CONCLUSION

In preliminary test, the channel catfish (*Ictalurus punctatus*) was promising as a commercial species in ponds. With feeding and within a 11-month period, a stocking rate of 1,000 fish per acre gave a production of 773 pounds per acre, while 2,000 fish per acre gave 1,242 pounds. Commercial production awaits the solution of problems involved in reliable and inexpensive rearing of fingerlings for stocking.

REVISED PROCEDURES FOR COMMERCIAL PRODUCTION OF BIGMOUTH BUFFALO FISH IN PONDS IN THE SOUTHEAST

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The bigmouth buffalo (*Megastomatobus cyprinella*) has been grown experimentally in ponds on a commercial basis at Auburn for the past 5 years. Methods of producing the young fish for stocking and results of preliminary experiments on their commercial production to a marketable size have been reported previously.[1] The present paper summarizes these results and reports the results of additional experiments on various phases of the commercial production of this species.

Selection and Care of Brood Fish: Bigmouth buffalo one or more years old and weighing 1 pound or more were found to be satisfactory for brood fish. Two- to 4-pound brood fish were preferred when available because they gave higher production of young fish. Brood fish should be selected from the most rapid growing individuals each fall as ponds are drained. To eliminate external parasites and to reduce disease, the brood fish should be thoroughly examined for parasites or external sores and carefully disinfected before placing them in the wintering ponds.

Treatment for Parasites and Disease: Prior to stocking in wintering, spawning, or other ponds, adult fish should be routinely treated with potassium permanganate at 10 p.p.m. for 1 hour, with formalin at 15 p.p.m. for 6 hours, and with acriflavine at 1 p.p.m. for twelve hours. The treatments can best be made in vats of wood or concrete, or in small earthen pools. Fish must be removed from the permanganate solution or it must be rapidly diluted with fresh water after 1 hour as this concentration is toxic to buffalo fishes at longer exposures. The formalin and acriflavine solutions are not toxic even at prolonged exposures. These treatments kill external protozoan parasites, gill flukes, and disease organisms on the body surface or in the water. They are ineffective against internal parasites and diseases.

Such treatments were also ineffective in curing ulcers appearing on the body of the brood fish following loss of scales or mechanical injury. It was found possible, however, to cure these ulcers by swabbing the injured area with cotton dipped in 20 per cent potassium permanganate solution. Care must be taken to keep this concentrated solution from coming into contact with the gills of the fish.

Wintering the Brood Fish: The treated brood fish should be stocked in the wintering pond during the period November-January. The pond should have water 4 to 6 feet deep and should not have a constant stream of fresh water pouring into it. When brood fish were wintered at the rate of 1,000 pounds or more per acre of wintering pond, excretion from the fish built up a repression preventing reproduction in that water. When stocked at 580 pounds per acre in December, reproduction was prevented until heavy rains occurred at a temperature of 70° F. in March. Heavy inflows of fresh water at temperatures

1 Swingle, H. S. Experiments on commercial fish production in ponds. Proc. Southeast. Assn. Game and Fish Comm. 1954:69-74.

above 60° often caused spawning, apparently by dilution of the repressive factor. If there is little or no dilution of the repressive factor, reproduction will not occur until the brood fish are transferred into spawning ponds for laying.

While in the wintering ponds, the brood buffalo fish were fed Auburn No. 1 fish feed [2] at the rate of 1 per cent of their body weight daily while water temperatures were above 55° F.

Spawning: Prior to flooding, the spawning pond should remain dry and preferably grow a crop of grass upon which the eggs may be laid. Bigmouth buffalo will lay eggs in the spring when water temperatures rise to 60° F. or above. Consequently, the brood fish should be kept in the wintering pond until the water temperature is 65 to 70° F. The spawning pond should then be filled with fresh water from a stream, or pond that does not contain this species. The brood buffalo may then be stocked at the rate of 50 per acre and will usually spawn the following day. In experiments at Auburn, equal numbers of males and females were stocked. The males can be recognized in the spring as milt can be expressed with light pressure against the sides of the fish. Also, the cheeks of the male feel rough, while those of the female are smooth.

It was found possible to obtain spawning when bigmouth buffalo were removed from the wintering ponds in March, April or May and placed in spawning ponds filled with fresh water. Eggs were laid at temperatures from 60° to 80° F. However, heaviest spawning occurred when the brood fish were transferred to spawning ponds shortly after the water temperature reached 60° to 65° F. Eggs hatched in 5 days at temperatures between 65° and 70° F.

