Acc# 2095

JOB REPORT

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Project Name: Oyster Investigations, Area MO-1.

Period Covered: 1 July 1959 to 30 June 1960. Job No. B-2-C

Interim Shrimp Study

Objectives: To provide a record of distribution, size, and relative abundance of shrimp species and other organisms taken in an otter trawl in the Galveston Bay system during the interval in which fisheries biologists were lacking in Areas M-2 and M-3.

Procedures: Seventy-one trawl hauls were made in this study in the period of 3 August 1959 to 3 December 1959. Estimated total trawling time is 21 hours and 35 minutes* or about 18.2 minutes per haul. The hauls were not timed between the 3rd and 6th of August and these records are not used in the catch-per-time-unit calculations.

Discounting records from 5 and 6 August, 32 hauls were made in Area M-2 from 3 August to 27 October 1959, totaling an estimated 638 trawling minutes, or 19.9 per haul. From 18 August to 3 December, 25 hauls were made in Area M-3 totaling 446 trawling minutes, or 17.8 minutes per haul. During August 40 hauls totaling 826 minutes were made in upper and lower Galveston Bay, but trawl stations were not established (Figure I). Commercial shrimp were sorted by species and measured and other organisms were noted and sometimes counted in most of these hauls. On 18 August shrimp were counted and weighed only.

After 30 September twelve stations were established (Figure I) in Trinity, Galveston, East, and West Bays and visited at bi-weekly or monthly intervals as time permitted from other duties. The length of the trawl drag was standardized at 15 minutes. Organisms taken in the trawl were sorted by species and counted and length measurements were made of certain common species. No liner was used in the trawl; and species such as anchovies, ctenophores, and bottom invertebrates or other species not fished representatively by the 1½-inch trawl mesh were not counted or measured. Their presence, however, was noted when evidence of their occurrence appeared among the trawled material. Shrimp were measured to the nearest millimeter from the tip of the rostrum to the tip of the telson. Blue crab measurements were made between the tips of the lateral carapace spines, usually to the nearest half centimeter. For fishes, standard Length (tip of snout to caudal articulation) was measured, usually to the nearest half centimeter. In the case of squid (*Lolliguncula brevis*) the total mantle length along the dorsal surface was measured to the nearest millimeter.

Findings: I. Species of Swimming Organisms Taken in the Trawl

Forty-five species classified as "swimming organisms" were sampled by the trawl, including 38 species of fish, 5 of shrimp, 1 crab, and 1 squid (see Tables 1 and 2). In addition, specimens or evidences of 42 other species classified as "incidental organisms" were noted, including 2 species of fish, 17 of mollusks, 12 of crustaceans, and 11 of other organisms (see "Incidental Organsisms", p.5).

* The recorded trawling time is the time the trawl was actually being dragged over the bottom.

By far the most abundant species of swimming organism trawled during the course of this study was the white shrimp, Penaeus setiferus Linnaeus; it comprised more than 50 percent of all individuals examined. The study period bracketed the beginning of the open bay shrimp season, and the trawl data from that time seems to show a sharp reduction in both abundance and average size of white shrimp.

Although this initial decline in catches can almost certainly be accredited to heavy fishing at the beginning of the season, the poor catches recorded during the latter part of the study are more likely attributable to the fall migration of shrimp from the bays to the Gulf.

The brown shrimp, Penaeus aztecus Ives, comprised about 9 percent of the total catch of commercial shrimp. It is believed that all the grooved shrimp taken in the trawl were this species, although some grooved individuals seined from the margins of West Bay have been identified as Penaeus duorarum Burkenroad. Very few of the brown shrimp taken during the sampling period were larger than "bait size"; their average size was such that none of the sample catches were of legal commercial as defined by the Texas Shrimp Conservation Act. Only in Clear Lake were brown shrimp found to outnumber whites in number of individuals taken.

Blue crabs, Callinectes sapidus Rathbun, were taken in nearly all areas sampled, but the largest individuals were more common in deeper waters and in higher salinities. Crab measurements were found to resolve themselves into two size modes -- juveniles about 35 mm across, more common in tributary bayous and shallow water; and mature adults about 170 mm across. According to Rathbun (1930, p. 104) adult female blue crabs vary in width from 5 to 7 inches (127 to 177 mm), but at Station TBP on 26 October 1959 a mature female blue crab was collected which measured 65.3 mm in greatest carapace width and which appeared to be C. sapidus Rathbun. The identification was subsequently verified by W.A. Van Engel, crab biologist at the Virginia Fisheries Laboratory. Several "dwarf" adult female C. sapidus have been reported recently from the coasts of North Carolina and Virginia (Fischler, 1959; and Van Engel, unpublished records).

