CULTURE OF BLUE, CHANNEL AND WHITE CATFISH IN BRACKISH WATER PONDS

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ABSTRACT

Brackish water pond studies were conducted in coastal Southwest Louisiana with blue, *Ictalurus furcatus,* channel, *Ictalurus punctatus,* and white catfish, *Ictalurus catus,* to determine if these freshwater species could be cultured in saline ponds.

The channel and white catfish proved to be the most rapid growing and the most hardy, averaging 0.80 and 0.70 pounds. The blue catfish averaged 0.6 pound. The channel catfish had the lowest S-value of 2.3, the white catfish had a S-value of 2.9 and the blue catfish had a S-value of 4.0. Survival was highest for channel catfish, 91 per cent, and lowest for the blue catfish, 69.6 per cent.

The condition indexes, using standard length, calculated for the white, channel and blue catfish were 2.15, 1.70 and 1.49, respectively. Blue and channel catfish collected from surrounding waters had K values slightly less.

Length-weight relationships were calculated for the pond reared blue, channel and white catfish and were compared to that calculated for wild blue and channel catfish collected from the refuge. The length-weight relationships for the pond reared channel catfish was Log W = -5.530 + 3.196 Log L, blue catfish was Log W = -7.566 + 3.985 Log L, and the white catfish was Log W = -5.487 +3.237 Log L. The R^2 values were 0.998, 0.999 and 0.995, respectively.

INTRODUCTION

The Refuge Division of the Louisiana Wild Life and Fisheries Commission began work in 1966 on brackish water research relating to the ecology and culture of various estuarine species. This is a report describing the results of our pond culture experiments with freshwater catfish that were conducted in the coastal prairie marshes of Rockefeller Wildlife Refuge, Grand Chenier, Louisiana in cooperation with Louisiana State University.

Many persons located along the coastal waters of our state have expressed interest in catfish culture and have asked our advice as to their possibilities since the advent of the recent catfish farming boom. Naturally, they did not wish to go to the expense of constructing a fish farming operation only to find that their fish grow slowly or die because of the presence of salt in their water supply.

Until the 1966 studies were initiated, the production of freshwater fish in brackish waters on an experimental base had not been tried before. A review of the literature resulted in only one mention of catfish production and salinity. Davis and Hughes (1967) had stated in a paper directed toward future catfish farmers in Louisiana that catfish could not be grown in waters with salinities up over 1.5 ppt (parts per thousand). This concentration lessened the acreage of available coastal marshland considerably.

Species selected for this study were channel, *Ictalurus punctatus*, white, *I. catus*, and blue catfish, *I. furcatus*. The reasons for the selection of these particular species are:

1. Channel and blue catfish are native fish well known to Louisianians because of their excellent flavor as a table food resulting in a relatively stable high market value.

2. Blue, white and channel catfish are tolerant of varied environmental conditions and indications are that they do extremely well in brackish water ponds with salinities ranging from 2.0 to 11.0 ppt (Perry and Avault, 1968).

3. Blue and channel catfish have proven desirable to freshwater fish farmers because at normal rates of stocking they attain a harvestable size in a relatively short period.

4. Prather and Swingle (1960) reported that the white catfish spawned readily in ponds and, like blue and channel catfish, responded to supplemental feeding giving a high production per acre.

The purpose of this study was to determine if these more commonly accepted freshwater catfish could be successfully grown in saline waters and to determine the effects of these marsh waters upon growth, survival, food conversion, and palatability.

MATERIALS AND METHODS

Stocking

On March 8, 1968, fingerling white and channel catfish were obtained from Auburn, Alabama and transported by truck to the Southwest Louisiana ponds. The fish were transported in freshwater containing 1 ppm acriflavine and 15 ppm formalin.

The fingerling catfish were weighted and stocked into six 0.1 acre ponds at a rate of 2,500 fish per acre after approximately three hours of acclimation. Only one species was placed in each pond resulting in three replications. The average pond salinity was 6.2 ppt. On April 25, 1968, blue fingerlings were obtained from Dumas, Arkansas and stocked in exactly the same manner as the channel and white catfish.

