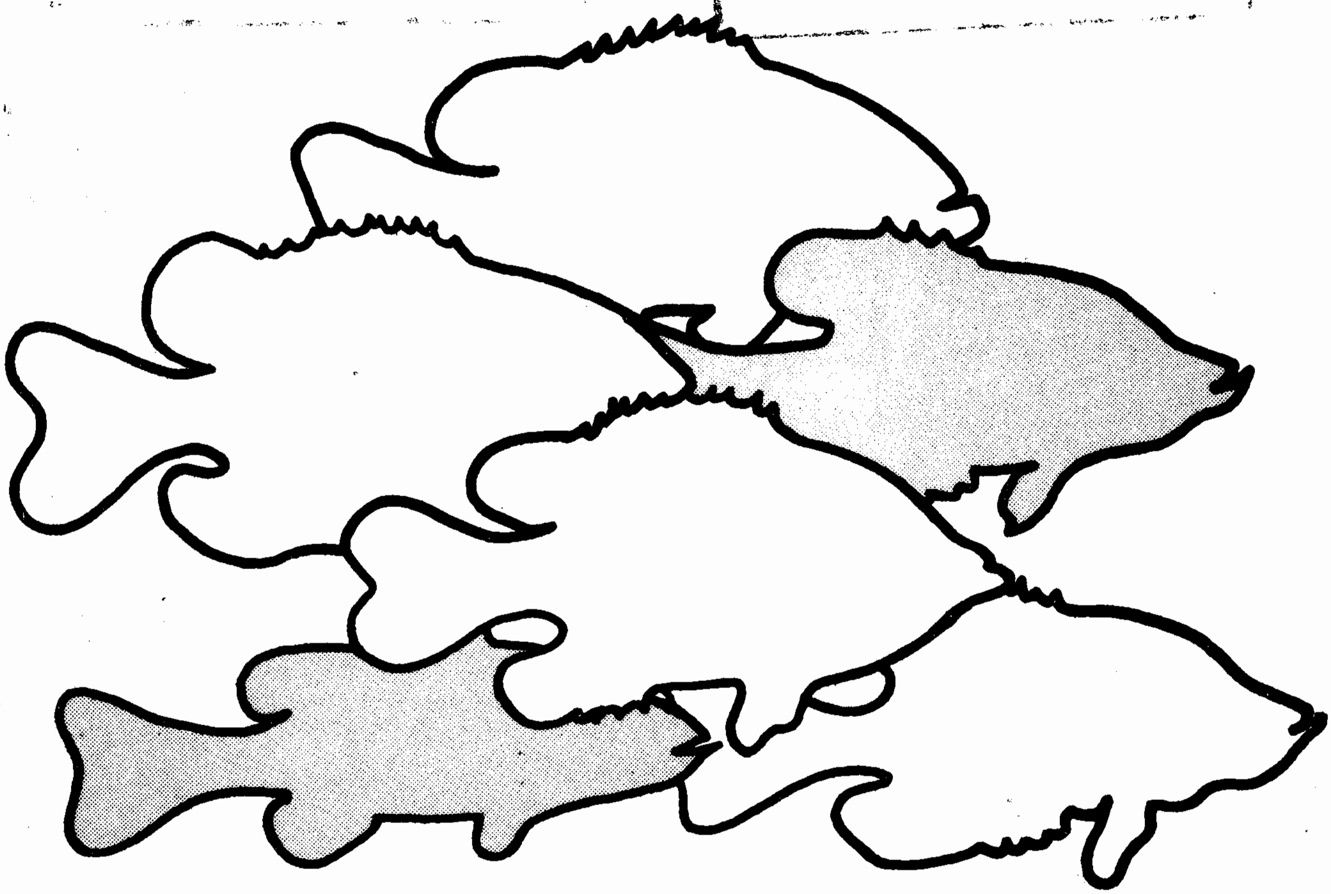
AMERICAN FISHERIES SOCIETY

# PROCEEDINGS

# ANNUAL MEETING
# MISSISSIPPI CHAPTER





FEBRUARY 17, 1977

OCEAN SPRINGS, MISSISSIPPI

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# ANNUAL MEETING

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# AMERICAN FISHERIES SOCIETY

FEBRUARY 17, 1977

OCEAN SPRINGS, MISS.

## OFFICERS

JACK HERRING, PRESIDENT
Mississippi Game & Fish Comm.

J. Y. CHRISTMAS, PRES.-ELECT
Gulf Coast Research Laboratory

HARRY BARKLEY, SECRETARY-TREASURER
Mississippi Game & Fish Comm.

Printed by Mississippi Game & Fish Commission
Jackson, Mississippi

## PREFACE

The third annual meeting of the Mississippi Chapter of the American Fisheries Society was held in Ocean Springs and Pascagoula, Mississippi on February 17th. for the purpose of exchanging information concerning Mississippi fisheries.

The success of the meeting was insured by the attendance of individuals associated with or representing various state and federal agencies and the private sector of the fishing industry.

The Chapter is relatively new, but a solid background that should provide for a continuing viable organization for Mississippi fisheries has been established. Membership was increased by approximately one third over the preceding year. The Chapter is indebted to the authors and speakers, local arrangement personnel and to all those who lent support through their participation in the meeting.

This is the first Proceedings attempted by the Chapter. Except for minor editing, the papers presented in the Proceedings are reproduced in the same form in which they were received. No attempt was made at editorial correction.

Cost for publication of the Proceedings have been met primarily by the Mississippi Game and Fish Commission and compiled by Jack Herring and Clara Johnston.

Mississippi Chapter
American Fisheries Society
March, 1977

PROGRAM OF 1977 ANNUAL MEETING

| | |
|---|---|
| 8:00-9:00 AM | Arrival and Coffee |
| 9:00-10:00 AM | Introduction and brief review of activities being done by members |
| 10:00-10:45 AM | General Business Session |
| 10:45-11:00 AM | Comments by Chapter President |
| 11:00 AM-1:00 PM | Lunch, Tour of the National Marine Fisheries Service Facility conducted by Benny Rohr |
| 1:00-3:40 PM | Paper Session |
| 1:00-1:20 | Majure, T. C. Addition of Fish Attractors to Lakes with Underwater Observation |
| 1:20-1:40 | Baker, J. A. and T. Modde. Susceptibility to Predation in Spottail Shiners Stained with Bismark Brown Y |
| 1:40-2:00 | Burris, J. W. Some Aspects of Bryozoa Ecology in Northern Mississippi Flood Control Reservoirs |
| 2:00-2:20 | Christmas, J. Y. Fisheries Management Planning |
| 2:20-2:40 | Lorio, W. The Impact of Commercial Netting and Sport Fishing on Economically Important Estuarine Species - A Pertinent Problem along the Northern Gulf of Mexico |
| 2:40-3:00 | Cooper, C. M. A Comparison of Abundance and Production of Littoral and Profundal Benthic Fauna in Flood Control Reservoirs |
| 3:00-3:20 | Bernet, C. and Charles M. Cooper. Impingement of Threadfin Shad at TVA Power Plants |
| 3:20-3:40 | Dearing, A. Catfish Farming in the Mississippi Delta |
| 3:40-4:30 PM | General Session |
| 4:30 PM | Adjourn |

TABLE OF CONTENTS

ADDRESS TO MISSISSIPPI CHAPTER OF AFS

Luther A. Knight, Jr., President

This is the third meeting of the Mississippi Chapter of the American Fisheries Society and in the short time we have been chartered, the groundwork for a functional organization to promote all aspects of Mississippi fisheries has been laid. We are still a small group, but I feel that our membership will continue to increase. Each of us must make every effort to get our colleagues in fisheries to join us.

At the meeting on April 8, 1976, Chapter constitution was changed to allow elections to be held prior to the annual meeting. I believe this change will facilitate our meetings, especially in the transition of officers. The election committee chaired by Charles Cooper and composed of Ben Barr and Dr. Gordon Gunter did an excellent job of handling the election this year.

Jack Herring, your new President, has arranged for the Game and Fish Commission to print the proceedings of this year's meeting. As you know, we do not have a very large balance in the bank, and in the future publishing the proceedings may be a problem. Some may think published proceedings are much too ambitious at this time. I think not. The information given in the various papers and reports should be made available to more people than are receiving it now. Although the quality of the reports is excellent, many may not necessarily lend themselves for publication in more widely distributed journals. Published proceedings will allow us to disseminate locally pertinent information to interested persons throughout the state. I am sure that we should be able to get help to defray publication costs from the private sector of fisheries, possibly our own institutions and from individual assessments.

As I recall, we set an assessment of $2.00 per person last spring to help cover costs of postage and incidental expenses. I believe everyone present at the last meeting paid their fee; apparently we were either unable to reach all of those persons not attending or else individuals let payment slip their minds. In any event, we need to arrive at some way of assessing and collecting fees that will reflect full support for the Chapter. It is suggested that a small registration fee, payable in advance, might be in order.

In helping Jack Herring with the program, I realized that with any growth at all we may need to extend our meeting to cover more than one day; we should continue having reports and papers given and if we do this, we will need more time.

No organization can remain viable if its members are lethargic. I would challenge each of you to constantly recruit your colleagues and to participate actively in the Chapter. I am sure your new president will be calling on each of you during the next year.

I should like to thank each of you for allowing me the privilege of being your president. Especially, I want to thank Jack Herring and Richard Coleman for their support, and without whose help I would have been lost in the job. Also, my predecessors set the conditions for making my tour of duty much easier and to Randy Robinette and Roland Reagan, I offer my appreciation.

Finally, I should like to present the charter for the Mississippi Chapter of A.F.S. to Jack Herring for safekeeping for the coming year.

# HISTORY OF MISSISSIPPI CHAPTER

# AMERICAN FISHERIES SOCIETY

by

Harry Barkley, Sec.-Treas., 1977

On January 22, 1975, Dr. Roland E. Reagan, Jr. mailed a questionnaire to each member of the American Fisheries Society residing in the State of Mississippi concerning the interest in the establishment of a Mississippi Chapter of AFS.

On February 14, 1975, a letter was written to Richard Wade, Executive Director of AFS, by Drs. Roland Reagan, Thomas Wellborn and Randall Robinette. In the letter, they stated the results of the questionnaire was favorable for the establishment of a state chapter and requested guidance in the procedure for gaining a Mississippi Chapter Charter.

Following the suggestions of Executive Director Wade, a letter from Drs. Reagan, Robinette and Wellborn was sent to all AFS members in the state informing of an organizational meeting, time and place.

The organizational meeting was held May 7, 1975 at the Mississippi Game and Fish Commission's Lab on the Barnett Reservoir with 11 members of the AFS present. The Chapter By-Laws were discussed and approved as the first item of business and the election of officers followed. Dr. Roland Reagan was elected President; Dr. Luther Knight, Vice President; and Dr. Randy Robinette, Secretary-Treasurer. Items of business included appointment of a committee to study the by-laws for possible amendment, approach to securing Chapter members, future meetings as to time and locations, fees or dues, and the petition to the parent society for our charter.

At the September, 1975 National Meeting of the American Fisheries Society, the Executive Board and the members approved the petition for establishment of the Mississippi Chapter of the AFS.

A Chapter meeting was held October 9, 1975 in Jackson at the Research and Development Center from 10 A.M. until 3:30 P.M. with 17 members present. The business meeting was conducted by President Reagan, Vice President Knight and Secretary-Treasurer Robinette.

Items discussed included the following: the new AFS dues structure and publication policy, by-law changes, chapter function, future meetings, dues set at $2.00 per year, and the appointment of a Nominating Committee and Resolution Committee. Each individual gave a brief summary about his agency and/or particular work.

The 1976 Annual Meeting of the Mississippi Chapter of the AFS was held at the Mississippi Test Facility, Bay Saint Louis, on April 8th. with 17 members present. The business meeting was conducted by President Reagan, President-elect Knight and Secretary-Treasurer Robinette. Business meeting items were as follows: approval of Oct. 9, 1975 minutes, Nominating Committee report, by-laws and voting rights, next meeting, distribution of funds from defunct Mississippi Environmental Society, distribution of ballots for election of officers and time limit for return. The program consisted of presentations by Jack Herring of the Miss. Game & Fish Commission, Dr. Troy Millican, Delta State University, and Dr. Wendell Lorio of Mississippi State University.

The 1977 Annual Meeting was held jointly by the Gulf Coast Research Laboratory and the National Marine Service Laboratory on February 17th. with 31 members present. The business meeting was conducted by President Luther Knight, President-elect Jack Herring and Richard Coleman, Secretary-Treasurer. Items of business were as follows: approval of minutes of April 8, 1976 meeting, Treasurer's report, Nominating Committee report (J. Y. Christman, President-elect, and Harry Barkley, Secretary-Treasurer), lengthy discussion on function and role of the Resolutions Committee, a Liaison Committee was appointed between the Chapter and the Legislature, resolution on rotenone and antimycin-A, and outgoing remarks by President Knight. New President Herring announced that proceedings of the afternoon program would be published and his appointments to the Resolutions Committee. The 1978 Annual Meeting will be at the University of Southern Mississippi. The afternoon program consisted of a tour of the Marine Service Facility and paper presentations by the following: Terry Majure, Miss. Game & Fish Commission, J. A. Baker and T. Modde, University of Southern Mississippi, J. W. Burris, University of Mississippi, J. Y. Christmas, Gulf Coast Research Lab, Wendell Lorio, Mississippi State University, C. M. Cooper, USDA-ARS, Oxford, Chris Bernet, University of Mississippi and Allen S. Dearing, Sunflower Catfish Farm, Anguilla.

# ADDITION OF FISH ATTRACTORS TO LAKES WITH UNDERWATER OBSERVATION 1975-1976

by

Terrence C. Majure

Mississippi Game & Fish Commission

## INTRODUCTION

In order to concentrate fish in some State Lakes, artificial spawning areas and brush shelters were introduced into their waters.

