

JOB REPORT

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Project Name: An Ecological Survey of Area M-2

Job No: A-2

Period covered: November 1960 to December 1961

A Study of the Fishes of Upper Galveston Bay

Abstract: Forage fish and juvenile game fish samples were taken regularly with standard trawls and seines, while trammel nets, gill nets, beach seines, and rod and reel were used extensively to sample adult game fish. Hydrographic and climatological data were collected in conjunction with each sample to correlate these factors with the seasonal abundance, occurrence, and distribution of the collected vertebrates.

Three hundred and thirty samples were made, resulting in the collection of over thirty thousand fish. Ten new species and one species, last collected two years ago, were recorded in this year's checklist, while nineteen species collected or observed last year were missing.

Anchovies, croakers, and sand trout, respectively, were the most abundant forage species in the collections. Game fish seemed to be more abundant in the bays in 1961 than in 1960. A total of 580 redfish, sand trout, speckled trout, drum, sheepshead, and flounder were tagged for growth and migration studies. Spawning and/or nursery habitats of these species were located and plotted.

Population mass and species composition varied with the seasons. The summer populations were usually large and predominantly marine, while the smaller winter populations were generally a mixture of fresh water and marine species.

Objective: To determine the vertebrate forms present, their relative seasonal abundance, periods present, and distribution in relation to hydrographic conditions.

Procedure: The vertebrate marine animals were collected by methods considered best suitable for the type habitat to be sampled. Following is a list of the standard equipment used:

- (1) 10 foot shrimp trawl - 1 1/4 inch - 1/4 inch mesh liner.
- (2) 12 foot shrimp trawl - 1 3/8 inch mesh - 1/2 inch mesh liner.
- (3) 20 foot bar-seine - 1 1/4 inch mesh.

- (4) 6 foot bar-seine - 1/4 inch mesh.
- (5) 60 foot bag-seine - 1/2 inch mesh.
- (6) 20 foot minnow seine - 1/2 inch mesh.
- (7) 100 foot bag-seine - 1/2 inch mesh.
- (8) 1200 foot trammel net - 3 1/2 inch mesh.
- (9) 1500 foot gill net - 3 to 5 inch mesh.
- (10) 900 foot beach seine - 2 1/2 inch mesh wings - 2 inch mesh pocket.
- (11) Rod and reel.
- (12) Plankton net.

Figure 1 is a map of Area M-2 with all sample stations plotted. All trawl and bar-seine collections were timed (15 minutes) and pulled at a regulated speed to cover approximately one acre. The minnow and bag-seine were pulled approximately one hundred yards for a quantitative sample at each station. The gill and trammel nets were set for a given period of time or were circled and the area covered calculated. The beach seine was also circled.

The marine animals caught in the above mentioned operations were measured in millimeters for standard length and sometimes for total length. Stingrays were the exception to the rule as they were measured from wing tip to wing tip. When an enormous number of one species was caught, a representative aliquot was usually measured and the remainder either calculated or counted. Hydrographic and climatological data were recorded at the time each sample was made to correlate occurrence and abundance with these factors. Most of the adult game fish were measured in standard and total length, weighed, tagged, and released. Monel tags with TC&FC stamped on one side and a number on the other were used. The tag number and related data were recorded in a log at the Seabrook Field Laboratory. Most game fish were tagged in the upper right jaw, with the exception of sheepshead which were tagged in the dorsal fin and flounder which were tagged in the peduncle.

A "Condition Factor" was determined to express the condition or "degree of well-being" of the game fish during the four seasons of the year. As this was to give only a general idea of the variation of the condition, the sex, length, and age of the fish collected were not taken into account. The reciprocal method was used to calculate the condition index. The formula used in determining the factor was $K \text{ (Condition factor)} = \text{Weight in grams times the reciprocal of the cube of the length.}$

Findings: The study was an extension of last year's project with certain modifications. Trawl samples were reduced to a minimum, while seine, trammel and gill nets were used more extensively to sample the game fish from juvenile to adult stages. More time was spent on life history studies of game fish than in the 1959-60 project which emphasized collection and identification of all species present. (A continuation of Renfro's 58-59 project.)

During the current period of study three hundred and thirty samples were made, resulting in the collection of over thirty thousand specimens.

The following nineteen species, collected or observed in 1959-60, were missing from this year's checklist:

Anchoa hepsetus, Opisthonema oglinum, Syngnathus floridae, Centropristes philadelphicus, Membras martinica, Poronotus triacanthus, Rissola marginata, Ancylopsetta quadrocellata, and Tursiops truncatus were all thought to be missing because of low salinities.

Ameiurus melas, Ictalurus f. furcatus, Gambusia affinis, Aphredoderus sayanus gibbosus, Chaenobryttus gulosus, Lepomis microlophus, Pomoxis annularis, Gobiesox strumosus, and Opsanus beta were missing due to unknown factors.

The vertebrate fauna were classified according to American Fisheries Society's "List of Common and Scientific Names of Fishes from the United States and Canada." Seventy-five species, including thirty-nine families of seven orders, were found in the bays this past year. These are included in the following checklist with related facts about each species.

Eleven species collected were not found in the 1959-60 vertebrate survey. Of the eleven, ten, noted in the following checklist by two asterisks (**), were species reported for the first time in Area M-2, while the eleventh, noted by a single asterisk (*), was reported in Renfro's 1958-59 survey.

Class Chondrichthyes

Order Squaliformes

Carcharhinidae

Carcharhinus leucas (Miller and Henle). Bull Shark. This species, caught in Trinity and upper Galveston Bays during the summer and late fall months, was taken only in gill and trammel nets in water with a salinity range of 7 to 10 ‰ and a temperature range of 27 to 30°C. It is a predatory species feeding chiefly on live fish.

Dasyatidae

Dasyatis sabina (LeSueur). Atlantic Stingray. Another common bay inhabitant during the spring and summer months, this stingray was usually caught during netting operations, although it was occasionally taken in trawl and seine samples. Found in a salinity range of 5 to 10 ‰ and a water temperature range of 19 to 30°C., it was most abundant in June when females moved into the bays to give birth to young.

Myliobatidae

Rhinoptera bonasus (Mitchill). Cownose ray. Large schools of this ray moved into the bay during August. The salinity at the time was 9 o/oo and the water temperature was 30°C. The rays probably moved into the area to give birth to their young.

Order Semionotiformes

Lepisosteidae

Lepisosteus osseus (Linnaeus). Longnose Gar. This gar, an occasional visitor to Area M-2, was usually taken in trammel and gill nets in both bays. It was found in a salinity range of 5 to 9 o/oo and a water temperature range of 12 to 25°C. Stomach analyses indicate that it feeds primarily on live fish.

Lepisosteus spatula Lacepede. Alligator gar. This was the most common gar and sometimes the most abundant fish taken during netting operations. Occasionally it was also taken in the trawl and seine. The alligator gar was found in a salinity range of 4 to 9 o/oo and a water temperature range of 12 to 30°C. Its feeding habits are similar to the longnose gar, as it also feeds voraciously on live fish.

Some local fishermen feel that since commercial netting has been prohibited in the bays this gar has multiplied to a point that it endangers the game fish population.

Order Clupeiformes

Elopidae

Elops saurus Linnaeus. Ladyfish or Tenpounder. Seining and netting in Trinity and upper Galveston Bays during the summer months usually yielded specimens of this fish. They were found in a salinity range of 5 to 10 o/oo and a water temperature range of 28 to 30°C.

Clupeidae

** Alosa chrysochloris (Rafinesque). Skipjack herring. One specimen of this fish was taken in October 1961 at Double Bayou in Trinity Bay in a salinity of 6 o/oo and a water temperature of 15°C.

Brevoortia patronus Goode. Largescale menhaden. (Figure 2). This was the fish usually involved in the tremendous fish kills in past years. Large schools of menhaden moved into boat basins and other areas of poor water circulation where they depleted the dissolved oxygen in the water. A case in point is the Houston Yacht Club in June 1960. However, during this year's study, no major menhaden kills occurred.

Menhaden were a common inhabitant of the bays all year, becoming more abundant during the winter months. This plankton feeder is an important food item for redfish, speckled trout, and channel catfish. It also plays an important part as a food item for other predatory species.

Dorosoma cepedianum (LeSueur). Gizzard shad. This is another forage species caught occasionally in trawl and net in Trinity and Upper Galveston Bays. It was found in a salinity range of 4 to 10 o/oo and a water temperature range of 12 to 30°C.

Dorosoma petenense (Gunther). Threadfin shad. Specimens of this shad were commonly caught in the fresher portions of the bays during the summer, fall, and winter. It probably plays the role of a minor forage species during periods of freshets.

Engraulidae

Anchoa mitchilli (Valenciennes). Bay anchovy. (Figure 3). This indigenous forage species, found in wide salinity and temperature ranges, was the most abundant fish caught during the summer and early fall. It was an important food item for croakers and sand trout as indicated by stomach analysis.

Order Myctophiformes

Synodontidae

Synodus foetens (Linnaeus). Inshore lizardfish. The lizardfish was caught only twice during this period of study, near Smith Point in Trinity Bay and at Humble Camp in upper Galveston Bay. Little is known of the feeding habits of this fish or of its value as a forage species.

Order Cypriniformes

Cyprinidae

Cyprinus carpio Linnaeus. Carp. One specimen of the carp, a freshwater species, was found at Surf Oaks in upper Galveston Bay during a period of extremely low salinity in July 1961.

** Notropis sp. This freshwater minnow was caught in a seine in a marshy habitat near McCollum Park in Trinity Bay in a salinity of 4 o/oo and a water temperature of 20°C.

Catostomidae

Ictiobus bubalus (Rafinesque). Small-mouth buffalo. Trammel netting at Lone Oak Bayou in Trinity Bay during periods of extreme freshets in March and July 1961 yielded over sixty specimens of this fish, ranging from 235 to 450 millimeters in length.

Ariidae

Bagre marinus (Mitchill). Gafftopsail catfish. (Figure 4). The gafftop was first taken in trawl and net samples in early May and continued to appear in the collections until late November 1961. Temperature seemed to be the important hydrographic factor controlling the occurrence of this species, while salinity seemed to have little effect. It is frequently taken by sportsmen and is considered by some to be an excellent food fish. Stomach analyses indicate that the gafftop feeds primarily on small fish and shrimp.

Galeichthys felis (Linnaeus). Sea catfish or Hardhead catfish (Figure 5). Hardhead catfish were abundant during the spring, summer and fall much to the chargin of most sportsfishermen and biologists. Large hardhead catfish first moved into the bays in March, when males carrying eggs dominated the collections. Young then began to appear in the late spring and continued to show up until late fall.

