TABLE XII. Monthly Catch Rates by Lakes

Month	Eufaula Catch raise	Eufaula Net night	Gibson Catch raise	Gibson Net night	Grand Catch raise	Grand Net night	Texoma Catch raise	Texoma Net night
July	23.9	1.1	144.7	3.1	145.6	4.2	84.0	2.7
August	38.5	0.7	115.9	3.5	179.7	3.7	66.1	2.1
September	57.8	0.8	146.3	2.5	190.1	3.5	170.8	5.0
October	202.9	2.6	145.6	2.5	142.1	3.1	98.4	4.0
November	119.5	2.1	90.1	1.9	111.6	1.9	208.6	6.3
December	55.1	1.2	174.6	1.4	152.4	2.0	157.8	2.8
January	42.6	1.2	76.4	2.1	204.5	1.0	...	...
February	122.0	2.2	160.0	3.6	137.8	4.8	238.3	2.5
March	116.1	2.1	245.1	1.9	643.3	3.2	447.2	7.0
April	165.9	2.8	222.0	4.3	....	..	333.9	6.9
May	115.1	5.1	179.3	6.6	461.9	7.7	284.7	7.3
June	82.2	3.5	210.0	4.2	108.2	4.1	192.3	8.7

TABLE XIII. Average Weights with 95 Percent Confidence Limits of Fish Caught in the Oklahoma Commercial Fishery

Species	Grand	Gibson	Eufaula	Texoma
Buffalo	4.3±0.1	3.9±0.1	4.0±0.4	7.0±0.2
Flathead catfish	6.7±0.8	6.6±0.5	8.3±0.4	9.2±1.1
Carp	4.3±0.2	3.8±0.2	2.8±0.6	6.7±0.2
Carpsucker	2.6±0.1	2.8±0.1	3.0±0.2	3.1±0.1
Paddlefish	....	26.4±1.3	....	....

A GROWTH STUDY OF REDBREAST, Lepomis auritus (Gunther), AND BLUEGILL, Lepomis machrochirus (Rafinesque), POPULATIONS IN A THERMALLY INFLUENCED LAKE

By ROBERT STEPHEN O'REAR *

B.S., The University of Georgia, 1968

ABSTRACT

Bluegill and redbreast populations were sampled by electric shocking techniques from two normal areas and an area affected by the heated discharge of a power generation plant at Lake Sinclair, Georgia. Growth of the fish was derived by the Lea method from measurements of the distance between the last formed annulus to the edge of the scale. By comparison of the study areas, temperature was found not to be the controlling factor of bluegill and redbreast growth in the discharge area.

INTRODUCTION

The purpose of this study was to determine whether thermal increases caused by discharges from a power generation plant affects growth

* A thesis submitted to the graduate faculty of the University of Georgia in partial fulfillment of the requirements for the degree of Master of Science in Forestry, Athens, Georgia, 1970.

rates in free living bluegill and redbreast populations. Fish are poikilothermic, and it is generally accepted that growth of these animals is controlled by temperature. Very little has been done though to determine whether growth in motile populations of fish is affected by thermal discharges.

ACKNOWLEDGMENTS

I wish to acknowledge with special thanks the guidance, suggestions, inspiration, and help with the field work provided by Dr. Melvin T. Huish. Appreciation is also expressed to Mr. James Clugston, Assistant Unit Leader of the University of Georgia Co-operative Fishery Unit, for his help with the field work and for supplying a fish shocking boat and other equipment. Another shocking boat and operator were supplied by the Georgia Game and Fish Commission and are gratefully acknowledged. Thanks are expressed to the Georgia Power Company for the use of Lake Sinclair and for supplying data on their electric power generating plant at that location.

Financial assistance was provided by the University of Georgia in the form of a fellowship which helped to make this work possible.

STUDY AREA

Lake Sinclair is a 15,350 acre reservoir located in the piedmont region of central Georgia. The lake was constructed by the Georgia Power Company on the Oconee River to supply water for the steam generation of electricity. Average temperature rise through the condensers is approximately 17°F over the ambient according to information supplied by the Georgia Power Company. A map showing the general extent of the thermally influenced area is given on page 5. Monthly temperatures were recorded at several stations also shown on this map. Graphs showing the monthly temperatures at these stations are given on pages 7 and 8.