A follow up was initiated with underwater observations by SCUBA to establish species utilization of these fish attractors.

Brush shelters and gravel beds have been used in several states with good success. Several investigators, Herring & Anderson (1975), Vogele & Rainwater (1975), found that fish attractors concentrated largemouth bass, bluegill and crappie. Bartholomew (1972) found that 75 percent of fishermen creeled preferred fishing cover areas for fish, while Davis & Hughes (1971) found 90 percent of fishermen fishing timbered areas in a three year old Louisiana Lake. Introduced brush shelters were found to be effective fish attractors and were intact five years later as reported by Wilbur (1974). Gravel beds were utilized as spawning areas as noted by Allan & Romero (1975).

The use of SCUBA as an effective means of surveying utilization has been used by several investigators; Prince, Raleigh & Corning (1975) used SCUBA to determine utilization of brush shelters with good success. Barkuloo and Byrd (1962) and Parker, Stone, Buchanan & Steimle (1974) also used SCUBA successfully to evaluate utilization of brush shelters and gravel beds.

## METHODS

SCUBA observations were made once a month for six months, from May through October on the following lakes: Mary Crawford, Columbia, Monroe and Mike Conner. Ten minute observation time was spent on each of three brush shelters and three gravel beds in each lake. Along with underwater observation, relevant information was recorded, such as number and species of fish occupying these areas, depth fish were found, barometric pressure, water temperature, dissolved oxygen and weather conditions.

Additional observations were made on the following lakes: Perry, Tippah and Bogue Homa. The same methods were used on these lakes as in the above lakes.

## FINDINGS

May 13, 1976: Underwater observation of gravel beds and brush shelters was initiated on four state lakes; Mike Conner, Columbia, Mary Crawford and Monroe.

Brush shelters attracted largemouth bass varying in sizes and numbers. The average size was from 1 to 4 pounds and the average number per brush shelter was 6. Bluegill were seen on 4 of the 12 shelters and were small, usually less than 4 inches. In close proximity of two brush shelters were schools of about 100 one inch largemouth bass.

Observation of gravel beds showed heavy utilization by adult bluegill for spawning purposes. Every usable inch of the gravel beds were pitted with bluegill beds. On close examination, spawns were observed in various stages of development. Eggs were seen in the majority of the beds, however, many beds contained yolk sac fry and some contained free swimming fry. Only 4 largemouth bass beds were seen on the gravel beds and these were in shallower water, about 1 1/2 foot deep. Failure of 4 gravel beds to be used as spawning sites was attributed to the 6 to 7 foot depth which fell into the oxygen devoid layer in the water column and dissolved oxygen readings were less than 2 ppm.

On June 27, 1976: Brush shelters had attracted largemouth bass from small fry to large adults up to 7 pounds. Average size of adults was from 1 to 4 pounds and number per brush shelter was 4. The largemouth fry seemed to prefer the thick brushy tops, while the larger bass were more commonly seen around the tree trunks. The 1 to 2 pound bass were constantly swimming through and around the brush tops. Fry were about 1 1/2 inches long and averaged 10 per brush shelter. Bluegill were seen in large numbers. The majority were fry about 1/4 inch in length and were present on all brush by the hundreds. Very few larger bluegill were present and were usually less than 4 inches long.

Observation of gravel beds showed continued heavy use. Examination of individual beds showed varying stages of development of spawn as in previous month. Some young largemouth bass fry were seen swimming in the gravel bed areas. Examination of the shoreline near the gravel beds showed numbers of bluegill and largemouth bass fry.

July 29, 1976: Brush shelters continued to attract largemouth bass and bluegill. The adult largemouth bass seen were from 1 to 3 pounds and fewer than in the two preceding months, averaging one per brush shelter. Two inch largemouth bass fry were seen consistently in thicker portions of brush shelters and averaged approximately 15. Bluegill fry were seen by the thousands in all areas of the brush shelters and varied in size from 1/4 inch to 1/2 inch in length. Very few 2 to 4 inch bluegill were on the shelters and no adults were seen.

Gravel beds continued to be used but more vacant individual beds were noted.

August 30, 1976: Brush shelters continued to attract largemouth bass and bluegill. The number of adult largemouth bass seen was very small as compared to previous months. Eight adults were seen on 3 of the 12 brush shelters and were between 1 and 3 pounds. Largemouth bass fry were 2 to 3 inches long and occupied the smaller branches of the tree tops. Largemouth bass fry averaged 5 per brush shelter. Bluegill were seen by the thousands in various sizes from 1/4 to 3/4 inches long. More 2 to 4 inch bluegill were seen in brush shelters with an occasional adult present.

Gravel beds were not being used very much. Only an occasional bluegill bed was seen, most of which contained sac fry or free swimming fry.

September 28, 1976: The adult largemouth bass were not seen on brush shelters as in previous months. Only an occasional 1 to 2 pound largemouth bass was seen swimming around the brush shelters. There were, however, some 1/2 pound largemouth bass seen which up until this time had not been noted in the brush shelters.

Bluegill fry varied in numbers from previous months in that they averaged approximately 100 per brush shelter as compared to the thousands the month before. Large and intermediate bluegill were seen in increasing numbers. Observations of the bottom and shallow water areas of the lake revealed heavy numbers of bluegill fry and largemouth fry, which heretofore had not contained these numbers of fish. The lakes had also destratified as indicated by the water quality tables.

Gravel beds were not being used for spawning and a slight silting of the beds had resulted.

October 14, 1976: Observation of adult largemouth bass was spotty on most of the brush shelters with the exception of one in Lake Columbia in shallow water. On this particular brush shelter, 20 to 30 largemouth bass averaging 1 to 6 pounds were observed swimming in and around this brush shelter in a rather tight school. On the same shelter a 5 to 6 pound channel catfish and approximately 30 intermediate adult bluegill were seen. Bluegill fry were seen in small numbers on most brush shelters. Adult and intermediate bluegill occupying the brush shelters averaged 20 and was an increase from previous months.

Gravel beds again were not being used for spawning.

## CONCLUSIONS

Underwater observations by the use of SCUBA were conclusive that brush shelters and gravel beds did concentrate fish. Underwater observations of the brush shelters found that these shelters consistently concentrated both fry and adult largemouth bass and bluegill. The largemouth bass adults frequented the shelters to prey upon young bluegill but did not use them on a permanent basis. Young largemouth bass were found consistently in or around the shelters, not only for cover but also as a food source due to large numbers of bluegill fry present throughout the growing season.

Adult bluegill did not use the shelters until spawning was completed. The bluegill fry, however, used the shelters extensively shortly after they became free swimming. They remained on the shelters throughout the growing season. They used the shelters for cover and due to amounts of periphyton insect larva and crustacea present as a food source also.

Gravel beds were found to be highly successful in attracting adult bluegill for spawning purposes. Every usable space of the gravel beds was put to use as spawning beds. Gravel beds were used repeatedly from May through August as spawning sites. It was observed that spawns were in all stages of development on the gravel beds at any given time during the growing season.

Only 4 largemouth bass beds were observed on the 12 gravel beds. These beds were located in shallow water and were used only once.

Environmental factors, such as weather conditions, barometric pressure and air temperature, seemed to have no effect on utilization of brush shelters or gravel beds.

There was, however, a direct correlation between water temperatures and oxygen devoid water as to the position of fish in the water column. Both adult and young largemouth bass and bluegill were seen in higher numbers just above the oxygen devoid water where the water temperature started to fall rapidly. They seemed to prefer the cooler water even though dissolved oxygen was less than that of the warmer water above. No fish were observed in the oxygen devoid layer and 4 gravel beds that were placed too deep were not utilized due to oxygen devoid water over the beds.

This study was supported by Mississippi Game & Fish Commission with Federal Aid funds under Mississippi Project F-40-1.

Table 1. Environmental factors relevant to SCUBA observations.

| Lakes & Date | Barom. Press. | Water Temp. Surf. | 1 | 2 | 3 | Dissolved Oxygen Sürf. | 1 | 2 | 3 | Air Temp. °F | Weather Cond. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mary Crawford | | | | | | | | | | | |
| June 25 | 30.81 | 85.4 | 83.2 | 80.9 | 76.8 | 9.4 | 9.2 | 9.0 | 3.3 | 87.0 | Clear-sunny |
| July 30 | 31.20 | 89.9 | 89.2 | 87.1 | 73.4 | 7.9 | 7.5 | 6.7 | 0.8 | 90.1 | Clear-sunny |
| Aug. 28 | 30.12 | 87.2 | 83.1 | 80.2 | 72.0 | 7.3 | 7.0 | 6.4 | 1.3 | 83.2 | Pt. Cloudy |
| Sept. 30 | 29.44 | 73.8 | 73.9 | 73.4 | 71.6 | 6.8 | 6.4 | 6.1 | 5.3 | 74.2 | Pt. cloudy |
| Oct. 15 | 30.14 | 69.3 | 68.9 | 68.6 | 68.4 | 9.8 | 8.7 | 8.4 | 8.0 | 63.8 | Clear-sunny |
| Mike Conner | | | | | | | | | | | |
| May 13 | 29.68 | 75.8 | 75.2 | 74.8 | - | 9.5 | 9.5 | 9.5 | - | 76.0 | Pt. cloudy |
| June 25 | 30.78 | 86.0 | 84.9 | 79.3 | - | 9.8 | 9.1 | 3.8 | - | 88.4 | Pt. cloudy |
| July 30 | 31.17 | 86.5 | 84.6 | 83.8 | - | 8.4 | 6.4 | 2.2 | - | 87.3 | Clear-sunny |
| Aug. 31 | 30.14 | 86.0 | 80.2 | 74.6 | - | 8.5 | 8.2 | 4.0 | - | 80.0 | Clear-sunny |
| Sept. 30 | 29.40 | 74.6 | 74.2 | 74.1 | - | 7.9 | 7.6 | 7.2 | - | 74.6 | Sunny-few clouds |
| Oct. 14 | 29.98 | 68.3 | 68.2 | 68.0 | - | 8.6 | 8.5 | 7.4 | - | 68.0 | Pt. cloudy |
| Monroe | | | | | | | | | | | |
| June 26 | 29.98 | 85.1 | 84.6 | 83.1 | 79.0 | 10.6 | 10.6 | 10.6 | 5.1 | 86.3 | Pt. cloudy |
| July 30 | 31.40 | 83.4 | 81.0 | 80.0 | 78.1 | 6.8 | 6.5 | 4.3 | 0.5 | 86.0 | Hazy |
| Aug. 28 | 30.28 | 82.7 | 82.0 | 76.0 | 73.2 | 8.1 | 7.9 | 4.0 | 0.7 | 79.0 | Rainy |
| Sept. 29 | 29.94 | 78.4 | 76.9 | 72.7 | 70.3 | 9.8 | 8.3 | 8.0 | 6.5 | 78.6 | Hazy |
| Oct. 30 | 29.98 | 66.4 | 66.1 | 65.8 | 62.7 | 8.3 | 8.1 | 7.8 | 7.1 | 65.8 | Pt. cloudy |
| Columbia | | | | | | | | | | | |
| May 13 | 29.78 | 78.2 | 78.2 | 77.4 | 75.3 | 8.9 | 8.9 | 8.1 | 7.3 | 76.5 | Pt. cloudy |
| June 25 | 30.78 | 80.4 | 80.0 | 79.3 | 76.1 | 10.1 | 9.8 | 9.2 | 5.1 | 84.3 | Clear-sunny |
| July 30 | 31.14 | 83.2 | 83.0 | 82.2 | 78.4 | 7.6 | 7.4 | 0.9 | 0.5 | 86.7 | Clear-sunny |
| Aug. 28 | 30.36 | 86.0 | 83.4 | 80.0 | 79.2 | 8.6 | 7.7 | 0.8 | 0.4 | 87.0 | Clear-sunny |
| Sept. 29 | 31.32 | 76.2 | 76.2 | 75.8 | 72.6 | 8.8 | 8.5 | 7.0 | 5.1 | 73.4 | Cloudy |
| Oct. 14 | 30.20 | 69.3 | 68.7 | 68.3 | 65.0 | 8.7 | 8.7 | 8.6 | 8.1 | 72.0 | Sunny-few clouds |

## LITERATURE CITED

Allan, Robert C. and James Romero. 1975. Underwater observations of largemouth bass spawning and survival in Lake Mead. Richard H. Stroud and Henry Clepper (ed) Black bass biology and management. Sport Fishing Institute, Washington, D. C. pp. 104-112.

Barkuloo, James M. and W. Keith Bryd. 1962. Self contained underwater breathing apparatus (SCUBA) as an aid in fisheries work. Proc. S. E. G&F Comm. 16:281-284.

Bartholomew, J. Phillip. 1972. An evaluation of cover retention as related to angling quality in Lake McClure (New Exchequer Reservoir), Mariposa County, California. Resour. Agency of Calif., Dept. of Fish & Game, Admin Report No. 72-7.

Davis, James T. and Janice S. Hughes. 1971. Effects of standing timber on fish populations and fisherman success in Bussey Lake, Louisiana. Reservoir Fish. & Limnol. No. 8, 1971 of Amer. Fish. Soc. pp. 255-264.

Herring, Jack and Bill Anderson. 1975. Lake investigations: Investigations of state lake's fishery resources. Miss. G&F Comm., Jackson, Ms. 39205.

Parker, R. O., Jr., R. B. Stone, C. C. Buchanan and F. W. Steimle, Jr. 1974. How to build marine artificial reefs. U. S. Dept. of Commerce, Fishery Facts - 10. Seattle, Wash.

Prince, Eric D., Robert F. Raleigh and Raymond Corning. 1975. Artificial reefs and centrarchid basses. In Richard H. Stroud and Henry Clepper (ed) Black bass biology and management. Sport Fish. Inst., Washington, D. C.

