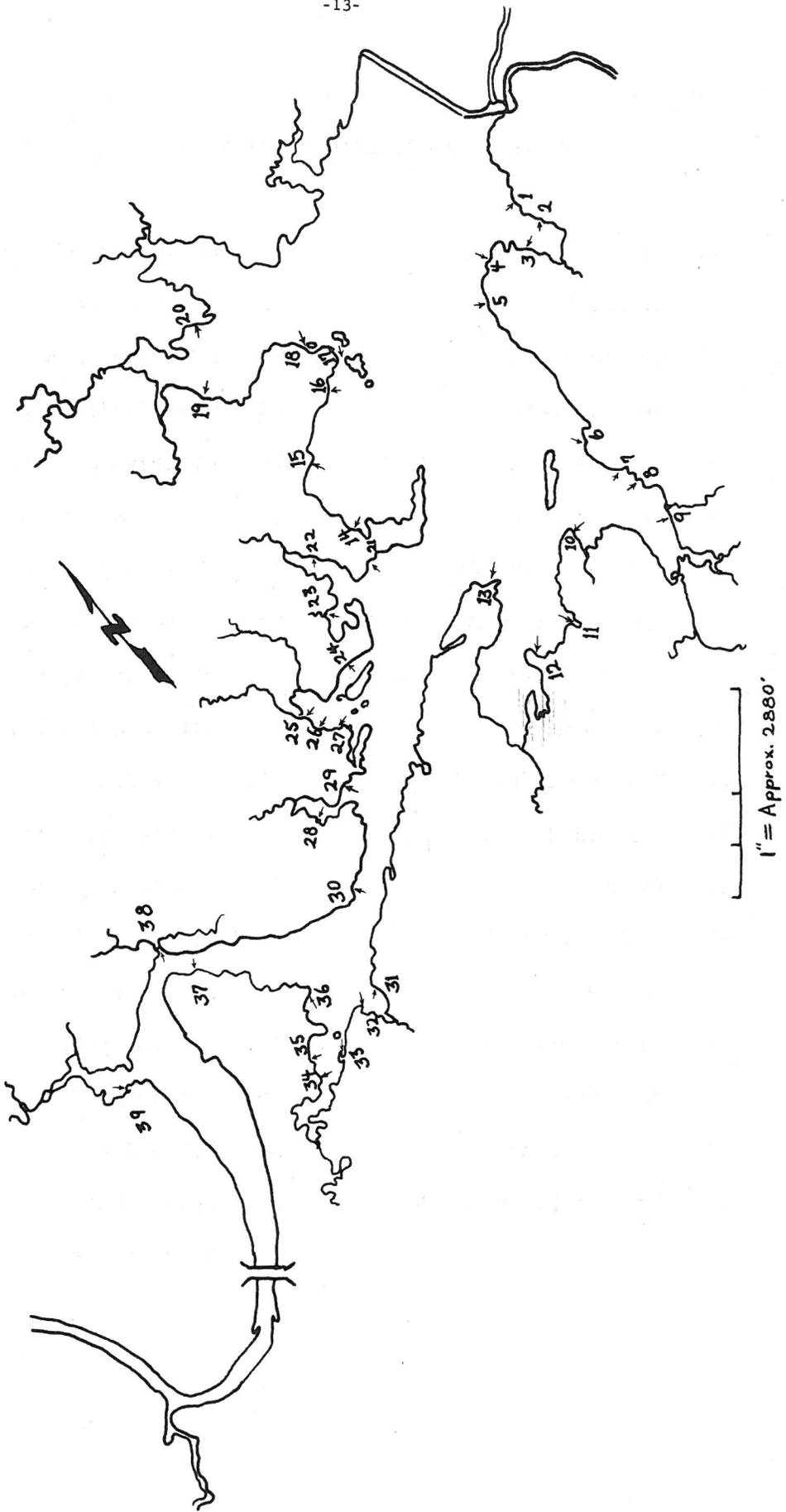
Fig. 1 Location of the Thirteen Netting Stations in Lake Diversion



