since the beginning. As Lake Commissioner, I see the future needs as well as the progress made and realize without the assistance and cooperation of the Interior Department, their supervisors and biologist, Mr. Bob Webb and Mr. Alex Montgomery, we could not have made the progress we have. With the continued cooperation of these men and other mentioned personnel, we feel we can accomplish all of the objectives in our long-range Lake Management Program at Fort Gordon.

SUMMARY OF FISH CAUGHT
(1 Oct. 62-8 Sept. 63)

Little Beaver Lake:

KIND OF FISH	QUANTITY	WEIGHT (Lbs.)
Channel Catfish	6,061	10,877
Bass	227	228
Other	2,204	1,905
TOTAL	8,492	13,010

Big Beaver & Whittimore Lakes:

Bluegill	15,001	8,715
Warmouth	3,124	2,111
Bass	2,508	2,230
Shellcracker	3,102	2,096
Catfish (speckled)	2,016	1,410
Other	585	478
TOTAL	26,336	17,040

DRAINING OF LITTLE BEAVER LAKE—9 September 1963
The following fish were taken out of Little Beaver Lake:

Channel Cat

Size	No. of Fish
0-1 lb.	775
1-2 lb.	525
2-3 lb.	1,662
3-4 lb.	250
4-5 lb.	75
5-6 lb.	5
TOTAL	3,292
Bass	50
Speckled or Mud Cat	2,500
Suckers	10,000
GRAND TOTAL:	15,842

18,500 man-days fished in 1963 in controlled lakes on installation.

AN INEXPENSIVE BACKPACK SHOCKER FOR ONE-MAN USE

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ABSTRACT

A small backpack fish shocker weighing 19 pounds was developed for use in sampling mountain trout streams on the National Forests in the Southern Appalachians. Power components include a small gasoline engine-generator combination and a step-up transformer. The completed backpack provides a choice of 125 volts, 300 volts, or 600 volts alternating current (AC).

This unit is adaptable to two electrode systems. One, consisting of an aluminum dipnet and a telescoping radio antenna for the electrodes, proved most useful and versatile in the rough headwater streams sampled. With it, one man handles both the power unit and the electrodes.

The other, a thirteen foot electric seine, required a larger crew but was useful in wide shallow streams.

During the period April, 1966-July, 1967, over 100 stream fish population samples were taken in North Carolina, Virginia, and Georgia with this gear.

INTRODUCTION

The electrofishing gear described here was designed for use on small, rough, inaccessible Southern Appalachian headwater streams. The result is an inexpensive light weight AC backpack unit that can be operated efficiently by one man, with a second man required only for safety purposes and for carrying fish.

Considerable survey and fish population analysis work has been done on streams in the Southern Appalachians. On Southern Appalachian National Forests, the majority of this work has been limited to relatively accessible areas where use of semi-portable equipment and large crews are feasible. Present development programs of various agencies and the increasing interest in preservation of our natural resources make it necessary, however, to carry surveys into the more inaccessible areas in order to establish proper management goals and objectives. These surveys often entail walking and carrying equipment 2-3 miles into the headwaters of streams. Portable electrofishing gear is essential for this work where the use of chemicals is not feasible or desirable.

Factors to consider when selecting electrofishing gear include initial cost, operating cost, simplicity of design, portability, and gear efficiency. Although portable shockers are available at present both from domestic and foreign sources, most have one or more of the following drawbacks or undesirable characteristics:

1. high initial cost
2. high operating costs (such as requiring large crews to operate)
3. complicated design requiring factory maintenance
4. limited portability

High operating costs or number of man-hours spent on projects often determine whether or not they are economically justifiable. Large crews for handling bulky equipment are costly when significant amounts of time are spent walking to and from sample stations. The number of qualified survey personnel available in most organizations also limits survey projects to minimum crews requiring specially designed equipment.

Simplicity of design facilitates quick repair in the field rather than factory repairs. Where time limitations are stringent, savings made by equipment repairable in the field can insure success of projects otherwise impractical.

Hazards are common when working with electro equipment and design simplicity helps improve safety characteristics.

