PRELIMINARY EXPERIMENT ON THE CULTURE OF BLUE, CHANNEL AND WHITE CATFISH IN BRACKISH WATER PONDS

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ABSTRACT

This paper reports on pond culture experiments conducted when fingerling blue, *Ictalurus furcatus*, channel, *I. punctatus*, and white catfish, *I. catus*, were stocked in nine brackish water ponds at Rockefeller Wildlife Refuge. All three freshwater species were stocked in ponds with an equal amount of acclimatization to determine survival, growth, food conversion, and to determine if freshwater catfish could be raised in brackish water ponds. In the past, fish culturist felt that catfish could not be grown in coastal ponds with salinities of over 1.5 parts per thousand. In the Rockefeller ponds the salinities ranged from 2.0 to 11.0 ppt.

Growth was good among all species. The channel and white grew best, averaging 1.3 and 1.0 pounds apiece. The blues average 0.6 pound. The results of the study proved very promising. Even though survival was low, it is surprising that the mortality was not higher. Predation, mostly by otters, alligators, mink and snakes, was tremendous.

Some of the fish were eaten at the cessation of the study since it was feared that they would possess a marshy taste. The taste of all fishes was rated excellent and none had a muddy taste or offensive odor.

INTRODUCTION

The increase in catfish farms in Louisiana is a good indication that the demand for catfish is growing. Multitudes of papers have been written on culture, feeding, parasites, transport and harvest of this commercially important delicacy. There are no listings of catfish culture in coastal ponds containing brackish water (both fresh and salt water are mixed). Louisiana with its vast coastal marshlands may possess a great potential in brackish water fish culture.

Monstrous blue catfish have been collected from our Pass-a-Loutre Waterfowl Management Area located at the mouth of the Mississippi River. This is in brackish waters. After talking to several potential catfish farmers, located on areas that possessed only brackish waters, it was decided to evaluate the three most accepted catfish species for pond culture and determine which if any could be reared in saline waters. The three species selected were blue, *Ictalurus furcatus*, channel, *I. punctatus*, and white catfish, *I. catus*.

The esturaries of Louisiana are reported to be the most fertile in the world with untild tons of fishes and other animals being produced yearly. For example, Kelley (1965) reported that over 34 tons of blue catfish are harvested annually on the 48,799 acre Delta National Wildlife Refuge alone. His data also indicated that very few channel catfish are harvested; and a ratio of 200:1 existed between the blue and channel catfish respectively.

Data from another study on Rockefeller Wildlife Refuge indicated that blue catfish were also dominate over channel catfish and that possibly a 2:1 ratio existed between the two species (Perry, 1967). Both species were collected from waters yielding such marine animals as blue crabs, *Callinectes sapidus*, shrimp, *Penaeus sp.*, red drum, *Sciaenops ocellata*, southern flounder, *Paralichthys lethostigma*, and Atlantic croaker, *Micropogon undulatus*.

Gunter (1945) took blue catfish in very limited numbers from Texas bays. He reported that one was taken from waters containing 6.3 ppt salinity. Rounsefell

(1964) took blue catfish from waters with salinities of 6.5 ppt.

Kelley (1965) in a taxonomic survey of the fishes at the Delta National Wildlife Refuge recorded 193 blue catfish taken from esturaine waters. He stated that salinity may be a limiting factor on distribution when a concentration of 2.0 ppt was reached. Blue catfish were taken in connection with an age and growth study (Kelley and Carver, 1965) from waters having salinities less than 7.0 ppt. Most were taken in waters having salinities ranging from 0.8 to 2.0 ppt.

Kelley reported that during his taxonomic survey only one channel catfish, 13.0 inches in total length, was captured in 1.03 ppt salinity. Bayless and Smith (1962) reported the absence of channel catfish in the brackish waters of the Neuse River, North Carolina.