Vogele, Louis E. and William C. Rainwater. 1975. Use of brush shelters as cover by spawning black basses in Bull Shoals Reservoir. Trans. Amer. Fish. Soc. Vol. 104 (2):264-269.

Wilbur, Robert L. 1974. Florida's fresh water fish attractors. Fla. Game and Fresh Water Fish Comm., Fisheries Bulletin No. 6.

Susceptibility to Predation of
Blacktail Shiners Stained with
Bismark Brown Y[1]

by

John A. Baker
Timothy Modde

Department of Biology
University of Southern Mississippi
Hattiesburg, MS 39401

The use of Bismark Brown Y as a tool in mark-recapture studies was tested under laboratory conditions. Dyed blacktail shiners, Notropis venustus, were consumed at a significantly greater rate than control fish by both largemouth bass and bluegill when predators were confined in 38, 55 and 95 liter aquaria. Selection of dyed prey by largemouth bass continued when 450 liter aquaria were used to simulate more natural conditions.

Largemouth bass selected dyed prey over control prey under three different lighting conditions: total darkness, total room light, and an intermediate condition approximating dusk. The greatest difference in selection between dyed and control prey occurred under conditions of total darkness.

When both dyed and control prey were anesthetized with MS 222 immediately prior to being offered to largemouth bass no differential selection was observed. After nearly 400 prey had been consumed over several trials there was a difference of only a single fish between dyed and control prey.

A test devised to measure the "reaction response" of dyed prey indicated that they did not recover from the effects of the dyeing process for at least six hours. After this time an observer could generally detect no behavioral difference between dyed and control fish. That such a difference must have existed was obvious, however, as the predators selected dyed prey even though we held them for at least six hours before beginning an experiment.

Based on our results, we conclude that an altered behavioral response resulting from dyeing in Bismark Brown Y, rather than the color of dyed fish, is the primary factor effecting differences in selection. The relative unimportance of color in determining selection of prey which we found is consistent with the findings of others.

Use of the stain Bismark Brown Y may introduce bias into population studies by increasing predation on dyed fish or by increasing the susceptibility of dyed fish to recapture, if recaptures are made too soon. The effect of this dye should be evaluated for a species prior to its use in the field.

[1]Summary of a paper submitted November 1976 to the Transactions of the American Fisheries Society for publication.

SOME ASPECTS OF BRYOZOAN ECOLOGY IN NORTHERN MISSISSIPPI FLOOD CONTROL RESERVOIRS

by

John W. Burris
University of Mississippi
Department of Biology
University, Mississippi 38677

ABSTRACT

A diverse assemblage of organisms have become established in flood control reservoirs in northern Mississippi since their construction less than 40 years ago. Investigations of one group, the Bryozoans, were made to determine the species distribution and to attempt to establish some interrelations in the reservoir community. Four Bryozoan species were encountered. The species are of no obvious economic importance, do not impair water outfalls, and are not endangered by the extreme water level fluctuations of more than 6 meters. Scant evidence of the use of these organisms as a food source for fishes was observed. Several genera of Dipterans, notably Chironomus, were found living within Bryozoan colonies and may have attracted incidental predation.

INTRODUCTION

The original intent of impounding a series of four major streams in northern Mississippi was that of flood control. The region north of Jackson, Mississippi, receives an average rainfall of 52 inches and the median cummulative runoff may reach more than 18 inches. Most of the rain falls during a period from late November through mid-May. The reservoirs contain their highest water levels into the growing and reproductive period of many animals and plants which have subsequently become part of the reservoir environment. To function as flood control devices the water is drawn down through the summer and into the fall to prepare for the next cycle of rain. The effects of the drawdown on many of the organisms, especially the sessile ones, is not known.

The study on which this report was based was undertaken to attempt to provide some insight into one commonly observed but lesser known phylum--the phylum Bryozoa. A search of the literature revealed only scant reports of the Bryozoans and records in Mississippi's fresh water are poorly established. Dendy (1963) reports many observations of Pectinatella magnifica Leidy 1851 in Alabama farm ponds; however, the relatively established pond environment does not present the additional problems concomitant with reservoir drawdown. Rogick (1934, 1937, 1940, 1945) established many records of distribution mainly in the North Central states. Bushnell (1965, 1966, 1973) has provided some insights concerning reproduction, survival, and distribution; however, these studies also are mostly confined to the northern tier states. The problem to be investigated in Mississippi was to be twofold: a taxonomic one and one of ecological relations within the reservoir system.

For purposes of this report, only those species associated directly with the reservoir pool are discussed. The most commonly observed species was Pectinatella magnifica. Three other species: Plumatella repens (Linnaeus) 1758, Fredericella sultana (Blumenbach) 1779, and Paludicella articulata (Ehrenberg) 1831 were found. Ecological relations to other organisms and apparent survival problems were investigated. Observations were initiated in March, 1974, and were terminated in July, 1975.

## METHODS

Four stations each were established on Sardis Reservoir (Figure 1) and Grenada Reservoir (Figure 2) in Mississippi. Bryozoan colonies were collected by hand from a variety of substrates and preserved in 10% formalin. Representative live specimens were returned to the laboratory for subsequent observation of associated inconspicuous organisms. Temperature (water and air), pH, sun-shade relation, distance beneath the surface, wave action, and type of substrate were recorded. An arbitrary distance of one centimeter was established to define what constituted an association between the colony and other organisms encountered on the substrate. Identification of the organisms were made by the use of Pennak (1953) and Ward and Whipple (1959).

## RESULTS

### Pectinatella magnifica

Pectinatella magnifica was encountered at all eight stations. Colonies of this species are commonly observed in both reservoirs and may be seen as clear or grey gelatin-like masses hanging from brush and stumps as the water recedes. Frequently, the exposed organism had a green cast due to algae growing within the gel. In July, 1974, an estimated 30,000 colonies over 5.0cm in diameter were present in Sardis Reservoir. Colonies as large as 0.5m have been reported; however, the largest encountered in this study was an elliptical one 31cm x 39cm weighing 1,387 grams. Colonies were most frequently observed on small submerged limbs measuring 1 to 4cm in diameter. These were incorporated through the center of the colony as it grew. Locations of the colonies varied from open water where 1m waves were common to quiet backwater. Colony growth declined as the water temperature increased above 27.0C and in the autumn when water temperature dropped below 20C. Below 10C was endured for a short time; a condition usually encountered in northern Mississippi reservoirs in November. The earliest observation of Pectinatella magnifica was May 10 and the last functioning colony was seen November 14. The colonies encountered were all taken from substrates which received sunlight for at least 50% of the time and in water with a pH range of 6.6 to 7.4. Observed depths ranged from exposed and occasional wave-bathed substrates down to the limits of visibility. Light may be expected to penetrate to 7m during the maximum growing season and Secci disc depths of 163cm have been recorded in other reports.

Colonies of Pectinatella magnifica secrete the gelatinous material which makes the colony conspicuous. The individual zooid is less than

1.5mm long and inhabits only the surface of the mass. There were an estimated 2,800 individuals on the perimeter of a colony 10cm x 8cm. The underlying material is quite stable but dessicates in air to form brittle, brownish, translucent plaques on the substrate to which it was attached. Laboratory studies of the gel material revealed it has a specific gravity of 1.018 and a water content of 99.52%. Organic solvents such as hexane, benzene, ether, and ethyl alcohol did not alter it. It was impervious to 10% solutions of HCl and KOH as well.

There was no evidence of actual predation by fish, nor the use of the zooids as a food source by any organism. The underlying gel was examined and found to contain a variety of organisms inhabiting it. Notably, Dipteran larvae were encountered in 87% of the colonies of Pectinatella magnifica with the genus Chironomus representing the majority. Cryptochironomus was observed in less than 10% of the colonies. Frequently the bacteria Rhodospirillium gave the gel a pinkish cast. A wide variety of algae was encountered within the mass usually near the gel-water interface. The algae Chlorella was the most commonly encountered genus and contributed most of the green color usually encountered in colonies left exposed by receding water. Other organisms such as planarians, nematodes, and protozoans were infrequently encountered.

Pectinatella magnifica asexually produces a statoblast consisting of an undifferentiated mass of cells enclosed in a round body approximately 1.0mm in diameter. These are equipped with a flotation device enabling dispersion over great distances. Production of statoblasts was observed in both reservoirs during the second week in July and continued until cold killed the parent organism late in the year. Maximum reservoir drawdown usually occurs during this same period. Sexual reproduction resulting in a small larval form approximately 1.5mm in diameter was encountered in water temperatures above 20C. Both the statoblast and larval forms will generate a new colony as long as suitable temperature and substrates are encountered. A diapause was not indicated. Many statoblasts were observed to overwinter in the dried, exposed colony remnants and await the rising water in the spring to begin the cycle again.

Plumatella repens

Plumatella repens was the second most frequently encountered Bryozoan. An abundance of colonies of this quite inconspicuous species was present at Grenada Stations 3 and 4. Sardis Stations 1 and 2 had a number of colonies but they were not numerically equal to Grenada. The presence of statoblasts of this species suggests that it is as common and as well established as Pectinatella magnifica; however, the growth habit of Plumatella repens tends to make it much less conspicuous. A colony usually consisted of from 20 to 75 zooids growing in a single column approximately aligned end to end extending over several $cm^2$ of substrate. There is little or no gelatinous material encasing the colony. Normal substrates were the underside of floating boards and other relatively flat surfaces as well as behind loose bark of inundated trees. Those colonies in protected locations such as behind bark were usually linear with few branches. Colonies on exposed undersides of floating materials were more stellate and branched especially when small fish were also present.

Plumatella repens appears to be slightly more tolerant of temperature extremes than *Pectinatella magnifica*. Viable colonies were encountered at temperatures as low as 14C. The pH range was identical to that of *Pectinatella magnifica*. Only rarely were colonies found in areas exposed to wave action and most were out of direct sunlight at least 90% of the time. The first observed colony was July 5 and the last recorded on December 10.

The only observed *Plumatella repens* reproductive cycle was the statoblast. Statoblasts were produced beginning in early July and some remained in deteriorated colonies through the winter. No larval stage such as that seen in *Pectinatella magnifica* was encountered in this study. The statoblast has a flotation device allowing wide dispersion and may germinate without diapause if temperature and substrate are suitable.

Organisms associated with *Plumatella repens* were similar to those found on most floating materials in the same environment with a few exceptions. The rotifer genus *Limnias* was far more abundant in areas near the bryozoan colony than on non-colonized substrates. In 35% of the colonies observed, the sponge genus *Spongilla* was present within 1.0cm of the colony. Each colony collected had at least one flatworm present with the predominant representative *Dalyella*. Representatives of Dipteran larvae were encountered randomly near the colony and consisted mainly of small *Chironomus*.

*Fredericella sultana*

A total of only 14 colonies of this species was observed during the study, the majority of which were found at Grenada Station 3. The largest of these contained only 53 individuals. The species inhabits a niche similar to *Plumatella repens* and may be competitive. Observations indicate growth habits including stellate colonies on exposed surfaces are quite similar. Insufficient data was obtained to make conclusions concerning the temperature tolerance of this organism. Organisms in close proximity may be expected to be similar to those encountered with *Plumatella repens*.

*Fredericella sultana* has an asexual overwinter stage called a sessoblast which does not float. No identifiable free sessoblasts were encountered in this study. Other limnological studies on the two reservoirs do not reveal any recognizable stages of the genus in any planktonic or benthic samples.

*Paludicella articulata*

*Paludicella articulata* was represented in the collection by only four colonies, all from Sardis Station 2. The type of substrate and habitat was identical to that observed for *Fredericella sultana* and *Plumatella repens*. Three colonies with a maximum of 25 individual zooids were found on a soft, floating log in 0.5m of water. Data gathered from so few specimens is deemed to be not representative. *Paludicella articulata* does not produce floating statoblasts and is expected to have limited distribution similar to *Fredericella sultana*.

