

## Job Report

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Project Name: Biological Survey of Commercial Shrimp Area 20 in the Gulf of Mexico.

Period Covered: 1 June 1960 to 30 October 1960. Job No. B-2a

Survey of the commercial shrimp and associated organisms of Gulf Area 20

Objectives: To determine the shrimp present in the area, their seasonal distribution, abundance and size. To establish a five month checklist of organisms associated with the shrimp population of the area.

Procedure: Stations were set up in the area to obtain representative samples at various depth in the Gulf of Mexico off Port Aransas, Texas. Figure I shows position of stations. Two general depth zones were set up arbitrarily, the area extending offshore from 3 to 10 fathoms and the area beyond from 11 to 20 fathoms. Stations were chosen, in the inshore zone at least, that would lend themselves to exact positioning by objects either in the Gulf or within sight on the barrier island forming the coast.

Daytime sampling was accomplished from the 38 foot Commission shrimp boat, Goby, using a 25 foot flat otter trawl of  $1\frac{1}{2}$  inch stretch mesh and a 42 foot flat otter trawl of 2 inch stretch mesh.

General description of area: Area 20, established by the U.S. Fish and Wildlife Service in dividing the Gulf of Mexico adjacent to Texas into zones for reporting the commercial shrimp catch, embraces an area 27 degrees North to 28 degrees North by 97 degrees 20 minutes West and 96 degrees 30 minutes West. In its upper portion, the eastern boundary of the area extends into the gulf beyond 96 degrees 30 minutes West. Only the northwestern part of the area was sampled.

Gulfward from Port Aransas, the slope of the continental shelf is relatively steep out to 10 fathoms, decreasing slightly from 11 to 20 fathoms. Considering the first twenty fathoms as a whole, the sloping gradient is about one fathom to the mile. The whistling buoy, five miles off Port Aransas at 27 degrees 47 minutes North by 96 degrees 57 minutes West, is in 10 fathoms of water, and generally a line drawn through this marker and parallel to the beach forms the 10 fathom contour. Stations were established on both sides of this depth contour, however, the inshore waters received the heaviest sampling.

The gulf floor in this area is more or less generalized. Sand forms the bottom from the shore to about 5 fathoms, graduating to mixed sand and mud through 10 fathoms and to mud and clay beyond. Sticky mud and isolated clay lumps are scattered at the twenty fathom zone. The few bottom samples taken agreed with this general pattern. An artificial fishing reef occupies a small area southwest of the whistling buoy. No other distinctive permanent features of the bottom in this area were noted.

## Invertebrate Study: Commercial Species

Brown shrimp, Penaeus aztecus Ives: total for period.

6,154 shrimp  
162 pounds  
2,248 males  
3,906 females

Brown shrimp make up, at present, the vast majority of the commercial shrimp catch. Causative factors such as previous drought years affecting whites and comparatively recent exploitation of deeper waters beyond the white shrimp grounds have been adequately discussed (Gunter, 1950; Gunter, 1954; Hildebrand, 1954). In this study browns also dominated the shrimp catch, however to a lesser extent than is true of the commercial landings. This is due specifically to the fact that no night sampling was accomplished and depths beyond 20 fathoms were inadequately sampled.

Browns were most abundant in June, July and August; however the bulk of the population sampled at this time was below the legal size of about 118 mm, 50 count tails. Three factors are probably responsible for this abundance pattern:

1. Waves of small shrimp were moving in numbers from the bays to shallow gulf during this period.
2. Brown shrimp began a strong migration to deeper waters in September, leaving the area of inshore sampling.
3. According to commercial shrimpers, in the months of May, June, and July brown shrimp are caught in the daytime as well as at night. After this period practically all shrimping for browns is done at night and few of these shrimp are taken during the daylight hours.

