AN ECOLOGICAL STUDY OF THE FISHES OF THE TAMPA BAY AREA

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JANUARY 1960

PROFESSIONAL PAPERS SERIES
NUMBER ONE

FLORIDA STATE BOARD OF CONSERVATION
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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd.)

AN ECOLOGICAL STUDY OF THE FISHES OF THE TAMPA BAY AREA

PREFACE

The Tampa Bay area is the second most populous area in the State of Florida. The population is steadily increasing as are the number of industries. These industries are increasing the amount of pollutants which are flushed into the bays. Real estate developers are dredging up artificial lands in the bays, both destroying the limited amount of bay bottom available and increasing the amount of turbidity in the water. All in all, man's ravages of the inland waters are progressing at such a rate that it will not be long before many species of fishes will no longer be found in these areas. Conditions during our study were disturbed ones. We believe that within a few years a study even as moderately successful as ours will be impossible in our area.

INTROD UCTION

An ecological study which concentrates on a particular phylogenetic group is in the broadest sense not a complete study. The motivation for such a study usually lies in the prejudices of the investigator who for reasons of his own, often inexplicable to himself, becomes entranced with a class of organisms to the exclusion of all others. There is a sound point to be found in this phyletic attitude, for there are very few students that can become proficient in the taxonomy of more than one group.

An ecological study of an area which restricts itself only to the fishes is perhaps less prone to the biases of most other groups, as fishes are found in all major niches: indwellers, bottom dwellers, pelagic. They are found in all aquatic habitats and on or over all types of bottoms, and at all depths. Their feeding and breeding habits are extremely diverse. In short it would seem that aquatic ecological studies restricted to fishes alone would cover indicators for each possible ecological situation.

Such a study, however, can only give a true picture in an area if all major habitat types are examined. During the past few years two ecological studies of importance on Gulf of Mexico fishes of the Florida coast have appeared (Reid, 1954; Kilby, 1955). Th es e studies were concerned with the fishes in certain types of habitats: grass flats and coastal marshes. The portrayals of the fauna are thorough for the areas surveyed, but they exclude the comparison of what is taking place in different types of habitats at the same time. Something must always be sacrificed. In our effort to develop a contemporal comparison of several habitats we have had to sacrifice the thoroughness which would be reached through the concentrated study of a single habitat.

All phases, however, are necessary and it is our hope that our contribution will fill a portion of the void which comprises our knowledge of fish ecology.

The most comprehensive ecological study of Gulf coastal fishes is that of Gunter (1945) made on the Texas coast. This monumental work laid the foundation for all future studies and offers a basis for comparison of findings. Almost all that Gunter stated in the introduction to his study applies to our study, and it is significant that there are few of our findings which are not in accordance with his.

Limitations

We acknowledge certain limitations in the value derived from our study. Our collecting gear was such that for the most part only small or young fishes were sampled and therefore only a portion of the life histories could be followed. It was not always possible to exert the same energetic collecting at each station because of the vagaries of sundry assistants, our own nature, the collecting gear and the elements. It was not possible to make collections at our stations both at night and during the day. Also it was not possible to make any particular station thoroughly more than once a month. The number of fishes

Contribution Number 36, Florida State Board of Conservation Marine Laboratory.

collected, we feel confident, would approach half a million. The number actually returned to the laboratory for study approaches forty-five thousand. It was possible, for the most part, to give only observations on the general nature of the fish fauna.

Much information which could add to the value of our study is known to the local inhabitants directly associated with the fishing industry. This and any additional information obtained in the future will he published in the form of addenda.

ACKNOWLEDGMENTS

In a study of this type a large number of persons are called upon for assistance. We have never had a refusal. To those who have assisted us we extend our sincerest appreciation. Many individuals are given appropriate acknowledgment in the text. We would like to take particular note here of the fine cooperation extended us by the many Conservation Agents throughout the State. We would also like to particularly acknowledge here the help of Dr. Richard T. Kirk, Dr. Paul Wallace and family, Mr. John Hurlbut, Mrs. Barnett Harris, and Mr. Red Marston and the library staff of the St. Petersburg Times.

Dr. Gordon Gunter spent considerable time in a cirtical reading of the manuscript. He offered many valuable suggestions which materially improved our study.

Dr. C. Richard Robins apprised us of several nomenclatorial errors in the manuscript and provided corrections.

All of our colleagues of the Marine Laboratory gave freely of their time and valuable advice, aiding in the field, criticizing the manuscript, or identifying organisms in their fields of competence.

Finally, we thank Mr. Robert M. Ingle, Director of Research, who proposed the investigation, for his continuous encouragement during difficult phases. Without this our study would never have been completed.

This study received financial assistance in part from the Central and Southern Florida Flood Control District, West Palm Beach.

PRESENTATION

The data are presented primarily under headings of each species which are arranged in phylogenetic order according to that of Briggs (1958). The common names listed for the fishes (or their absence) are those heard commonly among the local population. An accepted list of common names is in the process of being formed by the American Fisheries Society. Other names may be found by referring to Briggs (op. cit.) or Robins (1958A). Our reason for listing only those names used locally is to aid the stranger in identifying most quickly the fishes that the natives mention.

STATIONS

The roller frame trawl stations were established early in 1957 for the purpose of sampling the shrimp populations. With the beginning of the ichthyological survey the fishes collected with the shrimp were retained and incorporated in our study.

The establishment of the shore stations was arbitrary. A cursory survey was made of the Tampa Bay area and four stations representing the most diverse habitats were selected. Excluded from consideration were areas of obviously high pollution or disruption (from dredging and filling).

Several months after our study was underway periodic diving trips were made to the rocky reefs approximately nine to 20 miles offshore in the Gulf of Mexico. Collections were made with the use of rotenone, but many of the larger and more active fishes were recorded by observation only. The specimens collected on these diving trips were not used in computing monthly length frequency distributions. They were used to fill in the species list for the Tampa Bay area and to describe the faunal composition of the particular habitat in which they were found.

THE TAMPA BAT AREA

(Figure 1)

Definition. For the purposes of this study the Tampa Bay area is arbitrarily defined as that portion of the west coast of Florida bounded to the south by latitude 27° 32 00" and to the north by latitude 28° 00' 00". It includes all marine waters between these latitudes as far west as approximately longitude 84° 00' 00" which is about the distance

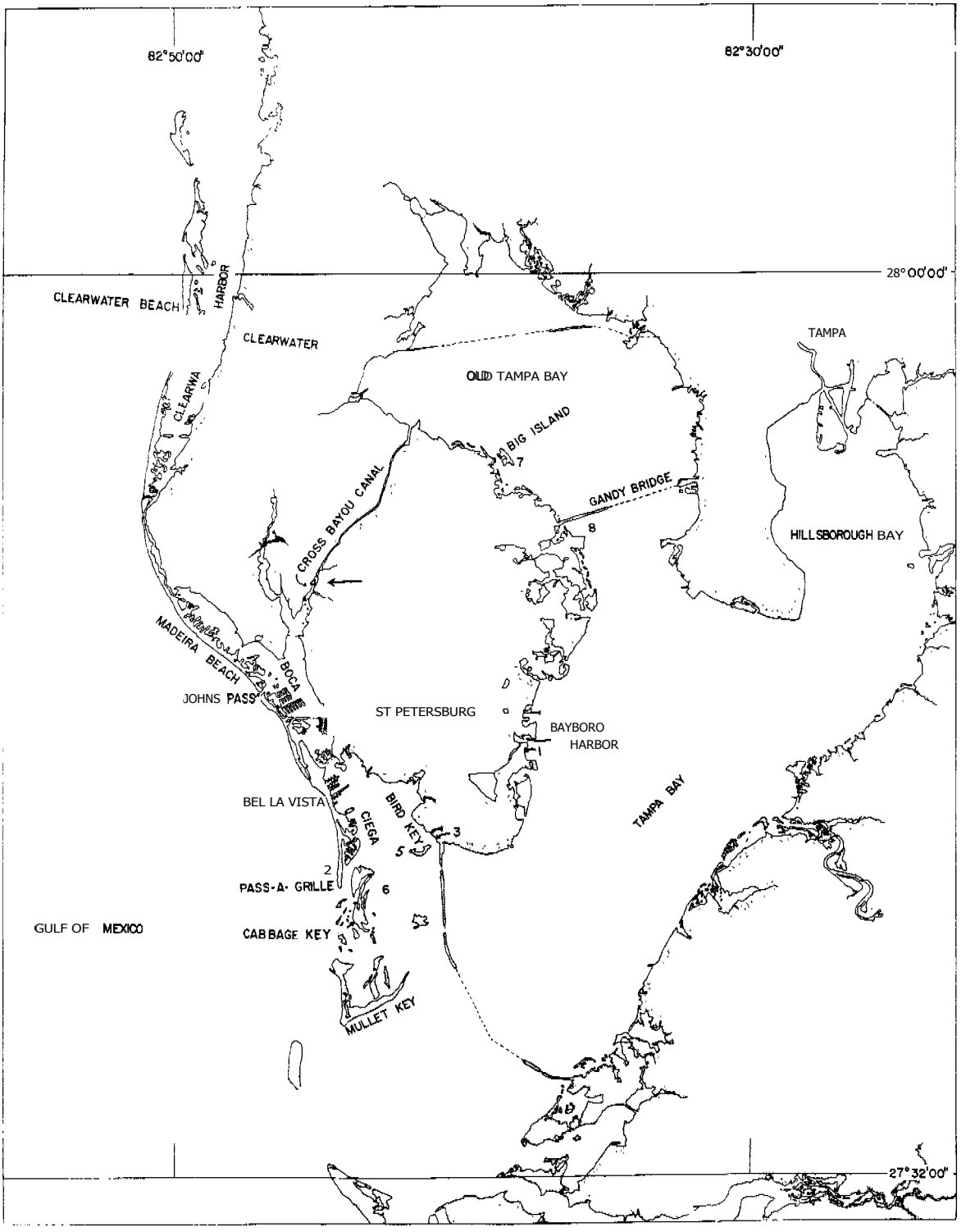

Figure 1. The Tampa Bay Area. 1—Tampa Bay station (near Bayboro Harbor). 2—Pass-a-Grille Beach stations. 3—Maximo Point station. 4—Cross Bayou Canal station (see arrows). 5 and 6—Boca Ciega Bay roller frame trawl stations. 7 and 8—Old Tampa Bay roller frame trawl stations. Egmont Key is the island just southwest of Mullet Key.

that a fishing vessel from Pinellas County may reach and return from in a single day (about 70 miles). Inasmuch as fresh waters are connected with the sea and there is a movement of forms between the two habitats, those records of fishes from the fresh waters of Pinellas County (primarily within the city limits of St. Petersburg) have also been included, though the fresh waters were less completely sampled than the marine waters. In most instances each record is specifically noted so that future investigators may restrict the geographic area as they see fit. In accord with this, those fishes listed as occurring on the rocky reefs offshore were collected at distances from approximately nine to twenty miles offshore in the Gulf of Mexico at Positions 230° to 270° (magnetic) from Johns Pass, Madeira Beach.

Description. The literature contains several recent papers considering in detail the marine habitat of the Tampa Bay area. Important among these are Dawson (1953), Woodburn et al. (1957), and Hutton et al. (1956). The latter paper summarizes most of the known oceanographic conditions of the area as well as presenting considerable biological information; however, many of the fishes recorded in tables 27 and 34 in that paper should not be accepted as records as they are frequently based on common names translated into scientific names (Snook: Centropomus pectinatus, C. parallelus; Sand Perch: *Gerres* cinereus; Gray Sea Trout: *Cynoscion* regalis). No specific identifications of the forms listed above were made (personal communication, R. F. Hutton).

The regular monthly collecting stations are described below.

TAMPA BAY STATION

(Figure 2; Table 1.)

This station is located on the west shore of Tampa Bay within the city limits of St. Petersburg (Figure 1:1). The area sampled extends from the foot of 15th to the foot of 16th Avenue South, and on occasion the area between 18th and 19th Avenue South. When the latter area was sampled only a pushnet

Figure 2. Tampa Bay station facing southwest from foot of 15th Avenue South, St. Petersburg. Background area extends to about 20th Avenue South. May, 1959. High tide.

was used; the abundance of algae precluded the use of seines. The shore of the station is moderately fine white sand which extends out into the bay as a sandy mud. During spring low tides, barren bars extending out several hundred feet are exposed. Water depth rarely exceeds three feet. The area collected never extended over 200 yards offshore.

The station is bounded on the north by a granite boulder breakwater. Along the south side of the 15th-16th Avenue portion a broad (about 100 ft.) expanse of Diplanthera wrighttii extends about 50 feet from the high tide mark offshore to about 200 feet. Some sparse patches of Thalassia testudinum punctuate these beds. The grasses are never under more than three feet of water, and they are never completely exposed during spring lows. During the summer the beds are luxuriant and during the winter they are stunted and appear dead. There is never a great abundance of algae in the area, though at places near high tide Enteromorpha *intestinalis* proliferates from any point of attachment during the winter and spring. The southern part of this portion is bounded by a channel which exceeds six feet in depth.

The 18th-19th Avenue portion is notable because of the luxuriance of the flora. The Diplanthera beds which again predominate extend offshore from about 50 feet beyond the high tide mark to perhaps 200 yards where the water never exceeded three feet in depth. The bottom then becomes a sandy mud which extends out considerably before the depth in-

Table 1. Tampa Bay, St. Petersburg, Florida, Station Data

A Off foot of 15th-16th Ayes. South
B Off foot of 18th-19th Ayes. South

Date	A	B	Gear	Tide	Salinity o/oo	Temperature °C.
10–25–57	x	x	6' Pushnet 20' Seine	High	22.5-24.3	22.8-23.9
11-26-57	x	x	6' Pushnet 50' Bag Seine	Low	25.8-26.5	21.0-24.6
1- 3-58	a		4' Pushnet	Low	23.8	16.0
1-15-58	x		4' Pushnet 50' Bag Seine	High	24.9	16.5
2-17-58	x	x	4' Pushnet 50' Bag Seine	Low	25.0-25.5	13.5-13.7
3-10-58	x	x	4' Pushnet 50' Bag Seine	Low	23.7-24.0	20.5-23.0
4-12-58	x	x	4' Pushnet 50' Bag Seine	Low	22.0	25.0-27.0
5–14–58	x	x	4' Pushnet 50' Bag Seine	High	21.0	24.5–25.2
6- 6-58	x	x	4' Pushnet 50' Bag Seine Rotenone	Low to High	24.3-24.4	31.0–32.5
7- 8-58	x	x	4' Pushnet 50' Bag Seine Rotenone	High to Low	25.5	30.3–32.4
8- 4-58	x		4' Pushnet 50' Bag Seine Rotenone	High	24.8	31.0–32.5
9- 3-58	x		6' Pushnet 50' Bag Seine Rotenone	Low	25.2	28.9
10- 3-58	x		6' Pushnet 50' Bag Seine Rotenone	High.	26.4	30.0–31.0
11- 4-58	x		4' Pushnet 50' Bag Seine	High	26.4-27.7	21.0
12- 1-58	x		4' Pushnet 50' Bag Seine	Low	27.7	24.0

creases. There are some large patches of Thalassia interspersing the Diplanthera beds, and some *Syringodium filiforme* is also interspersed. Great masses of rolling algae *(Hypnea, Gracillaria)* are almost always present. These seaweeds make pushnetting difficult. During winter and spring Enteromorpha and Ulva lactua become prolific.

During the summer and fall Penaeus duorarum (pink shrimp) and Callinectes sapidus (blue crab) are very abundant. During March, 1958, young Bulla occidentalis (bubble shell) was very common.

Noticeably absent were the tunicates which are common in both Old Tampa and Boca Ciega Bays.

The collections from both the Tampa Bay areas were combined. There are indications that if sufficiently large samples had been available from both areas, specimens from the southern portion would have averaged smaller than those from the northern portion.

The total time spent collecting in both areas was from three to five hours for any particular monthly station. When rotenone was used it was applied only along shore over the sandy flats just below mid- or high tide levels at the 15th-16th Avenue section.

MAXIMO POINT PARK STATION
BOCA CIEGA BAY
(Figure 3; Table 2)

This station is located on the lower east shore of Boca Ciega Bay just northwest of the entrance to the Sunshine Skyway bridge (Figure 1:3).

The area, which is now a public park, was unused by the public during most of the period covered by this study.

The shore consists of some sand with a considerable amount of shell rubble inter-

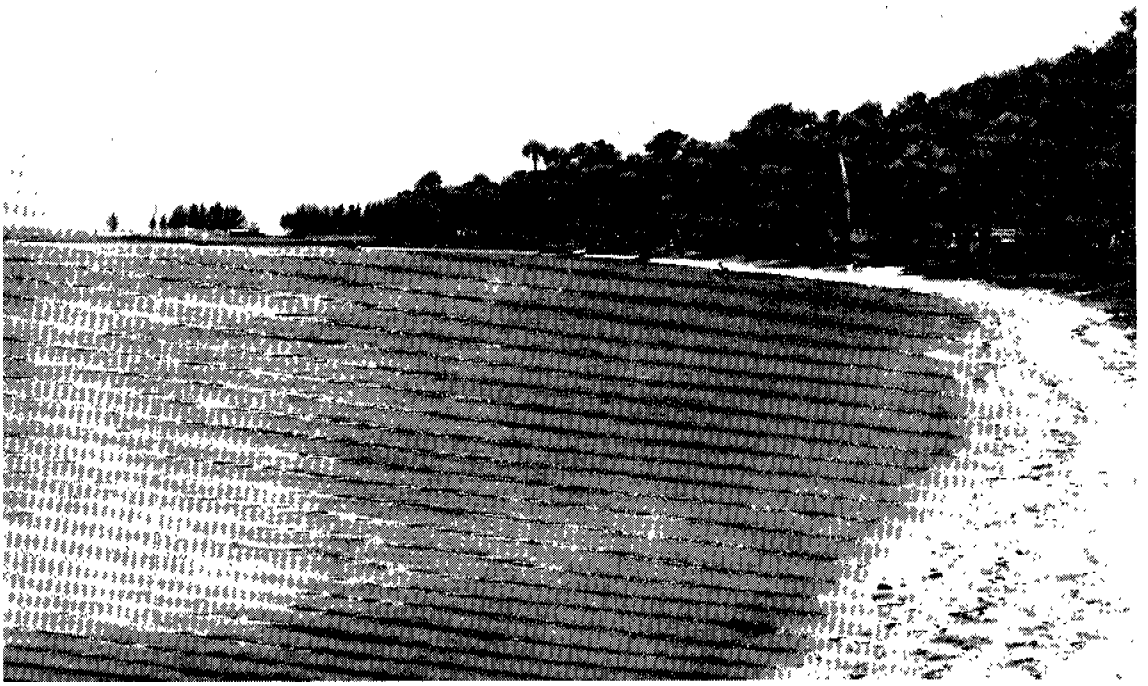

Figure 3. Maximo Point Park station, Boca Ciega Bay, facing south. May, 1959. High tide, incoming.

spersed. Immediately off the shore the bottom is vegetated, except for a small portion at the southern end of the area which abuts on a channel and has little vegetation but much detritus, conch shells, stobs, and a small oyster bar. The attached vegetation is predominently Diplanthera with a small amount of Thalassia and Syringodium. At times there are large amounts of *Gracillaria*, Hypnea, and Ulm. The bottom at depths of at least three feet is inhabited by large colonies of leathery tunicates. Tozeuma carolinensis, Penaeus duorarum, Callinectes sapidus, Batillaria and *Bugula* appear to be the major macroscopic invertebrate forms present. The area just north of the station is sandy.

The water drops off moderately fast and attains a depth of five feet within 100 feet of the shore at high tide. We never collected beyond 100 feet offshore. Inasmuch as numerous snags occurred over the bottom only the pushnet was used. On two occasions rotenone was used along the southern portion of the station.

The length of time occupied during each monthly station varied from one and one-half to two hours.

PASS-A-GRILLE STATION
(Figure 4; Table 3)

The Pass-a-Grille station is on a coarse sandy public beach facing the open Gulf of Mexico. Along the northern portion of the station between 22nd and 16th Streets (Figure 1:2) the water drops off moderately fast and attains a depth of four feet usually within 200 feet of the shore. There is no vegetation present. During the summer months stations were made during the early hours of the morning before the beach became populated with bathers. The second portion of the station was at the extreme southern end of Pass-a-Grille (Long Key) also facing the open Gulf. This area is punctuated with concrete breakwaters which extend from shore out to a distance of about 75 feet. The distance between the breakwaters does not exceed 100 feet. The depth drops off rapidly and at high tide a depth of five feet can be found about 75 feet from shore. There is frequently a strong south flowing current around this tip which made seining hazardous.

The catches of both these portions were considered together. In general the southern

Table 2. Maximo Point Park, Boca Ciega Bay, Station Data

Date	Cear	Tide	Salinity o/oo	Temperature °C.
11— 5-57	6' Pushnet	High	30.8	22.9
12–10–57	6' Pushnet	High	32.4	15.0
1-20-58	4' Pushnet	Low	32.4	13.4
2-21-58	6' Pushnet	Low	31.5	11.2
3-17-58	4' Pushnet	Low	29.7	20.8
4-17-58	4' Pushnet	Low	30.8	22.2
5-15-58	4' Pushnet	Low	29.8	27.8
6-12-58	4' Pushnet Rotenone	High	31.4	32.1
7—9-58	4' Pushnet	Low	29.9	31.0-32.5
8—8-58	4' Pushnet Rotenone	High	32.3	35.5-38.2
9-10-58	4' Pushnet	High	30.7	32.5-35.0
10-14-58	6' Pushnet	High	35.0	27.5
11—7-58	4' Pushnet	High	31.5	25.6
12—2-58	4' Pushnet	Low	33.0	21.2-23.5

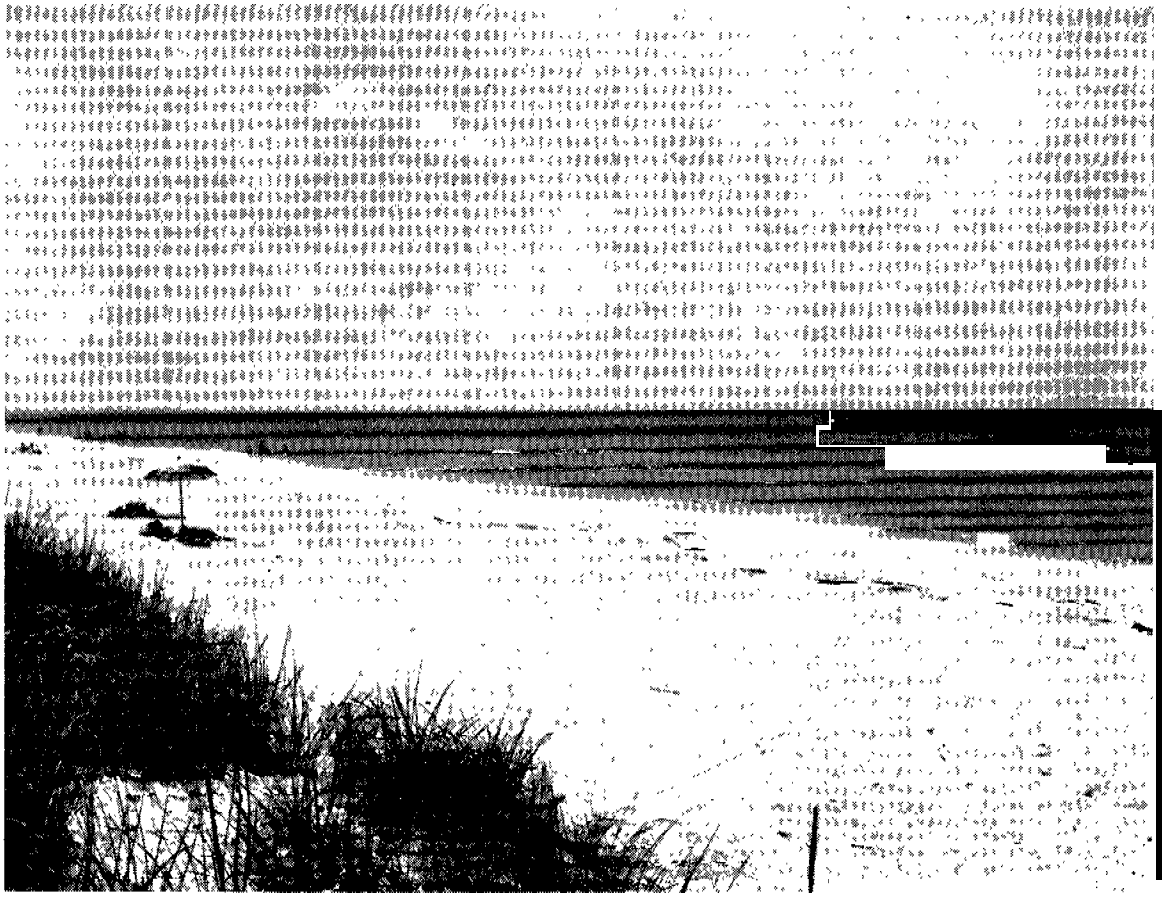

Figure 4. Beach station, Gulf of Mexico, facing southwest from foot of 22nd Avenue, Pass-a-Grille, May, 1959. High tide.

Table 3. Pass-a-Grille Beach, Gulf of Mexico, Station Data

A = Lands End
B = Between 22nd and 16th Streets

Date	A	B	Gear	Tide	Salinity o/oo	Temperature C.
11—2-57	x		50' Bag Seine	Low	32.5-33.5	21.2
12—2-57			"	Low	34.1	18.0
1-20-58			"	Low	33.0	12.2
2-21-58		x	"	Low	31.8	10.8-12.0
3-17-58		x	"	High	32.3	17.4
4-18-58		x	"	High	33.4	
5-15-58			"	Low	33.2	24.0
6-12-58		x	"	High	34.3	30.4
7—9-58		x	"	High	33.3-33.4	28.0
8—8-58		x	"	High	33.7	30.7
9-10-58	x	x	"	High	33.8	31.0
10-19-58	x	x	"	High	35.1	28.3-28.8
11—7-58	x	x	"	High	33.6	23.2
12—2-58		x	"	Low	34.2	21.0

portion seemed to have a greater variety of species, probably because of the attraction of the breakwaters.

The total collecting time at the station during any particular month ranged from one to two hours.

Cross Bayou Canal Station
(Figure 5; Table 4)

This station is located in the bayou where it is crossed by Bridge H 15-44 (1951) on Park Boulevard in Pinellas Park (Figure 1:4). The bayou extends from northeastern Boca Ciega Bay across peninsular Pinellas County into Old Tampa Bay. The bayou is a man-made canal in its middle reaches. No rivers or spring-fed streams enter the bayou and it receives its fresh water primarily from seepage and runoff. In the mid-portions the salinities are fresh (0.5 o/oo).

The portion of the bayou studied consists of a segment of the main canal with some adjoining flats and cut backs. Most of the shore is densely vegetated with Rhizophora mangle (red mangrove) and in some spots sparse Juncus is present. When the study was commenced the mangroves were alive, but the cold wave of December 12-13, 1957, killed them and at the time of this writing (June, 1959) very few live plants are to be seen. There is no vegetation growing in the main body of water or on the flats and only occasionally was Enteromorpha found. The embankment supporting the bridge is studded with concrete slabs and interspersed monocot grasses. Callinectes sapidus was the major invertebrate present. In spots very sparse concentrations of coon oysters were found on the mangroves.

The water is very brown and quite opaque. The bottom of the main channel and closely approximated flats is a hard muddy sand. That of a cut back west of the main channel is a very soupy mud which allows one to sink in it to a depth of three feet. When seining this area the bag filled with mud which made sorting specimens difficult. Isolated open ponds connected through strands of mangroves with the main channel were also sampled. These generally had a shallow muddy bottom.

Tides rarely exceeded three feet and the maximum depth of the main channel was

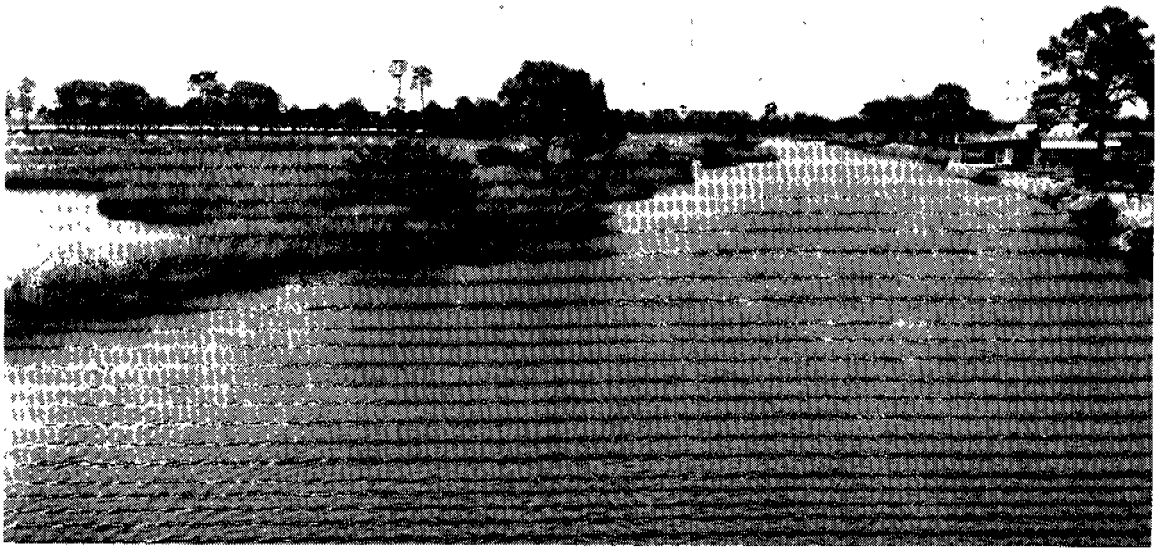

Figure 5. Cross Bayou Canal station facing northwest up main channel from bridge H 15-44 (1951) on Park Boulevard, Pinellas Park. A shallow flat is shown in the far left. May, 1959. High tide.

Table 4. Cross Bayou Canal Station Data

Date	Gear	Tide	Salinity o/oo	Temperature C.
10-12-57	6' CMS*	Low	3.2	26.5
11-14-57	& 20' CMS	High	20.5-23.1	22.0
12-13-57	50' Bag Seine	Low	15.8	13.0
1-22-58	50' Bag Seine	Low	7.2	17.0
2-24-58	50' Bag Seine 20' CMS	Low	11.4-18.7	19.9–21.5
3–18–58	50' Bag Seine	High	16.0-18.2	20.5
4-23-58	50' Bag Seine	High	5.0- 7.6	26.0-26.5
5–16–58	50' Bag Seine	High	6.6-17.5	26.2-27.5
6–17–58	50' Bag Seine 10' CMS	High	29.8	30.5-31.0
7–17–58	50' Bag Seine	High	16.1–16.5	31.2-31.5
8-13-58	50' Bag Seine 10' CMS	High	3.7- 4.2	29.5
9-11-58	50' Bag Seine	High	12.8-19.7	32.0
10-13-58	50' Bag Seine	Low	14.1-16.2	26.6–26.8
11-14-58	50' Bag Seine	Low	13.9-20.4	25.0-25.5
12- 4-58	50' Bag Seine	High	13.7-14.6	21.1-22.3

e Common sense minnow seine

not over five feet. The flats were usually less than two feet deep and only small portions were exposed even during very low tides. The cut back exceeded seven feet in depth during high tides.

The amount of time spent sampling the area during a monthly station varied from two to three and one-half hours.

OLD TAMPA BAY ROLLER FRAME TRAWL STATIONS

(Table 5)

The part of the Lower Gandy flats (Figure 1:8) which were sampled lie south of the western causeway approach to Gandy Bridge which connects Tampa and St. Petersburg.

Table 5. Old Tampa Bay Roller Frame Trawl Stations Data

Date	Tide	Salinity o/oo	Temnerature
10-17-57	High	21.9–22.0	25.6
11-18-57	Low	20.7	24.5
11-20-57	Low	21.0	21.5
12–16–57	Low	21.4-21.6	14.0-14.2
1-10-58	High	22.8-23.0	10.0
2-25-58	High	23.4	16.0–16.9
3-21-58	Low	21.0-21.4	14.6-14.9
4-22-58	Low	19.1-19.5	23.8–24.0
5- 8-58	High	23.1-23.5	24.0–24.1
6-19-58	Low	22.0-30.4	30.0-30.4
7- 9-58	High	24.4-24.6	29.7-31.0
8-19-58	High	19.1-24.2	28.5-28.8
9-10-58	Low	30.5	29.6
10- 8–58	Low	22.8	26.5
11-13-58	Low	23.6	22.6
12- 9-58	Low	23.9	23.1

After September, 1958, the Big Island Flat station was discontinued because the area had been dredged.

A narrow channel separates the causeway from the trawling area. Prior to the dredging and filling operations a few years before the commencement of this study these flats were considered one of the best bait shrimping and speckled trout fishing grounds in the Tampa Bay area. Since then there has been considerable siltation with an associated increase in the tunicate population. Grass growth has declined accordingly, but there remain moderately prolific stands of *Thalassia,* Dip*lanthera,* and *Syringodium* with none of the three being notably dominant. Most of the bottom is a sandy mud. The depth does not exceed four to five feet over the flats.

The Big Island flat area (Figure 1:7) was 50-75 yards south of Big Island. The area had a sandy bottom characterized by the presence of abundant Syringodium and red algae. After September, 1958, this station was discontinued as it was obliterated by dredging and filling. The area was uniformly shallow ranging in depth from about three to four feet.

For the purposes of this study collections from both these stations were combined. Depending on the quantity of specimens obtained, trawling at each station did not exceed two ten minute drags. These stations were sampled after sundown. Daytime collections were made from time to time, but are not included here.

BOCA CIEGA BAY ROLLER FRAME TRAWL STATIONS

(Table 6)

East of Cabbage Key (Figure 1:6) trawling was done along a shallow northwest-southeast bar lying approximately 1500 yards east of the northern tip of Cabbage Key. The Main Channel which runs from the Pass-a-Grill Channel to the Sunshine Skyway Channel in Boca Ciega Bay lies 75 yards to the north of this sampling area. *Thalassia* and *Diplanthera* are found growing on a bottom of sandy mud. During extremely low tides this station has been exposed. Unattached red algae were frequently encountered in such abundance that trawling was severely hampered. In deeper spots (four to seven feet) nearby where trawling was done inadvertently large quantities of sponges and tunicates were taken along with the usual plant detritus. On different occasions marine life abounded at this station while across the Main Channel at the Bird Key Middlegrounds there was a paucity of organisms, and vice versa.

Bird Key Middleground (Figure 1:5) is a sandy shoal one to five feet deep lying between Maximo Channel and the Main Channel. Sampling was conducted northward from flashing red light No. 18 (Main Channel) which is about 1300 yards southeast of Indian Key. There is a swash channel which virtual-

Table 6. Boca Ciega Bay Roller Frame Trawl Stations Data

Date	Tide	Salinity 0/00	Temperature
10-16-57	High	27.8–27.9	25.5
11- 5-57	High	31.8–32.3	22.0-22.1
12-14-57	Low	32.0	12.0-12.8
1-22-58	Low	30.3–30.5	14.5
2-19-58	Low	33.8	10.0
3-17-58	Low	28.7-28.8	17.3-17.5
4- 8-58	Low	30.9–31.3	21.9-22.0
5- 5-58	Low	28.5-30.1	27.5-27.7
6- 5-58	Low	30.3–30.4	29.0-29.3
7- 7-58	Low	30.3	28.7
8- 5-58	Low	32.0-32.1	29.1-29.3
9- 8-58	High	31.8-31.9	30.1–30.3
10- 1-58	Low	34.0	28.7
11–10–58	High	32.4	23.6
12-10-58	Low	30.6–30.7	22.5-22.6

ly disects the Middleground on its eastern end. Whenever trawling occurred in this deeper region, sponges, tunicates and horseshoe crabs *(Limulus)* were frequently taken in quantity. Although this whole area is sandier than that east of Cabbage Key, there are pockets of very soft mud which made trawling difficult. Thalassia and Diplanthera are found together, but there is not the luxuriance of growth found east of Cabbage Key.

For the purposes of this study collections from both these stations were combined. Depending on the quantity of specimens obtained trawling at each station did not exceed two ten minute drags. These stations were sampled after sundown. Daytime collections were made from time to time, but not included here.

EQUIPMENT AND METHODS

The following nets were used to sample populations at the regular monthly stations:

50 foot bag seine: stretch mesh of ⅜ inch, four feet deep; 6, 10 and 20 foot Commonsense Minnow Seines: stretch mesh ¼ inch.

Roller Frame Trawl, similar to the one described by Woodburn et al. (1957), but smaller: mouth 1x3 feet; 3/4 inch stretch mesh.

Two pushnets (Strawn, 1954): one 3x4 feet and one 3½ by 6 feet; ⅛ inch stretch mesh.

The same area was covered during each station. Each area was collected until it was subjectively considered that additional collecting would not evince new information from the station. On a few occasions it was necessary to stop sampling before such a point was reached. In these cases further sampling on a later date during the month was used to supplement the first collection.

In many instances it was not possible to preserve all the specimens collected. In such cases random handfulls of specimens were preserved and then the net checked for the rarer species which were selected and preserved also. Relative abundance is at best only a sketchy thing and open to many biases. For this reason we do not believe that the additional bias of selection of the rarer species is significant. Myrophis *punctatus,* a worm eel, (q. v.) would have been considered rare if we were to have relied only upon net collections.

All specimens preserved were placed in 10 per cent formalin. The specimens were returned to the laboratory where they were sorted and measured (standard length) with a pair of dividers which were then measured on a millimeter rule and estimated to the nearest tenth millimeter. In compiling the tables and graphs all fractions were discarded. Almost all the measurements were made by the senior author, the recorder varied with the availability of personnel. When large samples were returned to the laboratory, usually at least a random sample of one-third of the specimens of an abundantly represented species were measured. Many of the specimens collected were deposited in the collections of the Florida State Board of Conservation Marine Laboratory, Tulane University, and the United States National Museum, but by far the largest proportion were discarded.

Random specimens were dissected and gonads and stomach contents examined and identified.

Salinities (surface) at shore stations were determined by use of U. S. C. &G. S. calibrated densimeters (G. M. Corp.). Readings were corrected for temperature and converted to salinity. Salinities (surface) at roller frame trawl stations were taken by using salinometers. Readings were corrected for temperature.

Temperatures (surface) were taken with a glass rod, mercury filled, centigrade thermometer reading in whole degrees. Fractions were estimated.

In all the graphs, except Figure 11, the same symbols (Figure 6) have been used to represent the same stations. In Figure 11 all the Boca Ciega Bay stations have been combined. The total number of specimens found in each size group during a particular month is indicated by the upper level of the frequency polygon. The different segments of the frequency polygon for any particular size group for a month relate only to the number of specimens found at each of the stations. For instance, in Figure 17 for February under the size group 22 (=22.0-24.9) 62 speci-

mens were taken at the Tampa Bay station, two at the Gulf beach, and 11 in the bayou, for a total of 75 specimens for the class for the month.

The lower class limits (standard length, millimeters) are read across the top of the graphs and the frequencies are read from the left of the graphs.

SYSTEMATIC ACCOUNT

BRANCHIOSTOMIDAE

Branchiostoma caribaeum Su ndevall

Three specimens were collected on the sandy portion of the Tampa Bay station, one each during February, July, and August (25.0, 25.5, 24.8 o/oo and 13.5, 30.3-32.4, 31.0-32.5 CC., respectively). Hutton *et al. (1956)* reported taking l a r ge numbers (63 specimens) of this species in Boca Ciega Bay and there is a literature reference from Tampa (Wright, 1890).

CARCHARIIDAE

Carcharias taurus Rafinesque

Mako

At least two specimens are known to have been caught locally. One, identified from a newspaper photograph, was taken during early August, 1958, in Old Tampa Bay. It was said to be nine feet long and to weigh over 200 pounds. A second specimen, which was examined, was caught during early September about 15 miles off Pass-a-Grille. It was a female with very large ovaries containing hundreds of large eggs. The specimen was estimated to he eight feet long and to weigh about 300 pounds. Jaws and plaster casts of specimens caught off Clearwater are on display at the Sea-Orama on Clearwater Beach. Mrs. Barnett Harris, owner, says the species is commonly caught in that area.

Bigelow and Schroeder (1948) believed this species to range into the Gulf of Mexico as a stray only. We believe it to be a regular visitor, if not an inhabitant. Dr. Eugenie Clark informs us that she believes the species to be in the Charlotte Harbor area.

ISURIDAE

Isurus oxyrinchus Rafinesque

Mako

Bigelow and Schroeder (1948) reported a specimen of approximately ten feet six inches length and weighing 1,009 pounds from off St. Petersburg. A six and one-half foot female weighing an estimated 400 pounds was caught by commercial fishermen about 80 miles southwest of Egmont Key in 24 fathoms on February 3, 1958.

ORECTOLOBIDAE

Ginglymostoma cirratum (Bonnaterre)

Nursc Shark

Nurse sharks are one of the commonest sharks present locally both inshore as far north as Old Tampa Bay and offshore on the rocky reefs.

RHINCODONTIDAE

Rhincodon typus Smith

Whale Shark

The St. Petersburg Times for July 6, 1954, shows a photograph of a specimen (at the water's surface) which was caught and lost 50 miles due west of Johns Pass. Fishermen found the same (?) specimen in the same area several days consecutively.

CARCHARHINIDAE

Galeocerdo cuvieri (LeSueur)

Tiger Shark

Although St. Petersburg newspapers have carried stories on catches of tiger sharks and the species is well known to local fishermen, we have seen no specimens locally. Our identification is based on plaster casts of specimens caught off Clearwater and on display at the Sea-Orama on Clearwater Beach.

