Fig. 1. Pied channel catfish. Joe Hogan State Fish Hatchery, Lonoke, Arkansas.

LITERATURE CITED

Crawford, Bruce. 1957. Propagation of channel catfish *(Ictalurus lacustris* at State Fish Hatchery. Proc. 11th Annual Conf. Southeast. Assoc. Game and Fish Comm., pp. 132-141

Nelson, Ben. 1956. Propagation of channel catfish in Arkansas. Proc. 10th Annual Conf. Southeast. Assoc. Game and Fish Comm., pp. 165-168.

————. 1958. Progress Report on Golden channel catfish. Proc. 12th Annual Conf. Southeast. Assoc. Game and Fish Comm., pp. 75-78.

THE RESULTS OF POPULATION ALTERATION AND FACTORS AFFECTING BALANCE IN FARM PONDS IN GEORGIA [1]

By WILLARD W. THOMASTON
Georgia Game and Fish Commission
Atlanta, Georgia

ABSTRACT

Methods and results of population investigation and alteration in Georgia farm ponds for approximately seven years is presented. Results of fishing pressure is also included.

INTRODUCTION

The dynamics of fish populations in Georgia farm ponds have been investigated for several years to determine methods of management best suited to

1 This work was undertaken with Federal Aid to Fish Restoration Funds under Dingell-Johnson Project F-6-R, Evaluation of Pond Management Practices

the state. Evaluations were made through seining, rotenone samples, complete kills with rotenone, partial poisonings using rotenone, draining the ponds and weighing and measuring the fish, catch records, and response to fishing pressure. This work was done in a portion of the approximately 40,000 farm ponds in Georgia, averaging 3.5 acres each, but varying from one to forty acres. Ponds significantly smaller than one acre are not considered manageable bodies of water for the bass-bluegill combination. Approximately one-half of the freshwater fishing in Georgia is done in farm ponds, according to results from the Demographic Survey Division (1961). This makes it imperative that sound management be carried out in this type fishery.

One of the major problems encountered in Georgia ponds is an unbalanced fish population caused by an over abundance of intermediate size bluegills. Unbalanced populations are those unable to produce succeeding annual crops of harvestable fish (Swingle, 1945, 1950, 1956). Hooper and Crance (1959) reported an average catch of 193.4 lbs. per acre in a balanced pond, compared to an average catch of 132.7 lbs. per acre in unbalanced ponds. This is a decrease of over 30% catch by weight the years the ponds were unbalanced due to the crowding of intermediate bluegills. These ponds received prompt attention. Had the unbalanced condition been allowed to remain, a further decrease in fishing success probably would have occurred.

Ponds discussed in this report unless otherwise indicated were stocked with hatchery raised bluegills (*Lepomis macrochirus*), shellcrackers (*Lepomis microlophus*) and largemouth bass (*Micropterus salmoides*) as recommended by Swingle (1949, 1951, 1952). They were fertilized at the rate recommended by Swingle and Smith (1947) except for the addition of lime which is often required in Georgia, Zeller and Montgomery (1957), and Thomaston and Zeller (1961). The bluegill and shellcrackers are referred to collectively as bream in this report. This bass-bream combination has proven to be entirely successful in Georgia when sound management is carried out.

Swingle (1952) listed some common causes of pond failures, such as not removing the existing fish population before stocking hatchery fish, adding fish other than hatchery fish, high mortality of hatchery fish after they are stocked, and removal of the largemouth bass before spawning. The migration of fish into ponds both before and after adding fish from the hatchery (Moss and Hester, 1956), and ponds incorrectly stocked because of errors in reporting the acreage on the fish application caused failures. Hall (1958) reported incorrect stocking in Kentucky due to errors in reporting acreage on the fish application. Due to prestocking checks conducted in Alabama, Kelly (1961) reported 80% of 114 ponds were successful. This is in contrast to 59% of 82 ponds being successful that were not checked prior to stocking (Moss and Hester, 1956). Overstocking or understocking of bass and/or bream will cause pond failures, Swingle (1951). Failure or unbalance is generally traceable to an error in management in Georgia. A primary cause of a crowded bream population is an excess removal of adult or catchable size fish when the pond is initially opened for fishing. Although an excessive removal is possible in an old established population, apparently it is more apt to occur in a new pond.

