

# THE PRODUCTION AND COMPARATIVE GROWTH OF THREE BUFFALO HYBRIDS

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## ABSTRACT

Hybrids were produced by crossing the black, smallmouth, and bigmouth buffalo fishes. Growth-rate data for a two-year period are presented. The black x bigmouth individuals showed a pronounced acceleration of growth over that of the other hybrids and their parent species.

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## INTRODUCTION

The greatest production of fish per acre of water is possible through the utilization of species with short food chains (Riggs, 1957). According to the food habits of the buffalo as determined by Moen (1954), the genus *Ictiobus* should be well suited for intensive culture on fish farms.

Artificial culture of the buffalo fishes has been practiced by fish farmers for the past several years. Although production has been as high as 3,000 pounds per acre after two years, the individual sizes of the fish produced have been too small to bring prime market prices. Until fish farmers can produce larger buffalo in a reduced period of time, the culture of these species is not economically feasible.

One means of overcoming this problem is to improve the genotypes of the species. Three general approaches are possible: selection, inbreeding, and cross-breeding or hybridization. Since cross-breeding has often produced progeny with hybrid vigor, that is, more vigorous and larger than their parents, this approach was chosen for study.

Fish culturists have produced several hybrids, many of which have demonstrated an acceleration rate of growth over their parents. Smirnov (1953) developed and described a hybrid between the chum and pink salmon of the Pacific Ocean. He noted that these hybrids showed a shorter period of incubation, a more complete hatch, and faster growth in length and weight of the fry. The splake, a hybrid resulting from the cross of the eastern brook trout (*Salvelinus fontinalis*), and the lake trout (*Salvelinus namaycush*), was described by Buss and Wright (1956). Garside and Christie (1962), reported the successful hybridization between species of *Coregonus* and *Prosopium*. Hybrid fishes are not always the product of man's ingenuity since such individuals are often found in nature (Hubbs, 1955). Buffalo fish hybrids have been reported in nature. Trautman (1957) noted several records of bigmouth x smallmouth hybrids in Sandusky Bay.

## MATERIALS AND METHODS

Sexually mature individuals were collected from local waters to provide milt and roe for this study. Specimens of the bigmouth buffalo (*Ictiobus cyprinellus*), smallmouth buffalo (*I. bubalus*), and black buffalo (*I. niger*) were examined by several members of the staff of the Fish Farming Experimental Station to verify their identification. The

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majority of these fishes ranged in size from three to six pounds. However, larger fish were used occasionally when the preferred sizes were not available.

As spawning time approached, a number of each species was brought into the laboratory and isolated in 20-gallon aquaria. In 1963, groups of females were given injections of chorionic gonadotropin at the rate of 700 units per pound of body weight; males received one-half this dosage. During the 1964 season, natural pituitary was substituted for the chorionic gonadotropin. Groups of females were injected with two milligrams of acetone-dried pituitary per pound of body weight. Again, a group of males received one-half this dosage.

When eggs were free-flowing, the fish were hand stripped and the milt and eggs were combined in small plastic bowls according to the desired cross. After collection, the combined eggs and sperm were stirred with the hand for five minutes to insure fertilization.

Eggs were then poured into standard hatching jars. Although many of them clumped together or adhered to the sides, the eggs could easily be separated after two hours in the jars by rolling them between the fingertips. Eggs adhering to the sides were removed by gently scraping with a glass rod or similar tool. This method was adopted since it consumed less time and proved to be more effective than hardening the eggs in a starch or clay solution for the required two hours.

After hatching was complete, hybrids and controls (fry of the parent species) were taken from the jars and placed in aluminum troughs (four cubic feet) where absorption of the yolk-sac occurred.

Seventy-five per cent of the fry were free-swimming 48 hours after hatching at 66° F. and all were swimming within another eight hours. Yolk-sac absorption was not completed at this stage, so the fry were not fed until the next day when they were observed swimming actively at the surface. Finely ground commercial fish feed (33 per cent protein) in meal form was readily accepted at this time. Pigmentation was now evident and the fry appeared black.

At eight days the fry were transferred to fertilized 0.1 acre ponds containing moderate blooms of diatoms, *Euglena*, *Scenedesmus*, *Eudorina*, and *Cyclops*. Feeding of commercial fish feed meal was continued and additional applications of fertilizer were made as required to maintain the bloom. When the fingerlings reached a size of approximately 50 millimeters in length, the stocking rate was reduced to 5,000 per acre and commercial fish feed crumbs (33 per cent protein) replaced the meal.

During the 1963 spawning season, the hatching system and holding aquaria were supplied with well water ranging in temperature from 63 to 69° F. Water used in the 1964 phase of this study was supplied by a closed-water system in which the water was filtered, aerated, and recirculated at a temperature of 75° F.  $\pm$  .5. Fresh water was added to the system at the rate of approximately one liter per minute to compensate for evaporation and waste. Filter elements built into the system were washed daily, but no additional cleaning or flushing was necessary.