Feeding

Feeding was begun on March 9, 1968 and continued for approximately 222 days. The fish were fed 10 per cent of their body weight until they were accustomed to a floating ration. At this time the feeding rate was dropped to the standard 3 per cent body weight. Even though a small portion of the floating ration sinks, it was found desirable to mix it at first with a sinking ration in order to get the fingerlings started on the feed.

The fish were fed daily about one hour after sunrise in order that preventive measures could be taken in the event of low oxygen. This proved instrumental in saving three ponds from experiencing a complete die-off during the 1968 study.

Records

Bi-weekly samples of fish from each pond permitted recalculation of feeding rates based on gains made by the fish in each two-week interval. Often, good representative numbers were difficult to obtain by seining because of the irregularities of the pond bottoms. A 30 foot nylon bag seine was initially used. A 5-foot 3/8 inch square mesh treated nylon cast net was found to give better results immediately after feeding the floating feed.

The following limmological factors were measured during the course of this study: salinity, dissolved oxygen, water temperature, pH and turbidity. Initially, salinity data were taken monthly using the Mohr method in which the water samples were titrated with a standard silver nitrate solution using chromate as the end-point indicator (American Public Health Association, 1960). A Model R-S-5 Beckman salinity meter was obtained, October 1968, and used throughout the latter part of the study. The battery operated, electrodeless, induction type salinity meter permitted readings of conductivity in millohms/cm, temperature in degrees Centigrade and parts per thousand salinity to be taken directly from the instrument.

Dissolved oxygen was measured by a Precision Galvanic Cell Oxygen Analyser and the Winkler titration methods.

Water temperatures were recorded at a depth of 3.5 feet below the surface in order to get a more definite picture of the actual minimum-maximum temperature range that the fish experienced during the study period. A Ryan Model D submersible 30-day temperature recorder was used for three-quarters of the study. This was replaced by a Tayler, Model 76J temperature recorder which recorded both atmospheric and water temperature on the same chart.

Values of pH were measured throughout the study using the portable colorimetric Hach pH test kits Models No. 17N and 17H.

Turbidity was determined with the aid of the standard secchi disc.

Harvest

Ponds B-7 through B-10 were harvested December 6, 1968 and on December 11, 1968, ponds B-11 through B-15 were drained. The water was pumped down to a small basin and the fish from each pond were netted and placed in separate holding tanks with water circulation. Immediately after the harvest of the ponds, total and standard length were measured to the nearest millimeter and weights were recorded to the nearest gram.

Comparison of Catfish Species

Length-weight relationships were calculated by the procedure of Lagler (1956) for 75 individuals of each species selected at random. This was compared to data recorded with wild catfishes collected from nearby waters. The length-weight relationship was calculated by first averaging the lengths and weights in 10 millimeter total length increments. The length-weight relationships were based on the average measurements expressed logarithmically. This relationship is $\text{Log } W = \text{Log } a + b \text{ Log } L$.

where W=weight in grams
L=total length in millimeters

In order to compare the relative plumpness of these pond fish to wild fish a coefficient of condition was figured in class intervals in increments of 10 millimeters based on 75 fish for each species and the metric system was used because this coefficient includes the greater portion of the body weight of fish, where:

$$K = \frac{W \; 10^5}{L^3}$$

where W=weight in grams
L=standard length in millimeters
and 10^5 is a factor to bring the K value near unity.

Per cent survival, average weight and S-conversions were calculated for each species.

RESULTS AND DISCUSSION

Pond Hydrography

Pond waters were generally less saline in 1968 (Table I). The average pond salinity was 6.2 ppt when the fish were stocked. An average high of 6.8 ppt existed in June which declined to 4.1 ppt at harvest. This difference is in part because of the heavy annual rainfalls of this section of Louisiana and the greater amount of freshwater draining from the large northern Grand Lake-White Lake complex through the refuge.

The water temperatures of the relatively shallow ponds tended to fluctuate rather closely with atmospheric temperatures. It will be noted

TABLE I. Salinity data in ppt of catfish ponds, Rockefeller Wildlife Refuge, 1968.