Ictaluridae

Ictalurus punctatus (Rafinesque). Channel catfish. Last year, during periods of extreme freshets, Trinity Bay became an ideal habitat for channel catfish. They were so plentiful during spring and summer months that some of the commercial trot-liners moved their equipment to the bay. There were also reports of fishermen catching them in shrimp trawls. This species seemed to move into the bay primarily in search of food, as stomach analyses of several catfish revealed that they were feeding mainly on Rangia and menhaden.

** Ictalurus natalis (LeSueur). Yellow bullhead. One specimen of the yellow bullhead was caught in upper Galveston Bay during a period of low salinities in November 1960.

Order Anguilliformes

Ophichthidae

Myrophis punctatus Lutken. Speckled worm eel. This was the only species of eel caught during this period of study. It was taken in the trawl and bar-seine in the bays and adjacent lakes.

Order Beloniformes

Belonidae

Strongylura marina (Walbaum). Atlantic needlefish. Seine samples from Trinity and upper Galveston Bays during the summer normally yielded specimens of the needlefish. They were also observed feeding on young fish and shrimp at the bulkhead at the Seabrook Field Laboratory.

Order Cyprinodontiformes

Cyprinodontidae

Adinia xenica (Jordan and Gilbert). Diamond killifish. One specimen was taken in the seine in the Ruppia beds near Lone Oak Bayou in Trinity Bay in July 1961. This killifish probably plays a minor role as a food item for predatory species.

Cyprinodon variegatus Lecepede. Sheepshead minnow. This small minnow, a common inhabitant of the marshy areas, was capable of withstanding rapidly fluctuating salinities and temperatures, and low concentrations of dissolved oxygen. Like other cyprinid minnows, it probably played a minor role as forage species.

Fundulus grandis Baird and Girard. Gulf killifish. Another common marsh dweller, this species is also very hardy and capable of withstanding adverse hydrographic conditions. It too, is a minor food item for predator species.

**Fundulus pulvereus (Evermann). Bayou killifish. One specimen of this killifish was taken in a seine in the marshy area near Surf Oaks in upper Galveston Bay. This fish may also be a minor forage species.

Fundulus similis (Baird and Girard). Longnose killifish. This forage species was taken in the marshy habitats of both bays in relatively high salinities.

Lucania parva (Baird and Girard). Rainwater killifish. This brackish water species, generally caught in the seine in marshy habitats, plays a minor role as a food item for predator species.

Poeciliidae

Mollienesis latipinna LeSueur. Sailfin molly. The sailfin molly is another of the brackish water minnows that is usually taken in the seine in the marshy areas of the bays. It is probably a minor forage species.

Order Gasterosteiformes

Syngnathidae

Syngnathus scovelli (Evermann and Kendall). Gulf pipefish. One specimen was taken in the seine in the marsh at McCollum Park in Trinity Bay. The salinity at the time was 4 o/oo and the water temperature was 12°C.

Order Perciformes

Lobotidae

** Lobotes surinamensis (Bloch). Tripletail. Juvenile tripletails were observed swimming around the pilings and bulkhead at the Seabrook Field Laboratory boat basin in October 1961.

Centrarchidae

** Lepomis macrochirus Rafinesque. Bluegill. A juvenile specimen of this freshwater sunfish was taken in the bar-seine at Mud Lake in February 1961 in a salinity of 0.7 o/oo.

Pomatomidae

* Pomatomus saltatrix (Linnaeus). Bluefish. One juvenile was taken in a seine in May 1961, over shell bottom in Clear Lake. At the time the salinity was 8 o/oo and the water temperature was 27°C. This species is an excellent food fish that normally travels in large schools in the gulf. It is only a casual visitor to Area M-2, utilizing the bays as a nursery habitat.

Carangidae

Caranx hippos (Linnaeus). Crevalle jack or Common jack. In July 1961 four juvenile specimens of the common jack were caught in a seine in the Ruppia beds in Trinity Bay. The salinity at the time was 2.1 ‰. Although this fish is normally classed as a predator, in Area M-2 it probably plays the part of a forage species.

** Caranx latus Agassiz. Horse-eye jack. In July 1961 several specimens of this jack were taken in a salinity of 1.5 ‰, in a seine at Surf Oaks in upper Galveston Bay. The horse-eye jack is normally classed as a predator, but due to the size of the specimens taken in the bays, it was classed as a forage species.

Chloroscombrus chrysurus (Linnaeus). Bumper. The August trawl collections in the Houston Ship Channel at Five Mile Pass yielded one specimen of this forage species. The bottom salinity at the time was 13.9 ‰.

Oligoplites saurus (Bloch and Schneider). Leather jacket. Seining in the Ruppia beds in the Trinity Bay in July yielded several specimens of this forage fish. The salinity was 1.5 ‰.

Vomer setapinnis (Mitchill). Atlantic moonfish. Moonfish were caught sporadically during the summer and fall in the Houston Ship Channel and Cedar Bayou. This forage species was found in a salinity range of 11 to 18 ‰.

Gerridae

Eucinostomus sp. Mojarra. Mojarra were taken in the trawl at Cedar Bayou and Clear Lake in a salinity range of 5 to 8 ‰ in December 1960 and July 1961.

Pomadasyidae

Orthopristis chrysopterus (Linnaeus). Pigfish. A juvenile specimen of the pigfish was taken in July in the seine in a shallow, shell-bottom lagoon near Smith Point in Trinity Bay. This forage fish, normally considered a high salinity species, was taken in a salinity of 1.4 ‰.

Sciaenidae

Bairdiella chrysura (Lacepede). Silver perch or Yellow tail. (Figure 6). The silver perch, a seasonal visitor to Area M-2, moved into the bays in the spring and remained until late fall. Juveniles were found around Ruppia beds in July. This species was found in the bays in a wide salinity range.

Cynoscion arenarius Ginsburg. Sand seatrout. (Figure 7). The sand trout was a common inhabitant of the bays all year, although it became more abundant during the warmer months. Post larval specimens first appeared in early spring and continued to show up until early fall. This fish was more important as a forage species than a game fish, since

the adults are generally restricted to areas of higher salinities. Three adult fish were caught and tagged for growth and migration studies.

Cynoscion nebulosus (Cuvier). Spotted seatrout or Speckled trout. (Figure 8). Speckled trout, found in the bays all year, were most abundant during the warmer months. Spawners were first taken around Ruppia beds in early spring and continued to show up through the summer. Juveniles, however, did not appear until early June. They too were caught through-out the summer around Ruppia. Figure 9 is a map showing the spawning and nursery areas of the speckled trout in Area M-2. Stomach analyses indicate that this fish feeds primarily on menhaden, mullet, and shrimp, although other unidentifiable food items were found.

Twenty-five adult trout were tagged for growth and migration studies this year. The majority of these fish were caught with a rod and reel in areas near feeding sea gulls. Gill and trammel netting yielded poor catches, probably due to the technique employed rather than the equipment used.

** Larimus fasciatus Holbrook. Banded Drum. The November 1961 trawl collection at Five Mile Pass yielded one specimen of this drum. The salinity in the Ship Channel at the time was 18.5 o/oo, and the water temperature was 16.3°C.

Leiostomus xanthurus Lacepede. Spot. (Figure 10). This was a common forage fish found in the bays all year. Juveniles began to appear in the spring following spawning. Although commonly caught by sports-fishermen they were of little value as a game fish due to their small size.

Menticirrhus americanus (Linnaeus). Southern kingfish or Southern king whiting. The whiting is a casual visitor to the higher salinity portions of upper Galveston Bay. This fish was considered a forage species, as only juveniles ranging from 20 to 100 millimeters in length were taken. Large whiting, generally caught in the gulf, are excellent food fish.

Micropogon undulatus (Linnaeus). Atlantic croaker. (Figure 11). The croaker, another common fish found in the bays all year, was one of the most abundant fishes in the collections during the spring and summer. Following the fall spawning of the adult croakers, post-larval specimens began to appear in the collections in late fall and continued to show up until early spring. This fish was considered a minor game fish as adults were seldom caught in the bays. It was probably important as a food item for larger predator species. Six adult croakers were tagged for growth and migrations studies this year.

Pogonias cromis (Linnaeus). Black drum. (Figure 12). The drum, one of the most abundant game fish in the bays, was found all months of this study. Following winter and early spring spawning of this species, postlarval specimens appeared in the bays in early summer. Figure 9 is a map of the grassy, marshy, and shell bottomed nursery areas utilized by young drum. Stomach analyses indicate that this fish feeds chiefly on Rangia, shrimp, and other unidentified shellfish and crustacea.

One hundred and twenty drum were tagged and released for growth and migration studies.

Sciaenops ocellata (Linnaeus). Red drum, Channel Bass, or Redfish. (Figure 13). The redfish is a common game fish in the bays all year, becoming more abundant in the fall and early winter. Most of these fish were taken from schools in the shallows of both bays in gill nets, which were set in early morning and late evening. They seemed to feed chiefly on shrimp, menhaden, and mullet, although other, unidentified food items were found in their stomachs. Only two juvenile specimens, 50 and 130 mm, were collected in March and June 1961, respectively. Both specimens were taken in the bag-seine in the marshy area near Surf Oaks. More work needs to be done on locating and mapping nursery habitats for this important game species.

Eighty adult redfish were tagged and released in Area M-2 this past year. The majority of these fish were caught in the fall at Double Bayou in Trinity Bay. Others were collected, tagged, and released at various locations in both bays. One tagged fish, returned by a commercial fisherman, was found dead near the Seabrook Field Laboratory bulkhead on May 10, 1961. It had been tagged at Scott's Reef in upper Galveston Bay on the previous day. No valid data could be obtained from this return.

Stellifer lanceolatus (Holbrook). Star drum. (Figure 14). The star drum, a sporadic visitor to Area M-2 from June to December, was another of the forage species in the bays. Usually found in areas of relatively high salinity, numerous star drum were collected in the ship channel in the early summer. Two influxes of juveniles appeared in the bays in July and September 1961.

Sparidae

Archosargus probatocephalus (Walbaum). Sheepshead. (Figure 15). Sheepshead, the most abundant game fish taken during the summer, were common in the bays from March to November 1961. The majority of these fish were taken in the Ruppia beds near Lone Oak Bayou, although others were collected elsewhere in both bays. Only one juvenile specimen, caught in Mud Lake, in June, 1961, was taken this year. Additional study of the nursery habitats of this species is needed. Stomach analyses show that this fish feeds mainly on Ruppia and an unidentified algae. Barnacles, shells, crabs, and shrimp were also occasionally found. Three hundred and thirty eight sheepshead were tagged for growth and migration studies. As yet there have been no tag returns.

Lagodon rhomboides (Linnaeus). Pinfish. The pinfish was found in the bays during the warmer months in a habitat similar to that of its cousin, the sheepshead. Although it was a big nuisance during netting operations, it was an important forage species for game fish. Sportsfishermen sometimes use pinfish as live bait for trout and redfish.