Negaprion brevirostris (Poey)

Bigelow and Schroeder (1948) reported this species as common "as far north as Tampa and Pensacola." None are known by us to have been taken locally.

Carcharhinus acronotus (Poey)
Sand Shark

Large numbers of this species, about three feet in length, were caught by fishermen during August and September, 1958, about one mile off Redington Beach. Mr. Stewart Springer provided taxonomic characters on which our identifications are based.

Carcharhinus leucas (Müller and Henley)
Bull Shark

Bull sharks are commonly caught both in the bays and off-shore in the Gulf in the Tampa Bay area. Large specimens measuring from five to ten and one-half feet were commonly caught from September through December, 1958. The smallest specimen examined, 920 mm., was taken on November 6 in Boca Ciega Bay. According to local fishermen this species and other sharks are caught off the Johns Pass Bridge only on the incoming tide.

Carcharhinus limbatus (Muller and Henle)
Black-Tip Shark

This species is also commonly caught both in the bays and in the Gulf. Specimens were recorded from July through November. Dr. R. T. Kirk, a diving companion of the senior author, described a persistent menacing of aqualungers by a large black-tip which refused to be permanently driven off. The shark made withdrawals, but approached closer on each return finally forcing the divers from the water.

SPHYRNIDAE
Sphyrna tiburo (Linnaeus)
Hammerhead, Bonnethead, Shovelnose, Sand Shark

Bonnetheads are frequently caught by fishermen in the Tampa Bay area. We saw a specimen on a shallow flat in Tampa Bay during November, 1958. The only two other specimens examined by us were also caught during that month off the Gulf beaches.

Sphyrna mokarran (Rüppel)
Hammerhead

Although hammerheads are frequently caught locally, as indicated by newspaper photographs, we have actually seen only one, a five and one-half foot female caught on June 25, 1959, a half - mile off Redington Beach. We have a fairly clear photograph of a specimen about six feet long caught in Lake Maggiore in St. Petersburg, September, 1954. This lake has a salinity of less than 1.0 o/oo, but was formerly connected through a salt creek with Tampa Bay, at which time salinities must have been much higher in the lake.

PRISTIDAE
Pristis pectinatus Latham
Sawfish

Henshall (1895) reported an eight-foot specimen obtained at Tampa. Mr. John Hurlbut, operator of a commercial aquarium, told us that until a few years ago specimens (Pristis spp.) were frequently caught in Hillsborough Bay. We obtained a 34 inch specimen from a fisherman who caught it in Old Tampa Bay on May 27, 1959. The previous record was a specimen taken in the same area during August, 1957.

Pristis perotteti Muller and Henle
Sawfish

A small dried specimen taken near Clearwater is on display at the Sea-Orama on Clearwater Beach.

RHINOBATIDAE
Rhinobatos lentiginosus (Garman)
Guitarfish

Jordan (1884) and Henshall (1895) reported specimens from off Egmont Key and Tampa respectively. Although no specimens were seen locally by us, commercial fishermen have told us that they frequently catch the species in the bays.

TORPEDINIDAE
Narcine brasiliensis (Olfers)
Electric Ray

Bean and Weed (1911) reported specimens which were caught off Long Key, which includes the City of St. Petersburg Beach. We saw no specimens, but commercial fishermen know the species well.

DASYATIDAE

Dasyatis americana Hildebrand Schroeder

Bigelow and Schroeder (1953) reported this species from Tampa. No specimens have been seen by us.

Dasyatis sabina (LeSueur)
Sting Ray

Five specimens were seined in the bayou (March and December, 1958) and one specimen was obtained at the Tampa Bay station (February). Another specimen was found dead in the bayou on December 13, 1957, after a cold wave which occurred the previous night. All the specimens were males.

Dasyatis sayi (LeSueur)
Sting Ray

A single specimen was taken at the Gulf beach station on August 8, 1958. Another specimen was obtained at Bella Vista Beach, just north of this station, during June, 1958.

GYMNURIDAE

Gymnura micrura (Bloch and Schneider)
Butterfly Ray

Three specimens were taken: one at Johns Pass under a light, one offshore at a depth of 35 feet, and one off the Municipal Pier in Tampa Bay. All three were caught during July, 1958.

MYLIOBATIDAE

Aetobatis *narinari* (Euphrasen)
Spotted Eagle Ray

Bigelow and Schroeder (1953) reported a specimen from the Gulf of Mexico at Tampa. Although we have seen no specimens locally, fishermen report the species common.

RHINOPTERIDAE

Rhino ptera bonasus (Mitchill)
Cow Nose Ray

Specimens were commonly caught by fishermen in Tampa and Old Tampa Bays during May, 1958, and skin divers reported schools comprising hundreds of specimens in the same area during late June, 1959. Teeth of one specimen examined were intermediate in structure between this species and R. brasiliensis, which probably indicates that the two species are synonymous as suggested by Bigelow and Schroeder (1953).

MOBULIDAE

Manta birostris (Walbaum)
Manta Ray

Manta rays are frequently seen in the bays and on the Gulf beaches. For one reason or another bathers consider them a menace. On one occasion, police were called to chase them down and kill them with high-powered rifles.

LEPISOSTEIDAE

Lepisosteus osseus (Linnaeus)
Gar

Several specimens were caught in Bayboro Harbor off the Marine Laboratory during late October and early November, 1958. They ranged in total length from 1009 to 1314 mm. To our knowledge and the memory of local fishermen these were the only ones ever caught in the area. The largest specimen was a ripe female with barnacles growing on its side. This probably indicates residence in high salinity water for long periods of time. The salinity and temperature taken at the time of a catch on November 5, 1958, were 26.9 o/oo and 22.2 °C.

Lepisosteus platyrhincus DeKay
Gar

A small specimen was collected in Lake Maggiore, fresh water, on November 10, 1958, by Dr. F. Sogandares.

ELOPIDAE

Elops saurus Linnaeus
Ladyfish

Some 32 specimens, 59.9-295.0 mm., were taken at regular stations. Thirty-one were taken in the bayou (December, 1957, March, June-September, 1958) and one was taken at the Gulf Beach station (April). Also found in the bayou at the time of the December collection were several dead specimens which were probably killed as a result of the cold wave which occurred the previous night. The temperature of the water at the time of the

December collection was 13.0 °C. A non-regular collection which contained specimens was made in the bayou in May, 1958. Specimens ranging from 59.9-120.9 mm. were taken during June.

This species is common at all salinities from fresh to full strength sea water and I (Springer) have seen it in Lake George, Fla., perhaps a hundred miles from the sea.

Stomach contents consisted of decapod shrimp and fishes. Darnell (1959) has summarized the literature on food habits of this species and given findings of his own which indicate that fish form over 80 per cent and penaeid shrimp about 10 per cent of the diet.

MEGALOPIDAE
Megalops atlantica (Valenciennes)
Tarpon

Tarpon are very common locally and the subject of an intense sport fishery from spring through fall when they are most concentrated in the bays. A specimen, 201 mm., was found dead in the bayou on December 13, 1957, the morning after a cold wave when the water temperature was 13.0 °C.

ALBULIDAE
Albula vulpes (Linnaeus)
Bonefish

Henshall (1895) reported collecting specimens at Tampa. No catches have been made in the memory of any of the local fishermen with whom we spoke, and we saw none.

CLUPEIDAE
Brevoortia patronus Goode

Some 1112 specimens, 17.1-135.2 mm., were taken during regular collections. All these came from the bayou station from February through May. All but two of the specimens were less than 54 mm. in length. Young were seen at the Gulf beach station on March 17, but we failed to obtain any. The young were also very common along the bulkheads of Bayboro Harbor during April. A series of specimens (Table 7) were taken with a hoop net under a night light at Johns Pass during July, 1958.

During the month of May *B. patronus* and *B. smithi* were taken together in the bayou. The average size, 23.3 mm., of *B. smithi* at that time was about the same as that of *B. patronus,* 23.5 mm., for the month of March. This may indicate a similarity of habit, but a later spawning date, for *B. smithi.*

If our data are representative, a winter spawning period is indicated for *B. patronus.* Simmons (1957) reported that menhaden *(B. gunteri, B. patronus?)* spawned in the "area" (Texas coast?) during February, 1956, and that specimens 15 mm. long were present in the Laguna Madre during March through May. Suttkus (1956) presumed that *B. patronus* spawned from October through February off the Louisiana coast. The young migrated into Lake Pontchartrain during December through March and were about 20-30 mm. at the time they arrived (mid-class of strongly marked modal frequency of February, 1955: 27 mm.; for March, 1954 and 1955: 32 and 42 mm. respectively). We collected a single specimen, 22.2 mm., in February. During March we collected large numbers of specimens ranging from 20.1-31.0, with the average size 23.5 mm., which coincided identically with the mid-class of the modal frequency. This average and modal size is important as it demonstrates that *B. patronus* reaches our inland waters at a smaller size (earlier age?) than it does on the Louisiana coast. Suttkus collected only one specimen out of over 8000 in his 15-19 mm. class, whereas we collected 11 out of less than 1200 specimens in our 16-19 mm. class. We believe that we would have collected a considerably higher percentage of these smaller specimens with smaller meshed nets.

Also of interest are what appear to be differences in growth rates between our bayou population and Suttkus' Lake Pontchartrain population. His averages increase rapidly and in May when our specimens averaged 29.1 mm,, his averaged roughly 60 mm. Both his and our data indicate a sudden spurt of growth after May (after June?) which is indicated in the July sample. Our collection for that month averaged 85.1 mm. and is considerably less than the approximately 110 *mm.* average indicated for Suttkus' specimens. It is possible that the July data for both Suttkus' and our specimens are representative of

the previous year class. In Suttkus' data for August, 1954, there is a definite bimodality. One of the modes is in line with his previous June peak and the other is in line with his July peak.

In contrast to Suttkus' finding that emigration from estuarine waters took place in July and August, we found no specimens in the bayou after May; however, it is possible that the population had merely moved to the lower reaches of the bayou whereas our station was in the mid-reaches. The collection from Johns Pass (it is academic whether this locality is considered bay or Gulf) during July does indicate that migration to the Gulf had occurred at least this early, and possibly as early as June.

It is interesting to note that two collections of *B. tyrannus* in the St. Lucie River during March 25 and 26 averaged 26.0 and 31.8 mm. (67 specimens 21.2-35.8 mm. and 85 specimens 17.0-37.6 mm., respectively). Collections in the same area March 11, 1959, produced specimens ranging from 20.0-36.0 mm. These

Table 7. Frequency Distributions of Standard Lengths of Tampa Bay Area *Brevoortia patronus* for Certain Months of 1958'

Mid-Class	FEB	MAR[2]	APR	MAY	JUL[3]	
17.5			11			
20.5		92	11			
23.5	1	386	58	9		
26.5		87	179	25		
29.5		3	119	43		
32.5		1	17	8		
35.5			3			
38.5			1	2		
41.5				1		
44.5				1		
47.5			1	2		
50.5				1		
53.5				1		
65.5					1	
68.5						
71.5					1	
74.5				1	3	
77.5					4	
80.5					7	
83.5					15	
86.5					10	
89.5					8	
92.5					2	
95.5					3	
98.5					1	
101.5					1	
110.5					1	
134.5						
Total	1	569	400	95	57	1122
Average		23.5	27.0	29.1	85.1	

I Frequencies above lines in columns denote those used in compiling averages.
[2] Plus 47 specimens not measured.
[3] Data not from regular station.

results indicate that the two closely related species are in about the same stage of development at about the same time.

Salinities and temperatures at times of regular collections in the bayou ranged from 6.6-18.7 o/oo and 20.5-27.5 °C. Specimens were taken or seen in our area at salinities and terneratures as high as 34.2 o/oo and 30.0 °C. A specimen, 127 mm., was collected in Apalachicola Bay at a temperature of 11.2 °C. (surface and bottom salinity: 0.6 and 9.8 o/oo, respectively, January 28, 1958).

Darnell (1959) has discussed the feeding mechanism of menhaden which he believes to be strictly a filtration process.

Dr. R. D. Suttkus demonstrated for us the characters for separating the young of the two species of menhaden present in our area.

Brevoortia smithi Hildebrand

Some 269 specimens, 19.0408.2 mm., were taken during regular collections during May, July, and August. All but one, 43.8 mm. taken during July at the Tampa Bay station (25.5 o/oo, 30.3 °C.), were taken in the bayou. Of these, 560, 19.0-29.1 mm., were taken during May (6.6-17.5 0/00, 26.2-27.5 °C.), and eight, 55.0-108.2 mm., were taken during August (3.7-4.2 o/oo, 29.5 °C.). Forty other specimens, 41.5-72.0 mm., were taken in the fresh waters of Lake Maggiore during June, 1958, by Miss Jonny Wallace. Adults up to 250 mm. were taken by mullet fishermen in Sarasota Bay on January 13, 1959, (31.6 o/oo, 18.0 °C.). These large specimens are called "shad" by the fishermen.

Spawning probably occurs during the spring; somewhat later than for *B. patronus (q.v.).* The two species occurred together in the bayou during June. After that month *B. patronus* was no longer present.

Dorosoma petenense (Gunther)

We have taken examples of this species only from Lake Maggiore (within the St. Petersburg city limits) in the Tampa Bay area.

Opisthonema oglinum (LeSueur)

Greenback, Threadfin, Herring, Sardine

Some 251 specimens, 36.0-83.0 mm., were taken in regular collections. These were all taken at the Gulf beach together with larger numbers of *Harengula pensacolae* and sometimes with a few *Sardinella anchovia.* Regular collections occurred during the months of November, 1957, and August through December, 1958. Springer and Bullis (1956) record collections in the Tampa Bay area during March, 1953. The species is usually present offshore during most, if not all, of the year. It was most abundant in our October, 1958, collection. Salinities and temperatures at times of collection ranged from 32.5-35.1 o/oo and 21.0-31.0 °C.

According to commercial fishermen this is the commonest clupeid in the Gulf. Large catches are made locally and are now being frozen and packaged in 25 pound lots. The fish is sold to large aquaria for use in feeding, and there appears to be a possible market for the species in the production of fish meal.

Stomachs of three specimens examined all contained copepods, tiny molluscs, and bits of algae.

Etrumeus sadina (Mitchill)

We have not seen any specimens from the Tampa Bay area, but Mr. H. R. Bullis, Jr., has informed us that the species has been taken by the *Oregon* in our area. A sample was taken by the *Oregon* at station 2162, west of Charlotte Harbor, on April 14, 1958, at which time Bullis said the species was in our area.

Harengula pensacolae Goode and Bean

White Bait, Bait, White Minnow, Minnow, Sardine

This is one of the commonest fishes in the Tampa Bay area. Though only 2818 specimens were returned to the laboratory, tens of thousands of specimens were collected during the summer and fall months. Our specimens were caught primarily on the Gulf beach, but we believe that the species was abundant in the bays but unavailable to us because they were in the mid-bay and channel areas. Numerous specimens were killed in Hillsborough and Old Tampa Bays during seismographic operations in March, 1958, when we obtained no specimens at all at regular stations. Al-

though we collected no specimens at regular stations during January through April, 1958, we have records for the Tampa Bay area for every month except April, though not necessarily during the years that our study was carried on. Gunter (1945, as *H. macropthalma),* in Texas, did not take specimens from December through March, 1941, and noted the disappearance of the species during November the following year. Reid (1954), at Cedar Key, did not record the species from December through February. Fishermen in our area commented that they were surprised to see the "bait" in the area during the winter of 1958-1959 and believed that the prolonged stay of mackerel *(Scomberomorus maculatus)* during this time was due to the presence of the bait.

Ripe or spawning fish have not been recorded, but the presence of the young in June probably indicated that spawning took place during April-May. Young within our smallest size range for June, 1958, were present in late May, 1959. Gunter first took young of about the same size as our specimens during June and believed that spawning took place during April.

The majority of the young, 21.5-25.5 mm., that we collected were taken in the bayou; however, a collection made on Bella Vista beach on the Gulf, by Dr. Paul Wallace, on the same date as the bayou collection, contained specimens ranging from 18-38 mm. Gunter believed that there were two spawning periods on the Texas coast; the second during the latter part of the summer. The only evidence which we obtained that might support this supposition is a collection, 46-52 mm., taken under a night light at Johns Pass on December 29, 1958. These specimens are smaller than those taken at regular stations during that month, but are similar in size to specimens taken during August.

Growth is illustrated in Figure 7. Specimens averaging about 23 mm. in June increased steadily until they averaged about 65 mm. in October. Gunter's "0" year class sizes are roughly comparable to ours; he used total lengths. Another year class was present in our collection dur ing May-July which seemed to hold a constant average of about 95 mm.

Salinities and temperatures at times of regular collections ranged from 12.8-35.1 0/00 and 21.0-32.4 °C. Only one specimen was taken in a salinity of less than 25 o/oo, which accords with Gunter's findings. He took only 16 of 2140 specimens in salinities of less than 25 o/oo (4.8-36.9 0/00). We found two cold-killed specimens in the bayou in December after a severe cold wave, immediately after which the water temperature was 13.0 °C. The coldest temperature at which we recorded live specimens was 16.8 °C. at the time of the December Johns Pass collection. Gunter stated that this species vanished from catches when the temperature dropped below 24 °C.

Mysids, gammarids, copepods, ostracods, and small molluscs comprised the diet.

Sardinella anchovia Valenciennes
Sardine, White Bait, Bait

Only 15 specimens were taken in regular collections and all these were taken on the Gulf beach in the same hauls with larger numbers of *Opisthonema oglinum* and *Harengula pensacolae.* Five specimens, 44.3-54.0 mm., were taken on November 11, 1957 (32.5-33.5 o/oo, 21.2 °C.), and ten specimens, 61.2-77.0 mm., were taken on December 2, 1958 (34.2 o/oo, 21.0 °C.). In addition to these, seven specimens, 6:3.2-77.0 mm., were taken under a night light at Johns Pass on July 1, 1958 (34.2 o/oo, 29.5 °C.), and large schools,

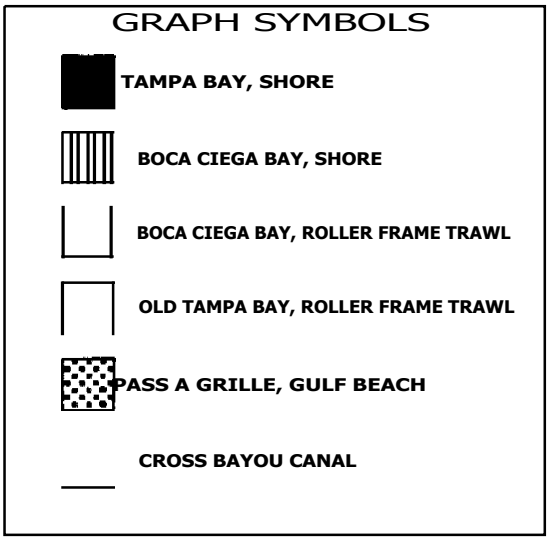

Figure 6. Key to symbols used in figures 7-18.

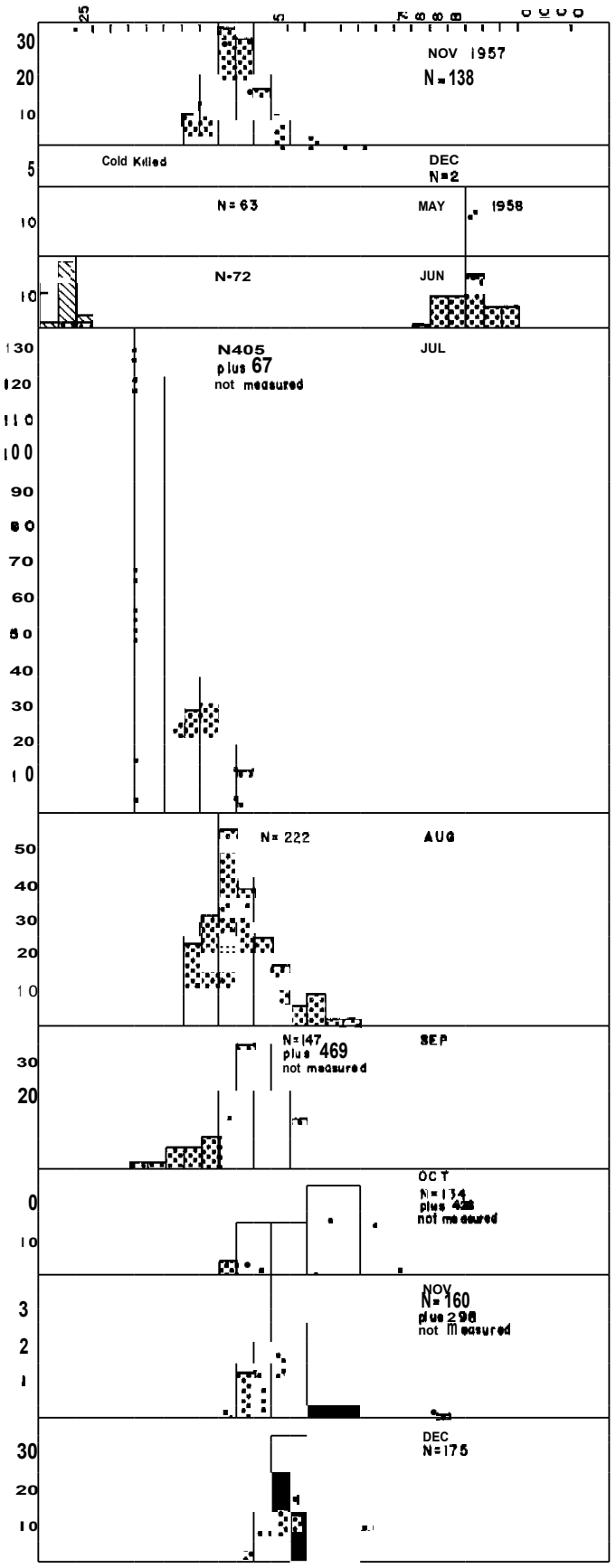

Figure 7. Monthly length-frequency distributions of *Harengula pensacolae.*

50-60 mm., were taken there just outside the sphere of the light's influence on June 18, 1959. At times the species is very common offshore and investigations have been carried on by the Fish and Wildlife Service to determine the feasibility of establishing a fishery for the species. It is esteemed locally as a bait and charter boatmen prefer it to *O. oglinum* or *H. pensacolae.*

ENGRAULIDAE
Anchoa hepsetus (Linnaeus)
Glass Minnow

Seventy-seven specimens, 32.0-114.2 mm., were collected at regular stations. They were taken during all months except January, February, and November. Of the 15 collections in which A. *hepsetus* occurred, seven were from the bayou, seven from the Gulf beach, and one from the Tampa Bay station. Ripe or almost ripe individuals were collected at the Gulf beach station on March 17, 1958, and from the bayou on April 23 and May 6, 1958. The smallest specimens, 32.0-36.6 mm., were taken in December at the beach station, but a collection of only slightly larger individuals, 35.5-51.0 mm., came from Tampa Bay the previous July. Hildebrand and Cable (1930) took eggs from April-July at Beaufort and stated that both this species and A. *mitchilli* spawn within the harbors, estuaries and sounds as well as offshore.

Salinities and temperatures for collections ranged from 3.7-35.1 o/oo and 17.4-32.0 °C. A collection made on February 1, 1958, in east Pensacola Bay occurred at a temperature of 11.2 °C., and Gunter (1945) reported a single specimen from a temperature of 8.1 °C., and others from salinities as low as 2.5 0/00. Simmons (1957) reported *A. hepsetus* in salinities of 75-85 o/oo, but stated that the species preferred them less than 50 o/oo.

Food was found to consist primarily of copepods, isopods, mysids, caridean shrimp, and tiny pelecypods. One specimen contained four small *Anchoa mitchilli* and another contained one small *Leiostomus xanthurus*. In addition to our findings, Hildebrand and Cable noted gastropods, ostracods, and annelid worms in the diet.

Anchoa cubana (Poey)
Glass Minnow

Several hundred specimens (247 were retained) ranging in size from 50.8-63.9 mm. were seined at the Tampa Bay station on April 12, 1958. The salinity was 22.0 o/oo and the temperature was 25.0 °C. The specimens were in almost ripe condition. A few other specimens were obtained on May 26 and July 1, 1958, and April 7, 1959, at Johns Pass under a light at night. The salinity and temperature at the latter date were 34.2 o/oo and 29.5 °C. A single specimen was taken on the Tampa Bay side of Egmont Key on August 3, 1958.

Two stomachs were examined. One contained unidentifiable animal matter and the other contained ostracods and copepods.

This species has not been previously reported from the Gulf coast between Marco and the panhandle of Florida. Dr. R. D. Suttkus verified the identification. We took specimens also off Englewood on February 22, 1958, and at Ft. Myers Beach on February 11, 1959. Probably many records of *Anchoa hepsetus* in the Gulf are referable to A. *cubana* because the two superficially resemble each other.

Anchoa mitchilli diaphana Hildebrand
Glass Minnow

Many thousands of this species (2381 were preserved for laboratory examination) were collected at regular stations. Of 26 regular collections 15 were in the bayou, which was the only station at which the species was taken every month in the study period; five were at the Maximo Pt. station (November and December, 1957, and August-October, 1958); four were from the Gulf beach (December, 1957, and February, August, and November, 1958); and one each from the Tampa Bay station and Big Island station (July and August, 1958, respectively). This information is in direct contrast to the findings of Gunter (1945), Reid (1954), and Kilby (1955) who noted that this species occurred primarily in the open bays. However, we agree with these authors that salinity was of very little consequence in limiting distribution. Our salinity range was from 5.0-35.0 o/oo. Simmons (1957) found A. m. *diaphana* in salinities as high as 75-80 o/oo, and we have taken the species in the St. Lucie River (Florida east coast) at a salinity of 0.5 o/oo.

We found abundance least during the winter and greatest during late summer and fall. Gunter *(op.cit.)* found peaks of abundance during February (Aransas Bay) and July (Copano Bay), with June as the month of least abundance. Our temperatures for collections ranged from 10.8-32.5 °C. Gunter obtained specimens at temperatures from 8.1-33.2 °C.

Running ripe individuals were not obtained during our study, but almost ripe individuals were obtained during July, September, and December. Gunter found ripe individuals from March-August.

Length-frequency tables were constructed, but little information on growth could be ascertained. There were indications of usually two and sometimes three year classes which accords with Gunter's findings.

Of 42 stomachs examined 22 contained copepods. Others contained ostracods, pelecypods, gastropods, crustacean larvae, mysids, and unidentifiable fish (six stomachs), or were empty. Darnell (1959) has made a detailed study of food habits of this species. He found that rotifers, calanoid and cyclopoid copepods were important components of the diet of the young, but these items were consumed less frequently with increase in size and composed less than two per cent of the diet of the largest specimens. He found a variety of organisms in stomachs with fishes and small shrimp prominently represented.

SYNODIDAE
Synodus foetens (Linnaeus)
Lizardfish, Snakefish

Although only 34 specimens, 33.9-167.4 mm., were taken at regular stations, lizardfish are commonly taken on hook and line by fishermen. Specimens were obtained at all stations except the roller frame trawl stations in Old Tampa Bay. The majority of the specimens were obtained from strictly sandy bottoms, frequently from the sandy areas punctuating the grass beds. Reid (1954) found this species more often on muddy bottoms. Only four specimens, 47.1-87.2 mm., were tak-

en in the bayou (October-December, 1958). No specimens were taken from January through May although some specimens were taken at the Tampa Bay station on May 26 (not a regular collection). Gunter (1945) took no specimens on the Texas coast during the winter, but Reid took specimens throughout the year at Cedar Key. Hildebrand (1954) found S. *foetens* to be the common inshore lizardfish on the Texas coast. In contrast to Gunter, he noted no seasonal trends.

Reid and Gunter both believed the species to spawn in the spring. Our smallest specimens, 33-35 mm., were taken during November and December.

Salinities and temperatures at times of collection ranged from 13.9-35.1 o/oo and 11.2-32.5 °C. Simmons (1957) found the species limited by salinities of 40 o/oo, but stated that specimens were taken in land cuts at salinities of 60 0/00. Reid took specimens in temperatures as low as 8.3 °C.

Of 20 stomachs examined 13 contained at least fish (identifiable: *Gobiosoma robustum* in three, *Anchoa mitchilli* in three and *Menidia beryllina* in two); five contained at least crustaceans, and four were empty.

Synodus intermedius (Spix)
Lizardfish, Snakefish

No specimens were taken at regular stations. This species is common over the sandy bottoms offshore where it replaces the inshore *S. foetens.*

ARIIDAE
Galeichthys felis (Linnaeus)
Catfish, Hardhead, Gafftop

Of 736 specimens, 37.4-285 mm., collected at regular stations only two did not come from Cross Bayou: one 254 mm., May 14, 1958, 21 0/00, 24.5 °C., Tampa Bay station; and one, 78.2 mm., December 2, 1958, (34.2 o/oo 21 °C.), Gulf beach station. This contrasts with the findings of Joseph and Yerger (1956) who took no specimens in tidal streams. Hardheads were taken during all but three collections in the bayou: October, 1957, and January and June, 1958, and all but six of the bayou specimens were less than 100 mm. The largest single collection, 444 specimens, 37.4-59.0 mm., except for one 197.8 mm., was made on August 8, 1958 (3.7-4.2 o/oo and 29.5 °C.). The average size of this collection was 49.7 mm. This agrees with the findings of Gunter (1945) who noted that the smaller individuals were in the least saline waters, but contrasts with his findings that few specimens were in waters less saline than 5 o/oo.

Large individuals are commonly caught by fishermen throughout the Tampa Bay area.

No information on growth could be obtained from our data.

Specimens occurred in salinities of 3.7-34.2 o/oo. However, very few were taken in salinities over 17 o/oo. Most investigators report greatest abundance in higher salinities, but their specimens were larger than ours. Simmons (1957) reported the species common in salinities up to 45 o/oo but none in salinities over 60 o/oo. We have collected the species in salinities of less than 1 o/oo in the St. Lucie and Caloosahatchee Rivers.

Temperatures at times of collection ranged from 13.0-32.0 °C. The lowest temperature occurred on December 13, 1957, after the cold wave the previous night. The hardheads were swimming sluggishly and were easily caught by hand. This species was obtained at temperatures as low as 9.3 C. in Apalachicola Bay.

Annelids and fish scales (with no other fish remains) were found to constitute the major portion of the stomach contents. Also found were insect larvae, gammarids, isopods, crabs, copepods, fish remains, and plant detritus. Darnell (1959) has summarized the food habits of this species which he found to be a bottom scavenger. He believed the presence of only the hard parts of fishes in catfish stomachs to be due to straining activity during feeding on the bottom. No live fish are apparently ingested.

Bagre marinus (Mitchill)
Catfish, Gafftop

Only three specimens, 72.8-87.1 mm., were taken during regular collections. They were collected at Cross Bayou On August 13, 1958 (3.7-4.2 o/oo; 29.5 °C.). Other specimens were obtained in Tampa Bay during March, 1958,

as a result of seismographic explorations. Large specimens were being caught from the Municipal Pier, also in Tampa Bay, during June, 1959.

ICTALURIDAE

Ictalurus nebulosus (LeSueur)
Catfish

This species was collected in Lake Maggiore within the St. Petersburg city limits.

On January 28, 1958, a freshly dead specimen was obtained beside the seawall in Bayboro Harbor off the Marine Laboratory. The salinity and temperature at the time were 24.0 o/oo and 18 °C. On March 3, 1958, immediately after a period of heavy rainfall, an estimated 1000 dead and dying specimens were seen on the surface in the same area as the first mentioned specimen. Salinity and temperature at this time were 14.0 0/00 and 19.5 °C.

Bayboro Harbor connects with Lake Maggiore through Salt Creek. The lake, which was formerly brackish, is now fresh (on July 4, 1958, a salinity of 0.7 o/oo was obtained) and is connected to the creek by a dam over which outflow only is possible, except possibly during periods of extreme high tides. It is possible that the catfish were washed over the dam and became stranded in the brackish water and were washed out during low tide.

Ictalurus *natalis* (LeSueur)
Catfish

This species was taken in the fresh water streams of Pinellas County, where it is common in shaded or protected areas.

CYPRINIDAE

Notemigonus *chrysoleucas* (Mitchill)

This species was taken in a fresh water stream entering upper Boca Ciega Bay.

ANGUILLIDAE

Anguilla rostrata (LeSueur)
Eel

One specimen, 193 mm., was taken at the bayou station on November 14, 1958 (13.9-20.4 o/oo, 25.0-25.5 °C.). Several specimens all about the same size, one of which measured 54.5 mm., were taken during March by Mr. Sebi Sohon from a creek entering Boca Ciega Bay.

MURAENIDAE

Gymnothorax saxicola Jordan and Davis
Moray

Specimens taken at Johns Pass and from Tampa Bay were seen. Specimens from Johns Pass were quite small (less than six inches) when taken. They were raised to more than triple their size in an aquarium by Mr. Jack Hurlbut. This is probably the same species reported as G. ocellata by Jordan (1885) from Egmont Key.

ECHELIDAE

Myrophis punctatus Lütken

Specimens were collected in the bayou and at the Tampa Bay station. Two specimens, 235 and 322 mm., were taken in the bayou during April and September respectively. All the specimens (312) from the Tampa Bay station were taken with the use of rotenone. On August 4, 1958, one specimen, 68 mm., was killed. On September 3, 1958, 231, 67-109 mm., of many more killed, were taken. On October 3, 1958, only 80 specimens, 67-117 mm., were found killed. At the November station rotenoning failed to produce any specimens. The fact that this species is quite common in this region would have been overlooked had not rotenone been used. The species lives in the sand just a little below high tide. Specimens 53-58 mm. were taken under a night light in April at Johns Pass.

Salinities and temperatures at times of regular collections varied from 5.0-26.4 o/oo and 26.0-32.5 °C. Specimens were taken in a creek where the salinity was less than 1 o/oo and a specimen, 103 mm., was taken at a temperature of 11.0 °C. in Old Tampa Bay.

Of 13 stomachs examined eight were empty, four contained polychaetes, and one contained a Branchiostoma caribaeum.

Ahlia *egmontis* (Jordan)

This species was described by Jordan (1885) from a specimen taken off Egmont Key. We know of no other specimens from this area.

OPHICHTHIDAE

Mystriophis intertinctus (Richardson)
Moray, Eel

Ginsburg (1951) and Jordan (1885) listed specimens from Clearwater Harbor and Egmont Key, respectively. Mr. John Hurlbut gave us a specimen, 810 mm., collected under a light at Johns Pass on January 28, 1959.

Mystriophis mordax (Poey)

A single specimen was found washed ashore on Madeira Beach during the red tide outbreak of 1957.

Ophichthus gomesi (Castelnau)
Eel

No live specimens were seen, but large numbers of dead specimens were identified amongst the fishes washed ashore during the red tide outbreak of 1957.

Bascanichthys teres (Goode and Bean)
Eel

Several of these eels have been taken under a light at Johns Pass. A 142 mm. specimen was taken on May 26, 1958. Much larger specimens were common during January and February, 1959.

Bascanichthys scuticaris (Goode and Bean)

This species was reported by Jordan (1885) from Egmont Key. No other records from the Tampa Bay area are known.

BELONIDAE

Strongylura timucu (Walbaum)
Needlefish, Gar

Needlefish (this species is also the S. *marina* of authors) were seen or collected at all regular shore stations. Some 133 specimens, 48-388 mm., were collected. These occurred from May through December. One specimen, 395 mm., was found dead in the bayou on December 13, 1957, after a cold wave the night before. The water temperature at the time of the finding was 13 °C. Specimens were most abundant during October and November, 1958.

No information on spawning is available, but our smallest specimens were taken in May. An interesting anatomical fact was noticed while examining stomachs: the female has a single gonad, on the right side. Males have two gonads.

Salinities and temperatures at times of regular collections ranged from 3.7-35.1 o/oo and 21.1-32.0 °C.

Food was found to be quite variable: fish, copepods, other unidentifiable crustacea, and insects. Darnell (1959) noted similar contents in specimens he examined from Lake Pontchartrain (as S. *marina).*

Strongylura notata (Poey)
Needlefish, Gar

Thirty-three specimens, 123-335 mm., were collected at regular stations. Thirty-one were collected at the Tampa Bay station and two were collected at the Gulf Beach station. The specimens were taken during November, 1957, February, July, September and October, 1958. One specimen, 249 mm., was found dead in the bayou on December 13, 1957, after a cold wave the night before. The water temperatire at the time of the finding was 13.0 °C.

Salinities and temperatures at times of regular collections ranged from 25.0-35.1 o/oo and 13.5-33.0 °C. Kilby (1955) reported specimens from salinities as low as 0.8 o/oo.

Strong ylura raphidoma (Ranzani)

One specimen, 881 mm., was obtained from a fisherman who caught it on the bay side of Egmont Key during April, 1958. A specimen, 238 mm., was dipnetted under a night light at Johns Pass on June 1, 1959, and another, 82.5 mm., under the same circumstances on the following June 21. Several others were seen at the surface about 10-15 miles offshore in the Gulf on June 28, 1959. This species, unlike the other two of its genus we collected, is probably most abundant at considerable distances offshore in our area. The other two species were never seen more than a few hundred feet from shore.

Ablennes hians (Valenciennes)

A plaster cast of a specimen caught off Clearwater was made by Mrs. Barnett Harris and is on display in the Sea-Orama on Clearwater Beach.

HEMIRHAMPHIDAE

Hyporhamphus unifasciatus (Ranzani)

Hound Minnow

Although hound minnows are distributed widely and commonly in the Tampa Bay area we collected only three at regular stations, all from the Tampa Bay station. Two, 108 and 115 mm., were taken in November, 1957 (25.8 o/oo, 31.0 °C.) and onc, 106 mm., was taken in September, 1958 (25.2 o/oo, 28.9 °C.). Kilby (1955) has taken this species at a salinity of 7.5 o/oo.

EXOCOETIDAE

Cypselurus *luetkeni* Jordan and Evermann

Flyingfish

Flyingfishes (spp.) were frequently observed offshore in the Gulf near the coast, but we know of no catches. There seems to be a seasonal variation in their appearance. None were seen during the winter and spring. A single specimen of C. *luetkeni* was caught by a fisherman from the Johns Pass bridge during September, 1958. It appeared to have been snagged.

CYPRINODONTIDAE

Lucania parva (Baird and Girard)

Only 37 specimens, 18.2-36.6 mm., were collected at regular stations. Of these, 24 were taken at the Maximo Pt. station, (February, March, June, October-December), nine were taken in the bayou (December, 1957, January, December, 1958), and four were taken at the Tampa Bay station (February). The few specimens taken are not indicative of the actual abundance in the area. We feel comparatively certain that the species is not common in lower Tampa Bay or in the bayou; and it is undoubtedly absent from the beach, but collections using more efficient equipment (i.e. seine) in Boca Ciega Bay would certainly take large quantities. Specimens were taken with the push net at Maximo Pt. probably because they became entrapped in masses of algae.

This species appears to vary widely geographically in salinity preference. Gunter (1945, Texas) found specimens most abundant in salinities of 10-15 o/oo, and later (1950) found the species most abundant below 2.1 o/oo (as low as 0.1 0/00 in Simpson and Gunter, 1956). Kilby (1955, Cedar Key) found 81 percent of his specimens in salinities of less than 11 o/oo. We found the species (including many non-regular collections in the Tampa Bay area) to be most common in salinities greater than 25 o/oo. Simpson and Gunter (1956) collected species in salinities as high as 48.2 0/00. Wherever taken the species prefers vegetated areas, the more heavily so the better, which probably indicates that salinity is of secondary importance in its immediate distribution (exclusive of its possible bearing on embryonic development)

Adinia xenica (Jordan and Gilbert)

One hundred and thirty specimens, 18.1-32.9 mm., were taken in the bayou during the regular collections made in December, 1957, January, February, July and December, 1958. Specimens were also taken in the bayou on a non-regular collection made in May, 1958. Other specimens were taken in the lagoon bounded by Indian Key in Boca Ciega Bay. The salinities (30.6-31.0 0/00, January and May respectively) in this latter locality were higher than those in the bayou (7.2-18.7 0/00) when this species was taken. Simpson and Gunter (1956, as *Adinia multifasciata)* recorded this species in salinities up to 53.9 o/oo, but most commonly between 20.0 and 36.9 o/oo, and Kilby (in Simpson and Gunter, op. cit.) recorded specimens in salinities as low as 0.8 o/oo. Similarly to Gunter (1945) we found this species most common in the winter. Kilby (1955) found the species most abundant in the fall, but common in the winter.

Fundulus grandis Baird and Girard

Chub

Some 306 specimens, 19.7-134.0 mm., were taken at regular stations. Except for one specimen taken in July and 12 in August from the Tampa Bay station all came from the bayou. The species was taken every month of the study except October, 1957, but was undoubtedly present then. No specimens are recorded on the graph (Figure 8) for April.

Specimens were collected in the bayou in April, but the measurements were misplaced. The species has been taken in various habitats in all the bays, but apparently prefers the bayou. In the bayou most of the specimens were collected in the same area as were most of the F. [illegible] (q. v.). Considerably more specimens were taken during the fall collections in the bayou than are reported here. These were discarded after a random sample of the entire seine haul had been removed.

From the small amount of data available it appeared that breeding took place from late fall through early spring, 1957-58, and again in the late fall of 1958. Females with ripe eggs were taken during the months of October-January and March. Gunter's (1945) smallest specimens, 23-28 mm., were taken in June and July which indicated a spring spawning on the Texas coast. He doubtfully postulated a second spawning in late fall which was also indicated by the data in Simpson and Gunter (1956). We believe a late fall spawning probable. Kilby (1955) believed spawning occurred in all seasons at Cedar Key.