Pond	March	April	May	June	July	August	September	October	November	December	Average per pond
B 7	7.0	6.5	6.3	6.1	6.0	5.7	4.4	4.6	4.1	3.8	5.4
B 8	5.9	6.4	6.9	7.1	6.8	6.9	5.5	4.6	4.0	3.7	5.8
B 9	6.0	6.6	6.5	6.1	5.9	5.9	4.9	4.7	4.5	4.0	5.5
B 10	6.1	5.9	5.9	6.1	6.2	6.1	5.9	4.5	4.1	3.9	5.5
B 11	6.0	6.4	6.6	7.0	7.0	7.1	6.9	4.7	3.9	4.3	6.0
B 12	6.0	6.3	6.5	7.1	7.2	6.9	5.8	4.8	4.3	4.3	5.9
B 13		5.9	6.6	7.1	6.9	6.9	5.8	5.1	4.0	4.1	5.8
B 14		7.1	6.9	7.2	6.9	7.1	7.0	6.9	4.1	4.4	6.4
B 15		6.9	7.0	7.1	6.7	6.6	6.7	6.1	3.9	4.0	6.1
Monthly Average	6.2	6.4	6.6	6.8	6.6	6.6	5.9	5.1	4.1	4.1	5.8

Figure 1. Monthly minimum-maximum range of temperatures recorded 3.5 feet below the surface of Rockefeller Research Ponds, 1968.

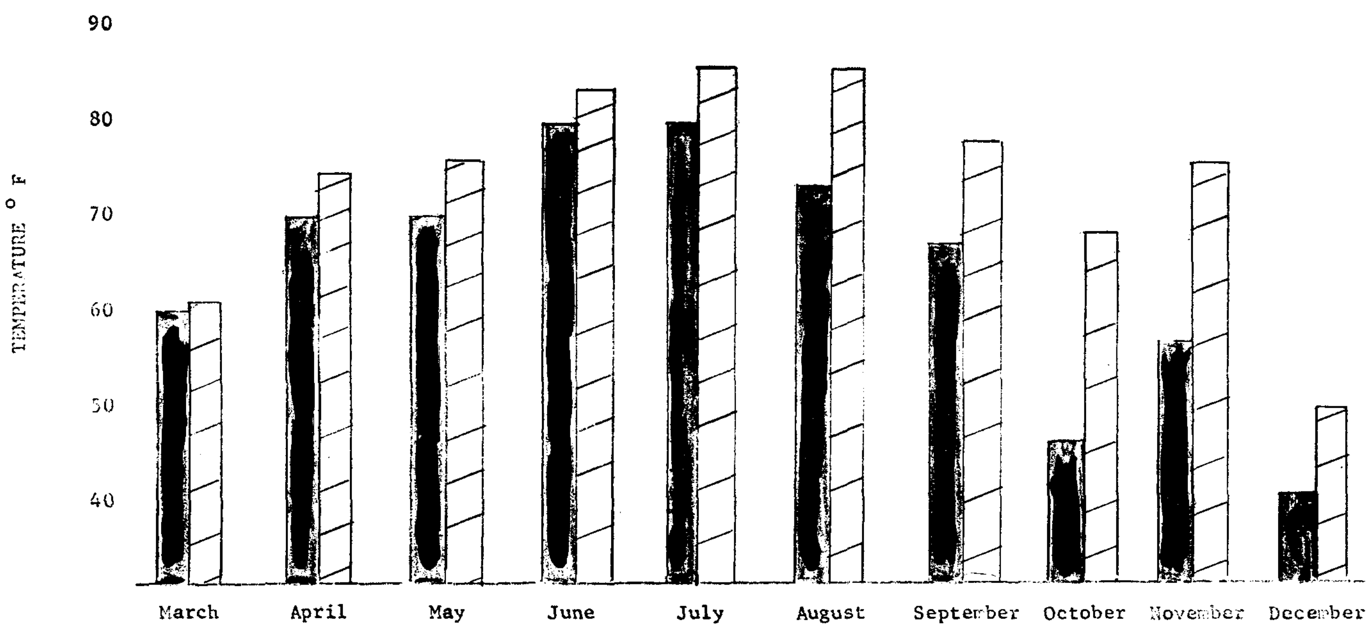

Figure 2. Growth curve of blue, channel and white catfish grown in Rockefeller Research Ponds, 1968.