Ephippidae

Chaetodipterus faber (Broussonet). Atlantic spadefish. This fish was found in higher salinity areas sporadically throughout the year. It was

considered a forage species as only juveniles were found in the samples.

Trichiuridae

Trichiurus lepturus Linnaeus. Atlantic cutlassfish. A casual visitor to the bays during the warmer months, the cutlassfish was most abundant in the ship channel during the summer. High salinities and water temperatures controlled the occurrence of this species in the bays. It is probably utilized as a food item by large predator species.

Eleotridae

** Dormitator maculatus (Blach). Fat sleeper. One specimen of this fish was taken in the trawl at Five Mile Pass in September 1961 in a salinity of 6 o/oo.

Gobiidae

Gobioides broussonete Lacepede. Violet goby. Trawl samples from Cedar Bayou, Clear Lake, and Trinity Bay yielded five specimens ranging in size from 260 to 410 millimeters. It occurred during periods of extremely low salinities, probably having migrated into the area from a nearby river, creek, or bayou.

Gobionellus boleosoma (Jordan and Gilbert). Darting goby. This Goby was usually taken in seine samples from Taylor and Mud Lakes during the fall. Specimens were never found in a salinity above 5 o/oo.

Gobionellus hastatus Girard. Sharptail goby. Taken sporadically in the trawl in upper Galveston Bay, this species was found in a salinity range of 0.2 to 10.0 o/oo.

Gobiosoma bosci (Lacepede). Naked goby. This minor forage species was found in the bays all year in a wide range of salinities. Apparently not confined to any particular type habitat, it was found on oyster reefs as well as in the open bays.

Microgobius gulosus (Girard). Clown goby. This is another member of the goby family that was common in the area all year. It was found in the low salinity areas of Mud and Taylor Lakes.

Triglidae

Prionotus tribulus Cuvier. Bighead searobin. This year-round inhabitant was most abundant in the fall. Spawning probably occurred in the late summer, as postlarval searobins moved into the nursery areas in October. This euryhaline species is probably of little value as a forage fish because of the sharp spines on its head and body.

Beleniidae

** Chasmodes bosquianus (Lacepede). Striped blenny. Two specimens, taken in a salinity above 15 o/oo, were collected in February at Five Mile Pass and in November 1961 at Redfish Island.

Hypsoblennius ionthas (Jordan and Gilbert). Freckled blenny. A reef dweller that was taken in the oyster dredge near Redfish Island, this fish was found in salinities above 15 ‰.

Ophidiidae

Ophidion sp. Cusk eel. Four specimens of the cusk eel, ranging in size from 30 to 50 millimeters, were caught in the trawl at station G in February 1961. The water temperature was 11.8°C. and the salinity was 18 ‰.

Stromateidae

Peprilus paru (Linnaeus). Harvest fish. This was a warm weather visitor that was usually confined to the high salinities of the ship channel.

Mugilidae

Mugil cephalus Linnaeus. Striped mullet or Black Mullet. This was a common forage species that usually moved in large schools. Roe mullet were caught in the fall and probably moved out of the area in early winter to spawn. Postlarval mullet began to appear in the bays in February and were common until July. The black mullet, which supports a valuable commercial fishery in Florida, has the same commercial potential in Texas if the public could be convinced of the excellent food value of this fish.

** Mugil curema Valenciennes. White mullet. In August seven specimens of this forage fish were caught in Trinity Bay in a salinity of 3.4 ‰.

Menidia beryllina (Cope). Tidewater silverside. Silversides, common in the bays all year, were most abundant during the spring and summer. This forage species was found predominately in marshy and grassy habitats.

Polydactylus octonemus (Girard). Atlantic threadfin or Eight-fingered threadfin. Although this was generally a common forage species found during the warmer months in 1960 it was not collected in 1961. Lower salinities probably accounted for its absence.

Order Pleuronectiformes

Bothidae

Citharichthys spilopterus Gunther. Bay whiff. This flat fish, a common forage species, was most abundant during the spring and summer when juveniles move into the nursery areas of Taylor and Mud Lakes.

Paralichthys lethostigma Jordan and Gilbert. Southern flounder. (Figure 16). The southern flounder was found all year in the bays, but was most abundant during the spring. Juveniles began to appear in the nursery areas in April and continued to show up until late summer. Large flounder were usually taken in trawls over mud and sand bottoms. Some larger specimens were also caught during netting operations. Juveniles were found in such shallow, muddy bottomed nursery areas as Mud, Taylor, and Clear Lakes. Stomach analyses indicate that this fish feeds principally on small fish, shrimp and various unidentified crustacea.

Figure 9 is a map of some of the flounder nursery grounds in Area M-2. In the future, more work needs to be done on locating and mapping nurseries for this important game fish.

All adult flounder were tagged and released in the bays for growth and migration studies. A few juvenile flounder were also tagged and released in the nursery areas.

One of the area's most highly prized game fish, the flounder usually averaged one pound in the sportsman's catch. The largest flounder reported in Area M-2 was a six pounder caught by a sportfisherman at San Leon in upper Galveston Bay.

Soleidae

Achirus lineatus (Linnaeus). Lined sole. This forage fish was common during the summer, fall, and early winter months. Juveniles were more abundant during the fall in areas such as Mud and Taylor Lakes.

Trinectes maculatus (Bloch and Schneider). Hogchoker. This is a common forage species that was taken in a wide salinity range in both bays and the lakes adjacent to the bays.

Cynoglossidae

Symphurus plagiusa (Linnaeus). Blackcheek tonguefish. Another of the year-round dwellers in the bays, this fish was also capable of withstanding a wide salinity range.

Order Echeineiformes

Echeneidae

Echeneis naucrates Linnaeus. Shark sucker. One specimen of the shark-sucker was found attached to a cownose ray, caught near La Porte in upper Galveston Bay in August 1961.

Order Tetraodontiformes

Tetraodontidae

Sphaeroides nephelus (Goode and Bean). Southern puffer. The puffer was found in the higher salinity portions of the bays during the summer and fall.

Order Batrachoidiformes

Batrachoididae

Porichthys porosissimus (Cuvier). Atlantic Midshipman. This is probably the most common member of the toadfish family occurring in the bays. It was usually taken in the ship channel and around oyster reefs.

Comments: The overall hydrographic conditions in the bays seemed to be much better suited for large game fish this year in comparison to the 1959-1960 survey. Table 1 shows the average number of each species caught per haul per month. There was little change in water temperatures except in November which was warmer than in 1960. Salinities were much lower, probably creating a barrier for some of the fish that were found in the bays last year but were missing in 1961. Of course, there were a number of freshwater species collected during the previous study that were missing this year, and their absence can not be explained on the basis of salinities. A more thorough study is needed of the physical and chemical conditions correlated with the occurrence of the various species before these and other questions can be answered satisfactorily.

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Table 1

Average Number of Fishes Taken per Haul, by Months, in Area M-2
Year 1960-61

<u>Species</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>
<i>Carcharias leucas</i>								.30		.20	.04		
<i>Dasypatis sabine</i>					.05		.12	1.50	.71	.20			
<i>Rhinoptera bonasus</i>										.50			
<i>Lepisosteus osseus</i>		.05			.05								.05
<i>Lepisosteus spatula</i>		.05			.82	.08		.25		.10		.91	.05
<i>Elops saurus</i>								.10	.39	.10			
<i>Alosa chrysochloris</i>													.05
<i>Brevortia petronus</i>	16.50	15.20	59.00	19.00	4.10	7.60	24.20	0.40	2.96	9.10	1.68	.27	3.22
<i>Dorosoma cepedianum</i>				.20	.96			1.10		.70		.04	.79
<i>Dorosoma petenense</i>	.20	1.10	9.40	.50					1.85	3.00	2.26	1.18	.74
<i>Anchoa mitchilli</i>	8.50	8.20	12.90	3.20	8.20	14.40	23.80	7.40	Num.	Num.	Num.	Num.	Num.
<i>Synodus foetens</i>	.20							.03					
<i>Ictiobus bubalus</i>					2.80				.03				
<i>Bagre marinus</i>	.05						.16	.20	1.29	1.50	.55	.18	
<i>Galeichthys felis</i>	7.00	.20			.32	.31	1.12	1.10	3.00	9.30	7.20	1.41	2.42
<i>Ictalurus punctatus</i>	.05	.05	.05		.73		.08		.28	1.50			.74
<i>Ictalurus natalis</i>	.05												
<i>Myrophis punctatus</i>	.30				.10		.04		.71		.04		
<i>Strongylura marina</i>								.40		.09			
<i>Adinia xenica</i>									.14				

Table I

Average Number of Fishes Taken per Haul, by Months, in Area M-2
Year 1960-61

Species	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
<i>Myrinodon variegatus</i>	.05	7.90		2.80	1.20	.63		2.90	.71				
<i>Undulus grandis</i>		2.90		.67	4.40	.94		.30	.36			.04	
<i>Undulus pulvereus</i>							.05						
<i>Undulus similis</i>				.05	.40				.32				
<i>Acania parva</i>					.05	.06		.03	.71				
<i>Callinectes latipinna</i>				.05	.50			.60	.03				
<i>Epomis macrochirus</i>				.05									
<i>Comatomus saltatrix</i>							.04						
<i>Arenx hippos</i>									.10				
<i>Arenx latus</i>									.03				
<i>Microscombrus chrysurus</i>									.09				
<i>Ligoplites saurus</i>									.32				
<i>Omer setepinns</i>									.09			.18	.05
<i>Magnathus scovelli</i>				.05									
<i>Yprinus carpio</i>									.03				
<i>Acinostomus sp.</i>		.10							.03				
<i>Rthopristis chrysopterus</i>									.03				
<i>Ardiella chrysur</i>	.10						.04	1.70	1.50	.40	.04		.10
<i>Moscion arenarius</i>	1.70	.70	.05		.05	.02	7.80	21.10	22.20	11.90	11.50	2.50	3.96
<i>Moscion nebulosus</i>	.05			.09			.04	.08	2.00	.09		.04	.15