Offshore migration was demonstrated fairly well in the samples. In June, July and August the peak abundance was found in 10-14 fathoms. By September the population had moved 15-18 fathom depths and in October was found at 20 fathoms. October actually showed two abundance peaks, the one at 20 fathoms and another inshore at 6 fathoms. The 6 fathom population shows another wave of bay shrimp, the first wave being in June/July.

Sexual dimorphism was definitely found in the population. The largest shrimp were females; the smallest shrimp, males. The peak size of the female part of the population was consistently larger than the peak size of the male portion.

The percentage of the sexes in the total number of shrimp sampled for the period was males, 36.5%, to females, 63.4%. A slight change in percentage by depth was noted. In June and July 30% males were found to 70% females in 10-14 fathoms. In August 44% males were found to 56% females in 10-14 fathoms. September showed a complete reversal of the June/July ratio. The count at the 15 fathom abundance zone was 66% males to 33% females. In October the ratio was back to 41% males and 59% females at 20 fathoms. As is true for other types of animals, there seem to be generally more females produced than males in the brown shrimp population. A tentative reason for the ratio of male to female becoming more nearly equal with depth may be that the larger females move offshore ahead of the smaller males, September being a period of accelerated migration of females. Burkenroad (1939) and Hildebrand (1954) have discussed some aspects of this sex ratio by depth.

In June and July only a few ripe males and females, all over 150 mm., were taken. Indications are that browns spawn earlier in March and April. None were taken ripe after July; however as stated before, sampling was not geared to catch the larger and more plentiful browns in deeper waters at night.

No clearly defined indication of growth rate was found. A vague indication of 0.7 to 0.9 mm per day showed up in the 11-14 fathom samples for June and July. As to general size, the peak millimeter lengths of the population increased steadily from June through September in the 3-10 fathoms zone. The size declined in October, indicating a wave of small shrimp from the bays. In 11-20 fathoms size increased steadily from June through September. October sampling in these depths was insufficient to graph; however the few shrimp taken showed continuing population growth. Generally, the population in the 11-20 fathom zone was of a slightly larger millimeter mode through the period of sampling compared with the mode in 3-10 fathoms.

White shrimp, Penaeus setiferus (Linnaeus): total for period:

3,178 shrimp  
205 pounds  
1,790 males  
1,388 females

White shrimp have decreased in importance to the commercial fishery with the rising importance of the browns. Perhaps with the general increase in rainfall on this coast, they will assume something of their former abundance and availability in the coming years. Within the dates of this study whites were most abundant in October. This stands to reason for by this month the majority of the May/June/July spawn has completed the period of necessary growth in the bays and moved out to the gulf.

No definite indications of offshore or southward migration were found. The 5-8 fathom depth zone was the most productive of sampled depths from June through October.

Sexual dimorphism was evident in the whites but less pronounced than in the browns. The largest shrimp taken of 191-195 mm were females; however large males of 181-185 mm also occurred. In the smaller mm size ranges of 86 to 90 mm the ratio of males to females fluctuated. Generally, the female peak size of the population was above that of the male.

The percentage of the sexes was 56% males to 44% females. Although the difference is small, it indicates a ratio in reverse of that found for the brown shrimp. An interesting monthly ratio change occurred. In July there were 20% more males than females; in August 10% more males; in September 16% more; and in October 4% more. The trend was, as in the browns, for the ratio of sexes to become more nearly equal in the fall. Movement, if involved here, is slight compared to the depth migrations of the browns. Burkenroad (1939) proposed sex longevity difference as the main probable factor in this ratio change in both species.

In June and July all male whites taken were in various stages of ripeness, as were about three-quarters of the female population. Scattered ripe shrimp of both sexes were taken through September. None were captured ripe in October, the period of greatest abundance.

No indication of growth rate could be determined.

With regard to general size white shrimp displayed a completely opposite picture to that of the brown size change. The July population peak of 161-165 mm decreased steadily through the sampling period down to 131-135 mm in October.