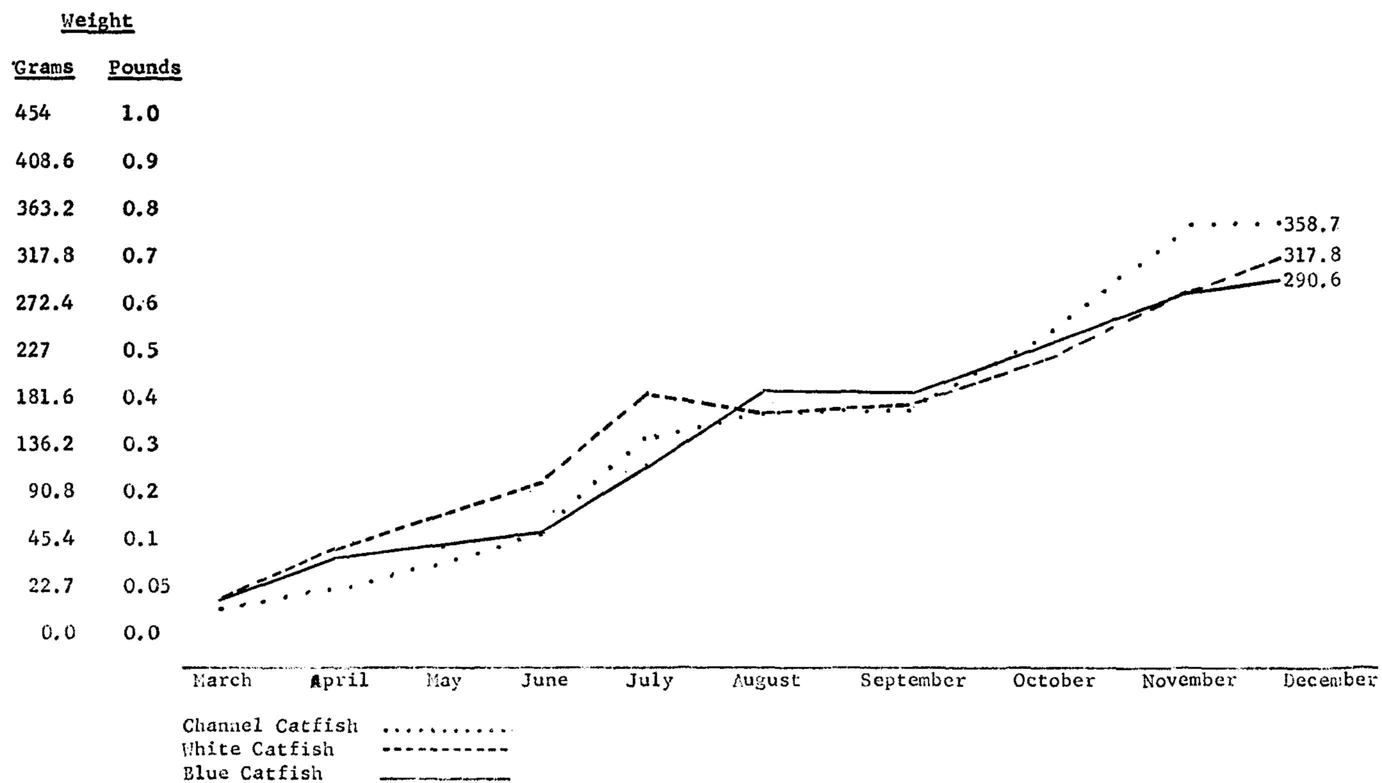

TABLE II. Growth and survival data for blue, channel and white catfish grown in 0.1 acre brackish water ponds, Rockefeller Wildlife Refuge, 1968.

	Ictalurus furcatus				*Ictalurus punctatus*				*Ictalurus catus*			
Pond Number	B 13	B 14	B 15	Avg.	B 8	B 9	B 11	Avg.	B 7	B 10	B 12	Avg.
Number Stocked	250	250	250	250	250	250	250	250	250	250	250	250
Weight Stocked (lbs.)	10.3	9.2	13.0	10.8	6.9	7.1	7.9	7.3	9.1	9.0	9.0	9.0
Average Size (lbs.)	0.04	0.04	0.05	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
Total Pounds Fed	101	399	399	300	406	406	406	406	406	406	406	406
Total Days Fed	89	192	192	158	222	222	222	222	222	222	222	222
Number Recovered	0	188	161	174	233	233	218	228	231	232	183	215
Weight Recovered (lbs.)	0	126.3	97.9	112.1	196.0	175.8	170.7	180.8	171.8	163.8	117.8	151.1
Average Size (lbs.)	0	0.67	0.61	0.64	0.84	0.75	0.78	0.79	0.74	0.71	0.64	0.70
Survival Percent	0	75.2	64.4	69.6	93.2	93.2	87.2	91.2	94.4	92.8	73.2	86.0
S Conversion	0	3.4	4.7	4.0	2.1	2.4	2.5	2.3	2.5	2.6	3.7	2.9