The breeding coloration of a near ripe 134 mm. male taken on February 24, 1958, is described here. Body color is that of non-breeding males; differences are manifested in the fins: anal fin orange-yellow with blood red spots distally in the membrane; dorsal fin with an orange-yellow margin of less intensity than that of anal; this margin wider anteriorly; basal and posterior portions dusky with iridescent light blue spots; caudal with a light green margin; remainder of fin with iridescent pale blue-green spots; pectoral fins orange-yellow with sparse red spotting; pelvic fins orange-yellow. Some males are less intensely colored than the one described, but all conform to the colors described.

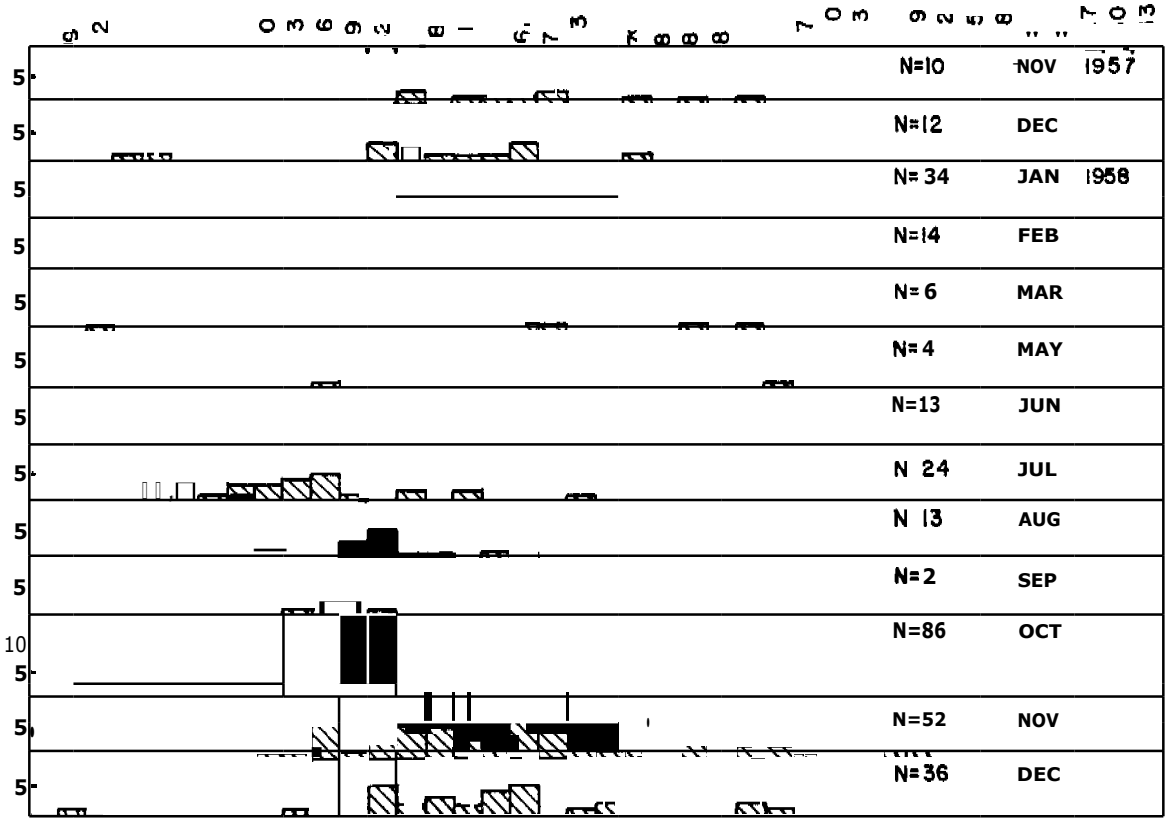

Figure 8. Monthly length-frequency distributions of *Fundulus grandis.*

Some evidence of growth is apparent in the graph (Figure 8) though the absolute rate is hazy. Specimens spawned in the late fall or winter of 1957 appeared to reach an average size of roughly 68 mm. by December, 1958. The December, 1957, specimens of the second class also average about 68 mm. It is doubtful that many specimens would exceed a fourth class though a number do reach the third class.

Salinities and temperatures during times of regular collections varied from 3.7-29.8 o/oo and 13.0-32.5 °C. Most specimens were taken between 13-20 o/oo. Gunter (1950) took a specimen at a salinity of 0.4 o/oo, but over half his specimens came from salinities over 13.0 o/oo. Simpson and Gunter (1956) took specimens at a salinity of 76.1 o/oo, but found them most common between 10 and 20 o/oo.

The diet was varied and was found to consist of hermit crabs and unidentifiable arthropods, pclecypods, Neritina virginca, Mollienesia latipinna and other unidentifiable fish remains.

Fundulus confluentus Goode and Bean

Thirteen specimens, 25.3-44.5 mm., were taken in regular collections, all from the bayou. The specimens were taken during October, 1957, and January, February, October-December, 1958. Specimens were taken during a non-regular collection in May, 1958. Most of the specimens came from an open pool surrounded by mangroves. The water of this pool was connected with the main part of the bayou through the mangroves. One specimen was collected from a freshwater creek.

Salinities and temperatures at times of regular collections ranged from 7.2-20.4 o/oo and 13.0-26.8 °C.

A stomach of a 29.5 mm. specimen contained an annelid and an unidentifiable arthropod.

Fundulus similis Baird and Girard) Chub

Until rotenone was employed over the sand flat at the Tampa Bay station in May, 1958, this species was only occasionally taken, although it was observed to be common in all habitats adjacent to shore with the exception of the Gulf Beach where the species was never recorded. No specimens were recorded (collected or observed) from February through April. Relative abundance would be difficult to assess other than the general statement that the species is most abundant from late spring to early fall. It is estimated that from 5000-7500 specimens were killed by rotenone during July at the Tampa Bay station, whereas probably no more than 1000 were killed under essentially the same conditions at the same station in September and none were killed (or seen) in November. Gunter (1945) found the species most abundant in summer and winter in Texas, and Kilby (1955) concurred for Cedar Key. Rotenone was never used in the bayou, but observations indicated that the species was never as common here (the particular station studied) as at either the Tampa Bay or Boca Ciega Bay stations.

The species is most often found within a short distance of the edge of the water and usually over a sandy or sandy mud bottom. Gunter (op. cit.) and Simpson and Gunter (1956) postulated that the species was absent from the Gulf beach because of lack of cover. F. similis seeks cover by burying itself in the sand. Since the species is found over sandy bottoms in the bay, the only postulation we can make to account for its absence from the Gulf beach is that the coarseness of the sand particles is greatest here and probably does not lend itself to the burrowing activities of the species.

Gunter (op. cit.) reported ripe specimens from April through August and Kilby stated that he obtained very young ones during all seasons (his smallest specimen: 12 mm.). Gunter (1950) recorded ripe specimens in March-June, and most numerously at a salinity of 2.0 o/oo (he took no specimens at less than 1.4 o/oo). Although we obtained specimens of less than 13 mm. only during June and August, we do not consider these months solely as the breeding period. A graph of length frequencies based on 1772 specimens taken during the period of the study indicates young present, 13-21 mm., during Jan-

uary. Also males in breeding color were collected by Dr. F. Sogandares of our laboratory during late February, 1959. Joseph and Yerger (1956) observed breeding color at Alligator Harbor from February to September. They briefly described this color (females remain unchanged). A more detailed description of the male is given here with notes on behavior as observed in an aquarium.

Fins: caudal with black margin dorsally, ventrally and posteriorly; center portion unmarked; anal, pelvics, and pectorals dusky black; dorsal unmarked. Ventral portions of head and belly dusky; posterior portion of opercle darker black than these portions. Top of head from tip of snout to mid-interorbital lemon yellow. Region of body covered by pectoral lemon yellow, but lighter than top of head. Vertical body bars light to absent. Scales posterior to yellow portion of body dark margined.

Three males and one female were placed in a 15 gallon aquarium, and had been there for several weeks when the following observations were made. The largest male (1) was the most conspicuously colored and was dominant, constantly chasing the other two males away from the female. The other two males did not molest each other. Male 1 most frequently attacked the next most conspicuously colored male (2). The least conspicuously colored male (3) was frequently ignored by male 1 even when the two were very close together, but male 3 always became agitated when in close proximity to male 1 and would swim away. Male 1 spent much of his time swimming in tight circles about the female, frequently touching her. The female at such times remained motionless, but occasionally would make a dive, head only, into the sand on the bottom of the aquarium, withdraw and eject sand particles from her mouth. When male 1 was not present either male 2 or male 3 would approach the female and attempt to swim closely around her. They never remained in the vicinity of the female for more than a few seconds before being chased off by male 1. The female seemed indifferent as to which male "courted" her. This activity was continued for several hours, but actual breeding was never observed.

Data on growth was not decipherable from the graph constructed. A definite bimodality at 27 and 53 mm. occurred for three months consecutively (August-October) and evidences of them are also present in earlier months. Peaks at lesser or greater sizes appear and disappear variously. Usually three or four classes are always apparent, but these may actually be only two age classes with each sex represented by a peak. It is known that the rotenone was not often effective on specimens over 90 mm. and for that reason the larger specimens are poorly represented in collections. Kills indicated that the species tends to form schools based on size.

Salinities and temperatures at times of collection ranged from 3.2-32.3 o/oo and 13.0-32.5 °C. Simpson and Gunter (1956) and Simmons (1957) reported the species common in salinities up to 76.1 and 75 o/oo respectively.

Food consisted of copepods, ostracods, tiny molluscs, and annelids. Remains of an insect and a caridean shrimp were found each on one occasion.

It was noticed early in the study that specimens from the bayou were darker and morphologically more robust (including larger eye, etc.) than those from Tampa Bay. Dr. R. R. Miller who examined comparative series stated (personal communication) that these differences were most probably ecophenotypic expressions. The fact that no individuals of the characteristic phenotype found in the bayou or that found in the bay waters were taken outside their respective habitats indicates that there is little or no interchange of specimens of this species between these habitats.

Fundulus seminolis Girard
Chub

This species is common in Lake Maggiore (freshwater) within the city limits of St. Petersburg.

Fundulus chrysotus (Günther)

A few specimens were obtained from freshwater creeks in Pinellas County. Kilby (1955) took two specimens in brackish water which suggests that the species strays into salty water occasionally.

Cyprinodon variegatus Lacépède
Chub

Some 502 specimens were collected at regular stations. Considerably more were collected at the bayou station, but these were released after a random sample of a particular seine haul was made. Except for five specimens taken at the Maximo Pt. station during November, 1957, all the specimens came from either the bayou or the Tampa Bay station. The species was taken every month of the study, but the relative abundance in the two habitats (Tampa Bay and the bayou) was quite different. The following table shows the number of specimens taken each month at each of the stations.

	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Bay	–	–	–	2	6	—	4	41	35	33	22	20	9	–	
Bayou	5	4	26	6	11	1	—				19	1	1	66	92	93

These data suggest that when the species is most common in the bay it is least common in the bayou and vice versa. They also suggest that the species moves into the bayou during the colder months of the year and into the bay during the warmer months. This pattern is marred only by the figures for July for which we have no explanation.

The species prefers the shallow waters adjacent to the shore which are devoid of vegetation.

Breeding behavior has been described by Raney et al (1953) and various phases of the ecology have been discussed by Gunter (1945, 1950), Kilby (1955), Simpson and Gunter (1956).

Spawning apparently took place during the summer months only. Our smallest specimens, 8.7-11.9 mm., were taken during June and August. It has not been possible to demonstrate growth rate. Gunter (1945) suggested a fast turnover in the population. His largest specimen, 93 mm. (total length), is probably a record; few attain a total length of 75 mm.

Cyprinodon variegatus has been found living in waters with a salinity from 0-142.4 o/oo (Simpson and Gunter, op. *cit.*), but Simpson and Gunter (op. cit.) and Hildebrand (1958) do not believe that it voluntarily enters waters above 80 o/oo. Hildebrand suggested that its voluntary absence from higher salinities might be the result of the absence of food at the higher salinities.

The species is also eurythermal; Gunter (1945) reported specimens in collections ranging from 8.8-34.9 °C.

Examination of stomach contents indicated the presence of plant material, usually filamentous algae, and sand particles. In one stomach tiny pelecypods were found.

Floridichthys carpio (Gunther)
Chub

This killifish is probably very abundant along the sandy shores of the moderately high salinity bays. At regular stations specimens were taken only in Tampa Bay except for one taken in the pushnet at Maximo Pt. (November, 1957). The species is not readily caught by the collecting equipment used in this study and many specimens were seen to escape the nets. Only 13 specimens were taken at the Tampa Bay station using a net. With the use of rotenone during the July-October collections in Tampa Bay, 69 specimens were taken, most of these during September. The smallest specimens, 16.2 mm., were taken during August and October. No specimens were taken at regular stations during December, 1957, and January through April, November and December, 1958. Some specimens were taken in Old Tampa Bay during February, 1958, using a pushnet (24.2 o/oo, 11.0 °C.).

Salinities and temperatures at regular stations ranged from 21.0-30.8 o/oo and 22.8-32.5 °C.

The species feeds on tiny crustacea, molluscs, and annelids.

Jordanella floridae Goode and Bean

This species is occasionally taken in the freshwater streams in peninsular Pinellas County.

POECILIIDAE

Heterandria formosa Agassiz

This species is common in the freshwater streams of Pinellas County.

Mollienesia latipinna LeSueur
Chub, Molly

Mollies were most common in the bayou where they were taken every month of the study except December, 1957. Although many specimens were collected, only 1003, 15.5-70.9 mm., were returned to the laboratory after random sampling of the seine hauls. The Tampa Bay station was the only other regular station where the species was taken. Only 13 specimens were taken there (July, August, and October, 1958). These were obtained as the result of rotenoning. A drainage ditch entering the Tampa Bay station contained numerous specimens, but this ditch was not considered for the purposes of our study as forming a part of the station. In the bayou, *Mollienesia* preferred a pool surrounded on three sides by mangroves and on the fourth by a grassy bank. Kilby (1955) found this species the most common one present in the marshes and that it preferred small pools.

The species was most abundant from October through December, 1958, and least abundant from April through September.

Stomach contents contained only vegetable matter.

Gambusia affinis (Baird and Girard)

Only 17 specimens, 14.1-37.0 mm., were taken. All of these were taken in the bayou, October, November, 1957, and March, May, June, 1958. The small number of specimens taken is surprising in view of the large number Kilby (1955) took at Cedar Key in habitats similar to the bayou. Simpson and Gunter (1956) took comparatively few specimens on the Texas coast. Numerous specimens were noticed, however, in the freshwater streams of lower Pinellas County.

SYNGNATHIDAE

Hippocampus hudsonius DeKay
Seahorse

Ten specimens of this species were taken at regular stations. Six came from the roller frame trawl station in Boca Ciega Bay; one came from the Maximo Pt. station in Boca Ciega Bay; two young were taken at the Tampa Bay station; and one specimen was taken at the roller frame trawl station in Old Tampa Bay. Other specimens (adults) were collected as far as 14 miles offshore drifting on the surface. The species was taken during all seasons and its absence from collections during certain months is undoubtedly due to incomplete collecting. Reid (1954) has stated that this species, in contrast to *H. zosterae*, prefers the deep flats and channels. Our data would tend to support this conclusion.

Specimens were taken at regular stations at salinities and temperatures ranging from 21.0-34.0 o/oo and 14.5-32.5 °C.

Hippocampus zosterae Jordan and Gilbert
Dwarf Seahorse

Though only 25 specimens were collected at regular stations this species is very common in the Tampa Bay area. Strawn (1958) reported collecting 394 specimens during February 17-18, 1951, in Old Tampa Bay, and he and one of us (Springer) collected over 100 in Boca Ciega Bay about a mile west of the Maximo Pt. station on September 5, 1958. Commercial pushnetters are known to take thousands in a single work day. These they market wholesale from 15-25 dollars a thousand. The chief area of abundance, according to one of these workers, was in the grass flats in the vicinity of Big Island in Old Tampa Bay, but he remarked that since dredging had occurred in that area specimens were no longer available. These pushnetters are convinced that the dwarf seahorses migrate from place to place in the bays. They state that areas which are barren of specimens one day may in a few days become densely inhabitated.

Twenty-four of the 25 we took came from Boca Ciega Bay. All specimens were found on the grass flats.

Strawn *(op. cit.)* made a thorough study of the life history of this species at Cedar Key and included notes on the species from other localities. He summarized his studies as follows:

"Females outnumbered males throughout the year. Season and environment can influence the observed sex ratio. The breeding season extends from mid-February to late October and is associated in time with days having over 11 hours of sunshine. A maximum of 69 large eggs was found in the ovaries of a female, and up to 55 young were counted in the pouch of a male. At about 85 °F. the average male probably has two broods per month. The young grow rapidly and mature within two to three months. At least three generations are produced a year. Few individuals attain the age of a year, and no evidence of two-year-old fish was found."

Specimens from regular stations occurred at salinities and temperatures ranging from 26.3-35.0 o/oo and 21.2-32.5 C. Strawn found the species breeding in salinities as low as 9.7 o/oo. The species was undoubtedly present in our area when surface temperatures dropped to 10 °C. during the winter of 1957-58.

Syngnathus scovelli (Evermann and Kendall)
Pencilfish

This is decidedly the commonest pipefish in the Tampa Bay area. Some 905 specimens were collected at regular stations. These all came from the grass flats in the bays except for two specimens taken in the bayou in February and October, 1958. The Maximo Pt. station was the area of greatest abundance. Although the species was present all year, abundance was considerably less during the winter than during the other seasons. It appears that this was due to the excessive cold of the particular winter encompassed by our study. Reid's (1954) data do not indicate a noticeable reduction in numbers for the winter (1950-51) at Cedar Key. Though S. *scovelli* is the commonest pipefish in the Tampa Bay area, at Cedar Key and along the Texas coast (Gunter, 1945), Joseph and Yerger (1956) found S. *louisianae* the commonest species in Alligator Harbor. S. *louisianae* is one of the least common pipefish in the other areas mentioned.

The smallest male recognizable externally (presence of a brood pouch) was 60 mm.; the largest was 133 mm. All specimens of less than 60 mm. were considered sex indeterminate. The largest female examined was 144 mm. Reid has discussed sexual dimorphism and brood size of specimens at Cedar Key. He found that the largest embryos were 15 mm., indicating that expulsion probably occurs at this size.

Table 8 lists data on sex ratios. Unfortunately most of the material during the first four months of our study was discarded after measurement and without determination of sex. These data are recorded under NR in the table.

Females are present in consistently larger numbers than males which probably accounts for the fact that pregnant males outnumber non-pregnant males. As at Cedar Key, breeding takes place all year apparently with little change in incidence.

Frequency of breeding appears to be related to size in males. One (9.1%) of 11 males, 60-64 mm., was pregnant; seven (53.8%) of 13 males, 65-69 mm., were pregnant; 18 (62.1%) of 29 males, 70-74 mm, were pregnant; 26 (89.6%) of 29 males, 75-79 mm., were pregnant; and 196 (90.3%) of 217 males, 80 mm. and over, were pregnant. The smallest pregnant male was 64 mm. In the Indian River at Stuart, Florida, on the east coast, males were recognizable at 47 mm. and a pregnant 50 mm. male was recorded. It appears that the east coast population may represent a different race.

Specimens were taken at regular stations in salinities and temperatures ranging from 14.1-35.0 o/oo and 10.0-32.5 °C.; very few specimens were taken at salinities of less than 23 o/oo. Gunter reported specimens at salinities of 3.2 o/oo and Simmons (1957) reported the species common in salinities up to 45 o/oo.

Copepods, gammarids, and tiny caridean shrimp comprised the *major portion* of the diet.

Syngnathus floridae (Jordan and Gilbert)
Pencilfish

Dr. E. S. Herald informs us that this species is represented by an undescribed subspecies on the west coast of Florida.

Some 98 specimens were collected at regular stations. The species was absent from

collections during October and December, 1957, and January, March and May, 1958. It occurred in five regular collections at the Tampa Bay station, ten at the Maximo Pt. station and two at the roller frame trawl station in Boca Ciega Bay. Although none were taken at the Gulf Beach station five small specimens, 41.6-79.0 mm., were collected on Bella Vista Beach, June 16, 1958, by Dr. Paul Wallace. Reid (1954) reported the species for all months at Cedar Key.

Pregnant males occurred locally only from April through November with the majority occurring during August and September. Reid found breeding at Cedar Key to occur throughout the year with a decrease from November through January.

The smallest males recognizable as such were 122 mm.; the largest were 189 mm. Reid noted pregnant males at 116 mm. Females, 122-196 mm., were always more numerous than males.

Specimens were taken at salinities and temperatures from 25.5-35.0 o/oo and 21.0-32.5 °C. Reid reported specimens from lows of 17.5 o/oo and 10 °C.

Of seven stomachs examined three contained grass shrimp and the remainder contained pieces of unidentifiable crustaceans.

Syngnathus louisianae Gunther
Pencilfish

Some 58 specimens, 68.6-282.0 mm., were collected at regular stations. They were all taken on the grass flats in the bays. Our findings agree with those of Reid (1954) for Cedar Key, who found this species less common than S. *floridae* and S. *scovelli*. Reid obtained no specimens during late winter or early spring; we collected none from February through April.

Of all our specimens we recognized only one male (116.2 mm., non-pregnant, May 15, 1958). Reid did not mention how many males he obtained, but stated that they were all non-pregnant. In contrast to our and Reid's findings Joseph and Yerger (1956) reported that *S. louisianae* was the commonest pipefish in Alligator Harbor and that the brood pouches of the larger males were filled with embryos in September. Boschung (1957) collected 150

Table 8. Monthly Sex Ratios and Breeding Conditions of Specimens of *Syngnathus scovelli* Collected in the Tampa Bay Area, 1957-58

	Males[1]	Males[2]	Total Males	Females	Unk	NR
Oct.						27
Nov.	1	14	15	40	5	6
Dec.						19
Jan.						20
Feb.[6]	3	4	7	16	6	
Mar.	2	6	8	14	1	
April	1	19	20	29	9	
May	1	27	28	52	4	
June	6	31	37	57	4	
July	14	28	42	70	7	
Aug.	5	14	19	31		
Sept.	4	29	33	61	2	
Oct.	4	17	21	37	3	
Nov.	5	28	33	52	5	
Dec.	6	30	36	43	4	
Total	52	247	299	502	50	72

[1] Brood pouches empty
[2] Brood pouches with eggs or young (Pregnant)
[3] At least 60 mm. standard length
[4] Includes all specimens under 60 mm. standard length
[5] Data not recorded
[6] Includes data from other than regular stations

specimens, all females on the Alabama coast. It is possible that most of the specimens obtained by Reid, Boschung, and ourselves were actually sex indeterminate young. The species attains a large size and the sexes might not be recognizable until they are considerably larger than the majority of the specimens we obtained. If this is true then very few adults ever find their way inshore. Hildebrand (1954) reported pregnant males, 254-308 mm., off Padre Island, Texas during July, and lie (1955) reported a male, 305 mm., with eggs during February in the Gulf of Campeche. However, Simmons (1957) reported specimens "spawning" in the Laguna Madre of Texas during May and June. The problem needs further clarification.

Our specimens were taken in salinities and temperatures ranging from 21.0-35.0 o/oo and from 15.0-32.1 °C. Reid took specimens from as low as 10.0 C. and 18.3 o/oo. Simmons obtained specimens frequently in salinities up to 45 o/oo.

Syngnathus elucens Poey

A specimen, 31.2 mm., tentatively identified as this species, was collected by Dr. Paul Wallace on Bella Vista Beach, June 16, 1958. Dr. E. S. Herald who examined the specimen stated that it conformed to the description of S. *elucens* except that the snout was smaller than would be expected.

Syngnathus springeri Herald

At least five specimens of this species were collected from floating *Sargassum* about ten miles offshore during February, 1959. Dr. E. S. Herald verified the identification.

Corythoichthys albirostris Heckel

Evermann and Kendall (1900) reported that the *Fish Hawk* collected this species in Tampa Bay in 1898. The identification was verified by Herald (1942). The species has not been recorded from this area since the original collection.

Micro gnathus crinigerus Bean and Dresel

Only three specimens, 68.3-75.4 mm., were taken at regular stations. These came from the Maximo Pt. and Tampa Bay stations during November, 1957, (30.8 0/00 and 22.9 °C.; 26.3 o/oo and 22.4-24.6 °C., respectively). Other specimens were collected in upper Old Tampa Bay through March 12, 1958. At no time was the species common and its absence from collections during the last nine months of the study (and at least through June, 1959) may indicate its disappearance from the Tampa Bay area. A single specimen, 66.4 mm., was taken in Old Tampa Bay on February 19, 1958, by Mr. R. C. Phillips of our staff, when the temperature was 7.0 °C. (23.6 o/oo). This is the coldest water temperature known to us for the Tampa Bay area.

GADIDAE

Urophycis floridanus (Bean and Dresel)

Data on the 66 specimens taken during regular collections supports the findings of other studies (Gunter, 1945; Reid, 1954) on this form in all important details. Specimens were taken from January through April. They came into the area very shortly after a hard freeze. They were most abundant during February. All but one of the specimens, from the bayou, were taken in the bays over grassy bottoms. Only one specimen was taken below a salinity of 21.0 o/oo (18.7 o/oo, bayou). The temperatures ranged from 10.0-21.9 °C. at times of collections, but the first specimens taken were at a temperature of 13.4 C. Monthly data is as follows: January, 15 specimens 39.0-58.6 mm.; February, 42 specimens 46.4-97.5 mm.; March, eight specimens 59.0-131.4 mm., April, one specimen 84.0 mm. Large numbers were also caught in Hillsborough Bay during February, 1958. The bottom there is mostly mud and shell.

Most of the stomachs examined contained gammarid shrimp. Others contained amphipods, isopods, mysids, decapod shrimp, polychaetes, insect larvae, and various fishes (including *Lagodon rhomboides* and *Paralichthys albigutta.).*

REGALECIDAE

Regalecus glesne (Ascanius)

Oarfish

During late June, 1954, a badly mutilated, but still living oarfish was found near shore

at Clearwater Beach. The specimen, about seven feet long, was missing an estimated foot of its length. A plaster cast of the specimen, restored, is on display at the Sea-Orama on Clearwater Beach.

HOLOCENTRIDAE

Holocentrus ascensionis (Osbeck)

A single specimen was taken from a hole on the rocky reefs offshore at a depth of 55 feet on September 7, 1958.

SERRANIDAE

Centropristes melanus Ginsburg
Sea Bass

In contrast to Reid (1954) who found this species common at Cedar Key, we took no specimens in regular collections. The only specimens seen in this area were caught off the bridge at Johns Pass or were seen swimming under the docks on Egmont Key. Eight specimens, 54-111 mm., were taken from October-December, 1957, and April, 1958, using pushnets and roller frame trawls in the area off Anclote Key, Pasco County. The species was considered common by local fishermen prior to the red tide of 1957. It is just beginning (June, 1959) to be caught again in numbers.

Centropristes ocyurus (Jordan and Evermann)

Small specimens, 53.5-83.5 mm., have been taken offshore at depths from 35-60 feet from August, 1958, through May, 1959. The species is a bottom dweller preferring the sandy bottom in close proximity to wrecks and reefs. It has been seen in the company of *Serraniculus pumilio* which has similar habits.

Serraniculus pumilio Ginsburg

Several specimens, 32.9-42.2 mm., were taken offshore in poison collections at depths from 35-55 feet from July, 1958-February, 1959. The species is sedentary and prefers sandy bottom near rocks and wrecks. It has been seen with *Centropristes ocyurus* which has similar habits. In life its coloration is coral pink on a cream ground color. There are brown bands on the body which fade to dusky black in alcohol.

Diplectrum formosum (Linnaeus)
Squirrelfish

A single specimen, 102.2 mm., was taken at a regular station (Tampa Bay, roller frame trawl, October 17, 1957, 22 o/oo, 25.6 °C.). Large individuals are frequently taken from the bridges and bulkheads in the bays and by party boats fishing the reefs offshore.

Serranellus subligarius (Cope)
Mousefish

A single specimen (51.6 mm., roller frame trawl station, Boca Ciega Bay, January 22, 1958, 30.5 o/oo, 14.5 °C.) was taken at a regular station. Nevertheless, this species is one of the commonest in the area offshore at least to depths of 10 fathoms. Until recently (Clark, 1959) it was never reported as common in any part of its geographic range. It is apparently common as far north as Panama City (Ralph Yerger, personal communication). The species is found offshore all year wherever there is a hard irregular substrate. It was taken abundantly in every poison station made on the reefs.

Clark *(op. cit.)* has discussed reproductive behavior in this species, which is a functional hermaphrodite.

Epinephelus adscensionis (Osbeck)

Specimens are occasionally taken by the party boats fishing offshore on the reefs at depths of 25 fathoms.

Epinephelus guttatus (Linnaeus)
Red Hind

Specimens are occasionally taken on the rocky areas offshore in the same vicinity as recorded under *Mycteroperca venenosa (q.v.)*. A live specimen taken by the party boats has been on display in Jack Hurlbut's Marine Arena for over two years at the time of this writing (June, 1959).

Epinephelus morio (Valenciennes)
Red Grouper

This species is second in abundance among the groupers in the Tampa Bay area only to *Mycteroperca microlepis*. Local fishermen claim that until about 1958 the red grouper

was more abundant than the black. The species is caught primarily on the rocky reefs offshore, where it is plentiful all year.

Mycteroperca falcata (Poey)
Scamp

This is the least common of the three groupers *(M. microlepis, E. morio)* habitually caught in the area. It is caught mainly on the rocky reefs offshore.

Mycteroperca microlepis (Good and Bean)
Black Grouper

No specimens were taken at regular stations, but this species is frequently taken by fishermen throughout the Tampa Bay area during every month of the year. It is most commonly found offshore among wrecks and rocky reefs where it is almost invariably associated with *Epinephelus morio*, *Promicrops itajara* and *Lutjanus griseus*. All these species have similar habits while on the reefs. They prefer the areas beneath the ledges on the periphery of the reefs or the cave-like recesses in the reefs. I have been told by commercial fisherman that at one time *E. morio* was the commonest grouper in the area, but that since about 1958 *M. microlepis* has become the most common.

There are numerous party boats in our area which are mainly dependent upon successful grouper catches.

Mycteroperca venenosa (Linnaeus)

A single specimen, the only one ever seen locally, was caught offshore (about 25 miles) in about 11 fathoms. The specimen is alive and has been on exhibition in Jack Hurlbut's Marine Arena for over two years at the time of this writing (June, 1959).

Promicrops itajara (Lichtenstein)
Jewfish

This species is primarily found offshore on the rocky reefs or wrecks in the company of the black (q.v.) and red groupers. Specimens estimated to weigh over 500 pounds are frequently seen while diving. Smaller specimens, 15 pounds, are occasionally caught in the bays along the bulkheads and bridges.

Rypticus saponaceous (Bloch and Schneider)
Soapfish

This is a very common species inhabiting holes in the rocky reefs offshore. Specimens were obtained or seen on all diving trips to the offshore reefs (35-60 feet) between June 1958, and May, 1959. Collections were not made during other months. On November 9, 1958, a specimen, 13.7 mm., was obtained at a depth of 39 feet. Body form is similar to the adult at this size, but life coloration is quite different:

Fins: *dorsal* white basally, grading into bright yellow dorsally; tips of spines and rays clear; a diffuse dusky band just below clear tops of dorsal rays; *anal* white basally grading into bright yellow distally; *caudal* with a black triangle, its base on the caudal base and its apex on the mid-distal margin of the caudal; areas on either side of the triangle bright yellow; dorsal and ventral fin rays with dusky smudges distally; pectorals immaculate.

A median pale band of diffuse chromatophores from base of first dorsal spine to tip of snout. This band bounded ventro-anteriorly from orbit by a solid black band which extends to the maxillary; bounded dorso-posteriorly from orbit by a white line which extends to mid-dorsal base. Another white line extending from postero-ventral margin of orbit to ventral margin of caudal peduncle. Area between two lines is solid black and extends onto the caudal as the triangle described above. Area below ventral white line is pale, without chromatophores, but is not as white as the line bordering it.

CENTRARCHIDAE

Micro pterus salmoides floridanus (LeSueur)
Bass, Black Bass, Largemouth Bass

Two specimens, 21.8 and 27.0 mm., were taken at the bayou station during the collection on April 23, 1958, (5.0-7.6 o/oo, 26.0-26.5 °C.). This species is common in the freshwaters of Pinellas County.

Chaenobryttus gulosus (Cuvier)
Brim, Sunfish, Warmouth

Specimens have been collected in the freshwater streams of Pinellas County.

Lepomis microlophus (Günther)
Sunfish, Brim, Redear, Shellcracker

Specimens have been collected in the freshwater streams and lakes of Pinellas County.

Lepomis macrochirus Rafinesque
Bluegill, Brim, Sunfish

Two specimens, 33.6 and 25.2 mm., were collected at the bayou station during the collections on March 18, (16.0-18.2 o/oo, 20.5 °C.) and August 13, 1958, (3.7-4.2 o/oo, 29.5 °C.), respectively. The species is common in the freshwaters of Pinellas County.

APOGONIDAE
Apogonichthys alutus (Jordan and Gilbert)

This species is common on the rocky reefs offshore. One specimen was provided us by a bait fisherman operating in Boca Ciega Bay. Dr. E. A. Lachner has informed us that the specimen reported by Caldwell (1957A) as *Apogon pigrnentarius* is a small specimen of *Apogonichthys alutus.*

Apogon conklini (Silvester)

Four specimens have been collected on the rocky reefs offshore. These are the first Gulf records north of the Florida Keys.

Apogon aurolineatus? (Mowbray)

Nine small specimens have been collected on the rocky reefs offshore at depths from 39-55 feet during the months of November and December, 1958, and January, 1959. These are the first Gulf records north of the Florida Keys.

BRANCHIOSTEGIDAE
Malacanthus plumieri (Bloch)

The St. Petersburg Times for January 4, 1953, has a picture of a specimen which was caught in our area offshore in the Gulf.

POMATOMIDAE
Pomatomus saltatrix (Linnaeus)
Bluefish, Blues

Bluefish are taken offshore in the Gulf during much of the year. Young specimens of about six to eight inches were being caught in Tampa Bay from the Municipal Pier during April, 1959.

RACHYCENTRIDAE
Rachycentron canadum (Linnaeus)
Cobia

Cobia are caught commonly offshore in the Gulf. A single specimen, 77.0 mm., was seined at the Gulf beach station on July 9, 1958, (33.3 o/oo, 28.0 °C.). The specimen was taken at a depth not greater than ten inches.

CARANGIDAE
Trachinotus carolinus (Linnaeus)
Pompano

This species was only taken at the Gulf beach station. During June, 1958, Dr. Paul Wallace and family collected nine specimens at Bella Vista Beach which ranged from 10.1-29.2 mm. We took 59 specimens, 22.8-87.0 mm., at the Gulf beach station during July (33.3 o/oo, 28.0 °C.) and five specimens, 59.3-64.0 mm., during August (34.6 o/oo, 29-33 °C.).

This species and *T. falcatus (q.v.)* were taken together at about the same size. Of the two, *T. falcatus* was the more abundant and persistent in the area. During the summer of 1957, the senior author collected on the Gulf beach at Port Aransas, Texas, where he found *T. carolinus* the only pompano. Gunter (1945) reported only *T. carolinus* and a single specimen of *T. palometa (=T. glaucus).*

According to newspaper reports pompano (species ?) come into the lower reaches of Tampa Bay during the spring and summer where they are caught in large numbers.

There is a color difference (in addition to other meristic and qualitative differences) which permits rapid separation of the young of *T. carolinus* and *T. falcatus* in the field. *Trachinotus carolinus* has a lemon yellow anal fin and T. *falcatus* has a bright orange one.

Gunter reported the species common in salinities as low as 28.1 o/oo and Simmons noted it as common in salinities of 45-50 o/oo.

Five of six stomachs examined contained *Donax* and two contained *Hip pa.* Gunter (1959) has stated that pompano (mostly *T.*

carolinus) fed on young *Harengula* on the beaches of the Texas coast. Though the young of both genera were present contemporaneously on our beaches we never found *Harengula* in the stomachs of either *T. carolinus* or *T. falcatus.*

Trachinotus falcatus (*Linnaeus)*
Pompano

The few records of specimens from the Gulf and Reid's (1954) statement to the effect that this species is probably uncommon throughout its range are surprising in view of the commoness of this species in the Tampa Bay area. We collected 226 specimens, all from the Gulf beach station, during November and December, 1957, and July through December, 1958. In addition to these, 22 specimens were collected by Dr. Paul Wallace during June, 1958, from Bella Vista Beach just north of our beach station. The species is much more common than *T. carolinus (q.v.)* which ordinarily outnumbers it in collections from other localities.

The size of the June specimens (Table 9) indicated a spring spawning concurrent with that of *T. carolinus.* Growth was rapid with specimens ranging from 8.2-19.8 mm. in June increasing to 63.6-109.6 mm. the following November. The species absented itself from the beach during December. There seems to be some variation from year to year in size attained; the largest specimen in November, 1957, was smaller than the smallest specimen in November, 1958. It is possible that spawning took place earlier in 1958 than in 1957 or that growth was more rapid in 1958.

A second year class was indicated in September and October, 1958. These ranged from 94-111 mm. in September and 131-142 mm. in October. If these figures are indicative the species is probably in at least its third year before reaching marketable size.

Most of the specimens were taken in that portion of the beach station lying between the breakwaters on the southern tip of Pass-a-Grille. Although the stomach contents *(Hip pa, Donax)* indicated simply a bottom feeding habit it is possible that the breakwaters have a positive tropic effect.

Salinities and temperatures at times of regular collections varied from 33.3-35.1 o/oo and 18.0-31.0 °C.

Chloroscombrus chrysurus (Linnaeus)
Pumpkinseed

Only ten specimens were taken at regular stations, all during September. One, 35.6 mm., was taken on the Gulf beach (33.8 o/oo, 31.0 °C.) and nine, 23.4-31.5 mm., were taken in the bayou (12.8-19.5 o/oo, 29-33 °C.). Two specimens, 23.2 and 38.0 mm., were taken under a night light at Johns Pass during July, 1958, (34.2 o/oo, 29.5 °C.).

Caranx crysos (Mitchill)
Blue Runner

No specimens were taken in regular collections, but catches are frequently made by fishermen in lower Tampa Bay, Boca Ciega Bay, and on the Gulf beaches. They have also been seen over the rocky reefs offshore.

Caranx hippos
Jack, Yellowtail Jack, Hardtail Jack, Amberjack

This is the commonest species of *Caranx* caught in the Tampa Bay area. Schools are abundant during most seasons and from spring through fall are found far up in the bays. The smallest specimens seen measured 186-207 mm. (November 2, 1958) and were caught on hook and line in Bayboro Harbor. Specimens caught in the same locality on October 30, 1957, ranged from 239-246 mm. Both these samples were indicative of the sizes in large schools present at the times they were caught.

Ginsburg (1952A) in his key to the species of Carangidae separates C. *hippos* from C. *latus* by a single character: chest unsealed in the former versus scaled in the latter. Specimens of C. *hippos* taken locally may have the chest partly scaled. The species are easily separated in the field by color. C. *hippos* is always perfused with bright yellow in the caudal and ventral regions; C. *latus* is always steel gray without any yellow on the body. The presence of an irregular black spot on the pectoral fin in C. *hippos* will distinguish that species from *C. latus* in which there is no spot.

Caranx latus Agassiz
Jack, Hardtail Jack

A single specimen, 111 mm., was found dead in the bayou on the morning of December 13, 1957, after the onset of a cold wave the night before. The water temperature at the time the specimen was found was 13.0 °C. Larger specimens are infrequently caught in the bays.

Trachurus *lathami* Nichols

I have been informed by Mr. H. R. Bullis that this species has been taken in the Tampa

Table 9. Frequency Distributions of Standard Lengths in Trachinotus falcatus 1957-58

Mid-Class	Nov.	Dec.	June[1]	July	Aug.	Sept.	Oct.	Nov.	Dec.	
8.5			4							
11.5			9							
14.5			5							
17.5			9							
20.5	3		2							
23.5	1						1			
26,5	4			4	1					
29.5	2			17						
32.5	3	1		19						
35.5	5	1		3						
38.5	3			8	1	1				
41.5	8			1		1				
44.5	11			1						
47.5	2			1		1				
50.5	5			1	9					
53.5					3	3				
56.5					12	2				
59.5					8	2				
62.5					5				2	
65.5					1		1		1	
68.5					2		1		1	
71.5									2	
74.5							2		2	
77.5								1		
80.5							3	2		
83.5							3	4		
86.5							5	1		
89.5							1	6		
92.5							1	5		
95.5	1					1	1	3		
98.5							1	1		
101.5								1		
104.5						2		2		
107.5						2		2		
110.5						1		1		
131.5							2			
140.5							1			
143.5							1			
Total	49	2	22	55	35	18	27	31	9	248

[1] Data from Bella Vista Beach

Bay area by the M/V Oregon. Large schools were present over the rocky reefs offshore during May, 1959.

Seriola zonata (Mitchill)
Amberjack

A specimen, 428 mm., obtained from a party boat during November, 1958, was identified for us by Mr. F. J. Mather, III. A specimen about four inches long was taken at Johns Pass during May, 1959. This species is commonly caught by the party boats fishing offshore in the Gulf. Except for the May specimen all Our records are from September-December, 1958, but the species certainly abounds during other months.

Seriola rivoliana Valenciennes

Ginsburg (1952A) reported this species as *S. falcata* from Clearwater. We know of no other records.