Pink shrimp, Penaeus duorarum Burkenroad: totals for period:

27 shrimp  
7 males  
20 females

Too few pinks were caught to allow statements of any validity; however four items might be mentioned. Males formed 26% of the population; females 74%. One-half of the pinks taken in July were ripe. Pinks were of largest size in July at 156-160 mm, decreasing to 91-95 mm in October. The most pinks were caught in 5-7 fathoms in August, mixed with the white population of this area.

Sea bobs, Xiphopeneus krøyeri (Heller):

One male and three females were caught in 7 fathoms in August. Two of the females were ripe.

#### Conclusions from Information on Commercial Shrimp

(1). A total of 6,154 brown shrimp were caught, almost twice as many as the 3,178 whites taken. The browns weighed 162 pounds; the whites 205 pounds. Throughout the project the white shrimp were consistently larger than the browns. Had equal sampling been accomplished, undoubtedly browns would have been an even higher proportion of the catch. The technique of daytime sampling of inshore waters weighted the effort to the more efficient sampling of the white population. No computation of fishing effort to catch was possible as a small net was used at first until the standard 42 foot trawl could be obtained.

(2). Brown shrimp were most abundant in June, July and August the population being continually augmented by smaller shrimp moving from the bays. White shrimp were most abundant in October, indicating a later mass movement from the bays. Figure II shows abundance of browns plotted against abundance of whites by month.

(3). Offshore migration to deeper water was indicated for the browns beginning in 10-14 fathoms in June to 20 fathoms in October. White shrimp displayed no discernible offshore movement; although one probably exists within limits with dropping temperature later in the fall.

(4). Sexual dimorphism was found in both populations. Male/female ratios differed. Browns showed a 35/65 ratio; with females definitely predominating. Whites showed a more nearly equal relationship, 56/44 with in this case, males the more abundant.

In both species the ratio of males to females attained a narrower margin in October than in June. This change apparently occurred in the whites only in succeeding months; in the browns, in conjunction also with offshore migration.

(5). In June and July a few large ripe browns were taken. In this same period all male whites and most female whites were ripe. Scattered ripe whites were taken through September.

(6). Growth rates were too vaguely indicated for both species to be reliable. The general length mode changes of the two species showed different patterns. Brown shrimp were smallest in June/July, growing larger in 3-10 fathoms through September. In October the population peak dropped due to bay influence. Beyond 11 fathoms the June to September size increase appeared to continue steadily through October. This represents a comparatively simple life history involving the movement of small shrimp from the bays in June, July, and August and the further growth of these shrimp in the gulf. The decline in length mode for the population in October was the result of a second wave of smaller shrimp from the bay into the inshore waters of the gulf.

More complex is the situation in the white shrimp population. Large spawning adults formed the mode of the population in June and July. After this period these large shrimp began to disappear from the catch. This was possibly due to three factors:

- a. Natural accelerated mortality after spawning.
- b. Harvest by the commercial fleet when the inshore Gulf was opened to trawling July 15.
- c. Movement of minor groups of large shrimp back to the bays for various periods of time.

Population mode length of the whites continued to decrease through October with the steady influx of smaller shrimp from the bays.

Figure III graphically illustrates the percentage size of brown and white shrimp by month in the 3 to 20 fathom zone.

(7). Territory of the white shrimp extended from 3 fathoms (and presumably shallower) to 12 fathoms. Browns utilized depths out to the limit of the project at 20 fathoms and of course beyond, as indicated by commercial landings not covered in this report.

#### Invertebrate Study: Non-commercial Species

##### Decapoda

##### Penaeidae

Trachypeneus similis Smith: The broken back shrimp was taken in small numbers from June through August. Most were taken in June at 10 to 14 fathoms. Peak size was 66-75 mm. Sexual dimorphism seems to be especially pronounced in this species. The small males attained only 55 mm. Females were taken at sizes up to 85 mm.

Trachypeneus constrictus (Stimpson): One male of this similar species, 63 mm long, was taken in August in 15 fathoms.