List of Netting Stations Shown on Map (Figure 1)

- |                  |                          |
|------------------|--------------------------|
| 1. Dam Sinking   | 8. Rattlesnake Island    |
| 2. Dam Floating  | 9. Sandy Beach Sinking   |
| 3. Gravel Beach  | 10. Sandy Beach Floating |
| 4. Rock Island   | 11. Fence Line           |
| 5. Cedar Point   | 12. Hackberry Bay        |
| 6. Little Brushy | 13. Cottonwood Creek     |
| 7. Rocky Point   |                          |

Fig. 2 Location of the Thirty-Nine Seining Stations in Lake Diversion



List of Seining Stations Shown on Map (Figure 2)

- |                             |                             |
|-----------------------------|-----------------------------|
| 1. Biffle Bay No. 1         | 20. Crappie Creek Bay No. 1 |
| 2. Biffle Bay No. 2         | 21. Rocky Point Bay         |
| 3. Biffle Bay No. 3         | 22. Game Warden Bay No. 1   |
| 4. Gravel Beach             | 23. Game Warden Bay No. 2   |
| 5. Griffen Point No. 1      | 24. Rattlesnake Island      |
| 6. Griffen Point No. 2      | 25. Three-way No. 3         |
| 7. Little Brushy Bay No. 1  | 26. Three-way No. 2         |
| 8. Little Brushy Bay No. 2  | 27. Three-way No. 1         |
| 9. Little Brushy Bay No. 3  | 28. Wildmule Bay No. 2      |
| 10. High Point              | 29. Wildmule Bay No. 1      |
| 11. Big Brushy Bay No. 1    | 30. Sandy Beach             |
| 12. Big Brushy Bay No. 2    | 31. Little Boggy Bay No. 1  |
| 13. Swampy Point            | 32. Little Boggy Bay No. 2  |
| 14. Duck Bay No. 3          | 33. Big Boggy Bay No. 1     |
| 15. Duck Bay No. 2          | 34. Big Boggy Bay No. 2     |
| 16. Duck Bay No. 1          | 35. Big Boggy Bay No. 3     |
| 17. Sand Bar                | 36. Big Boggy Bay No. 4     |
| 18. Quail Island            | 37. Fence Line              |
| 19. Crappie Creek Bay No. 2 | 38. Rocky Bend              |
|                             | 39. Hackberry Bay           |