Portability is critical since equipment on these projects must be hand carried for long distances. In addition, lightweight equipment is less dangerous than heavy equipment since footing in rocky streams is usually hazardous.

The shocker described in this paper is designed to eliminate or minimize the above characteristics.

CONSTRUCTION OF SHOCKER

The complete backpack power unit consists of a small gasoline engine-generator combination and a simple step-up transformer, mounted on an aluminum frame. Overall measurements of the backpack are 20 inches high by 14 inches wide by 10 inches deep. Total weight is 19 pounds.

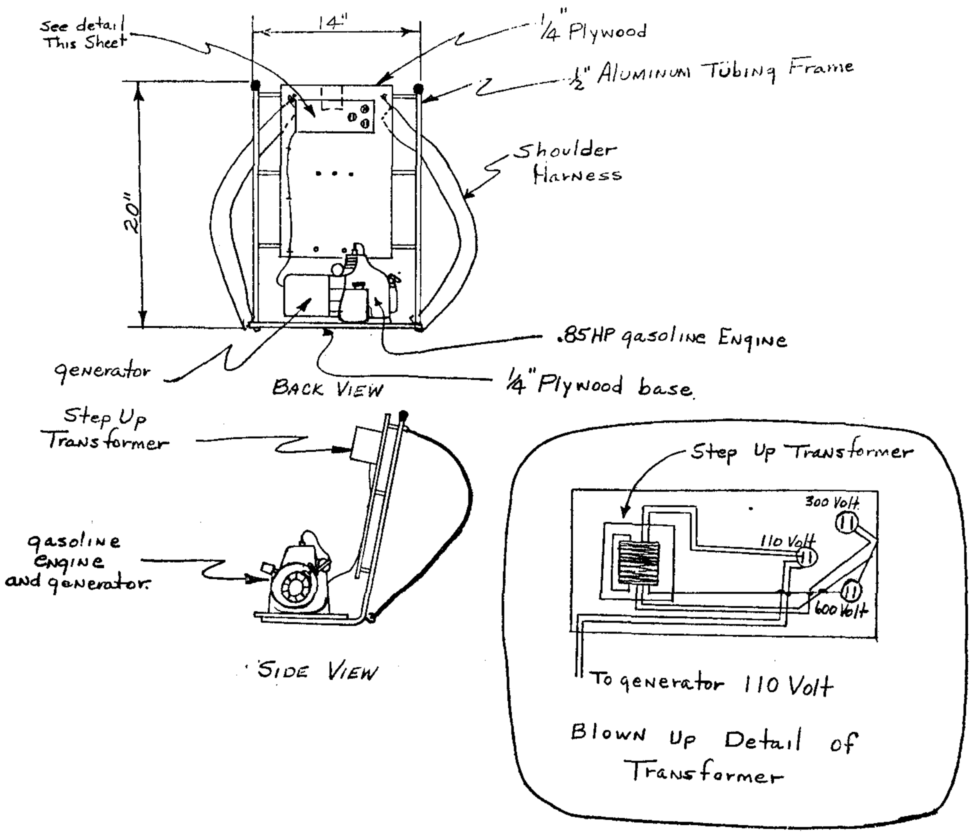
The 2-cycle engine, manufactured by Ohlsson and Rice of Los Angeles, California, is rated at .85 horsepower.

The generator, manufactured by Techmo Electric, of Long Beach, California, for the Kigel Manufacturing Company, is rated 115 volts AC and 12 volts DC concurrently. Actual voltage as measured with the engine governor approximately half-open, however, is 125 volts.