Sicyonia dorsalis (Kingsley): This small rock shrimp was extremely abundant during the summer. June and July samples sometimes produced as much as twenty pounds of this species per haul. Millimeter average was about 60 mm. The greatest abundance was taken in 11 to 14 fathoms; however scattered specimens were caught at all depths.

Sicyonia brevirostris (Stimpson): Six 65 mm specimens were taken in June at 20 fathoms.

Sicyonia stimpsoni Burkenroad: A few specimens were taken in June in 19 and 20 fathoms.

### Squillidae

Squilla empusa Say: The mantis shrimp or sea louse was common but not especially abundant in all depths.

Lysiosquilla scabricauda Lamarck: This large squillid was taken once at 20 fathoms in October.

### Paguridae

Petrochirus bahamensis Herbst: This large red hermit was not uncommon beyond 6 fathoms.

Pagurus floridanus Benedict: This white hermit was fairly common from 3 to 10 fathoms.

### Portunidae

Callinectes sapidus Rathbun: The gulf blue crab was taken regularly throughout the project, generally in water below 12 fathoms. Two large peaks of abundance occurred. In June there was an abundant population consisting of large females carrying eggs in various stages of development. This was possibly the bulk of the gulfward movement of berried females. In mid-October quantities were taken consisting wholly of males averaging 80 mm in size. This might indicate a bayward movement of this sex during this period.

Callinectes danae Smith: The little blue crab was abundant and taken regularly between 3 and 16 fathoms. Large males of 100 mm carapace width were caught occasionally. Females taken were characteristically smaller. Females in berry were taken from time to time through the summer.

Arenaeus cribrarius (Lamarck): The speckled crab was caught irregularly in 3 to 8 fathoms.

Ovalipes ocellatus quadalupensis (de Saussure): The lady crab was taken in July in 5 fathoms.

### Raninidae

Raninoides louisianensis Rathbun: One frog crab was caught in August in an area of small mud lumps at 20 fathoms.

### Leucosiidae

Persephona punctata aquilionaris Rathbun: Scattered specimens were taken through the summer in 3 to 8 fathoms.

### Calappidae

Hepatus epheliticus (Linnaeus): This distinctive species was taken only in October, but was in that month not uncommon in 3-5 fathoms.

### Echinodermata

### Astropectinidae

Astropecten antillensis Lutken: This small starfish was common from 11 to 20 fathoms; less common inshore, although taken regularly.

#### Luidiidae

Luidia clathrata (Say): This larger starfish was fairly common in 8-12 fathoms in early summer, decreasing in abundance toward fall.

Luidia alternata (Say): One 10 inch specimen came up clutching the trawl jumper chain from 19 fathoms in July.

#### Scutellidae

Mellita quinquiesperforata (Leake): The sand dollar was very abundant off the beach in 3 to 4 fathoms in what appeared to be scattered communities. After August it became less common.

#### Siphonophora

##### Rhizophysaliidae

Pysalia pelagica Bosc: The Portuguese Man-of-War was observed at the surface in small numbers in early summer.

##### Semaeostomeae

##### Pelagidae

Dactylometra quinquecirrha Agassiz: Stinging nettles were seen in June and July, inshore but rarely.

#### Ulmaridae

Aurelia aurita Lamarck: The moon jelly was fairly common in inshore waters in early summer.

#### Rhizostomae

Stomolophus meleagris Agassiz: The cabbage head was fairly common inshore throughout June and July.

#### Anthozoa

##### Renillidae

Renilla mulleri Kolliker: Sea pansies were common from 3 to 14 fathoms, with patchy areas of great abundance in the lesser depths. Some were collected out to 20 fathoms.

#### Virgularidae

Virgularia mirabilis (Linnaeus): This pink octocoral occurred in abundance in two areas at 6 to 8 fathom depths. One area lay just northeast of the well platforms south of Port Aransas; the other was off St. Joseph Island north of the ranch house.