In many situations the best procedure to correct an unbalanced fish population would be the elimination of the entire population and restocking. This is undesirable, if the pond can be made to produce satisfactory fishing by other means, since it would be out of production for approximately eighteen months. Swingle, Prather and Lawrence (1953) reduced the intermediate bluegill population by marginal, section and spot poisonings with rotenone, but failed to do so by seining because of the time involved. Hooper and Crance (1960) corrected over-crowded bream populations by partial poisoning five Alabama state-owned lakes, ranging from 32 to 80 acres. Seining has been unsuccessful in Georgia with the pond at its normal water level. Success was possible when the water level was lowered sufficiently to congregate the fish so that a significant catch was possible. Removal by baskets was unsuccessful although no emphasis was placed on this phase of management because preliminary results were discouraging.

METHODS

Balance was determined by the principles set forth by Swingle (1945, 1950, 1956). Intermediate bream are defined as those in the 3, 4 and 5 inch groups. A three inch fish measures from 2.5 to 3.5 in length. The smallest intermediate

fish would be 2.5 inches and the largest 5.5 inches. Bream larger than 5.5 inches are considered harvestable fish.

When no reproduction can be found in late spring or early summer, or when more than an average catch of 20-35 intermediate bluegills was made per 50′ or 75′ seine haul, the pond is considered out of balance in Georgia. Hooper and Crance (1960) considered a pond out of balance when 35 intermediate sunfish were caught per 50′ seine haul and when no fry could be found with a minnow seine. The variance in numbers of fish per seine haul in Georgia depends upon other conditions existing in the pond and ability to get a satisfactory sample. A 15′ minow seine with six meshes per inch was used to determine reproduction. Seining samples were made for reproduction until it was fairly well assured that an adequate sample had been taken. Most of the time a 15′ minnow seine would determine the condition of the pond. However, the larger seine was used to get a more reliable sample.

Approximately 100 ponds have been partially poisoned during the past seven years to eliminate a portion of the intermediate bream. Attempts to correct an unbalanced fish population with species present other than bass and bream were unsuccessful. Cube powder or emulsifiable rotenone was used as a toxicant. The powdered rotenone was mixed with water to form a paste and placed in a dip net or held by hand in the water as the boat moved parallel with the shoreline. Emulsifiable rotenone was applied with a John Bean sprayer. A line of rotenone diluted with water to get adequate distribution was applied toward the shoreline by spraying. The relief hose of the sprayer was thrown over the side of the boat to apply a heavy line of rotenone which would presumably help prevent possible escape of the small fish from the shallow water. A gravity flow method was also used by mixing the rotenone with water and running it out the drain plug of the boat. This technique was unsatisfactory, possibly because the wake of the boat diluted the rotenone too rapidly. Rotenone was also mixed in a container in the boat and poured out as the boat moved along and was satisfactory. The spray method was considered most successful.

Rotenone was applied only in water depth of four feet or less. Normally, this is 10-30 feet from the shoreline, except near the dam. Amounts of rotenone have varied from 1-3 pints of 5% emulsifiable rotenone or 1 to 3 pounds of approximately 5% powdered rotenone per 100 yards of shoreline. In some instances these amounts were sufficient to kill the entire fish population, especially if the shoreline was irregular and the pond small. For these reasons rotenone is only applied in water less than four feet deep and rarely around the entire pond.

The most successful partial poisoning was usually done after September 1 of each year and on days the wind was relatively calm. Normally the bream will not reproduce after a partial poisoning this time of year until the following spring. The water temperatures usually range from 70° F. to 80° F. this time of the year in Georgia. When water temperatures drop below 70° F. success was inconsistent. Although it is not consistent at any temperature, it is better when the water temperature is above 70° F. Swingle, Prather and Lawrence (1953) reported success at 56° F.