Figure 3. Monthly Percentages of Shad Taken from the Upper 5 Stations

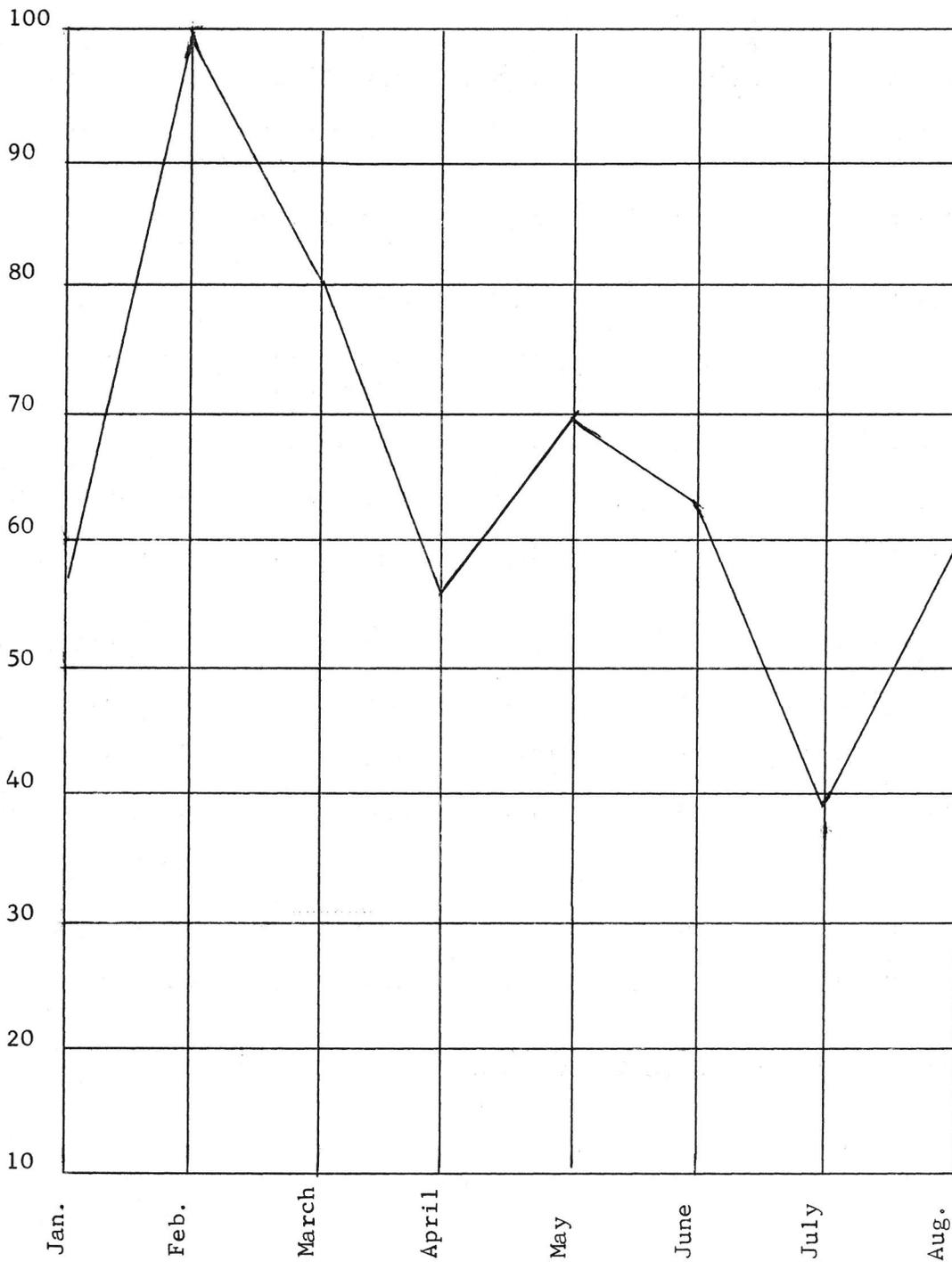


Table 1. Characteristics of the 13 lake netting stations in Lake Diversion

<u>Station Name</u>	<u>Station No. As Shown in Figure 1</u>	<u>Water Depth Range In Feet</u>	<u>Vegetation</u>	<u>Bottom Type</u>	<u>Usual Relative Turbidity</u>
Dam Sinking	1	5-22	Potamogeton*	Rock to soft mud	Clear
Dam Floating	2	5-22	Potamogeton*	Rock to soft mud	Clear
Gravel Beach	3	7-20	None	Mud	Clear
Rock Island	4	3-7	Thick Chara & Potamogeton*	Rock to silt with shell	Clear
Cedar Point	5	4-5	Sparce Chara	Clay & Silt	Moderate
Little Brushy	6	4-13	Potamogeton*	Silt to mud	Moderate
Rocky Point	7	3-22	Potamogeton*	Sand to silt to mud	Clear
Rattlesnake Island	8	2-6	Chara	Clay & silt	Moderate
Sandy Beach Sinking	9	10-15	None	Soft mud	Moderate
Sandy Beach Floating	10	10-15	None	Soft mud	Moderate
Fence Line	11	4-12	None	Clean sand to silt to mud	Moderate
Hackberry Bay	12	2-4	None	Soft mud	Very Muddy
Cottonwood Creek	13	1-4	None	Soft mud	Muddy