The white catfish is not native to our state, but is found in coastal areas of other states and possess qualities resembling the more commercially known blue and channel catfish. It was originally described as inhabitating the Atlantic coastal states of the United States. Now it is found in the middle west and even into Nevada and California where it supports a substantial sports fisheries (Borgeson and McCammon, 1967). It is reported as being adapted to a variety of habitats including brackish waters.

DESCRIPTION OF STUDY AREA

The research ponds used in this experiment are located in the coastal prairie marshes of Southwest Louisiana on Rockefeller Wildlife Refuge. The refuge, comprising 85,000 acres, is located in the southeast corner of Cameron Parish and southwest corner of Vermilion Parish (Fig. 1).

The Rockefeller marsh resulting from an ancient change in the course of the Mississippi River has an average elevation of 1.1 feet above sea level, average tidal fluctuation is approximately 18 inches between mean low and high tides. However, storm tides range from two to ten feet above mean high tide. The average annual precipitation is 51.9 inches. The water table over much of this marsh is equal to the

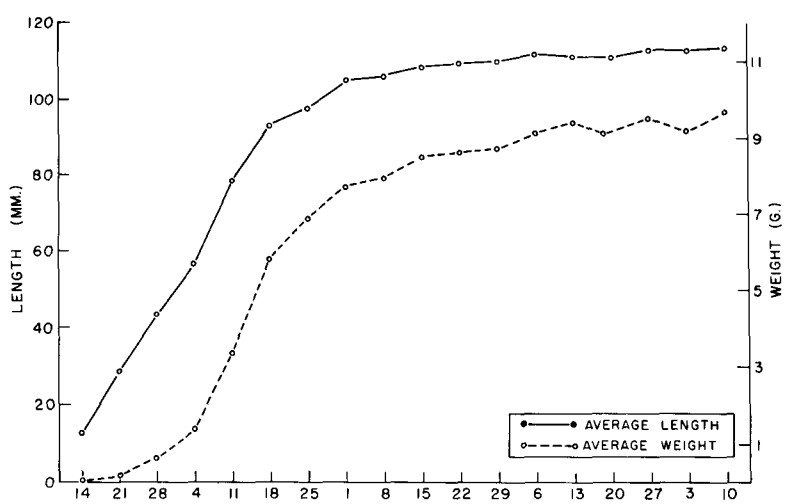


Figure 2. Growth of white shrimp over a 4-month period in 1966.

Figure 1. Rockefeller Wildlife Refuge, Grand Chenier, Louisiana.

land surface and the salinities of the waters vary from 0.1 ppt to 30 ppt. Cameron Parish has a mean temperature of 68.2 degrees. The research ponds had surface temperatures ranging from 39 degrees Fahrenheit to 98 degrees Fahrenheit.

The marsh land is broken by intermittent shallow lakes, bayous and pot holes. The floor is high in organic material with a typical salt marsh flora. Major plants present are *Spartina patens, Distichlis spicata, Eleocharis sp., Scirpus robustus* and *Ruppia maratima.*

The nine catfish ponds, one-tenth acre each, are arranged along a water reservoir canal that runs through a complex directly to the Gulf. Surrounding each pond is an eight foot levee which measures 20 feet at the base and 10 feet at the crown. The average depth of the ponds was four feet. Pond bottoms for the most part are identical with the surrounding marshes. Pond bottoms are high in organic matter. One to four feet of ooze or muck had accumulated by harvest time as would be expected of a humus type salt marsh. The clay pan is approximately 15 feet (Nichols, 1959). Water had to be pumped to and from the research ponds as the levees were still settling and would not permit the placement of permanent water lines.