Ponds were partially poisoned during the spring and early summer and followed with a supplemental stocking of bass. When bass were not available for restocking partial kills were not attempted until the late summer or fall. From 9:00 to 2:00 o'clock appears to be the best time of day. Apparently more small fish are nearer the shoreline and the larger fish are in the deep water at this time. However, Davis' pond was partially poisoned during midday and only two pounds per acre of fish were killed. One week later, the same procedure was repeated and approximately 112 lbs. per acre of small and intermediate bream killed. This can be avoided if the pond is seined immediately prior to the rotenone application.

Preliminary evaluations of the kills were made the day of the rotenone application. The following day a complete estimation of the number and weight of the fish killed was made. In about one week the pond was seined again to determine if an adequate amount of fish had been removed. The removal process continued until it was assumed an adequate number had been removed. The remaining number varied from five to twenty intermediate bream. These numbers depended upon factors such as the presence of bass, tadpoles, fertility of pond and ability to get a good sample. The remaining number of fish is the

important factor and not the amount killed. Four applications of rotenone have been insufficient in some ponds to kill a desired number of intermediate bream. One application has been satisfactory in smaller ponds. Final evaluation of population renovations were not possible for as long as three years in some ponds.

RESULTS

The following ponds are representative of the results achieved during the population alterations. Unless otherwise indicated recommended management procedures were carried out.

HALL'S LAKE

This six-acre lake was unfertilized and received virtually no fishing pressure because of a crowded intermediate bream population. The length of time this situation existed or past management procedures are unknown. During September and October of 1959, 143 lbs/A of intermediate bluegills were removed with two rotenone applications. One five pound bass was killed. Bass and bream reproduced satisfactorily during 1960 and the fishing quality improved. During 1961 the pond was in balance and providing a satisfactory fishery. In 1962 fishing was good and the population was considered in balance.

CANNAFAX'S LAKE

This two-acre lake was providing satisfactory fishing until the fall of 1958. At this time a fish kill occurred, predominately of bass. The following year the pond was crowded with intermediate bream and was partial poisoned in September, 1959. Approximately 125 lbs. per acre of intermediate bluegills and 5.5 lbs. per acre of bass were removed. During 1960 the pond indicated it would come into balance and remained in this condition through 1961. However, in 1962 the pond was again crowded with bluegills but bass continued to reproduce slightly. Fishing improved after partial poisoning but continues to be unsatisfactory.

ANDERSON'S LAKE

This two-acre lake opened for fishing during the spring of 1957. Balance was not achieved at this time. In 1958, 200 bass fingerlings per acre were added but was of no apparent value. In June of 1959 the pond was partial poisoned and killed 37 lbs/A of intermediate bream plus 2.5 lbs. of bass. The water level was lowered later in the year and 38 lbs/A of bream were removed. In 1960 balance was indicated and in 1961 balance was attained. A heavy infestation of Pithophora during 1961 hampered management and fishing. No reason is known for the initial unbalanced situation. In 1962 Pithophora was too abundant to get a reliable sample but from the fish that were caught, balance was indicated. Unless the Pithophora is controlled the balanced population probably will not continue to exist.

DAVIS' LAKE

This two-acre lake opened for fishing during the spring of 1959. An undetermined number of bass were removed shortly before spawning by poachers. Fishing was good but only a few bass were caught after the pond opened. The population did not come into balance and was partial poisoned twice during September removing approximately 114 lbs/A of intermediate bluegills. In 1960 the pond returned to balance and remained in this condition during 1961 and 1962 and provided a good fishery. Fishing was never poor during this period. This is attributed to the immediate corrective action taken.

THEUS' LAKE

This three-acre lake was stocked with 2,000 bluegills and 100 bass per acre and opened for fishing during 1958. It did not come into balance and fishing was poor. In August of 1959 the water level was lowered to the old stream bed and 125 lbs/A of bream and tadpoles were removed with dip nets and seines. An estimated 200 pounds of tadpoles were drained out the drain pipe when the water level was lowered. During the fish removal approximately 10 large bass were observed.