Table I

Average Number of Fishes Taken per Haul, by Months, in Area M-2
Year 1960-61

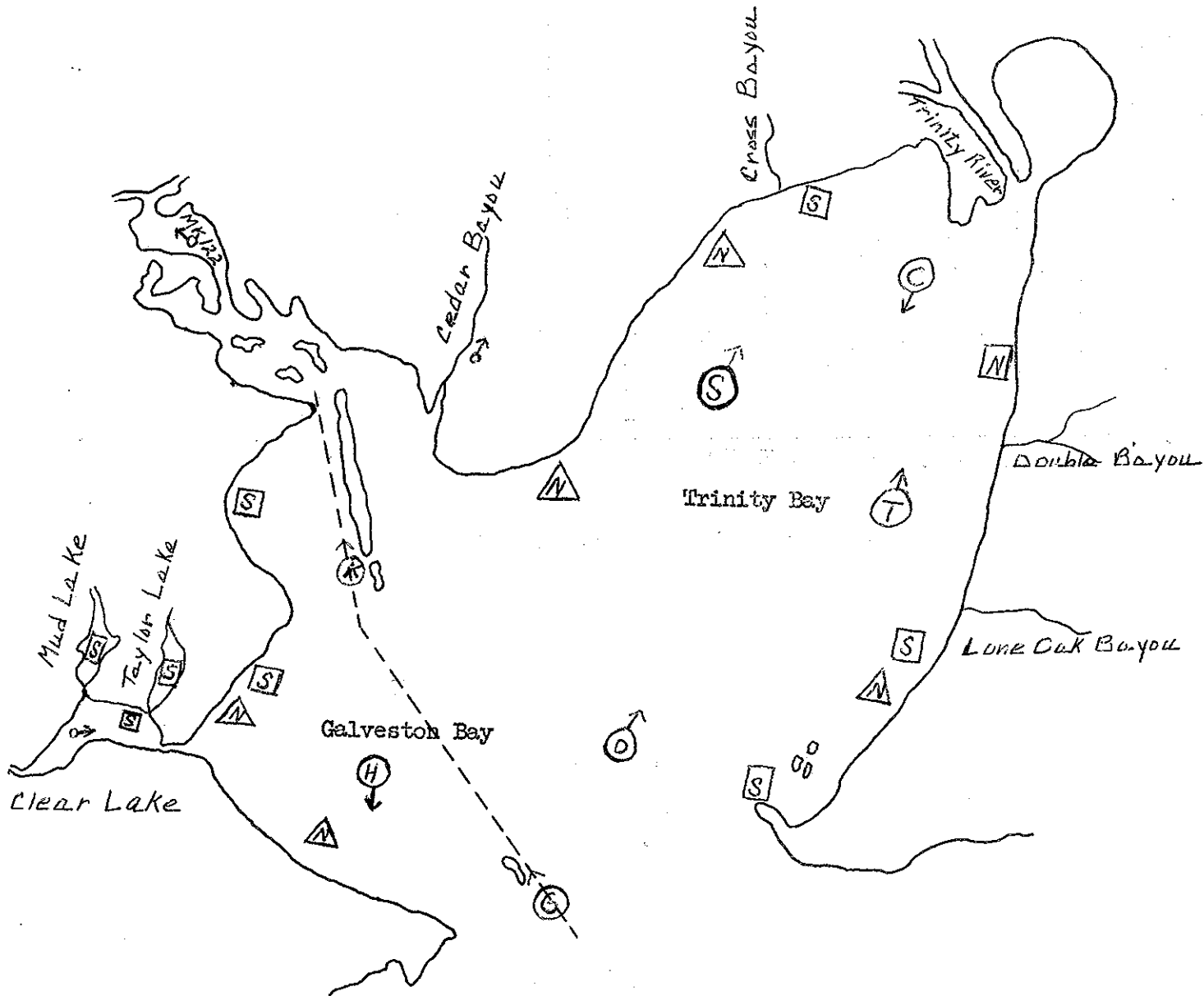
Species	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
<i>Larimus fasciatus</i>													.15
<i>Leiostomus xanthurus</i>	9.70	2.90	4.20	2.60	6.00	7.00	1.12	2.70	2.32	2.00	.55	.18	1.53
<i>Microgogon undulatus</i>	9.40	19.60	18.80	30.00	20.40	40.00	38.00	51.40	86.00	34.10	13.50	1.40	16.80
<i>Menticirrhus americanus</i>		.20							.03		.04		.05
<i>Pogonias cromis</i>				.09	1.40		.04	.30	1.70	.10		6.40	.31
<i>Sciaenops ocellata</i>					.60		.25	.10		.10		.36	4.10
<i>Stellifer lanceolatus</i>	2.00	.10						7.60	29.40	.90	Num.	4.40	8.50
<i>Archosargus probatocephalus</i>	.10				.40		.25	2.50	9.60	.50	.04	.32	.01
<i>Lagoon rhomboides</i>								.50	.71	1.00			
<i>Chaetodipterus faber</i>	.20	.10	.05				.16	.08	.03	.09	.13		.05
<i>Trichiurus lepturus</i>						.50	.20	.08	.71	.20		.09	.16
<i>Dormitator maculatus</i>											.04		
<i>Gobioides broussonete</i>	.05		.05		.10		.04					.04	
<i>Gobionellus boleosoma</i>												.09	.90
<i>Gobionellus bastatus</i>	.30	.05	.05						.03		.04		.10
<i>Gobiosoma boscii</i>	.10	.40	.17	.14	.05	.20			.71	.30	.04	.09	.31
<i>Microgobius gulosus</i>	.20	.30	.05	.57	.50	.06	.20	.03	.26	.70	.04	.09	
<i>Prionotus tribulus</i>	.60	.10	.05	.05		.06				.09	.09	.45	.19
<i>Chasmodes bosquianus</i>													.05
<i>Hypsoblennius ionthas</i>													.05

Table I
Average Number of Fishes Taken per Haul, by Months, in Area M-2
Year 1960-61

Species	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
<i>Ophidion</i> sp.				.20									
<i>Perilus paru</i>								.10	.43		.23		
<i>Mugil cephalus</i>	.05	4.90	.41	22.00	6.40	5.90	.75	7.40	4.70	.70		.04	1.58
<i>Mugil curema</i>										.30			
<i>Mentha beryllina</i>		.05	.18	1.00	7.50	.88	.54	1.10	.53		.04		.05
<i>Polydactylus octonemus</i>	.10												
<i>Citharichthys spilopterus</i>	.30	.45		.05		4.90	3.00	3.50	2.06	.60	.36	.36	.60
<i>Paralichthys lethostigma</i>	.30	.10	.59	.14	.40	.44	.33	.08	.14	.10			.01
<i>Achirus lineatus</i>	1.20	.35							.03	.09	1.45	.95	.37
<i>Trinectes maculatus</i>	.40	.60	1.00	.05	.30	.06	.16	.40	.28	.09	.18	.09	
<i>Symphurus plagiusa</i>	2.40	.40		.30				.03	.14	.09	.68	.41	1.66
<i>Echeneis naucrates</i>										.09			
<i>Sphaeroides nephelus</i>	.20							.10	.17	1.50	.50	.13	.31
<i>Forichthys porosissimus</i>	.10						.04			.09	.13		.15
<i>Notropis</i> sp.				.05									
Number hauls per month	20	20	.6	21	22	16	24	35	28	22	22	22	26

Figure I

Collection Stations, Area M-2

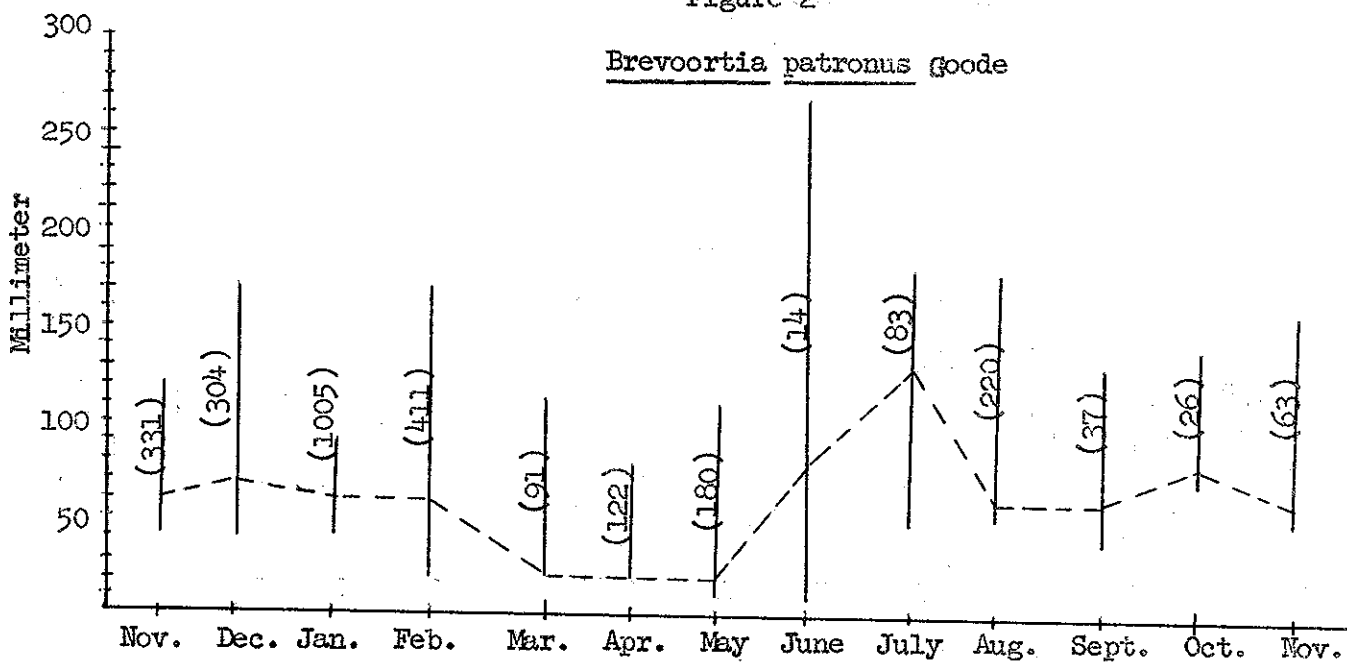


♂ - Trawl stations and trawling direction (Clear Lake and H. are trawl stations for the shrimp study).

□ - Small seine stations (Mud and Taylor Lakes are Bar-seine stations for the shrimp study).