\* Only near end of net in shallowest water

Table 2. Segment totals of netting results - January to August 1961

Species	Number Taken at Each Station														Total No.	Per Cent
	Dam Floating	Dam Sinking	Gravel Beach	Rock Island	Cedar Point	Little Brushy Bay	Rocky Point	Rattlesnake Island	Sandy Beach Floating	Sandy Beach Sinking	Fence Line	Hackberry Bay	Cottonwood Creek			
Carp	1	5	9	14	11	12	4	6	1	5	6	5	9	88	3.35	
No. of Males	1	0	2	7	2	3	2	1	0	3	3	2	3			
Carp sucker	0	25	23	118	91	18	60	46	11	34	224	75	76	801	30.45	
No. of Males	0	4	10	54	53	9	13	16	4	20	105	30	40			
Bigmouth Buffalo	0	0	1	0	1	0	0	0	0	0	0	0	0	2	0.08	
No. of Males	0	0	0	0	1	0	0	0	0	0	0	0	0			
Smallmouth Buffalo	11	33	26	86	70	23	23	53	17	9	34	51	63	499	18.97	
No. of Males	6	14	12	39	40	10	9	29	7	4	16	28	37			
Shad	31	4	27	34	19	10	58	23	55	66	187	74	37	625	23.77	
No. of Males	11	1	7	13	8	1	15	8	21	17	72	31	16			
Longnose Gar	3	0	2	9	3	4	5	3	6	0	14	4	47	100	3.80	
Shortnose Gar	0	0	0	1	3	0	1	1	2	0	3	1	6	18	0.68	
Channel Catfish	1	1	4	2	3	8	12	1	3	3	15	3	2	58	2.20	
Bullhead Catfish	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.04	
Flathead Catfish	0	1	2	0	0	0	0	1	1	0	1	0	0	6	0.23	
White Bass	19	18	9	25	15	10	10	3	4	1	30	4	17	165	6.27	
Black Bass	1	2	1	3	3	1	1	5	0	0	2	2	3	24	0.92	
Crappie	6	5	21	17	8	7	25	4	17	7	39	2	7	165	6.27	
Drum	0	0	17	6	2	5	23	1	6	7	10	1	0	78	2.97	
Total	73	94	142	315	229	98	222	147	123	132	565	222	268	2630	100.00	