Seining, after the pond refilled, indicated that an adequate amount of fish were removed. Fishing success improved drastically the following year, 1960,

TABLE I

SUMMARY OF THE TYPICAL RESULTS OF POPULATION ALTERATIONS IN EIGHT GEORGIA FARM PONDS

Date	*Owner*	*Size Acres*	*Rotenone Per 100 Yds. Shoreline*	*Pounds Per Acre Fish Removed*			*Attained Balance*	*Reason for Unbalance*
				Bass	*Bluegills*	*Total*		
6- 9-59	Anderson	2	1.0 pt.	2.5	38.0	77.5	Yes	Unknown
10- 1-59			A					
9- 3-59	Cannafax	2	0.75	11.5	127.0	138.5	No	Fish Kill
9- 1-59	Hall	6	0.5		58.0		Yes	Unknown
10-20-59			0.1	1.0	84.0	143.0		
9- 1-59	Webb	7	0.5		72.0	72.0	Yes	Overfishing
10- 1-59	Davis	2	0.5		2.0	114.0	Yes	Fish before
10- 5-59			1.0		112.0			bass spawn
10-15-60	Upson	19	1.0	5.0	82.0	132.0	No	Overfishing
10-27-60			1.5		45.0			
6-17-59	Barnes	6	1.5		150.0	150.0	Yes	Overstocking
8-19-60	Theus	3	A		66.0 59.0 tadpoles	124.0	No	Overstocking

A—Lowered water level and seined.

but the population did not return to balance. Fishing quality decreased during 1961. By midsummer of 1961 the population was comparable to that when the renovation began. The reason for lack of success is attributed to an inadequate removal of the intermediate bluegills and an inadequate number of bass present. In 1962 the crowded bluegill population was still prevalent.

WEBB'S LAKE

This seven-acre lake was opened for fishing in the spring of 1958. Fishing was good and intensive. During the first fishing season approximately 300 per acre were removed. The following year fishing success was very poor, as a result of a crowded intermediate bream population. In September, 1959 partial poisoning removed approximately 72 lbs/A of intermediate bream. Seining indicated a satisfactory amount has been killed. An extremely heavy bass reproduction occurred during the spring of 1960, returning the population to a balanced condition. In 1961 the population was slightly crowded with bass, but fishing was good. In 1962 fishing was good and the population in balance. Apparently the excess removal of fish during the opening year resulted in the crowded intermediate bluegill population.

BARNES' LAKE

This six-acre lake was initially stocked for 10 acres. The pond was opened for fishing during 1956, but did not come into balance. The catch consisted primarily of intermediate bream. During the spring of 1958, three years after having been opened for fishing, 150 lbs/A of intermediate bluegills were removed by partial poisonings and one hundred bass fry per acre were added. Continued periodic seining did not indicate any bluegill reproduction until late summer. Balance was indicated during the fall. Fishing quality improved during the winter, but declined the following year. In 1960 there were no further indications of bass or bluegill reproduction. In early 1961 there was a heavy reproduction of bream, which grew into the intermediate range. Intermediate bream were caught extensively by fishing and seining during this time. There were probably very few adult bass present in the population when renovation began. If an adequate number of bass had been present, balance probably would have been achieved. The initial unbalance is attributed to overstocking of bream. During the fall of 1961 the pond was lowered to one acre in size and remained in this condition for five months. Rye grass was planted in the exposed area. The pond was refilled in late February of 1962. The bass and bluegills reproduced tremendously in the spring and summer of 1962. This was probably due partially to heavy predation by the bass. However, other factors such as a population adjustment to the size of the pond, when lowered, should be considered. A repressive factor was possibly involved. Aeration of the pond bottom could have eliminated this. Swingle (1953) recognized a repressive factor involving goldfish in 1932 and suggested that it was an excretion from the fish. Although the bluegill population was reduced the repressive factor could have remained chemically bound to the pond bottom which was removed by aeration. This definitely needs more research and investigation.