Three sites were selected from which to sample fish. One was in the outflow basin of the power plant; the others were in areas unaffected by the thermal discharge. The sample areas were at least a mile and a half apart by water. Three thousand six hundred feet of shore line were sampled in the discharge area. One of the unaffected sample areas was located at the water intake point for the plant. Five thousand seven hundred feet of shore line were sampled here. Two coves were selected as the third sample location. Their total shore line was three thousand four hundred feet. All of the sample areas had soft clay bottoms sparsely covered with rooted vegetation. Trees surrounded all the shore line of the sample areas except the one affected by thermal discharge. In this area about half the shore had trees. A map showing the location of the sample areas in relation to the power plant is given on page 6.

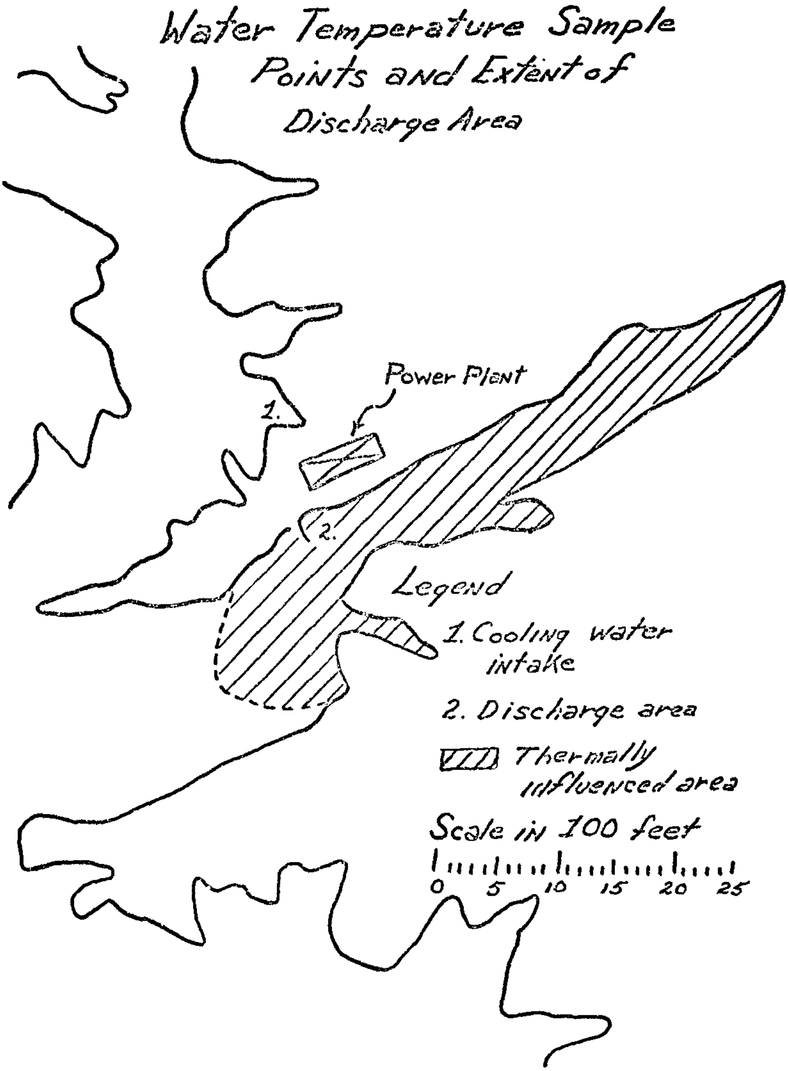
METHODS

Fish were sampled by electric shocking on June 4 and June 10, 1969. According to Starrett and Barnichol (1955) this is a good sampling technique for sunfish. Bennett and Brown (1968) have found no significant difference in the catch of bluegill with regard to time of day when using electrofishing techniques. Therefore, time of day was assumed not to affect the fish sampling.

It was assumed that annulus formation occurred in the fish scales when the fish stopped feeding in the fall when the water temperature dropped. Growth increments were measured from the time of the last annulus formation to the time the samples were taken to determine the effect of the thermal discharge. Total lengths of the fish would not be satisfactory for this study since redbreast and bluegill may spawn several times in one season and their total lengths may depend on the time of hatching.