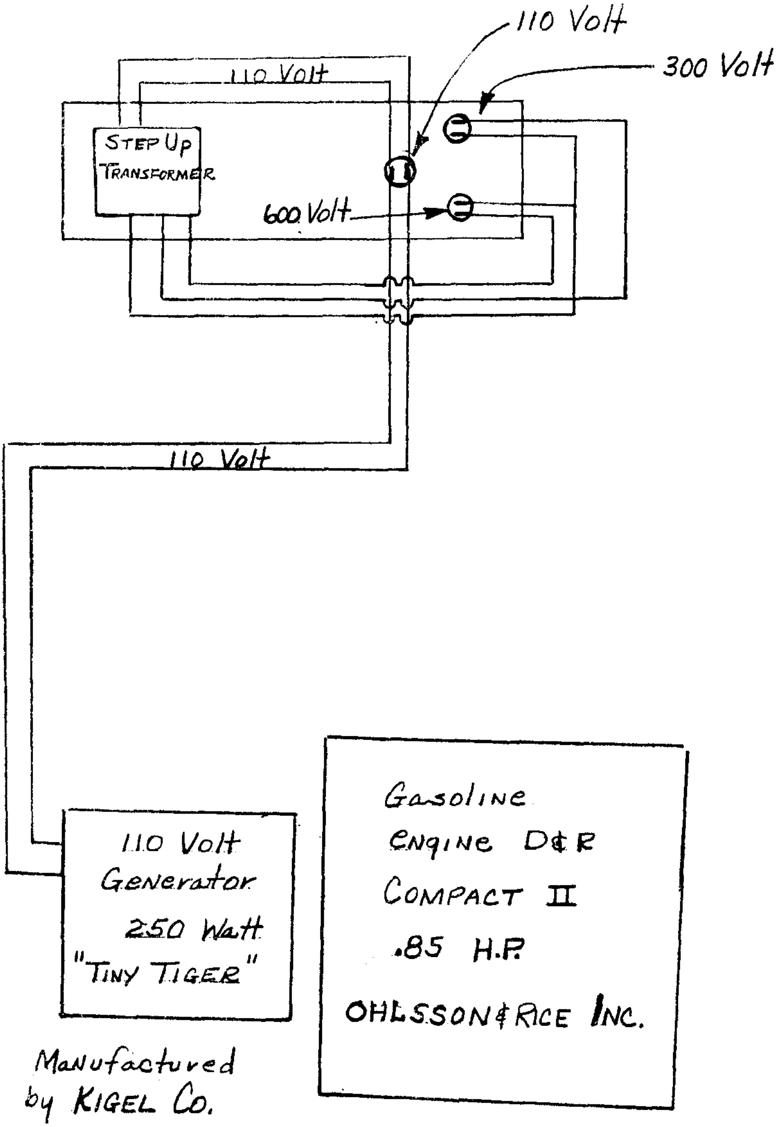
Except for horsepower, this motor-generator combination is similar in all respects to the unit described by Carufel and McDonald (1) in the July, 1965, issue of the "Progressive Fish Culturist."

A MERIT Model P-3051 transformer, added to increase versatility, provides a choice of two additional voltages. The transformer rated 260 and 520 volts at 70 milliamps actually puts out slightly over 300 and 600 volts with the engine governor half open. By completely opening the governor, these voltages can be increased by 20 percent or more. Where higher voltages are needed, the MERIT Model P-2966 transformer rated 350 and 700 volts at 700 milliamps (or equivalent in another make) can be substituted with only a slight increase in weight.

The transformer and motor-generator combination are mounted on ⅜" plywood and bolted to the aluminum backpack frame. (Figures 1 and 2) Three separate turn-lock receptacles mounted in a strong plastic



Complete Power Unit Fig. 1.