#### Actinaria

##### Hormathiidae

Calliactis tricolor (LeSueur): This sea anemone was commonly found attached to shells utilized by the pagurids.

## Mollusca

### Neptuneidae

Busycon perversum Linne: This conch was sparsely scattered in samples at 3 to 8 fathoms.

### Naticidae

Polynices duplicata Say: One or two specimens of the moon snail were taken in 3-4 fathoms.

## Cephalopoda

### Loliginidae

Loligo pealei LeSueur: These comparatively large squid were abundant in 6 to 12 fathoms in early summer. Numbers decreased through August, and none were taken in September.

Lolliguncula brevis Blainville: The common small squid was even more abundant than the above cephalopod during the same period. This squid was found from 3 to 12 fathoms, being more common in the shallower zones. The last specimen was taken in September.

## Vertebrate Study

### Checklist of Fishes

### Sphyrnidae

Sphyrna tiburo (Linnaeus): Small specimens of the bonnetnose shark were taken occasionally in 3-4 fathoms in June and July.

### Rhinobatidae

Rhinobatos lentiginosus (Garman): The guitarfish was scattered at 3-6 fathoms.

### Torpedinidae

Narcine brasiliensis (Olfers): The electric ray was moderately abundant at 3-7 fathoms throughout the period of sampling.

### Rajidae

Raja texana Chandler: The Texas clearnose skate was taken sporadically in 6 to 14 fathoms.

### Clupeidae

Brevoortia patronus Goode: Menhaden were occasionally taken in 3-8 fathoms.

Opisthonema oglinum (LeSueur): Some small thread herring were taken in August and September in 3-6 fathoms.

#### Engraulidae

Anchoa hepsetus (Linnaeus): Small numbers of this anchovy were taken from time to time in 3-4 fathoms.

Anchoa mitchilli diaphana Hildebrand: This anchovy was uncommon but taken in 3-4 fathoms.

#### Synodontidae

Synodus foetens (Linnaeus): The inshore lizardfish was extremely common in 3 to 10 fathoms but not especially abundant.

Synodus poeyi Jordan: This smaller offshore lizardfish was less common than S. foetens, and generally taken in deeper water.

#### Ariidae

Bagre marinus (Mitchill): Medium sized gafftops were taken in scattered samples through June and July.

Galeichthys felis (Linnaeus): Large hardhead catfish were fairly common through June and July in 3-6 fathoms.

#### Ophichthyidae

Myxostomus punctatus (Richardson): The spoon-nosed snake eel was taken twice in 8 and 10 fathoms in August.

Ophichthus gomesi (Castelnau): Gomes' snake eel was taken from time to time in 6-10 fathoms.

#### Ophidiidae

Lepophidium brevibarbe (Cuvier): Scattered specimens of the short-bearded cusk eel were taken in 14-20 fathoms.

Otophidium welshi Nichols and Breder: Rare specimens were caught 8-12 fathoms.

#### Stromateidae

Poronotus triacanthus (Peck): The butterfish was very abundant in June and July in 3-8 fathoms. During this time, it was second only to T. lathami in the catch. It decreased in numbers through August and disappeared in September.

#### Gadidae

Urophycis floridanus (Bean and Dresel): The southern hake was uncommon. Scattered specimens were taken in 8-12 fathoms in June and July.

#### Serranidae

Centropristes philadelphicus (Linnaeus): The rock sea bass was common but not abundant in 3-14 fathoms.

Diplectrum arcuarium Ginsburg: The sand perch was fairly common but not abundant in the inshore waters.

### Lutianidae

Lutianus blackfordi Goode and Bean: Small red snapper, 80 to 120 mm, were fairly common inshore in early summer.

Lutianus synagris (Linnaeus): Small lane snapper were taken irregularly through the summer.

Rhomboplites aurorubens (Cuvier): Small vermillion snapper were common in June/July at 8 to 14 fathoms.