UPSON COUNTY SPORTSMEN LAKE

This 19-acre lake was opened for fishing during the spring of 1958. There was a removal of 372 lbs/A of fish the opening year, 82 lbs/A in 1959 and 45 lbs/A during 1960 and 1961, consecutively. The sharp decrease in fishing success is attributed to overfishing the opening year. The pond was crowded with intermediate bream and partial poisoned twice during the fall of 1960. A total of 132 lbs/A of intermediate bream and 5 lbs/A of bass were killed. Fishing quality improved following this removal, but balance was not achieved during 1961. In 1962 the population was providing an improved fishery, but continued to be crowded with intermediate bream.

DISCUSSION

An overcrowded intermediate bluegill population can be restored to balance, when an adequate poundage of these are removed and sufficient bass are present or are added. The reduction of a crowded bream population will result in a temporary improvement in fishing even though balance is not accomplished.

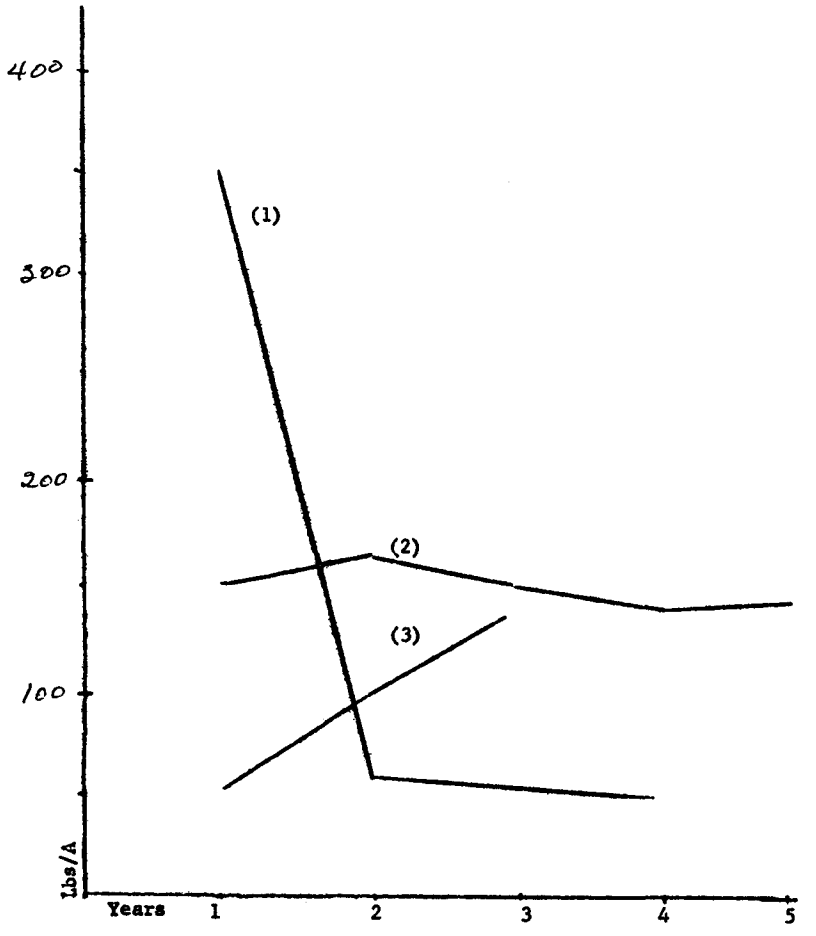
The poundage of intermediate bream that should be removed will vary for each population. A certain poundage removal is not a factor to be sought. The remaining fish is the important factor. The sooner corrective action is taken to restore balance the easier it is accomplished. The length of time required to re-establish a balanced population has varied from one to three years, although success is not assured at any time. Supplemental restocking of bass was not beneficial unless there was a reduction of the intermediate bream. The value of this is still doubtful because, unless the population is adjusted so that the existing bass will spawn, the introduced bass fry will usually disappear. The bass fry are in competition for food and space and probably cannot survive. Foster's pond was lowered and 105 lbs. per acre of bream were removed by seining. Fifty bass per acre, averaging one lb. each, were added. The pond came into balance the following year. Presently, acquiring this size bass is almost impossible for management. Harp's 10-acre lake was partial poisoned with a lowered water level of about one-third its original size. The exact number of bream killed was not estimated. During the following three years the pond was crowded with bass, possibly because too many bluegills were killed. This has occurred in Georgia but not frequently.