## DISCUSSION

Bryozoans are of little apparent economic importance in the flood

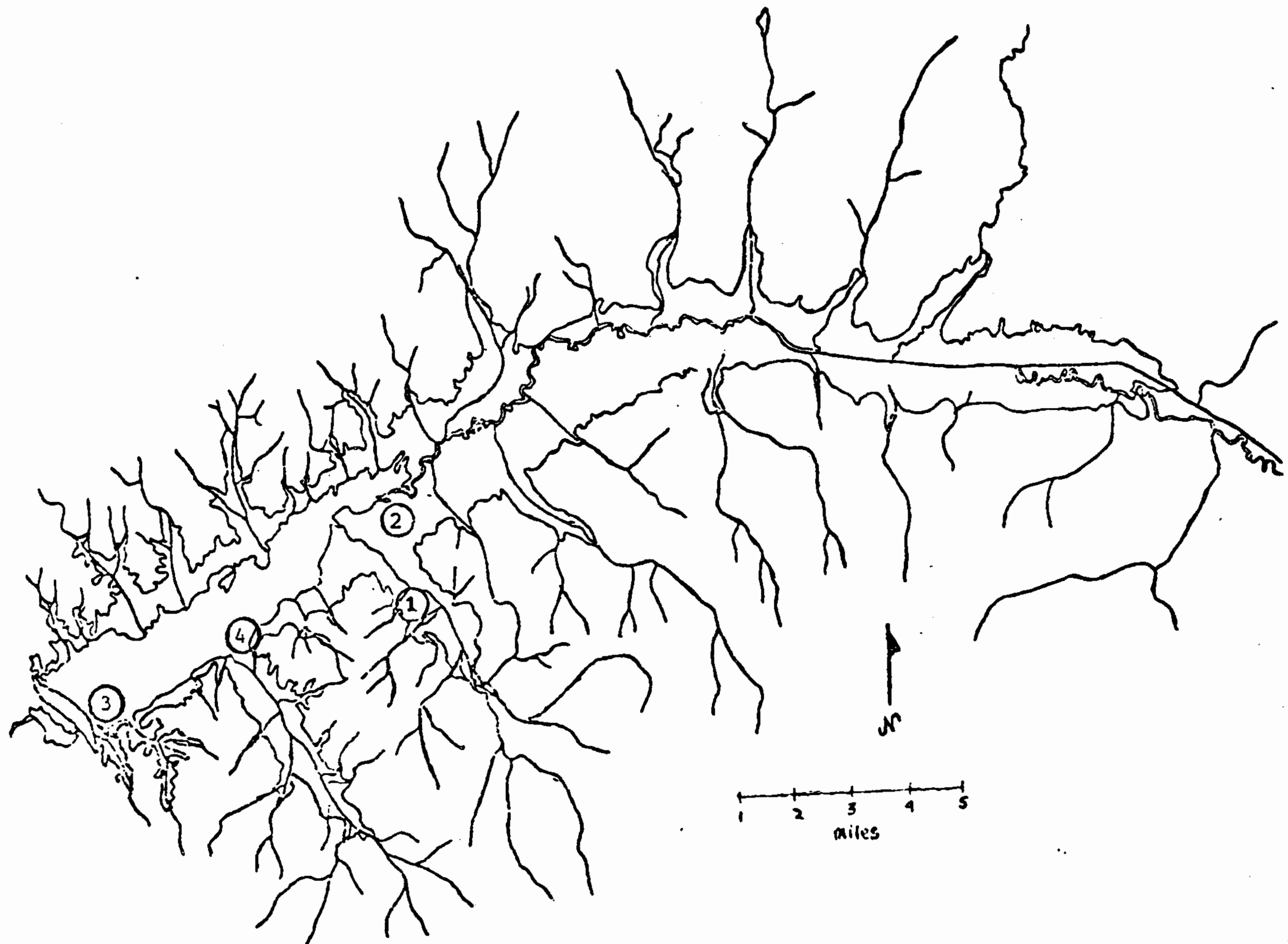


Figure 1. Map of Sardis Reservoir showing sampling stations.

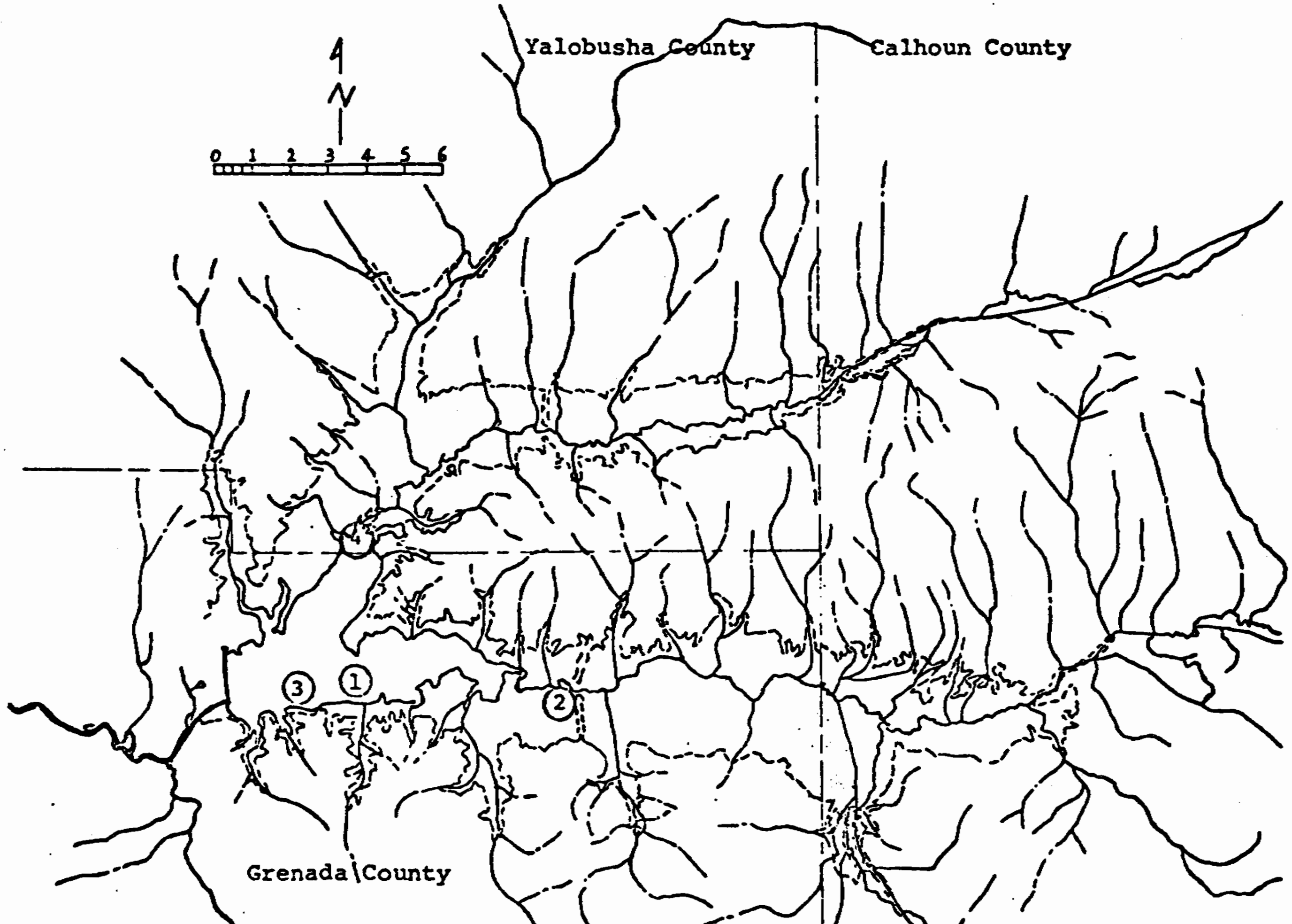


Figure 2. Map of Grenada Reservoir showing sampling stations

control reservoirs of northern Mississippi. Reports from other locations list them as an annoyance in stopping drains or water intakes; however, this problem does not exist within the confines of the two reservoirs investigated.

Fishermen sometimes refer to the exposed colonies of Pectinatella magnifica as "crappie eggs" and are frequently alarmed by the threat to fishing if they are left exposed. It appears there is only an incidental or no relation between reservoir fishes and the bryozoans. Feeding upon the Dipteran larvae found within the gel may occur and ingestion of some of the colony may subsequently result; however, there was no evidence of deliberate consumption of zooids as a primary food source by any organism. The appearance of stellate colonies of Plumatella repens and Fredericella sultana in exposed places as opposed to linear ones in sheltered positions suggests small fish may feed on these species though there was no recorded observation of this occurring during the study. Osburn (1921) reported finding statoblasts in the stomach of Pomoxis, Lepomis, Micropterus, and Dorosoma, all of which are indigenous to the observed area. Ducks and geese have been known to dispense the statoblasts and sessoblasts on their feet and in the digestion tract for more than 600km (Bushnell, 1973). Whether the presence of these stages was the result of intended consumption of parent colonies is not known, but may account for some species being introduced to Mississippi waters.

Water level fluctuations of 6 meters occurred during the course of this study. The presence of a floating statoblast produced by both Pectinatella magnifica and Plumatella repens enables them to overcome water level extremes and their subsequent survival does not appear to be threatened. The limited number of Fredericella sultana colonies encountered suggests that it does not have as wide a distribution and the effects of water level extremes are not clear. Paludicella articulata must be considered as infrequent and ecological observations are inconclusive.

## LITERATURE CITED

Bushnell, J. H. 1965. On taxomy and distribution of freshwater Ectoprocta in Michigan. Trans. Am. Microsc. Soc. 84:231-244, 339-338, 529-548.

__________. 1966. Environmental relations of Michigan Ectoprocta and dynamics of natural populations of Plumatella repens. Ecol. Monogr. 36:95-123.

__________. 1973. The freshwater Ectoprocta: A zoogeographical discussion. p. 503-521. In Living and Fossil Bryozoa, 1st ed. ed. G. P. Larwood. Academic Press, New York, 634 p.

Dendy, J. S. 1963. Observations on bryozoan ecology in farm ponds. Limnol. Oceanogr. 8:478-482.

Osburn, R. C. 1921. Bryozoa as food for other animals. Science 53:451-453.

Pennak, R. W. 1953. Freshwater invertebrates of the United States. Ronald Press Co., New York, 769 p.

Rogick, M. D. 1934. Additions of North America Freshwater Bryozoa. Ohio J. Sci. 34:316-317.

__________. 1937. Studies on freshwater Bryozoa V. Some Additions to Canadian farms. Ohio J. Sci. 37:99-104.

__________. 1940. Studies on Freshwater Bryozoa IX. Trans. Am. Microsc. Soc. 59:187-204.

__________. 1945. Studies on freshwater Bryozoa. Ohio J. Sci. 50:136-146.

Ward, H. B., and G. C. Whipple. 1959. Fresh-water biology, 2nd ed. John Wiley and Sons, New York, 1248 p.

The Impact of Commercial Netting and Sport Fishing on Economically Important Estuarine Species - A Pertinent Problem along the Northern Gulf of Mexico

Presented at

Annual Meeting
Mississippi Chapter
American Fisheries Society

February 17, 1977

by

Wendell J. Lorio, Director
Mississippi State University Research Center
Bay St. Louis, Mississippi

# The Impact of Commercial Netting and Sport Fishing on Economically Important Estuarine Species - A Pertinent Problem Along the Northern Gulf of Mexico

As fishery biologists working in the State of Mississippi it is imperative that we be aware of the problems that tax our expertise since in many cases we do not have the answers to pertinent questions that are involved in the management of our fishery resource. Whatever the problem, we should all work together, for cooperation is the only way problems of any magnitude can be solved.

One such current problem is the controversy between the sport fisherman and the commercial gill netters in Mississippi Sound. Sport fishermen argue that the gill and trammel net fishermen are depleting the populations of spotted seatrout (*Cynoscion nebulosis*) and red drum (*Sciaenops ocellata*). Most fishery biologists contend that this commercial fishing pressure has had little effect on the populations of spotted seatrout and red drum, however, there is no data available to support this conviction. Preliminary indications based on creel census surveys being conducted in Louisiana indicate the sport catch is four times the commercial catch (Max Summers, personal communication, Louisiana Wildlife and Fisheries Commission, New Orleans, Louisiana).

The State of Mississippi is involved in a similar program of managing a coastal fishery. We cannot depend on information derived from Louisiana because their coast line, hydrology and tidal conditions are different. Also, because of limited area, a mile of Mississippi coastline is much more precious than the same size area in Louisiana.

It is not often that a fishery biologist is given the opportunity to appear before his peers for advice and counsel prior to initiating a study. As a result, the methods that will be used are outlined as follows. Your comments are encouraged.

The study area is the entire coast of Mississippi extending to Petit Bois, Horn, Ship and Cat Islands. The area is divided into three zones and the interview schedule for the creel census statistically programmed by the North Carolina Institute of Statistics. This study is very similar to that being conducted by Louisiana Wildlife and Fisheries Commission.

A roving clerk technique will be used. The clerk will interview all sport and commercial fishermen in view along a prearranged route. Information such as type of fishing, profession, catch and residence will be obtained. Data collected will be statistically analyzed in order to obtain fishing pressure and fishing success.

All information derived from this study will be of value to the Mississippi Marine Conservation Commission, Mississippi Marine Resource Council and Louisiana Wildlife and Fisheries Commission. This new research is badly needed in order to provide information that enables decision makers to properly manage our sport and commercial fisheries along the Mississippi

Coast. Since this is a controversy between proponents and opponents of gill and trammel netting, it is necessary to find out the relative catch of sport and commercial fishermen. With the forthcoming results from this study, management recommendations will be made. This fin fishery has to be managed in such a manner as to insure the proper allocation and utilization of the resource.

# ABUNDANCE AND PRODUCTION OF LITTORAL AND PROFUNDAL BENTHIC FAUNA IN A FLOOD CONTROL RESERVOIR[1/]

Charles M. Cooper[2/]

## ABSTRACT

During a 3 year study of Grenada Reservoir, Mississippi (40 to 260 $km^2$), benthic fauna of the littoral and profundal areas were compared. Because of large-scale water level fluctuations and lack of rooted vegetation, littoral and profundal regions were best defined by bottom substrate types rather than by classical definitions. Definition by substrate types generally corresponded with boundaries defined by the conservation and flood pool levels. The profundal areas of Grenada Reservoir, unlike those of most natural lakes, were more productive than the littoral zones in species and total numbers. The profundal zone produced 62%, 70%, and 77% of the benthic biomass per unit area of lake bottom during the 3 years. The littoral areas normally most productive in stable lakes yielded little benthos. This lack of benthos occurred because of habitat destruction from wave action and drying during periods of low water due to drawdown. Production increased 8 to 15% when no drawdown occurred. Management policies should be formulated to better use littoral productivity when drawdown procedures permit.

## INTRODUCTION

In limnology, the bottom associations have traditionally been divided into three zones: littoral, from the shore line to the outward extent of rooted vegetation; sublittoral, that transitional area from littoral to profundal; and profundal, that area of lake bottom that contains the hypolimnion (Welch, 1952). The littoral zones have been shown to be the most productive areas in lakes that have such zones (Adamstone, 1923; Sublette, 1957). However, all inland bodies of water do not conform to this rigid concept of zones. The advent of large flood control reservoirs has brought a new situation to the field of limnology that of large bodies of water subject to extreme fluctuations in water level. Such constantly changing water levels bring about many environmental changes that cause faunal responses not ordinarily seen in more stable lentic environments. Few extensive studies have been made of benthos in flood control reservoirs where water level fluctuations prevent the formation of a well-established classically defined littoral zone with rooted vegetation or a sub-littoral zone.