Seriola *dumerili* (Risso)
Amberjack

The St. Petersburg Times for January 4, 1953, contains a picture of an amberjack five feet long and weighing 106 pounds which was caught at Pass-a-Grille. The size of this specimen places it only in S. dumerili.

Selene vomer (Linnaeus)
Lookdown

Specimens are occasionally caught in the Tampa Bay area by fishermen, but none were collected at regular stations. A specimen 17.9 mm. was collected by Dr. Paul Wallace and family at Bella Vista Beach on June 16, 1958.

Oligoplites saurus (Bloch and Schneider)
Bastard Mackerel, Skipjack, Stinging Jack

This species is quite common in the Tampa Bay area at least from spring through late fall. Because of its agility in escaping nets only 91 specimens, 28.5-138 mm., were taken at regular stations. These were collected during November, 1957, and July through December, 1958. Other specimens were seen or caught in the area from April through June, 1958. Specimens were most commonly taken in November and the Gulf beach appeared to be the preferred habitat. Only three specimens were taken in the bayou (July, August, September).

Salinities and temperatures at times of regular collections ranged from 3.7-35.1 o/oo and 20.5-32.5 °C.

Fish remains and copepods were the only items identifiable in the stomachs examined. Usually digestion had progressed so far as to make identification to phylum impossible.

CORYPHAENIDAE
Coryphaena hip purus Linnaeus
Dolphin

Dolphin are occasionally caught offshore. They have been taken within a mile of the coast off Johns Pass. Two specimens, 320 and 325 mm., were caught about 50 miles west of Johns Pass on June 1, 1959.

CENTROPOMIDAE
Centropomus undecimalis (Bloch)
Snook

All 35 of the specimens, 26.6-191 mm., taken in regular collections came from the bayou. All of these were taken in water of less than two feet in depth and all were taken at temperatures above 20 °C. On December 13, 1957, after a cold wave of the evening before, three dead specimens were found in the bayou. The temperature of the water was 13.0 °C. Susceptibility of snook to cold has been discussed by Storey and Gudger (1936) and Storey (1937). Marshall (1958), who has published the only biological study on the snook, noted that distribution in Florida was limited by temperatures of 60 °F. or less for the coolest month of the year. Snook are found in salinities ranging from 0-36 0/00, but they usually inhabit waters from the mid to upper levels of this range. The preferred habitats of the young are protected bodies of water usually of small surface area and shallow depth.

Marshall reported that spawning took place from June to November. Our smallest specimens taken during August would tend to support a strictly summer spawning period.

Snook of 56 mm. are already feeding on fish, and above this size fish constitute the major portion of the diet. Smaller specimens were found to have eaten small crustacea.

LUTJANIDAE

Lutjanus griseus (Linnaeus)

Gray Snapper, Mangrove Snapper

The literature contains little or no information on growth and spawning of the gray snapper. The smallest recorded is a 19 mm. specimen (Reid, 1954) taken at Cedar Key at some date between August and November.

Although gray snapper are caught in considerable quantities locally, usually during the summer and fall, we took only 102 specimens at regular stations. These ranged from 14.0-164.0 mm. with only four specimens exceeding 91 mm. All but four of these were collected during the months of September-January. The remaining four were taken during March, April, and May. Although most of the specimens were from the grass flats at the Maximo Point station, the bayou station was most frequently recorded for the species. No large specimens were collected at the Gulf beach station although large ones were seen around the concrete groins extending into the water. Only one specimen, from Bird Key Middleground, Boca Ciega Bay, was taken at any of the roller frame trawl stations.

Of the 1957 "0" year class ten specimens averaged 42.6 mm. in November, and 22 specimens averaged 51.7 mm. in December. In the 1958 "0" year class, 26 specimens averaged 18.2 mm. in October, 20 averaged 25.3 mm. in November, and 12 averaged 34.0 mm. in December. Collections in the St. Lucie River during September 28-30, 1957, contained 25 specimens in the "0" year class which ranged from 12.8-75.0 mm., and which averaged 33.0 mm.

We believe that this species spawns offshore in the Gulf, otherwise one would expect that the young would be more commonly taken inshore. Large adults were frequently seen on the rocky reefs as far offshore as about 20 miles and at depths up to 60 feet. Springer and Bullis (1956) reported gray snappers from the southwestern and southeastern Gulf from depths of 18-150 feet. Specimens taken inshore have a deep maroon ground color while those offshore have an orange one.

The habitat of this species is quite similar to that occupied by the sheepshead. The young are found for a few months on the grass flats and the adults are found along wharves, pilings and rocky areas. The species takes the name "mangrove snapper" from the fact that it is also frequently taken in areas bordered by mangroves, which probably accounts for the frequency of its occurrence at the bayou station.

We recorded the species from regular stations in salinities and temperatures ranging from 3.0-35.0 o/oo and 13.4-32.5 °C. We also took specimens in the St. Lucie River in salinities of less than 1 o/oo. Two of the specimens obtained at Cross Bayou were found dead after the cold wave of December 14, 1957, at which time the water temperature was 13.0 °C. Gunter (1945) reported a specimen presumably killed by cold. The temperature of the water at the time of his collection was 9.1 °C.

Specimens under 60 mm. were found to have eaten primarily caridean shrimp and copepods, but included also small fish, annelids and insects. Only fish were found in the stomachs of larger specimens. Longley and Hildebrand (1941) list a variety of fishes that they were able to induce gray snappers to eat.

Lutjanus spagris (Linnaeus)

Lane Snapper

Lane snappers were uncommon in collections. Only 17 specimens were collected at regular stations. These ranged in size from 18.5-69.1 mm. All came from grassy areas. Specimens were obtained only during the months of October-December, and on several occasions were associated with gray snapper. Specimens as large as 99.5 mm. were taken off the mouth of the Anclote River during October, 1958. The smallest specimen taken was from Maximo Pt. during November, 1958. Reid (1954) reported specimens 21-22 mm. from Cedar Key during the months of August and October.

Springer and Bullis (1956) reported this species from several stations which paralleled the Gulf coast. Their catches occurred during April, May, July, August, November and December at depths of 21-198 feet.

Salinities and temperatures recorded from the Tampa Bay area for this species ranged from 22.0-35.0 o/oo and 15.0-27.5 °C. A sa-

l nity of 19.1 o/oo was recorded for the species off the mouth of the Anclote River on October 29, 1957. A salinity of 19.5 o/oo was obtained for a collection in the Indian River at Jensen Beach on September 28, 1957.

Copepods were found in the stomach of the 18.5 mm. specimen. Gammarids and grass shrimp were present in three stomachs from specimens 63.8-69.1 mm. A fish, gastropod, and crustacean were obtained from the stomach of the 99.5 mm. specimen.

Lutjanus aqa (Bloch)
Lutjanus campe*chanus* (Poey)
Red Snapper

There is considerable confusion as to the correct name and number of species which fall into this group. Jordan (1885) reported L. campechianus (sic) from Egmont Key, and Lönnberg (1894) reported L. aya from Tampa. Commercial fishermen and charter-boats bring in considerable numbers of red snappers from the reefs well offshore, but we have been unable to obtain any for study.

Ocyurus chrysurus (Bloch)
Yellowtail Snapper

This species is occasionally caught in the Gulf offshore. Mr. Jack Hurlbut maintained several, caught during the summer of 1957, in his aquarium, the Marine Arena.

Rhomboplites aurorubens (Cuvier)
Vermillion Snapper

This species was reported by Springer and Bullis (1956) from Oregon station 933: 27° 36' N. and 83° 18' W., March 18, 1954. Specimens are obtained commonly on the red snapper banks about 50 miles offshore.

POMADASYIDAE

Anisotremus virginicus (Linnaeus)

Mr. J. Hurlbut maintained a single specimen for about one year in his aquarium. It was caught off Johns Pass sometime during 1957. To his knowledge this is the only one ever caught locally. The Sea-Orama at Clearwater Beach has a plaster cast of a specimen caught off Clearwater.

Bathystoma aurolineatum rimator
(Jordan and Swain)

No specimens were taken at regular stations, but the species is quite common offshore especially around the reefs. A specimen of *Epinephelus morio* regurgitated hundreds of small specimens when it was brought to the surface. A collection made at Egmont Key on August 3, 1958, contained specimens 19.0-55.6 mm. in length. Specimens taken off Andote Key (Pasco County) on October 29, 1957, occurred in a salinity of 19.1 o/oo and a temperature of 22.3 °C. A specimen in the same area on December 5 was taken at a salinity of 30.0 o/oo and temperature of 16,2 °C.

Haemulon macrostomum Günther

Goode and Bean (1880) reported a specimen from Clearwater Harbor (as H. *fremebundum).* It has not been reported since.

Haemulon *plumieri* (Lacépède)
Grunt

Only four specimens, 38.6-79.9 mm., were taken at regular stations. These came from Maximo Pt. and Bird Key Middleground during December, 1957, and December, 1958. Salinities and temperatures varied from 30.8-32.4 o/oo and 22.1-23.6 °C. The number of specimens taken belies the actual abundance of the species which is very commonly caught by fishermen throughout the area. The species is especially abundant on the reefs offshore. During the summer and fall young grunt are readily obtained on the grass flats at most points north of Clearwater.

Orthopristis chrysopterus (Linnaeus)
Grunt, Pigfish

This species is much less common locally than it is in more northern areas of the Gulf. Only 470 specimens were taken during regular collections, compared with 1791 taken by Reid (1954). This comparison is particularly striking because it is one of the few common species which Reid obtained in much greater quantity than we did. It was his second most abundant species. As one proceeds further south in the eastern Gulf, *O. chrysopterus* decreases in abundance. Longley and

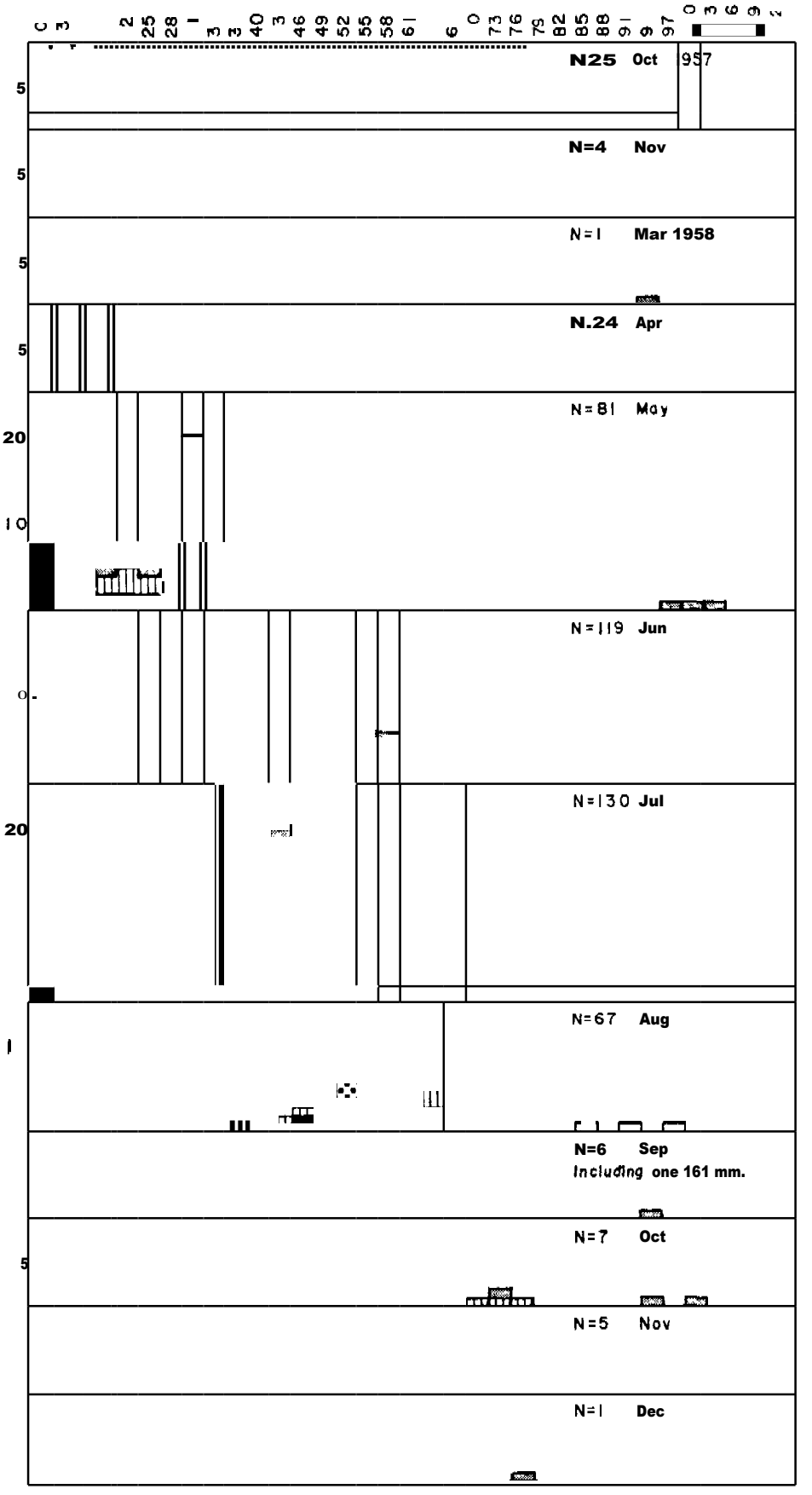

Figure 9. Monthly length-frequency distributions of **Orthopristis** *chrysopterus*.

Hildebrand (1941) did not report the species from Tortugas. Dr. C. R. Robins (personal communication) informed us that *O. chrysopterus* was normally rare in the Miami area, but that after the cold wave of 1957-58 it became abundant.

Our specimens (Figure 9) were taken in all months of the study except December, 1957, January and February, 1958. It was most abundant during June and July. Specimens, 194-297 mm., were taken offshore during February, 1958, and others, 73.2-91.6 mm., were taken from the Gulf north of the mouth of the Anclote River, Pasco County, on December 5, 1957 (26.0 o/oo and 16.0 °C.). Reid noticed the absence of *O. chrysopterus* from his collections during January at Cedar Key, and Hildebrand and Cable (1930) collected none from December-February at Beaufort.

Of 36 stations offshore in the Gulf from which *O. chrysopterus* was obtained by Springer and Bullis (1956) 34 occur during the months of October-March, those months when the species is least common inshore.

Hildebrand and Cable *(op. cit.),* whose important discussion of this species has received no attention in subsequent literature, obtained considerable information on this species at Beaufort. The following statements, pertinent to our study, have been extracted from their paper:

"No pigfish have been taken during the winter in catches made with a 30 foot otter trawl . . . in depths as great as 10 fathoms. The local . . . fishermen, however, take a few throughout the winter on the sea bass grounds about 20 miles offshore in depths of about 18 fathoms.

". . . the larger fish are the first ones to migrate away from local waters in the autumn.

". . . the temperature in March, when the fish usually begin to return to the shallow waters, are near those that prevail in November when the last ones leave [Average: March: 14.3, April: 18.3, October: 22.2, November: 16.3].

. . . spawning may begin at Beaufort as early as the middle of March, that it ends near the latter part of June, and that the principal spawning period occurs in May.

"Gravid fish are particularly numerous along the inside shores of Bogue and Shackleford Banks during the spawning season, and it is here that the greatest concentration of eggs occurs. It is rather certain that the comparatively quiet waters on the inside shores of these banks constitute the chief spawning grounds of the pigfish in the vicinity of Beaufort. However some spawning certainly takes place elsewhere within the harbor, in the estuaries and along the outer shores of the banks.

"In general the larger fish spawn first.

"It might be inferred from these results that the young pigfish after absorbing its yolk falls to the bottom, where it remains in the sand until a length of about 11 millimeters is attained, when it resorts to shallow water in grassy areas which are its favorite haunts during the first summer.

"Very recently hatched pigfish 2.0-2.5 millimeters long appeared in the tow as early as the middle of March (in 1927 and not until April in 1926, 1928, and 1929) . . . Pigfish . . . are only about 1.5 millimeters long at the time of hatching, but they attain a length of 2.0-2.5 millimeters in a few days.

". . . it seems certain that sexual maturity is not reached until the fish are about 2 years old."

No ripe or spawning individuals were taken during our study. The smallest individual, 12.5 mm., was taken in April during which time the "0" year class averaged 17.5 mm. The largest specimen Hildebrand and Cable took during April was only 12.0 mm. and their average for the month was only 6.2 mm. Spawning probably takes place during March locally which parallels that occurrence at Beaufort. The spawning period is over within one or two months as is evidenced by the lack of small individuals after April. At Beaufort it continued through June. During the early months we found growth to be more rapid locally (Table 10) than at Beaufort, but by the end of the fifth month the Beaufort averages had at least equalled ours.

Salinities for collections ranged from 19.1-35.0 o/oo with the average at 28.9 o/oo. Reid found the average salinity to be 25.1 o/oo for that period of time when 99 percent of his

specimens were taken, and Gunter (1945) stated that 85.9 percent of his specimens were caught in salinities above 25.0 o/oo. Simmons (1957) obtained specimens 30-35 mm. at a salinity of 43 o/oo and others up to 490 mm. in salinities of 56.0 o/oo.

Temperatures for our collections ranged from 17.5-32.5 °C. with the average at 27.6 °C. Reid found an average temperature of 25.2 °C. for that period of time when 99 percent of his specimens were taken, and Gunter recorded a range for collections of 13.7-33.0 °C.

O. chrysopterus appears to be one of the few common species with a comparatively restricted tolerance of temperature and salinity variation.

Our findings of food parallels those of both Hildebrand and Cable and Reid. The species is a bottom feeder and as a juvenile or adult subsists on pelecypods, gastropods, sundry crustacea, and polychaetes. Juveniles under 60 mm. subsist primarily on copepods, ostracods, and small pelecypods.

LOBOTIDAE

Lobotes surinamensis (Bloch)
Buoytender

Specimens are occasionally caught by fishermen, usally in the vicinity of buoys, from whence the local name is derived. A 17.5 pound specimen was reported by a local marina on September 10, 1958. A small dried specimen taken in Boca Ciega Bay, date unknown, was given us by Mr. Alex Dragovich of the U. S. Fish and Wildlife Service.

GERRIDAE

Eucinostomus argenteus Baird and Girard
Sand Perch, Mutton Minnow

This species was taken during all months of the year, but it was almost entirely restricted to the Cross Bayou station. Temperatures and salinities at which it was found ranged from 12.8-32.5 °C. and 3.2-35.1 o/oo. During the cold wave of December, 1957, when the water temperature dropped to 13 °C. in the bayou, many individuals were killed, while those that were alive were swimming sluggishly and could be caught by hand. Herald and Strickland (1949) found this species in fresh water at Homasassa Springs, Fla. Collections during 1957 and 1958 from the Caloosahatchee River near Ft. Myers, Fla., and the St. Lucie River, Martin County (east coast), were made in salinities of less than 1 o/oo.

Both Kilby (1955) and Reid (1954) noted that there was an ecological separation between this species and E. *gula*. This study tends to confirm theirs, but with certain reservations. Reid and Kilby noted that *E. gula* was only primarily found in the beach and higher salinity areas. We rarely took *E. gula* from other than such areas; however, in contrast to their findings ours show that *E. argenteus* spends a part of its life history in typical *E. gula* habitats and in the open Gulf, as well as in the protected and low salinity areas. The two species were infrequently taken in the same seine haul. It is interesting to note that Hildebrand (1958) took *E. ar-*

Table 10. Comparative Monthly Average Size (mm.) of the "0" Year Class of *Orthopristis chrysopterus*

	April	May	June	July	Aug.
Springer and Woodburn[1] Tampa Bay Area	17.5	28.7	40.0	47.5	62.1
Hildebrand and Cable[2] Beaufort	6.2	5.6	18.6	57.4	85.9
Reid[3] Cedar Key 1950		36			
1951			49	52	66

1 Standard length
2 Total length (T.L. 60 = S.L. 48; T.L. 82 = S.L. 66; T.L. 91 = S.L. 71)
^ Standard length, estimated from graph.

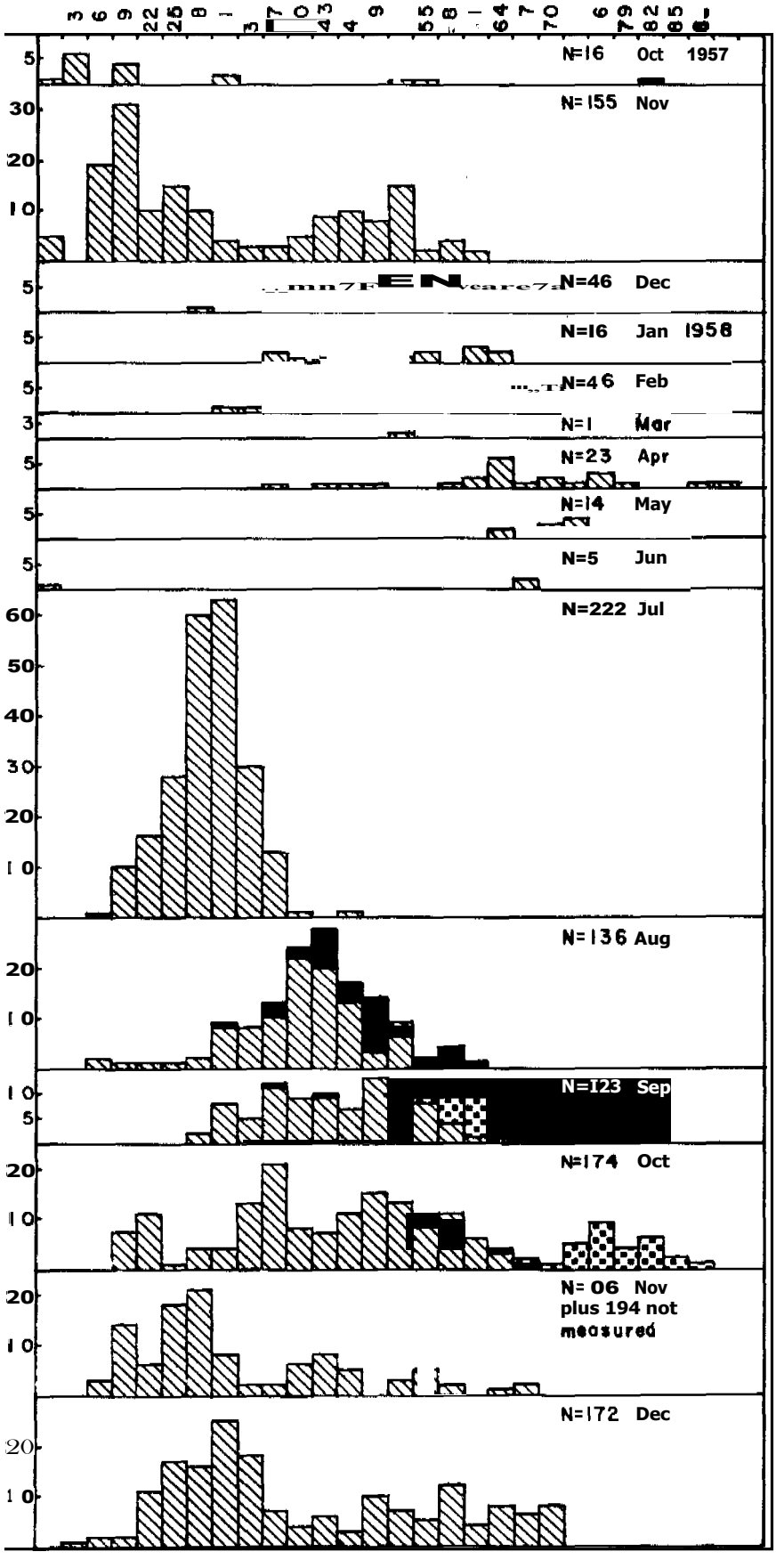

Figure 10. Monthly length - frequency distributions of Eucinostomus **argenteus.**

genteus more commonly than he took *E. gula* in the Laguna Madre of Tamaulipas where the salinity ranged from 47.2-49.9 o/oo. A fuller interpretation of the data leads to the conclusion that only the young of the two species are ecologically separated.

An examination of the graph (Figure 10) shows an interesting phenomenon which began in August, 1958. At that time quantities of *E. argenteus* appear to have detached themselves from the population in the bayou type habitat and moved into Tampa Bay. Our gear was probably ineffective for catching them in Boca Ciega Bay. The species also made a slight appearance at the Gulf beach habitat. These fish averaged a little longer in length than the remaining bayou specimens and might have been a distinct year class. By September this segment of the population had entered the Gulf beach habitat with only a few stragglers left in the bay. During October this segment remained at the Gulf beach habitat (or was continually supplemented) and became more distinctly separable from the Bayou population by having a larger average size. During November this segment of the population was absent from collections and it obviously did not return to the bayou as no specimens large enough were again found in the bayou. It should be noted that the portion of the population which split off from the main bayou group continued to grow, as can be discerned from the modal progression. It is presumed that the splinter group moved offshore into the Gulf. In support of this contention Springer and Bullis (1956) list 26 stations throughout the Gulf of Mexico in water of depths from 60 to 222 feet from which *E. argenteus* was taken. These stations were made during June, 1950, February and August, 1951, May, October, and December, 1952, and October and November, 1953. Both *E. argenteus* and *E. gula* were taken at several of these stations at widely scattered localities. Hildebrand (1954) considered *E. argenteus* rare on the brown shrimp grounds off the Texas coast. He found it distributed in depths from 18 to 222 feet, mentioning that "small" specimens, 94 to 113 mm., were taken in 18 feet off Mustang Island (Texas) in October, 1950; and he (1955) reported this species off Campeche during July, 1951.

The environmental factors causing this species to undergo migration are unknown at present, but the following information is applicable. At the beginning of the migration the salinity at Cross Bayou (3.7 0/00) was close to the lowest recorded, while coincidentally the temperatures at the Tampa and Boca Ciega Bay stations were at their highest recorded (35.5 to 38.2 °C. and 31.0 to 32.5 °C., respectively). During September when *E. argenteus* was leaving Tampa Bay and entering the Gulf beach, the highest temperature recorded for that station (31 °C.) was obtained. In any event it is obvious that the larger members of the species preferred the saltier and deeper waters offshore to the bays and bayous.

The graphs for October and November, 1957, seem to be quite similar to those of October and November, 1958, indicating that quite possibly a similar migration occurred in 1957. The tendency toward bimodality of the November, 1957, graph is attributed to the use of six and twenty foot minnow seines as collecting equipment. All later collections were made with the 50 foot bag seine, except for a single specimen taken in a roller frame trawl from Bird Key middle ground in December, 1957.

The year class (es?) remaining in the bayou during 1957 and early 1958 continued to grow, but were lost from this study between June and July, 1958, at which time the first young were noticed.

No ripe specimens were noted during the study and none have ever been recorded in the literature. Two male specimens (51.5 and 53.3 mm.) taken in September, 1957, in the St. Lucie River appeared to be in an advanced state of gonadal development. Spawning probably occurs in the Gulf and over a long period of time as the young were still being taken in December; however, net mesh was too large to demonstrate an inward migration of the young, if it occurs, from the Gulf. Altogether very few young were taken. Large quantities of 11-13 mm. young were obtained in the St. Lucie River during September, 1957, using a small-meshed minnow seine. Long-

ley (Longley and Hildebrand, 1941) reported that the young were common about Long Key and the flats inside Bush Key in the Dry Tortugas, but he does not mention the time of the year or how small the young were; the smallest specimens listed in his tables were 51 mm. Joseph and Yerger (1956) report specimens from Alligator Harbor ranging from 18-74 mm. and state that "young *mojarras*" were taken *as* early as June and remained abundant throughout the summer.

The main constituent of the diet appeared to be polychaetes which were found in 15 of 27 stomachs examined. Other contents noted were copepods, *Hip pa,* unidentified crustaceans, insect larvae, *Bulla, Crepidula,* and *Donax* which indicate that diet is dependent on habitat and availability (i.e., *Hippa* and *Donax* are found only on the sandy beaches of the open Gulf). Two stomachs were empty.

Stomachs of specimens from the St. Lucie river contained ostracods, copepods, polychaetes, large quantities of tiny pelecypods, and insect larvae.

Eucinostomus gula (Cuvier)

(Also see *Eucinostomus argenteus* above)

Sand Perch, Mutton Minnow

This species was taken during all months except April and May, though a few specimens were taken at Punta Rassa and Estero Bay, Lee County, Florida during May, 1958. It was taken only infrequently during January, February, March, and June. Reid (1954) collected none from February to May; Kilby (1955) took none from December through May; and Gunter (1945), possibly including *E. argenteus,* found this species absent from the Texas coast in late winter and spring. Joseph and Yerger (1956) found *E. gula* abundant only in September, which month appeared to be the peak of abundance in our study. These results indicate essential agreement with the findings of all workers concerned with the near shore habitat.

Springer and Bullis (1956) recorded this species from ten stations offshore in the Gulf of Mexico in depths varying from 24 to 174 feet during March, May, August to October, and December. Kilby believed that this species migrated into the Gulf to spawn during its absence from the inshore habitat. He found no ripe individuals, nor did *we.* Hildebrand (1955) gives evidence in favor of Kilby's supposition by mentioning that all specimens taken during February, 1951, on the Campeche pink shrimp grounds were ripe. Reid, however, found one ripe female (81 mm.) during November at Cedar Key.

Reid found young of 14-17 mm. first *in* July but Joseph and Yerger found none at all. We found young during July also, though we believe they first actually appeared during June. Young continued to appear in the Tampa Bay area through December.

Examination of the graph (Figure 11) indicates primarily that there was a movement from Tampa Bay to Boca Ciega Bay as winter approached. Little can be discerned relating to growth.

Temperature and salinity ranges recorded for this species during our study were 12.8-32.5 °C. and 3.7-25.1 o/oo though it was usually taken in salinities from 24-32 o/oo. Hildebrand (1958) recorded it from salinities in the high forties from Laguna Madre de Tamaulipas, and (1955) he also mentioned that a shrimp boat off Campeche netted several tons (probably including some *E. argenteas).* Presumably this large catch would have been in a salinity of about 35 o/oo. Reid recorded this species from temperatures of 7.2-32.2 °C. and salinities of 9.7-33.8 o/oo, and Kilby found that 90% of his *E. gula* from Bayport were in salinities of 5-15 o/oo and 96% of his specimens of this species from Cedar Key were in salinities of 20-30 o/oo.

Of 26 stomachs examined from the study area 13 contained at least polychaetes, and seven contained at least copepods. Other organisms recorded included: filamentous algae, ostracods, gammarids, a holothurian, *Bulla,* unidentified tiny pelecypods and sundr y pieces of crustacea. One stomach was empty. Reid found that copepods were in 65.8% of the stomachs he examined and polychaetes were in 51.2%. Shrimps and mysids were each found in 7.3% of the stomachs he examined. We did not find copepods in the stomachs of specimens over 45 mm.

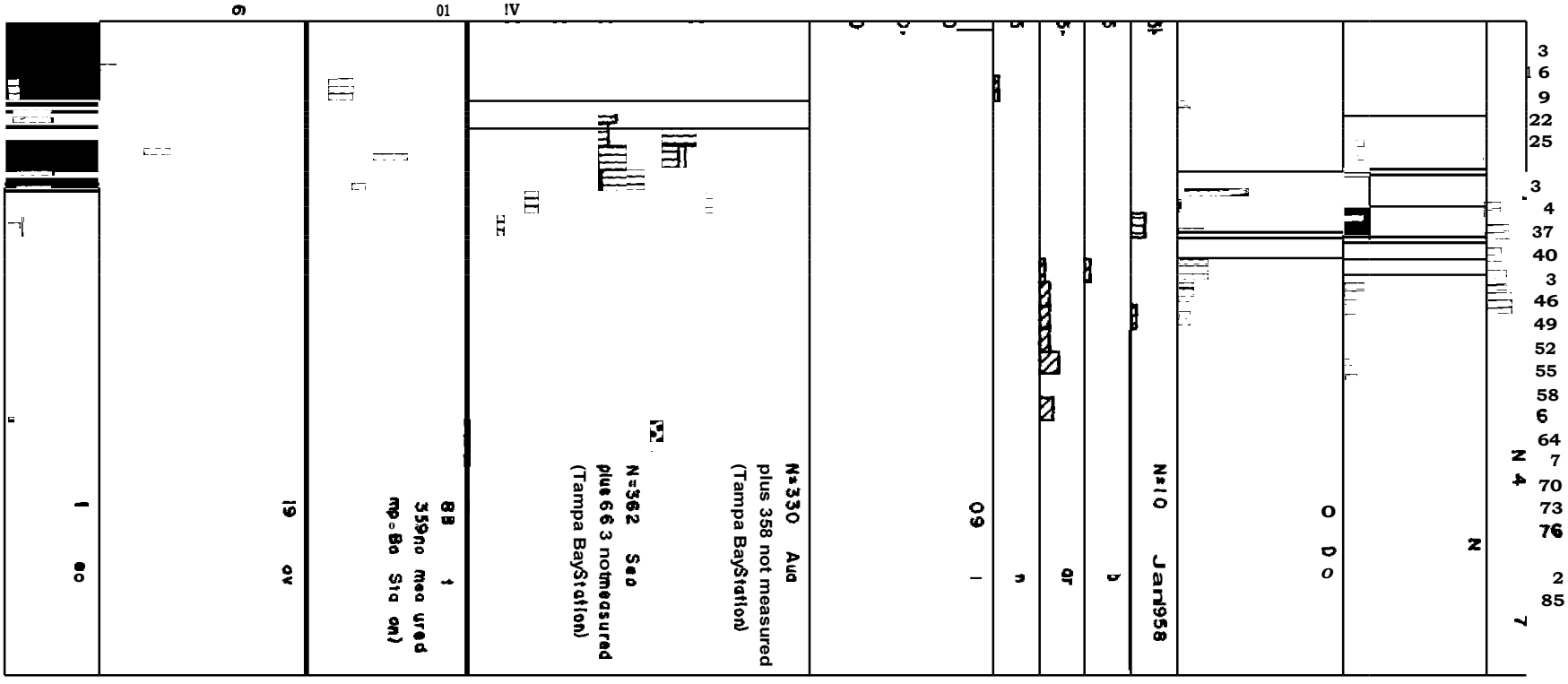

Figure 11. Monthly length-frequency distributions of *Eucinostomus gala.*

Because of mechanical difficulties in the printing process, *the* following histograms should **be** altered **to** read as follows:

July-10 mm. column—should indicate one vertically lined and one *solid* black section.
19 mm. column—a vertically lined section should be indicated to represent one specimen.
31 *mm.* column—a checkered section should be indicated to represent one specimen.

August-37, **73** mm. columns—a checkered section should be indicated to represent one specimen in each.

September-64 mm. column—should be checkered and solid black to indicate one specimen *each.*
67, 73, 76 mm. columns—histograms should *all* be checkered.

October 1958-31, **40** mm. columns—should indicate **one** specimen each vertically lined pattern.
64, 70 mm. columns—should indicate one **specimen** each by **checkered pattern.**

November 1958—31, 34 mm. columns—should be composed of solid black, vertically **lined and diagonally** lined sections **to** *indicate* one **specimen for each column.**
46 mm. **column—should consist vertically** lined and **solid** black **sections to indicate one specimen each.**

Diapterus plumieri (Cuvier)
Sand Perch; Goat, Sand Brim

We took only nine specimens of this species during the course of our study, but our data belie its actual abundance. On February 17, 1958, we observed commercial fishermen using cast nets which took considerable quantities of this species from schools estimated to be comprised of individuals each weighing as much as two pounds. The schools were close to a pile of partially submerged rocks in about four feet of water in Bayboro Harbor. This fish occasionally is sold in the markets. It is rarely caught on hook and line.

A specimen, 26.8 mm., was taken at the Tampa Bay station on August 4, and specimens 56.5-175.5 were taken in Cross Bayou during December, 1957, and August and October-December, 1958.

Temperatures and salinities recorded for this species ranged from 21.1-32.5 °C. and from 3.7-24.8 o/oo. Specimens from the St. Lucie River on the east coast were taken in salinities of less than 1 o/oo during September, 1957. Two dead specimens, 56.5 and 81.6 mm., from Cross Bayou were taken the morning of the December 13, 1957, cold wave. The temperature of the water that morning was 13 °C. Several larger (approximately 200 mm.) specimens also killed by the cold wave of the same date, were sent to us from Ginger Creek, Charlotte County, and Terra Ceia Bay, Manatee County. A kill of unknown cause in the north fork of the St. Lucie River occurred during February 1958. Examinations of large numbers of skeletons and rotting fishes along the shore a month later indicated that this species was the second most commonly killed.

An examination of the stomach contents of a specimen, 175.5 mm., indicated a diet of polychaetes. Two specimens, 71 and 77.7 mm., from the St. Lucie River contained ostracods and copepods.

There is little biological information available on this species. The only citation of this species from the Gulf coast of Florida is that of Lonnberg (1894) from Punta Gorda. Our specimens represent a northward extension of range of about 75 miles. Hildebrand (1958) reported seeing this species in Brownsville, Texas, in a truckload of fish taken from the Laguna Madre de Tamaulipas, Mexico (just south of the Rio Grande). He further notes that D. plumieri has not been taken from the Texas coast.

SCIAENIDAE
Bairdiella chrysura (Lacépède)
Butterfish, Yellowtail

This species was taken during all months of the study except April, 1958, but was abundant only from May-October, 1958. These data are misleading as our gear was not effective for the larger fish (over 90 mm.). Larger individuals were commonly seen being taken on hook and line during November, 1957-January, 1958. The April absence from our collections coincides with the presumed spawning period as the young were first taken in early May and an almost ripe female was obtained during March. Gunter (1945) reported that he took no Bairdiella in the Gulf except during November and January. We took a single specimen, 129 mm., (the largest taken during the study) from the Gulf beach station in February. The remainder of the specimens came from the bays and bayou. Gunter (1938) believed that spawning occurred from April through June in Louisiana and he (1945) took a ripe specimen from a Texas Bay in April. As we took our smallest specimens (13.0-15.9 mm.) only during May, we believe that spawning had completely ceased in our area by early May. We believe that the appearance through August of specimens in the 16.0-18.9 mm. class is evidence only of stunted individuals or late arrivals from spawnings in other areas. Reid (1954) reported the abundance of this species to be greatest during the summer. He obtained specimens from 15-20 mm. from June through September, 1950, and in May, 1951.

Kuntz (1916) made the statement that spawning occurred at Beaufort regularly each day at approximately the same hour, as eggs he took at the same hour on successive days were at the same stage of development. His indications were that spawning occurred in the early evening before 8 o'clock. He also found the height of the spawning season at Beaufort to be from the last week in June to the first week in July. However, he did

not begin his study until June 9. Hildebrand and Cable (1930), after four seasons of study at Beaufort, found no support for Kuntz's spawning peak. They observed that spawning occurred from the last week in April through the first week in July. Their peak occurred from the last half of May to early June, and was almost over by the end of June. Welsh and Breder (1923), working in New Jersey, found that spawning occurred during June through August with the peak in June. Hildebrand and Schroeder (1928) working in Chesapeake Bay procured ripe individuals as early as May 16, and believed spawning continued into early summer. They mention that some young remain in the Bay throughout the winter. It is our belief that these "young" were actually stunted individuals.

Hildebrand and Cable *(op. cit.)* found that spawning sites were quite variable. Eggs and larvae occurred in the harbors, estuaries, and sounds, and at least fifteen miles out to sea, which was as far out as they worked. Gunter (1945) believed that spawning occurred in the bays. We concur with Gunter inasmuch as we never procured very small specimens at our Gulf beach station.

Our data on growth (Figure 12; Table 11) must be interpreted to allow for the selectivity of our gear. Inasmuch as we obtained no individuals under 13 mm. and few over 75 mm., it must be assumed that our gear was effective only for specimens between these two size limits. Our average for specimens for all stations in May is quite high when compared with that of Hildebrand and Cable *(op. cit.)*. The fact that they took no individuals over 6 mm. during May, and that their largest specimen of the "0" year class during June was only 38 mm. indicates a disparity in the nature of the early growth or spawning between Tampa Bay and Beaufort. A perusal of Table 11 leads us to believe that young at Beaufort appear later in the year or start out growing much more slowly than young on the west coast of Florida, but within six months modal (average?) values for the "0" year class are equivalent in the two areas (Note: In contrast to Reid and us, Hildebrand and Cable used Total Lengths. A specimen of 70 mm. Standard Length has a Total Length of about 91 mm.). This is somewhat contrary to what one might expect. Ordinarily it is considered axiomatic that fish populations from colder climates grow more slowly than those from warmer ones. Apparently the cold delays only the spawning or very early growth. Reid *(op. cit.)* does not give monthly averages, but data taken from his graphs for Cedar Key roughly corroborates ours.

An interesting insight into the movements of *Bairdiella* in the Tampa Bay area can be obtained from the graph (Figure 12). The young appear in Boca Ciega Bay in May. In June they are still abundant in Boca Ciega Bay and are just beginning to appear in Tampa Bay; also a large quantity of young appear in Cross Bayou which are of larger average size than those in either Tampa or Boca Ciega Bays. In July the population in Tampa Bay increases considerably, but there are no longer very many in Cross Bayou, nor do they reappear here in any quantity. Both the larger (roller frame trawl) and smaller (pushnet) individuals are in Boca Ciega Bay. In August the numbers in all areas are decreasing, but small individuals are still present in Boca Ciega Bay. By November very few individuals were taken at any of the regular stations.

Specimens were taken in salinities of 3.7-35.0 o/oo, but most records of captures are in salinities over 20.0 o/oo. Water temperatures during collections ranged from 10.0-32.5 °C. Cold killed specimens were noted in Cross Bayou after the December 13, 1957, cold wave. The water temperature at that time measured 13.0 °C.