MATERIALS AND METHODS

Fingerling blue, channel and white catfish were stocked at a rate of 2,000 per acre in a total of nine ponds at Rockefeller to determine survival, growth, food conversion, and to determine if these freshwater catfishes could be raised in brackish water ponds. All three species originally came from freshwater. Blue catfish fingerlings came from Dumas, Arkansas, white catfish from Auburn, Alabama and channel catfish were obtained locally. The fingerlings were transported to the refuge in water containing 15 ppm formaldehyde and 1 ppm acriflavine in order to eliminate parasite problems. All ponds were stocked on April 16, 1967.

Initially, fish were fed 10 per cent of body weight per day for approximately a month and a half. At this time it appeared that they were use to the feed and the ration was cut to the standard 3 per cent body weight. Excessive temperatures (surface, 90-98) in July and August necessitated that the feeding rates be cut to 1.5 per cent of body weight. A commercial catfish ration was fed during the duration of the study.

After the ponds were stocked, they were seined bi-weekly to determine growth and to adjust the feeding rate. Good representative numbers were difficult to obtain because of the irregularity of the pond bottoms. We obtained our best results immediately after feeding.

Fish in pond B-7 through B-13 were harvested February 2, 1968 and B-14 and B-15 were drained on February 15, 1968. These ponds were first seined with a 3/4 inch mesh nylon net. Then we dropped the ponds to the basin and seined until most of the fish were recovered. After, we pumped all of the water possible from the basin, the remaining fish were dipped from the muck as they surfaced because of lack of oxygen. The fish were then placed in temporary holding troughs with water circulation. None of the fish were lost due to this handling procedure as the weather was quite cold.

Dissolved oxygen was measured throughout the summer using the Winkler method. Toward the end of this study an electrical galvanic cell oxygen analyser was used.

Pond waters were measured for pH with portable colorimetric pH test kits. Constant recording thermometers were used throughout this study. The instruments, Ryan Model D, are the submersible types and remained in place for approximately 30 days.

During the course of the experiment, salinity data was taken using the Mohr method in which the sample is titrated with a standard silver nitrate solution using chromate as the end-point indicator (American Public Health Association, 1960).

Several catfish heads were found on the pond levees in the middle of January. These heads were separated from the fish immediately posterior of the dorsal spine. At first we found from two to five heads a day until the end of the month when as many as 20 were found on a single pond levee. The tracks found on the levees were

identified as being those of an otter. Otters have a vast territory and evidently a family had included our ponds in their route. Methods used for their capture were trapping and setting of gill nets in areas they frequented.

RESULTS

The production of catfish in brackish water ponds on an experimental basis had not been tried before. Until now, workers believed that channel catfish could not be grown in waters with salinities of over 1.5 ppt (Davis and Hughes, 1967). However, data from an earlier study on the Rockefeller Refuge indicated that blue and channel catfish were present. Most species had been collected from waters with salinities ranging up to 11.4 ppt.

Blue, channel, and white catfish were stocked in nine 0.1 acre ponds at the rate of 2,000 per acre, April 16, 1967. The freshwater catfish were stocked with an equal amount of acclimization in the brackish water ponds. Water from the ponds was added little by little to the 150 gallon transport tank until the temperatures and salinities were in close agreement. This procedure took approximately 1 1/2 to 2 hours. The water temperature and the salinity gradent from the tank to the ponds were 74°F., freshwater to 78°F., 2.4 ppt.

Sinking fish pellets were used and a good portion may have been lost to the fish because of the very mucky bottoms or because of the existence of an oxygen deficient layer along the pond bottom. Much natural food was available, especially grass shrimp, crawfish and topwater minnows belonging to the family Cyprinodontidae.

The average weights were checked throughout the summer for adjusting feeding amounts. Inconsistencies were evident in that some samples showed a reduction in growth following samples. Since there is no way of measuring the seined fish each time it is assumed that the reduction in average size was due to apparent sample variation.

Pond temperatures were recorded at a depth of 3.5 feet in order to get a clearer picture of the minimum-maximum temperature range during the study period (Fig. 2). The surface waters naturally had much greater extremes.