In making the present study, the bottom zones used were not based on their classical definitions but rather on a more logical approach for flood control reservoirs, that of bottom substrate types (Welch, 1952;

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1/ Contribution of the Sedimentation Laboratory, Alabama-North Mississippi Area, Southern Region, Agricultural Research Service, U. S. Department of Agriculture in cooperation with the University of Mississippi.

2/ Biologist, Sedimentation Laboratory, Oxford, Mississippi.

Sublette, 1957). These types are influenced greatly by minimum water levels during drawdown and are less stable than those found in many natural lakes. The Grenada Reservoir littoral zone was found to shift, but it was roughly from 0 to 6 m deep at normal maximum water level. It had areas of sand-gravel cenosis and hardpan clay produced by shallow-water wave action and periods of drying and baking. The ecotone between the littoral and profundal areas was 6 to 8 m deep during periods of high water; its gumbo clay substrate was produced when the zone was out of water for one to two months each year, but was not subjected to extensive drying or to shallow-water wave action. The profundal zone consisted of those conservation pool associations that were never subject to drying and had a muck-mud substrate.

This study was made to investigate faunal productivity in the benthic zones of a flood control reservoir and to investigate the effects of water level fluctuations upon that productivity.

## MATERIALS AND METHODS

Grenada Reservoir in north-central Mississippi has an impoundment basin consisting of two alluvial valleys that before impoundment, were lowlands, farmland, or forestland--all of which were periodically flooded. The immediate drainage area surrounding the basin consists of a sandy-clay loess soil and clay subsoil over Eocene sediments. The Y-shaped reservoir was built 1.6 km below the confluence of the Skuna and Yalobusha rivers. Its conservation pool covers 39.7 $km^2$ while the flood control pool occupies up to 261 $km^2$.

Samples of bottom deposits were collected from February 1973 through August 1975 at stations and transects covering both littoral and profundal zones (Fig. 1). These areas were classified by bottom substrate types (Fig. 2). Because of drawdown practices, the littoral and profundal zones generally corresponded with the flood and conservation pool areas of the reservoir.

Samples with an area of 0.28 $m^2$ were taken by Ekman dredge and washed in a bucket having a U. S. Standard No. 30 sieve as a bottom. Organisms were separated from debris in the laboratory by sugar floatation (Anderson, 1959). More than 3500 organisms from the 425 samples were mounted on slides for identification during counting. Biomass measurements utilized volumetric analysis described by Ball (1948) and Anderson and Hooper (1956).

## RESULTS AND DISCUSSION

Profundal areas of the reservoir were more productive (Fig. 3) than littoral zones when biomass was calculated. Profundal regions produced 62%, 70%, and 77% of benthic wet weight per $m^2$ during the years studied. The absence of littoral flora and the decomposition layer beneath it was reflected in the lack of the large number of faunal species that usually accompany such flora. Ball (1948) found that reduction of flora on natural lakes resulted in a reduced fauna while extensive growth of aquatic macrophytes generally produced an abundant fauna.

The absence of flora and accompanying fauna in bays and other littoral areas was directly associated with changes in water level and wave action. The fluctuating water level of the reservoir left aquatic plants and the associated fauna without water for 2 to 4 months each year. Although some fauna migrated into deeper water, much was trapped and died. These dry periods and the grinding action of shallow water waves in these areas effectively destroyed any aquatic plant communities attempting to populate the littoral zones.

The lack of production in the littoral zone was the result of habitat destruction that was further substantiated by other evidence. During the 1972-73 life cycle period, abnormally high rainfall increased water levels in Grenada Reservoir until drawdown could not be completed. Thus, littoral habitats were preserved that year, and littoral macrofauna production was 8% higher than the next year when normal drawdown occurred. Total benthic biomass was also greater that year (Fig. 4).

Littoral biomass averaged 44.5 kg/ha during the study period, and profundal biomass averaged 103.48 kg/ha. Benthic production in Grenada Reservoir compares favorably with that of other flood control reservoirs. Sublette (1957) found Lake Texoma, Oklahoma and Texas, to have a mean standing crop of 21.75 kg/ha in the littoral regions and 102.9 kg/ha in the profundal zone. The richness of benthos production in natural lakes was shown by Anderson and Hooper (1956) who collected 101 kg/ha of littoral fauna in Sugarload Lake, Michigan.

Representatives of the midge _Chaoborus punctipennis_ (Say) were found at all sampling stations. Production of _C. punctipennis_ greatly increased in the littoral zone when this zone was stabilized, but was reduced drastically during winter drawdown (Fig. 5). During years with normal drawdown, _C. punctipennis_ far outnumbered all other species of benthic fauna. This may have been less than desirable since several food habit studies have indicated that this midge is poor-quality fish food (Ball, 1948; Geagan and Allen, 1960).

The benthic fauna of two adjacent sampling stations only 100 m apart showed that the productivity of the profundal zone (Fig. 6) was usually much higher than that of the littoral zone. Observations of the littoral zone revealed a gravelly-sand cenosis on hardpan clay with no decomposing vegetation or mud substrate, conditions which are unsuitable for abundant life.

The poor habitat conditions found in littoral areas are a major cause of poor macrobenthos production in flood control reservoirs. Pierce, et al. (1963) found that drawdown in small impoundments reduced benthic populations to 0.1 of their previous volumes, and drawdown alone did not improve fishing. Another detrimental aspect of drawdown seen during the study was that it occurred so late each year that no vegetation grew on exposed areas. This resulted in erosion of littoral zones and increased turbidity. Drawdown is often a necessary process and can be desirable in certain instances although it destroys most of the littoral benthos. However, policies should be formulated to consider littoral productivity where possible in reservoir management.

ACKNOWLEDGEMENTS

This paper is a contribution of the Sedimentation Laboratory, USDA-ARS-SR, Alabama-North Mississippi Area, in cooperation with the University of Mississippi. Work was done at the University of Mississippi and was partially supported by the Biology Department, The Graduate School, and the Mississippi Water Resources Institute. John Burris, Fred Rutherford, Jerry Hollis, and Chris Bernet helped with the field work, and Donna Bethany helped prepare the manuscript.

LITERATURE CITED

1. Adamstone, F. B. 1923. The bottom fauna of Lake Nipigon. Publ. Ontario Fish Res. Lab. 19:45-70.

2. Anderson, R. O. 1959. A modified floatation technique for sorting bottom fauna samples. Limnol. Oceanogr. 4:223-224.

3. Anderson, R. O. and F. F. Hooper. 1956. Seasonal abundance and production of littoral bottom fauna in a southern Michigan lake. Trans. Amer. Micros. Soc. 65:259-270.

4. Ball, R. C. 1948. Relationships between available fish food, feeding habits of fish, and total fish production in a Michigan lake. Mich. State College Agri. Exp. Stat. Tech. Bul. 206:1-59.

5. Geagan, D. W. and T. D. Allen. 1960. An ecological survey of factors affecting fish production in Louisiana waters. Louisiana Wildlife and Fisheries Commission. 100 pp.

6. Pierce, P. C., J. E. Frey, and H. M. Yawn. 1963. An evaluation of fisheries management techniques utilizing winter drawdowns. Proc. S. E. Assoc. Game and Fish Comm. 17:347-363.

7. Sublette, J. E. 1957. The ecology of the macroscopic bottom fauna in Lake Texoma (Denison Reservoir), Oklahoma and Texas. Amer. Midl. Nat. 57:371-402.

8. Welch, P. S. 1952. Limnology. McGraw-Hill, New York, 510 pp.

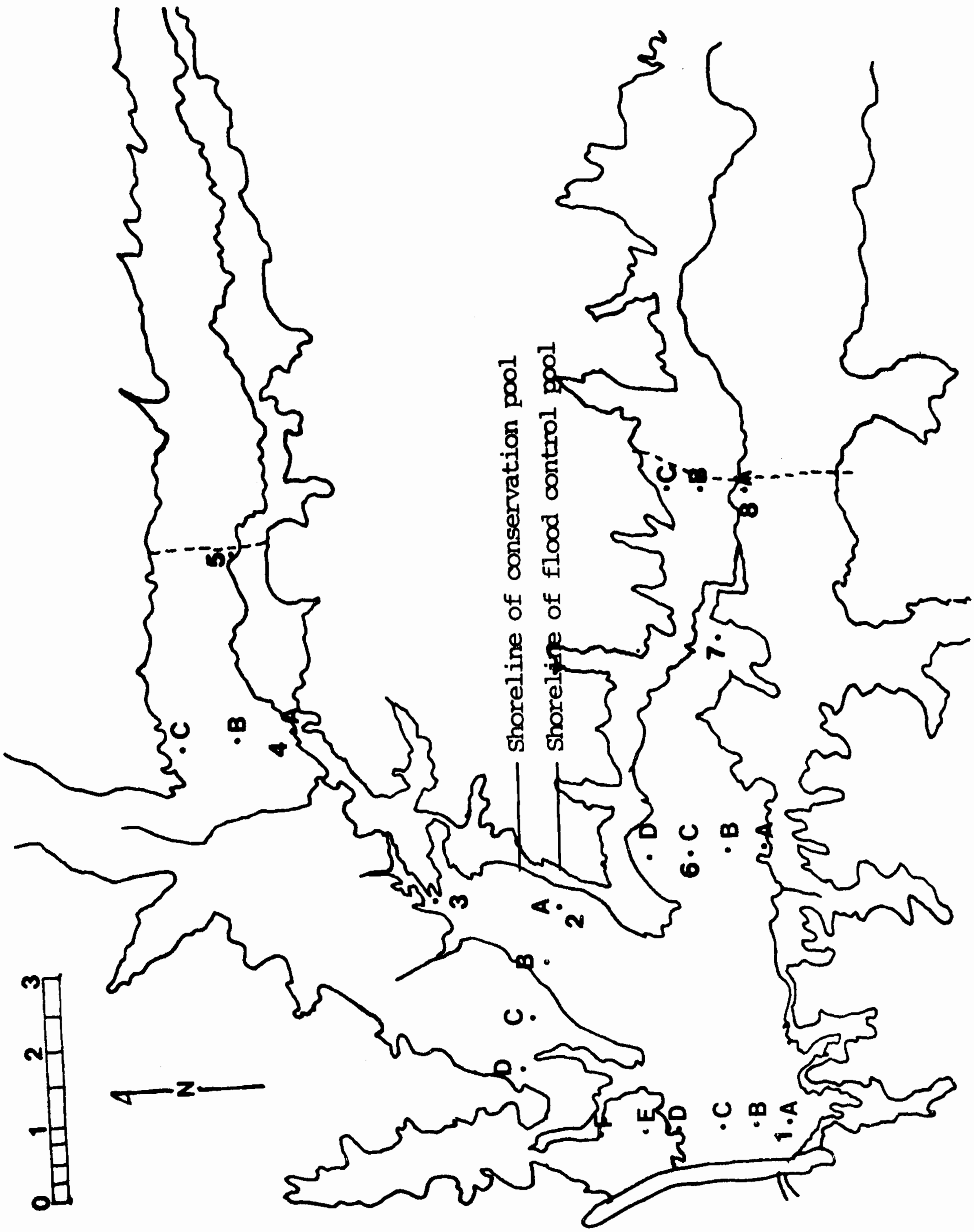


Fig. 1. Grenada Reservoir conservation and flood control pools, showing stations and transects.

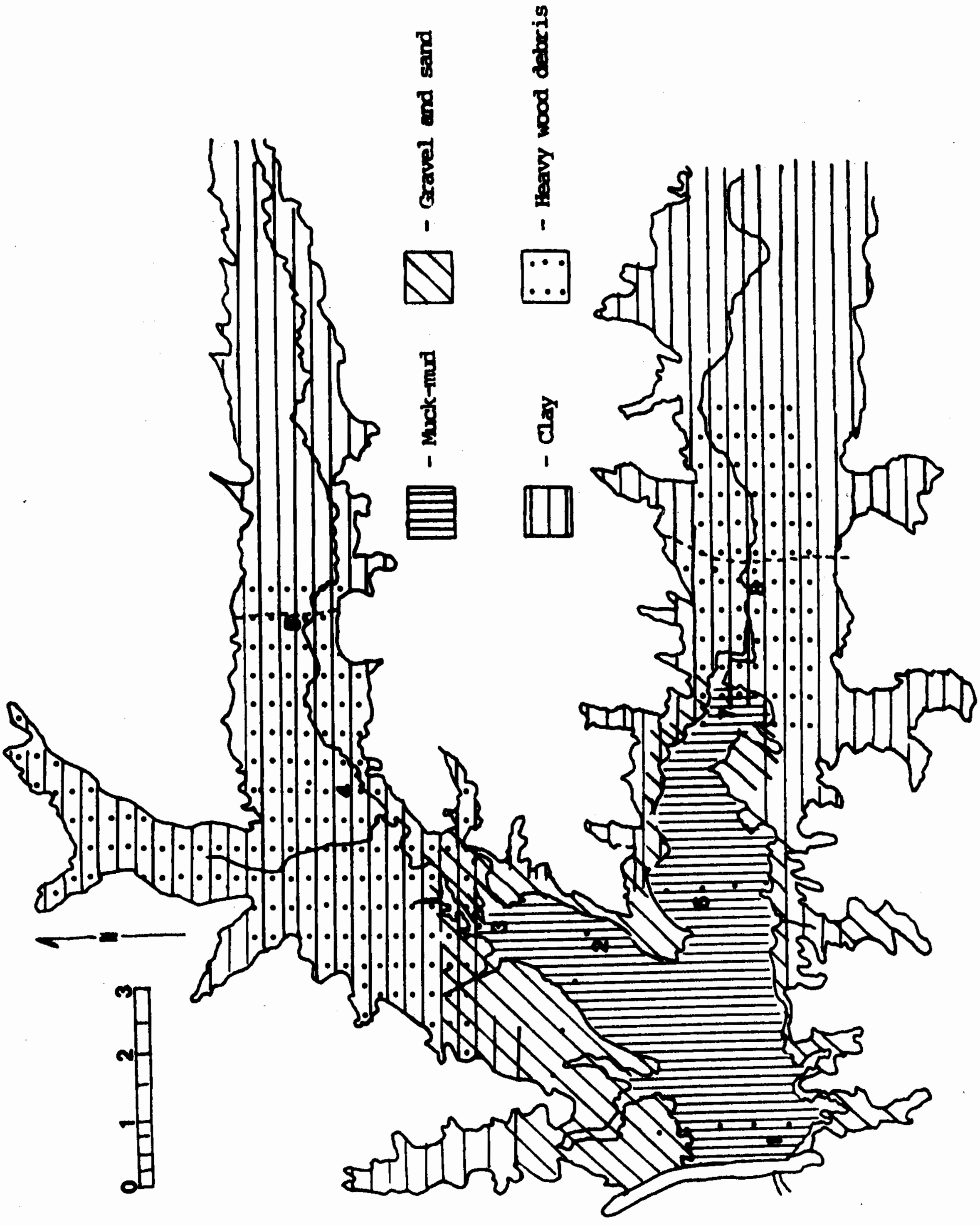


Fig. 2. Grenada Reservoir conservation and flood control pools, showing bottom substrate types.

