

sidered, namely, the relatively unchecked loss of irreplaceable estuarine environment, every preventative action that we can undertake will be a highly significant contribution to the cause of conservation.

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DISTRIBUTION AND ABUNDANCE OF POSTLARVAL AND EARLY JUVENILE STAGES OF THE BROWN SHRIMP IN GALVESTON BAY, TEXAS

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ABSTRACT

The early life history of the brown shrimp (*Penaeus aztecus* Ives) in Galveston Bay was investigated during 1963 and 1964. Postlarvae, after entering from the Gulf, were most abundant in the channels and deeper waters as they moved into the upper reaches of the estuary. In each season of study, they were observed to spread throughout the estuary and become concentrated in surrounding marshes and bayous within about 2 weeks of first entry. After spending 2 to 4 weeks in these peripheral areas where they grew rapidly, the young shrimp, now juveniles, once again dispersed throughout the estuary before eventually returning to the Gulf. Observations also indicated that the estuarine life history phase of the brown shrimp is quite variable, with its duration probably being related in large measure to prevailing water temperature.

A PLEMINARY REPORT OF SEXUAL DEVELOPMENT OF FISHES IN BILOXI MARSH, LOUISIANA

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ABSTRACT

The investigation of the spawning habits of fishes in the Biloxi Marsh is one of the phases of Project F-8-R. Only those fishes regarded as game species are included in this spawning study—since those which comprise the group known as rough fish are of no significant value to this area as an attraction to sportsmen.

The gonad conditions of Spotted seatrout, Atlantic croakers, and Red drum are examined at intervals of three weeks. A 200-yard trammel net is the method used to acquire the fish for this research.

Development of the gonads in relation to the seasons of the year will be discussed in this paper to try to establish a peak or climax spawning season for this particular area.

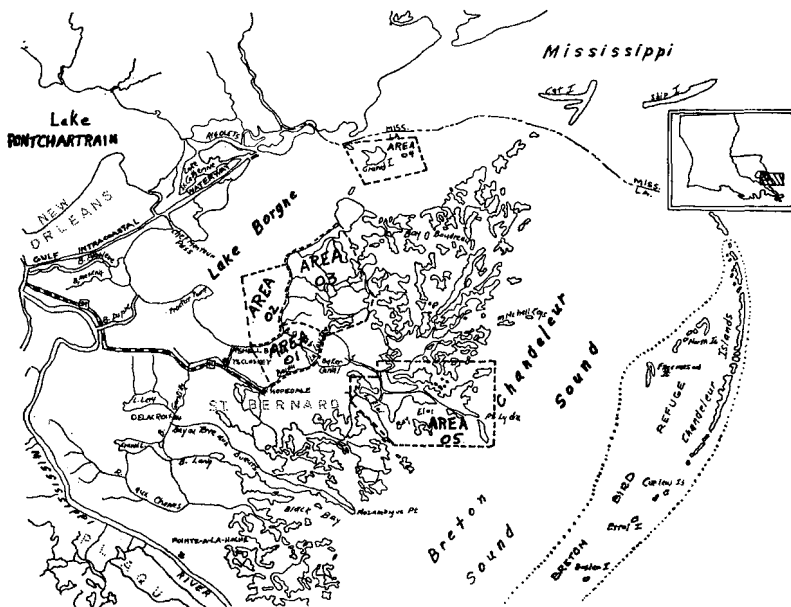
INTRODUCTION

The Biloxi Marsh is located in St. Bernard Parish in Southeast Louisiana. This area is rich in brackish water game fishes. Some of the more common species present are the Red drum *Sciaenops ocellata*, Spotted seatrout *Cynoscion nebulosus* and the Atlantic croaker *Micropogon undulatus*. The text of this paper is concerned with the gonadal development of these species. The gonadal development of game fishes in the Biloxi Marsh is one of the objectives of Dingell-Johnson Project F-8-R.

There are five sampling areas that are used in the Biloxi Marsh, however, only two of these will be discussed in this paper. The two areas chosen are 02 and 03 (Figure 1).

Area 02 comprises mainly the south and eastern Lake Borgne shoreline. The water in Lake Borgne is brackish and usually turbid. The bottom of the shoreline varies with location being either sand or clay. The clay bottom is the more dominant type. Aquatic vegetation is absent in this area. Tidal variation between high and low tide is usually 1 foot.

Area 03 is an inland brackish marsh area with typical *Spartina sp.* vegetation. The bottom in this area is predominantly clay and is usually



high in organic matter. Water is very seldom turbid and tidal fluctuation is not as great as the Lake Borgne area. Fish have easy access to the area because of the many canals and bayous transversing the area. Movement is not retarded in any way. Aquatic vegetation present in the area is primarily widgeon grass, *Ruppia maritima*.

Materials and Methods

Fish used for this study were collected with a 200 yard nylon trammel net with one inch bar mesh. The net was put out from an 18 foot flatboat and the ends closed to form a circle. After the net was put out, the flatboat was run inside the netted area. This running around inside the area forces many of the fish to hit the net and become entangled. The net was then brought in and the fish removed at the same time.