The consensus of pond owners is that a pond must be fished to produce fish and maintain balance and cannot be overfished. Many articles have been published urging intensive fishing to keep a pond in balance. Investigations were made in Georgia where the fishing pressure was restricted to an average annual removal of 150-200 pounds per acre for several years. These ponds have provided and continue to maintain good fishing. Lewis' 40-acre lake near Griffin, Georgia, has maintained balance and good fishing for seven years with an average annual removal of 170 lbs. per acre per year. Payne's pond had a catch of 200 lbs. per acre the first two days after opening. A total of 345 lbs. per acre were removed the first year. The following year approximately 50 lbs. per acre were caught, primarily intermediate. The following year the decrease continued because of poor success with subsequent lack of interest by the fisherman. When the harvestable fish population is reduced below the requirements for balance, poor fishing and a crowded bluegill population usually occurs, Swingle (1950).

Overfishing can occur in new ponds or old ponds that receive a sufficiently heavy removal of harvestable fish. A pond can be overfished. Many ponds were encountered in this study, where an insignificant amount of fish were removed over a period of several years, which were in balance and were producing an excellent fishery. However, if ponds are in balance and not fished at all for a long period of time, they tend to become crowded with bass. This is found to be more pronounced in ponds where the edges are at least four to five feet deep. Ponds were encountered, where no significant fishing had been done for an estimated seven years. An example of this is Watkin's pond. This pond changed ownership and suddenly received a heavy fish removal, primarily of bass. Incomplete catch records indicated 125 lbs. per acre of bass, averaging about one lb. each, were caught. Fishing became very poor and the pond was drained. Only a very few bass and bream were found. The few bream recovered were in excellent condition, as contrasted to the poor condition of the bass. After the heavy bass removal, if the pond had not been drained, it probably would have become crowded with bream. This pond was built according to recommendations (Lawrence, 1949). The initial stocking ratio and reason for the crowded bass population is unknown.

Ponds do not have to be fished to stay in balance. These ponds usually have a high percentage of harvestable size fish but in poor condition. McKenney's lake located near Cusetta, Georgia, is approximately 20 years old. The ownership of the pond had changed several times and the exact date of construction is unknown. Fishing until 1955 was erratic, but never good. Fishing pressure was very light, due to poor success. A satisfactory fertilization program, which had not been carried out in the past, was initiated. Fishing success began to increase and by 1958 was very good. This pond receives only restricted fishing. It is crowded with bass and contains very large bluegills. One pound bluegills are very common. A slightly crowded bass situation is not necessarily undesirable. However, less poundage of fish can be caught in slightly crowded bass populations. The edges of McKenney's pond average at least 6 feet deep with an overall average depth of approximately 20 feet. Generally ponds with

FIGURE I
TYPICAL RESULTS OF FISHING PRESSURE
AND FERTILIZATION IN GEORGIA FARM PONDS



1-Ponds overfished
2- Restricted fishing pressure
3- Unfertilized and fertilization started

deeper edges than recommended by Lawrence (1949) tend to bcome crowded with bass more frequently. However, these depths are entirely satisfactory in Georgia. In the coastal and southern portion of Georgia the ponds have an average depth of approximately 3.5-4.0 feet. In the more mountainous section beginning in the piedmont and extending into north Georgia the ponds average approximately seven to eight feet deep with deep margins. A higher percentage of these ponds are crowded with bass than in the southern part of the state. This is attributed to the water depth at the edges, lack of weed growth and possibly to a shorter growing season in the northern section whereby the reproduction period of bream is considerably shorter. The extreme difference in growing season of northern and southern sections of the state is 92 days. (Yearbook of Agriculture, 1939.)