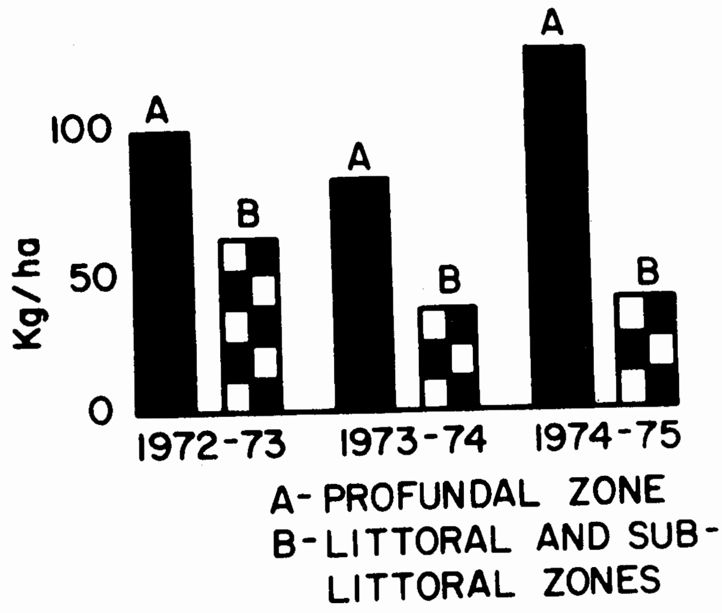


Fig. 3. Comparison of kg/ha of benthic fauna of the littoral and sub-littoral zones and the profundal zone of Grenada Reservoir.

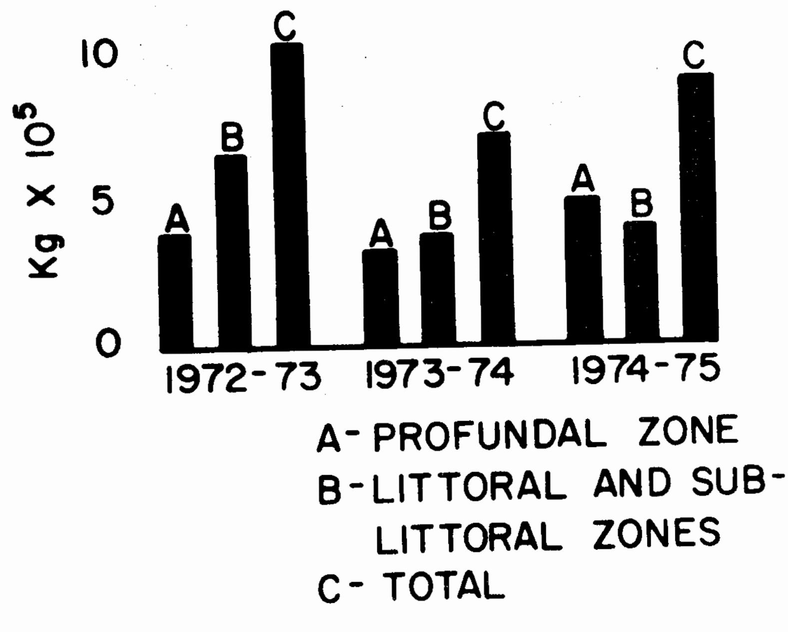


Fig. 4. Comparison of yearly biomass of the benthic fauna for the bottom zones and total biomass of Grenada Reservoir.

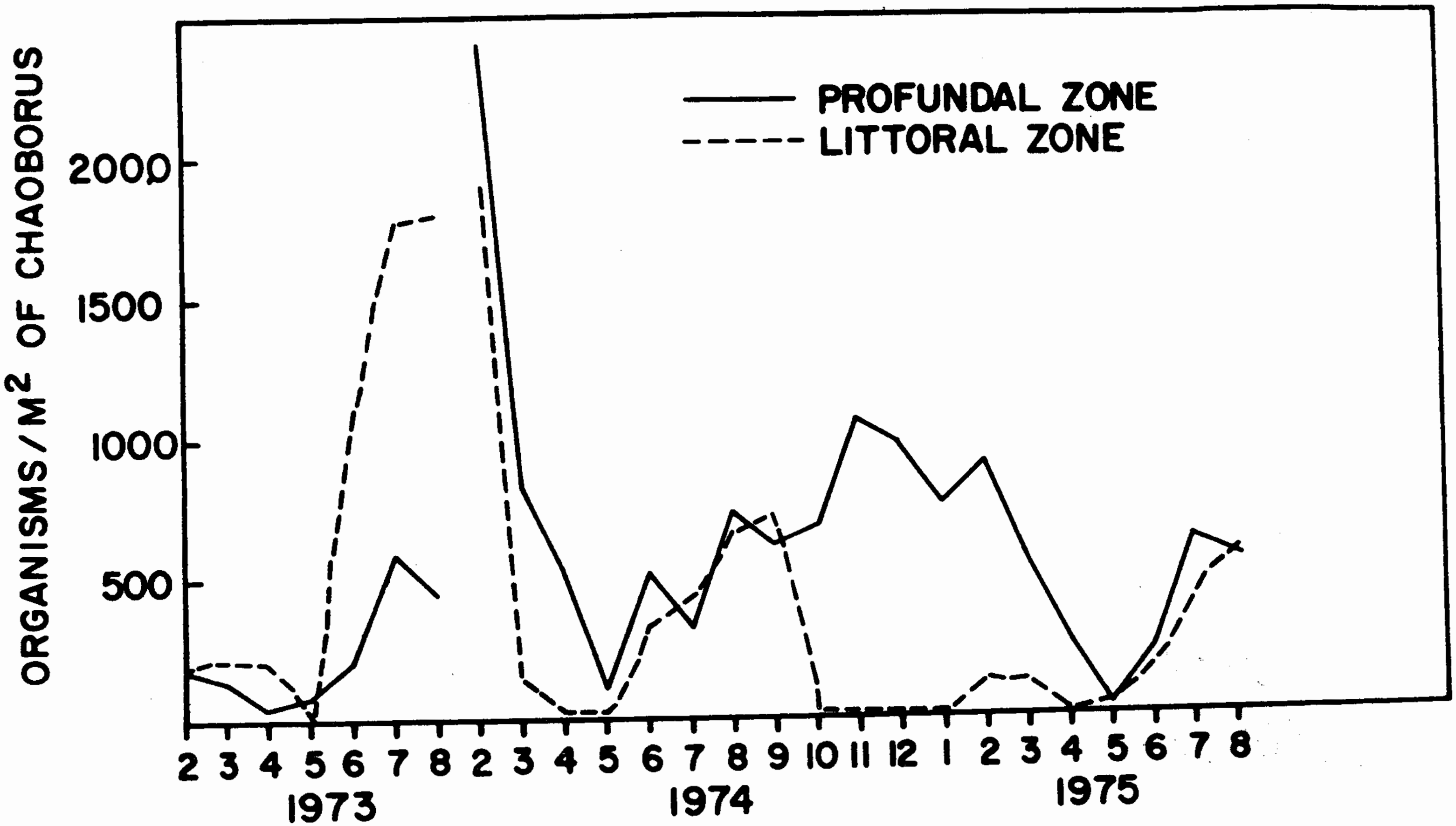


Fig. 5. Occurrence of _Chaoborus punctipennis_ (Say) in littoral and profundal zones of Grenada Reservoir.

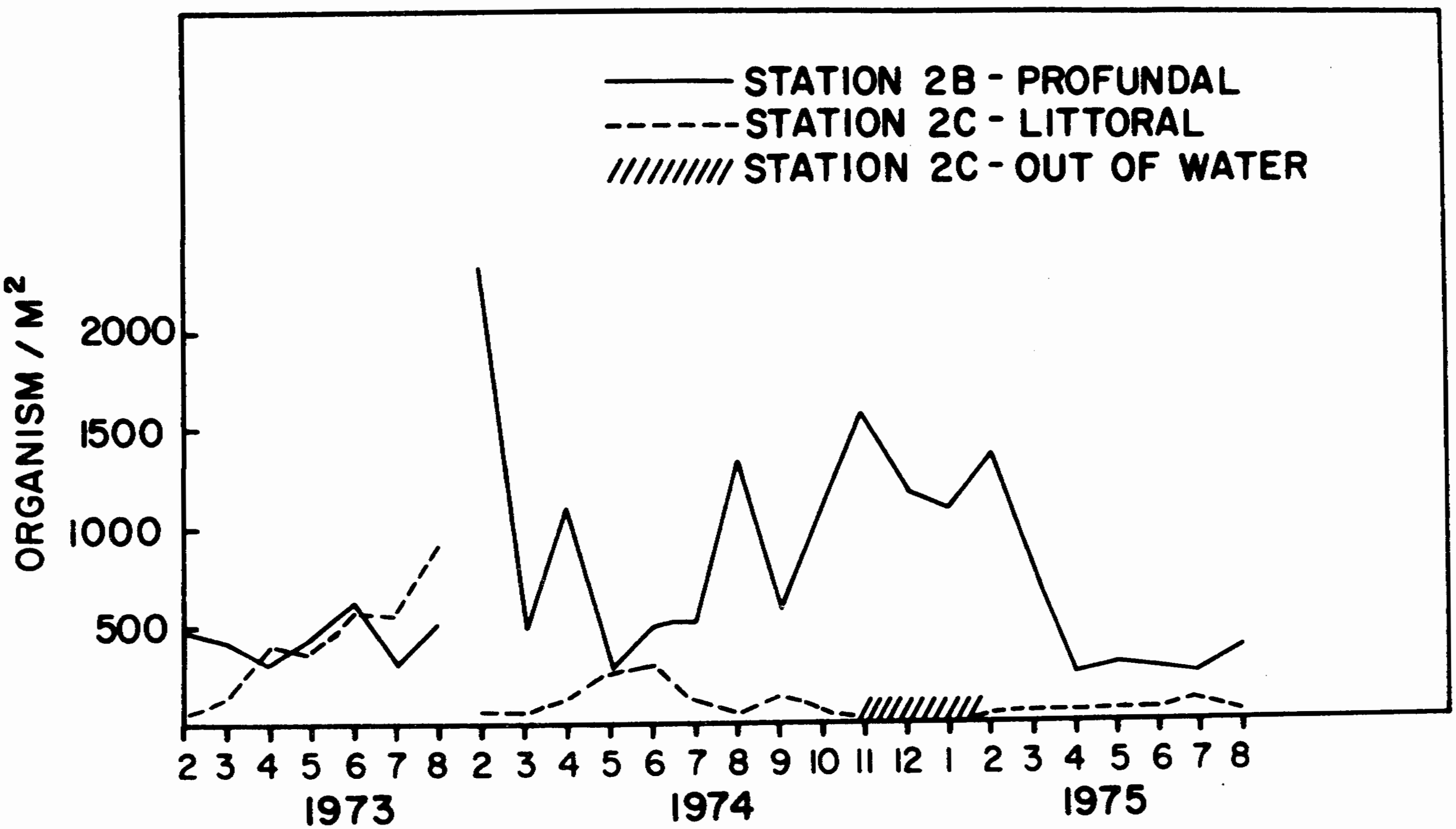


Fig. 6. Comparison of benthos in adjacent littoral and profundal zones (100 m apart) in Grenada Reservoir, MS.

# IMPINGEMENT OF GIZZARD SHAD AND THREADFIN SHAD AT A TVA POWER PLANT

by

Christopher K Bernet and Charles M. Cooper[1]

Department of Biology
University of Mississippi, University, Mississippi 38677

## Abstract

Fishes impinged against vertical water-intake retaining screens at the TVA Allen Steam Plant, Shelby Co., Tennessee, were studied from August 1974 through February 1976. Fishes entrapped by the screens during a 24-hour period each week were sampled. Thirty-nine species entered the catch with gizzard shad, *Dorosoma cepedianum*, and threadfin shad, *Dorosoma petenense*, accounting for 95.0% of the total number impinged. More than 99% of the gizzard shad were young-of-the-year, while no threadfin shad exceeding 175 mm total length were captured. Mass mortality of threadfin shad and gizzard shad occurred during winter months. Each quarter year a 6:00 a.m. and 6:00 p.m. count was taken to ascertain differences in night and daytime catches. Ratios of night to daytime catch densities varied seasonally from 1:1 to 4:1. Numbers of gizzard shad impinged were one to six times greater at night, while the occurrence of threadfin shad was three to 13 times greater at night.