While the buffalo brood fish normally laid eggs within 48 hours after being stocked in spawning ponds, they occasionally failed to spawn promptly because of falling temperatures or immaturity. If eggs had not been laid within 1 to 2 weeks, it was found necessary to drain most of the water and refill with fresh water before spawning would occur. After spawning, the brood fish were removed with a large-mesh seine to reduce danger of transmission of parasites and disease to the young fish.

Raising Fingerlings for Stocking: The newly-hatched fish may be left in the spawning pond, or removed when about 1 inch long to another pond for rearing to a fingerling size and for holding until needed for stocking. The number required for stocking should be seined and removed to holding tanks or vats where they should be treated with 15 p.p.m. formalin plus 2 p.p.m. acriflavine for 2 to 4 hours. They are then ready to stock in holding pond at rates up to 10,000 per acre. The pond should be fertilized at the rate of 100 to 200 pounds 8-8-2 per acre each month till October. At that time the fingerlings should be 4 to 5 inches long.

Raising Fingerlings to Market Size: Prior to stocking the fingerlings in large commercial ponds, they should be placed in vats and disinfected with potassium permanganate, formalin, and acriflavine as described previously.

The rate of stocking will depend upon the size of marketable fish desired and the length of time the pond is to be operated before the fish are harvested. In all experiments at Auburn, the ponds were fertilized at the rate of 100 pounds 8-8-2 per acre per application and 13 applications were made during the period of February to October. Also, from 25 to 200 largemouth bass per acre were stocked along with the buffalo to feed upon wild fish; the most satisfactory rate was between 25 and 50 per acre.

In a 9-month period, June to March, a stocking of 432 buffalo (5-inch fingerlings) per acre resulted in an average production from 3 experiments of 586.2 pounds per acre at an average cost for fertilizer of 6.2 cents per pound of fish produced. The average size of the bigmouth buffalo raised in these tests was 1.3 pounds.

Since buffalo fish of larger size sell at higher prices, lower stocking rates were tried. The average results from 2 replications with stocking rates of 120 and 240 buffalo (5-inch fingerlings) per acre were as follows (Table I): In a 6-month period, the average sizes of fish from both rates of stocking were

2 The Auburn No. 1 fish feed was developed by E. E. Prather of this Station as a supplemental feed for minnows and consists of 35 per cent soybean oil meal, 35 per cent peanut oil meal, 15 per cent fish meal and 15 per cent distillers dried solubles.

approximately equal—1.3 pounds, while after 18 months those stocked at 120 per acre averaged 3.6 pounds and those at 240 per acre 2.4 pounds each. The higher rate of stocking produced the greater poundage of fish at the end of both the 6-month and 18-month periods, and resulted in a lower cost for fertilization per pound of fish produced.

TABLE I

AVERAGE PRODUCTION PER ACRE FOR BIGMOUTH BUFFALO IN A 6-MONTH AND 18-MONTH GROWING PERIOD AT TWO RATES OF STOCKING

Rate of Stocking Per Acre (Number)	*Average Initial Weight (Pounds)*	*Recovered on Draining After 6-Month Period* 1				*Recovered on Draining After 18-Month Period* 2			
		Number	*Total (Lbs.)*	*Average Size (Lbs.)*	*Cost Per Lb.* 3 *(Cents)*	*Number*	*Total (Lbs.)*	*Average Size (Lbs.)*	*Cost Per Lb.* 3 *(Cents)*
120	0.05	98	135.4	1.38	15.4	120	423.8	3.6	10.4
240	0.05	184	244.2	1.33	8.6	228	540.8	2.4	8.3

1 May 4 to October 26, 1954.
3 Cost of fertilizer only.
2 May 4, 1954 to October 24, 1955.

In general, these results are similar to those obtained in experiments with other types of fish. Low rates of stocking produced fish of large size, gave low production per acre and a high cost per pound. Higher rates of stocking produced smaller fish, higher production per acre, and lower costs per pound. Since, for species such as buffalo, large fish sell at premium prices, it may often be profitable to use lower rates of stocking to produce fish of large size despite lower production per acre.

With the production reported (Table I), if the 2.4-pound fish obtained as a result of stocking at 240 fish per acre sold at 20 cents per pound live weight, the return per acre for labor, capital and management costs would be $63.27; the 3.6-pound fish obtained by stocking at 120 fish per acre would have to sell at 25 cents per pound, a 5-cent premium for larger size, to return $63.18 per acre. The most profitable rates of stocking thus are dependent upon the market prices for fish of various sizes. For most profitable operation, the fish farmer must know the initial rates of stocking necessary to obtain salable fish of various sizes and also the production per acre he can expect with each rate.