Table 3. Seining Collections, January through October 1961

	January		February		March		April		May		June		July		August		October		Totals	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Seining Stations																				
Biffle Bay #1	0	0.13	2	0.16	6	0.17	12	0.76	1	0.03	45	1.10	9	0.20	45	2.22	22	0.81	142	0.56
Biffle Bay #2	4	0.53	8	0.54	35	1.03	1	0.07	57	2.20	8	0.19	88	2.04	9	0.44	3	0.11	213	0.86
Biffle Bay #3	16	0.53	2	0.16	16	0.47	4	0.25	1	0.04	32	0.79	50	1.15	13	0.65	33	1.23	167	0.67
Gravel Beach	1	0.04	5	0.40	7	0.20	35	2.24	27	1.04	95	2.32	61	1.42	69	3.40	36	1.33	336	1.35
Griffen Point #1	1	0.03	2	0.16	1	0.03	2	0.13	78	3.01	46	1.13	10	0.23	29	1.44	17	0.63	186	0.74
Griffen Point #2	2	0.07	1	0.08	8	0.23	3	0.19	1	0.04	70	1.72	42	0.97	12	0.59	9	0.33	498	1.99
Little Brushy #1	55	1.84	4	0.33	127	3.72	1	0.06	91	3.51	25	0.61	117	2.70	11	0.54	67	2.56	1160	4.66
Little Brushy #2	178	5.95	5	0.40	239	7.01	6	0.38	52	2.00	323	7.91	200	4.63	88	4.35	69	2.56	1160	4.66
Little Brushy #3	17	0.57	1	0.08	31	0.91	4	0.26	0	0	105	2.57	82	1.90	53	2.62	108	4.00	401	1.61
High Point	22	0.73	11	0.88	8	0.23	83	5.30	4	0.16	24	0.59	84	1.94	43	2.12	6	0.22	285	1.14
Big Brushy #1	1202	40.21	5	0.41	406	11.90	8	0.51	167	6.44	179	4.39	135	3.12	75	3.71	39	1.45	2216	8.89
Big Brushy #2	4	0.13	2	0.16	161	4.71	0	0	64	2.47	64	1.56	331	7.66	56	2.77	26	0.96	708	2.84
Swampy Point	53	1.77	1	0.08	32	0.94	0	0	81	3.12	35	0.86	24	0.55	31	1.53	48	1.78	305	1.22
Duck Bay #1	2	0.07	0	0	4	0.12	43	2.75	0	0	445	10.91	7	0.17	4	0.20	43	1.60	548	2.20
Duck Bay #2	6	0.20	0	0	43	1.26	3	0.19	3	0.04	7	0.17	1	0.02	8	0.40	27	1.00	96	0.38
Duck Bay #3	102	3.41	3	0.24	4	0.12	30	1.92	0	0	107	2.62	16	0.37	10	0.49	42	1.56	314	1.26
Sand Bar	134	4.48	55	4.42	377	11.04	10	0.64	0	0	25	0.61	131	3.02	32	1.58	25	0.92	789	3.17
Quail Island	1	0.04	1	0.08	22	0.65	2	0.13	51	1.97	24	0.59	49	1.14	37	1.82	42	1.56	229	0.92
Crapple Creek #1	27	0.90	3	0.24	93	2.72	47	3.00	41	1.58	72	1.76	38	0.88	45	2.23	76	2.81	442	1.77
Crapple Creek #2	4	0.13	10	0.81	53	1.55	33	2.11	78	3.00	47	1.15	184	4.25	37	1.83	80	2.97	526	2.11
Rocky Point Bay	210	7.03	89	7.16	19	0.56	26	1.66	70	2.70	78	1.91	54	1.75	17	0.84	161	5.97	724	2.90
Game Warden #1	13	0.43	60	4.83	53	1.55	61	3.90	78	3.01	18	0.44	88	2.04	26	1.28	135	5.01	532	2.14
Game Warden #2	57	1.91	61	4.90	416	12.19	16	1.02	39	1.51	219	5.37	17	0.39	37	1.83	171	6.34	1033	4.14
Rattlesnake Island	57	1.90	59	4.75	17	0.50	7	0.45	17	0.65	46	1.13	70	1.62	22	1.09	55	2.04	350	1.40
Three-Way #1	7	0.24	9	0.73	9	0.26	3	0.19	31	1.19	47	1.16	41	0.95	100	4.94	58	2.15	305	1.22
Three-Way #2	45	1.50	214	17.21	47	1.38	1	0.07	12	0.47	378	14.16	128	2.96	39	1.93	51	1.90	1115	4.48
Three-Way #3	4	0.14	101	8.13	37	1.05	4	0.25	48	1.85	42	1.02	37	0.85	61	3.01	60	2.22	394	1.58
Wildmule #1	12	0.40	97	7.80	48	1.41	5	0.32	64	2.47	98	2.40	74	1.71	40	1.98	98	3.63	536	2.15
Wildmule #2	29	0.97	46	3.70	221	6.48	52	3.32	145	5.59	67	1.64	163	3.77	41	2.02	103	3.82	867	3.48
Sandy Beach	5	0.16	10	0.81	54	1.58	37	2.37	347	13.38	386	9.45	99	2.29	28	1.38	190	7.05	1156	4.63
Little Boggy #1	158	5.62	55	4.42	32	0.94	37	2.36	149	5.75	62	1.52	40	0.93	136	6.72	63	2.33	742	2.98
Little Boggy #2	14	0.47	0	0	74	2.16	423	27.03	246	9.49	169	4.14	154	3.56	148	7.31	218	8.08	1446	5.80
Big Boggy #1	19	0.64	9	0.72	172	5.04	239	15.27	185	7.13	94	2.31	1125	26.02	209	10.33	125	4.64	2177	8.73
Big Boggy #2	26	0.87	17	1.37	31	0.91	166	10.61	87	3.36	56	1.37	205	4.74	144	7.11	132	4.89	864	3.47
Big Boggy #3	14	0.46	120	9.66	28	0.82	100	6.39	41	1.58	55	1.35	134	3.03	86	4.25	77	2.86	655	2.63
Big Boggy #4	32	1.08	41	3.29	61	1.79	30	1.91	83	3.20	27	0.66	131	3.10	114	5.64	45	1.67	564	2.26
Fence Line	26	0.85	10	0.81	276	8.09	3	0.20	8	0.31	25	0.61	22	0.51	17	0.84	68	2.52	455	1.82
Rocky Bend	332	11.11	89	7.16	35	1.05	23	1.47	32	1.23	112	2.74	19	0.43	31	1.53	36	1.33	710	2.85
Hackberry	89	2.98	35	4.82	109	3.20	5	0.32	116	4.48	125	3.07	64	1.49	21	1.04	33	1.23	597	2.40
Totals	2990	11.99	1243	2.98	3413	13.69	1565	6.28	2593	10.40	4082	15.37	4324	17.35	2024	8.12	2697	10.82	24,931	100.00