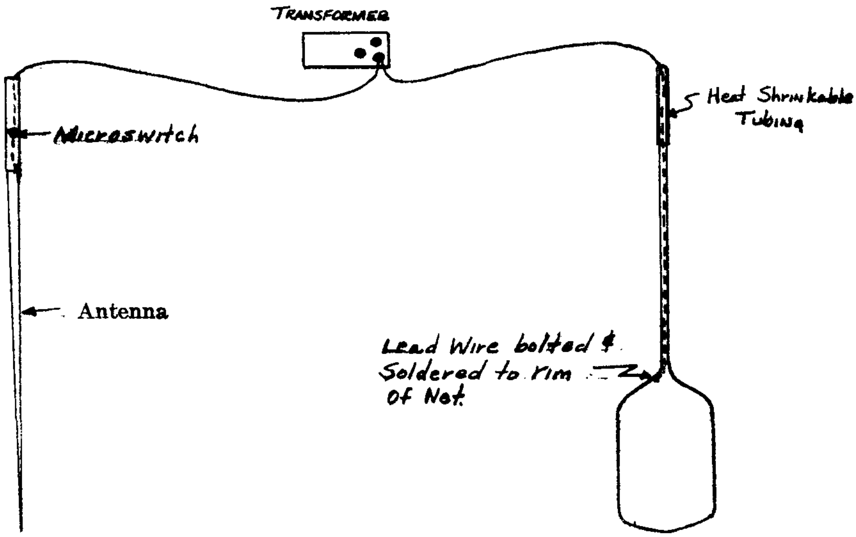


Wiring Diagram   Fig. 2.

box covering the transformer provide choice of voltages. In this case, the plastic box was a battery case salvaged from a small portable FM radio. Mounting holes were cut with a drill press after which the receptacles were installed and held in place with an epoxy resin.

Dimensions of the motor-generator unit are 11 inches long by 7.5 inches wide by 8.5 inches high. The MERIT Model P-3051 transformer measures 2½ x 3 x 3⅛ inches while the Model P-2966 measures 2 13/16 x 3⅜ x 3⅝ inches. The plastic box covering the transformer and holding the three receptacles measures 7.7 inches long by 3.5 inches wide by 3.3 inches deep.

Two electrode systems are adapted for use with the shocker. (Figure 3) Stream characteristics and crew organization determine which will produce best results.



Antenna — Dipnet Electrodes

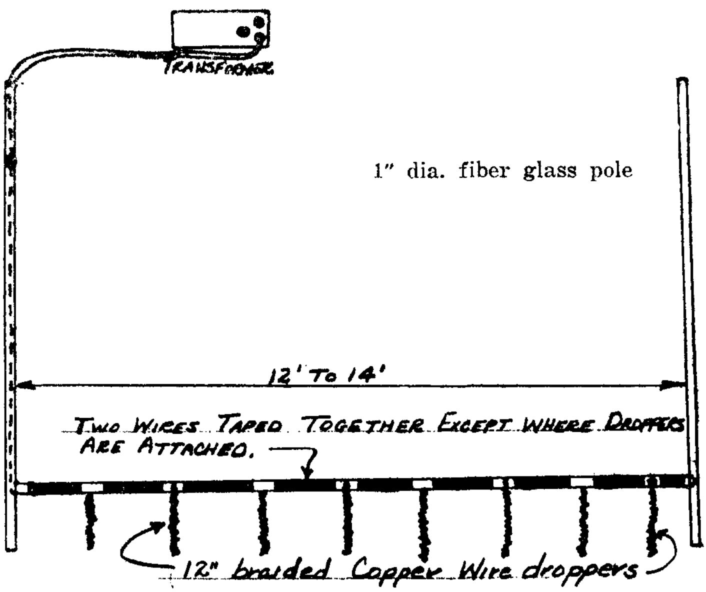


Figure 3—Electric Seine.

One system consists of an aluminum dipnet with a 42 or 54 inch handle for one electrode and a 6½ foot telescoping radio antenna for the other. A piece of rubber hose slipped over the base of the antenna serves as a handle and insulation. A small positive pressure microswitch attached to the rubber handle and completely wrapped with waterproof electrician's tape provides a safety measure. Double-insulated, flexible, multi-strand wire leads from the transformer to each electrode. The wire to the dipnet runs through the hollow handle and bolts directly to the net frame. The dipnet handle is insulated by slipping a 24 inch section of heat-shrinkable plastic tubing over the handle and then heating it with a small torch. Total weight of the electrodes and wire is approximately two pounds.

The size ratio of the two electrodes is far from the 2:3 recommended by Meyer-Waarden (2), but results have nevertheless been excellent.