### Rachycentridae

Rachycentron canadum (Linnaeus): Cobia or "Ling" were observed around buoys and under the boat through summer.

### Carangidae

Trachurus lathami (Nichols): During June rough scad were extremely abundant and formed the bulk of the catch. They disappeared abruptly toward the end of July.

Selene vomer (Linnaeus): Occasional specimens were taken through the summer.

Vomer setapinnis (Mitchill): The moonfish was fairly common inshore through the summer.

Trachinotus carolinus (Linnaeus): Three or four pompano were taken inshore in early summer.

Caranx hippos (Linnaeus): A few specimens of the crevalle jack were taken through the summer.

Chloroscombrus chrysurus (Linnaeus): The bumper was fairly common inshore in July and August.

### Pomadasyidae

Orthopristis chrysopterus (Linnaeus): Scattered specimens of the pigfish were taken through the summer, never commonly.

### Sciaenidae

Micropogon undulatus (Linnaeus): The croaker was very abundant in early summer, forming the bulk of the catch in July and August. It became relatively scarce through September and October.

Leiostomus xanthurus Lacepede: The spot was abundant in July and especially in August, declining somewhat in the later months.

Larimus fasciatus Holbrook: Banded croaker were taken occasionally in 3-8 fathoms.

Cynoscion nothus (Holbrook): Gulf sandtrout were very abundant and third in importance in the catch from June through August in the inshore waters.

Cynoscion arenarius Ginsburg: Bay sandtrout were taken as scattered specimens in 3-6 fathoms.

Cynoscion nebulosus (Cuvier): Only a few speckled seatrout were taken from 3 to 6 fathoms in the summer.

Menticirrhus littoralis (Holbrook): The gulf kingfish was not uncommon in 3-6 fathoms.

Bairdiella chrysura (Lacepede): Scattered specimens of silver perch were taken at 3 and 4 fathoms.

#### Mullidae

Upeneus parvus Poey: The dwarf goatfish was common in 8 to 14 fathoms in early summer. None were taken after August.

#### Sparidae

Lagodon rhomboides (Linnaeus): The pinfish was common but not at all abundant in 3-6 fathoms.

Stenotomus caprinus Bean: The longspine porgy was common from June through September in 6 to 14 fathoms.

#### Ephippidae

Chaetodipterus faber (Broussonet): Small spadefish became fairly abundant in September in 3-6 fathoms.

#### Trichiuridae

Trichiurus lepturus Linnaeus: Cutlassfish were common and at times abundant throughout the summer.

#### Scombridae

Scomberomorus maculatus (Mitchill): Small Spanish mackerel, 100 to 200 mm, were taken in September and October in 3-6 fathoms.

#### Gobiidae

Gobionellus gracillimus Ginsburg: Scattered specimens were taken at 10-16 fathoms.

#### Triglidae

Prionotus rubio Jordan: The blackfin sea robin was common but not abundant in 3-12 fathoms.

Prionotus stearnsi Jordan and Swain: The shortwing sea robin was fairly common, 8-14 fathoms, through summer.

#### Sphyraenidae

Sphyraena guachancho Cuvier: Young specimens, 70 to 120 mm, of this small barracuda were taken in August and September in 3-8 fathoms.

#### Mugilidae

Mugil cephalus Linnaeus: Striped mullet were occasionally taken in 3-4 fathoms.

#### Polynemidae

Polydactylus octonemus (Girard): The threadfin was very abundant in 3-6 fathoms in June, July and August.

#### Bothidae

Syacium gunteri Ginsburg: This was the most common flatfish, being taken in all hauls in varying abundance.

Citharichthys spilopterus Gunterh: This small flatfish was taken regularly.

The following flatfish were taken occasionally:

Ancylosetta quadrocellata (Gill)

Cyclopsetta chittendeni Bean

Citharichthys macrops Dresel

Paralichthys lethostigma Jordan and Gilbert.

#### Soleidae

Trinectes maculatus (Bloch and Schneider): The hogchoker was fairly common in early summer in 3 to 6 fathoms.