An intensive research program on aquatic weed control has been carried out in Georgia for several years, Montgomery, Zeller, 1958 and Thomaston, Pierce, Wyatt, 1959, and Thomaston, 1961.

The undesirability and effects of aquatic weeds on fish production and fishing has been long recognized by fishery workers (Swingle and Smith, 1947). When a pond is infested badly with an underwater weed and filamentous algae, it usually becomes crowded with small intermediate bluegills. Upon removal of the underwater weed, fishing is slightly improved, because the nutrients were producing weeds instead of fish. After the removal of marginal weeds or water lilies, fishing is usually good for a short period of time. The removal of this vegetation removes the major obstacles to fishing. These factors are dependent upon the species of weeds, their density and duration. The best recommendation in these instances is to drain and restock the pond. The pond should not be drained just to kill the weeds, except in isolated instances. Unfertilized ponds or ponds that receive no nutrients from the watershed are not considered practical for management. They invariably become infested with weeds and production is low.

LITERATURE CITED

Byrd, I. B. 1959. Angling Success and Seasonal Distribution of Catch in Alabama's State Owned Public Fishing Lakes, N. Am. Wildl. Conf., 24:225-237.

———— and D. D. Moss. 1956. The Production and Management of Alabama State Owned Public Fishing Lakes, Trans. Am. Fish. Soc. (1955), Vol. 85, pp. 208-216.

————. 1962. Demographic Surveys Division, Bureau of the Census, Ga. Survey of Fishing and Hunting, 40 pp.

Hall, John F. 1958. Final Report on the Success of Largemouth Bass-Bluegill and Largemouth Bass-Shellcracker Rates and Ratios in Kentucky Farm Ponds, Proc. Southeastern Assoc. of Game and Fish Comm., pp. 91-116.

Hooper, Archie D. and Johnnie H. Crance. 1960. The Use of Rotenone in Restoring Balance of Overcrowding Fish Populations in Alabama Lakes, Trans. Am. Fish. Soc., Vol. 89, No. 4, pp. 351-357.

Kelly, H. D. 1961. An Evaluation of Prestocking Checks in Alabama Ponds, South. Assoc. Game and Fish Comm., 1961 (in press).

Lawrence, J. M. 1949. Construction of Farm Fish Ponds, Ala. Poly. Inst. Agriculture Exp. Sta., Cir. 95, 55 pp.

Moss, D. D. and J. M. Hester. 1956. Farm Pond Investigations in Alabama, Prog. Fish Culturist, 18:4, 171-177 pp.

Swingle, H. S. 1945. Improvement of Fishing in Old Ponds., Trans. N. Am. Wildl. Conf., 10:299-308.

————. 1947. Management of Farm Fish Ponds, Ala. Poly. Inst., Agri. Exp. Sta., Bull. 254, 30 pp.

————. 1949. Experiments with Combinations of Largemouth Black Bass, Bluegills, and Minnows in Ponds, Trans. Am. Fish. Soc., Vol. 76 (1946), pp. 46-62.

————. 1950. Relationships and Dynamics of Balanced and Unbalanced Fish Populations, Ala. Poly. Inst., Agri. Exp. Sta., Bull. 274, 74 pp.

————. 1951. Experiments with Various Rates of Stocking Bluegills, *Lepomis mœrcrochirus* Rafinesque, and Largemouth Bass, *Micropterus Salmoides* (Lacepede), in Ponds, Trans. Am. Fish. Doc., Vol. 80 (1950) pp. 218-230.

————. 1952. Farm Pond Investigations in Alabama, Jour. Wildl. Mgt., 12, (3):243-249.

————. 1953. A Repressive Factor Controlling Reproduction in Fishes, Proc. of the Eighth Pacific Science Congress, Vol. 111 A., pp. 865-871.