## Introduction

In recent years the Environmental Protection Agency (EPA) has launched an extensive search to locate environmental pollution problems centered around large factories, generating facilities, and other potential polluters of air or water. Throughout the southeastern United States at electric generating facilities large numbers of fishes are collected from vertical water-intake retaining screens (impingement). Recognizing this problem the Division of Forestry, Fisheries, and Wildlife Development of the Tennessee Valley Authority (TVA) has been diligent to meet environmental qualities in accordance with the Federal Water Pollution Control Act, Section 316(b), by initiating studies at facilities where impingement may be constituting an environmental problem.

At the Allen Steam Plant an impact study concerning fish impingement was conducted from August 1974 through February 1976 to identify the species, numbers, and size ranges of fish captured by retaining screens annually. Other impact studies were coordinated by TVA biologists at eleven fossil-fuel plants and one nuclear generating facility (Browns Ferry Nuclear Plant) which comprise the TVA power system. All catch data

1. Currently employed by the U.S.D.A. Soil Sedimentation Laboratory, Oxford, Mississippi, 38655.

have been organized for analysis by a computer program now being developed by TVA biologists (Tomljanovich, personal communication). The computer program will analyze the data for total catch, catch per unit time, and species composition for all sampling stations. Other programs will enable TVA to study previous calculations of growth, fitting of growth models, and analysis of age structure of certain populations of fishes at selected stations (Baker and Schmitz, 1971).

The Allen Steam Plant is located on the south bank of Lake McKellar, Shelby County, Tennessee, approximately 1.5 miles east of the lake's junction with the Mississippi River. Lake McKeller is a typical oxbow lake with fluctuating water levels directly associated with the Mississippi River. The lake bottom is generally composed of coarse sand and mud at the collection site. Due to the frequent occurrence of sand bars throughout the lake, TVA has dredged a channel which extends from the water-intake silo to the lake's main channel to ensure the availability of water coolant for the plant when low water levels exist.

## Method of Study

Water from Lake McKellar enters the Allen Steam Plant through three intake silos. Vertical retaining screens, 12.4 mm mesh, composed of a series of screened panels, 2.5 m x 0.6 m, prevent fishes and debris from entering the water circulators which distribute water to the main powerhouse. Six water circulators pump water through nine retaining screens which are arranged into three sets, with each set of three screens removing fishes from water pumped by no more than two corresponding water circulators. If no circulators were circulating water through a set of screens (during periods of the year when generating demands were minimum), those screens were not sampled for impinged fish.

Fish counts were made each week from August 1974 through February 1976. Since fishes are impinged continuously at the plant, personnel wash the screens as frequently as required under ordinary operating conditions; however, for this investigation, retaining screens were washed 24 hours prior to the sampling period. The count each week consisted of the fish population captured during a 24-hr period. Each quarter year a 6:00 a.m. and 6:00 p.m. count was made to ascertain differences in night and daytime catches. For these counts screens were washed at 6:00 p.m. of the previous day to allow for a 12-hr sample (night catch) instead of a 24-hr count.

To collect the fishes, each vertical traveling screen was rotated for 20 minutes while being backwashed by one or two corresponding water circulators. Fishes and debris were flushed off of the panels and washed into a catch basket installed in the screen wash sluice trench. After collecting the fishes from each screen, they were separated by species, placed into 25 mm length-groups, and weighed. Fishes appearing to be decomposed and/or impinged for more than 24 hours were disregarded from the count.

In order to enumerate large numbers of fish accurately during periods of mass mortality, the sampling method was modified. When more than 500 fish of a species were entrained against a single screen, a subsample of fish was taken at random for only those members less than 150 mm total length. A subsample consisted of approximately 500 individuals which were enumerated, measured, and weighed by the usual procedure. The remainder of specimens from each particular screen was placed into large buckets and weighed. This subsample method allowed for an accurate estimation of the total catch from each sample during mass mortality. Individuals of other species occurring in the catch were processed by the usual method.

## Results

At the Allen Steam Plant members of the Clupeidae were the dominant fishes impinged representing 95.6% of the catch from August 1974 through February 1976. Threadfin shad (Dorosoma petenense) represented 72.1% of the total, while gizzard shad (Dorosoma cepedianum) constituted 22.9%. The skipjack herring (Alosa chrysochloris) was impinged in small numbers (0.6% of the total), although its occurrence was observed each month. The majority of gizzard shad (99%) entrapped were young-of-the-year, while no threadfin shad exceeding 175 mm total length were ever impinged. The majority of threadfin shad captured were 51 to 125 mm total length, however smaller individuals were impinged during May and June 1975 when the catch was predominantly juveniles 26 to 50 mm in length. No fish smaller than 26 mm in length were impinged against the 12.4 mm mesh screens. Impingement of predominantly young fishes and those of small size may be attributed to their preponderance in the population or reduced avoidance to the water-intake because of poor swimming ability.

Although threadfin shad constituted 72.1% (143,043 specimens) of the total catch (202,678 fish) for 88 regular sampling periods, 139,585 (97.9%) were entrapped during January and February 1976. This mortality rate may be attributed to cold water temperatures and cold shocks associated with these months. Impingement rates were greatest from January 16-23, 1976, when more than one million fish were estimated from daily impingement samples. Water temperatures during mass mortality of threadfin shad averaged 4.9 C, ranging from 4.4 to 8.9 C. Mortality did not occur immediately at these temperatures. After a prolonged period of susceptibility to cold temperatures, threadfin shad were not able to overcome the induced stress from severe environmental conditions, and their ability to avoid impingement was inhibited. No specimens of threadfin shad were captured in August 1974, and only one was impinged in July 1975. This seasonal absence from catches was also recognized at several other TVA plants (Griffith and Tomljanovich, 1975).

## Results of Night and Daytime Counts

In 1968 a population study concerning night and daytime densities of fishes in Beaver Reservoir was conducted by Netsch et al. (1971). They reported that nighttime catch rates were 5 to 110 times greater than daytime rates, but the relative vertical distribution patterns were generally similar in the same area regardless of time. The number of threadfin shad, as well as gizzard shad were consistently greater at night than in the daytime in Beaver Reservoir. Mean gizzard shad densities at night were 5 to 18 times greater respectively in June and July, and night catches of threadfin shad were 11 to 110 times greater. Mean lengths of members from both species captured at night were greater.

Catch rates at the Allen Steam Plant were greater in the 6:00 a.m. sample (night catch) for all six night-daytime test periods (Table 1). Ratios of the total number of fishes in the night catch to those of daytime samples varied from 1:1 to 4:1. There was a seasonal variation of these ratios. Catch rates were similar for the test periods of January, February, and March, but catch rates of other sampling periods varied from a 2:1 to 4:1 ratio. There was no evidence of species diversity changing from night to daytime catches or of size range differences.

Numbers of gizzard shad impinged at night were one to six times greater than those of the daytime. Threadfin shad were entrapped three to 13 times greater at night for five of six sampling periods. In March 1975 a greater number was collected during the daytime sample. No size differences were observed in association with night and daytime catches for individuals of either species.

## Discussion

### The Gizzard Shad- -Dorosoma cepedianum.

Populations of gizzard shad impinged peaked during autumn and winter months of each year. The first peak occurred during October 1974 when 2,861 were entrained, and a second peak was observed during February 1975 when 4,314 were captured. After February, numbers decreased each month until June 1975 and remained fairly consistent (100-150 individuals/test period) until September and October 1975 (Figure 1). The number of impinged gizzard shad in September 1974 reached a level almost identical to that which occurred in August 1974. An increase of monthly totals began in September 1975 (Figure 1) which correllated favorably with an increase observed during the same month of 1974. The largest numbers of gizzard shad captured during this study was the November 1975 collection when 14,876 specimens were entrained during four sampling periods. Water temperatures during the months of peak abundance were at/or approaching a minimum each consecutive period. Decreasing water temperature was probably an important factor influencing the occurrence of large numbers in the catches. Migratory movements were also observed during these months as large schools of young-of-the-year were often seen near the surface.

The second peak of impinged gizzard shad during February 1975 (4,314 specimens) was associated with the appearance of an obligate cytozoic microsporidian, Plistophora cepedianae, as well as with the decreasing water temperatures. About 95% of the young-of-the-year were parasitized during February 1975, but a year later very few individuals showed infection, although a fourth peak of impinged fish was occurring toward the latter part of the month. The parasite, which is host specific for young-of-the-year gizzard shad, was not evident from April 1975 through February 1976, although it does apparently cause mass mortalities during winter months along certain sections of the Mississippi River each year.

Very few gizzard shad exceeding 150 mm total length were impinged. More than 95% of the impinged population were young-of-the-year ranging from 26 to 125 mm long. Impingement of large numbers at the Allen Steam Plant may or may not be detrimental to other fishes which are predaceous upon these young. With the occurrence of 4,314 specimens during February 1975 showing a high rate of parasitism, the weaker fish may be eliminated from the population by impingement, thus strengthening the year class. Representatives exceeding 300 mm total length were rarely captured. Adults inhabit deeper waters and remain in the main river channel throughout much of the year. Young-of-the-year leave the shallow waters of Lake McKellar and the inlet channel with rising water temperatures and return during winter months. Thinning of the population of gizzard shad by impingement probably does not affect the numerical density or the year class strength in waters near the plant.

The Threadfin Shad- -Dorosoma petenense.

Threadfin shad have long been known to exhibit high mortality rates when exposed to rapidly changing water temperatures. Parsons and Kimsey (1954) concluded that stable water temperature was an important environmental factor for survival of shad. When introduced into Tennessee reservoirs greatest survival rates occur when water temperatures are maintained between 10 and 16 C, and highest mortality rates occur when water temperatures are below 8 C. Shell and Shelton (personal communication, 1976) mentioned that threadfin shad in rearing ponds at Auburn University exhibited mass mortality during 1975 when water temperatures were near 42 F (7.6 C).

At Browns Ferry Nuclear Plant an annual cyclic pattern of mortality occurred during 1975 with the primary factors being yearly temperature changes and the size range of the fish impinged. The death rate there is greatest in February and March during cold weather, but large numbers are also found impinged during the summer months following the spawning season when the size range of the fish is very small (Griffith and Tomjlanovich, 1975).

At the Allen Steam Plant an annual cyclic mortality pattern also occurred with cold water temperatures being the primary causal factor. In 1975 and 1976 the highest rates of impingement occurred during January and February, with mass mortality occurring in 1976. The rate of impingement for threadfin shad in 1976 was more than 100 times that of 1975.

Threadfin shad were not found during August 1974, the initial month of the study, and few specimens were captured during September and October of 1974. Not until January 1975 did threadfin shad constitute a major portion of the catch representing 15.2%, while gizzard shad were dominant species representing 84.5%.

Threadfin shad populations peaked in February 1975 when 1,270 specimens constituted 21.0% of the monthly catch. Gizzard shad, however, were still dominant representing 71.5%. Numbers of threadfin shad, as well as gizzard shad, decreased for the next few months with threadfin shad virtually disappearing from the collection in June 1975. Only one specimen was impinged in July 1975, and it should be mentioned that during August 1974, the initial month of the investigation, there were no threadfin shad collected. Since threadfin shad were absent during the summer months of July and August of both years, they may migrate from Lake McKellar during summer months and return to the lake during winter months at which time they become extremely vulnerable to impingement.

The second peak occurred during January 1976 when 126,500 specimens were entrapped during six sampling periods. On January 16, 1976, a large number of threadfin shad was impinged and the total number was calculated from subsamples. As shown in Figure 2, the greatest abundance of fish appeared January 20 when 67,398 were captured during a 16-hour test period (instead of a 24-hour period). A fluctuation in numbers occurred during the month of January with a reduction toward the middle of February. The total number of threadfin shad impinged each week from January 2 through February 27, 1976, is shown in Figure 2.

Biologists of the TVA, realizing that millions of shad were being impinged during January 1976, made arrangements for personnel at the plant to keep records of the number of large collecting baskets that were filled with fishes during this period of mass mortality. Records taken from January 19 through February 4 of that year showed that 25 large baskets of fishes were collected. Subsamples of fishes impinged on January 20 indicated that one basket of fishes weighed 550,500 grams, and the mean weight per fish taken from the subsample was 14.1 grams. Calculations from these data indicate that a single basket contained approximately 39,000 fish; therefore, during a continuous period from January 19 through February 4, nearly one million fish were impinged against retainer screens. The highest rate of impingement, according to records kept by plant personnel, occurred from January 19 to 22, when 430,000 fish were estimated from a three day catch. These approximations require further consideration since segregation to species was not made, and although the population of fishes was predominantly threadfin shad making up more than 99% of the entire catch, the few larger fish would alter the mean to some extent.

The estimated total annual impingement for other TVA power facilities during 1975 range from 13,000 to 4,900,000. Impingement studies at five facilities (Kingston, John Sevier, Johnsonville, Paradise, and Allen Plants) indicated that 90.5 - 99.9% of the threadfin shad were impinged when intake water temperatures were below 10 C. At these plants the majority of impingement occurred within a few sampling periods. At three other facilities (Bull Run, Watts Bar, and Shawnee Plants) nearly 50% of the impinged threadfin shad population appeared during or shortly after periods of cold shocks. Only two plants (Cumberland and Gallatin) showed the greatest impingement rates during other seasons when water temperatures exceeded 20 C. Laboratory studies at Browns Ferry Nuclear Plant by TVA biologists and researchers from the Oak Ridge National Laboratory have indicated that increased entrapment and mortality has occurred from induced stress upon the fish when water temperatures were below 12 C. The shad also had difficulty avoiding impingement in a test flume when water temperatures were below 8 C. (Griffith and Tomljanovich, 1975).