The hardhead catfish, Galeichthys felis Linnaeus, was abundant, especially over sandy bottom areas in Area M-2; more than 200 were taken in a single 15 minute trawl haul off Red Bluff Point, Upper Galveston Bay. Most of the individuals encountered in the trawl catches were juveniles measuring less than 100 mm SL. Another abundant species in Area M-2 was Brevoortia patronus Goode, the Gulf menhaden. However, these fish, at least at the time of the study, were found to be more concentrated in the deeper channels. As in the case of G. felis, most specimens of this species taken in the trawl were juveniles.

Aside from the hardhead and menhaden, the most abundant fish were three species of sciaenids. Again, the trawl catch was comprised predominantly of juvenile individuals, especially of the sand trout, Cynoscion arenarious Ginsburg, which were sporadically abundant, particularly over sand bottoms. Specimens ranging 100 to 300 mm were, however, taken occasionally.

The spot croaker, Leiostomus xanthurus Lacepede, was sometimes abundant, especially in Area M-3, where it occurred commonly and consistently at Station TBP.

By far the most abundant sciaenid and in Area M-3 the most abundant swimming organism other than the white shrimp was the Atlantic croaker, Micropogon undulatus Linnaeus. In this case also, specimens longer than 100 mm were uncommon in the trawl catches.

II. Abundance of Swimming Organisms Taken in the Trawl

Table 2 tabulates an estimate of the abundance of all "swimming organisms" taken during the period of study in each of the two major areas studied, and the total number of individuals taken of each species. Figure II compares the rank among the total organisms taken of the commoner species trawled in the two areas. Figures III and IV show the relative abundance of organisms taken in each area in terms of percentage of total catch by individuals.

Penaeus setiferus was by far the most abundant species in both areas. Galeichthys felis ran a distant second in Area M-2, and Micropogon undulatus did likewise in M-3. The four species Penaeus aztecus, P. setiferus, G. felis and M. undulatus comprised 79.9% of the catch in M-2 and 74.5% of the total in Area M-3. In the case of the remaining species, there was considerable difference in their rank in the catch in the two areas. It is believed that this condition is a reflection of the difference between the lower average salinity conditions in Area M-2 and the higher ones in M-3. Among the species relatively more abundant in M-2 than in M-3 were Brevoortia patronus, Callinectes sapidus, Stellifer lanceolatus, and Spheroides nephelus. In M-3, those more abundant included Lagodon rhomboides, Cynoscion arenarius, Leiostomus xanthurus, and Chaetodipterus faber. In addition to the salinity difference mentioned, other environmental variations between the two areas may be indicated by these results; for instance, Area M-2 has a higher proportion of mud bottom than M-3, whereas M-3 has more sand bottom. In Table 3 the average salinities and water temperatures are given for the areas and periods compared in this section. In the interest of making trawl hauls of differing lengths more directly comparable, relative abundance will be expressed in terms of number of individuals per 15 minutes' trawling time. Since there was a certain amount of variation in boat speed due to winds, currents, and other factors, causing differences in the area covered by the trawl in a given time unit, these figures will not be strictly valid as catch-per-unit-effort calculations, but they will serve as a reasonable approximation.

Figure V compares the relative abundance of 8 species in Area M-2 and M-3, whose most important environmental difference is believed to be salinity (see Table 3), although bottom type, turbidity, and other factors may be influential. It will be seen that those species more abundant in M-2 were extremely so, compared with those more abundant in M-3. Thus it may be that those organisms adapted for survival in the lower salinity areas of the Galveston Bay System encounter fewer competitive species and are able to greatly increase their numbers, as is usually the case with organisms in specialized environments everywhere. October was chosen as the month for comparison of the two areas because data was kept for more species that month.

Figure VI compares the abundance of 8 species in Area M-3 for the months of October, November and December. Decline seemed to be the order of the season for all species, but some had their biggest decline between October and November (Figure VI, - II) and others between November and December (Figure VI, - I.). The falling water temperature is probably the biggest factor related to this decline (see Table 3) causing many species to migrate Gulfward, but sport and commercial trawling undoubtedly take their toll, and some species as they grow may become more adept at avoiding the trawl.