Game fishes removed from the net were weighed, measured, and identified as to the sex and gonadal development. Gonadal development is divided into the following six categories: adolescent, immature, mature, maturing, ripe and spent.

"Adolescent" includes fish that are of such age that the gonadal condition cannot be determined because of size or undeveloped gonads.

"Immature" includes those fish whose gonads show no sign of development. The ovaries are shown to be present only upon close examination and the tests are barely distinguishable.

"Maturing" includes those ovaries and testis that are beginning formation of sperm as well as ova although the ova are not distinguished as such.

"Mature" is distinguished by the appearance of the developing ova which resembles granules or grains. During this period the ovary is swollen but firm. The testis contains a thick milky fluid.

"Ripe" condition is recognized by swollen ovary in a soft or semi-soft condition. At this time, pressure on the abdomen will cause a discharge of the eggs or sperm. Also a reddish fluid can be seen mixed with the egg mass.

The "spent" stage is easily recognized by the flaccid ovary and testis.

Discussion of Results

Gonadal development in relation to time or seasons of the year will be discussed in this paper. The areas earlier described, although physically different, do not show any great difference in sexual development of the fish occurring in the areas. Because of sampling variation and the movement of fishes, there are months in the year where the specimens desired were not collected in the trammel net samples. This blank data leaves holes where valuable information could have been obtained. Spawning characteristics of the three species mentioned earlier will be discussed and the two areas compared at the same time.

According to Pearson as reported by Guest and Gunter (1958) Spotted seatrout spawn heaviest in April and May with some sparse spawning from March through October. Tables I and II show that heaviest spawning occurred in May and June in the Biloxi Marsh. This was derived by observing the relatively high numbers of "spent" individuals in the period from June through September. September is the last month in which "ripe" specimens occurred. Both areas show approximately the same peaks so that no differential can be made between them.

Spotted seatrout are known to spawn in Areas 02 and 03 because of the small numbers of fingerling that are collected in other phases of the F-8-R project.

The data for the Atlanta croaker for Area 03 (Table III) is unusual in that no mature specimens are recorded over a two-year period.

According to Pearson (1929) as reported by Gunter the period between September and February is the time for heaviest spawning. It is interesting to note that during this period our samples showed only one specimen collected. This can be explained to some extent by the belief that the Atlantic croaker spawns in passes leading from the Gulf of Mexico into the Marsh. This would account for the absence of croakers in the Marsh area during the time of spawning.

Table IV shows the results for Area 02. The same periods as above gave no specimens for examination. The specimens are scattered and no clear cut trend can be seen from this information. More intensive research is needed before a conclusion can be attempted as to the spawning habits in the Biloxi Marsh area.

No information can be obtained from the data available on the Red drum. Gowanloch (1933) stated that the Red drum does not become sexually mature until they are approximately 30 inches in length. Between November, 1961 through June, 1963 only one specimen collected was of mature size. The gonadal development of this fish was immature. There were 52 other specimens collected, all being adolescent.

Conclusion

Much more research is needed before a final report can be given on the spawning characteristics of fishes in the Biloxi Marsh area.

Acknowledgments

Some data used in this paper were collected by Donald W. Geagan and Larry H. Ogren when they were project leader and assistant project leader.

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Table 1. Gonadal development and the number of specimens represented by months from 1961 through June, 1964 for the Spotted seatrout, *Cynoscion nebulosus* for Area 03.

Date	Total No.	Stage of Development					Spent
		Adolescent	Immature	Maturing	Mature	Ripe	
11-61	0	—	—	—	—	—	—
12-61	48	—	48	—	—	—	—
1-62	0	—	—	—	—	—	—
2-62	0	—	—	—	—	—	—
3-62	1	—	—	1	—	—	—
4-62	2	—	1	1	—	—	—
5-62	5	—	3	2	—	—	—
6-62	4	—	4	—	—	—	—
7-62	8	—	—	—	5	1	2
8-62	4	—	—	—	—	2	2
9-62	7	—	5	—	—	—	2
10-62	7	—	1	—	—	—	6
11-62	4	—	2	—	—	—	2
12-62	0	—	—	—	—	—	—
1-63	0	—	—	—	—	—	—
2-63	0	—	—	—	—	—	—
3-63	0	—	—	—	—	—	—
4-63	4	—	3	1	—	—	—
5-63	2	—	1	—	—	—	1
6-63	1	—	1	—	—	—	—
7-63	0	—	—	—	—	—	—
8-63	0	—	—	—	—	—	—
9-63	0	—	—	—	—	—	—
10-63	0	—	—	—	—	—	—
11-63	0	—	—	—	—	—	—
12-63	0	—	—	—	—	—	—
1-64	0	—	—	—	—	—	—
2-64	0	—	—	—	—	—	—
3-64	2	—	1	1	—	—	—
4-64	0	—	—	—	—	—	—
5-64	0	—	—	—	—	—	—
6-64	0	—	—	—	—	—	—

Table II. Gonadal development and the number of specimens represented by months from 1961 through June, 1964 for the Spotted seatrout, *Cynoscion nebulosus*, for Area 03.