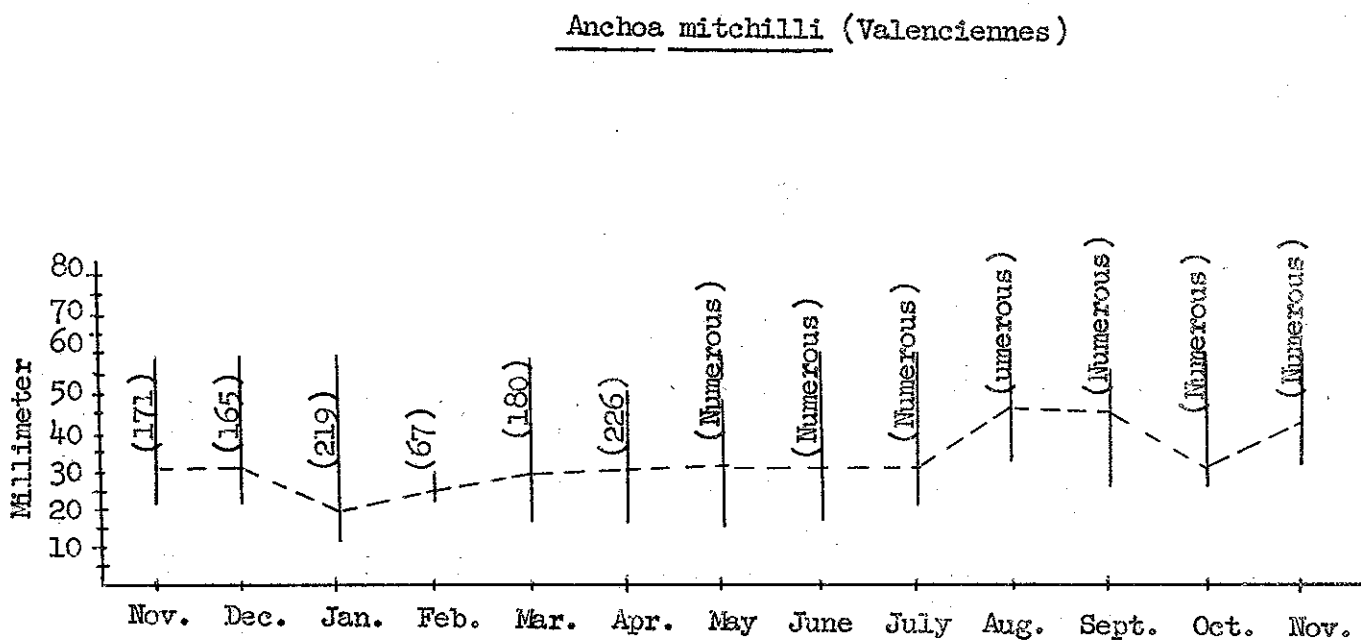
△ - Beach seine, gill and trammel net stations.

Figure 2



Size range of the Menhaden, maximum, minimum and mode.

Figure 3



Size range of the Anchovie, maximum, minimum and mode

Figure 4

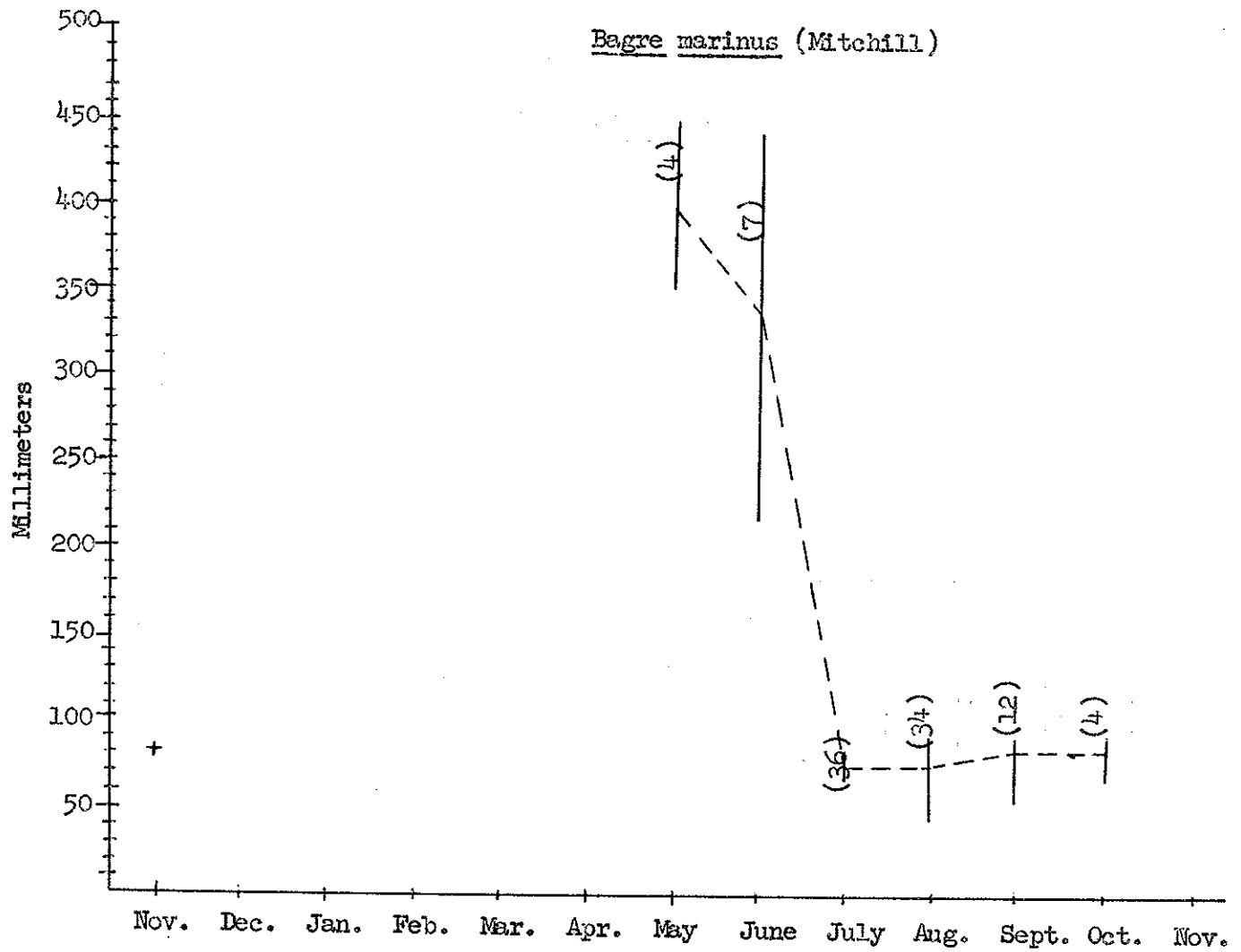


Figure 5

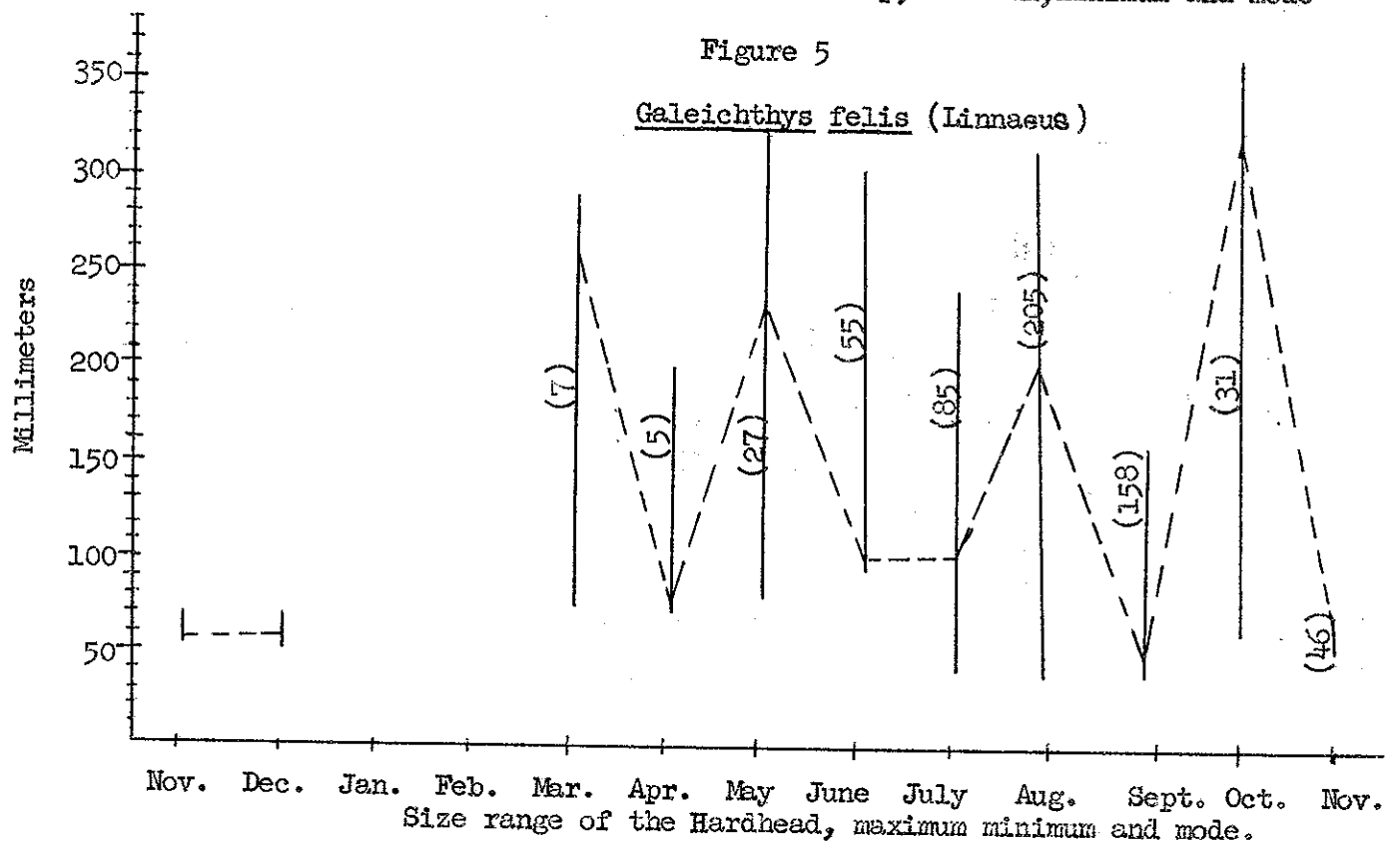
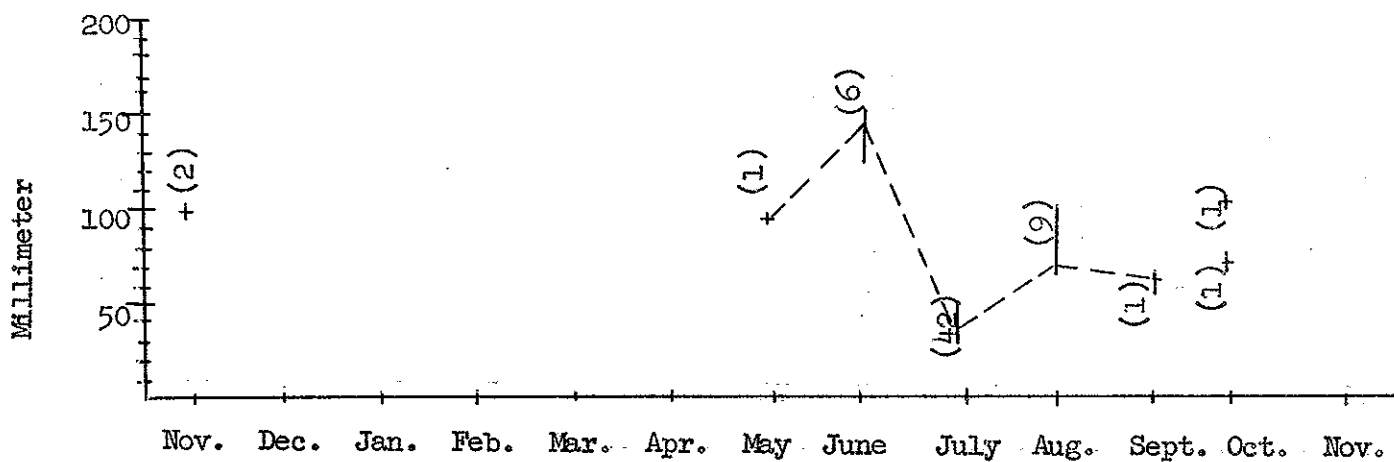