Legend: (1) Total number of fish taken  
(2) Per Cent of total

Table 4. Numerical and percentage composition of seine collections by species, January through October 1961

Species	January		February		March		April		May		June		July		August		October		Totals	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Longnose Gar	0	0	0	0	0	0	0	0	0	0	2	0.04	3	0.06	0	0	0	0	5	0.02
Gizzard Shad	0	0	1	0.08	0	0	0	0	0	0	2367	57.99	512	11.85	225	11.11	17	0.63	3122	12.51
Smallmouth Buffalo	1	0.03	0	0	0	0	0	0	0	0	0	0	10	0.23	3	0.15	1	0.03	15	0.06
Carp	0	0	1	0.16	2	0.05	0	0	4	0.15	5	0.12	11	0.25	3	0.15	0	0	26	0.11
Suckermouth	1	0.03	16	1.28	22	0.65	6	0.38	3	0.11	2	0.05	5	0.12	12	0.59	9	0.34	76	0.31
Plains Shiner	12	0.40	21	1.69	54	1.58	37	2.36	10	0.39	1	0.03	0	0	1	0.05	47	1.74	183	0.73
Red River Shiner	0	0	94	7.56	0	0	0	0	0	0	1	0.02	0	0	0	0	0	0	143	0.58
Red Shiner	1300	50.17	215	17.28	648	18.99	610	38.98	1228	47.36	982	24.06	1173	27.13	419	20.70	1146	42.49	7921	31.77
Sand Shiner	1	0.03	1	0.08	3	0.08	1	0.06	8	0.31	6	0.14	7	0.16	2	0.10	0	0	29	0.11
Ghost Shiner	0	0	1	0.08	1053	30.86	436	27.86	694	25.76	47	1.16	11	0.25	17	0.84	46	1.71	2305	9.25
Plains Minnow	0	0	2	0.16	4	0.11	1	0.07	0	0	0	0	0	0	0	0	1	0.03	8	0.03
Bullhead Minnow	742	24.82	418	33.60	901	26.40	367	23.45	372	14.35	314	7.69	1766	40.85	678	33.50	872	32.34	6430	25.79
Channel Catfish	0	0	0	0	0	0	0	0	0	0	1	0.02	3	0.06	0	0	0	0	4	0.02
Red River Pupfish	42	1.40	5	0.40	12	0.35	5	0.32	22	0.85	0	0	7	0.17	0	0	0	0	93	0.37
Mosquitofish	97	3.25	43	3.46	194	5.69	26	1.66	87	2.35	78	1.91	248	5.73	245	12.10	127	4.70	1145	4.60
White Bass	0	0	0	0	0	0	0	0	0	0	41	1.01	7	0.16	0	0	48	1.78	96	0.38
Black Bass	4	0.13	0	0	1	0.03	1	0.05	3	0.12	80	1.96	77	1.78	46	2.27	8	0.30	220	0.88
Green Sunfish	35	1.21	0	0	4	0.12	2	0.13	1	0.04	0	0	6	0.14	9	0.45	0	0	58	0.24
Spotted Sunfish	13	0.43	53	4.26	164	4.80	18	1.15	65	2.50	62	1.52	249	5.76	235	11.61	169	6.27	1028	4.12
Redear Sunfish	23	0.77	1	0.08	20	0.59	0	0	0	0	0	0	2	0.05	0	0	0	0	46	0.18
Bluegill	503	16.82	349	28.06	299	8.76	42	2.68	89	3.44	40	0.98	174	4.02	99	4.89	116	4.30	1711	6.87
Orangespotted Sunfish	12	0.40	13	1.04	24	0.70	1	0.07	4	0.15	2	0.05	0	0	6	0.30	2	0.07	64	0.25
White Crappie	0	0	1	0.08	0	0	0	0	0	0	5	0.12	10	0.23	1	0.05	1	0.04	18	0.07
Logperch	3	0.11	8	0.65	8	0.24	7	0.45	3	0.12	44	1.08	38	0.88	21	1.04	39	1.45	171	0.69
Drum	0	0	0	0	0	0	5	0.32	0	0	2	0.05	4	0.10	0	0	0	0	11	0.05
Totals	2990	11.99	1243	4.98	3413	13.69	1565	6.28	2593	10.40	4082	16.37	4324	17.35	2024	8.12	2697	10.82	24,931	100.00