Darnell (1959) has discussed the literature containing information on the diet of this species. Past workers have found that the smaller specimens fed primarily on copepods, supplemented by other small crustaceans. With increase in size there is a changeover to the larger crustaceans and fish. Darnell found that specimens, 70-143 mm., from Lake Pontchartrain fed about equally on four categories of food: mysids, peneids, fishes, and a catch-all of other organisms, mostly crustacean. Our findings based on the examination of 49 stom-

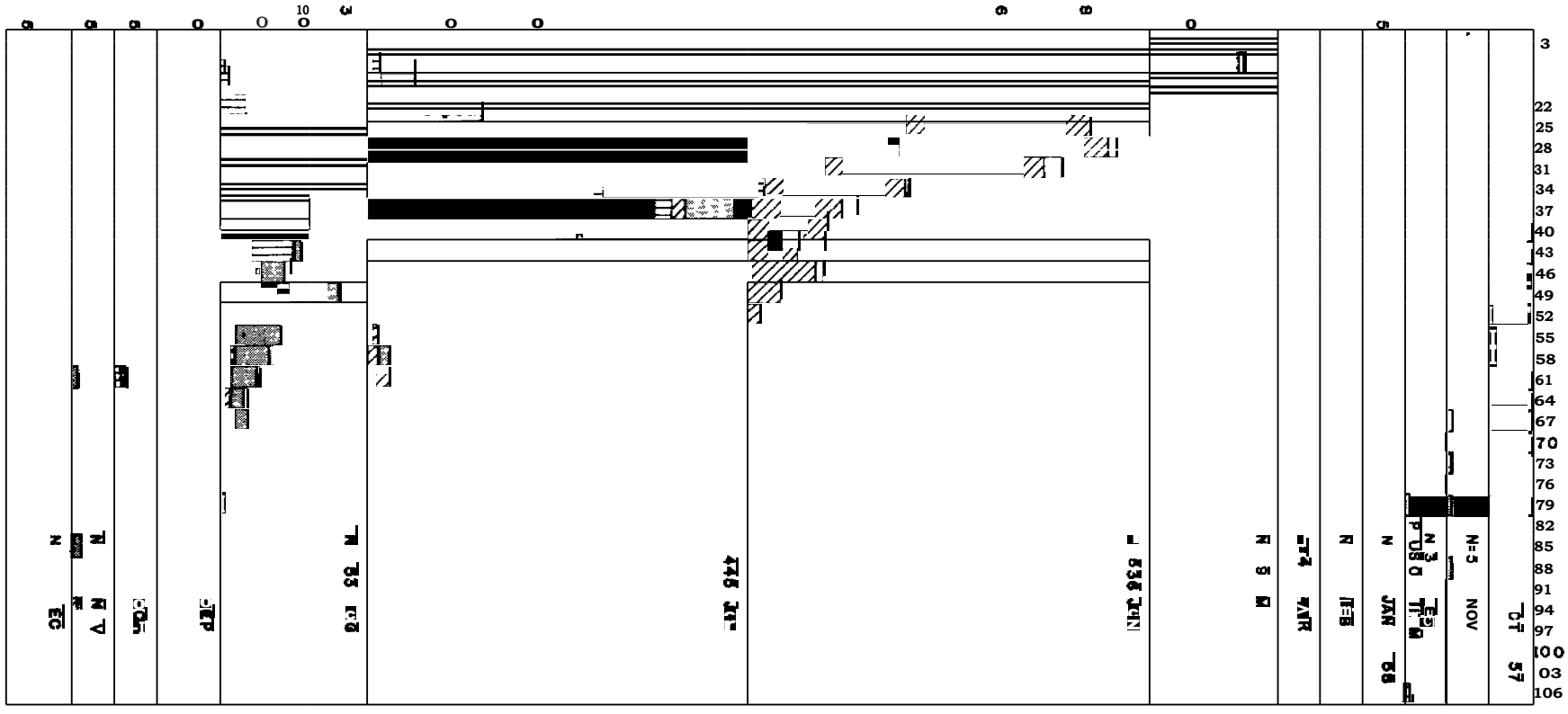

Figure 12. Monthly length-frequency distributions of **Bairdiella chrysura.**

Because of mechanical difficulties in the printing process, the following histograms should be altered to read as follows:

July-61 mm. column—the solid black should be stippled.

August—58 mm. column—the bottom three histogram sections are from top to bottom: one diagonally lined, one vertically lined, one solid black.
61 mm. column—the top histogram section should be clear.

October 1958—58, 61, 64 mm. columns: the top histogram section in each should be diagonally lined.

November 1958—40 mm. column: the top histogram section should be stippled.

achs are in agreement with past findings. Crustaceans of various groups (amphipods, copepods, mysids, gammarids, caridean and peneid shrimp, crab larvae) and to lesser extent fishes, polychaetes and insect larvae, formed the diet.

Cynoscion nebulosus (Cuvier)
Speckled Trout, Speck

Guest and Gunter (1958) have summarized the literature for this species. For a complete account reference should be made to their paper.

Three hundred and twenty-two young speckled trout, 11-96 mm., were taken from all stations except the Gulf beach. They were taken during all months except February-April, 1958. A single specimen, 173 mm., was taken from the Gulf beach during October, 1958 by a sport fisherman. Specimens were uncommon in the bayou where only seven were collected. This species spends most of its life over the grass flats, but on several occasions we saw specimens being caught on hook and line at the Gulf beach station.

The smallest individual we took was collected at the Maximo Pt. station on May 15, 1958, and for this reason we believe that spawning first occurred during April; also, a specimen, 5.9 mm., was taken on May 5, 1959. Specimens from 20-40 mm. were present from June-November, which agrees with Moody's (1950) observations at Cedar Key and Pearson's (1929) at Corpus Christi, Texas.

Little information was obtained on growth. Moody's findings at Cedar Key indicated that the species in that area reaches 200 mm. after 12 months growth. This seems rather high to us. He (p. 161) stated: that this is somewhat higher than would be expected from a comparison with other studies of growth on the species, but (p. 163) then goes on to say that his data from Cedar Key compare quite closely with Welsh and Breder's (1923, Punta Gorda) and Pearson's *(op. cit.)* findings. He demonstrated his latter remark by comparing his measurements (made in standard length) with theirs (made in total length). For this reason we feel that his first statement of the conflicting pair is the correct one.

Salinities and temperatures recorded for this species during our study ranged from 7.2-35.1 o/oo and 14.0-33.0 °C. Breuer (1957) reported that C. *nebulosus* is conspicuous by its absence from Baffin Bay (Texas) when the salinities reached 55 o/oo. Simmons (1957) reported that some trout over four pounds appeared never to leave the upper Laguna Madre (Texas) even though the salinity ranged from 25-75 o/oo and the temperatures from 4-33 °C. He stated that no spawning took place in salinities over 45 o/oo.

As our specimens were all juveniles, stomach contents were comprised mostly of crustaceans: mysids, copepods, and especially caridean shrimp. One stomach contained a specimen of *Gobiosoma robustum*. Moody demonstrated the preference of small (up to 150 mm.) specimens for the smaller crustacea, and of the larger specimens for peneids and fish. Moody, and Gunter (1945), noted a summer to winter shift of diet from shrimp to fish. Breuer *(op. cit.)* reported that large

Table 11. Geographic Comparison of Monthly Size Increments of "0" Year Class Populations of *Bairdiella chrysura*

	Springer & Woodburn Tampa Bay (Standard Length)		Reid Cedar Key (Standard Length)	Hildebrand & Cable Beaufort (Total Length)	
	Average Size mm,	Mode Class mm.	Approx. Mode mm.	Average Size mm.	Mode Class mm.
May	18.2	19.0-21.9	15	2.4	0-4
June	29.7	22.0-24.9	35	8.7	0-4
July	38.4	37.0–39.9	45	31.9	35–39
Aug.	45.6	52.0-54.6	55	55.8	50-54
Sept.	65.5	58.0-60.9	62	81.0	80-84
Oct.	59.9	73.0–75.9	72	93.2	90-94

trout preferred mullet one-half to two-thirds their own length. This finding was confirmed by Simmons (op. cit.). Breuer noted that complete digestion took from two to three days. Of 200 stomachs examined containing food Simmons found 12 containing *Elops* saurus, six containing young C. nebulosus, and 182 containing mullet *(Mugil).* He found that from May through June Cyprinodon *variegatus* was the preferred diet of fishes from landcuts. For a detailed discussion of the food habits of this species the reader is referred to Darnell (1959), who noted differences in the habits of Lake Pontchartrain specimens from specimens in other localities.

Cynoscion arenarius Ginsburg
Gray Trout, Silver Trout, Weakfish

Ninety-six specimens f r om Cross Bayou were the only ones taken from regular collecting stations. These ranged in size from 28.9-141.2 mm. They were obtained from November and December, 1957, and June through December, 1958. Other specimens were taken in the Tampa Bay area in Hillsborough Bay and offshore during February, 1958. No ripe or adult specimens were obtained locally, but one specimen, a nearly ripe female, was collected from the Gulf 15 miles due west of Sanibel Island during seismographic operations in February, 1958. Large quantities of silver trout were caught by fishermen offshore during February, 1959.

Springer and Bullis (1956) took this species on numerous occasions throughout the Gulf. Their specimens occurred in depths from 24-348 feet. Unlike Cynoscion nebulosus which spends most of its time in the bays over grass flats (Springer and Bullis recorded C. nebulosus only once from the Gulf), C. arenarius spends much of its adult life in the Gulf, and when in protected bodies of water prefers channels (Reid, 1954; Hildebrand, 1958; Joseph and Yerger, 1956). The finding of young C. *arenarius* exclusively in the bayou, which can be considered a shallow channel, emphasizes this ecological separation. Only seven of several hundred young of C. nebulosus taken were from the bayou. Hildebrand (1954) noted that all C. *arenarius* taken offshore were large (over 200 mm.).

No one has yet reported the spawning area of C. *arenarius,* although a number of ripe individuals are recorded (April-June, Gunter, 1938; March, Gunter, 1945). Presumably spawning takes place in the Gulf during early Spring. This would follow the winter migration from bay to Gulf noted by Gunter (1938, 1945) although he attributes the migration to change in temperature. Reid (1955B) reported gravid females from East Bay, Texas, during the summer and believed, therefore, that spawning took place in the bays. The absence of any information on very young forms would seem to disprove this assumption.

Specimens were taken in Cross Bayou in salinities of 3.7-29.8 0/00. Others taken by the River Basin Study group of the U. S. Fish and Wildlife Service in the Caloosahatchee River occurred in salinities of 0.1 o/oo. Simmons (1957) noted that C. arenarius was uncommon in the Laguna Madre (Texas) in salinities above 45 o/oo. Temperatures during times of collections ranged from 21.1-31.5 °C. Three cold-killed specimens were taken in Cross Bayou after the December 13, 1957, cold wave. The water temperature at this time was 13 °C. Live specimens were taken during February, 1958, from Pensacola Bay when the surface temperature was 10.2 °C. Kilby (1955) reported specimens from a tide pool which measured 33 °C. and Gunter (1945) recorded this species from temperatures as high as 36.7 °C.

Previous authors (Hildebrand, 1954; Reid, 1955 A & B; Reid et al, 1956) have indicated that fish (Anchoa mitchelli, Brevoortia patronus, sciaenids, Prionotus stearnsi, *Paracentropristes* pomospilus) constitute the major portion of the diet of adult C. arenarius. Darnell (1959) concurred. Reid et *al* (1956) found shrimp to be the second most common constituent in the diets of juveniles. Our findings agree with previous studies with regard to fish: 10 of 19 stomachs examined contained fish. Peneid shrimp were never common in Cross Bayou and for that probable reason were recorded in only one stomach. Paleomonetes, mysids, gammarids, and crab zoea constitute other stomach contents.

Equetus acuminatus (Bloch and Schneider)

This species is very common, when present, on the rocky reefs offshore. Specimens were obtained only from June, 1958, through January, 1959. It was taken at depths from eight feet at Egmont Key to 60 feet about 20 miles offshore. The smallest specimens collected, 39-41.5 mm., were taken at a depth of eight feet under a dock on Egmont Key June 8, 1958. The largest specimens, up to 163 mm., were taken offshore during September. Springer and Bullis (1956) took this species on many occasions in depths up to 302 feet. Its distribution is apparently widespread in the Gulf.

It was noticed that the young swam in groups over the outer surface of an irregular rock while the adults preferred the smooth areas under overhanging ledges.

This species changes color and form as it grows older. The young have dark stripes over a light ground color, with the caudal and anterior dorsal fins elongate. The ground color gradually becomes darker with age and the number of stripes increases and their presence becomes obscured. At the same time the caudal and anterior dorsal fins become much shortened.

Equetus lanceolatus (Linnaeus)

This species is much less common than E. acuminatus, in whose company it is frequently seen. The young of these two species occupy the same niche. No adults have been seen, although seisomographic operations offshore during February killed many specimens up to 218 mm. The smallest specimen, 31.4 mm., was taken on September 14, 1958, at a depth of 60 feet. It has a caudal length of 19.2 mm. and an anterior dorsal height of 31.3 mm. As is true of E. acuminatus, these fins become shortend with increasing size, but not greatly so. Color pattern is not appreciably different in the largest and smallest specimens.

Springer and Bullis (1956) reported this species from widely scattered localities in the Gulf in depths of 54-122 feet. Apparently E. *lanceolatus* does not come as close to shore in our area as E. acuminatus; the shallowest depth recorded for it was 35 feet.

Leiostomus xanthurus Lacépède
Spot, Croaker, Jimmies

Spot were one of the commonest fishes obtained during this study. Although 7,067 specimens were returned to the laboratory, many more were collected. Abundance was variable with time of year and locality (Table 12). No spot were taken during October-December, 1957, although they were taken during all months of 1958. Numerous young under 10 mm. standard length were observed in Boca Ciega Bay during late January, 1959. Spawning occurs offshore either close to the entrances of bays (Pearson, 1929) or in deep water well out from land (Dawson, 1958). Our data, which is in accord with that of other authors, suggests that spawning begins during late December or early January and continues through March in the Tampa Bay area.

Dawson (op. *cit.*), in an excellent study of the spot in South Carolina waters, has reviewed the literature and we do not feel that a repetition is needed. Only such information that is not covered in his paper will be presented here.

The average monthly standard lengths for the different stations are given in Table 12. Each station exhibits monthly length increments at least through July, but the averages are not all equal. Monthly averages from the beach station run somewhat higher than the others. In addition to possibly faster growth in the beach habitat these higher averages may also be the result of the addition to the beach fauna of the larger individuals from the other habitats (see below). Dawson reported differences in the average lengths of specimens from different localities in his study area which were similar ecologically.

Specimens from Cross Bayou averaged shorter in August than they did in July, and after August occurrence of spot was considerably decreased and almost entirely restricted to the bayou station. The monthly averages of the bayou population began to increase again in September and were still increasing at the close of this study. During December, 1958, the average was 9.9 mm. greater than in July just before the reduction in average size occurred. Suttkus (1955) has explained

Table 12.

Average Monthly Standard Lengths of *Leiostomus xanthurus* from Regular Stations, 1958

	TAMPA BAY			PASS-A-GRILLE			MAXIMO PT. BOCA CIEGA BAY			CROSS BAYOU			ROLLER FRAME TRAWL STATIONS BOCA CIEGA BAY			ROLLER FRAME TRAWL STATIONS OLD TAMPA BAY		
	Class Range mm.	Mean mm.	N	Class Range mm.	Mean mm.	N	Class Range mm.	Mean mm.	N	Class Range mm.	Mean mm.	N	Class Range mm.	Mean mm.	N	Class Range mm.	Mean mm.	N
Jan.	13-18.9	14.7	15							13-33.9	21.7	76						
Feb.	13-30.5	19.9	113	22-24.9	23.5	1	16-21.9	15.2	17	16-51.9	29.6	619				13-33.9	20.0	43
Mar.	13-42.9	26.9	1437 (683 not measured)	19-36.9	30.5	6	10-42.9	24.4	170	19-75.9	30.0	1614 (954 not measured)				52-54.9	53.5	1
April	19-48.9	33.6	312	31-72.9	49.8	167	19-39.9	32.8	48	22-81.9	34.5	978 (508 not measured)	43-54.9	49.7	4	37-51.9	44.8	9
May	34-69.9	46.5	196	40-69.9	53.2	37	58-60.9	59.5	1	25-81.9	42.9	295	55-87.9	67.3	13	46-51.9	49.0	2
June				49-96.9	70.5	212	37-69.9	49.5	51	31-104.5	52.0	209				61-75.9	70.5	3
July	52-90.9	68.0	27	49-108.9	74.0	45				48.9-120.9	80.2	154	88-90.9	89.5	1			
Aug.	58-78.9	67.0	5	76-105.9	92.0	6	49-63.9	57.5	3	49-78.9	57.6	34						
Sept.	82-84.9	83.5	1							52-72.9	62.1	14						
Oct.										52-96.9	71.7	84						
Nov.										67-93.9	80.7	18						
Dec.										76-111.9	90.1	26						
Total			2106			474			290			4121			18			58

the phenomenon of decreasing average lengths in Lake Pontchartrain *Micropogon* and Hildebrand and Cable (1930) have explained it for Orthopristis by postulating that the larger individuals migrated offshore. Thus a population of smaller individuals would remain. Suttkus believed that a change in temperature caused the onset of the migration. This does not seem to be the case with spot which began to disappear in our area in August. Kilby (1955) obtained no spot after June in the marshes at Cedar Key, but Reid (1954) reported them present in all months on the grass flats in that same area. Probably most of the spot in our area migrate offshore in late summer.

Gunter (1945) believed that the larger examples of a species seek saltier waters, or the converse, smaller fish of a species are found in the less saline waters. It may be that the initial exodus of spot from the bayou (low salinity area) was triggered by size, but this raises the problem as to why the remaining individuals in the bayou once increasing to and beyond the average length of the earlier migrating group did not themselves leave the bayou. Reid and Hoese (1958) gave evidence that size distribution of spot and croakers in a Texas estuary was independent of salinity. Our data on spot would tend to give support to their findings.

Comparison of growth rates in different areas are given in Table 14. By the use of the conversion formula determined by Dawson for spot: Total Length = 1.233 (Standard Length) + 2, we have given our measurements in total length. Our averages represent the combined average of all specimens (Tables 13 & 14) taken during a particular month. Indications are that the southern populations have a faster initial growth, but they apparently attain a smaller ultimate size. This characteristic has been discussed in some detail by Gunter (1950). The appearance of the "0" year class only during April in Dawson's data raises doubt in our minds that his average for that group is representative. He was using large mesh and would have missed the smaller individuals.

Salinities and temperatures at which spot were taken during regular collections ranged from 5.0-34.2 o/oo and 10.8-32.5 °C.

Forty-three stomachs were examined. The contents of these indicate that the larger spot are bottom feeders, seeking only tiny forms, and apparently indiscriminate as to quality. The following items were recorded: filamentous algae, desmids, forams, gammarids, mysids, copepods, amphipods, ostracods, isopods, chaetognaths, insect larvae, pelecypods, gastropods, and polychaetes. Young specimens (less than 40 mm.) fed primarily on planktonic organisms: copepods, ostracods, chaetognaths. Darnell (1959) summarized the literature and gave data on feeding habits of Lake Pontchartrain spot.

Menticirrhus americanus (Linnaeus)
Whiting

Although only 74 specimens, 25.2-117.0 mm., were taken at regular stations during the course of the present study, numerous others were seen being caught by local fishermen. All those specimens recorded from the regular stations were juveniles; all those taken on hook and line appeared to be adults. Of the 74 specimens taken 72 came from the Gulf beach station and two came from Cross Bayou. Two specimens, 180 and 182.5 mm., were taken in Hillsborough Bay with a try-net during February, 1958. Peak catches by fishermen during the period of the study were during the late summer, 1958.

Based on the appearance of young, spawning probably took place in May and June in the Tampa Bay area. Reid (1954) found ripe females during April and August at Cedar Key. Gunter (1938) took fish with well-developed roe from April through June on the Louisiana coast, and he (1945) found a specimen with large roe during November in a Texas Bay. Miles (1949) reported that all the specimens of M. americanus which he examined during March and April from Port Aransas, Texas, were ripe. Hildebrand (1958) obtained a ripe specimen during November in the Laguna Madre of Tamaulipas, Mexico. On the Atlantic coast Hildebrand and Cable (1934) believed spawning to take place from April through August and possibly September off North Carolina; and Hildebrand and Schroeder (1928) found ripe and spent individuals during May and June from Chesa-

Table 13. Standard Length Frequency Distributions of *Leiostomus xanthurus* (All Stations). January-December, 1958[1]. Tampa Bay Area.

Class				A	M	J	J	A	S	O			
10			1										
13	27	7	1										
16	14	81	15										
19	12	154	127	2									
22	16	130	306	7									
25	15	106	454	109	1								
28	5	67	383	180	5								
31	2	65	177	191	19	1							
34		62	60	129	39								
37		59	26	103	59	5							
40		37	2	76	94	15							
43		14	2	52	82	55							
46		9	13	42	84	41	6						
49		2	7	42	71	57	18	7					
52			5	21	37	41	23	4	1	1			
55			2	21	16	19	37	10	3	2			
58			3	16	13	17	31	11	3	2			
61			3	7	6	30	19	3	1	7			
64				1	9	35	26	4	4	12			
67			1	3	5	37	16			17	1		
70			2	1		37	20	1	2	17			
73			1	1	3	27	3			6	2		
76						19	7	3		6	4	1	
79			(plus	1	1	15	9			4	5	3	
82			1637			6	2		1	2	2	5	
85			not	(plus	1	9	1	2			2	4	
88			meas-	508		3	4			4	1	3	
91			wed)	not		1	1			3	1	2	
94				meaF-		1		1		1		2	
97				ured)		3	1					2	
100							1	1				2	
103						1		1				1	
106							1						
109												1	
112													
115													
118							1						
Total	91	'793	3228	1518	544	475	227	48	15	84	18	26	7067
Ave. S. L.	20.5	27.4	27.9	36.8	45.5	60.1	77.6	62.9	63.5	71.7	80.7	90.1	

[1] None obtained October-December, 1957.

peake Bay. It would tentatively seem that spawning takes place at about the same time of year throughout the range of this species.

Some indication of growth rate can be obtained from the graph (Figure 13). A speci-

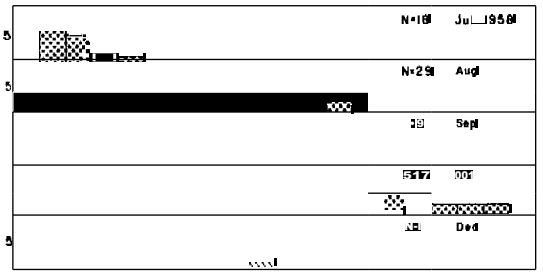

Figure 13. Monthly length-frcquency distributions of *Menticirrhus americanus.*

men as small as 25 mm. in July could reach a length of 117 mm. by October. This growth rate is roughly comparable to that found for more northern populations on the Atlantic coast. Hildebrand and Cable *(op. cit.)* found that spring young reached 135 mm. (Total Length) by November in North Carolina and mature during the second year of life. Welsh and Breder (1923, New Jersey), however, believed this species to average only 170 mm. by its second winter and to mature at the age of three years.

Salinities and temperatures during times of regular collections ranged from 13.7-35.1 o/oo and 12.5-31.0 °C. These figures agree with the findings of Reid *(op. cit.;* 17.5-25.5 o/oo, 10.0-27.1 °C.) and Gunter (1945; 14.4-36.7 o/oo, 13.7-30.5 °C.). Hildebrand (1958) took the species at a salinity of 38.5 o/oo in the Laguna Madre of Tamaulipas, but neither Simmons (1957) nor Breuer (1957) reported it from the high salinity bays of Texas. The species apparently prefers moderate to full strength sea water (Gunter, 1945, stated that most of his specimens were taken in waters with salinities of over 30.0 o/oo).

Stomachs of specimens, 38.4-101.4 mm., we examined contained polychaetes, crabs, mysids, *Emerita,* and unidentifiable remains. Reid *(op. cit.)* found similar items in the stomachs he examined. Miles (1949) reported the following items among the contents of 82 stomachs of *M. americanus* he examined: *Penaeus aztecus, P. setiferus, Crangon, Squilla, Menippe, Myrophis, Menidia beryllina,* flatfish, and unidentifiable shrimp, crabs and

Table 14. Comparative Monthly Average Total Length (mm.) of "0" Year Class of *Leiostomus xanthurus* from Different Localities

Month	Springer & Woodburn (Tampa Bay) All Stations	Kilby[1] (1955, Cedar Key)	Pearson[2] (1929, Texas)	Hildebrand and Cable (1930, North Carolina)	Dawson (1958, South Carolina)
				3.7	
	27.3	20		12.6	
			26.7		
	35.8	36		18.5	
			31.8		
	36.4	48		20.3	
			55.4		
A	46.5	60		29.8	69.3
			62.6		
	58.1	66		45.8	
	76.1	97		57.7	
	97.5			81.4	
A	79.6			104.6	
	80.3			115.5	
	90.4			129.5	
	101.5			139.3	
	113.1				

[1] Approximated from Kilby (1955. Figure 9)
[2] Intervals encompassed periods involving two months.

fishes. Shrimps constituted the largest proportion of the contents of the stomachs. Smith (1907) obtained molluscs, fish, and crustaceans from stomachs, and Hildebrand and Schroeder (op. cit.) found that 85 percent of the stomachs they examined contained crustaceans and 15 percent fish. Hildebrand and Cable (1934) obtained crabs, grass shrimp, *Myrophis* punctatus, and other fishes from stomachs. It would appear that most of these authors examined adult fish.

This species is primarily a bottom feeder, the young of which spend much of their time on open sandy beaches (Springer and Bullis, 1956, list M. americanus from 43 localities in the Gulf during all months of the year except May. Their specimens were taken at depths of 24-222 feet). Our observations indicated that the juveniles came into a few inches of water to feed, almost to the water's edge. These findings are also true of M. *littoralis* and M. focaliger, and all three of these species have been taken in the same seine haul. Joseph and Yerger (1956) also collected all three together.

Menticirrhus littoralis (Holbrook) Whiting

Of the three species of whiting M. littoralis was by far the commonest. Although only 926 specimens were returned to the laboratory during the course of this study, it would have been possible to have obtained an almost infinite number during July, 1958. All specimens were taken from the Gulf beach station except for a group of young collected at Bella Vista Beach during June, 1958. This locality is about two miles north of the regular beach station, but it exhibits the same ecological features as our regular station. This particular collection was made by Dr. Paul Wallace and family with a fine-mesh, 20 foot minnow seine.

That this species is confined to open stretches of sandy beach when inshore is well-evidenced in the literature. Joseph and Yerger (1956) reported that M. littoralis was common on the Gulf side of their area, but that it did not enter the bays. Reid (1954), who worked only grassy inshore habitats did not take this species at Cedar Key, nor did Kilby (1955) who worked the Gulf coastal marshes. Gunter (1945) took only three out of 54 specimens in bays on the Texas coast; the remainder came from the surf area on the beaches. Jordan and Gilbert (1879) reported M. *littoralis* common at Beaufort during the summer and found the young in the surf on the outer beach in company with pompano. Hildebrand and Cable (19:34) noted that the species was found only in the outside waters at Beaufort, while M. saxatilis (which is represented in the Gulf by the sibling M. focaliger) and M. americanus were found both inside and out. In contrast to our findings they found M. littoralis less common than M. americanus, but about equally as common as M. *saxatilis* (in our case M. focaliger).

Indications from the graph (Figure 14) are

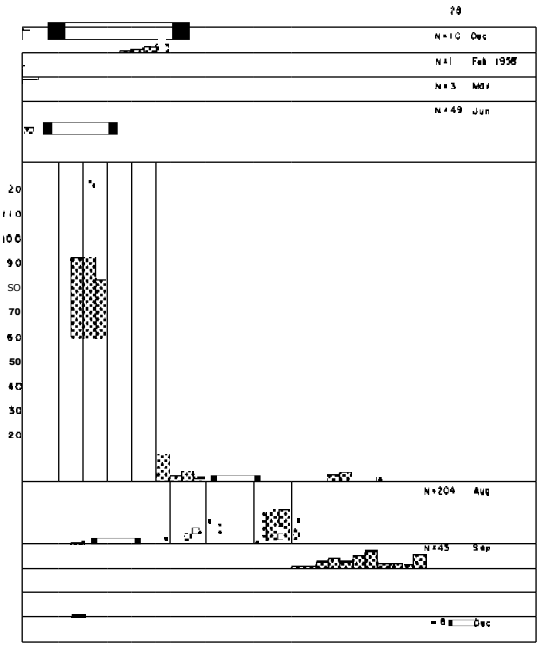

Figure 14. Monthly length-frequency distributions of Menticirrhus *littoralis*.

that spawning probably took place during May as the young were first taken during mid June. Hildebrand and Cable (op. cit.) reported spawning to be simultaneous with the other two species of Menticirrhus at Beaufort. They believed that spawning started no later than May 1. Gunter (op. cit.) found a ripe

fish during late June in Texas. Some spawning may occur throughout the summer although our data does not favor this.

Growth is easily followed for the first four or five months of life, after which the population became unavailable to us. It may be that the species then moved to deeper water in the Gulf. In this matter it is interesting to note that Springer and Bullis (1956) did not take any specimens in their offshore collecting in the Gulf of Mexico. Gordon Gunter (personal communication) stated that M. *littoralis* is strictly a littoral form found in a very narrow ecological habitat. Growth is fast during the early months of life. Individuals from 9-21 mm. in June may attain a length of from 129-149 mm. by October. This is a somewhat higher rate than that found by Hildebrand and Cable at Beaufort. Their "0" year class in July ranged from 11-58 mm., total length, and by September it ranged from 11-120 mm.

A bimodality appears on the July graph which can be followed through October. Because of the fast growth rate, the closeness of the peaks can only be interpreted as belonging to the same year class. This may represent two spawning peaks which occurred close together or sexual differences.

Salinities and temperatures during regular collections ranged from 31.8-35.1 o/oo and 10.8-31.0 °C. Gunter (1945) recorded salinities and temperatures for his collections at 17.9-36.7 o/oo and 13.8-30.6 °C. Few of Gunter's specimens were taken at salinities below 25 o/oo.

Most of the contents of the 15 stomachs examined were unidentifiable; however, the following items were noted: polychaetes, *Emerita* and Donax. Gunter found razor clams in two stomachs.

Menticirrhus focaliger Ginsburg
Whiting

Only 128 specimens, 13.0-116.0 mm., were taken during regular collections. They were taken during all months except May and September. A few young were taken at the Tampa Bay station; all others were taken on the Gulf beach. In addition to specimens from the Tampa Bay area, a specimen was collected from Punta Rassa, Lee County. This appears to be the southernmost record on the Florida west coast.

It was noticed that the young of M. focaliger under 22 mm. exhibited two distinct types of color pattern. In one type the entire specimen except for portions of the fins is deeply and uniformly pigmented. In the other dark and light areas appear over the specimen in approximation of the adult coloration.

The smallest specimens were taken in Tampa Bay during October and November, 1957. Summer collections during 1958 give some evidence that spawning is concurrent with that of the other two species of Menticirrhus in the Gulf.

This species was taken at salinities ranging from 21.0-35.1 o/oo, but usually at over 25 o/oo. It was taken at temperatures ranging from 13.5-30.7 °C.

Food of specimens under 30 mm. consisted of copepods, mysids, tiny crabs and gammarids. Above this size Emerita, gammarids, mysids, hermit crabs (without shells), polychaetes and unidentifiable crustaceans were found in stomachs.

Micropogon undulatus (Linnaeus)

Two hundred-sixty-four specimens, 18.5-102.6 mm., all from Cross Bayou, were obtained during the study. They occurred only from April-July. Croakers are seemingly rare in this area. We know of no sport catches. Neither Reid (1954) nor Kilby (1955) reported Micropogon in their studies at Cedar Key. It was Joseph and Yerger's (1956) belief that Apalachee Bay in the Florida panhandle was the southern or eastern limit of its distribution in the Gulf. However, Henshall (1895) noted that croakers were common in Florida west coast bays and he obtained examples from Tampa (Hillsborough Bay?). Reid (op. cit.) mistakenly noted that croakers were not reported from Key West. Evermann and Kendall (1900) reported that they collected this species in that locality in 1896. Also they reported croakers from Biscayne Bay (Miami), and Henshall (1891) reported them from Marco and Gordon Pass. It is possible that croakers invade the southern regions of the Florida coast during exception-

ally cold winters such as the one encompassed by our study. C. R. Robins (personal communication) informed us that after the severe winter of 1957-58 *Bairdiella* and *Orthopristis* became common in the Miami area where ordinarily they were rarely found.

As this paper went to press it was noticed that large croaker were being caught from the Johns Pass Bridge by sport fishermen (October and November, 1959). One specimen reported to us by Mr. John Hurlbut was said to weigh two pounds. The weather at this time was unusually warm for this time of year.

Reference to the name "croaker" by local fishermen was found to apply to *Leiostomus xanthurus*.

Suttkus (1955) reported that spawning took place on the Louisiana coast during October-January; Pearson (1929) came to similar conclusions for Texas, but extended the period into February. Welsh and Breder (1923) placed the spawning period in Chesapeake bay from August to December; and Hildebrand and Cable (1930) reported spawning over nine months, September-May, for Beaufort, but limited the principal spawning to October-March. The latter named authors summarized that spawning begins in August in Chesapeake Bay and northward, September at Beaufort, and October in Texas (to which may be added Louisiana); and that it ends in December or January in Chesapeake Bay and northward, April at Beaufort, and February in Texas (January in Louisiana). The progressively later commencement of spawning as one moves south is to be expected in a cool weather spawner. The uncorrelated variation in the terminal period is unexpected.

Welsh and Breder *(op. cit.)* stated that spawning took place in estuaries. All other authors cited indicated that spawning occurred offshore usually around the mouths of passes. Hildebrand and Cable *(op. cit.),* however, found eggs and young as much as 15 miles offshore at Beaufort (as far out as they worked). It is believed that either the young are transported into the bays by tidal currents or they reach there by swimming along a comparatively higher salinity level found at the bottom of estuaries. The young remain in the bays until The following fall when they migrate out to sea. Evidence of a fall migration during October of each year from 1952-56 has been obtained for the Lydia Ann Channel, Texas, by Springer and Pirson (1959). Whether or not there is any appreciable return of the adults which migrate offshore is not known, but Springer and Bullis (1956) list numerous catches offshore in the northern Gulf for all months and in depths ranging from 18-300 feet. It appears that quite possibly the belief that most croakers do not exceed two years of age is the result of limited or no return migration inshore. Springer and Pirson *(op. cit.)* indicate only one catch peak per year in the Lydia Ann Channel. One would expect two if there were an active return migration into the channel at any particular time.

Growth was exhibited by Cross Bayou specimens (Figure 15; Table 15). Specimens averaged 28.5 mm. in April and by July they averaged 89.7 mm. This growth is compared with the findings of other authors in the Table (15). Pearson's *(op. cit.)* data is difficult to interpret and has not been included in the Table as we feel that it is not representative. Superficially his monthly averages appear to be much larger than those of other investigators, and, as he noted, it was not possible to segregate the year classes. Suttkus *(op. cit.)* gave some monthly averages on the "0" year class for 1953, but mentioned only that the "0" year class of 1954 had somewhat lower averages than those of 1953. We have obtained averages on this class from his data and these are presented in the Table. In addition to the data presented in the Table a collection of 249 young from the St. Lucie estuary on the Florida east coast on March 25, 1958, averaged 34.8 mm., somewhat higher than the April average at Cross Bayou. In the Table our data are in standard lengths, while those of the other authors arc in total lengths. A croaker of 87 mm. standard length has a total length of about 111 mm., and one of 94 mm. standard length has a total length of about 119 mm. From the meager data presented it is, nevertheless, quite evident that "0" year classes for different years in the same areas may have considerably different growth rates; and also, that the "0" year class in different

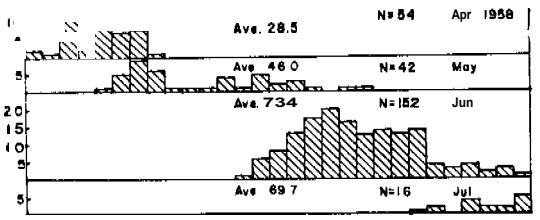

Figure 15. Monthly length-frequency distributions of *Micropogon undulatus.*

areas have different growth rates. This information is not unexpected, but the seeming lack of pattern in these differences is noteworthy.

Our specimens were taken in salinities and temperatures of 5.0-29.8 o/oo and 26.0-31.5 °C. Gunter (1945) reported salinities and temperatures for catches of croaker from 2.0-36.7 o/oo and 9.1-32.0 °C. Simmons (1957) reported that croakers were common in the upper Laguna Madre in salinities as high as 70 o/oo, and the Vero Beach office of the Fish and Wildlife Service has records from the Caloosahatchee River as low as 0.1 o/oo.

Hildebrand and Cable *(op. cit.)* reported that the young were less sensitive to cold than adults and that unharmed, but numb, specimens were taken in waters of 5 °C. where no adults were to be found. It may be that the young are unable to leave the area where-as the adults being stronger swimmers are able to.

Twenty-one stomachs of young specimens, 30-107 mm., examined from Cross Bayou, Apalachicola and Pensacola Bays, and the St. Lucie River contained essentially the same contents: copepods, mysids, caridean shrimp, polychaetes, insect larvae, and in one instance each isopods and small pelecypods.

Most authors cited in the above discussion have given information on the food habits of *Micropogon.* In general their findings indicate a high degree of bottom fauna in the diet with especial emphasis on molluscs. Roelofs (1954) compared the diets and feeding mechanisms of spot and croaker. His table shows a high degree of occurrence of annelids and, secondarily, copepods in croaker stomachs. In different habitats different foods may be emphasized; for a discussion of this see Reid, *et. al.* (1956). Darnell (1959) has given a review of the literature concerning the food habits of croakers as well as a detailed discussion of the food habits of the croaker in Lake Pontchartrain. Reid and Hoese (1958) have discussed the distribution of croakers with regard to size, salinity and food.

Odontoscion dentex (Cuvier)

This species has not previously been reported north of Tortugas. Eleven specimens

Table 15. Comparative Monthly Average Lengths (mm.) of "0" Year Class of *Micropogon undulatus.*

	Springer and Woodburn Tampa Bay Area (Standard Length)	Gunter[1] Texas (Total Length)		Suttkus Louisiana (Total Length)		Hildebrand and Cable North Carolina (Total Length)
		1941	1942	1953	1954	
APRIL	28.5	78	88		65.0	
MAY	46.0	88	95		65.8	
JUNE	73.4	93	118		74.8	72.1
JULY	89.7	113		102.7	86.5	95.8
AUG.		123	118	116.6	94.6	110.6
SEPT.		128		126.5	104.2	132.7
OCT.		143		145.5	104.7	143.4
NOV.		138		152.8		

I Averages estimated from Gunter (1945) Figure 9.

have been taken from the rocky reefs offshore. Numerous others have been seen. It prefers the smooth areas under overhanging ledges where it mingles with the adults of *Equetus acuminatus*. *Specimens* were taken on September 14, 21, November 9, 1958, and January 31, 1959, in depths from 39-60 feet. The smallest specimen, 63.2 mm., was taken on September 14; the largest, 141 mm., was found dead on the beach on December 2, 1957, at the regular Gulf beach station. It was among thousands of fishes which had been killed by the "red tide at that time.

Pogonias cromis (Linnaeus)
Drum, Drumfish

Only three specimens of this species were taken during the course of our study. Two juveniles, 143 and 247 mm., were taken from Cross Bayou on November 14, 1957, and July 17, 1958. A 593 mm. spent female was collected from the Gulf beach station on March 17, 1958. This species is frequently taken on hook and line during summer, fall and winter. Our specimens were taken in salinities of 16.1-32.3 o/oo and temperatures of 17.4-31.5 °C. A fourth specimen was seen being taken on hook and line at our beach station during July when the salinity and temperature were 35.1 o/oo and 28.3 °C. respectively. Kilby (1955) took nine young (17-43 mm. in May and 49-83 mm. in June) from tide pools at Cedar Key (Salinities 20.6-26.1 o/oo and temperatures 32.0-34.5 °C.). Joseph and Yerger (1956) reported one specimen from Alligator Harbor.

Sciaenops ocellata (Linnaeus)
Redfish, Reds, Channel Bass

Eighty-two specimens (20-126 mm.) were taken from regular stations during the present study. Seventy-nine of these were taken in Cross Bayou. The species was absent from collections from June through October, 1958. Three specimens 13.2-18.8 mm., were collected in Sarasota Bay on October 23, 1958, (temperature 26 °C.; salinity 34.5 o/oo). Spawning in our area apparently took place in late September or early October, 1958. Welsh and Breder (1923) believed that some spawning took place as early as September in New Jersey. Kilby (1955) reported specimens ranging from 12-146 mm. The smallest were taken at Cedar Key in September and October. Hildebrand and Schroeder (1928) collected specimens 24-34 mm. in mid-September, indicating that spawning may take place as early as August in Chesapeake Bay.

Redfish are caught locally primarily during the fall and winter. In 1958 the redfish were abundant in hook and line catches during late June. Local bait house operators noted their appearance as being three months earlier than usual and also commented that the fish were about six inches shorter than usual. Presumably a single year class comprises the great majority of catches in any particular year. It is possible that these occurrences were the result of the excessively cold winter of 1957-58. Redfish were still being caught in quantity during January, 1959.