Growth as measured between the annuli on a scale was considered not to be valid in this study. From the temperature data provided by the

Figure 1.



Georgia Power Company (pages 7 and 8), the water temperatures in the summer in the discharge basin was above the tolerance limits for the fish studied. For example, for bluegill acclimated to an 86°F temperature the LD_{50}, the maximum water temperatures survived by 50% of the animals, has been determined to be 96.9°F for 24 hours (Anon., 1962) (in September, 1968, the water temperature in the heated area was 100.5°F). The fish sampled in the discharge area were assumed to have moved there following the decline of the lethal summer temperatures or to have been spawned there following the temperature drop.

The bulk of the fish sampled had formed one annulus. Relatively few had developed more than one. For this reason the fish were separated by year class. Analysis of variance techniques were used to compare these groups. Age-growth tables (pages 13 and 14) were constructed to show the past history of fish from each area. From an inspection of these tables, it was concluded that the fish in the discharge area were from average growing stock as their rate of growth was neither consistently faster nor slower than fish from the other areas.

RESULTS

Redbreast populations from the thermally influenced sample area did not show increased growth over other areas. Growth increments in centimeters for the fish with one annulus (the 1968 year class) were 3.2 for the heated area, 3.1 for the intake area, and 3.8 for the coves. Eighty-two fish were taken from the discharge area, 79 fish from the intake area, and 50 fish from the coves. The growth increments were significantly different at the 5% level with a F-value of 11.7.

Growth increments in centimeters for the redbreast with two annuli (the 1967 year class) were found not to be significantly different with a F-value of .4. The 8 fish from the thermally influenced area had a growth increment of 2.0. The 3 fish from the intake area had a growth increment of 2.3, and the one from the coves had an increase of 1.7.

The bluegill populations from the thermally influenced area, with the exception of fish with two annuli, did not show increased growth over the other areas. Growth increments in centimeters for the fish with one annulus (the 1968 year class) were 3.0 for the heated area, 2.5 for the plant intake, and 3.1 for the coves. A hundred and thirty-eight fish were sampled from the discharge area, 127 from the intake area, and 50 from the coves. The growth increments were found to be significantly different at the 5% level with a F-value of 14.7.

Growth increments in centimeters for fish with two annuli were also found to be significantly different at the 5% level with a F-value of 3.7. The growth increment for the 19 fish from the heated area was 2.7. For the 39 fish from the plant intake area, the growth increment was 2.2, and for the fish from the coves, the growth increment was 2.4.

DISCUSSION AND CONCLUSIONS

For both species growth of fish with one annulus was greater in those from the coves. For the redbreast with two annuli, growth was not significantly different between areas. Bluegill with two annuli from the heated area outgrow the other areas. This may not be a valid difference as the sample size of this year class was small. No bluegill with three annuli were found in the discharge area, so comparison of this age class was not possible.

Roush (1968) obtained similar results for bluegill from a thermally influenced Missouri lake. He found no measurable increase in the monthly growth increment of small centrarchid fish from the heated area.

Others factors or combinations of factors may be more important in controlling fish growth in motile populations than temperature alone. Variation in factors such as amount of food, water quality, species present, and amount of cover could be more limiting than temperature.

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TABLE 1. Standard Lengths and Growth Increments of Redbreast From Each Sample Area by Year Class