in Figure 1 that the waters were always above 41°F. and below 85°F. which were recorded in the months of October and July-August, respectively.

Pond pH values influenced by such factors as pond soil and water chemistry, pond biological content and the intensity of photosynthesis and respiration varied from 7.5 to 9.0. The readings were constantly in the 8.0 to 8.5 range.

The waters of the ponds were quite turbid with secchi disc readings ranging from 4 to 13 inches. Pond waters were chemically analyzed by the Louisiana State University Feed and Fertilizer Laboratory and found to have the following:

Nitrogen	0.07%
Phosphorus	0.40 ppm
Potassium	80.00 ppm
Magnesium	153.00 ppm
Calcium	34.00 ppm
Salinity	1.6 ppt
pH	7.8

Harvest

With supplemental feeding, the channel, white and blue catfish stocked in March and April of 1968 gave a net production of 1,808, 1,511 and 1,121 pounds per acre, respectively (Table II). The white and blue catfish averaged 0.7 and 0.6 pounds, respectively. The channel catfish averaged 0.8 pound apiece. S-conversion factors averaged from 2.3 calculated for the channel catfish to 2.9 and 4.0 for white and blue catfish. The channel also had the highest per cent survival with the blues having the poorest.

These results followed the same general pattern as those of the earlier 1967 study (Perry and Avault, 1968). However, the average sizes were larger as were the S-factors, in the initial study, which were distorted because of poor survival due to predation and low oxygen. Upon a closer analyses of the data it was obvious that the 1967 fish remained in the ponds over a much longer period than those in 1968. Thusly, these were able to forage for themselves on natural foods attaining a larger size. This factor alone should dispense with any theory that the floating feed was inferior to the sinking ration used in 1967 and perhaps the larger stocking rates of 1968 may be permissible, particularly when predation is a problem.

A floating ration was used in the 1968 study since it was felt that a good portion of the sinking feed used in 1967 was not eaten by the fish because of the very mucky nature of the pond bottoms and due to the presence of an oxygen deficient layer in the deeper areas.

Figure 2 illustrates that some months had negative or no fish growth since there was no definite way of measuring the same fish at each sample period and it is highly possible that runts and hogs were included in the samples. Larger samples would have resulted in a more definite growth curve, but as stated previously bottom irregularity made this practically impossible without draining the ponds.

As in most commercial and experimental ponds it is practically impossible to keep other species from gaining entrance into the ponds. Upon harvest, grass shrimp, crawfish, sheephead minnows, and gambusia were numerous, offering much in the way of natural foods.

Analysis of Data

The mean weight and per cent survival for each of the species were analyzed for variances using a randomized block design with orthogonal comparisons where needed. An analysis of variance of the per cent survival of blue, white and channel catfish grown in 1967 showed the difference for replicas and between species to be statistically nonsignificant ($F = 0.76$, d.f. $= 6.94$; $F = 0.88$, d.f. $= 6.94$, $P < .95$). The analysis of variance for the 1967 growth of blue, channel and white also showed the difference for replicas to be nonsignificant ($F = 0.33$, d.f. $= 6.94$, $P < .95$).

However, the differences between species approached significance ($F = 8.66$, d.f. $= 6.94$, $P<0.05$). Orthogonal comparisons demonstrated the growth of channel catfish to be statistically significant over blue and white catfish ($F = 11.00$, d.f. $= 6.94$, $P<0.05$). No significant difference was found between mean weights for blue and white catfish at the 0.05 level of probability ($F = 6.00$).

