

# GROWTH, SURVIVAL, FOOD HABITS, AND SEXUAL DEVELOPMENT OF CROAKER, *Micropogon undulatus*, IN BRACKISH WATER PONDS

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## ABSTRACT

Croaker, *Micropogon undulatus*, were stocked in 6 ponds in 1966 and again in 6 ponds in 1968 to determine general desirability for pond culture in brackish water. Growth and survival was low both years. In the fall, when ponds were drained, fish were about one year old; both males and females were ripe. Stomach analyses revealed that croaker preferred grass shrimp, *Palaemonetes* sp. (78.4 per cent occurrence) to fish (13.3 per cent occurrence). The condition index, using total length, was 1.36, while the length-weight relationship was  $\log W = -5.2498 + (3.1652) (\log L)$ .

## INTRODUCTION

The Atlantic croaker, *Micropogon undulatus*, is one of the most abundant fish species along the coast of Louisiana. Studies on its life history have been reported by Welsh and Breder (1923), Pearson (1929), Wallace (1940), Gunter (1945), Roelofs (1954), Reid (1955), and Haven (1957). The croaker is considered an important sport and food fish in many areas. Haven (1957) reported that in Virginia alone 55 million pounds of croaker were landed in 1945.

Since 1966 Louisiana State University and the Louisiana Wild Life and Fisheries Commission have been screening various marine species for mariculture. This paper reports on a 2-year study of croaker, which were tested in 12 coastal-marsh ponds at Rockefeller Wildlife Refuge in southwest Louisiana. Growth, survival, food habits, sexual development, and general desirability for pond culture were determined. The condition factor and length-weight relationship were also calculated.

## MATERIALS AND METHODS

Croaker were stocked April 2, 1966 in 6 brackish water ponds at a rate of 1,000 per acre. Croaker were again stocked March 19, 1968 in 6 brackish water ponds at rates of 500, 1,000, or 2,000 per acre. All fingerling croaker were easily obtained by trawling near shore in the Gulf of Mexico. Salinities at collection site were 11 ppt in 1966 and 24 ppt in 1968. The salinity in ponds, when fish were stocked, ranged from 2 to 6 ppt both years. Fingerling croaker were adjusted to the low salinity in ponds for approximately 2 hours before stocking.

Initially, the fish were fed a commercial ration in all ponds. Later feeding was discontinued, when there was no evidence, by stomach analysis, that the croaker were utilizing the feed.

Fish stocked in 1966 were harvested December 17, 1966 (258 days in experiment). Fish stocked in 1968 were harvested October 30, 1968

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(225 days in experiment). Total number and weight of fish were determined for each pond to obtain production per acre and survival.

A total of 24 croaker from the 1966 test were examined to determine food habits, using the methods described by Lagler (1956). Sexual development was determined for all fish harvested. A condition factor and length-weight relationship was calculated for the fish harvested in 1968, using the techniques of Rounsefell and Everhart (1953) and Lagler (1956). Weights were taken in grams and total lengths in mm.

## RESULTS AND DISCUSSION

### *Growth and Survival*

The survival of croaker stocked in 1966 was very low, with only 24 fish recovered from a single pond. Unfortunately, there was little help available to adequately supervise the ponds. It is possible that the croaker died from low water temperatures, since ponds were not drained until December. Water temperatures at that time were 4°C. Croaker mortalities, due to low water temperatures were reported by Hildebrand and Cable (1930). Dovel (1968) suggested that croaker move out to warmer waters when the water temperature drops to 5°C.

Growth and survival data for the 1968 experiment are presented in Table 1. Production per acre ranged from 144 to 300 pounds. Survival ranged from 0 to 94 percent. The average size of croaker ranged from 108 to 189 grams per fish. Total length of fish in mm ranged from 165 to 264 with a mode of 215. Pearson (1929) stated that year-old croakers in Texas reached a total length of about 150 mm.

TABLE 1. Growth and survival of croaker in 0.1 acre brackish water ponds. Ponds were stocked March 19, 1968 and drained October 30, 1968 (225 days).

Pond number	B-30	B-31	B-32	B-33	B-34	B-35
Numbers stocked	200	200	50	100	100	50
Weight (g)	660	660	165	330	330	165
stocked (lbs.)	1.45	1.45	0.36	0.73	0.73	0.36
Average size						
stock (g)	3.3	3.3	3.3	3.3	3.3	3.3
Number recovered	50	116	47	71	78	0
Weight recovered						
(g)	9,470	13,625	6,539	7,680	10,642	..
(lbs.)	20.9	30.0	14.4	17.0	23.5	..
Average size						
recovered (g)	189	117	139	108	136	..
Survival percent	25	58	94	71	78	0

TABLE 2. Contents of 24 stomachs from the Atlantic croaker showing the numerical percent occurrence and volume in milliliters

Food Organism	Number present	Percent occurrence	Volume	Percent volume
<i>Palaemonetes</i> sp.	135	78.4	9.5	28.4
<i>Cyprinodon variegatus</i>	10	5.8	8.3	24.9
<i>Mollienisia latipinna</i>	4	2.3	4.6	13.8
<i>Lucania parva</i>	4	2.3	4.1	12.3
<i>Fundulus grandis</i>	2	1.2	1.6	4.8
<i>Menidia beryllina</i>	3	1.7	1.0	3.0
<i>Procambarus</i> sp.	2	1.2	0.7	2.1
Insect matter	5	2.9	0.3	0.9
Unidentified matter	7	4.1	3.3	9.9

Largest croaker came from a pond stocked at 2,000 per acre. These fish averaged 189 grams apiece. This growth is faster than that reported in nature (Pearson, 1929); yet, the fish were far below an acceptable market size. Although small, the taste of croaker was rated very good by the authors. Further research should be conducted with croaker before it is entirely ruled out as a potential species for pond culture. Tests should be conducted in the laboratory to study the effect of water temperatures on both survival and feeding activity. Although Haven (1957) lists the croaker as an important food fish in some areas, the croaker is considered a trash fish in other areas. In Louisiana most croaker caught by shrimpers and other fishermen are too small for market. Some croaker are sold for crab bait and others go into cat food. A croaker mix, mostly croaker, with other fish, is available at \$2.50 per hundred pounds.