Figure 6

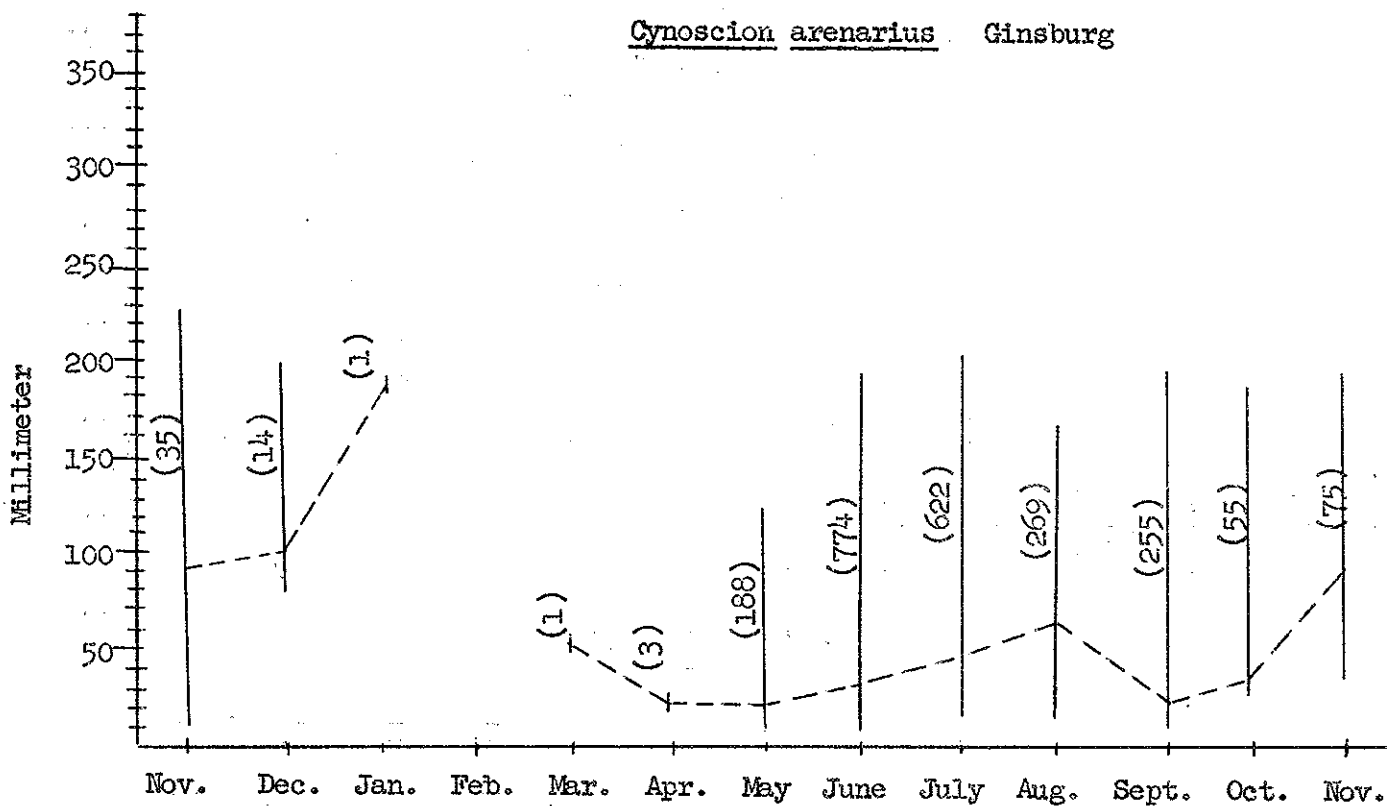
Bairdiella chrysura (Lacepede)



Size range of the silver perch, maximum, minimum and mode

Figure 7

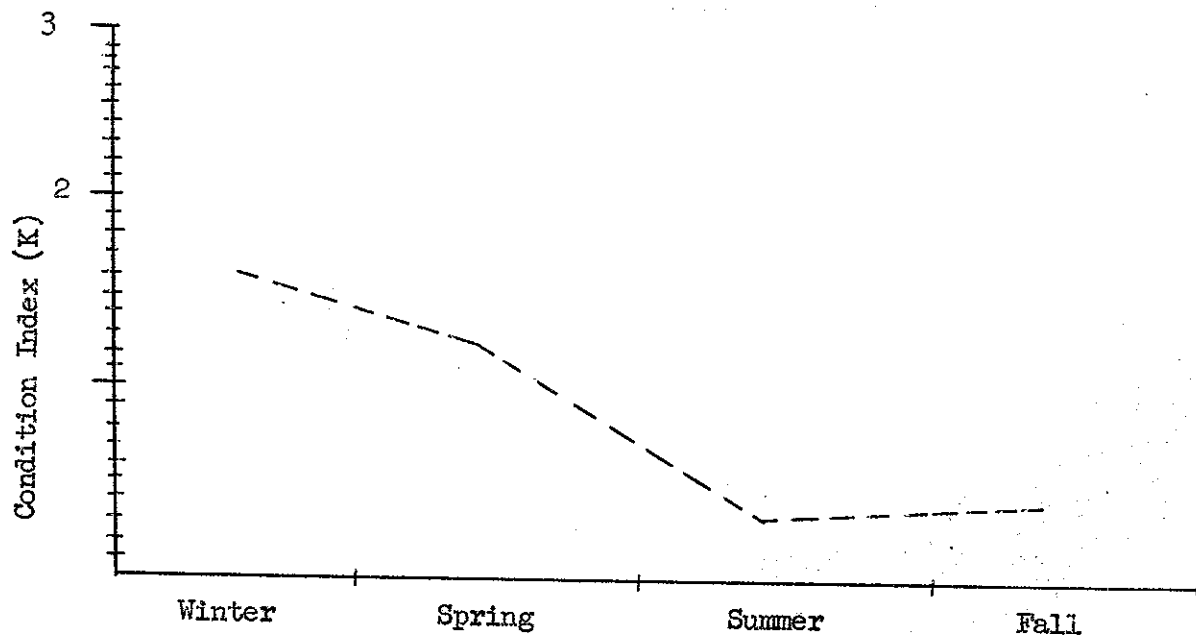
Cynoscion arenarius Ginsburg



Size range of the sand trout, maximum, minimum and mode

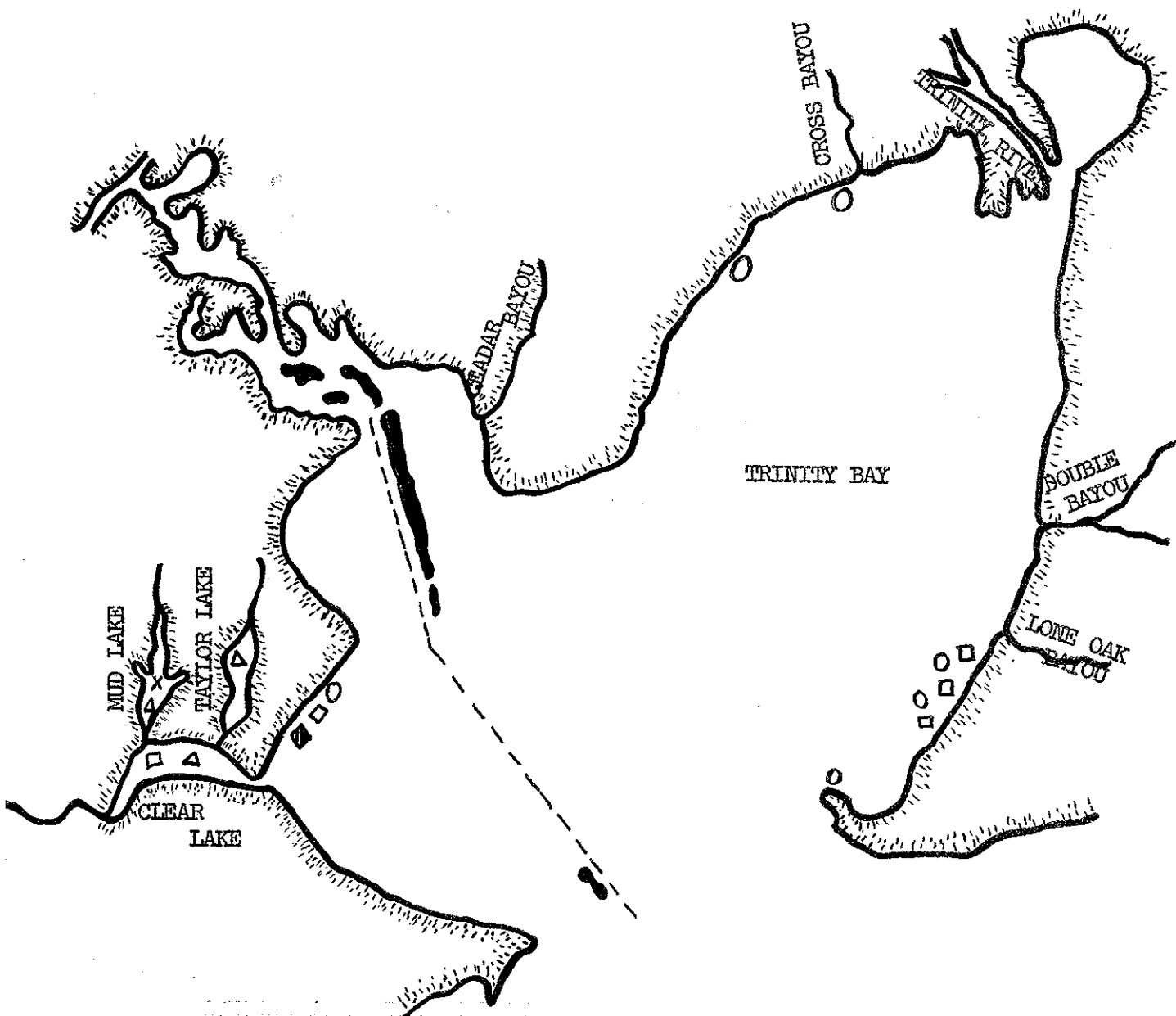
Figure 8.