The analysis of variances calculated for per cent survival and growth of channel, blue and white catfish in the 1968 experiment showed the differences for replicas (Survival $F = 1.93$, Growth $F = 1.52$, d.f. $= 9.55$) and between species (Survival $F = 2.58$, Growth $F = 4.54$, d.f. $= 9.55$) to be statistically nonsignificant at the 0.05 level of probability for each analysis.

These data indicated that in the 1967 studies the channel catfish were considerably superior in growth than blue and white catfish. However, there was no significant different in the per cent survival of the three. In the 1968 data, Pond B-13, was not considered in the analysis because of 100 per cent mortality experienced early in the study. Allowances were made for the unequal number of replicas of blue catfish in the tabulations.

Length-Weight

Length-weight relationships were calculated for the 1968 pond-reared blue, channel and white catfish for comparison to those calculated for wild blue and channel catfish collected from the refuge. Least-squares fittings of the logarithms of weights and lengths produced the following equations:

Pond Channel $\quad \text{Log } W = -5.530 + 3.196 \text{ Log } L$

Pond Blue $\quad \text{Log } W = -7.566 + 3.985 \text{ Log } L$

Pond White $\quad \text{Log } W = -5.487 + 3.237 \text{ Log } L$

The R^2 value for the channel data is 0.988, or 99.8 per cent of the change in weight of channel catfish is related to change in length. The R^2 for the white and blue catfish were 0.995 and 0.999.

The length-weight relationship for the wild blue and channel catfish is expressed as:

Wild Channel $\quad \text{Log } W = -5.840 + 3.316 \text{ Log } L$

Wild Blue $\quad \text{Log } W = -5.471 + 3.140 \text{ Log } L$

and R^2 for Channel $= 0.974$

R^2 for Blue $= 0.976$

where $W =$ weight in grams

$L =$ total length in millimeters

The regression coefficients (b) from the length-weight equation of each species indicated that weights increased at a rate slightly greater than the cube of the total lengths. It is suggested that if "b" is significantly greater than 3, it may be preferred to use a calculated L^b rather than L^3 in future computations of coefficients of condition.

Coefficient of Condition

Coefficients of condition were calculated for each of the cultured species at harvest in 1968 for comparison with each other and with fish collected from the wild. Table III list the pond-reared white catfish as having a weighted K value of 2.15, the channel as having a K value of 1.70 and the blue had a weighted K value of 1.49. When these channel and blue catfish were compared to fish of approximately the same size taken from the brackish waters of the refuge, the coefficients of condition of the fed fish were higher (Table IV) with the wild channel and blue catfish having coefficients of 1.62 and 1.44.

The difference in the calculated K values was not as great as expected. Simco and Cross (1966) found that the condition advantage of fed fish, unlike wild fish, diminishes as they grow larger, and as their standing crop increases in ponds. They also stated that the coefficient of condition of fed fish actually decreased in late summer. This may account for the very close agreement recorded since the ponds were harvested in December, 1968.

Palatability

Pond-reared catfish are generally considered one of the most delicious of freshwater fish. Catfish obtained commercially from the wild sometimes have a strong taste reflecting the environment from which they were taken. With this in mind we prepared some of the fish at the termination of the study in order to find if any of the fish possessed an odor characteristic of the marsh. The results of these tests were excellent as the fish were rated as superlative.

TABLE III. Length-weight and condition factors calculated for catfish cultured in Rockefeller Research Ponds, 1968

BLUE CATFISH

Class Intervals	Number of fish	Average Total Length	Average Standard Length	Average Weight	K
T. L.					
280-289	3	282	230	178	1.46
290-299	5	293	239	221	1.62
300-309	11	302	246	219	1.47
310-319	4	315	259	244	1.40
320-329	18	324	263	260	1.43
330-339	10	334	274	306	1.49
340-349	10	341	276	311	1.48
350-359	7	353	291	375	1.52
360-369	2	363	295	413	1.61
370-379	3	373	311	472	1.57
380-389	2	388	311	502	1.67
				Weighted Average	1.49