The extent to which threadfin shad were impinged at the Allen Steam Plant can be associated with water temperatures of winter months, but to report that cold water temperature is the only causal agent for the death of this fish seems to be an oversimplification. Water temperature is a very important factor in an aquatic community and has many direct and indirect relationships. Although the composition of air is about 20.9% oxygen and 79.1% nitrogen, the amount of air that can be dissolved in water is 34.91% oxygen and 65.09% nitrogen (Welch, 1952). As water becomes cooler, the amount of dissolved oxygen, as well as certain other gases, increases, and a sudden change in the gaseous relationships of the water may be responsible for the environmental stress which threadfin shad exhibit following periods of cold shocks.

Mass mortality of threadfin shad occurred at the Allen Steam Plant when water temperatures varied from 4.4 to 5.6 C (40 to 42 F), although total mortality did not occur immediately at these temperatures. With a sudden decrease in temperature threadfin shad went into some form of induced stress probably caused by a change in the gaseous relationships which were related to the temperature change. After several weeks of susceptibility to cold temperatures, threadfin shad were no longer able to avoid intake currents and impingement was nearly total for threadfin shad in the area. The schooling behavior of shad (Miller, 1967) could be responsible for large numbers impinged during certain seasons of the year, but cold shocks have been shown to cause high mortality rates at other generating facilities (Griffith and Tomljanovich, 1975). The dredged channel extending from the main channel of Lake McKellar into the intake silos of the Allen Steam Plant may blso be serving as underwater structure which schools of shad follow directly into the entrainment area during seasonal migrations.

## Tables and Figures

Table 1. Results of Night and Daytime Fish Counts (6:00 a.m./6:00 p.m.).

| | Gizzard Shad | | Threadfin Shad | |
|---|---|---|---|---|
| | a.m. | p.m. | a.m. | p.m. |
| 1/01/74 | 13 | 10 | 3 | 1 |
| 3/07/75 | 317 | 255 | 66 | 102 |
| 5/23/75 | 12 | 2 | 75 | 19 |
| 8/15/75 | 9 | 3 | 9 | 2 |
| 11/14/75 | 399 | 186 | 13 | 1 |
| 2/13/76 | 1246 | 763 | 1004 | 822 |

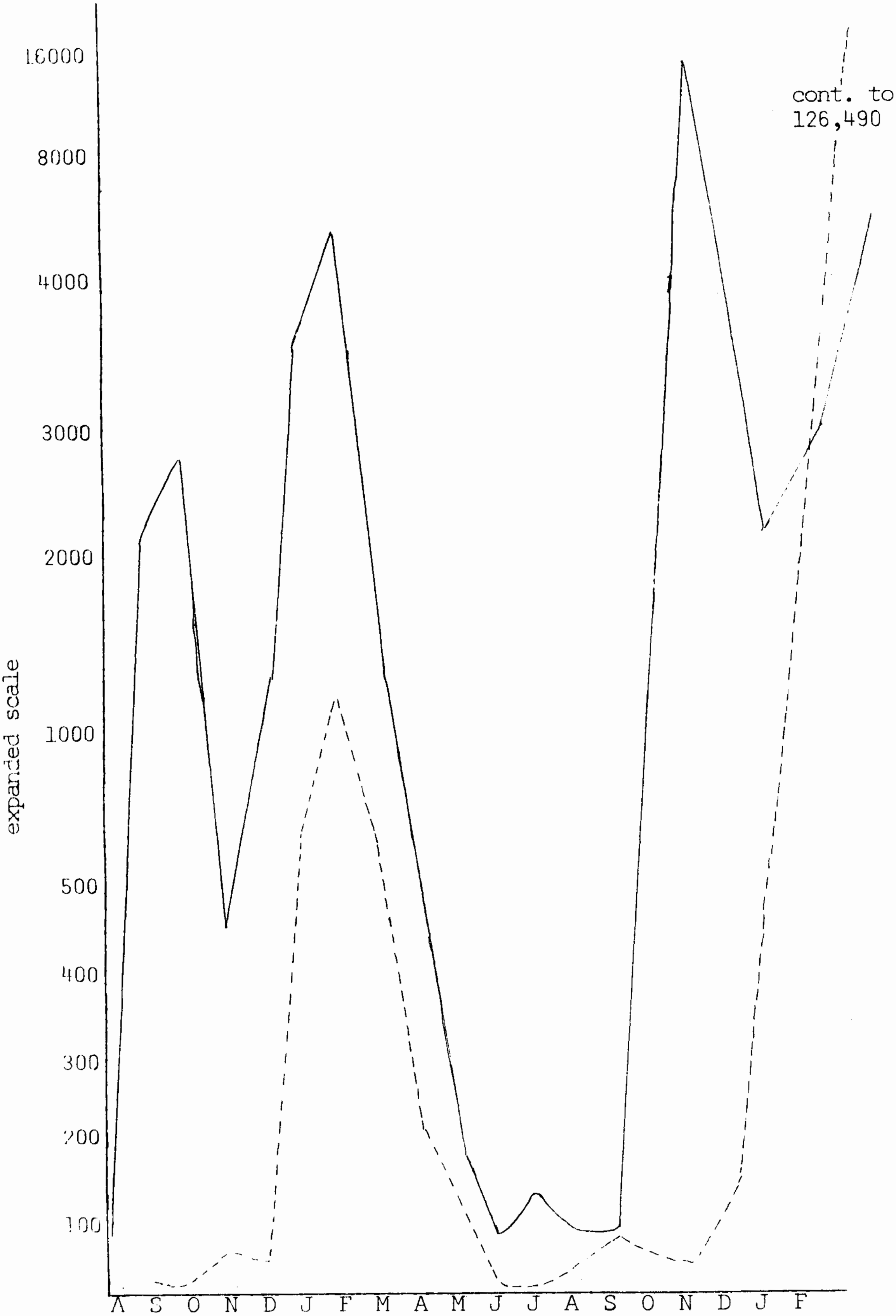


Figure 1. Numbers of shad impinged from August 1974 through February 1976.
Gizzard shad -----
Threadfin shad ———

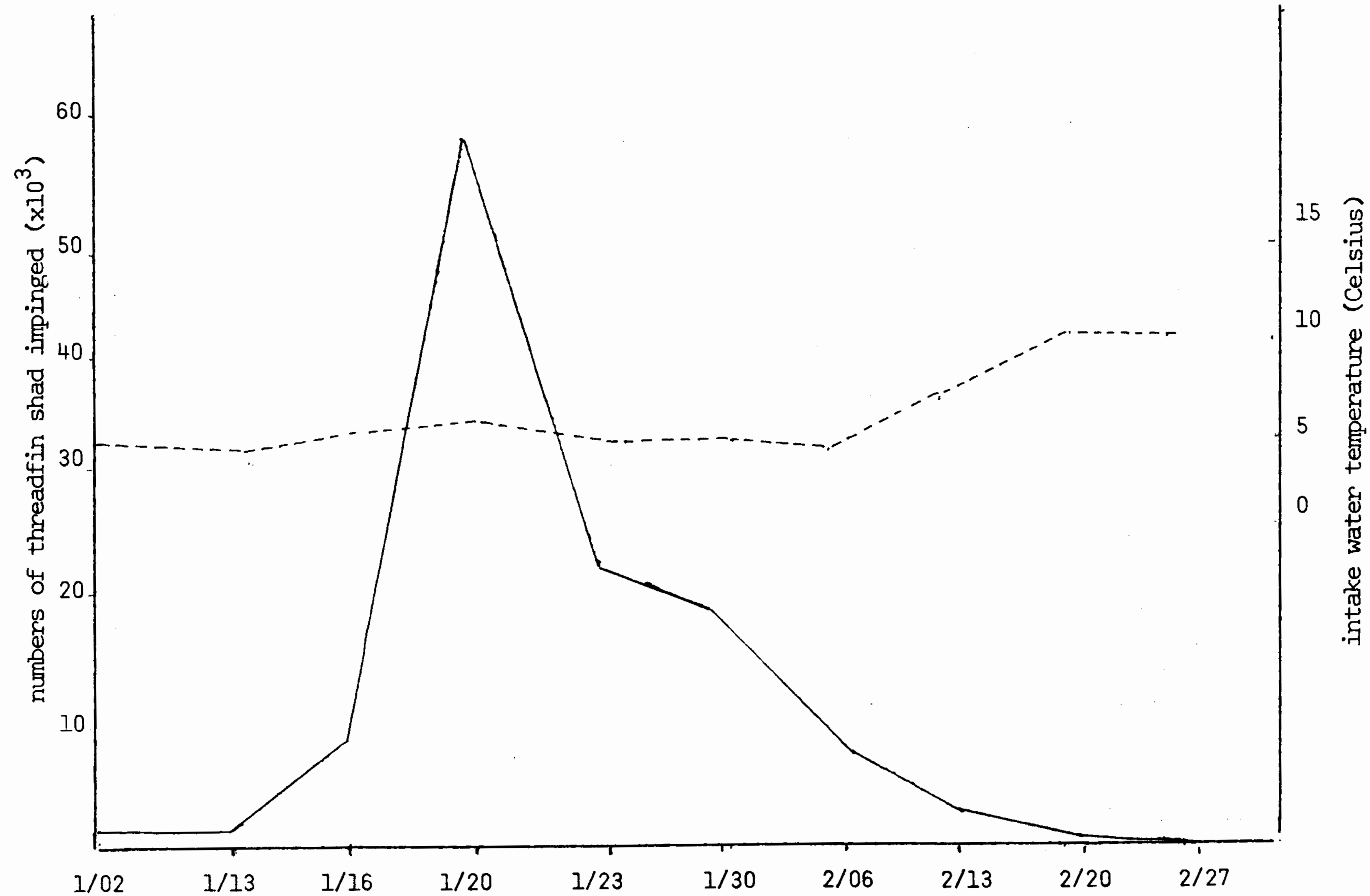


Figure 2. Numbers of threadfin shad impinged from January 2, 1976, through February 27, 1976, in relation to intake water temperature at the Allen Steam Plant.

## Literature Cited


Griffith, J. S., and D. A. Tomljanovich. 1975. Susceptibility of Threadfin Shad to Impingement. Pro. Southeastern Assoc. Game and Fish Commissioners. 29:223-234.

Miller, R. R. 1960. The Systematics and Biology of the Gizzard Shad and Related Fishes. U. S. Fish and Wildlife Fish. Bull. 60:371-392.

Netsch, N. F., G. M. Kersh, Jr., A. Houser, and R. V. Kilambi. 1971. Distribution of Young Gizzard Shad and Threadfin Shad in Beaver Reservoir. In Reservoir Fisheries and Limnology. Edited by G. E. Hall. spec. pub. no. 6, Am. Fish. Soc., Washington, 425 p.

Parsons, J. W., and J. B. Kimsey. 1954. A Report on the Mississippi Threadfin Shad. Prog. Fish. Cult. 16(4):179-181.

Welch, P. S. 1952. Limnology. 2nd ed. McGraw Hill Book Co., New York, 538 p.

# CATFISH FARMING

1977

by

Allen S. Dearing

Sunflower Catfish Farm, Inc.

Anguilla, Mississippi

Sunflower Catfish Farm is located in the Mississippi Delta. We have 350 acres of food fish production and 30 acres of fingerling ponds. Fingerling ponds range in size from 5 to 7 acres and food fish ponds are 15 to 40 acres in size. The ponds average 3½ feet deep.

Channel Catfish, Ictalurus punctatus, in our area spawn around the first of May when water temperature reaches 70° F. In March we stock two males to three females into our broodfish ponds. The fish are 4 to 10 pounds in size, and females will produce two thousand eggs per pound of body weight. Fish are allowed to mate at random in the ponds.

During spawning season we check spawning containers every two days and remove any spawns found. Spawns are placed in hatching troughs, where a paddle wheel is used to simulate the actions of the male during incubation. The eggs hatch in seven days at 75° F. and the sac fry collect in the corners of the hatching vats. The sac fry are then moved to feed out vats. The yolk sac is absorbed in three days and the fry are then fed every two hours. At the end of two weeks the fry are stocked into ponds at 50,000 to 250,000 head per acre. We can produce 2,500 pounds of fingerlings per acre.

The major problems in fingerling production are predators, diseases, and parasites. Fish predators are controlled by draining the ponds and poisoning them with rotenone before stocking. Insects are controlled by spraying diesel fuel and oil on the ponds once a week for four treatments after stocking. Fingerlings are sampled weekly to check for parasites and diseases. Special attention is always paid to the feeding activities of fingerlings to try to detect any disease symptoms as early as possible.

Fingerlings are fed four times daily at 1½ per cent of their body weight each feeding. When the fingerlings reach an adequate size, they are graded to obtain uniform size fingerlings for stocking. By stocking 40 pounds to 100 pounds per thousand (4 to 6 inches) fingerlings by May, we can produce salable size fish by September. Ponds are stocked at the rate of 3,000 to 5,000 head per acre and fish are harvested at 1 to 1½ pound size.

Floating feed is normally used due to the better possibilities for management. Blower type feeders are used to distribute the feed down the upwind side of the ponds. Fish are fed 3 per cent daily.

The major problem with food fish production is oxygen. Oxygen is checked at daybreak and again at noon each day. Channel Catfish are under stress at 3ppm of oxygen and are gasping for air at 1ppm. When an oxygen problem develops, the main objective is to keep the fish alive until the pond can correct itself. This can be done by running wells or using pumps to aerate the water.

The main vegetation problems are with Blue-green Algae, Pitophora, and Najas in our area. Chemical controls are very costly and not many are cleared to use on food fish. Mechanical control is impractical. Biological control seems to be the best answer for the future.

Harvesting has become highly mechanized with seine haulers, live cars, and mechanical loaders being used commonly. It is becoming less common for ponds to be drained for complete harvest due to high pumping and man power cost. The main market for fish in our area is processing plants. Outside our area the main markets are catch out lakes and local consumers.