The average salinities of the ponds was 2.0 ppt when the fish were stocked. In the months of September and November the average rose to 9.7 ppt and declined to 7.8 ppt at harvest. The two highest readings were in July when ponds B-14 and B-15 had 11.2 and 10.1 ppt (Table 1). A wide range of salinities resulted because of rainfall and the number of times the ponds had to be refilled due to water loss by evaporation and because of water replacement in oxygen deficient ponds.

Oxygen depletions beginning towards the end of June plagued the study throughout August. Fish were found surfacing due to low dissolved oxygen on nine separate occasions. Twice, fish in three ponds were surfacing simultaneously. However, only ninety-six fish were lost due to oxygen depletions. Oxygen depletions were mainly the results of several hot, windless, cloudy days and the lack of proper water circulation as a preventive. Live fish were examined each time they were found surfacing for possible parasite or disease problems.

Fish were fed seven days a week during early morning hours in order to catch the oxygen depleted ponds before mass mortality. Some fish were lost only on three occasions due to oxygen depletion. All three times the ponds were not fed until late in the morning. On the other six days the ponds were caught in the initial stages of depletion and water from a reservoir pond was immediately pumped in for at least ten hours. Table 2 presents a typical day's reading

The pH of the ponds were determined by a number of factors including the nature of the pond soil, the composition of the water entering the pond, the biological population and the intensity of photosynthesis during the day. Values of pH were measured throughout the study. The majority of the values were in the 8.0 to 8.5 range, although extremes of 7.2 and 9.0 were recorded (Table 3).

It was suggested by numerous observers that catfish grown in these saline ponds might prove to be free of the more common parasites and diseases. None of the fish cultured in this study suffered to a noticeable degree from parasites or diseases.

FIGURE 2. Temperature curve obtained by placing constant temperature recorder 3.5 feet below surface of Rockefeller Fisheries Ponds.

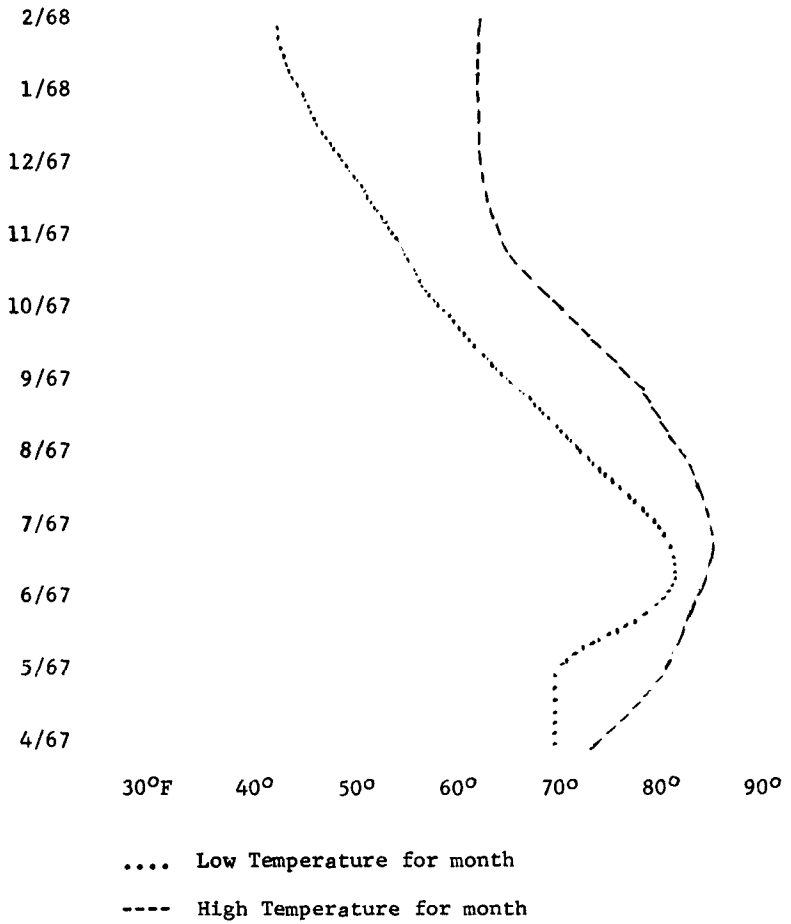


TABLE 1

Salinity data in ppt of catfish ponds, Rockefeller Wildlife Refuge.