An electric seine may be substituted for the "dipnet-antenna" electrodes. The seine used in the survey consisted of two, six-foot by one inch, hollow fiberglass poles and thirteen feet (seine width) of flexible multi-strand wire. Five twelve inch braided copper wire droppers soldered to small alligator clips create an effective electric field. A small positive pressure micro-switch on the pole handled by the man with the backpack completes the circuit and helps to insure safety. Total weight of this electrode system is approximately three pounds.

COST OF CONSTRUCTION

Materials

Cost of materials includes:

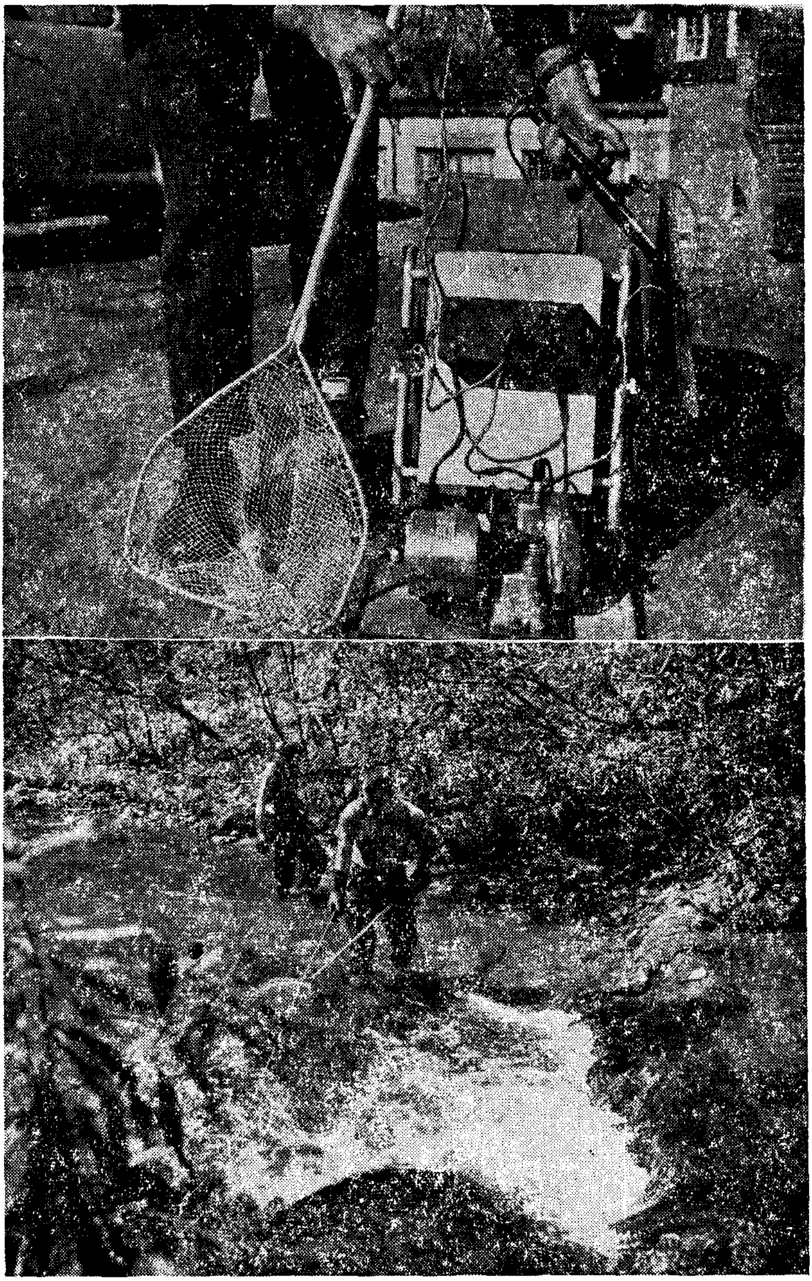
Backpack components	
Motor-generator	$ 73.00
Transformer	8.00
Turn-lock receptacles ($2 each)	6.00
Backpack frame	5.00
Case for transformer (Salvaged)	—
	$ 92.00
"Dipnet-Antenna" electrodes	
Dipnet	$ 3.50
Antenna (any light metal rod will serve the purpose (Salvaged)	—
Wire (Approx. 15 feet)	3.00
Micro-switch	.40
Heat shrinkable tubing (per foot)	.75
	$ 7.65
Electric Seine	
Fiberglass poles (Approx. $2.50 ea.)	$ 5.00
Wire (Approx.)	4.00
Micro-switch	.40
	$ 9.90

Labor

Design is simple enough that with the proper tools two men can assemble the components in as little as 2-3 hours' time. Assembly time in most cases, however, will run 3-4 hours for two men.