#### Food Habits

Food habits of 24 croaker, from the 1966 experiment, were determined (Table 2). Stomach analyses revealed that these croaker contained grass shrimp, *Palaemonetes* sp. (78.4 per cent occurrence) and fish (13.3 per cent occurrence). Grass shrimp made up 28.4 per cent of the volume.

Food available for croaker was determined by sub sampling the pond where the 24 fish were recovered. Projected results were:

Species	Pounds per acre	Per cent of total
<i>Cyprinodon variegatus</i> .....	575	45.5
<i>Lucania parva</i> .....	235	18.6
<i>Mollienisia latipinna</i> .....	155	9.1
<i>Palaemonetes</i> sp. ....	115	9.1
<i>Menidia beryllinna</i> .....	100	7.9
<i>Fundulus grandis</i> .....	85	6.7

The high occurrence of grass shrimp eaten compared to the relatively low percentage, 9.1, of available grass shrimp, indicates a preference for grass shrimp over fishes. The frequency of occurrence for all fishes was 13.3 per cent, whereas the percentage of fish present in the pond as forage fish was 91.0 per cent.

The foods of croaker have been studied by Welsh and Breder (1923), Hildebrand and Schroeder (1928), Pearson (1929), Hildebrand and Cable (1930), Gunter (1945), Roelofs (1954), and Darnell (1958). These early investigators found the following foods: mollusks (both pelecypods and gastropods), annelids, small crustaceans, shrimp, crabs, fishes, bryzoans and tunicates.

#### Sexual Development

Pond-reared croaker were sexually mature when approximately one year old. Fish examined on October 30, 1969 were running ripe. At first each fish was examined. Later it was evident that virtually every fish, male and female, was ready to spawn. Both eggs and sperm flowed freely, while handling the fish. These results varied from those reported by other workers. Pearson (1929) concluded that croaker of Texas spawn at the end of the second year; Wallace (1940) and Welsh and Breder (1923) stated that fish mature when 3 to 4 years old. However, Hildebrand and Cable (1930) suggested that individuals of the same species may mature at an earlier age in warmer climates.

#### Condition Factor and Length-Weight Relationship

The overall condition factor of pond-raised croaker, based on 362 fish, was  $K_{t1} = 1.36$ . The fish ranged in size from 165 to 264 mm in total length.

The formulae used for the length-weight relationship was  $\log W = \log a + n \log L$ . In this study the formulae for croaker was:  $\log W = -5.2498 + (3.1652) (\log L)$ . These values are very close to those of Dawson (1965). He found the length-weight relationship for croaker from the Gulf of Mexico to be:  $\log W = -5.2848 + (3.1475) (\log L)$ .

#### SUMMARY AND CONCLUSIONS

It will not be feasible to grow croaker in brackish water ponds until certain criteria are met. First, a stable market must be established. Perhaps favorable publicity, as was done with shrimp, may help to develop a market for croaker as food fish. Presently in the Southeastern United States the market for croaker as a food fish is nil. This is because luxury fish such as pompano, *Trachinotus carolinus*, and channel catfish, *Ictalurus punctatus*, are in high demand. Although culture techniques for pompano have not been worked out, the channel catfish has been successfully cultured in brackish water ponds. Top production to date has been one ton per acre per year (Perry and Avault, 1968, 1969). Allen and Avault (in press) found that channel catfish could tolerate up to 12 ppt salinity.

Second, to get maximum production in ponds it is usually necessary to feed fish. Until croaker take artificial feed it is doubtful that high production can be obtained. Croaker are not low on the food chain and therefore, natural production would be low.

Third, croaker must be able to survive cool water temperatures in the fall and winter. Moreover, they must reach market size in one growing season.

Finally, croaker must be made to spawn under pond conditions. Reliance on natural supplies of croaker is too unstable.

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## AGE AND GROWTH OF RIVER REDHORSE, *Moxostoma carinatum* (Cope) FROM THE CAHABA RIVER, ALABAMA

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#### ABSTRACT

The river redhorse, *Moxostoma carinatum* (Cope), is a Catostomid fish of east-central North America. In rivers where it is common, the river redhorse frequently affords a sport fishery, especially during its spawning period.

During the period July, 1966, to July, 1968, 339 river redhorse were collected from the Cahaba River, Alabama. Scales from 183 of these specimens were aged and back calculated. An additional 52 pond-reared specimens were utilized for scalation and length-weight studies. Length-weight equations were computed.

Female river redhorse were significantly heavier than males throughout the data ranges studied. Male river redhorse from the Cahaba River were greater in length at age groups I, II, III, and IV than were females. Specimens from the Duck River, Tennessee, grew more slowly than those from the Cahaba River although larger sizes were reached in Duck River.

#### INTRODUCTION

The river redhorse, *Moxostoma carinatum* (Cope), is a Catostomid fish of east-central North America. The northern limit of its range is from Iowa east to western Pennsylvania (Trautman, 1957), with an apparent relic population remaining in the St. Lawrence River (Vlady-

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