CHANNEL CATFISH

Class Intervals	Number of fish	Average Total Length	Average Standard Length	Average Weight	K
T. L.					
270-279	1	272	214	164	1.67
280-289	3	282	247	191	1.27
290-299	2	294	243	245	1.71
300-309	5	301	247	247	1.64
310-319	5	313	257	283	1.67
320-329	6	322	261	304	1.71
330-339	4	334	274	336	1.63
340-349	12	342	282	385	1.72
350-359	12	352	287	441	1.86
360-369	9	362	301	458	1.68
370-379	9	372	309	520	1.76
380-389	2	380	317	539	1.69
390-399	2	392	331	635	1.75
400-409	2	403	336	612	1.61
410-419	1	415	355	589	1.32
				Weighted Average	1.70

WHITE CATFISH

Class Intervals	Number of fish	Average Total Length	Average Standard Length	Average Weight	K
T. L.					
200-209	2	205	171	104	2.08
210-219	1	210	171	111	2.22
220-229	6	223	181	127	2.14
230-239	1	234	191	150	2.15
240-249	3	243	200	170	2.12
250-259	2	253	205	179	2.08
260-269	9	261	216	215	2.13
270-279	7	272	226	236	2.04
280-289	5	284	234	295	2.30
290-299	4	292	243	295	2.06
300-309	7	305	251	353	2.23
310-319	8	311	258	382	2.22
320-329	1	328	274	468	2.28
330-339	6	332	282	514	2.29
340-349	7	341	288	504	2.11
350-359	3	350	299	546	2.04
360-369	3	360	309	605	2.05
				Weighted Average	2.15

TABLE IV. Length-weight and condition factors calculated for wild channel and blue catfish collected from the brackish waters of Rockefeller Wildlife Refuge, 1968

CHANNEL CATFISH

T. L.					
120-129	2	127	97	14	1.53
130-139	2	133	103	20	1.83
140-149	..	...	...	...	...
150-159	1	157	124	28	1.47
160-169	..	...	...	...	...
170-179	3	171	133	33	1.40
180-189	3	186	143	51	1.74
190-199	1	192	143	45	1.54
200-209	5	204	156	58	1.53
210-219	3	214	166	75	1.64
220-229	11	224	176	89	1.63
230-239	2	232	182	99	1.64
240-249	2	241	192	130	1.84
250-259	1	250	189	130	1.93
260-269	4	265	211	144	1.53
270-279	3	276	221	176	1.63
280-289	2	288	231	200	1.62
290-299	4	294	236	207	1.57
300-309	10	304	241	211	1.51
310-319	2	317	253	235	1.45

T. L.					
320-329	1	322	263	270	1.48
330-339	3	330	271	338	1.70
340-349	..	...	...	...	...
350-359	3	355	292	473	1.90
360-369	2	364	309	549	1.86
370-379	2	370	306	460	1.61
380-389	..	...	...	...	...
390-399	1	396	336	863	2.28
400-409	..	...	...	...	...
410-419	..	...	...	...	...
420-429	2	424	352	590	1.35
430-439	..	...	...	...	...
				Weighted Average	1.62

BLUE CATFISH

Class Intervals	Number of fish	Average Total Length	Average Standard Length	Average Weight	K
T. L.					
130-139	1	137	109	15	1.16
140-149	4	141	110	20	1.50
150-159	10	153	121	27	1.52
160-169	7	165	130	31	1.41
170-179	6	176	138	41	1.56
180-189	5	182	145	43	1.41
190-199	7	193	153	51	1.42
200-209	3	206	163	64	1.48
210-219	4	213	164	59	1.34
220-229	2	222	175	80	1.49
230-239	5	235	187	97	1.48
240-249	1	247	191	111	1.59
250-259	1	253	198	116	1.49
260-269	5	262	210	130	1.40
270-279	6	274	220	147	1.38
280-289	1	288	235	140	1.08
290-299	1	298	241	192	1.37
300-309	1	300	236	180	1.37
310-319	..	...	...	...	...
320-329	..	...	...	...	...
330-339	2	335	267	254	1.33
340-349	..	...	...	...	...
350-359	2	356	293	283	1.13
360-369	..	...	...	...	...
370-379	..	...	...	...	...
380-389	..	...	...	...	...
390-399	..	...	...	...	...
400-409	..	...	...	...	...
410-419	..	...	...	...	...
420-429	..	...	...	...	...
430-439	1	435	360	908	1.95
				Weighted Average	1.44

Problems

Two of the major problems encountered in the pond experiments included levee erosion and pond construction. It was found necessary to build the levees from soil obtained from outside the ponds. Disturbing the pond floor resulted in a bog or muck in which it was impossible to work. Coastal bermuda grass was found to give the best results in holding the levee soils together.