Cynoscion nebulosus (Cuvier)



Seasonal variation in condition factor in
Speckled Trout.

Figure 9
Game Fish Nursery Areas
Area M-2



Archosargus probatocephalus --- X

Sciaenops ocellata --- [hatched square]

Cynoscion nebulosus --- [open square]

Paralichthys lethostigma --- [triangle]

Pogonias cromis --- [circle]

Figure 10

Leiostomus xanthurus Lacepede

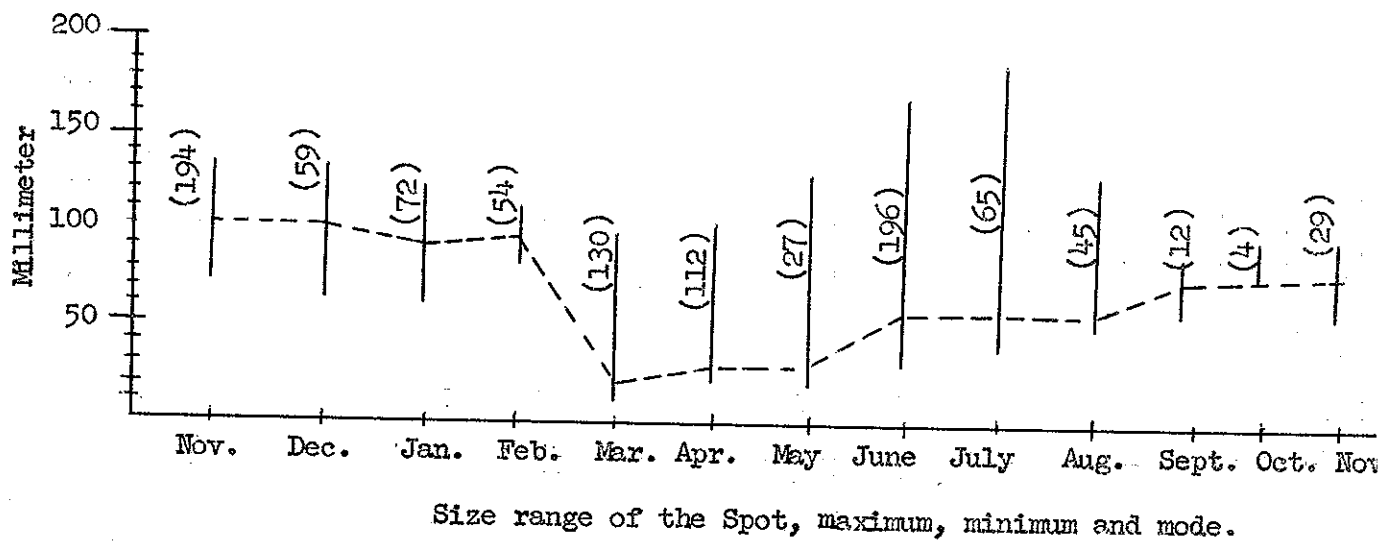


Figure 11

Micropogon undulatus (Linnaeus)

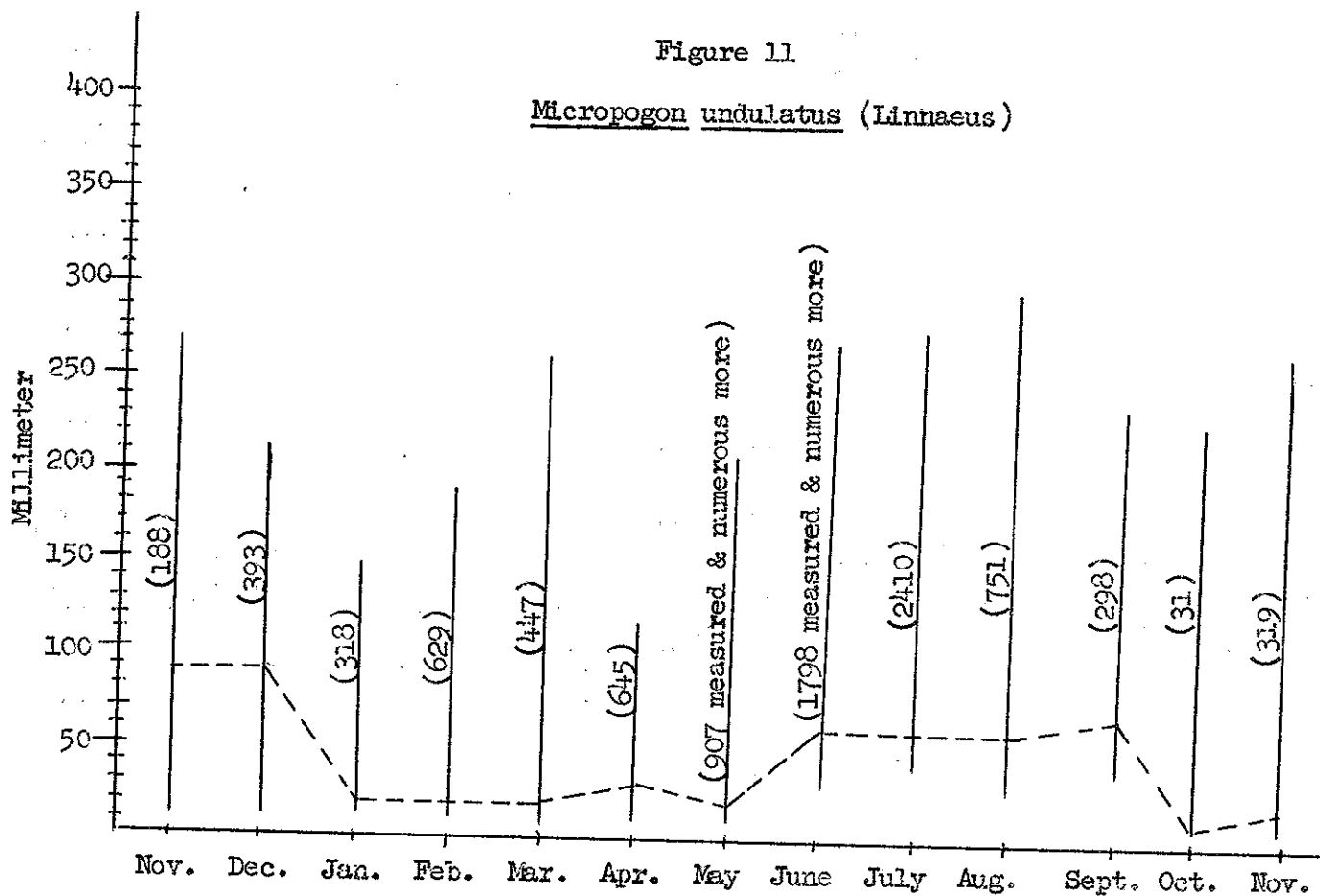
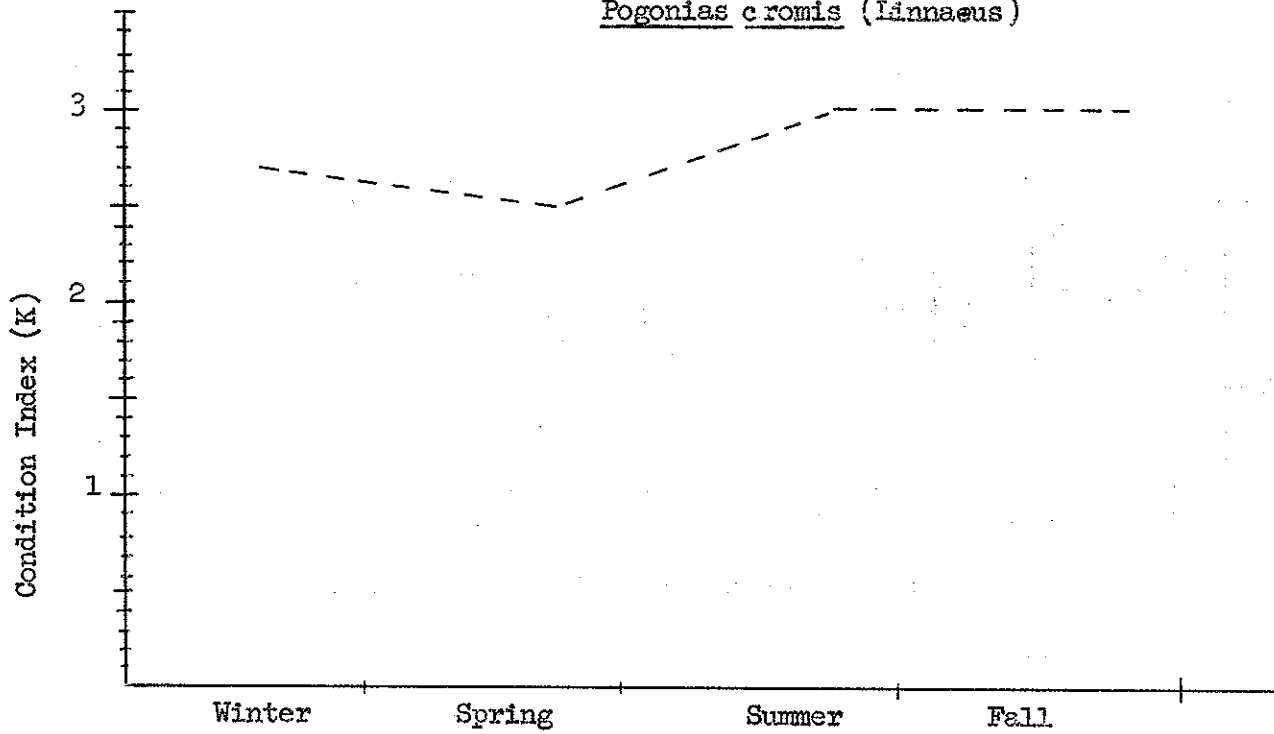