Date	Total No.	Stage of Development					Spent
		Adolescent	Immature	Maturing	Mature	Ripe	
11-61	35	—	35	—	—	—	—
12-61	2	—	2	—	—	—	—
1-62	4	—	4	—	—	—	—
2-62	0	—	—	—	—	—	—
3-62	0	—	—	—	—	—	—
4-62	0	—	—	—	—	—	—
5-62	0	—	—	—	—	—	—
6-62	0	—	—	—	—	—	—
7-62	5	—	—	—	4	1	—
8-62	3	—	—	—	—	—	3
9-62	2	—	—	—	—	—	2
10-62	29	—	11	—	—	—	18
11-62	14	—	12	—	—	—	2
12-62	11	—	2	—	—	—	9
1-63	17	—	17	—	—	—	—
2-63	0	—	—	—	—	—	—
3-63	13	—	3	5	5	—	—
4-63	5	—	5	—	—	—	—
5-63	0	—	—	—	—	—	—
6-63	0	—	—	—	—	—	—
7-63	1	—	—	1	—	—	—
8-63	0	—	—	—	—	—	—
9-63	31	—	2	—	1	—	28
10-63	0	—	—	—	—	—	—
11-63	0	—	—	—	—	—	—
12-63	0	—	—	—	—	—	—
1-64	17	—	17	—	—	—	—
2-64	3	—	3	—	—	—	—
3-64	11	—	10	1	—	—	—
4-64	16	—	—	5	9	2	—
5-64	3	—	—	—	—	2	1
6-64	0	—	—	—	—	—	—

Table III. Gonadal development and the number of specimens represented by months from 1962 through June, 1964 for the Atlantic croaker, *Micropogon undulatus* from Area 03.

Date	Total No.	Adolescent	Stage of Development				Spent
			Immature	Maturing	Mature	Ripe	
1-62	0	—	—	—	—	—	—
2-62	1	—	1	—	—	—	—
3-62	22	—	22	—	—	—	—
4-62	28	—	28	—	—	—	—
5-62	31	—	31	—	—	—	—
6-62	27	—	27	—	—	—	—
7-62	34	—	34	—	—	—	—
8-62	8	—	7	1	—	—	—
9-62	0	—	—	—	—	—	—
10-62	0	—	—	—	—	—	—
11-62	1	—	1	—	—	—	—
1-63	0	—	—	—	—	—	—
2-63	0	—	—	—	—	—	—
4-63	4	—	4	—	—	—	—
5-63	3	—	3	—	—	—	—
6-63	3	—	3	—	—	—	—
7-63	0	—	—	—	—	—	—
9-63	1	—	—	1	—	—	—
1-64	0	—	—	—	—	—	—
3-64	2	—	2	—	—	—	—
4-64	15	—	15	—	—	—	—
6-64	4	—	4	—	—	—	—

Table IV. Gonadal development and the number of specimens represented by months from 1961 through 1964 for the Atlantic croaker, *Micropogon undulatus*, from Area 02.

Date	Total No.	Adolescent	Stage of Development				Spent
			Immature	Matur-ing	Mature	Ripe	
1-62	0	—	—	—	—	—	—
2-62	0	—	—	—	—	—	—
3-62	0	—	—	—	—	—	—
4-62	1	—	1	—	—	—	—
5-62	0	—	—	—	—	—	—
6-62	2	—	2	—	—	—	—
7-62	1	—	1	—	—	—	—
8-62	8	—	7	1	—	—	—
9-62	0	—	—	—	—	—	—
10-62	1	—	—	—	—	—	1
11-62	0	—	—	—	—	—	—
12-62	0	—	—	—	—	—	—
1-63	0	—	—	—	—	—	—
2-63	0	—	—	—	—	—	—
3-63	1	—	1	—	—	—	—
4-63	9	—	9	—	—	—	—
6-63	8	—	7	1	—	—	—
7-63	34	—	34	—	—	—	—
8-63	0	—	—	—	—	—	—
10-63	3	—	—	—	—	3	—
12-63	0	—	—	—	—	—	—
1-64	0	—	—	—	—	—	—
2-64	0	—	—	—	—	—	—
3-64	0	—	—	—	—	—	—
4-64	21	—	21	—	—	—	—
5-64	12	—	7	5	—	—	—
6-64	25	—	11	—	—	14	—

A THREE-YEAR STUDY ON THE EFFECTS OF LIME APPLICATIONS ON THE STANDING CROP OF BENTHIC ORGANISMS IN GEORGIA FARM PONDS

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, ABSTRACT

Six Georgia farm ponds, three on sandy soils and three on clay soils, were observed during a 32-month study period to determine the quanti-