Comparison is made in Figure VII of catches over various bottom types. No trawl hauls were made directly over oyster reefs, but merely around the edges, thus insufficient "reef fishes" (Chaetodipterus, Lagodon) were taken to merit comparison in these graphs. The channel environment would appear to be by far the most productive trawling ground at this season, and channels are favored by many shrimpers. The piscivorous sand trout (true to its name) occurred most commonly over sand bottoms, accompanied by the hardhead catfish. The croaker and spot croaker showed a slight preference for mud bottoms, possibly correlated with their habit of preying upon the mud-dwelling mollusks Rangia spp. and Macoma mitchelli (see Reid, Inglis, and Hoese, 1956; also stomach-contents data of Game and Fish Commission biologists E.J. Pullen and J.K. Shidler.)

III. Size of Swimming Organisms Taken in the Trawl

The size range, average size, and standard size deviation of seven species measured in this study are shown in Figure VIII and Table 4. Due to the diverse methods of measuring squid, crabs, shrimp and fish, comparison between the graphs of those different groups is of course of limited value. They are graphed together merely for the sake of convenience.

No brief squid, L. brevis, were encountered in Area M-2; of the remaining six species, all had a smaller average size in Area M-3 except the blue crab, C. sapidus, and the sand trout, C. arenarius.

The relatively enormous standard deviation of blue crab sizes reflects the preponderance of small (25-45 mm) and large (150-180 mm) crabs and the comparative rarity of medium-sized ones.

The size dispersion shown for the croaker, M. undulatus, indicates the size composition found to be true for many species as sampled by the trawl; that is, the majority of individuals measured were juveniles near the small extreme of the size range.

Table 5 compares the average sizes and the size ranges of the 7 commonest species that were measured. Sizes in the two areas for October are compared and also sizes in M-3 for the 3 successive months of October, November, and December. All of the species considered averaged larger in M-2 except the blue crab, C. sapidus, and all had a greater size range in M-2 except the croaker, M. undulatus.

All species showed a decline in average size from October to December, except the croaker and the blue crab. This does not mean that the other species shrunk, but that the larger specimens migrated somewhere, probably into the deepest channels or the Gulf. The croaker and the crab range naturally farther north along the Atlantic coast than any of the others except the spot and might be expected to be more resistant to winter cold. Only one spot, L. xanthurus, was collected after October; additional data might show an increase for this species, too. Excepting the squid, L. brevis all species showed a net decrease in size range with the progression of the study period.

The percentage-length-frequency polygons in Figure IX compare the age composition of shrimp in the two areas by months. After November insufficient P. setiferus were taken to graph in this manner, and after October not enough P. aztecus were taken to graph.

The P. setiferus population in Area M-3, which was sampled in August, October, and November shows a steady regression of the major size mode during that period. The data are insufficient to indicate whether a similar regression took place in Area M-2; however, a "raggedness" of the major mode appears in both areas in October, possibly due to the combined effects of regular heavy fishing after the opening of the bay shrimp season on August 15 and of the fall migration of the large shrimp into the Gulf.

Comparison of the graphs of P. aztecus with those of P. setiferus will serve to reiterate the considerably smaller average size of the former.

The lines on the graph indicating the "legal size" or the average size that the shrimp in a trawler's catch must equal or exceed in order to "meet legal requirements" and be harvested for food purposes show that the harvestable portion of the population quickly disappears either from fishing or migration and that by the onset of winter only a few undersize shrimp are left in the bay.

IV. Incidental Organisms Taken in the Trawl

Organisms which by reason of their size (such as anchovies) or their consistency (such as jellyfish) were incompletely trapped by the trawl meshes or whose domain was sometimes but not consistently entered by the trawl (such as burrowing mollusks) are among those which have been classified as organisms incidentally taken in the trawl. Record was also kept of evidences such as mollusk shells and worm tubes of the occurrence of certain species. On the basis of average salinity conditions at the places where these and other collections were made (See Hydrographic and Climatological Data Report), Areas M-2 and M-3 can be divided into the following faunal areas (Figure X):

A. Low Salinity Fauna (0-10 ppt) -- typified by the occurrence of bivalve mollusks Rangia cuneata and Macoma mitchelli.

B. Medium-Low Salinity Fauna (10-15 ppt) -- where the bivalves Rangia flexuosa and Tagelus plebius typicallly occur and often entered by the hermit crab Clibinarius vittatus, carrying with it the shells of Polinices duplicatus and Thais haemastoma floridana, which are not commonly found alive in this salinity range.