Salinities and temperatures at times of capture ranged from 5.0-34.5 o/oo and 10.0-27.5 °C. Kilby *(op. cit.)* obtained specimens from salinities of 0.8-37.6 o/oo and Simmons (1957) stated that the distribution of redfish in the upper Laguna Madre (Texas) was sharply limited by salinities of 50 o/oo and that no specimens under nine inches in length were taken in salinities over 45 o/oo. Specimens 12.2-27.5 mm. taken by us in the Indian River at Jensen Beach on September 28, 1957, occurred in salinities of 22.0-27.5 0/00 and at a temperature of 29 °C. Gunter (1945) recorded redfish in temperatures as high as 32.4 °C.

Of twelve stomachs of specimens ranging from 59.5-126.0 mm., eight contained at least fish remains (one identifiable as *Micropogon undulatus);* the others contained decapod shrimp, crabs, insect larvae, and mysids. Three stomachs of specimens 31.0-46.3 mm. contained mysids and polychaetes. Gunter (1945) examined the stomachs of 237 Texas redfish, 245-745 mm., of which 196 contained identifiable contents. Of these, 49 contained at least fish (mullet six times) and 177 contained at least crustacea, of which peneid shrimp were *present* 95 times and blue crabs *(Callinectes sapidus)* 87 times. Algae and grass were found in two stomachs. Gunter stated that blue crabs were the principal food species of the

redfish. In contrast to Gunter, Breuer (1957) found that fingerling mullet were the preferred diet of Texas redfish. Simmons (op. cit.) reported mullet, blue crabs and Cyprinodon variegatus in the stomachs he examined. Pearson (1929) stated that the food consisted principally of crabs and shrimps, with Penaeus the main constituent in specimens 60-720 mm. and Callinectes second most abundant. He identified mullet, gobies, and Menidia among the fishes eaten.

MULLIDAE

Pseudupeneus maculatus (Bloch)

Springer and Bullis (1956) reported taking this species in the Gulf of Mexico at 27° 30', 83°, 18' at a depth of 20 fathoms on March 18, 1954.

SPARIDAE

Calamus arctifrons Goode and Bean
Porgy

No specimens were taken during regular collections. A number were found dead on the beach during the red tide kill of 1957. Others were obtained offshore during February, 1958, as the result of seismographic operations. During May, 1959, specimens were occasionally seen being caught off the Johns Pass Bridge.

Diplodus *holbrooki* (Bean)
Spot Tail

Only one specimen, 52.4 mm., was taken at a regular station: off Cabbage Key, Boca Ciega Bay, June 5, 1958. A number of other specimens have been seen or collected in various habitats in the area. Three specimens, 170-191 mm., were caught on December 18, 1957, on hook and line in Bayboro Harbor. A number of large specimens were seen about 12 miles offshore at a depth of 35 feet on February 8, 1959. They were hovering over a sandy bottom just beyond a rocky reef. The normal distribution of this species in the Gulf should include the Tampa Bay area and probably areas further south than just Cedar Key as proposed by Caldwell (1955).

Caldwell procured young as small as 17 mm. at Cedar Key. He was able to follow growth for several months. The smallest specimens obtained locally, 19-33 mm., came from Johns Pass on April 7, 1959.

Archosargus probatocephalus (Walbaum)
Sheepshead, Convict Fish, Striper

This species is much more common than is indicated by the 94 specimens we took at regular stations during the present study. Catches of over 100 individuals by a single fisherman during one day have been noted in the local newspapers.

Observations and collections of sheepshead were made during all months of the year except May, but we believe that the species was present then. Sheepshead are caught in greatest abundance by local fishermen during late fall and winter. Springer and Pirson (1959) recorded similar catch data for Port Aransas, Texas.

Spawning takes place in the spring, but there seems to be some doubt as to where it occurs. Rathbun (1892) reported stripping and fertilizing eggs from individuals taken from sandy beaches at Charlotte Harbor during March. We believe that spawning probably takes place offshore; individuals have been observed commonly around the rocky reefs offshore at depths up to 60 feet. An almost ripe male, about 20 inches in length, was poisoned at a depth of 35 feet on February 8, 1959. The young, to about 50 mm., inhabit Ruppia beds in North Carolina (Hildebrand and Cable, 1938), and we found them primarily in Diplanthera beds locally. It has been suggested by Hildebrand and Cable that after attaining a length of about 50 mm. individuals leave the grass beds and establish themselves in the adult habitat: around rocks, pilings, wrecks and bulkheads. They infer that lack of teeth forces the young to feed on tiny forms found only in the grass beds. We also found that young under 50 mm. (11 stomachs examined) ate mostly gammarids, copepods, and polychaetes, although the gastropod Crepidula occurred in two stomachs of specimens 46-47 mm. Above 50 mm. (8 stomachs) molluscs and barnacles constitute the major portion of the diet, although a sea urchin and sundry small crustaceans were also found. The stomach of one specimen,

86.0 mm., was completely packed with filamentous green algae. Some algae was also found in the smaller specimens. Of 18 stomachs of specimens 190-365 mm. Gunter (1945) found large balls of plant material in 11 and crabs and molluscs (with or without some plant material) in seven. He believed sheepshead to be largely herbivores because of their extremely long digestive tract.

We were able to follow growth (Figure 16) for only three months. Specimens averaged 20.7 mm. during June, 29.0 mm. during July, and 41.5 mm. during August. These figures are 5-6 mm. higher than the averages given by Hildebrand and Cable *(op. cit.),* total length, for the same months at Beaufort. After August specimens moved off the grass flats and entered the adult habitat which was inaccessible with our equipment.

We recorded sheepshead in salinities and temperatures of 5-35 o/oo and 12.8-32.5 °C. Kilby (1955) collected a single specimen, 23.0 mm., from Bayport at a salinity and temperature of 2.2 o/oo and 33 °C. Simmons (1957) reported that sheepshead were uncommon in salinities over 40 o/oo and Herald and Strickland (1948) recorded them commonly in the freshwaters of Homosassa Springs.

Caldwell (1958) has discussed an aberrant specimen taken from Tampa Bay.

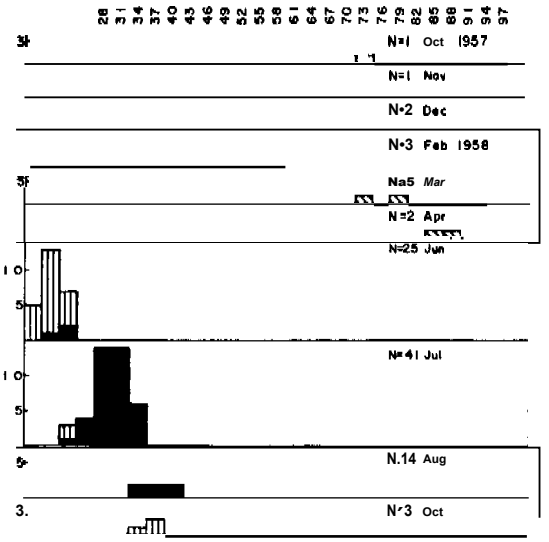

Figure 16. Monthly length-frequency distributions of *Archosargus probatocephalus.*

Lagodon rhomboides (Linnaeus)
Pinfish, Shiner

Pinfish is one of the most ubiquitous and plentiful species in the Tampa Bay area. Specimens were taken during all months of the year and were rarely absent at any station. In contrast to Gunter (1945) who found pinfish poorly represented in the sandy beach areas we found it commonly there. Of 6,573 specimens returned to the laboratory during our study 1,225 were from the Gulf beach station.

Caldwell (J,957B) has summarized the literature on this species. We will only include information and opinions not found in his study.

Very little information has been obtained on the spawning of pinfish which probably takes place offshore in the Gulf during late fall and early winter. Locally the young appeared in December in 1957-59; this has also been demonstrated repeatedly at Cedar Key (Caldwell, *op. cit.;* Reid, 1954; Kilby, 1955). Hildebrand and Cable (1938) found that the young first appeared in late October at Beaufort.

Tables 16 and 17 embody information on the growth rate in the Tampa Bay area, while Table 17 also gives comparative rates of the growth of the "0" year class in other areas. It is immediately obvious from Table 17 that the average for any particular month may vary considerably for different localities, and also that the averages for any particular month in a particular locality may vary from year to year. It is significant that Caldwell's data for 1953 closely approximates ours for 1958. We and Caldwell used several types of collecting gear in our studies. This might explain why Reid's *(op. cit.)* data for 1950 differs so considerably from ours; he used a try net almost exclusively. Hildebrand and Cable's *(op. cit.)* data are probably combinations of data covering several years and as such are of limited comparative value. Their averages, when converted to standard lengths, are not very different from ours. Caldwell, referring to length of a "O" year class reached after the "first full year" of growth, stated that Hildebrand and Cable's data indicated a faster growth rate for Beaufort than his did for

Table 16.

Length Frequency Distributions of all Specimens of *Lagodon rhomboides* Measured from the Tampa Bay Area.[1]

Mid-Class mm.	1957 Oct.	1957 Nov.	1957 Dec.	1958 Jan.	1958 Feb.	1958 Mar.	1958 Apr.	1958 May	1958 June	1958 July	1958 Aug.	1958 Sept.	1958 Oct.	1958 Nov.	1958 Dec.
11.5						1	2								6
14.5				24	56	17	9								6
17.5			1	59	52	92	44	1							1
20.5				31	34	121	78	3							1
23.5					64	103	146	19							
26.5					18	42	89	75	3	1					
29.5					5	32	47	132	10						
32.5					1	30	25	214	11	4					
35.5						11	24	207	22	16	1				
38.5						7	55	263	40	49	6				
41.5						1	40	197	84	114	13				
44.5							33	120	83	155	16	1			
47.5				2			15	93	76	138	15	11	1		
50.5					1		7	68	117	113	29	8	7		
53.5				5	3		1	45	173	113	39	9	12		
56.5				2	1			21	122	124	73	7	13		
59.5		1	1	2	2	2		13	86	113	70	11	11		
62.5	1	1			5	6		8	38	79	78	9	11	2	
65.5	3	2		1	2	15		4	20	64	58	14	4		
68.5	7	1			2	18		2	12	61	58	20	7	1	1
71.5	11	6				17	5	1	8	35	39	8	12	4	
74.5	11	4		1		12	5		4	32	35	7	9	5	
77.5	12	6		1		4	7	4	7	24	28	10	7	5	6
80.5	8	10		1		2	10	1	1	10	16	10	3	10	9
83.5	7	7	1	3		1	1	4	1	8	4	24	3	5	16
86.5	3	4	1	1		1	2	1		3	5	11	9	3	32
89.5						1		2		5	1	3	15	10	30
92.5		2		1				1	1	2	2	4	23	3	19
95.5	3	2					1	1		3	1	4	19	8	11
98.5	4						3			1	1	2	10	5	4
101.5	1							1		3		1	4	5	4
104.5										3		1	2	5	
107.5							1					2	1		
110.5						1				1					
113.5												1	1		

Table 16.—(Continued)

Mid-Class mm.	1957 Oct.	Nov.	Dec.	1958 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
116.5										1		1			
119.5								1		2		1			
122.5								2		3		1			
125.5										1					
128.5											1				
131.5									1						
134.5									1						
137.5										1					
140.5													1		
143.5													1		
TOTAL	71	46	4	134	246	537	650	1504	921	1282	589	181	188	72	146	6573

I Figures between solid lines represent data from which "0" year class averages were computed in Table 17.

Table 17.

Comparative Monthly Average Size (mm.) of "0" Year Class Individuals of Lagodon *rhomboides*.

	Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Springer and Woodburn[1] Tampa Bay	1957										78.6	78.8	76.5	17.5
	1958	17.7	19.9	23.0	28.8	38.7	51.3	54.7	62.6	72.3	78.1	86.5	88.3	16.8
Reid[1, 2]	1950						42	48	50	55	60	65	53	15
Cedar Key	1951	17	22	20	30	42								
Caldwell[1]	1953		19.9	22.7	30.4	38.1	53.2	60.9	67.9	68.3	71.3	73.9	71.2	+ 14.3
Cedar Key	1954	14.3	17.2	16.7	19.7	23.8								
Hildebrand and Cable[3] Beaufort		14	15	16	18	35	49	72	78	98	9	12	12	

I Standard lengths (The newly spawned year class is included in December)
[2] Averages estimated from graph.
[3] Total lengths (A standard length of 86 mm. 110 mm. Total length; 59 mm. S. L. 78 mm. T.L.; 48 mm. S. L. 62 mm. T.L.

Cedar Key. There is one fact which alters Caldwell's conclusions: Hildebrand and Cable used total lengths. In their three papers (1930, 1934, 1938) on growth and development of fishes at Beaufort, methods were listed only in the earliest paper. It is presumed that these did not change as the authors referred to the latter paper as a continuation of their earlier studies. Caldwell used standard length in his studies. The result is that the Beaufort averages were about the same as Caldwell's for any particular month, and were actually smaller when compared on a strictly age basis. The Beaufort forms were spawned one or two months earlier than the Florida forms. In summary then, the Beaufort pinfish require the handicap of an earlier spawning in order to keep up with their faster growing and later spawned colleagues from Florida.

Caldwell has stated that large pinfish (over 200 mm.) are rarely taken inshore other than in certain deep channels and holes in close proximity to deep, unprotected, offshore water. He further stated that those large fish taken inshore are usually taken only in the late spring and early summer. In areas where they are taken in the colder months, there appears to be deep water particularly close inshore. Our findings are in contrast to his. During November and December, 1957, specimens at least as large as 264 mm. (standard length) were commonly taken on hook and line from Bayboro Harbor off the Marine Lab. The greatest depth indicated for the whole harbor is 14 feet and Tampa Bay in general is much shallower. Again during the late fall of 1958 we observed catches of these large pinfish in the same area. Dr. R. F. Hutton, who has been in charge of the laboratory since 1955 has regularly noted their appearance every fall. It is interesting to note that these appearances of large pinfish occur at the same time as appearances of large *Diplodus holbrooki* (at least as large as 191 mm. standard length).

Salinities and temperatures recorded for regular stations at times when pinfish were collected ranged from 3.7-35.1 0/00 and 10.0-32.5 °C. A salinity of 0.9 o/oo was recorded for a collection in the Caloosahatchee River, and Hildebrand (1958) reported a collection in Laguna Madre de Tamaulipas in a salinity of 44.5 o/oo.

In contrast to Caldwell, we feel that pinfish ingest plant material deliberately. Of 57 stomachs examined 11 contained exclusively, or almost exclusively, masses of *Diplanthera,* and one contained mostly *Enteromorpha.* We cannot accept as incidental the fact that a 140 mm. specimen ingested only a large mass of *Diplanthera.* Darnell (1959), who was unaware of Caldwell's study stated, There is no question of the algae being an 'incidental' item in the food of this fish . ." Otherwise we have little to add to the food habits as discussed by Caldwell or Darnell .

KYPHOSIDAE

Kyphosus sectatrix (Linnaeus)

Henshall (1895) reported collecting specimens from Mullet Key. We know of no other reports.

EPHIPPIDAE

Chaetodipterus faber (Broussonet)

Angelfish, Spadefish

Eight small specimens were taken in regular collections. At the Tampa Bay station two specimens, 8.2 and 8.5 mm., were taken on June 6; one, 10.0 mm., was taken on August 4; one, 10.1 mm., was taken on September 3; and one, 16.8 mm., was taken on October 3. Three specimens, 19.5, 23.0, and 24.7 mm., were taken at the Gulf beach station on July 9. Adults are occasionally taken by fishermen, but the species is not considered abundant. Our specimens would indicate a spring and summer spawning. Ryder (1887) stated that the spadefish spawns the latter part of June and the early part of July in Chesapeake Bay. Reid (1954) believed the species to spawn in the spring at Cedar Key. Hildebrand and Cable (1938) caught specimens 2.5-9.0 mm. in July at Beaufort and believed the species spawned offshore. They stated that spadefish were found at Beaufort only from May through October noting that it was found all year long at Key West. Gunter (1945) did not take spadefish during the winter on the Texas coast. A specimen, 162 mm., was found dead in a boat basin near our Maximo Pt. station the morning after a

cold wave which occurred on December 13, 1957. Probably the species withdraws from our area to the offshore waters in the winter. Springer and Bullis (1956) reported collections in various parts of the Gulf from October through December, and February through April, with one collection each for August and September. These occurred from depths from 6-37 fathoms with the September collection in the middle eastern Gulf having been taken in water 254 fathoms deep. Most of the collections were from depths greater than 15 fathoms.

Our specimens were taken at salinities and temperatures ranging from 20.3-33.4 o/oo and 19.5-32.5 C. Gunter reported specimens at 11.1-35.8 o/oo and 17.1-29.0 °C.

CHAETODONTIDAE

Chaetodon ocellatus Bloch

This species is frequently seen on the offshore rocky reefs at depths from 40-60 feet.

Holacanthus ciliaris (Linnaeus)

Mr. John Hurlbut, commercial aquarium operator on Madeira Beach, maintained a specimen for several months which he said was caught on the Boca Ciega Bay side of the tip of Pass-a-Grille Beach. He stated that to his knowledge this was the only specimen ever taken in the area. Three young specimens tentatively identified as this species were taken on the rocky reefs offshore at a depth of 55 feet during November, 1959.

Holacanthus bermudensis (Goode)
Queen Angelfish

The young and adults of this species are frequently common offshore on the reefs. Local fishermen often catch specimens which they call Queen Angels, a name more correctly applied to *H. ciliaris.*

Pomacanthus arcuatus (Linnaeus)
Black Angelfish

One specimen was speared by Dr. R. T. Kirk at a depth of 35 feet on a wreck offshore. A few others have been seen on the reefs.

POMACENTRIDAE

Eupomacentrus variabilis Castelnau

This species is very abundant on the rocky reefs offshore. It was seen or taken on almost every collecting trip. Identification of our specimens was made by Mr. Loren P. Woods.

Eupomacentrus leucostictus
(Muller and Troschel)

Goode and Bean (1880) reported this species from Clearwater Harbor. We know of no other records.

Chromis enchrysurus Jordan and Gilbert

Jordan and Evermann (1898) reported this species from the snapper banks off Tampa. We have seen no specimens.

Abudefduf saxatilis (Linnaeus)

Mr. John Hurlbut has told us that he obtained specimens for his aquarium from Johns Pass. He stated that the species disappeared after the cold wave of December, 1957. Repeated collections in the locality up to April, 1959, evinced no specimens. A single specimen was found washed up on the beach during the "red tide" outbreak of 1957.

LABRIDAE

Lachnolaimus maximus (Walbaum)
Hog Snapper

This species was seen on almost every diving trip on the offshore rocky reefs at depths from 35-60 feet. Never more than one or two specimens were seen on any excursion.

Halichoeres bivittatus (Bloch)

This species was seen on most of the rocky reefs visited offshore. It was one of the most abundant and conspicuous species whenever it was present. In other instances it was completely absent. This latter phenomenon is unexplainable in terms of depth, time of year, or on general observations of the habitat. Specimens are infrequently taken in Boca Ciega Bay.

Halichoeres caudalis (Poey)

Two specimens were obtained on the rocky reefs offshore. One during September, 1958,

at a depth of 45-50 feet and one during November, 1958, at a depth of 55-60 feet. Another specimen believed to be this species was seen during April, 1959, at a depth of 60 feet.

Xyrichthys psittacus (Linnaeus)

This species was described by Jordan (1888) as X. *jessiae* from a specimen taken from a grouper caught off Tampa Bay. It has not been reported since, although an unidentified parrotfish seen on June 29, 1959, at a depth of 58 feet may have been this species. The fish was hovering over a soft sand bottom and dove directly into the sand when approached. There was no hole or burrow opening present and probing in the area failed to reveal the presence of the fish.

SCARIDAE
Nicholsina usta (Valenciennes)

Only four specimens, 14.5-41.2 mm., were taken at regular stations. These were taken during November and December, 1958, at the Maximo Pt. and roller frame trawl stations in Boca Ciega Bay. Specimens were taken during November, 1958, and February, 1959, on the rocky reefs offshore at depths of 35 and 39 feet. Specimens taken inshore were green while those taken offshore were amber yellow.

Specimens from the Gulf coast of Florida will not key in Schultz (1958) review of the Scaridae. It is necessary to add to "1b" of his key the fact that 5 or 6 scales may be present in the single row of cheek scales below the eye.

Scarus croicensis Bloch

This species was reported by Jordan and Evermann (1887, as S. *evermanni* Jordan) from off Tampa Bay and has not been recorded since.

ACANTHURIDAE
Acanthurus caeruleus Bloch and Schneider

The bright yellow young of this species were seen and taken on the rocky reefs offshore at depths from 40-60 feet during September through December, 1958. The species was not common.

URANOSCOPIDAE
Astroscopus ygraecum (Cuvier)
Electric Stargazer

Six specimens were collected from the Tampa Bay station. Two, 20.2 and 30.6 mm., were obtained during January (24.9 o/oo, 16.5 °C.), two in February, 31.4 and 34.0 mm. (25.0 o/oo, 13.5 °C.), one each in October and December, 1958 (77.0 and 145 mm., 26.4 and 27.7 o/oo, 20 and 24 °C., respectively). The specimens came from a sandy bottom just off a channel passing through the collecting site. Another specimen, 93.0 mm., was caught during June at the Gulf beach station by a fisherman (34.2 o/oo, 30 °C.).

Observations were made on the shocking behavior of this species. The area delivering the shock occurs in the region just behind the snout. Each shock is accompanied by an abrupt movement of the fish. The head is suddenly thrown back, the mouth simultaneously opened, the opercles expanded, and the pectoral fins thrown down and out with a jerk. Gunter (1945) observed a similar behavior in his specimen.

Large specimens estimated to weigh about five to eight pounds were found dead on the Gulf beaches during the red tide kill of 1957.

Stomachs contained young *Mugil cephalus, Leiostomus xanthurus,* and *Menidia beryllina,* also an unidentified gastropod.

TRICHIURIDAE
Trichiurus lepturus Linnaeus
Cutlassfish, Ribbonfish

Although local fishermen recalled catching this species in quantities in previous years it was notably absent from catches during the period of our study until November, 1958. From then through February, 1959, fishermen caught large numbers of specimens from the Johns Pass bridge and the sea walls along Boca Ciega Bay. The specimens were all quite large with many larger then 900 mm. On the Texas coast Gunter (1945) reported specimens ranging from 236-520 mm. He (1938) reported young on the Louisiana coast. The fact that all our specimens are considerably larger than any of those from the northwestern Gulf probably indicates a mi-

gration of the larger individuals from there to our area.

SCOMBRIDAE
Euthynnus alletteratus (Rafinesque)
Bonito

This species is occasionally caught by the charterboat men fishing offshore in the Gulf.

Thunnus atlanticus (Linnaeus)

During the summer of 1958, Dr. A. J. Barker, St. Petersburg physician, caught a moderately large (estimated 40 pounds) specimen of a tuna offshore in the Gulf. The specimen was not seen by us, but color slides of the specimen were kindly made available. The specimen is clearly a tuna. Dr. C. R. Robins felt almost certain that it was a blackfin as the finlets were black (they would be yellow in T. *obesus* and T. *albacares*). The size of the pectoral fins would exclude T. thynnus, in which they are much smaller, and T. alalunga, in which they are much longer. In addition the latter species is not known from Florida shores.

Scomber *colias* Gmelin

Mr. Harvey Bullis has informed us that the M/V Oregon has collected this species in the Tampa Bay area.

Scomberomorus maculatus (Mitchill)
Spanish Mackerel, Mackerel

Six specimens, 133-158 mm., were taken at the Gulf beach station near the concrete groins while seining, September 10, 1958 (33.8 o/oo, 31. 0 °C.). A specimen, 36.0 mm., was taken at the bayou station on September 11, 1958 (12.8-19.7 o/oo, 32.0 °C.). Mackerel are commonly caught from spring through fall in the Tampa Bay area. They were present during the winter of 1958-1959. Fishermen considered it unusual and ascribed it also to the unusual presence of bait (H. pensacolae) in the area during the winter.

Scomberomorus cavalla (Cuvier)
Kingfish, Kings

Kingfish are one of the most sought after species in the Tampa Bay area. Their movements up the coast are avidly reported in the newspapers. They receive notice in the Naples area and are thenceforth reported as they appear off each of the larger west coast cities. The first large catches in the Tampa Bay area reported in the St. Petersburg Times for the years 1955-59 were made on the following dates:

April 5, 1955
March 24, 1956
March 23, 1957
April 12, 1958
April 2, 1959

The 1958 date for kingfish appearance may have been influenced by the excessively cold winter of 1957-58. In estimating the speed of the migration the following information may be applicable. On March 25, 1955, the kingfish were centered off Naples. On March 18, 1956, they were centered off Venice. On October 17, 1958, they were centered about Panama City. In the latter instance the return migration was expected to pass Pinellas County in about two weeks. It is not known whether the schools were present at the expected time, but some catches were made about then. The ascending and descending migrations along the Florida west coast are expected annually.

LUVARIDAE
Luvarus imperialis Rafinesque

In the St. Petersburg Times for May 3, 1941, is an excellent picture of a rather large specimen (perhaps 50 pounds or more) which was caught in the Gulf off St. Petersburg. According to Briggs (1958) this species is known in the Western Atlantic only from Connecticut to the eastern Gulf of Mexico near the Florida Keys.

ISTIOPHORIDAE
Istiophorus albicans (Latreille)
Sailfish

Sailfish are caught as close as nine miles offshore. Newspapers reported the first sailfish of 1958 on May 3 and that of 1959 on April 10. The species remains in the area at least through August. Charterboatmen believe that the sailfish follow tile king mackerel northward up the coast.

ELEOTRIDAE

Ioglossus calliurus Bean

Two specimens were taken offshore. One was speared by Dr. J. Randall, in 35 feet. Another was spit up alive by a red grouper *(Epinephelus morio)* which had been caught on hook and line by Mr. J. Hurlbut at a depth of 78 feet. Numerous others have been seen while diving. Sometimes no evidence of the species is present; on other occasions hundreds are found in a small area. The species "vibrates" head down at an angle of about 10 above its burrow which occurs in the sand usually just a few feet from a patch of rock or a reef. An approach in its vicinity causes it to dart into its burrow. Examination of the burrow will show the fish peering up a few inches inside. Probing causes the fish to disappear deep in the burrow. The burrows are lined with pieces of rock and shell. The fish were rarely seen singly. Usually two or three occur over burrows within a very few inches of each other.

Dormitator maculatus (Bloch)

Several individuals of this species were collected on various occasions by Mr. Sebi Sohon. They were all obtained from a shallow creek entering Boca Ciega Bay just north of the Treasure Island Causeway. Salinities in the creek are very low as *Notemigonus chrysoleucas* was taken at this same location.

GOBIIDAE

Bathygobius soporator catulus (Girard)

Four specimens were collected at regular stations. Three, 53.0-57.1 mm., were taken in a shell *(Atrina)* at the Maximo Pt. station on June 12, 1958, (31.4 o/oo, 32.1 °C.). One, 28.0 mm., was killed with rotenone among the rocks bordering the Tampa Bay station on August 4, 1948, (24.8 o/oo, 31.0 °C.). Other specimens were taken with rotenone in Bayboro Harbor among oyster shells along the sea wall bordering the Marine Laboratory. The species inhabits hard irregular substrates in the Tampa Bay area.

Two of the specimens from Maximo Pt. were examined internally (the third escaped). One appeared to be a spent male with an empty stomach. The other was a ripe female with an empty stomach but the gut contained an insect larva and a caridean shrimp.

Coryphopterus sp.

Three specimens of an undescribed species of *Coryphopterus* were collected, and many others seen, on the rocky reefs offshore. Observations were made on four separate occasions. The depth varied from 55-60 feet. The species is extremely wary and disappears into its burrows at the least provocation. It inhabits holes under ledges at the peripheral bases of the rocky areas (Robins (1958B) has reported a similar habitat for *C. glaucofraenum).* It rests on the fine silty sediment found under these ledges. The least disturbance causes the silt to obscure the entire area, making collecting difficult. The species will be described elsewhere.

Garmannia macrodon (Beebe and Tee Van)

This species is variably common on the rocky reefs offshore. Several specimens of this diminutive goby have been collected from depths ranging from 35-60 feet. It inhabits the interstices of the calcareous rubble found on the surface and around the bases of the reefs, and to some extent the crevasses which honeycomb the reefs. Robins (1958B) has reported on the habits of this species in the Florida Keys.

Gobionellus hastatus Girard

Seventeen specimens, 47.5-164.4 mm., were taken. All came from the Cross Bayou station. They occurred during all months except June and September. Salinities varied from 3.7-20.4 o/oo and temperatures from 17.0-31.5 °C. during collections. No ripe individuals were noted.

Food of the bayou specimens consisted entirely of filamentous algae: *Enteromorpha.* Stomachs of specimens taken in the St. Lucie River contained ostracods, copepods, and insect larvae. A female, 64.2 mm., taken on September 30, 1957, from this locality appeared to be ripe.

Micro gobius gulosus (Girard)

Eighty-one specimens, 18.5-43.3 mm., were obtained at regular stations during all months of the study except April and June, 1958. Specimens were taken during these two months at other locations in the Tampa Bay area. Cross Bayou was the most frequent station at which this species was taken, but most of the specimens came from the Maximo Pt. station (November and December, 1958). No specimens were taken from the Gulf beach or either of the roller frame trawl stations in Boca Ciega Bay. The locality at which the species was found most abundantly, and from which the largest specimens were collected, was Mullet Key Bayou, Boca Ciega Bay. The species appears to prefer a muddy bottom, preferably with vegetation, in protected areas. Salinity does not appear to be a determining factor in distribution as specimens have been taken from fresh to full strength sea water; however, moderately high salinities (20-30 o/oo) seem to be characteristic of areas of greatest abundance (also Kilby, 1955).

Ripe individuals were noted during November, 1957, and July, 1958.

Stomach contents consisted of copepods, gammarids, other unidentifiable crustaceans, polychaetes, tiny bivalves, and algae.

Micro gobius thalassinus (Jordan and Gilbert)

Seven specimens, 20.6-27.5 mm., were taken at regular stations during October-December, 1958. Six of the specimens were taken in three collections in the bayou (13.7-20.4 o/oo, 21.1-26.8 °C.), and a single specimen was taken on December 2 at Maximo Pt. (33.0 o/oo, 21.2-23.5 °C.). These are the first records of this species for the Florida Gulf coast south of the Panhandle.

Micro gobius carri Fowler

Eight specimens, 20.2-35.8 mm., were collected offshore at depths ranging from 35-40 feet. The species is comparatively common. It is the only freeswimming goby known from this area. It occurs in schools which swim from one to two feet off the bottom. They occur over a sandy bottom a few feet to several yards off the rocky reefs and superficially look like *Gambusia* while swimming. When the rotenone cloud disappears, most of the specimens have also disappeared; they were probably carried off by the ever present currents. A specimen 53 mm. long was collected by R. Forsyth off Venice as the result of seismographic operations. He stated that several others were present.

This species has not been reported since its original description from a single specimen, 66 mm., by Fowler (1945) from Sanibel. The following is a description of life coloration of a 35.0 mm. specimen:

Anterior portion of side white to pearl. Pale yellow bands on head separated by a thin line of pearl. This line of pearl above the eye extends to the dorsal caudal fin base. A similar line of pearl from ventral caudal base to axil of pectoral. Opercle with irridescent blotch. An irridescent vertical stripe on pectoral base. First dorsal fin clear. Second dorsal faintly rust orange. Anal fin same color as second dorsal, but even fainter. Caudal fin yellow with irregular pale markings. Ventral fins clear. Venter and ventral head regions pale, unmarked. Specimens are perfectly pale and unmarked in alcohol.

Gobiosoma robustum Ginsburg

Although only 473 specimens, 13.7-37.9 mm., were collected, this is one of the commonest species on the grass flats. Considerable quantities of specimens were seen to escape through the mesh of the pushnet befor we could remove them. All except 17 specimens taken with the roller frame trawl were collected with the pushnet.

Of 37 regular collections 14 (every month but December, 1957) occurred at the Tampa Bay station; 13 (every month but October, 1957, and October, 1958) occurred at the Maximo Pt. station; 8 (December, 1957-April, 1958, June, September and December, 1958) occurred at the Old Tampa Bay station; and two (July and October, 1958) occurred at the Boca Ciega Bay roller frame trawl station. The comparative absence at this latter station is misleading as periodic pushnetting in the identical area covered by the roller frame trawl procured hundreds of specimens. No specimens were obtained from the bayou or Gulf beach stations. These absences are be-

lieved real as pushnetting over sand flats adjacent to grass beds at the Tampa Bay station did not elicit any specimens.

Ripe or near ripe specimens were obtained during November and December, 1957, and February, March, April, and May, 1958. Reid (1954) noted ripe fish during June and April at Cedar Key. The smallest specimens we took occurred during March and December, 1958.

Length-frequency distributions indicate a moderate rate of growth. Specimens averaged 18.5 mm. in October, 1957. This increased gradually until May, 1958, at which time they averaged 26.9 mm. After May there was a gradual decrease in average size. It is difficult to expain this as it is hard to conceive that a species which rarely exceeds 40 mm. migrates to any extent. The "V" pattern of growth exhibited in Table 18 is unlike that of larger species which have a "\" pattern of growth. It is quite possible that our data consists of more than one "year" class, but this would have no bearing on the "V" pattern.

Reid found two peaks of abundance, midwinter and midsummer. Our data does not support this finding. A single peak occurred during the spring of 1958. There was a possible peak during late fall of 1957, but this was not repeated in 1958.

Gobiosoma *robustum* prefers waters of moderately high salinities, usually between 22 and 32 o/oo, although it may rarely be taken in salinities as low as 7.0 and as high as 37.6 o/oo (Kilby, 1955).

Temperatures at times of collection ranged from 10.0-32.5 °C.

Table 18.
Length Frequency Distributions of Monthly Samples of *Gobiosoma* robustum.

Class mm.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
13.5						1									1
14.5		2		1							1				
15.5		1		1	1					1					2
16.5	1	5		3					1		2		1	2	2
17.5	3	5		1		3				1				2	7
18.5	2	9		1		1	2			3	1	2		4	
19.5	3	5	5	5	4	3	2		2	2	3	1			1
20.5	1	3	3	5	5	3	4	2	1	7	5			4	8
21.5		7	1	5	3	5				4		2		7	7
22.5		10	3	1	5	6	6	1	1	3	1	1		3	6
23.5		6		3	1	4	12	6	1	6	2			1	3
24.5		4	2	3	5	2	11	2	—	2		1		1	2
25.5		2		3		6	12	4	—	1	2	1			
26.5		1	2	2	2	4	6	6	2	5	2				—
27.5		1		3	1	2	12	2		1					
28.5						3	6	3							
29.5				1	2	1	3	3	2						
30.5			1	—			3		1						
31.5							3	2		1					
32.5				1				1							
33.5							1	1							
34.5								1							
35.5								1							
36.5															
37.5			1				1								
Total	10	61	18	39	29	44	87	35	11	37	20	8	2	24	39
Average (S.L. mm.)	18.5	20.6	21.1	22.1	22.7	23.1	25.5	26.9	24.0	22.5	20.0	21.5	17.0	20.4	20.2

Stomach contents consisted primarily of small crustaceans: copepods, isopods, gammarids, although tiny pelecypods and decapod shrimp occasionally occurred.

Gobiosoma bosci (Lacépède)

Twenty-two specimens, 10.1-29.5 mm., were obtained at regular stations. All but one, from the Tampa Bay station, were collected at Cross Bayou. The species is much more common than is indicated from this data. Numerous other specimens *were* collected at other localities in the Tampa Bay area. The nature of the local habitat, rocks and oyster bars, except for the one specimen mentioned above, makes collection difficult without the use of rotenone. The local habitat contrasts with that found by other workers (Gunter, 1945; Simmons, 1957; Hildebrand and Schroeder, 19280 who reported the species common in grassy areas. Joseph and Yerger (1956) took their specimens among sea squirts; Kilby (1954) obtained his from a marsh pool; and Hildebrand and Cable (1938) mentioned that they found the species in many habitats, but did not mention oyster bars or rocks.

Gunter found *G. bosci* most abundant in the fall and early winter and did not take any specimens in late winter or spring. Kilby took specimens during February, April, and July; Simmons found the species common all year; Hildebrand and Cable took no specimens from December-May. Our specimens were procured locally (all collections) during February, April, July, August, October, November, and December. The species is probably present all year, hut eludes collecting.

No ripe or spawning individuals were noted, but the presence of the 10.1 mm. specimen in the bayou on October 12, 1957, indicated spawning had occurred not long past. Hildebrand and Cable reported *Gobiosoma* (G. *bosci, G. ginsburgi)* of less than 10 mm. during the spring and summer and believed spawning to take place from May-September at Beaufort. Hildebrand and Schroeder believed spawning to take place from June-October in Chesapeake Bay.

This species prefers low salinities locally (0-24.8 o/oo). Most of the specimens were taken at salinities of less than 15 o/oo. This at various localities in the state. Gunter's spe- also seemed to be true of collections we made cimens were most abundant at salinities of 5-20 o/oo. However, all of Kilby's specimens were taken at salinities ranging from 20.8-26.1 o/oo, and Simmons obtained specimens in salinities as high as 45 o/oo.

We recorded the species only at fairly high temperatures 21.1-32.5 °C., which findings agree with Kilby's: 25-32 °C. Gunter, however, recorded the species at temperatures from 13-33.2 °C.

CALLIONYMIDAE
Callionymus calliurus
Eigenmann and Eigenmann

Two specimens, 19.5 mm. each, were collected on the rocky reefs offshore at depths of 39 and 40 feet during November and December, 1958. Dorsal counts of VI,4, anal counts of 4, and a preopercular spine ending in three upturned points in each specimen identifies both with *C. calliurus* only. These are the first records for the Gulf of Mexico north of Key West.

OPISTHOGNATHIDAE
Opisthognathus macrognathus Poey

Several specimens have been collected on the sandy bottom in the vicinity of the rocky reefs offshore at depths from 40 to 60 feet. It was at first believed that more than one species was included in the specimens collected, hut it was found that there is considerable variation in the proportionate size of the head and the eye, nature of the ocellus on the dorsal fin and the presence or absence of a black spot in the rictus. None of these characters were consistently correlated.

Reid (1954) has reported *O. maxillosus* from Cedar Key. I have examined his specimen and find it to be the same species as ours. *Opisthognathus maxillosus* remains unknown from the Gulf of Mexico north of Tortugas. Caldwell (1957A) has also reported *O. macrognathus* from the Cedar Key area.

BLENNIIDAE
Hypsoblennius hentzi (LeSueur)

Thirty-eight specimens, 15.0-68.8 mm., were collected at regular stations. Of these, 34

were obtained at the Tampa Bay station, two at the Maximo Pt. station, and one each at the roller frame trawl stations in Boca Ciega and Old Tampa Bays. Specimens were taken during the months of October and November, 1957, and July, August, October through December, 1958. Specimens were taken during June and September in non-regular collections. Reid (1954) took specimens only from September through December at Cedar Key. We and Joseph and Yerger (1956) found the species most common on the grass flats; Reid found it most common in areas where vegetation was not very abundant. Hildebrand and Cable (1938) reported that the summer habitat at Beaufort was in shallow grassy areas and the winter habitat in holes or channels.

Nothing is known of the breeding habits in the Gulf, but Hildebrand and Cable (op. cit.) found fry less than 5.0 mm. from May through September at Beaufort.

Salinities and temperatures at times of regular collections ranged from 23.6-35.0 0/00 and 20.5-32.5 °C. Reid reported collections in minimums of 17.5 o/oo and 10.0 C.

Stomachs examined contained plant matter, hydroids, gammarids, and annelids. Hildebrand and Schroeder (1928) suggested that the diet might include vegetable matter.

Chasmodes saburrae Jordan and Gilbert
Little Dogfish

Some 288 specimens, 15.1-60.5 mm., were collected at regular stations. Specimens were taken during all months of the study except December, 1957, but records including non-regular stations show collections during that month. The species was most abundant during the summer and least abundant during the winter. A large non-regular collection was made during late November, 1957, in north Old Tampa Bay (21.8 0/00, 21.5 °C.). The species was found only over grass beds and was primarily collected with push nets. Subjective observation indicated that it preferred the small Thalassia beds found interspersed among the more extensive Diplanthera beds. No specimens were found in the bayou or on the beach.

Temperatures and salinities at times of regular collections ranged from 22.0-35.0 o/oo and 16.0-32.5 °C. That the species is tolerant of lower salinities is indicated by collection of specimens from Whitewater Bay (Monroe Co.) made by the University of Miami Marine Laboratory: 5.5-8.0 o/oo, 32.2-32.4 °C. These specimens showed certain morphological differences from series of specimens collected from throughout the range of the species (Springer, 1959). It is conceivable that these characters were ecologically influenced. A specimen from the Crystal River area (9.6 o/oo, 22.7 °C.) did not show the same variation.

Little is known concerning breeding and growth in this species. Reid (1954) gave data which indicated a spring and early summer breeding period and also indicated an average length of about 60 mm. attained after the first year. We found ripe females in August and October.

Reid's comment that the species is apparently restricted to the Gulf coast has been revised by Springer (1959) to include the east coast of Florida from Volusia County south.

Food consisted mainly of gammarids with decapod shrimp, tanaidacean isopods, annelids, Battilaria, pelecypods, and fish embryos filling in to a lesser extent.

Examinations of the specimens listed as Hypsoblennius ionthas by Joseph and Yerger (1956) showed them to be young C. *saburrae.*

Hypleurochilus geminatus (Wood)

No specimens were taken in regular collections, but collections were made under the Pilot House dock on the bay side of Egmont Key on August 3, 1958, on the rocky reefs offshore at a depth of 39 feet on November 9, 1958, and at a depth of 55 feet on January 31, 1959.