Legend: (1) Number fish taken  
(2) Per cent of total

Table 5. Percentages of spent adult female rough fish occurring in the netting collections March - August, 1961

Collection Date	Water Temperature (°F.)	No. Adult Females Collected	Spent Females	
			Number	Per cent of monthly total
<u>SHAD</u>				
March 14	57	55	0	0.00
April 7	56	23	0	0.00
May 3	67	68	0	0.00
May 23	71	91	51	56.04
June 14	82	47	38	80.85
July 19	83	13	6	46.15
August 2	84	28	16	57.14
<u>SMALLMOUTH BUFFALO</u>				
March 14	57	16	0	0.00
April 7	56	16	2	12.50
May 3	67	25	10	40.00
May 23	71	35	19	54.28
June 14	82	43	31	72.09
July 19	83	13	10	76.92
August 2	84	30	26	86.66
<u>CARPSUCKER</u>				
March 14	57	40	0	0.00
April 7	56	55	10	18.18
May 3	67	52	9	17.30
May 23	71	37	13	35.13
June 14	82	31	20	55.00
July 19	83	16	14	87.50
August 2	84	33	31	93.93
<u>CARP</u>				
March 14	57	3	0	0.00
April 7	56	10	0	0.00
May 3	67	11	2	18.18
May 23	71	7	1	14.28
June 14	82	11	4	36.36
July 19	83	6	3	50.00
August 2	84	9	4	44.44

Table 6. Maximum, minimum, and average lengths (in mm.) of fish taken by seining, May to October 1961

Species	Dates of Collections					
	May 23 Mx-Mn-Av	June 15 Mx-Mn-Av	June 28 Mx-Mn-Av	July 18 Mx-Mn-Av	Aug. 3 Mx-Mn-Av	Oct. 6 Mx-Mn-Av
Shad No. in Sample	25-18-21 25	44-18-29 100	45-22-34 50	49-26-34 100	54-19-36 100	59-43-53 12
Black Bass No. in Sample	25-20-23 7	48-17-30 78	46-22-30 22	83-36-46 75	77-36-49 50	97-62-78 8
White Bass No. in Sample	30-19-23 18	48-21-31 45	36-14-29 4	66-38-49 15	- - - 0	120-68-88 12
Crappie No. in Sample	- - - 0	25-25-25 1	30-30-30 1	43-26-34 8	- - - 0	59-59-59 1
Longnose Gar No. in Sample	- - - 0	75-52-64 2	86-52-69 7	164-162-163 2	- - - 0	- - - 0
Drum No. in Sample	- - - 0	40-35-38 2	13-11-12 2	55-41-49 4	- - - 0	- - - 0
Shortnose Gar No. in Sample	- - - 0	- - - 0	97-80-88 2	- - - 0	- - - 0	- - - 0
Smallmouth Buffalo No. in Sample	- - - 0	- - - 0	41-13-28 50	51-25-38 27	52-43-48 2	63-63-63 1
Carp No. in Sample	- - - 0	- - - 0	37-22-27 6	40-37-39 2	50-40-46 3	- - - 0
Carp No. in Sample	- - - 0	- - - 0	43-11-16 50	42-42-42 1	64-59-62 2	- - - 0