————. 1956. Determination of Balance in Farm Fish Ponds, Trans. N. Am. Wildl. Conf., 21:298-322.

————, E. E. Prather and J. M. Lawrence. 1953. Partial Poisoning of Overcrowded Fish Populations, Ala. Poly. Inst., Agri. Exp. Sta., Cir. 113, 15 pp.

————. 1939. Yearbook of Agriculture, Climate and Man, pp. 820.

Montgomery, Alex B. and Howard D. Zeller. 1957. The Evaluations of Chemical Aquatic Weed Control in Georgia Farm Ponds, Proc. of South. Assoc. of Game and Fish Comm., 1958, 8 pp.

Thomaston, Willard W. 1962. Results of Experimental Weed Control in Georgia Farm Ponds Using Simplified Gravity Flow Techniques, Proc. of South. Weed Conf., Vol. 15, pp. 234-243.

————, Phillip Pierce and Herbert N. Wyatt. 1959. Experimental Use of Silvex and Other Aquatic Herbicides in Georgia Farm Ponds, Proc. South. Assoc., Game and Fish Comm., 1959, 7 pp.

———— and H. D. Zeller. 1961. Investigation of Chemical Soil and Water Analysis and Lime Treatment in Georgia Farm Ponds, South. Assoc. of Game and Fish Comm. (in press).

Zeller, H. D. and A. B. Montgomery. 1957. Preliminary Investigations of Chemical Soil and Water Relationships and Lime Treatment of Soft Water in Georgia Ponds, Proc. Assoc. of Game and Fish Comm., pp. 71-76.

VARIABILITY IN SEINE HAUL SAMPLING OF SUNFISH IN A FARM POND

By BRADFORD E. BROWN
Auburn University Agricultural Experiment Station

INTRODUCTION

A large number of hauls were made with 50- and 15-foot seines in a recent study of a 26-acre farm pond at Auburn, Alama. Although this seine sampling method for determination of balance is used widely in the Southeast (Swingle, 1956), usually only a few seine hauls are made per pond. Variations involved in such seining are reported here.

DISTRIBUTION OF SEINE HAUL CATCHES

There is the problem of how to treat statistically the number of fish captured a particular method in all studies of fish populations. If fish were distributed randomly, the form of the distribution of numbers per seine haul would be Poisson. However, aquatic organisms generally are not distributed randomly. Where the form of their distributions has been studied, these forms generally have been contagious (Gulland, 1956, 1957; Kutkuhn, 1958; Lambou, 1960, 1961; Moyle and Lound, 1960; Scheftel, 1960; Strasburg, 1960; Taft, 1960; and Taylor, 1953). In order to transform contagious distributions where the variance is equal to the mean plus some constant times the mean to normal distributions the exact form of the distribution should be known. However, a transformation of the logarithm to the base 10 of N + 1, where N equals the number of items per observation, will approach a normal distribution and enable statistical techniques requiring the assumption of normality to be used (Gulland, 1956).

An attempt was made to determine if the transformation as described would be useful. A frequency distribution was constructed for 1- and 2-inch fish captured in 131 hauls taken with a 15-foot seine during the period August 13 to 19, 1960. These hauls were taken to determine what changes could be expected in seine hauls within a week. In this case only random fluctuations occurred. The plotted distribution for these values (Figure 1) was extremely skewed as revealed by a chi-square test that was significantly different from the normal distribution at the 0.005 level. Visual observation indicated that the square root transformation did not change the skewness; thus the distribution was not Poisson. The data transformed by the logarithm of N + 1 approached normality (Figure 1). The transformed distribution was not significantly different from a normal distribution at the 0.05 level.

EFFECTS OF ADJACENT SEINE HAULS ON VARIATION

The most important determination in sampling fish populations for balance by 50-foot seine hauls (Swingle, 1956), is the count of intermediate (3- through 5-inch groups) sunfish. It is important to know whether two seine hauls taken close together and consecutively will give samples of the fish population that will be useful in deciding the condition of balance in a pond. The following