Gravity drainage was particularly impossible if the ponds were below sea level, thus, we tried to locate our ponds above marsh level. Pond levees also experienced as much as 60 per cent shrinkage during drying, a factor which must be considered before laying any permanent water lines.

Oxygen depletions were a problem whenever we were lax in our surveillance of pond waters and did not circulate or freshen them. All of the fish were lost only in one pond in 1968, although they were found surfacing on three occasions in other ponds due to oxygen depletion.

Fish diseases were not experienced during the 1968 study, possibly because of a therapeutic effect of the salt on the fish.

Predation was again a problem. Otters, mink, frogs and snakes were believed to have been detrimental to the fish. Predation by alligators is not as serious as we had once believed. However, of the animals listed, otters were the most detrimental.

Data collected thus far are too inconclusive to give results of salinity upon the reproduction of freshwater catfish. However, as we reported last year, field observations indicate that the fish may not be able to spawn successfully in waters containing salinities in excess of 2.0 ppt.

It should be pointed out that all saline water including, brackish and oil brines will not contain the same proportions of salts as the waters in which these studies were conducted. And possible synergistic or antagonistic interactions may exist causing a difference in these toxic to fish. Therefore, persons interested in farming fish in waters of unknown toxic effects should conduct detail bio-assays or further studies before constructing an elaborate operation.

SUMMARY

Brackish water ponds 0.1 acre each were stocked in order to determine growth, survival, food conversion and to determine if blue, channel and white catfish could be reared in brackish waters.

Growth, survival and food conversion followed the same general pattern as reported in the 1967 study, although the fish averaged more in 1967 due to a longer period of growth. The now commercially important channel catfish outgrew the rest averaging 0.8 pound, the white catfish averaged 0.7 pound and the blue catfish averaged 0.6 pound after approximately 222 days of feeding. The channel catfish had the lowest S-value of 2.3, the white had a S-value of 2.9 and the blue had a value of 4.0. Survival was highest for the channel catfish and lowest for the blue catfish both years.

All species did well in the experiment which indicates that these fish may be successfully grown in coastal waters which will not exceed 8.0 ppt salinity for any extended period of time. Even though these fish will tolerate up to 11.0 ppt, it is felt that this may not produce optimum growth.

Both the white and channel catfish survived exceptionally well during the study period under conditions of hot weather, muddy waters and low oxygen concentrations. The white catfish possessing features of channel and bullhead catfish may be harder to sell to the public. This fish also tends to develop a rather large head in proportion to its body after 2.5 to 3 years of growth. The channel catfish, however, proved to be the best suited of the two for commercial production in coastal areas. It is already accepted as a commercial pond species and is also tolerant of many of the conditions experienced in coastal waters.

ACKNOWLEDGMENTS

We are extremely grateful to Ted Joanen, Research Leader, Refuge Division of the Louisiana Wild Life and Fisheries Commission for his constructive criticisms and comments of this project. Sincere appreciation is extended to Howard Dupuie, Sr., Howard Dupuie, Jr., and to Adam Swire for their assistance in maintenance, sampling, feeding and harvest of the research ponds. Special recognition is also due to Brandon Carter, Biologist Aide, for his valuable assistance and enthusiastic interest exhibited during the course of the entire study.

Support for this project was partially provided by the National Science Foundation through the Sea Grant Program.

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CHANGES IN POND BOTTOM SOILS DURING THE INITIAL FIVE YEARS OF USE

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ABSTRACT

Bottom soil samples were taken after each draining during a five-year period from a series of 12 small earthen ponds ranging in size from 0.70 to 1.39 acres. Except in one pond, drainings occurred one or more times annually. The ponds were used to produce one or more crops of fingerling fish each year. Species cultured were largemouth bass, bluegill, channel catfish and redear sunfish. Chemical analyses for pH, calcium, phosphorus, potassium, carbon and nitrogen were done on each sample. All ponds except one were fertilized and supplemental feeding was done on a limited scale in some of the ponds.