Table 7. Frequency of occurrence of food items for white bass,  
January - August 1961

<u>Month</u>	<u>Shad</u>	<u>Other*</u> <u>Fish</u>	<u>Mayfly</u> <u>Larvae</u>	<u>Misc. and</u> <u>Other Insects</u>
January	13	11	3	1
February	1	5	3	1
March	-	2	11	-
April	-	11	13	2
May	-	1	1	2
June	-	-	-	-
July	-	-	-	-
August	<u>4</u>	<u>2</u>	<u>3</u>	<u>8</u>
Yearly Total	18	32	34	14

\* Includes unidentifiable fish remains

Table 8. Frequency of occurrence of food items for black bass,  
January - August 1961

<u>Month</u>	<u>Shad</u>	<u>Other *</u> <u>Fish</u>	<u>Mayfly</u> <u>Larvae</u>	<u>Misc. and</u> <u>Other Insects</u>
January	-	-	-	-
February	1	2	-	-
March	-	3	-	-
April	-	-	-	-
May	-	1	-	-
June	-	-	-	-
July	-	-	-	-
August	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Yearly Total	1	6	-	-

\* Includes unidentifiable fish remains

Table 9. Frequency of occurrence of food items for crappie,  
January - August 1961

<u>Month</u>	<u>Shad</u>	<u>Other *</u> <u>Fish</u>	<u>Mayfly</u> <u>Larvae</u>	<u>Misc. and</u> <u>Other Insects</u>
January	-	-	-	-
February	-	-	-	2
March	-	-	5	-
April	-	-	-	-
May	-	3	-	1
June	-	8	3	2
July	-	7	1	-
August	<u>5</u>	<u>7</u>	<u>5</u>	<u>3</u>
Yearly Total	5	25	14	8

\* Includes unidentifiable fish remains

Table 10. Frequency of occurrence of food items for channel catfish,  
January - August 1961

<u>Month</u>	<u>Shad</u>	<u>Other *</u> <u>Fish</u>	<u>Mayfly</u> <u>Larvae</u>	<u>Misc. and</u> <u>Other Insects</u>
January	-	-	-	-
February	-	2	4	6
March	-	2	1	5
April	-	-	-	-
May	-	2	1	3
June	-	3	2	3
July	-	1	1	1
August	<u>-</u>	<u>-</u>	<u>2</u>	<u>3</u>
Yearly Total	-	10	11	21

\* Includes unidentifiable fish remains

1. The first part of the document discusses the importance of maintaining accurate records of all transactions.

2. It is essential to ensure that all entries are supported by appropriate documentation and receipts.

3. Regular audits should be conducted to verify the accuracy of the records and to identify any discrepancies.

4. The second part of the document outlines the procedures for handling cash and other assets.

5. All cash receipts should be recorded immediately and deposited in a secure bank account.

6. Disbursements should be made only for authorized purposes and supported by proper vouchers.

7. The third part of the document describes the methods for calculating and reporting financial results.

8. Financial statements should be prepared on a regular basis and reviewed by management.

9. The final part of the document provides a summary of the key points and recommendations.

10. It is recommended that these procedures be followed strictly to ensure the integrity and reliability of the financial data.

11. The document concludes with a statement of the author's responsibility for the accuracy of the information presented.

12. The author acknowledges the assistance of the staff in the preparation of this document.

13. The document is intended to serve as a guide for all personnel involved in the financial management of the organization.

14. Any questions or concerns should be directed to the Finance Department.

15. The document is effective as of the date of its approval by the Board of Directors.

16. The author reserves the right to revise this document as needed.

17. The document is a confidential document and should be handled accordingly.