Achirus lineatus (Linnaeus): Scattered specimens of the lined sole were taken in 3-6 fathoms.

Gymnachirus texae (Gunter): One naked sole was taken in 19 fathoms in July.

#### Cynoglossidae

Symphurus plaguiza (Linnaeus): Tonguefish were common, being more abundant toward fall.

#### Echeneidae

Echeneis naucrates Linnaeus: Young remoras were taken in July and August inshore.

#### Balistidae

Balistes capriscus Gmelin: Two or three small filefish were found in 6 to 8 fathoms in August.

#### Tetradontidae

Lagocephalus laevigatus (Linnaeus): Smooth puffers were not uncommon in 3-8 fathoms in July and August.

#### Batrachoididae

Porichthys porosissimus (Cuvier and Valenciennes): Midshipmen were taken fairly often through the summer in 3 to 10 fathoms.

#### Antennariidae

Antennarius ocellatus (Bloch and Schneider): A few frogfish were taken in July in 3 and 4 fathoms.

## Ogcocephalidae

Ogocephalus sp. (Valenciennes): A few specimens of the shortnose batfish were found in 3-8 fathoms in July, August and September.

### Comments on Organisms other than Commercial Shrimp

Invertebrates taken included 16 species of crustaceans, 4 echinoderms, 7 coelenterates, 2 gastropods, and 2 cephalopods. This, needless to say, is not a complete list of the more conspicuous invertebrates inhabiting the area. The rock shrimp, S. dorsalis, was the most abundant of the invertebrates taken, followed closely by the blue crab, C. sapidus. Abundance in both cases was periodic.

No extensive work was done with the fish caught during this project, the main objective being to obtain a workable checklist of the area for future investigation. Taken were 66 species of fish comprising 36 families. Greatest representation was in the Sciaenidae, the Carangidae, and the Bothidae. The most abundant single species was M. undulatus, the common croaker. Altogether, 2,322 pounds of scrap fish were sampled of which the greatest percentage was the croaker.

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24 February 1961

### Bibliography

- American Fisheries Society, 1960. A List of Common and Scientific Names of Fishes from the United States and Canada. Special Pub. No. 2 Ann Arbor, Michigan.
- Breder, C.M. Jr., 1948. Field Book of Marine Fishes of the Atlantic Coast. G.P. Putnam's Sons, New York and London.
- Burkenroad, M.D., 1939. Further observations of Penaeidae of the northern Gulf of Mexico. Bull. Bingham Ocean. Coll. 6(6): 1-62.
- Gunter, G., 1950. Seasonal population changes and distributions as related to salinity, of certain invertebrates of the Texas coast, including the commercial shrimp. Publ. Inst. Mar. Sci. Univ. Texas. 1(2): 7-51.
- \_\_\_\_\_ and H.H. Hildebrand, 1954. The relation of total rainfall of the state and catch of the marine shrimp (Penaeus setiferus) in Texas waters. Bull. Mar. Sci. Gulf and Car. Vol. 4, No. 2: 95-103.
- Hildebrand, H.H., 1954. A study of the brown shrimp (Penaeus aztecus Ives) grounds in the western Gulf of Mexico. Publ. Inst. Mar. Sci. Univ. Texas. 3(2): 233-266.
- Miner, R.W., 1950. Field Book of Seashore Life. G.P. Putnam's Sons, New York.

Figure I

Location of Stations

1. 27 57' N by 96 54' W
2. 27 57' N by 96 50' W
3. 27 52' N by 96 52' W
4. 27 51' N by 96 49' W
5. 27 47' N by 96 54' W
6. 27 42' N by 96 50' W
7. 27 39' N by 96 46' W
8. 27 41' N by 96 57' W
9. 27 45' N by 96 59' W
10. 27 44' N by 97 03' W
11. 27 47' N by 97 04' W
12. 27 41' N by 97 07' W