Pond	*4/28/67*	*6/7/67*	*6/28/67*	*7/24/67*	*8/17/67*	*9/13/67*	*11/14/67*	*1/23/68*
B 7	2.4	3.3	7.8	7.9	6.7	10.1	11.2	7.9
B 8	1.8	2.5	7.8	8.9	7.9	10.1	10.1	7.9
B 9	2.2	2.9	5.6	7.9	7.9	8.9	9.0	6.7
B 10	2.0	2.7	7.8	7.9	7.9	10.1	8.0	7.9
B 11	1.8	3.5	8.9	7.9	6.7	8.9	9.0	7.9
B 12	2.2	3.7	6.7	7.9	6.7	10.1	9.0	7.9
B 13	2.0	3.2	7.8	7.9	6.7	8.9	9.0	7.9
B 14	2.2	3.2	7.8	11.2	9.0	10.1	10.1	7.9
B 15	1.8	3.2	7.8	10.1	6.7	10.1	10.1	7.9

TABLE 2.

Typical day's dissolved oxygen data in PPM taken throughout the day in catfish ponds, Rockefeller Wildlife Refuge.

	7/25/67 5-6 am		*7/24/67 2-3 pm*		*7/24/67 6-7 pm*	
Pond	*T*	*B*	*T*	*B*	*T*	*B*
B 7	4.00	3.83	14.01	4.62	15.00	13.71
B 8	2.33	2.17	7.73	4.92	8.29	7.57
B 9	3.50	2.83	7.87	3.29	8.00	4.86
B 10	3.00	2.83	7.87	2.62	8.43	4.43
B 11	2.50	2.17	8.40	3.23	8.43	4.43
B 12	2.17	1.83	7.33	4.71	7.71	5.86
B 13	2.73	1.00	10.89	1.33	10.00	1.08
B 14	2.00	2.00	7.47	1.85	7.00	3.43
B 15	3.50	3.50	7.43	5.43	8.29	4.29
Avg.	2.9	2.5	8.80	3.60	9.00	5.5

T – Top
B – Bottom

However, it appears possible that parasite species not yet described could possibly cause future problems in brackish water aquiculture.

Ponds B-7 through B-13 were drained February 2, 1968 and B-14, B-15 were drained on February 15, 1968. Data are presented in Table 4.

It is remarkable that survival was as high as it was. Predation, mostly otters, mink and alligators, were most detrimental to the catfish. At draining time fish heads were observed in most ponds.

Growth was good for all three species (Fig. 3). Of the three species of catfish, the white and the channel grew best. The channel averaged 1.3 pounds apiece at harvest. The blue averaged 0.6 pounds apiece and the whites averaged 1.0 pound. The average S-conversions were 3.2, 10.1 and 5.8 respectively. This, of course, is distorted because of poor survival. In freshwater, blues also grow slower the first two years, but outgrow the channel from the third season (Perry, 1968).

Survival was low, 39.3 per cent for white catfish, 34 per cent for blue catfish and 53.6 per cent for channel catfish; but results indicated that the catfish could be successfully cultured in waters with salinities ranging as high as 11.0 ppt. It is doubtful however that growth would continue at salinities much higher than this.

Some of the fish were eaten after the termination of the study since it was feared that they would have a marshy flavor. The taste was rated excellent by everyone and none had a marshy taste or odor.