Blennius marmoreus Poey

This is one of the more common forms found on the rocky reefs offshore. It was present in all rotenone collections made on the reefs. Specimens were also taken with Hypleurochilus geminatus (q. v.) in the collection made on Egmont Key.

CLINIDAE

Paraclinus marmoratus (Steindachner)

This species was reported by Springer (1954) from Tampa Bay and has not been reported since. Actually the specimens, which were collected by Dr. R. K. Strawn, came from the vicinity of Gandy Bridge in Old Tampa Bay. They were collected during February, 1951, and at that time, according to Strawn, were very abundant. The apparent disappearance of this form in our area points out similar situations on the Florida west coast.

Despite considerable collecting in the Cedar Key area by Reid (1954), Kilby (1956) and others in habitats where this species would be expected it has not been found in recent years. Springer (op. cit.) reported this species from Cedar Key based on specimens collected on November 21 and 27, 1901, and on deposit at the U. S. National Museum. Breder (1939, 1941) found the species common in the Charlotte Harbor area (lower west coast) in 1939 and 1941. Dr. Eugenie Clark, who has been in charge of the Cape Haze Marine Laboratory (in the area where Breder worked) for several years at the time of this writing (1959), has collected only one specimen in that area.

In December, 1957, we collected three specimens on the flats approximately one mile north of North Anclote Key. They were taken by pushnet in the company of P. fasciatus and were the only ones taken in over 30 collections made in that general area.

Brannerella sp.

Ten specimens were taken with rotenone on the rocky reefs offshore at depths from 39-60 feet in collections made each month from September 14, 1958-January 31, 1959. Their presence or absence during other months is not known. Joseph and Yerger (1956) reported a single specimen (as Malacoctenus culebrae) taken in Alligator Harbor during November, and Longley and Hildebrand (1941, as Starksia ocellata) reported this species from Tortugas. Briggs (1958, as Starksia ocellata) failed to note that this species occurs in the northeastern Gulf.

The correct name for this species, which is the common one of its genus on both coasts of Florida, is presently the subject of an investigation by the senior author.

Emblemaria atlantica Jordan and Evermann

This species was taken on the rocky reefs offshore during poison collections. Two specimens were taken at a depth of 60 feet on August 9, 1958, and a single specimen was taken at a depth of 55 feet on January 31, 1959.

Dr. J. Böhlke examined the first two specimens collected and confirmed our identification. In contrast to the 14 pectoral rays contained in the holotype the first two specimens have 13 rays in each pectoral and the third specimen has 12 rays in each pectoral (see Böhlke, 1957, for a discussion of the emblemaids).

Chaenopsis ocellata Poey

A single specimen was taken during a poison collection on the rocky reefs offshore at a depth of 40 feet on December 6, 1958. There are also two specimens in poor condition at the U. S. National Museum (134923) which were collected at Albatross station 2405 (28° 45' N., 85° 02' W., 26 fathoms) off Cedar Key. These are the first records of this species on the west coast of Florida, north of Tortugas.

BROTULIDAE

Dinematichthys cayorum (Evermann and Kendall)

Several specimens have been collected on the rocky reefs offshore. These represent the first records of this species in the Gulf north of Tortugas.

OPHIDIIDAE

Ophidion holbrooki (Putnam)

A single specimen taken by a bait fisherman in Boca Ciega Bay on December 5, 1958, is the only one seen by us from the Tampa Bay area. The fisherman claimed that the species was occasionally taken in his trawls.

STROMATEIDAE
Peprilus alepidotus (Linnaeus)

Jordan (1885) reported this species from off Egmont Key. It has not been seen or taken by us.

SPHYRAENIDAE
Sphyraena barracuda (Walbaum)
Barracuda

This species is very common throughout the Tampa Bay area. Although no specimens were taken at regular stations a number of specimens, 203-336 mm., were taken at O'Neill's Marina just north of the Maximo Pt. station. They were swimming sluggishly in the basin after a cold wave on December 13, 1957. I (Springer) have been swimming with an aqualung amidst many hundreds of large adults. The species is less wary than many fishes, but at no time was I threatened.

*Sphyraena borealis (*DeKay)
Senet

Thirty-four specimens, 79.8-106.5 mm., were collected at a poison station on the Bay side of Egmont Key on August 3, 1958. Five stomachs were examined and found to contain fishes. The identification was verified by Dr. Donald P. deSylva.

MUGILIDAE
Mugil cephalus (Linnaeus)
Black Mullet, Mullet

Black mullet are found in all habitats during all times of the year in the Tampa Bay area. Neither salinity nor temperature appear to limit the distribution of adults or young in our area as both were seen or obtained in salinities of 0-35 o/oo and in temperatures of 10.7-32.5 °C.

Kilby (1948, 1955) believed that spawning occurred from October-May at Cedar Key, and from December-July at Bayport. Gunter (1945) believed that the spawning period occurred from October-December on the Texas coast. Arnold and Thompson (1958) reported spawning *Mugil cephalus* on December 11, 1956 about 40-50 miles southeast of the Mississippi River Delta. We believe that Gunter's dates are probably representative of the spawning months in the Gulf. It is our opinion that Kilby's (1948) data does not present evidence of a spawning period later than November. His smallest size class (16 mm.) does not occur after October, and his next class (17 mm.) does not occur after November. Small individuals (18-19 mm.) in his and our data after November seem more plausibly attributed to stunting or arrivals of individuals spawned in other areas. Commercial fishermen have told us that the mullet are finished spawning by January, at which time the fish become emaciated.

Anderson (1958) found that spawning occurred from October through February with a December peak on the south Atlantic coast of the United States.

An interesting observation on the spawning migrations of mullet in Tampa Bay has been furnished us by a local commercial fisherman, Mr. Myron Ayesworth, who said that it was common knowledge among mullet fishermen. He stated that the mullet begin migrating along the north shore in the fall, particularly during northwesterly winds. This means that the fish are in the protected waters at the time of migration. He further stated that the mullet will cross Tampa Bay from eastern Tampa Bay in order to follow the protected shoreline during this period. When reaching the Gulf, the schools always turn north. Commercial fishermen utilize this knowledge to increase catches during the fall.

Of 1,279 specimens (17.3-238 mm.) collected, only six were over 115 mm. in length, and most were under 100 mm. Kilby believed that the species migrated into deeper water at a length of between 60-100 mm. Although this is true to some extent, we found mullet difficult to capture once they reached about 80 mm. The absence of the larger specimens from our studies is more likely due to selectivity of the gear. No specimens were caught in roller frame trawls, which are very inefficient for pelagic species. Only a few specimens were obtained with pushnets as even very small mullet can avoid a pushnet.

Growth of the "0" year class is evident in the graph (Figure 17). Populations averaging about 24 mm. in January increased gradually

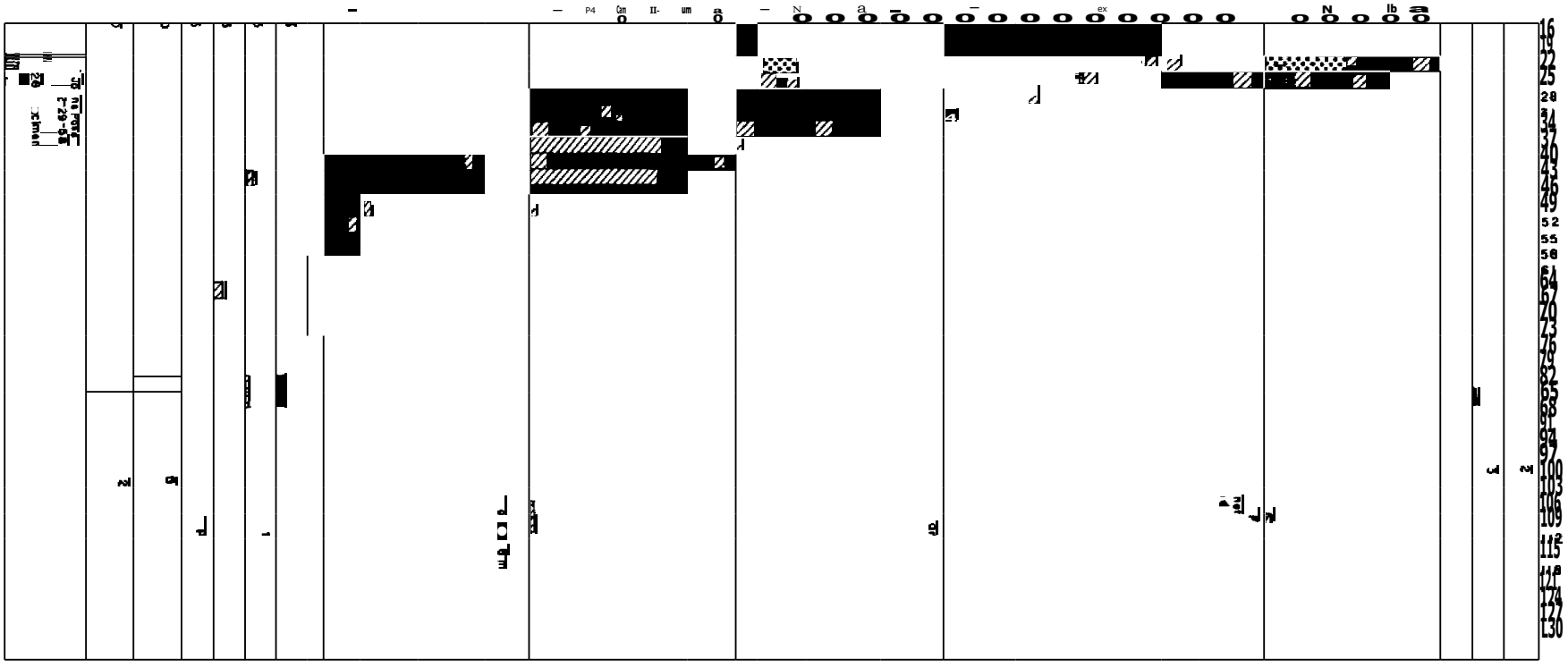

Figure 17. Monthly length-frequency distributions of *Mugil Cephalus.*

Because of mechanical difficulties in the printing process, the following histograms should be altered to read as follows:

February-25 mm. column—in the middle of the histogram there should he vertically lined and checkered sections to indicate one specimen each.

August—all histograms should be horizontally lined.

September—the histograms should read from left to right : horizontally lined, solid black, horizontally lined, half solid black and half horizontally lined, and horizontally lined.

December 1958--all of the five small histograms should be horizontally lined.

to about 45 mm. in May and then abruptly increased to about 65 mm. in June. After June insufficient specimens were available from which to draw conclusions. Our growth data are roughly comparable to those found by Kilby, who reported greatest, rather than average, size attained. His monthly curves appear to be less consistent than ours in moving to the right. Anderson *(op. cit.)* has summarized growth rates from the literature and included data from the Georgia coast. His growth rates appear to be slower than ours, but it is difficult to obtain an accurate comparison as he reported only ranges for particular months, and these included data for several years.

A sample of 219 *M. cephalus* of the "0" year class taken in the St. Lucie River estuary, east coast of Florida, March 25, 1958, averaged 27.8 mm., while the sample of 152 specimens from Cross Bayou on March 15, 1958, averaged 31.3 mm. This may indicate a faster growth rate or earlier spawning for the west coast populations.

Other conclusions may be drawn from the graph. Young do not remain in the Gulf beach habitat beyond March (except for a single specimen in May). It appears that the young prefer protected bodies of water. Growth is not evident for the first few months at the Tampa Bay station, but it is noticeable in April, May, and June. The bimodality of both abundance and size in April, and the subsequent increase in number and size at the Tampa Bay station (and decrease in numbers in the bayou) probably indicate an outflow of the population from the less saline bayou into the more saline bay. Salinities and temperatures were fairly constant at each of the two stations during April and May, and there is no information available which might explain this migration.

Dr. John D. Kilby demonstrated for us the characters used in separating the young of the three species of mullet collected in our area.

Mugil trichodon (Poey)
Silver Mullet, Mullet

Contrary to general opinion among biologists, *Mugil trichodon* rather than *M. curema* appears to be the common silver mullet on the west coast of Florida, with the possible exception of the Panhandle. Our conclusions are based on collections from Sarasota Bay north to Honeymoon Island. The few specimens of silver mullet in museum collections from the Panhandle which were examined were all M. *curema.*

We collected 144 specimens of *M. trichodon* from regular stations. The first collection, 77-213 mm., was taken in Cross Bayou on December 13, 1957 (15.8 o/oo, 13.0 °C.) after the cold wave of the previous evening. The mullet were swimming sluggishly and were easily taken by hand. The next collection, 8.9-22.4 mm., occurred at the Tampa Bay station on June 6, 1958 (24.3 0/00, 31.5-32.5 °C.). Young specimens, less than 15 mm., were present at Johns Pass during late May, 1959. A single specimen, 23.0 mm., was taken on June 17 from the Bayou (29.8 o/oo, 30.5-31.0 °C.). A collection, 13.7-18.2 mm., was made at Bella Vista Beach (habitat similar to our Gulf beach station, but a few miles north) on June 17, 1958, by Dr. Paul Wallace. These data suggest that spawning was probably taking place, and may have started in May. Indications are that the three species of mullet in our area have different spawning periods. *Mugil cephalus* spawns earliest, then M. *curema* follows three or four months later, and finally *M. trichodon,* which follows *M. curema* by no more than a month.

Specimens, 17.9-30.0 mm., were taken at the Gulf beach station on July 8 (25.5 o/oo, 30.3-32.4 °C.). Others, 23.1-60.2 mm., were taken at the same station on August 4 (24.8 o/oo, 31-32.5 °C.). After this date no other specimens were obtained at regular stations. A collection, 59.2-89.1 mm., was seined on a sandbar about one-quarter mile northwest of Honeymoon Island on September 16, 1958 (34.6 o/oo, 29-33 °C.). Although only 80 specimens were procured large schools consisting of thousands of individuals of this species were seen.

Mugil curema Valenciennes

Only 40 specimens, 22.9-44.4 mm., were collected. These came from Cross Bayou in June, July, and December, 1958, and from the

Tampa Bay station in June and July, 1958. Salinities and temperatures varied from 13.7-29.8 o/oo and 21.1-31.5 °C. Young, less than 30 mm., were present at Johns Pass in late May, 1959.

It is interesting that no large M. *curema* were obtained or seen in the Tampa Bay area. Kilby (1955) obtained none larger than 65 mm. from Bayport or Cedar Key, and he obtained only 61 specimens from the two localities. Gunter (1945) took only one adult at Port Aransas, and (personal communication, 1959) informed us that in ten years at Port Aransas he took only five adults and saw only one school of them, comprised of perhaps several thousand individuals. Mefford's (1955) findings indicated that adults are common on the southern coast of Florida where a fishery for the species exists. Despite its uncommoness in the northern Gulf, M. *curema* appears to be the only silver mullet found in any quantity in that area, and it is probably there primarily as a stray.

Mefford *(op. cit.)* stated that the peak spawning period of M. *curema* in south Florida is April-June.

ATHERINIDAE

Membras sp.

Hardhead, Glass Minnow

Only two specimens were taken during regular collections. Both came from the Gulf beach station: July 9 (33.3 o/oo, 28.0 °C.) and August 8 (33.7 o/oo, 30.7 °C.). Other specimens have been taken in Old Tampa Bay (June, 1958, and March, 1959) and under a night light at Johns Pass (February-May, 1959). The U. S. Fish and Wildlife M/V Bowers caught a large number off Johns Pass during January, 1959. The species does not appear to be as common inshore in our area as it is at Cedar Key and in Texas.

Dr. C. R. Robins has informed us that there are two species of *Membras* on the eastern coast of the United States. He stated that the two may occur together and that they vary geographically in the same characters. Of the two one has a larger *eye* and more obtuse snout. He has identified all our specimens as of this type. The correct specific name is still in doubt.

Atherinomorus stipes (Muller and Troschel)

This species was reported from Clearwater Harbor by Goode and Bean (1880 as *Atherina veliena).* It has not been reported since.

Menidia beryllina (Cope)

Hardhead, Glass Minnow

This is one of the commonest and most ubiquitous species in the Tampa Bay area. Only a few specimens were collected by means other than the seine. This accounts for its absence in collections from the regular Boca Ciega Bay stations.

Only a small percentage (1,876 specimens) of those specimens actually collected were returned to the laboratory. Specimens were taken during all months of the study from the bayou, from February-November at the Tampa Bay station and sporadically between December and June at the Gulf beach station.

Ripe specimens were taken during all months except January and August. Simmons (1957) found ripe specimens in all months in the Laguna Madre, Texas, though Gunter (1945) reported Texas specimens ripe only from February-August. Hildebrand and Schroeder (1928) found ripe specimens from April-September in Chesapeake Bay and believed that the species spawned more than once a year. Gunter gave evidence that two spawning peaks occurred, during spring (April) and fall (September-October). Our data (Figure 18) would tend to confirm Gunter's findings. For the period October, 1957, through April, 1958, two peaks are more or less discernible on the monthly graphs. These would correspond to the fall and spring spawned individuals of 1957. In the graph for May, 1958, a third peak becomes present indicating the spring spawning of 1958. There is no evidence, however, that a fall spawning occurred again in 1958.

It is puzzling that this species, which is ripe throughout the year in our area, should breed only during one or two comparatively short periods.

Growth is also indicated in Figure 18. By extrapolation it can be estimated that the species achieves a size of roughly 75-85 mm. after a year's growth. Probably very few specimens reach the age of two years.

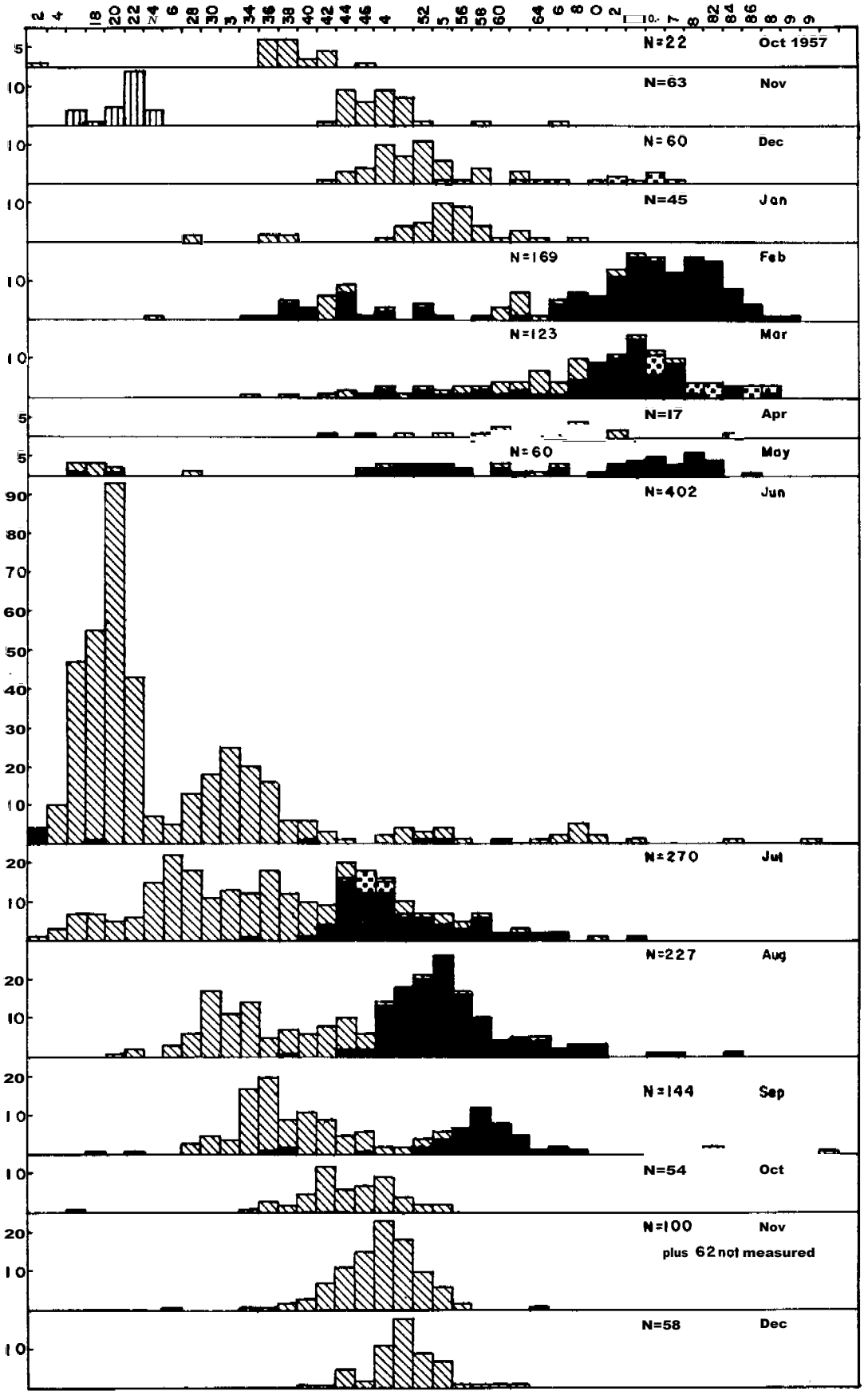

Figure 18. Monthly length-frequency distributions of *Menidia beryllina*.

Contrary to usual expectations, the southern populations seem to reach a larger size than the northern ones. Hildebrand and Schroeder stated that their largest specimens were 75 mm. (females; largest males: 70 mm.). Specimens of over 80 mm. are common locally, the largest taken was 95 mm. Kilby (1955) reported a specimen 99 mm. from Cedar Key.

The double peak in the smaller size range on the graph for June is difficult to explain. One possibility is that during this month only a ten foot common-sense minnow seine was used to augment collections made with the 50 foot bag seine. It is thus possible that one or the other of the peaks is disproportionately high and that the true mean lies further to the right. However, it can be seen that both of these peaks can be followed for the succeeding months when the smaller seine was not used. Also of interest here is the apparent migration of the larger members of the second peak from the bayou into Tampa Bay in July. In October they were subsequently lost. Indications from the latter months of 1957 are that they migrated into the Gulf. As the 1958 spring approached they returned to the bays (but apparently not to the bayou).

M. beryllina is euryhaline and is commonly taken in either fresh or full strength sea water. Gunter reported (and we concur) that the larger individuals preferred the saltier waters. Simmons *(op. cit.)* found the species in salinities up to 75 o/oo, and commonly in 45 o/oo. Temperature does not appear to be a limiting factor as individuals are found in shallow waters during all months of the year.

Small insects, crustaceans and tiny molluscs were the main items of the diet. Darnell (1959) has studied the food habits of silversides in some detail. He gave a list of stomach contents he found in Lake Pontchartrain specimens. Specimens, 40-54 mm., fed primarily on isopods, those 55-79 mm., on amphipods. The very young undoubtedly feed on copepods.

POLYNEMIDAE

Polydactylus octonemus (Girard)

A single specimen caught from the Johns Pass bridge during September, 1958, is the only one seen by us. In contrast to this Gunter (1938, 1945, 1959) took several thousand during his studies on the Texas and Louisiana coasts.

SCORPAENIDAE

Scorpaena brasiliensis Cuvier
Scorpionfish, Dogfish

Only four specimens were taken during regular collections. One, 60.0 mm., was taken at the roller frame trawl station in Boca Ciega Bay on October 16, 1957 (27.8 0/00, 25.5 °C.) and the other three, 66.5-78.2 mm., were taken at the same station on May 5, 1958 (28.5 o/oo, 27.5 °C.). Specimens, 28-54 mm., were taken offshore on the rocky reefs at depths of 35-38 feet during February, 1959.

A local marine collector (pushnetter) has described to me (Springer) his reaction to being stuck by the dorsal spines of this species. He stated that on each occasion that he was wounded he became "violently" ill, progressively worse each time. His physician informed him that any future wounds might be fatal. It would appear that this is a case of anaphylactic shock. 1 have been stuck by *S. plumieri* of the Texas coast on several occasions but never experienced painful consequences other than would be expected from the mechanical damage alone.

Scorpaena calcarata Goode and Bean

This species was described by Goode and Bean (1883) from a specimen taken in Clearwater harbor. It has not been recorded since.

Helicolenus dactylopterus maderensis
Goode and Bean

Ginsburg (1953) reported specimens off Egmont Key. No other specimens are known.

Setarches parmatus Goode

Ginsburg (1953) reported specimens off Egmont Key. No other specimens are known.

TRIGLIDAE

Prionotus scitulus latifrons Ginsburg
Sea Robin

Eighty specimens, 17.0-71.6 mm., were collected at regular stations. The majority of the

specimens came from the Tampa Bay station and were taken with a pushnet. No specimens were taken on the Gulf beach or in the bayou. Specimens were collected at regular stations during October and November, 1957, and January through July, November and December, 1958. Our records for the area, however, indicate that the species was missing from collections only during December, 1957, and August, 1958, during the study period. Reid (1954) collected specimens during all months at Cedar Key while Gunter (1945) took specimens only during August, and December through April in Texas. Hildebrand (1955) reported this species to be one of the commonest and most characteristic fishes on the pink shrimp grounds off Campeche, reporting it very abundant in February, but not nearly so abundant in July. In contrast, he (1954) took only one specimen on the brown shrimp grounds off the Texas coast (St. Joseph Island, December).

Salinities and temperatures at times of our regular collections ranged from 21.0-33.0 o/oo and 10.0-32.5 °C. Reid recorded the species in 17.5-31.5 o/oo and 11.8-30.6 °C., and Gunter (1945) recorded it in 25-30 o/oo and 13.8-30.3 °C.

Similar to the findings of Reid, the 13 stomachs (specimens 25.6-71.6 mm.) examined contained primarily crustaceans and secondarily annelids. Unlike him we found no peneid shrimp.

Prionotus tribulus crassiceps Ginsburg
Sea Robin

Only 21 specimens, all young 13.6-67.4 mm., were taken at regular stations. Sixteen of these came from the bayou, two each from the Tampa Bay and Boca Ciega Bay stations, and one from the Old Tampa Bay station. The concentration in the muddy bayou conforms to Reid's (1954) finding that this species was most common in channels. Our specimens were taken during October and November, 1957, and January, February, November and December, 1958. A specimen, 109 mm., was caught by a fisherman on May 15, 1958, at our Gulf beach station. Reid took specimens in all months except July and May, but 86.8 per cent of his specimens were taken from November through March. Gunter (1945) also found the species least abundant in the summer but, unlike ourselves, took no specimens in the bays during winter. Kilby (1956) took specimens in the marsh areas at Cedar Key only during February, October, and November.

The appearance of young during the late fall and winter accords with Hildebrand's (1954) finding of a nearly ripe female during August on the Obregon shrimp grounds. Hildebrand noted that the species occurred only rarely at depths greater than 12 fathoms and not at all at depths over 23 fathoms.

Salinities and temperatures at times of regular collections (including the May, 1958, specimen) ranged from 11.4-33.2 o/oo and 11.2-26.8 °C. Gunter's ranges were 10.2-37.2 0/00 and 13.7-29.5 C.

Prionotus roseus Jordan and Evermann

This species was described by Jordan and Evermann (1887) from the "spewings" of a red grouper taken off Tampa Bay. It has been reported on two other occasions from our area: Clearwater Harbor (Goode and Bean, 1880); Tampa Bay (Evermann and Kendall, 1900).

BATRACHOIDIDAE
Opsanus beta (Goode and Bean)
Toadfish, Dogfish

One hundred ninety-one specimens, 20.8-300 mm., were collected at regular stations. Specimens were taken during every month of the regular collecting period and the species was recorded from all the stations except the Gulf beach. It was found most frequently at the Maximo Point station. It was found only occasionally at the Tampa Bay station. The greatest concentration of specimens (22) occurred during June; secondary concentrations occurred during May, July, and October (11, 14, 11 specimens respectively). Reid (1954) reported the greatest abundance at Cedar Key from June through September. Joseph and Yerger (1958) reported a collection of 28 *specimens* averaging 12 mm. during June at Alligator Harbor. The period of greatest abundance probably accords with the breeding season and the subsequent appear-

ance of the young. We obtained specimens of less than 30 mm. during November and December, 1957, and February, June, August, and October, 1958, which allowed for little interpretation of breeding season. I (Springer) have collected specimens in burrows (tin cans, concrete blocks, etc.) lined with their yellow eggs during June on the Texas coast.

The species always prefers a recess as a niche. It leaves this only upon severe provocation or forced removal. Specimens were taken in salinities ranging from 3.2-35.0 o/oo, but they were most frequently taken in salinities above 25 0/00. Simmons (1957) reported the species in salinities up to 45 o/oo. Temperatures at times of collection ranged from 11.2-32.5 C. The species is exposed for many hours without harm during periods of extreme low tides when its refusal to leave its tin can or other hiding place causes it to be stranded. Specimens returned to the laboratory alive and allowed to remain unimmersed overnight are still capable of a vicious snap in the morning.

Opsanus beta in our area is strictly an inshore form restricted to the shores of the mainland and the adjacent islands. As soon as one leaves the mainland 0. beta is replaced by 0. pardus (q.v.). Although the two species are very similar morphologically and occupy similar niches they are never taken together nor is one found in the habitat type of the other.

Decapod crustaceans and gastropods comprised the major portion of the diet. One specimen, 109 mm., had eaten one of its own species, 42 mm.

Opsanus pardus (Goode and Bean)
Toadfish, Dogfish

This is a moderately common species on the rocky reefs offshore. It was never killed by rotenone (at least during a maximum period of two hours after the rotenone was released). Numerous specimens were killed as a result of seismographic operations. A photograph taken by Dr. R. F. Hutton of a stretch of beach on Longboat Key, Sarasota Co., littered with fishes killed by the red tide during the summer of 1954 shows this species to be the most abundant by volume (17 specimens were strewn across about 15 feet of beach. According to Dr. Hutton this was a typical segment). Specimens were obtained by forcing the fish out of its hole into a dipnet.

Porichthys porosissimus (Cuvier)
Midshipman

Two specimens, 16 and 25 mm., poisoned offshore at a depth of 39 feet on November 9, 1958, are the only specimens we know of from the Tampa Bay area. Photophores were already developed in the smaller specimen. The species is frequently taken off Anclote Key, Pasco Co., by shrimpers. Springer (1957) has discussed this species on the Texas coast with special reference to its bioluminescence. Shoemaker (1957) has done the same for the Mississippi. He maintained specimens at a salinity of 16.9 o/oo. Gunter (1945) collected four specimens on the Texas coast in temperatures from 15.9-28.0 °C. and salinities of 11.6-19.5 o/oo. Hildebrand (1954) found this species particularly abundant on the Obregon shrimp grounds in the Gulf of Campeche.

GOBIESOCIDAE

Gobiesox strumosus Cope

Twenty-six specimens, 8.5-33.2 mm., were taken at regular stations, 25 from the Tampa Bay station and one from the Maximo Pt. station. None of these were taken with regular collecting equipment. They were obtained by poisoning rocks or by emptying the contents of cans, bottles, or rubber tires into a net. The species is strictly a shallow water inshore form. Specimens were taken in the Tampa Bay area during all times of the year. Specimens 8.5 mm. were taken in April and June probably indicating a spring and summer spawning period. The species is frequently left trapped in its abode at low tide. One specimen, which was lost, but measured about 10 mm., was obtained from a rock in a tide pool where the salinity was 27.2 0/00 and the temperature 37.0 °C. The salinities recorded for the species ranged from 21.2-33.8 o/oo. The lowest temperature recorded was 15.0 °C. but it undoubtedly survives much lower temperatures.

BOTH1DAE

Etropus crossotus atlanticus (Parr)

A single specimen, 85.0 mm., was taken on November 7, 1958, at the Gulf beach station (33.6 o/oo, 23.2 °C.). A second specimen, 21.8 mm., was taken by Dr. Paul Wallace at Bella Vista Beach on June 16, 1958. This locale is similar to that of the Gulf beach station. The species appears to be much less common locally than at Cedar Key or along the Florida Panhandle where specimens are commonly reported.

Ancylopsetta quadrocellata Gill

Two specimens, 73.2 and 100.0 mm., were taken during April (31.3 0/00 and 22.0 °C.) and May (30.1 o/oo and 27.7 °C.) respectively, at the roller frame trawl station in Boca Ciega Bay.

Citharichthys macrops Dresel

This species was reported from Egmont Key by Henshall (1891) and has not been reported from the Tampa Bay area since.

Paralichthys lethostigma Jordan and Gilbert

This species was reported from Tampa by Henshall (1895), and verified by Ginsburg (1952B). No other specimens than Henshall's are known; this in contrast to Ginsburg's statement that the species is common or abundant throughout its range.

Paralichthys squamilentus Jordan and Gilbert

This species was reported from Egmont Key by Henshall (1891) and has not been reported from the Tampa Bay area since.

Paralichthys albigutta Jordan and Gilbert
Flounder

A total of 121 specimens, 11.6-194.0 mm., were taken at regular stations. They were collected during all months of the year except October. The specimens were found in all types of habitats although only two, 136 and 163 mm., were taken in the bayou (December, 1958; 13.7-14.6 o/oo and 21.1-22.3 °C.). Specimens taken while pushnetting or seining over grass beds appear to have actually been picked up from sandy areas which punctuate the grass flats.

Young specimens were first collected during January. Specimens less than 20 mm. were taken through April. Ginsburg (1952B) and Reid (1954) believed that spawning took place during late fall or winter. Our data support this opinion. Ginsburg believed that spawning occurred offshore.

Too few specimens were obtained to give information on growth, but our specimens averaged much smaller during the months of February-May than did Reid's. Reid's specimens averaged roughly 70 mm. in May while ours averaged only 44.6 mm. (N:.=20).

Salinities and temperatures at times of collection ranged from 13.7-33.7 o/oo and 11.2-32.5 °C. Very few specimens came from salinities under 20 o/oo. Gunter (1945) obtained a specimen at a salinity of 9.6 o/oo and Simmons (1957) stated that this species was sharply limited by 45 0/00, but that a few specimens were taken at 60 0/00. Reid obtained specimens at temperatures as low as 8.3 °C.

Reid reported that the young fed primarily on small crustaceans and that specimens over 45 mm. begin to feed on fish. Of six stomachs of fishes under 45 mm. taken in our collections four contained crustaceans, one contained a small fish, and one was empty. Of 16 stomachs examined from fishes over 45 mm. six contained fishes, five contained crustaceans, and five were empty. All the stomachs of specimens over 100 mm. contained only fish or were empty.

SOLEIDAE

Achirus lineatus (Linnaeus)
Flounder

Ninety-one specimens, 12.6-68.5 mm., were taken at regular stations during every month of the study. The only station not represented in collections of this species is the Gulf beach. The smallest specimens (under 14 mm.) were taken during October, January, and July. Kilby (1955) believed spawning took place in late summer or early fall. Reid (1954) believed it to take place a little later. Our data might support either of these findings.

Our specimens were taken in salinities and temperatures ranging from 4.0-34.6 o/oo and 11.2-32.4 °C. These correspond with the findings of other investigators, who like ourselves, found most of their specimens in salinities above 15 o/oo.

Food was found to consist of primarily polychaetes and gammarids.

Trinectes maculatus fasciatus (Lacépède)
Flounder

Only five specimens, 53.5-125.1 mm., were collected at regular stations. The two smallest specimens came from the bayou during February and May (6.6-18.7 o/oo; 19.9-27.5 °C.); the two intermediate sized specimens (60.7-70.0 mm.) were taken in Old Tampa Bay during April (19.1 o/oo; 24.0 °C.), and the largest specimen was taken during August in Boca Ciega Bay (32.0 o/oo; 29.1 °C.) thus giving some evidence that the larger specimens are in the saltier water.

CYNOGLOSSIDAE
Symphurus plagiusa (Linnaeus)
Flounder

Some 179 specimens, 18.7-118.5 mm., were collected at regular stations. They were taken during all months of the study except September, 1958, and they occurred at all stations except the Gulf beach. As has been indicated by Reid (1954), the species prefers a sandy or muddy bottom. In contrast to Gunter (1945) who stated that the species definitely preferred waters of high salinity (90.6 per cent of his specimens came from waters over 30 o/oo) we took 27 specimens (15 per cent), 23.7-92.0 mm., in the bayou at salinities of 5.0-20.4 0/00. Gunter's equipment was probably more effective for larger specimens. He has demonstrated that the larger individuals of marine species are found in the saltier waters.

Hildebrand and Cable (1930) ascertained that spawning took place offshore at Beaufort during the months of May through October. Our data are not conclusive, but our smallest specimen was taken during October. No information is available on growth rate, but indications of our data are in accord with the statement of Hildebrand and Cable that it is probably slow.

Specimens were obtained in regular collections in salinities and temperatures ranging from 5.0-33.0 o/oo and 14.5-32.5 °C. We took specimens in the St. Lucie river at a salinity of 1.6 o/oo. Simmons (1957) noted that the species did not tolerate a salinity much above 35 o/oo. Gunter reported the species in 36.7 o/oo. During February, 1958, we recorded a temperature of 11 °C. in Old Tampa Bay at the time of collection (not regular).

Food consisted almost entirely of copepods and polychaetes.

ECHENEIDAE
Echeneis naucrates Linnaeus
Shark Sucker

A single specimen, 80.9 mm., was taken at the Gulf beach station during September. It had been attached to a needlefish. Others have been taken offshore.

BALISTIDAE
Balistes capriscus Gmelin
Triggerfish

Several specimens were seen on the rocky reefs offshore during June and July, 1958. They were not seen during the winter months.

ALUTERIDAE
Ste phanolepis his pidus (Linnaeus)
Filefish, Foolfish, Triggerfish

Some 125 specimens, 15.5-98.0 mm., were taken during regular collections. Specimens were taken during every month of study except May, 1958. Only one specimen was taken at the Gulf beach station (November, 1957, 18.2 mm.) and at the Old Tampa Bay station (July, 1958, 27.7 mm.). The Boca Ciega Bay roller frame trawl stations were represented every month the species was taken. The Boca Ciega Bay pushnet station and the Tampa Bay station were represented sporadically. No specimens were taken in the bayou.

Specimens 7.5-22.5 mm. were taken at Bella Vista Beach on June 16-17, 1957, by Dr. Paul Wallace. Large numbers of specimens esti-

mated at less than 10 mm. were taken from floating *Sargassum* several miles out in the Gulf on February 14, 1959. The species appears to have a lengthy breeding season.

Salinities and temperatures at times of regular collections ranged from 24.3-34.0 0/00 and 10.0-31.5 °C.

The species has the same food habits as *Monacanthus ciliatus (q.v.)* with which it is frequently taken.

Monacanthus ciliatus (Mitchill)
Filefish, Foolfish, Triggerfish

Only 30 specimens, 16.9-68.0 mm., were collected at regular stations. These were all taken in Boca Ciega Bay. Specimens were collected at the pushnet station during November, 1957, and September through December, 1958. At the roller frame trawl station they were taken during October and November, 1957, and October through December, 1958. Indications arc that the species is offshore in the Gulf all year. Salinities and temperatures during regular collections ranged from 27.8-35.0 o/oo and 22.1-32.5 °C. A specimen was taken at a salinity of 23.9 o/oo off the mouth of the Anclote River on December 18, 1958 (13.4 °C.). However, most of the specimens taken throughout the State occurred at salinities over 30 o/oo. On February 12, 1958, a specimen was taken one mile north of Anclote Key when the surface temperature was 11.0 °C.

Our findings of stomach contents (primarily copepods and molluscs) were essentially the same as Reid's (1954).

Investigators trying to distinguish this species from *Stephanolepsis his pidus* for the first time are known to have difficulty. The two species are easily separated when both are available for comparison. The following information may be of assistance to those unfamiliar with the two species. The presence of small spines on the caudal peduncle of small specimens of M. *ciliatus* is not always constant (sexual differences in the nature of the spines when present in adults are not constant either). The dorsal outline of the predorsal region when viewed laterally is concave in *M. ciliatus* and straight in S. *hispidus*. Total rays in both pectorals range from 19-25 with a modal value of about 50 percent at 22 in *M. ciliatus;* they range from 23-29 with a modal value of about 50 percent at 26 in *S. his pidus*.

Alutera schoepfi (Walbaum)
Foolfish, Unicornfish

Only four specimens, 52.4-280 mm., were taken at regular stations. These were taken at the Boca Ciega Bay roller frame trawl station during July, August, and November, 1958. Dr. Paul Wallace obtained two specimens, 15.0 and 27.6 mm., on June 16, 1957, at Bella Vista Beach. Others were seen in the area during most of the months of the year. These were primarily adults floating head down at the surface offshore in the Gulf. One specimen was seen lying on its side among some rocks at a depth of 38 feet. A close approach was made before the specimen swam away.

We took no specimens at a salinity of less than 31 o/oo, but Reid (1954) collected some at salinities as low as 15.4 o/oo. Reid recorded specimens at 15.5-32.2 °C. which figures exceed both our upper and lower records, (23.6 -30.2 °C.).

OSTRACIIDAE
Acanthostracion tricornis (Linnaeus)
Cowfish

Seventy-one specimens of cowfish, 5.1-176.5 mm., were taken at regular stations. They were taken during all months of the study except February, 1958, and were about equally distributed among the Tampa Bay, Boca Ciega Bay, and Old Tampa Bay stations. None were taken in the bayou or on the Gulf beach. The species is restricted to grassy areas of moderately high salinities while residing inshore. Salinities and temperatures at times of collection ranged from 21.0-35.0 o/oo and 13.4-32.5 'C. Reid (1954) reported the species from a salinity as low as 15.4 o/oo and a temperature of 10 °C.

The species probably breeds during the summer months. Young, 5.1-11.2 mm., were collected from June through September. The place of spawning has not been reported, but it seems probable that it occurs in the bays or in the Gulf only a short distance from shore.