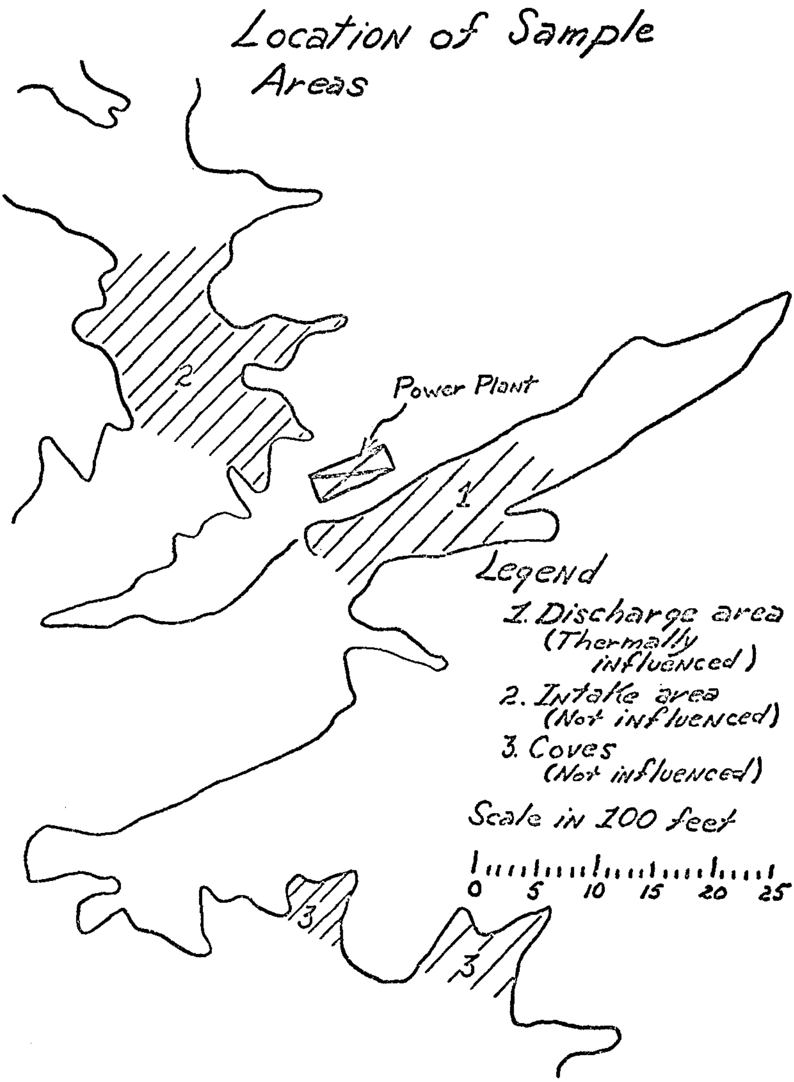
Area	Year Class	Number of Observations	Standard Length in Centimeters at Time of Sample	Growth Increment	Standard Lengths in Centimeters at Time of Annulus Formation		
					1	2	3
Plant Discharge	1968	82	5.3	*3.2	2.1	..	..
(Thermally influenced	1967	8	6.1	2.0	2.8	4.1	..
Plant Intake	1868	79	6.4	*3.1	3.3	..	..
(Not thermally influenced)	1967	3	8.7	2.3	2.2	6.4	..
Coves	1968	50	6.3	*3.8	2.5	..	..
(Not thermally influenced)	1967	1	6.9	1.7	3.6	5.2	..

TABLE 2. Standard Lengths and Growth Increments of Bluegill From Each Sample Area by Year Class

Area	Year Class	Number of Observations	Standard Length in Centimeters at Time of Sample	Growth Increment	Standard Lengths in Centimeters at Time of Annulus Formation		
					1	2	3
Plant Discharge	1968	138	5.4	*3.0	2.4	..	..
(Thermally influenced)	1967	19	8.3	*2.7	2.9	5.6	..
Plant Intake	1968	127	5.5	*2.5	3.0	..	..
(Not Thermally Influenced)	1967	39	8.0	*2.2	2.7	5.7	..
	1966	11	9.6	...	2.6	5.0	8.0
Coves	1968	50	5.5	*3.1	2.4	..	..
(Not Thermally Influenced)	1967	10	7.1	*2.4	2.8	4.7	..
	1966	4	8.8	...	2.8	4.8	7.6

* Significantly different at the 5% level.

Figure 2.