Experiments are now being conducted with brood catfish of the three species to determine the effect of salinity upon reproduction. Data collected, thus far, is too incomplete to give results. However, indications are that the fish may not be able to spawn successfully in waters cocontaining salinities in excess of 2.0 ppt.

SUMMARY

Blue, channel and white catfish were all obtained from freshwater hatcheries and stocked in brackish water ponds to determine growth, survival, food conversion and to determine if freshwater catfish could be raised in brackish water ponds.

Each of the species were placed in separate 0.1 acre ponds at a stocking rate of 2,000 per acre. The fish were initially fed 10 per cent body weight; later feeding was dropped to the standard 3 per cent. However, even this had to be reduced during much of the summer, due to excessive heat and rain.

All the species grew well. The now commercially important channel catfish outgrew the others averaging 1.3 pounds, white catfish averaged 1.0 pound, and the

TABLE 3.
Temperature and Ph values obtained from catfish ponds, Rockefeller Refuge.

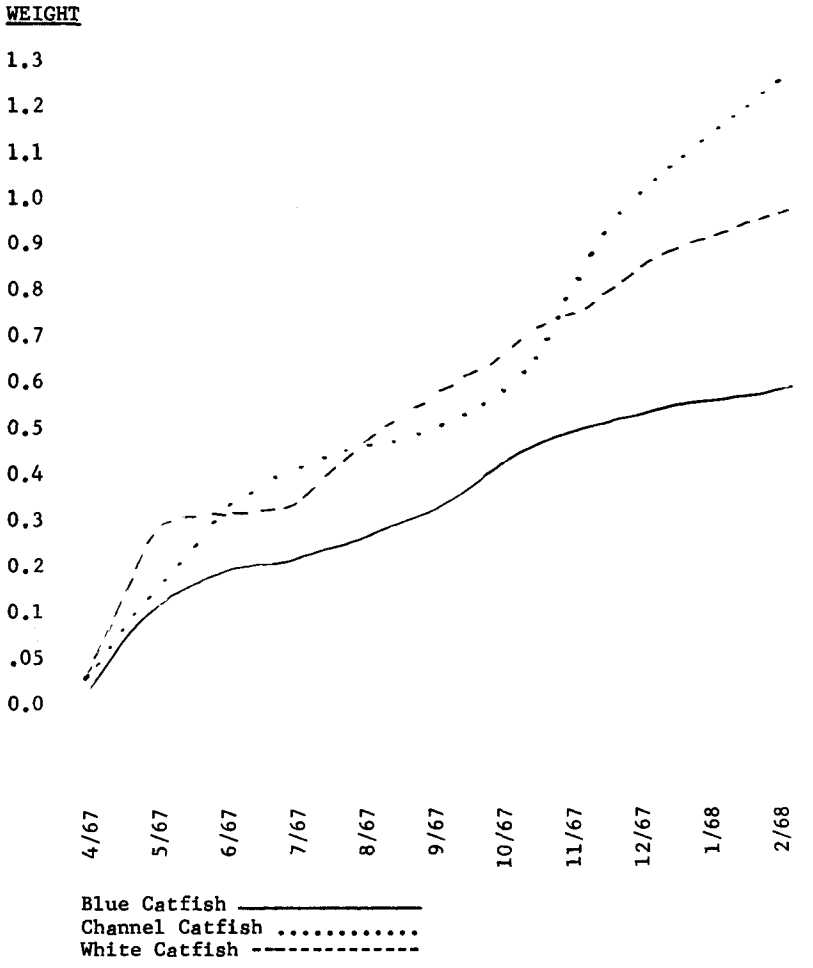
Pond	2:00 pm 4/28/67		7:30 am 6/28/67		2:30 pm 7/24/67		8:00 am 8/17/67		11:30 am 9/22/67		10:00 am 11/14/67		1:00 pm 1/23/68	
	T°F	Ph	T°F	Ph	T°F	Ph	T°F	Ph	T°F	Ph	T°F	Ph	T°F	Ph
B 7	85	8.7	85	8.0	-	9.0	77	7.5	-	7.5	-	8.0	59	7.5
B 8	85	8.6	85	8.0	-	8.5	77	7.5	-	8.0	-	8.0	-	7.5
B 9	85	8.3	85	8.0	-	8.5	77	8.0	-	8.0	-	8.5	-	8.0
B 10	85	8.7	86	8.0	-	8.0	77	8.0	-	8.0	-	8.0	-	8.0
B 11	85	8.6	86	8.5	-	8.5	78	8.0	-	8.0	-	8.0	-	8.0
B 12	85	8.5	87	8.0	-	8.5	79	8.0	-	8.0	-	8.5	-	8.0
B 13	85	7.6	87	8.0	-	9.0	80	8.0	-	8.0	-	8.0	-	8.0
B 14	85	7.2	82	8.0	-	8.0	78	7.5	-	8.0	-	8.0	-	8.5
B 15	85	8.3	86	8.0	-	8.5	79	8.0	-	8.0	-	8.0	58	8.0