Concurrent with laboratory study, male buffalo were paired with females of another species in 0.1 acre ponds in an attempt to produce hybrids under pond conditions. Daily observations were made to detect spawning activities. The fish were fed daily and fertilizer was added to the ponds as required.

## RESULTS

All possible mating combinations of the buffalo species and their reciprocals were performed during this study. Black x bigmouth\*, duced in the laboratory but only the black x bigmouth occurred in black x smallmouth, and smallmouth x bigmouth hybrids were pro- the ponds.

Brookstock which received injections of chorionic gonadotropin were held in aquaria at an average temperature of 66° F. Twenty-two to 24 hours after injection, some of these fish were successfully stripped of eggs and milt. Several females required repeated injections to bring them to maturity; others never produced free-flowing eggs.

In 1963, eggs were incubated in the hatching jars at a tempera- ture of 66° F. At this temperature, 36 hours were required for develop- ment and hatching. Numerous eggs failed to hatch and others were noted in which the hatching process could not be completed. In these, the tail protruded from the egg membrane but the body failed to emerge. Such "tailed-eggs" could be observed struggling about in the jars. When a number of eggs, including several with incomplete hatch- ing, were placed in a heated aquarium (80° F.) all fry emerged nor- mally within two hours. Fry held at 66° F. required 45 to 50 hours to become free-swimming.

In 1964, the eggs were incubated at 75° F. At this temperature level, no abnormalities were noted and the hatching time was reduced to 24 hours. Fry became free-swimming in 36 hours.

Hatching percentages were widely different in 1963 and 1964. In 1963, at the lower water temperature, hatches were poor and num- erous dead eggs were removed. The time required for hatching and swim-up was grater at 66° F. than at 75° F. Data from 1963 and 1964 are summarized in table 1.

TABLE 1. HATCHING LEVELS OF EGGS OBTAINED IN MAT-  
INGS BETWEEN BUFFALO SPECIES, 1963 AND 1964.

Cross	Percent of hatch	
	1963	1964
smallmouth x black	0	0
black x smallmouth	65	98
smallmouth x bigmouth	30	95
bigmouth x smallmouth	0	98
bigmouth x black	0	98
black x bigmouth	65	98
smallmouth	25	95
black	5	30
bigmouth	60	95

Sampling data taken throughout the growing season indicated an accelerated growth rate by all hybrids, especially by the black x big- mouth cross. No significant variation in growth rates was discernible between the black x bigmouth fry produced in the pond and the same cross produced in the laboratory. Figure 1 shows the growth of each hybrid and that of the controls during 1963. The black x bigmouth showed a significantly accelerated growth rate when compared to the controls. At the end of the growing season, this hybrid was twice as long as the controls, and five times heavier.

At the end of the first growing season 200 fish from each cross and an equal number of controls were stocked in duplicate 1.0 acre ponds. By this means, hybrids and controls were subjected to identical

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\* Females listed first in all crosses.