USE OF SHOCKER

The dipnet-antenna electrodes proved more effective, in general, than the electric seine on rough mountain streams. It works especially well on streams with undercut banks, overhanging vegetation, and on debris-filled streams. The main advantage of this system, over other systems where extra dipnetters are required, is that one man has complete control of the shocking unit and also does the netting. (Figure 5)



This improves efficiency since he, as the dipnetter, is in the best position to see stunned fish. A second man is necessary only for carrying fish and for safety purposes when using this gear although he can serve as a dipnetter if needed.

Best operating distance between the two electrodes ranges from 3-8 feet, although some fish are stunned with the electrodes ten or more feet apart.

The electric seine was seldom used on the survey work referred to in this article for two reasons. First, it proved less effective than the other type electrode system on rough streams, especially where overhanging vegetation and debris hindered maneuverability. Second, only two men were available during most of the survey and since the electric seine requires a minimum of four people for operation, this factor ruled out its use. The few times it was used, was in fairly wide streams with few pools or escape cover. Under these conditions, it served as effectively as the other electrodes.

Streams sampled with the electrofishing gear ranged in size from six to forty feet wide. Procedures used in the largest streams consisted of spot or qualitative sampling for species composition.

Fish population samples were taken during all months of the year and water temperature appeared to be the biggest single factor limiting gear efficiency in these waters. As water temperature increased, effectiveness decreased. This is in contrast to Webster's (3) observation indicating as good or better results with AC current in warm water as in cold water. This variation could be due to differences in water chemistry since total hardness and conductivity of streams in the Ithaca region of New York is somewhat greater than in the Southern Appalachian streams. Streams in the Southern Appalachians are extremely soft, usually falling below 5 ppm total hardness, while hardness of 40 ppm or greater is common in streams around Ithaca. Good results were obtained by addition of an electrolyte (salt blocks) during the warmer summer months, tending to bear out the above observation.

General observations indicate the necessity for adding an electrolyte when water temperatures reach about 55°F. In temperatures from 36°F-50°F complete immobilization of both large and small fish including trout sometimes lasted as long as several seconds to several minutes after the current was shut off. In warmer waters, recovery by trout especially, was generally instantaneous as the current was shut off. Occasionally, the backbone in small trout was broken when sampling in water below 50°F. This effect has not been observed by the author during summer months. Relatively little direct mortality in trout has been observed either during winter or summer months, although suckers and certain minnows are often killed immediately by the shocker. Bleeding at the anus observed in dead suckers indicates the force of electric current on these bottom dwellers.

DISCUSSION

The shocker described here has been in use since March, 1966, on mountain streams of the National Forests in North Carolina, Georgia, and Virginia. Over 100 fish population samples ranging from 200-1500 feet in length were taken during this period. Results of these sampling efforts appeared excellent although no statistical tests were attempted.

The unit has required no maintenance since construction other than replacing spark plugs (two) and repairing netting on the dipnets. A tool kit for emergency field maintenance should, however, include pliers, screwdriver, waterproof electrician's tape, and an extra recoil starter rope.

Considerable strength is needed to handle the shocker and electrodes when operating in swift water. If this poses a significant problem, use of slightly larger mesh netting (¼ inch minnow netting was the only size used in the above-mentioned survey work) will help to reduce drag. If the problem still exists, another man can be assigned to one of the electrodes, increasing the minimum crew to three.