TABLE 4.

Growth Data for blue, channel and white catfish grown in 0.1 acre brackish water ponds, Rockefeller Wildlife Refuge.

Pond	*Ictalurus catus*				*Ictalurus punctatus*				*Ictalurus furcatus*			
Number	*B 7*	*B 8*	*B 11*	*Avg.*	*B 9*	*B 14*	*B 15*	*Avg.*	*B 10*	*B 12*	*B 13*	*Avg.*
Number Stocked	200	200	200	200	200	200	200	200	200	200	200	200
Weight Stocked (lbs.)	14.5	4.6	4.9	8.0	7.4	7.0	7.0	7.1	5.6	5.8	5.5	5.6
Average Size Stocked (lbs.)	0.07	0.02	0.02	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03
Total Pounds Fed	501.7	385.9	384.2	423.9	411.5	405.5	415.5	410.8	387.8	390.5	358.5	378.9
Total Days Fed	221	220	216	219.0	220	221	222	221.0	217	218	214	216.3
Number Recovered	71	107	58	78.17	93	112	117	107.3	102	85	17	68.0
Weight Recovered (lbs.)	82.1	107.8	52.8	80.9	99.2	142.2	161.8	134.4	53.6	62.5	13.0	43.0
Average Size Recovered (lbs.)	1.16	1.00	0.91	1.0	1.07	1.3	1.4	1.3	0.52	0.74	0.76	0.6
Survival Percent	35.5	53.5	29.0	39.3	46.5	56.0	58.5	53.6	51.0	42.5	8.5	34.0
S Conversion	7.4	3.7	8.0	5.8	4.5	3.0	2.7	3.2	8.1	6.9	47.8	10.1

FIGURE 3. Growth curve of blue, channel and white catfish grown in Rockefeller Refuge ponds.



blue catfish 0.6 pound. The mortality rates were approximately twice as high for the blue and white catfish than for the channel.

The food conversions were naturally quite high because of poor survival due to predation. The channel catfish had the lower S-conversion of 3.2, the white had an S-value of 5.8 and the blue catfish's value was 10.1.

Data from this study indicates that the three species could be grown in water with salinities of 11 ppt and less. The channel catfish seemed to be the most hardy of the three species, contrary to common belief, and probably would give the best returns to future fish farmers in coastal areas for one or two years growth. However, it is possible that the blue catfish will surpass the others in its second or third year. And, if larger fish are desired this species should be considered. The white catfish, possessing features of a channel and bullhead catfish might be harder to sell to the

public. Even though the flavor is thought equal, or superior, to the blue and channel it is thought of as trash fish to those unfamiliar with it. Also, some of the white catfish that have reached 2.5 to 3 years of age seem to be developing an unusually large head, a feature desired by only a few who enjoy cooking couvillion.

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