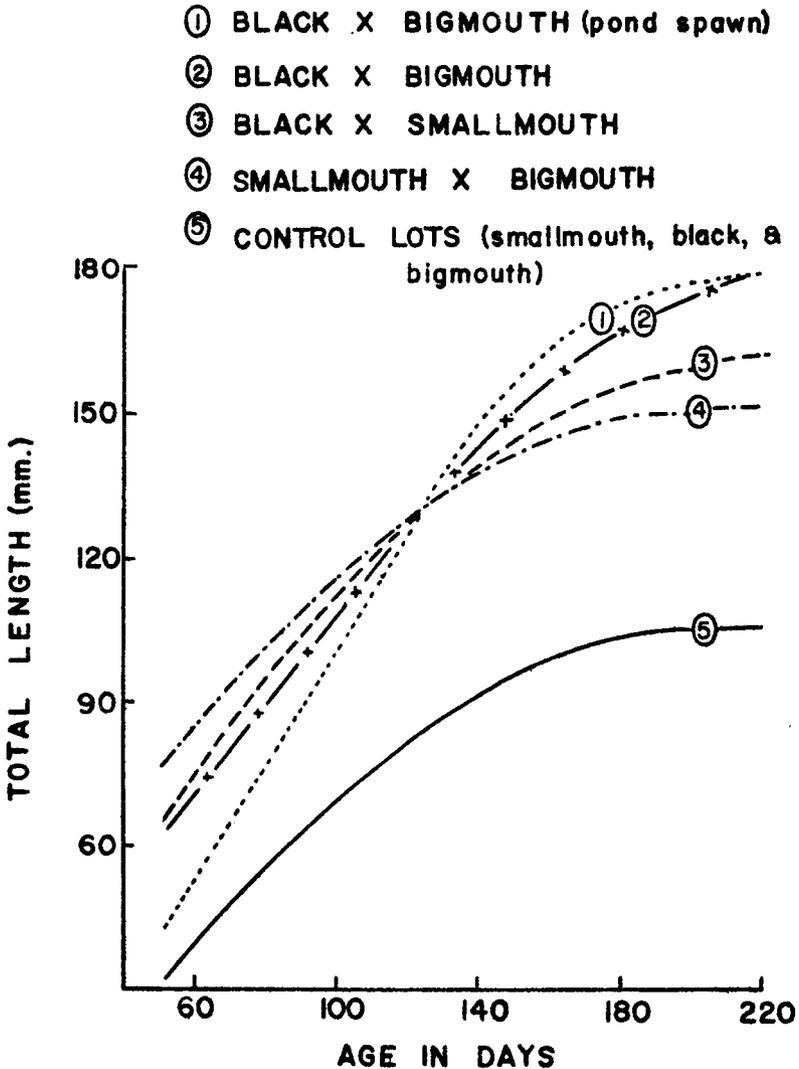


Figure 1. Growth of hybrid and non-hybrid buffalo fingerlings.

environmental conditions and population densities. Since no morphological differences were apparent at this time, each hybrid was identified by a fin-clip. Throughout the second growing season the black x bigmouth hybrid continued to demonstrate its ability to outgrow the other hybrids and its parent species.

Growth data were subjected to an analysis of variance. The black x bigmouth hybrid was consistently 33 per cent heavier and 10 per cent longer than the parent species, at the eight and one per cent level of significance, respectively.

The black x smallmouth hybrid was 10 per cent longer than the controls but weighed the same. Growth of the smallmouth x bigmouth hybrid was equal to that of its parent species.

The hybrid individuals were examined in an effort to detect dominant morphological characteristics which might have been retained from either parent species. Twelve characteristics were studied, namely: body depth in total length; diameter of eye in head length; diameter of mouth in head length; gut length in total length; diameter of eye in head width; length of upper jaw in snout length; dorsal fin-ray count; angle of mouth; striation of mouth; pharyngeal arch; gill-raker count; and posterior fontanelle. In each characteristic, the morphology of the hybrid was found to be intermediate to the parents. Additional specimens were sent to Dr. G. A. Moore<sup>1</sup> who also found this to be true.

## DISCUSSION

No studies have been made to test the fertility of the hybrid since the individuals are still too young. Various other workers have found disproportionate sex ratios or varying degrees of sterility in hybrid fishes (Ricker, 1945 and Lagler and Steinmetz, 1957). If the degree of sterility in the black x bigmouth hybrid is high, still another advantage would be accredited to this cross since, in cases where fish must be retained for a three-year period, chances of over population resulting from spawns of the stocked fish would be reduced.

Should the black x bigmouth hybrids continue to show the accelerated growth rate during their third year of life, it would be possible to produce a market-sized fish in two years after stocking instead of three or more years as is now required.

Several factors favor the artificial method of fertilizing and hatching eggs. Under controlled conditions, made possible by a closed-water hatching system, eggs will develop rapidly and uniformly, resulting in a high percentage of hatch. Large numbers of fry can be acquired almost simultaneously resulting in a uniform size. The influence of varying climatic conditions is eliminated. The artificial method of culture would provide fry in numbers as desired. Since fry are less difficult to handle than fingerlings, stocking of fry would eliminate losses and handling involved in stocking fingerlings out of nursery ponds.

The results obtained in this study indicate that the optimum temperature for the spawning of buffalo and hatching of their eggs is above 66° F.

## SUMMARY

1. Hybrids resulting from the crosses of the three species of buffalo fishes were produced. All crosses showed accelerated growth rates.
2. Although all hybrids exceeded their parents in length and weight, the black x bigmouth cross showed the most pronounced increment.
3. Hybridization is readily facilitated by artificial spawning and the production of hybrid fry for fish farming should not be difficult.
4. Water temperatures in the range of 66° F. were found to be less than optional for the incubation of buffalo eggs.

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## EVALUATION OF SLAT TRAPS AS COMMERCIAL FISHING GEAR IN LOUISIANA

by

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### INTRODUCTION

Dingell-Johnson research project F-5-R dealt with an evaluation of commercial fishing gear in Louisiana and, when completed in 1959, recommended certain changes in the commercial fishing laws. The legalized use of wooden slat traps for catfish was one of the proposals. Project research had indicated that slat traps were selective for catfish and it was thought that there would be a need for such gear should the minimum mesh size of 2.5" bar measure be adopted. An industry which depended strongly on the use of 1.0" or 1.5" square mesh nets for capturing catfish had developed in certain areas of Louisiana. It was evident that those fishermen would need a selective and efficient gear to continue their harvest.

The proposed changes in commercial fishing regulations were enacted by the legislature in 1960 and were scheduled to become effective on May 1, 1961. This legalized the use of wooden slat or basket traps having slats six inches or less in width spaced so as to leave at least a one inch opening between slats. However, just before the date on which slat traps were to become legal gear that portion of the law which legalized their use was suspended by Senate Concurrent Resolution Number Eleven until further action by the legislature. The