For specialized purposes such as research projects requiring repeated intensive sampling of the same fish population, gear producing direct or pulsating current may be more desirable than the AC gear. AC current is more efficient (greater neuro-physical effect) than DC current, but the after-effect resulting in mortality is also greater (1). Pulsating current is best suited for this work since it is most efficient of the three types and at the same time has the least after-effect. If low costs, minimum weight, and simplicity of design are not primary requirements, pulsating current equipment should definitely be considered.

For general stream survey work and other purposes where these characteristics must be considered, however, the AC unit described here should be of considerable interest to fresh water fishery biologists.

SUMMARY

A lightweight AC backpack fish shocker was designed for use on rough mountain streams of Southern National Forests. Basic design incorporates the following features.

1. **Versatility**—Can be used by one man requiring a second man only for safety purposes and for carrying fish.
2. **Simplicity**—Can be assembled by two men in 3-4 hours' time. Most repair work can also be accomplished in the field.
3. **Portability**—Weighs only 19 pounds.
4. **Low Cost**—Components for the backpack and the electrode system cost approximately 100 dollars. Operating costs are minimal since only two men are required when using this gear.

Over 100 fish population samples were taken, with satisfactory results, over a 16-month period. During this time, no maintenance was required other than changing spark plugs and replacing netting on dipnets.

ACKNOWLEDGMENTS

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PRODUCTION AND RETURNS FROM THE COMMERCIAL PRODUCTION OF FISH IN ARKANSAS DURING 1966*

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J. MAYO MARTIN,[1] B. R. WELLS[4]

1967

ABSTRACT

Commercial fish farming is the fastest growing industry in the field of agriculture in Arkansas. Due to its fast growth, allied industries have not kept pace. Part of the difficulty has been the lack of knowledge in the right places as this industry has developed.

To collect statistics on this ballooning industry, a meeting between interested agencies was held at Stuttgart, Arkansas. At this meeting a questionnaire was developed with the idea of programming the information for IBM storage. The results of the questionnaire are discussed in the paper, the information received was expanded to cover the non-responders.

It is the express purpose of this paper to present an accurate estimate of the 1966 commercial fish production in the State of Arkansas. An industry as young as this one with a value of $9,165,000 is worth keeping tabs on.

INTRODUCTION

Commercial fish farming currently represents one of the fastest growing facets of agriculture in Arkansas. Although the industry is relatively young, farm production of fish has experienced an explosive rate of growth. New ponds are rapidly being constructed and the acreage increases monthly. Already land devoted to fish farming represents one-ninth that of the mammoth rice culture in the state (Sneed, 1966).

Recent advances in technology and in the availability of trained personnel have contributed to the growth of the industry and favorable attitudes on the part of lending agencies have given further impetus to the continued expansion. Once considered a highly specialized type of farming which could be of limited importance to the state, fish farming now contributes significantly to farm income. Although early buffalo culture was unprofitable, the returns from the intensive production of minnows and catfish have been good. In Lonoke County, the 1965 contribution to the income of the county from 10,000 acres of fish farming was estimated to be $4 million. Income from 110,000 acres of soybeans, on the other hand, contributed only $6 million (Sneed, 1966).

A rapid change in the major species produced has occurred during the past ten years. Green and Mullins (1959) reported that in 1958, buffalo were the predominant species of food fish raised, usually in some combination with bass, catfish, or crappie. Acreage devoted to this type of commercial fish production was reported to have been 3,446 acres. Minnow culture was not included in their report, but it is estimated to have been about 4,000 acres. A survey of fish farming conducted in 1960 by Stevenson and Meyer (unpublished) indicated that approximately 3,600 acres of buffalo were being raised at that time with about 250 acres devoted solely to channel catfish. By 1963, however, buffalo played only a minor role in managed commercial fish production in the state. An unpublished 1963 survey by Sims and Martin showed that the acreage of buffalo at that time was 748 acres as opposed to 3,585 in 1960. Minnow acreages had increased over 100 per cent, rising from a

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*A portion of this data collected under the auspices of PL 88-309, the Commercial Fisheries Research and Development Act.

** All authors are entitled to equal credit.

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