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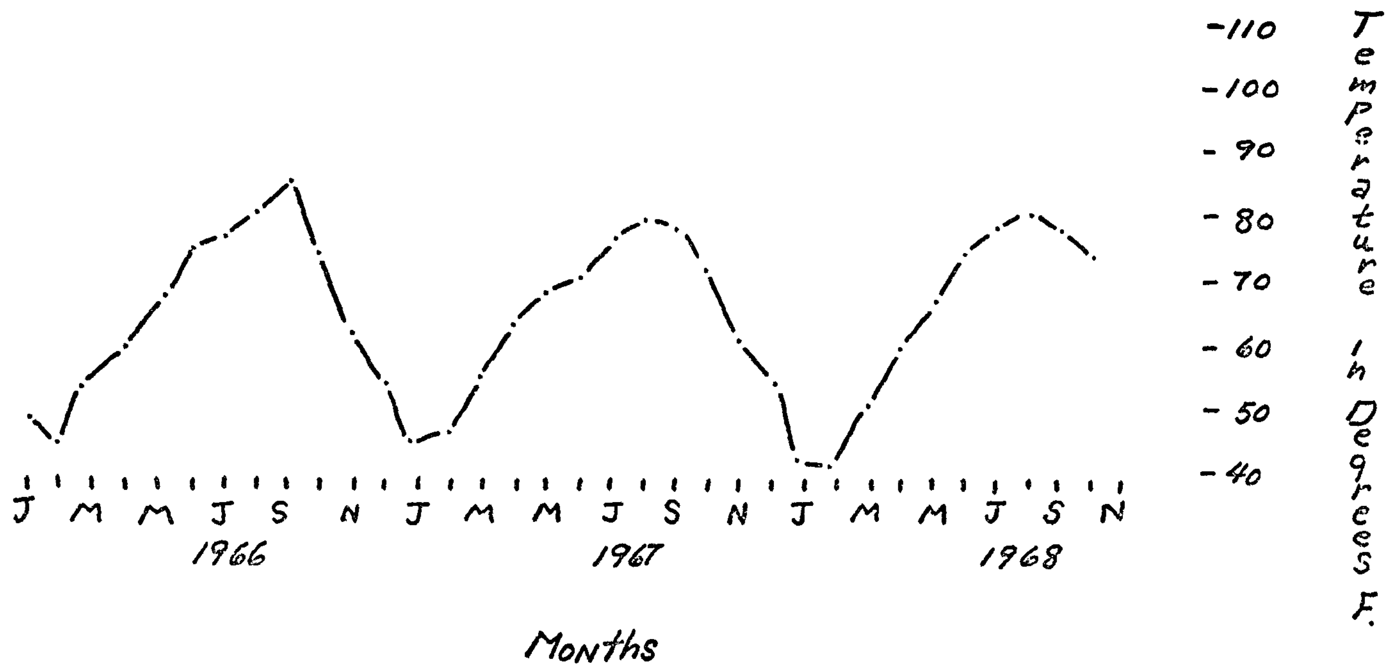
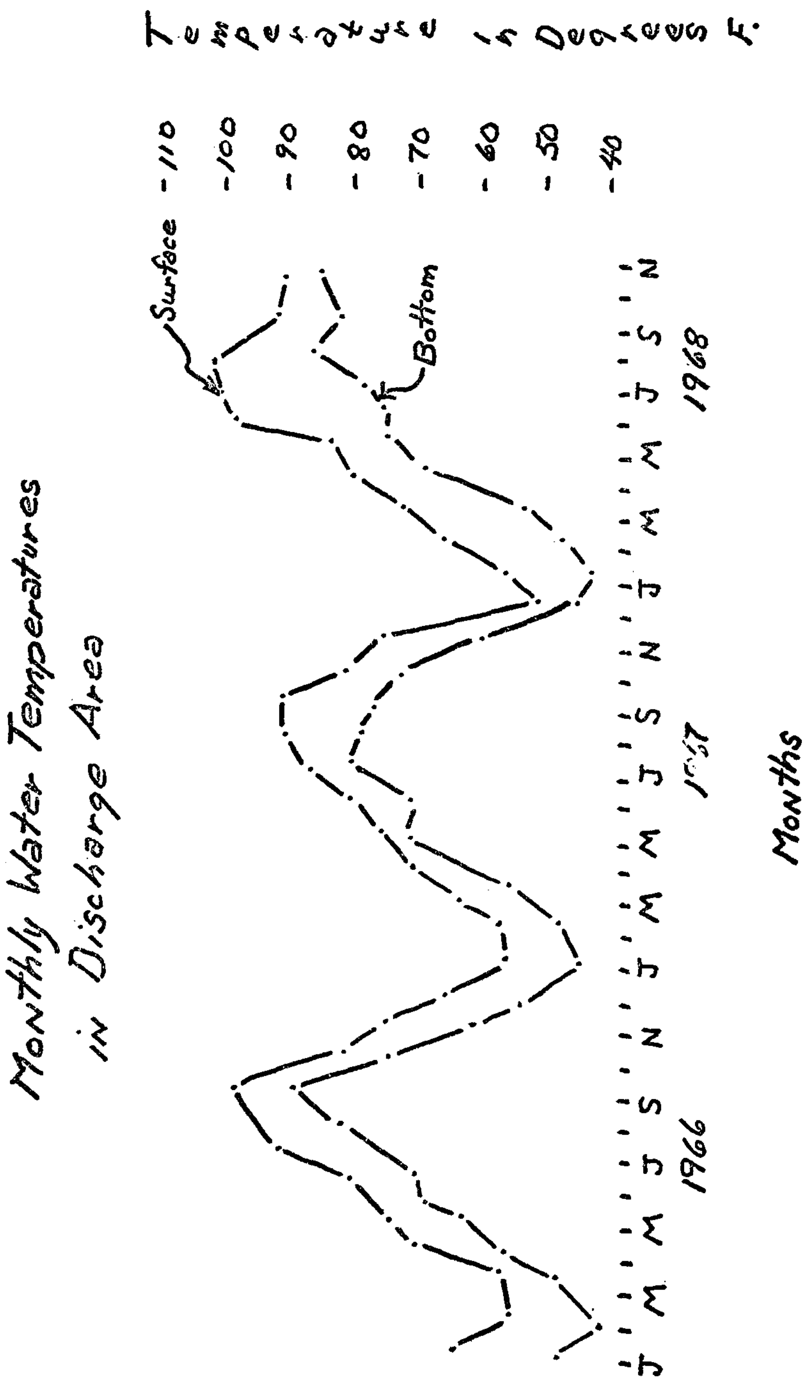
Monthly Water Temperatures in Intake Area