Hildebrand (1955) reported the *species* common during the winter months at depths to 16 fathoms in the Gulf of Campeche.

Lactophrys trigonus (Linnaeus)
Trunkfish

Two specimens have been brought to us by bait shrimpers who collected them in Boca Ciega Bay during the winter of 1958-59. They stated that the species is uncommon in their catches.

TETRAODONTIDAE
Sphoeroides nephelus (Goode and Bean)
Puffer, Swellfish, Blowfish

Sixty-one young specimens, 11.6-56.5 mm., were collected at regular stations from November, 1957-January, 1958, and May, June, July, November, and December, 1958. Seven of the 12 collections were from the Tampa Bay station. The species occurred in four collections made at Maximo Pt. and one at the Gulf beach station. Specimens less than 20 mm. in length occurred during November, December, January, May and June. A collection of 77 specimens (7.0-16.0 mm.) was made on June 16, 1958, by Dr. Paul Wallace, at Bella Vista Beach, a habitat similar to the Gulf beach station, but a few miles north. In contrast to these small specimens, sizes ranged from 19.4-56.5 mm. on June 6 at the Tampa Bay station.

Salinities and temperatures of regular collections ranged from 21.0-33.6 o/oo and 15.0-32.5 °C. Reid's (1954) collections (102 specimens 14-189 mm.) were taken during all months of the year and in all habitats. His salinities and temperatures ranged from 17.5-31.5 o/oo and 11.8-30.6 °C. Gunter (1945 as S. *marmoratus)* reported his specimens in salinities of 4.4-35.8 o/oo, but rarely below 10 o/oo, and in temperatures as low as 8.1 °C.

Sphoeroides spengleri (Bloch)

No specimens were taken in regular collections, but the species is occasionally seen over sandy bottoms offshore. Two specimens were speared by Dr. J. Randall at a depth of 35 feet on July 13, 1958, about nine miles offshore.

Sphoeroides dorsalis Longley

Seven specimens were obtained by the M/V Oregon at station 2168 (27° 48.5' N., 83° 28.5' W., west of St. Petersburg Beach) on April 18, 1958, at a depth of 19-20 fathoms.

Lagcocephalus laevigatus (Linnaeus)
Puffer, Blowfish

Two specimens, both spent females, (368 mm., March 8, 1958, and 328 mm., May 17, 1958) were caught by local fishermen off Pinellas Pt., Tampa Bay. The smaller specimen contained the remains of *Chilomycterus schoepfi.* A fishing camp operator informed us that *L. laevigatus* was a very common catch during World War II, but it has been rarely caught since then. In the St. Petersburg Times for January 8, 1949, and February 5 and 6, 1957, are photographs of specimens taken in Tampa Bay and also from 50 miles offshore. The earlier article stated that Tampa Bay was "flooded" with specimens nine years ago (1940).

DIODONTIDAE
Chilomycterus schoepfi (Walbaum)
Porcupinefish

Some 142 specimens, 15.0-220.0 mm., were collected at regular stations. Specimens were most frequently taken in the fall (Table 19) and at the roller frame trawl station in Boca Ciega Bay. They were taken least frequently during the winter and none were taken at the Gulf beach or the bayou stations. Gunter (1945) believed that the species was absent from the Gulf because of the absence of reef animals on which it feeds. Reid (1954) agreed with this conclusion. However, Springer and Bullis (1956) have listed this species from well offshore throughout the Gulf of Mexico in depths up to 50 fathoms, and also during all seasons of the year. Their trawls would not have caught specimens had these been in the vicinity of reef type habitats. We believe that this species does not normally prefer a sandy bottom. Those catches in the Gulf may have been the result of catches of individuals moving from the mainland bays to the reefs offshore (or vice versa). However, this species has not been seen on our offshore reefs.

The spawning area is not known, but we believe it to be offshore in the Gulf. A collection of very small individuals (estimated at less than 10 mm.) made during the spring of 1958 was shown to the senior author. These were taken on one of the Gulf beaches; complete data were unavailable. Reid's data indicated an early spring spawning, which he believed to be very short, followed by rapid growth.

Table 19 indicates the presence of two or three year classes and suggests that intensive collecting for this species would provide more definite growth data.

Specimens were collected in salinities and temperatures ranging from 21.0-35.0 o/oo and 14.5-32.5 °C. Very few specimens were taken at salinities of less than 25 o/oo which agrees with the findings of Gunter and Reid.

Food of 17 stomachs examined was not indicative of dependence on reef organisms. Contents of 13 included numerous free living molluscs: Cerithidae, Laevicardium mortoni, Olivella, Chione, and others unidentified. Barnacles were found in only five stomachs, and sundry other crustacea (crabs, gammarids, etc.) in six stomachs.

Diodon holacanthus Linnaeus
Porcupinefish

No specimens were taken at regular stations. A single specimen, 92 mm., taken on December 5, 1958, in the vicinity of Mullet Key by T. Stokell, a bait fisherman, was presented to us. He stated that the species was infrequently taken in the bays. Jordan (1885, as D. liturosus) reported this species from Egmont Key.

ANTENNARIDAE
Histrio histrio (Linnaeus)
Sargassumfish

We saw no specimens during the course of our study, but Dr. R. T. Kirk and Mr. John

Table 19.

Monthly Standard Length-Frequency Distributions of Chilomycterus schoepfi 1957-58, from the Tampa Bay Area.

Mid-Class mm.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
15										1	1	2			
25	—	—										1		2	
35	1									1	1	3			—
45	2			1		1					1			1	1
55	1	1									1	2	2	2	
65	7	2										5	1	7	1
75	6	6					1					2	2	3	2
85		3				2		1					2	5	
95		5				1		2				1	1	3	
105		1											1	1	
115	3														
125	1					1	1	1							
135		1				1		1		1			1		
145	3	1										1	1	1	1
155	1	1				2		1	1	1	1	1			3
165	1	2								2			1		
175	1							3							
185										1			1		
195															
205															
215		1													
225						1					1				
Total	27	24	0	1	0	10	2	9	1	8	6	18	13	25	8

Hurlbut both informed us that large numbers were carried into Johns Pass during a long period of prevailing south winds in 1957. The species is probably in the Tampa Bay area only as a stray.

Antennarius ocellatus (Bloch and Schneider)
Frogfish

Specimens are taken frequently by the charterboats offshore at depths at least up to 25 fathoms. A specimen poisoned on the rocky reefs offshore was taken at a depth of six fathoms on February 8, 1959. Mr. John Hurlbut gave us a specimen with a total length of about 350 mm. taken offshore during April, 1959, at a depth of 37 fathoms.

OGCOCEPHALIDAE
Ogcocephalus sp. (prob. *cubifrons)*
Batfish

Batfish (spp. ?) are occasionally caught both in the bays and offshore in the Gulf. At some time in the past, according to local fishermen, they were quite commonly caught. Henshall (1895) reported *Malthe (=Ogcocephalus) vespertilio* and *Malthe radiata* from Tampa. He separated the two on color and the length of the rostrum, both of which are quite variable in batfishes. To which species his specimens belong will have to be decided in the future. We believe that all the local specimens we saw belong to a single species which seems to differ from other species in having well-developed patches of cirri about the body. It conforms most closely with the *O. cubifrons* of Longley and Hildebrand (1941).

POPULATION STRUCTURE AND RELATIVE ABUNDANCE

Table 20 is an attempt to show the species structure of each of the habitats under consideration. Habitats and stations are considered synonymous although this is not strictly true, i.e. the shore and offshore stations in Boca Ciega Bay have been combined. Also the Table includes not only regular station data, but all observations made during the period covered (September, 1957, through June, 1959). With regard to abundance the interpretation is subjective. Actually a species might have been common but escaped our attention. Many of the 44 species known from the area for which we obtained no records during the period covered were probably present and quite probably common in some instances. Certainly there must be a large number of species not recorded from the area which are present. Berry (1958) has extracted from Briggs (1958) checklist of Florida fishes the fact that there are about 550 species recorded from west Florida. Of these, 135 have not been reported north of the Florida Keys. The ranges of several of these are extended northward in our paper. It seems only plausible that many more species will be ultimately added to the list of Tampa Bay area fishes. We also feel certain that percentages of overlap (in the second chart at the end of the Table) will increase; for instance: *Menticirrhus americanus* will almost certainly be taken in Old Tampa Bay. Also, most of the fishes taken in Boca Ciega Bay will eventually be taken in the Gulf at Johns Pass. On the other hand species which were common during the period covered by our observation may become scarce in other years, or vice versa. *Strongylura raphidoma* became very abundant after June, 1959, whereas John Hurlbut, commercial aquarium operator, never recalled seeing more than one or two a year in years of close association with the fishes of the area.

Table 20 is misleading in that we were unable to add the seasonal parameter to the indications of abundance. In some instances this problem is satisfied in the discussions under the particular species and the accompanying graphs. Abundance here is in terms of number. If biomass were to be used, entirely different interpretations would be evinced. As we have less information on this subject, we do not feel competent to make estimates.

It is academic whether or not Johns Pass is considered as Gulf of Mexico or Boca Ciega Bay. Records from this locality have been included under both habitat numbers (2 and 4). For this reason there is considerable overlap between the species recorded from these areas.

Table 20.

Distribution and Relative Abundance of the Species

Records refer only to species collected or observed for the period of September, 1957, through June, 1959. Data is included here which is not included in the body of the text.

1 = Gulf of Mexico, vicinity of the rocky reefs offshore.
2 = Gulf of Mexico, including Johns Pass (see 4), precise Gulf habitat unknown or not in region of reefs.
3 = Gulf of Mexico, Pass-a-Grille or Bella Vista Beaches.
4 Boca Ciega Bay including Johns Pass (marine species recorded from Cross Bayou Canal, but not collected in Boca Ciega Bay are considered to have passed through Boca Ciega Bay and are registered accordingly.)
5 = Tampa Bay (marine species recorded from Old Tampa Bay, but not collected in Tampa Bay are considered to have passed through Tampa Bay and are registered accordingly.)
6 = Old Tampa Bay.
7 = Cross Bayou Canal.
8 = Freshwater, Pinellas County (lower peninsular only.)
( ) = Uncommonly collected.
[= Very abundant.
A dash (—) in a column indicates no record for the period covered.

Habitat	1	2	3	4	5	6	7	8
Branchiostoma caribaeum	—				(x)			
Carcharias taurus	—	x	—	—	x	x		
Isurus oxyrinchus	—	—	—	—		—		
Ginglymostoma cirratum	x	x	—	x				
Rhincodon typus	—	—	—	—				
Galeocerdo cuvieri								
Negaprion brevirostris	—	—						
Carcharhinus acronotus		x						
Carcharhinus leucas		x		x	x			
Carcharhinus limbatus	x	x		x	x			
Sphyrna mokarran		x	—	—				
Sphyrna tiburo		x	—	x				
Pristis pectinatus	—	—	—	—	(x)	—		
Pristis perotteti	—							
Rhinobatos lentiginosus				—				
Narcine brasiliensis	—	—	—					
Dasyatis americana	—	—	—	—				
Dasyatis sabina	—	—		x	x	x	x	
Dasyatis sayi			(a)					
Gymnura micrura	x	a	—	x				
Aetobatis narinari		—	—	—	—	—		
Rhinoptera bonasus					[a]	x		—
Manta *birostris*		x		—	x	x		—
Lepisosteus osseus			—	—	x	—	—	—
Lepisosteus platyrhincus			—	—	—	—	—	x
Elops saurus		—	x	—	x	—	x	
Megalops atlantica	—	x	—	x	x	x	x	—
Albula vulpes		—	—	—	—	—	—	—
Brevoortia patronus	—	x	x	x	[x]	—	[x]	—
Brevoortia smithi						—	x	
Dorosoma petenense	—	—						x
Opisthonema oglinum		[x]	x	x	x	a	—	—
Etrumeus sadina	—	x		—	—	—	—	—
Harengula pensacolae	—	x	[x]	a	[a]	x	x	—
Sardinella anchovia	—	x	x	[x]		—	—	—
Anchoa hepsetus	—	x	x	x	x	x	a	—
Anchoa cubana	—	x	—	a	x	—	—	—
Anchoa mitchilli		[x]	x	[x]	[x]	x	x	a
Synodus foetens	—	—	x	x	x	x	(x)	—
Synodus intermedius	x	x	—	—	—			
Galeichthys fells	—	—	(x)		x	x	[a]	—
Bagre marinus			—	(x	x		(x)	—
Ictalurus nebulosus			—		x	—		x
Ictalurus natalis			—	—	—			

Table 20.—(Continued)

Habitat	1	2	3	4	5	6	7	
Notemigonus chrysoleucas	—	—	—	—	—	—	—	x
Anguilla rostrata	—	—	—	—	—	—	x	x
Gymnothorax saxicola	—	x	x	x	x	—	—	
Myrophis punctatus	—	x	x	x	[x]	x	x	
Ahlia egmontis	—	—	—	—	—	—	—	
Mystriophis intercinctus	—	(x)	—	(x)	—	—	—	
Mystriophis mordax		(x)		—	—	—	—	
Ophichthus gomesi		x	x	—	—	—	—	—
Bascanichthys teres		x		x	—	—	—	
Bascanichthys scuticaris		—		—			—	
Ablennes hians		—	—	—			—	
Strongylura notata	—	x	x	x	x		x	
Strongylura raphidoma	—	x	—	x	—			
Strongylura timucu		x	[x]	x	x	x	x	
Hyporhamphus unifasciatus		x		x	x	x	—	—
Cypselurus luetkeni		x	x	(x)	—	—	—	
Lucania parva		—	—	x	x	x	x	
Adinia xenica	—	—	—	(x)	—	—	x	
Fundulus grandis	—		—	x	x	x	[x]	
Fundulus con fluentus		—	—	—	—	—	x	x
Fundulus similis			—	[x]	[x]	x	x	
Fundulus seminolis		—	—	—	—	—		x
Fundulus chrysotus		—	—	—	—	—	—	x
Cyprinodon variegatus		—	—	x	x	x	[x]	
Floridichthys carpio			—	x	x	x		
Jordanella floridae	—		—	—				x
Gambusia affinis	—	—		—	x		(x)	[x]
Heterandria formosa	—		—	—	—	—	—	x
Mollienesia latipinna	—	—	—	x	x	—	[x]	x
Corythoichthys albirostris	—		—	—	—			—
Hippocampus hudsonius	—	x		x	x	x		
Hippocampus zosterae	—	—	—	x	x			
Syngnathus springeri		x	—		—			
Syngnathus elucens	—	—	(—)		—			
Syngnathus scovelli		—	(x)	[x]	[x]	x	(x)	
Syngnathus floridae		—	x	x	x	x	x	—
Syngnathus louisianae	—	—		x	x	x		—
Micrognathus crinigerus	—	—		(x)	(x)	(x)		—
Urophycis floridanus		x		x	x	x	(x)	
Regalecus glesne			—	—			—	
Holocentrus ascensionis	(x)				—	—		—
Centropristes melanus	(x)	( )		(x)				—
Centropristes ocyurus	x				—		—	
Serraniculus pumilio	x			—			—	
Diplectrum formosum	x	x	—	x	x	—	—	—
Serranellus subligarius	[x]	—	—	(x)	—	—	—	—
Epinephelus adscensionis	(x)		—	—	—	—	—	—
Epinephelus guttatus		—	—		—			
Epinephelus morio	[x]		—		—	—		—
Mycteroperca falcata	x	—	—		—	—		
Mycteroperca microlepis	[x]							
Mycteroperca venenosa	—	—		—	—			
Promicrops itajara	x	—	—		x	—		
Rypticus saponaceous	x		—	—		—		
Micropterus salmoides		—	—	—	—		(x)	x
Chaenobryttus gulosus			—		—	—	—	x
Lepomis microlophus	—		—		—	—		x
Lepomis macrochirus	—		—		—	—	( )	x
Apogon conklini	(x)			—				
Apogon aurolineatus	x		—			—		
Apogonichthys alutus	x	—			—	—		
Malacanthus plumieri		—	—		—		—	
Pomatomus *saltatrix*	—	x			x			
Rachycentron canadum	x		(x)	—	—	—	—	—
Seriola *zonata*	(x)	(x)		(x)	—	—	—	—
Seriola *rivoliana*		—						

Table 20.—(Continued)

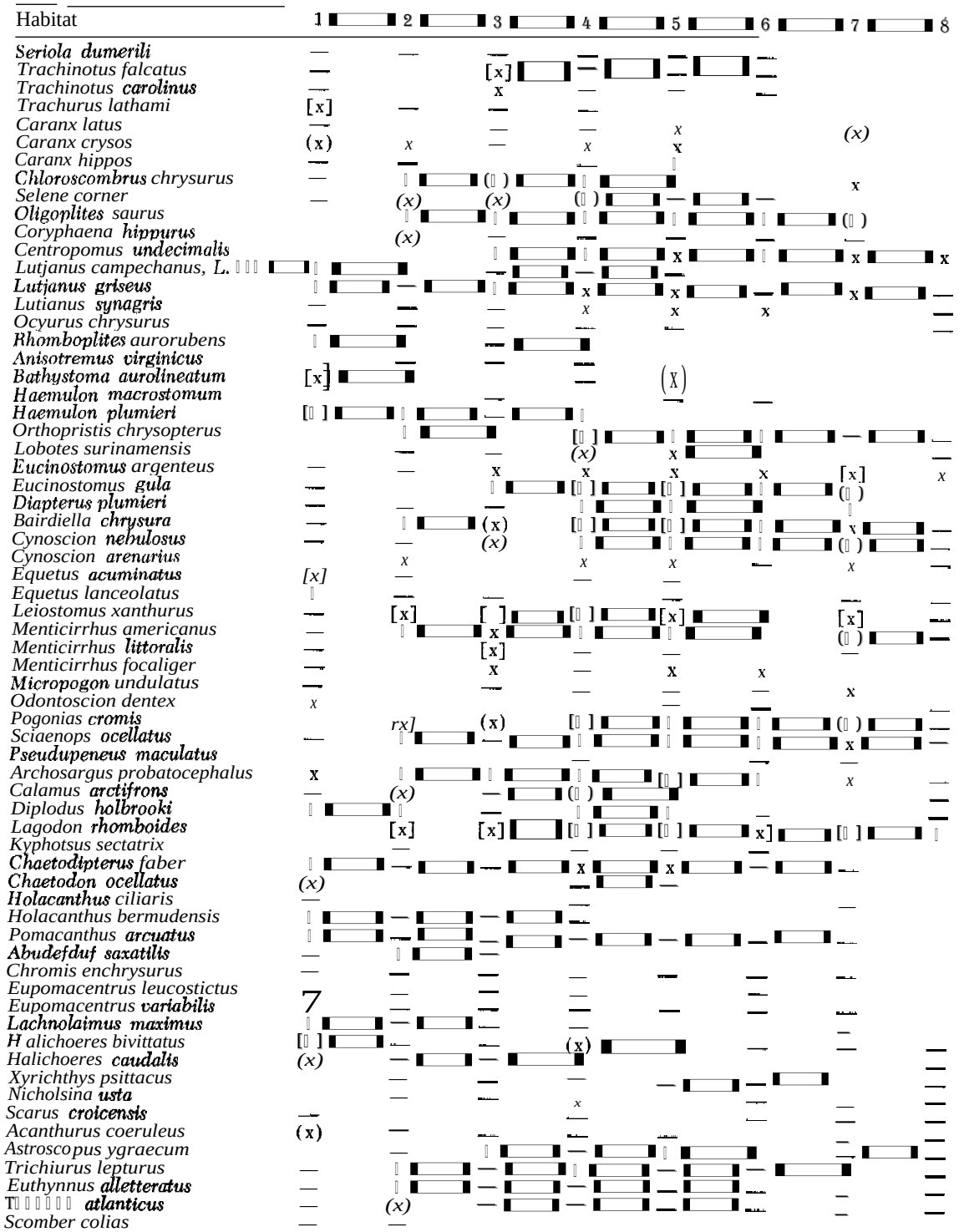

TABLE 20.—(CONTINUED)

Habitat	1	2	3	4	5	6	7	8
Scomberomorus maculatus		[x]	x		x	—	(x)	
Scomberomorus cavalla	(x)	[illegible]				—	—	
Luvaris imperialis			—	—	—	—		
Istiophorus albicans	—		—	—	—			
Dormitator maculatus	—	—	—	—	—	—		
Ioglossus calliurus		—	—					
Bathygobius soporator				x	x			
Coryphopterus sp.					—			
Garmannia macrodon				—	—			—
Gobionellus hastatus			—		—		x	—
Gobiosoma bosci			—		(x)		x	—
Gobiosoma robustum			—	[illegible]	[illegible]			
Microgobius carri								
Microgobius gulosus				x		x		
Microgobius thalassinus					—			
Callionymus calliurus	(x)				—			—
Opisthognathus macrognathus						—	—	
Blennius marmoreus	[x]							
Chasmodes saburrae						x	—	—
Hypleurochilus geminatus	(x)			—				
Hypsoblennius hentzi	—	—		x	x	x	—	
Chaenopsis ocellata	(x)	—						
Emblemaria atlantica	(x)	—						
Brannerella sp.								
Paraclinus marmoratus	—		—	—		—		
Dinematichthys cayorum		—	—		—	—		
Ophidion holbrooki		—	—	(x)		—		
Peprilus alepidotus			—	—				
Sphyraena barracuda	[x*]	—	—			—	—	
Sphyraena borealis			—	—	—			
Mugil curema		—	—	x		—		
Mugil cephalus		[x]		[illegible]	[x]	[illegible]	[illegible]	
Mugil trichodon								
Membras sp.		[illegible]	—	x	x	x		
Menidia beryllina	—	[illegible]			[x]		[illegible]	
Atherinomorus stipes								
Polydactylus octonemus	—	(x)	—	(x)				
Helicolenus dactylopterus	—			—			—	
Scorpaena calcarata				—			—	
Scorpaena brasiliensis	(x)	—	—	(x)		—	—	
Setarches parmatus		—	—	—		—		
Prionotus scitulus		—				x		
Prionotus roseus		—	—		—			
Prionotus tribulus		—	x					
Opsanus beta	—							
Opsanus pardus				—	—		—	
Porichthys porosissimus	(x)	—	—		—	—	—	
Gobiesox strumosus			—				—	
Ancylopsetta quadrocellata	—	—	—	(x)	—	—		
Citharichthys macrops	—			—				
Etropus crossotus	—		(x)	—	—			
Paralichthys albigutta		x				x	x	
Paralichthys lethostigma		—	—		—			
Paralichthys squamilentus	—			—	—		—	—
Achirus lineatus	—							
Trinectes maculatus	—		—		—		x	
Symphurus plagiusa		—	—	x	x	x		
Echeneis naucrates	x	x	x	x		—	—	
Balistes capriscus		—	—	—	—	—	—	
Alutera schoepfi	(x)				—			
Monacanthus ciliatus			—		—		—	—
Stephanolepis hispidus	—	[x]	(x)	[illegible]	x	(illegible)	—	—
Acanthostracion tricornis			—					—
Lactophrys trigonus			—	(x)	—	—	—	—
Lagocephalus laevigatus					x	—	—	—
Sphoeroides dorsalis					—	—	—	—

Table 20.- (Continued)

Habitat	1	2	3	4	5	7
Sphoeroides nephelus						
Sphoeroides spengleri	( )					
Chilomycterus schoepfi						
Diodon holacanthus				(x)		
Antennarius ocellatus						
Histrio histrio						
Ogcocephalus sp.						
Total number of species recorded during period covered: 205						
Total number of species recorded from area• 249						
Total number of species recorded for each habitat during period covered:	65	74	48	108	93	57 60 26
Number of species recorded only from particular habitat during period covered:	40	12	5	3	6	0 2 11

Number of species in common with other habitats:

Habitat	1	2	3	4	5	6	7	8
1		13	6	21	9	1	2	0
2			25	56	39	27	24	5
3				35	35	26	29	6
4					73	51	47	8
5						56	48	10
6							35	7
7								13

Percentage of species overlap between habitats (see discussion under Population Structure and Relative Abundance):

Habitat:	1	2	3	4	5	6	7	8
1	100	20.0	9.2	30.8	13.8	1.5	3.1	0.0
2	17.6	100	33.8	74.3	52.7	36.5	32.4	6.8
3	12.5	50.0	100	70.8	72.9	54.2	60.4	12.5
4	19.4	51.8	32.4	100	67.6	47.2	43.5	7.4
5	9.7	41.9	37.6	78.5	100	60.2	51.6	10.8
6	1.8	45.6	45.6	89.5	98.2	100	84.2	17.5
7	3.3	38.3	48.3	78.3	80.0	58.3	100	21.7
8	0.0	19.2	23.1	30.8	38.5	26.9	50.0	100

* Common in the vicinity of wrecks, but not particularly so near rocks.

At the end of Table 20 are summaries of various facts which are obtained from the Table. The two charts at the end of the Table are to be read similarly to the reading of mileage charts. In the last chart, read across the table to find the percentage of species found in the station listed in the far left vertical column which were also found in the station listed in the upper horizontal column. For example, 60.2 percent of the species found at station 5 (Tampa Bay) are also found at station 6 (Old Tampa Bay), and 98.2 percent of the species found at station 6 are also found at station 5. This indicates a relatively high exchange of species between habitats, with the additional indication that some factor limits a number of species from entering Old Tampa Bay from Tampa Bay. Station 6 and

station 1 (rocky reefs offshore in Gulf of Mexico) have a very small exchange of species.

The rocky reefs and freshwaters have the largest percentage of species not found elsewhere. Boca Ciega Bay has the largest number of recorded species, but only three were not taken at other habitats. This bay is probably an optimum habitat species-wise as it offers a wide variety of ecological niches. The fresh waters, which were poorly collected, contained the least number of species, but nevertheless are probably accurately described as species poor habitats. They offer comparatively few niches locally, and the number of species may be additionally limited by pollutants. Not unexpectedly the freshwaters show their closest faunal relationship with the bayou.

The Bays

The characteristic ecological features of the shallow bay habitats we studied are the presence of heavy bottom vegetation and moderately high and stable salinities. The number of species, but not necessarily the observed total biomass, decreases as one proceeds away from the Gulf. The fish fauna decreases also in numbers and species with the change from summer to winter. The decrease is probably associated as closely with the decrease in flora as with temperature, for even in summer the areas over the sandy bottoms contain few fishes. The majority of the fishes present are either young or small; the adults of most species eluded capture with the equipment used.

The composition of the fauna was very closely allied to that of Cedar Key (Reid, 1954). It differed primarily in the presence of a larger number of species and individuals, which may have been a function of more concentrated collecting or higher average water temperatures in the Tampa Bay area.

The Gulf Beach

Compared with the other habitats we studied (where regular stations were maintained), the beach was notable for harboring the fewest species. The beach can be considered biologically as an extreme sub-habitat of the close shore marine waters because it is an area offering comparatively little physical or chemical variety. Most of the organisms present are competing for the same few available niches.

Gunter (1959) has pointed out the paucity of our knowledge concerning the nature of the fish fauna of shallow sandy beaches on the open ocean. He has given (1945, 1959) a discussion of the fish fauna of this habitat on the Texas coast and noted its ichthyo-faunal similarities with the same habitats in North Carolina (Pearse, Humm, and Wharton, 1942) and New England (Warfel and Merriman, 1944).

We find that the composition of our beach fauna is allied to that of the Texas coast, but there are several notable differences. Lagodon rhomboides was very abundant at our beach station during most months, whereas Gunter found this species poorly represented. During spring and early summer Leiostomus *xanthurus* was a major component of our beach fauna; Gunter did not report this species from the beach habitat. During the summer Menticirrhus *littoralis* also was present in great quantities; Gunter found it in only moderate abundance.

Polydactylus was not to be found in our area (one specimen was recorded from Johns Pass), but on Texas beaches it was abundant. Mullet, menhaden, Micropogon undulatus, Trachinotus carolinus, and Menidia *beryllina* were completely absent or poorly represented in our beach collections, but they were abundant on Texas beaches. Trachinotus falcatus, for the most part, replaces T. carolinus on our beaches, but it was never as abundant in our area as T. carolinus was on the Texas beaches. Both Gunter and ourselves found Harengula very abundant in the beach habitat during the summer and fall.

Gunter recorded 44 species from his beach stations and we recorded 48. He obtained 10,633 specimens in 144 seine hauls on the beaches, but we probably obtained at least half that many at a single monthly station during the summer (consisting of about 20 hauls; the number of hauls was never recorded). Of his total catch Gunter found only 11 specimens 100 mm. or over in length. We obtained specimens this size commonly (both we and Gunter used comparable col-

lecting gear). We know specimens of this size to have been more abundant than our catches indicated as a fifty foot seine is comparatively ineffective for catching most species of fishes in unrestricted waters if they are of a standard length of about 80 mm. or more. Both his and our studies indicated a considerably depauperized fauna on the beaches during the cold months.

We question the degree of validity of Gunter's (1959) statement "It appears that over such great distances as from south Texas to southern New England the populations of small beach fishes are similar." Certainly there are some basic similarities, but there seem to be just as many fundamental dissimilarities, at least in comparing our more tropic fauna with the more temperate faunas. The agreement of the fauna of the Texas beaches with that of the upper Atlantic seaboard beaches may be an example of biology comparable in nature to the systematic examples of disjunct species (see Springer, 1959).

The Bayou

The bayou station, an estuary of wide salinity fluctuation, was notable for its large populations of small or young fishes present during all times of the year although less so during the winter. The greatest number and volume of these fishes inhabited the shallower cutbacks and flats leading off from the main channel of the bayou. Collections at this station, on a year round basis, indicate that in terms of fish biomass it was the most densely populated of the habitats studied.

The station was particularly characterized by the constant predominance of engraulids and young mugilids, atherinids, gerrids, sciaenids, and ariids. At certain times of the year it was inhabited by dense populations of young menhaden. It was the only area from which we collected any quantity of *Centropomus undecimalis, Elops saurus, Micropogon undulatus, Mollienesia latipinna, Adinia xenica,* and *Fundulus grandis.* Also it is the only locality in our area at which we know *Gobionellus hastatus* to exist.

Gunter (1945) has already pointed out the correlation of the presence of the young of many marine species with the less saline habitats.

The fish fauna of the station conforms in many respects with that found by Kilby (1955) for the coastal marshes of Bayport and Cedar Key. The bayou can probably be considered, therefore, as a marsh type habitat in Kilby's sense.

There are several notable differences, however, between our findings and Kilby's. Part of this is probably attributable to the concentrated study he made which was restricted only to this type habitat. The fact that he found 55 species of fishes at his Cedar Key stations and 49 at his Bayport stations (for a total of 75 different species) indicates that the *species* magnitude of the habitat in these two areas is comparable to that of ours (60 species) and probably is indicative of the maximum complexity attainable in such a habitat.

At the Cedar Key stations Kilby found relatively large quantities of *Fundulus confluentus, Gambusia holbrooki, Membras* sp. and *Microgobius gulosus,* which are slightly or not at all present at our bayou station. (This discussion is limited to the major components.) At Bayport he took relatively large quantities of *Fundulus confluentus, Lucania parva, Chriopeops goodei, Floridichthys carpio, Jordanella floridae, Gamhusia affinis, H eterandria formosa,* and *Lepomis punctatus* which were slightly or not at all present at our bayou station. However, many of these species are common in the mid-reaches of the bayou where the salinities are, or approach 0 o/oo.

On the other hand, we took relatively large quantities of *Brevoortia patronus, B. smithi,* and *Micropogon undulatus* which he did not collect at either of his major localities.

Gunter's (1950) study of the Aransas National Wildlife Refuge on the Texas coast indicates a faunal similarity with our bayou which may be closer than those of Kilby's marshes. Gunter's collections, however, were not extensive.

The Rocky Reefs

The reef-type habitat in our area, which is formed of a dolomitic limestone, probably of

Tertiary age (Dr. Robert N. Ginsburg, personal communication), is one of the least known biocoenoses in the Gulf of Mexico. In the shallower depths that were studied, to 60 feet, certain species of fishes were invariably encountered and can be considered descriptive of the habitat: *Promicrops itajara, Mycteroperca microlepis, Ephinephelus morio, Serranellus subligarius, Rypticus saponaceous, Haemulon plumieri,* 13 *lennius marmoreus, Opsanus pardus, Eupomacentrus variabilis.* The serranid complex is dominant, whereas inshore this group is poorly represented. *Halichoeres bivittatus is* a dominant form at these depths whenever it is present, hut it is not always present and its appearance is not correlated with any factor yet known to us.

There arc other serranids, sciaenids, and pomadasyids which are common on these reefs, but they appear to be seasonal. Certain species of clinids, brotulids, apogonids, etc., are present variably in collections, but never appeared to be dominant in numbers or mass.

The rocky reef habitat is usually characterized by a considerable body of "on" or "in" reef dwellers with comparatively few "above" (pelagic) reef inhabitants. In contrast to this, such shipwrecks (metallic) as were investigated were decidedly characterized by the opposite set of conditions. i.e.: *Sphyraena barracuda* was invariably present about the wrecks, but was rarely seen about the reefs. This was also true of certain pelagic clupeids, carangids, and pomadasyids. However, the large groupers were also abundant about the wrecks.

True corals are very small, but numerous, on the rocky reefs. The dominant invertebrate forms are *Millepora,* alcyonarians, and sponges. Various crustaceans, echinoderms and other invertebrates are plentiful. A report on the algae present is now in preparation.

MASS MORTALITIES

During the course of the present study fish kills of various kinds occurred. The most inclusive kill was that of a "red tide" which occurred during late September through mid-December, 1957. Some information on this particular red tide can be found in Rounsefell and Evans (1958). At the time of the occurrence the senior author was not thoroughly familiar with the local fishes. Identifications which were made, however, are considered accurate. The observations (Tables 21 and 22) were jointly made by the senior author and Dr. Eugenie Clark. The findings are of importance with reference to relative abundance of species. Three species not otherwise recorded during the period of the study were found dead during the kill.

Red tide kills on the west coast of Florida are not uncommon. Gunter, *et al.* (1948) discussed one in detail. Hutton (1956) has given a bibliography of red tides in Florida marine waters. The oldest record is for 1844 (Ingersoll, 1882). It can, in general, be considered that the phenomenon of red tides has been occurring for many years in our area. So far as we know, many of those species which are most affected in any red tide kill will be the same for all the kills (i.e.: *Lagodon rhomboides, Haemulon plumieri, Orthopristis chrysopterus, Mugil cephalus).* Nevertheless, these species remain some of the most common in the area. There was no noticeable decrease in numbers of those species listed above following the red tide of 1957. In fact local fishermen reported that the new crop of *L. rhomboides* only two months after the kill was the largest in their recollection. Noticeable increases were also reported to us for *Leiostomus xanthurus, Mugil cephalus,* and *Callinectes sapidus* (blue crab). What bearing other ecological factors may have had on this increase in abundance is not known. Nor is it known if there is always an increase in the abundance of certain species after a red tide kill. Fishermen reported no decrease in number of sport fish catches following the red tide. Mr. John Hurlbut has told us that sea bass *(Centropristes melanus)* were common before the red tide, but were rarely caught thereafter. This may explain the relative absence of this species during our study as compared with their abundance reported at Cedar Key by Reid (1954). Newspaper reports stated that fishing along the outer edge of an area of red tide water produced greater catches than usual. Gordon Broadhead (personal communication to R. M. Ingle, February

Table 21.

List of fishes killed by red tide and found floating in a boat basin in Boca Ciega Bay, Pinellas Co., Florida, October 3, 1957.

Species	Approximate Number	Species	Approximate Number
Harengula pensacolae	100's	*Chaetodipterus faber*	*10*
Lagodon rhomboides	100's	*Paralichthys* sp.	3
Brevoortia sp.	100's	*Balistes capriscus*	*1*
Mugil cephalus	*100*	*Stephanolepis hispidus*	*1*
Galeichthys felis	50	*Strongylura* sp.	1
Ophichthus gomesi	50	*Trinectes maculatus*	*1*
Leiostomus xanthurus	50	*Synodus foetens*	*1*
Cynoscion nebulosus	50	*Diapterus plumieri*	*1*
Archosargus probatocephalus	50	*Gymnothorax* sp.	1
Orthopristis chrysopterus	30	*Caranx* sp.	1
Eucinostomus argenteus	30	*Scomberomorus* sp.	1

Table 22.

List of red-tide killed fishes on a 1030 foot stretch of uncleared Gulf of Mexico beach just north of Madeira Beach, Pinellas Co., Florida, October 3, 1957.

Species	Approximate Number of Specimens	Species	Approximate Number of Specimens
Opisthonema oglinum	800	*Synodus foetens*	5
Haemulon plumieri	500	Symphurus *plagiusa*	5
Mugil cephalus	250	*Astroscopus ygraecum*	5
Brevoortia sp.	200	*Sphoeroides nephelus*	4
Bairdiella chrysura	100	*Chaetodipterus faber*	3
Bagre marinus	100	*Archosargus probatocephalus*	2
Orthopristis chrysopterus	100	*Rypticus saponaceous*	2
Leiostomus xanthurus	80	*Gymnothorax* sp.	2
Ophichthus gomesi	80	*Trachinotus carolinus*	2
Cynoscion nebulosus	50	*Calamus arctifrons*	2
Cynoscion arenarius	50	*Pogonias cromis*	2
Menticirrhus sp.	50	*Scorpaena* sp.	2
Opsanus beta	50	*Paralichthys* sp.	2
Anchoa hepsetus	30	*Abudefduf saxatilis*	*1*
Prionotus scitulus	30	*Stephanolepis hispidus*	*1*
Epinephelus morio	25	*Centropomus undecimalis*	*1*
Lagodon rhomboides	20	*Ophidion holbrooki*	*1*
Galeichthys fens	20	*Centropristes* sp.	1
Chilomycterus schoepfi	15	*Caranx crysos*	*1*
Strongylura notata	6	*Mystriophis mordax*	*1*
Elops saurus	6	*Strongylura timucu*	*1*
Acanthostracion tricornis	5	*Hyporhamphus unifasciatus*	*1*

14 and 22, 1955), who analyzed commercial fish catches during red tide periods on the Florida west coast, wrote, "I can't *see* that the red tide caused any decrease in the fish production." It is our opinion that as massive as the kills may be (we have seen miles of shoreline piled and completely littered with dead fish) their overall effect is negligible and short lived.

Shortly following the red tide Florida suffered its coldest winter in over fifty years. Small fish kills were noted on the mornings of December 13 and 14, 1957, in the Tampa Bay area. In general the species affected coincided with the findings of Storey (1937). Snook, barracuda, silver mullet, and goats *(Diapterus)* were the most obviously affected forms. The water temperature at the time of the fish kill was 13.0 °C. The temperature prior to the onset of the cold wave is not known, but undoubtedly it was the rate of temperature change which caused the mortality. Many of the species killed have been recorded as active at temperatures several degrees lower than 13 °C.

A saltwater kill of the freshwater catfish *Ictalurus nebulosus* is discussed under that species. A kill of *Anchoa mitchilli* was observed in a salt creek leading off Bayboro Harbor. Local residents reported that the same type kill had occurred several times, always after the passing of a large barge in the creek. Presumably the barge stirred up the thick bottom muds releasing H_2S which killed the anchovies.

SUMMARY

1. A study of the fishes of the Tampa Bay area was undertaken with the view towards evincing as much information as possible on the life histories, habits, and environmental requirements of as many species as possible, for the most part between September, 1957, and December, 1958.
2. Monthly collecting stations were established in a variety of habitats. The collecting gear was, however, effective primarily for only small or young fishes.
3. It is estimated that some 500,000 fishes were collected, of which almost 45,000 were retained for study.
4. Of the 249 species of fishes now known from the Tampa Bay area, 205 were collected during the period covered by the study: September, 1957-June, 1959.
5. Prior to the commencement of the study it appeared that some species of fishes which were previously found in abundance were no longer present. Other species disappeared during the course of the study.
6. An attempt has been made to give the comparative faunal compositions of all the habitats studied, and in some instances it has been possible to show the ecological relationships of certain species with regard to these habitats.
7. Included is a discussion of the effects of a red tide kill and a severe cold spell which occurred during the early stages of the study.
8. Information obtained during the study has been correlated with similar information on the same species of fishes found in other areas, obtained both from the literature and from our own observations.
9. It is believed that man's alterations of the inshore aquatic habitats will be detrimental to the future abundance of fish species in the Tampa Bay area.

ADDENDA

The following records were obtained while this paper was being set in type. They bring the total number of species for the area to 253.

Hypoplectrus unicolor (Walbaum)

A specimen was speared at a depth of 55 feet on October 4, 1959, by Dr. R. T. Kirk, on the rocky reefs about 18 miles offshore.

Lutjanus apodus (Walbaum) Schoolmaster

Several specimens, about 125 mm., were caught by Mr. John Hurlbut during August, 1959, from Johns Pass. These were kept by him in aquaria, but soon died and were discarded.

Elegatis bipinnulatus (Quoy and Gairnard)

A specimen was speared by Dr. Peter McGarry on August 15, 1959. It was one of sev-

eral hovering about a wrecked tanker about 20 miles offshore at a depth of 55 feet.

Gobionellus boleosoma (Jordan and Gilbert)

Six specimens, 25.8-30.4 mm., were obtained in a pushnet collection made at the regular Tampa Bay station on August 13, 1959 (19.0 o/oo, 32.2 °C.). None were obtained in this area on November 11, 1959 (23.0 o/oo, 25.5 °C.). These salinities are the lowest we have recorded for this station and were probably the result of the record-breaking rainfall of the year. It is difficult to explain why this species was never taken at any time during our study even though the identical station was worked in an identical fashion on many occasions. The fact that it was not taken again may be evidence of its tenuous existence in our area.

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