Figure 12

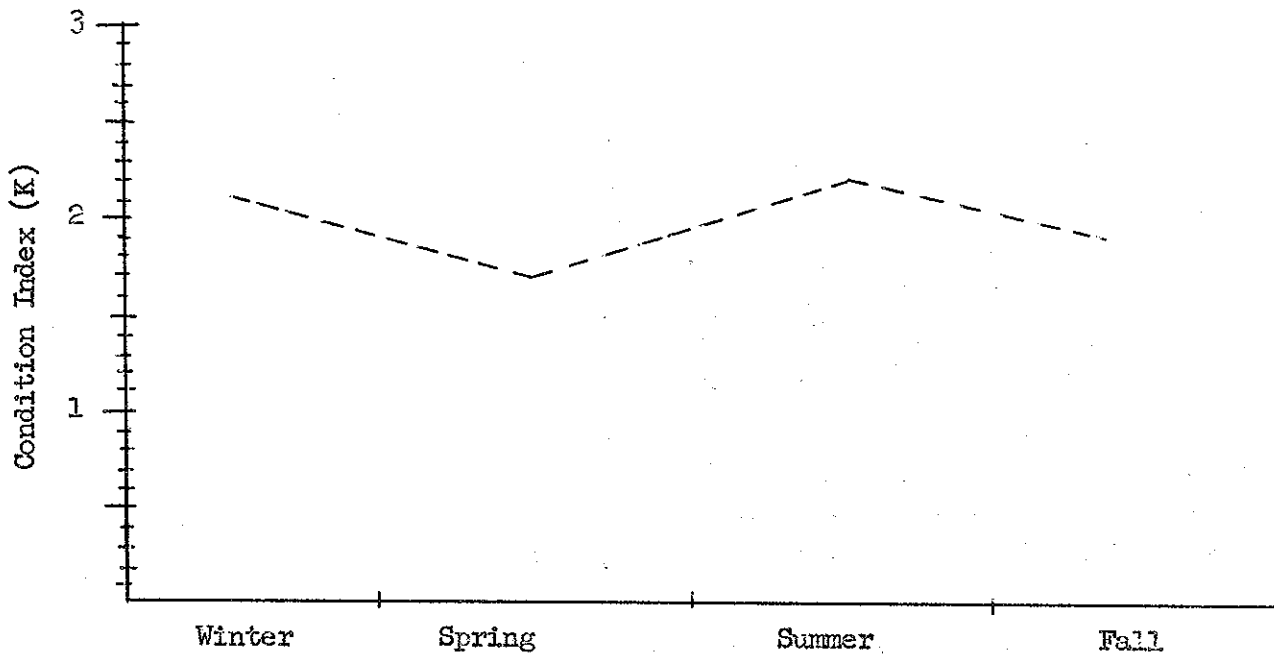
Pogonias cromis (Linnaeus)



Seasonal variation in condition factor in Black Drum.

Figure 13

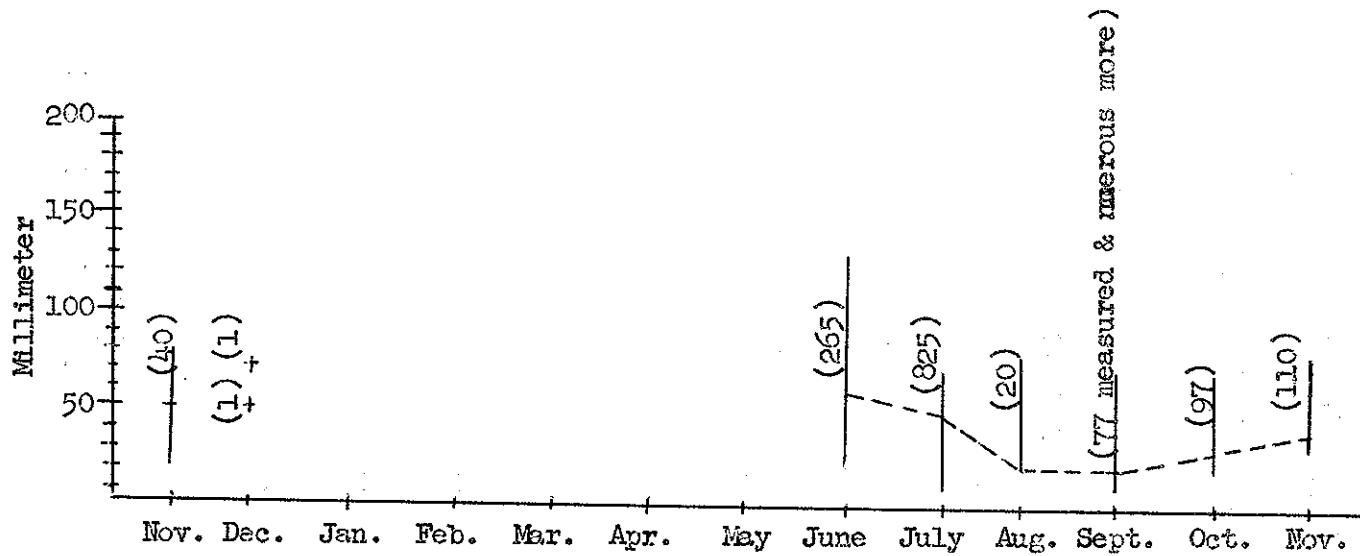
Sciaenops ocellata (Linnaeus)



Seasonal variation in condition factor in Redfish.

Figure 14

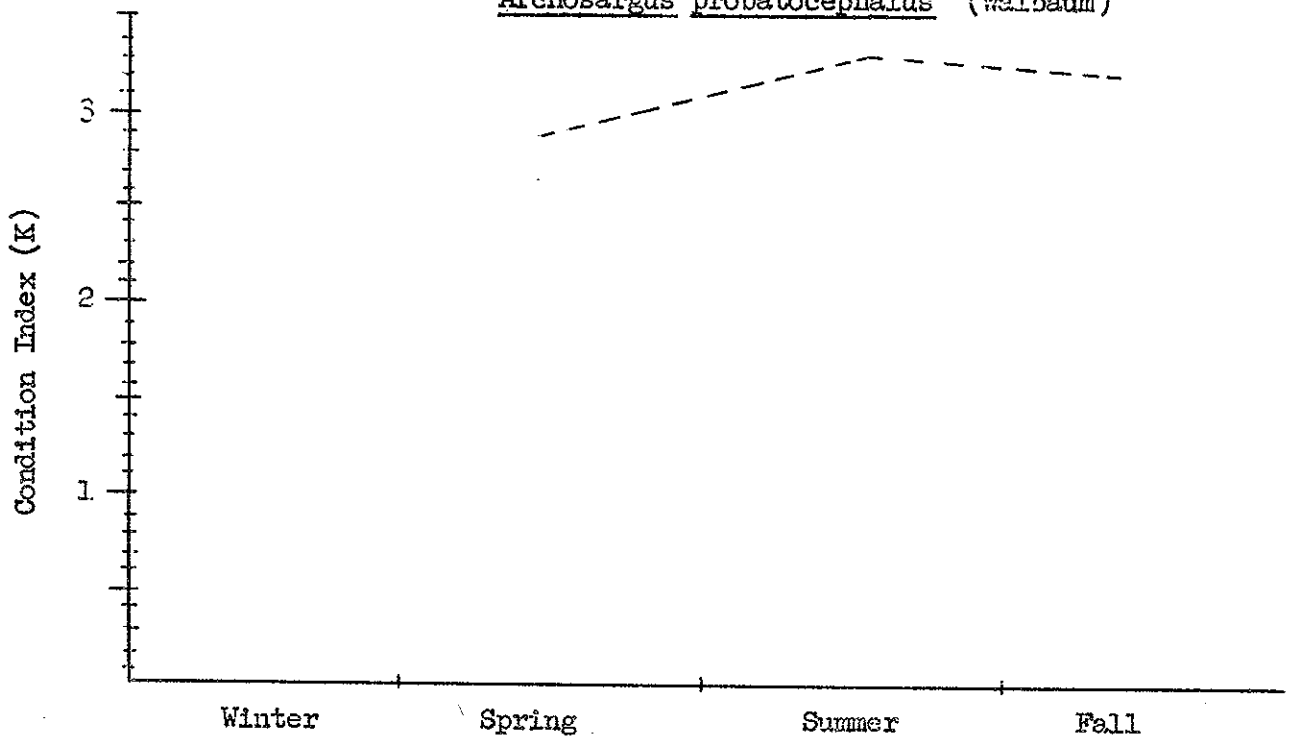
Stellifer lanceolatus (Holbrook)



Size range of the Star Drum, maximum, minimum and mode.

Figure 15

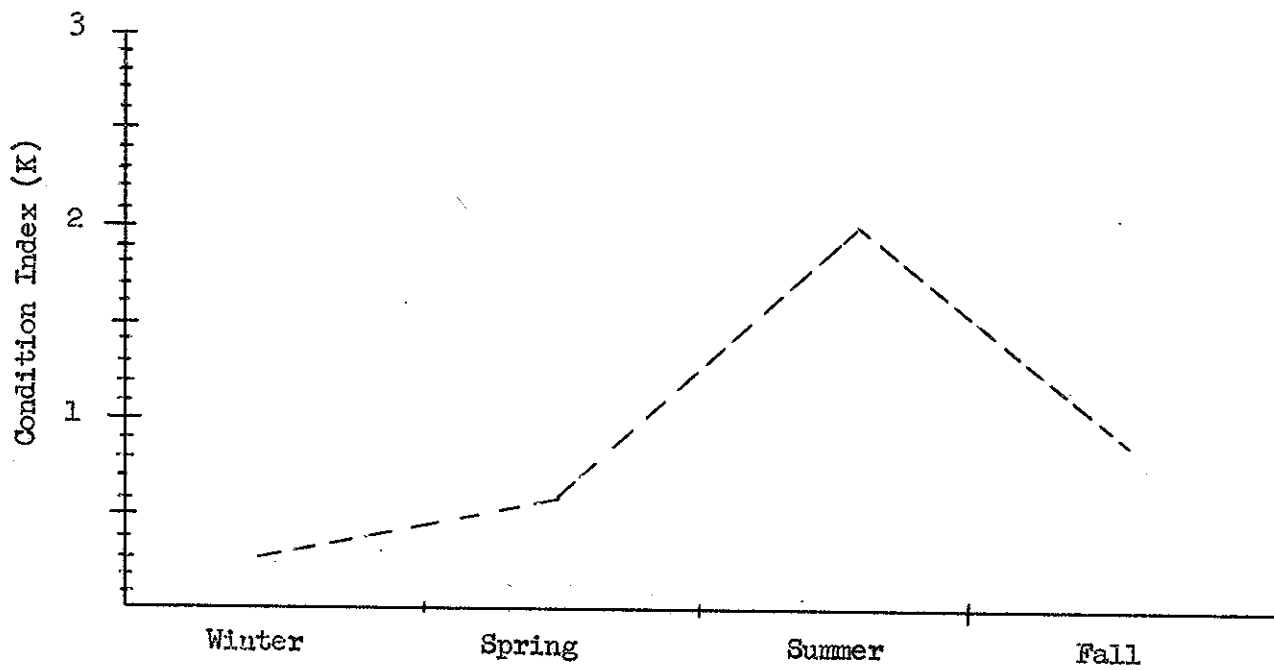
Archosargus probatocephalus (Walbaum)



Seasonal variation in condition factor in Sheepshead.

Figure 16.

Paralichthys lethostigma Jordan and Gilbert.



Seasonal variation in conditionfactor in Southern Flounder.