Loss on Dressing Bigmouth Buffalo: While in certain areas, buffalo fish may be sold by the grower alive or iced without dressing, most fish must be sold cleaned and dressed. They may then be iced for the fresh-fish trade or quick-frozen. Since the dressed fish are beheaded, skinned, and the viscera removed, a considerable loss in weight in the saleable product results. Records were kept on this loss for bigmouth buffalo weighing 2.4 pounds live weight each:

Total Live Weight	60.4 pounds
Loss (heads, skins, viscera, body fluids)	31.9 pounds (47 per cent)
Total Dressed Weight	36.5 pounds (53 per cent)

The bigmouth buffalo fish, therefore, dressed out at 53 per cent of their live weight. Consequently, when the grower's cost of production was 10 cents per pound live weight, his cost per pound of dressed fish was 19 cents plus the cost of labor of dressing.

SUMMARY OF REVISED MANAGEMENT PROCEDURES

The revised management procedures for the production of bigmouth buffalo on a commercial basis are as follows:

1. Select the fastest growing bigmouth buffalo for brood fish each year as ponds are drained.
2. Disinfect the brood fish with 10 p.p.m. potassium permanganate for 1 hour, and with 15 p.p.m. formalin plus 1 p.p.m. acriflavine for 12 hours prior to

stocking into the wintering pond. Raw spots or ulcers should be swabbed with cotton dipped in 20 per cent potassium permanganate.

3. Stock into wintering ponds in the fall at rates of 1,000 to 2,000 pounds fish per acre and feed at 1 per cent of their body weight per day while water temperatures are above 55° F., using Auburn No. 1 feed.
4. When water temperatures in the spring rise to between 65° and 70° F., fill the spawning pond with fresh water from a well or a pond or stream which does not contain buffalo fish. Disinfect the brood buffalo with 10 p.p.m. potassium permanganate for 1 hour and stock at the rate of 50 per acre.
5. Eggs are usually laid the next day after brood fish are stocked into spawning ponds, but egg-laying may be delayed for a week if unsuitable temperatures occur or the eggs are not fully mature. If eggs are not laid within a week, drain out almost all the water and refill with fresh water. Eggs hatched in about 5 days at 65°-70° F. The number of young produced per acre averaged between 30,000 and 100,000 per acre.
6. Brood fish should be removed from the nursery pond by seining shortly after the young fish hatch. This is to reduce danger of transmission of parasites and disease to the young fish. After the fry reach a size of 1 inch, they may be stocked into nursery ponds at rates up to 10,000 per acre or left in the brood ponds to grow to a larger size. Prior to stocking into the nursery pond the young buffalo fish should be disinfected with 15 p.p.m. formalin plus 1 p.p.m. acriflavine for 2 to 4 hours.
7. Fertilize the pond containing the small buffalo with 100 pounds 8-8-2 once monthly until October. The fingerlings should be 4 to 5 inches long by October and may be stocked into large growing ponds during the fall, winter or following spring.
8. The rate of stocking into growing ponds varies depending upon the size of fish desired for market, the productivity of the ponds and the length of the growing period. In ponds at Auburn, stocking at the rate of 250 bigmouth buffalo fingerlings per acre into fertilized ponds produced fish of an average size of 1.3 pounds in 6 months, 2 pounds in 1 year and 2.4 pounds in 18 months. Stocking at the rate of 120 per acre yielded fish averaging 1.3 pounds in 6 months and 3.6 pounds in 18 months.
9. After stocking the buffalo fingerlings, growing ponds should be stocked with 25 to 50 largemouth bass fingerlings per acre to feed upon any wild fish present and thus reduce their competition with the buffalo.
10. Ponds may be drained and fish harvested at any time of the year after the fish have reached a suitable size for sale. Production has varied in fertilized ponds from 600 pounds per acre with an average size of 1.3 pounds to 432 pounds per acre averaging 3.6 pounds. When larger sizes were produced, the pounds of fish per acre decreased.

PROPAGATION OF CHANNEL CATFISH IN ARKANSAS

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ABSTRACT

The propagation of most game fish and the methods used in producing them have been more or less established; and with the exception of small details are relatively the same throughout most of the South.

The propagation of Channel Catfish (*Ictalurus lacustris*) has from all appearances been more difficult, because of the wide range of methods used and the wide range in cost of production.

The demand for Channel Catfish in the state of Arkansas was increasing steadily, and upon my return from the armed services, Mr. Joe Hogan of