Monthly Water Temperatures
in Discharge Area
Temperature in Degrees F.
-110
-100
-90
-80
-70
-60
-50
-40
Surface
Bottom
J M M J S N J M M J S N J M M J S N
1966
1968
Months

Roush, Thomas Herbert. 1968. The Effect of Heated Water Discharge on the Growth of Fishes. (Unpublished Master's thesis, Graduate School, University of Missouri).

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POOL FLUCTUATION IN CORPS IMPOUNDMENTS IN RELATION TO FISH SPAWNING

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ABSTRACT

Each spring and early summer the Corps of Engineers and the associated conservation agencies of the various states work together to program and operate the Corps' reservoir levels so that a minimal alteration of environment will occur during the spawning period of game fish in these reservoirs. The demands of flood control, navigation, hydro-electric power and fisheries resources must be coordinated to produce a condition in which these varied interests are working together to produce the required results to the benefit of all.

Communications between all involved agencies during the time of gamefish spawning, and notification of operational procedures is the major contributor to failure or success at this time. Public awareness of the problems involved as well as the action being taken by all agencies decreases the usual rash of complaints against both the conservation agencies and the Corps of Engineers.

In spite of coordinated efforts, this reservoir level manipulation has not been proven to have either a beneficial or detrimental effect on the fisheries resources. In areas where such activities have taken place desirable fish populations have continued to increase and maintain high populations. This correlation between the fish populations and intensive water level management is such however, that it will be continued until proven to have no effect. The high fishing effort-catch ratio is such that it would not be prudent to alter the present system of management and in any way jeopardize the success of the fishermen utilizing these areas.

POOL FLUCTUATIONS IN CORPS IMPOUNDMENTS IN RELATION TO FISH SPAWNING

In the southeastern United States the springtime brings forth dogwood, azaleas, mosquitoes and the sports-fish ball game. Like a professional game of basketball the fish conservation agencies are trying to run out the clock as opposed to the spawning to the spawning plays of fish populations. The problem of stalling is further complicated by two factors, the first being that the game can be shortened or prolonged according to the desires of the fish population team. The conservation team is limited by a strict set of rules while the opposition can and does play according to the exigencies of that particular point in the game.