C. Medium Salinity Fauna (15-20 ppt) -- containing a great diversity of incidental organisms. Many of these organisms will be recognized as those commonly associated with oyster reefs and it is true that this area contains the most extensive oyster bottoms in the Galveston Bay system. Typical examples, besides the oyster Crassostrea virginica, are the mussel Brachidontes recurvus, the oyster conch, Thais haemastoma floridana, and the barnacles Balanus eburneus and B. improvisus. A polychaete worm and a bryozoan, both unidentified, are also common. Clibinarius vittatus and a mud crab Eurypanopeus depressus often occur.

D. Medium-High Salinity Area (20-25 ppt) -- many of the organisms from the last area range into this one, especially Clibinarius vittatus. Organisms typical in this area include another hermit crab, Pagurus pollicaris, a grass shrimp Palaeomonetes sp., and the mantis shrimp, Squilla empusa.

E. High Salinity Area (25 ppt +) -- this is known to be an area of extensive beds of small bivalves of the families Tellinedae and Mactridae, but these organisms, perhaps because of their size or burrowing habit, were infrequently taken in the trawl. Other organisms appeared commonly, such as the Gulf oyster Ostrea equestris, the snails Crepidula plana and Polinices duplicatus and the crab Petrolisthes armatus.

A few anchovies Anchoa mitchelli were found in all areas. Though the species is known to be abundant few were seen in the trawl hauls; most individuals were undoubtedly able to slip through the trawl mesh. Along with small shrimp and juvenile Scianidae, A. mitchelli must be an important element in the forage ecology of species of game fish in the bays.

The comb jelly Mnemiopsis mccradyi sometimes occurs everywhere in the bays and even well up into the tributary bayous, and are the source of great quantities of unrecognizable slime taken in trawls. Quite possibly other species of ctenophores and jellyfish are taken in this manner also and their presence is missed.

Table 6 is a record by areas of incidental species observed.

V. Summary

Eighty-seven species were sampled with the otter trawl, including 45 swimming organisms and 42 incidental organisms. The white shrimp Penaeus setiferus was by far the most abundant species during the period of study. Four species -- Penaeus setiferus, Galeichthys felis, Penaeus aztecus, and Micropogon undulatus -- made up about three-quarters of the total catch in terms of number of individuals in both Areas M-2 and M-3.

In nearly all cases where comparison was made, individuals of a species had a larger average size in Area M-2 than in M-3. Almost all the species measured showed a decline in average size from October to December, probably due to migration of the larger individuals from the study area.

Though fewer species were recorded from Area M-2, by far the greater number of individual organisms were taken there. The organic population of the bays dropped sharply from October to December. The preponderance of organisms came from hauls made in dredged channels; otherwise, sand bottom was the favorite environment.

Specimens or traces of many species of non-motile and small motile organisms were observed. These creatures seemed to come from about 5 more-or-less distinct ecological communities.

Caution should be exercised in making any sort of extrapolation based on the data presented here. The study was perhaps not intensive enough to total an adequate trawl sample; and, of course, there are definitely limitations to the trawl as a sampling device. The period of study was not long enough to include more than a segment of any seasonal cycles that may exist.

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Accepted by Howard T. Lee (signature)
Howard T. Lee

Date 7 November 1960

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Fischler, K.J. 1959. Occurrence of extremely small ovigerous crabs (Callinectes sp.) in coastal North Carolina. Ecology 40 (4): 720.

Rathbun, M.J. 1930. The cancroid crabs of America of the families Euryalidae, Portunidae, Atelecyclidae, Cancridae, and Xanthidae. U.S. Nat. Mus. Bull. 152.

Reid, G.K., Anthony Inglis, and H.D. Hoese 1956. Summer foods of some fish species in East Bay, Texas. Southwestern Naturalist 1 (3): 100-104.

FIGURE I

Areas in Galveston Bay System Sampled by Otter Trawl, August - December 1959.

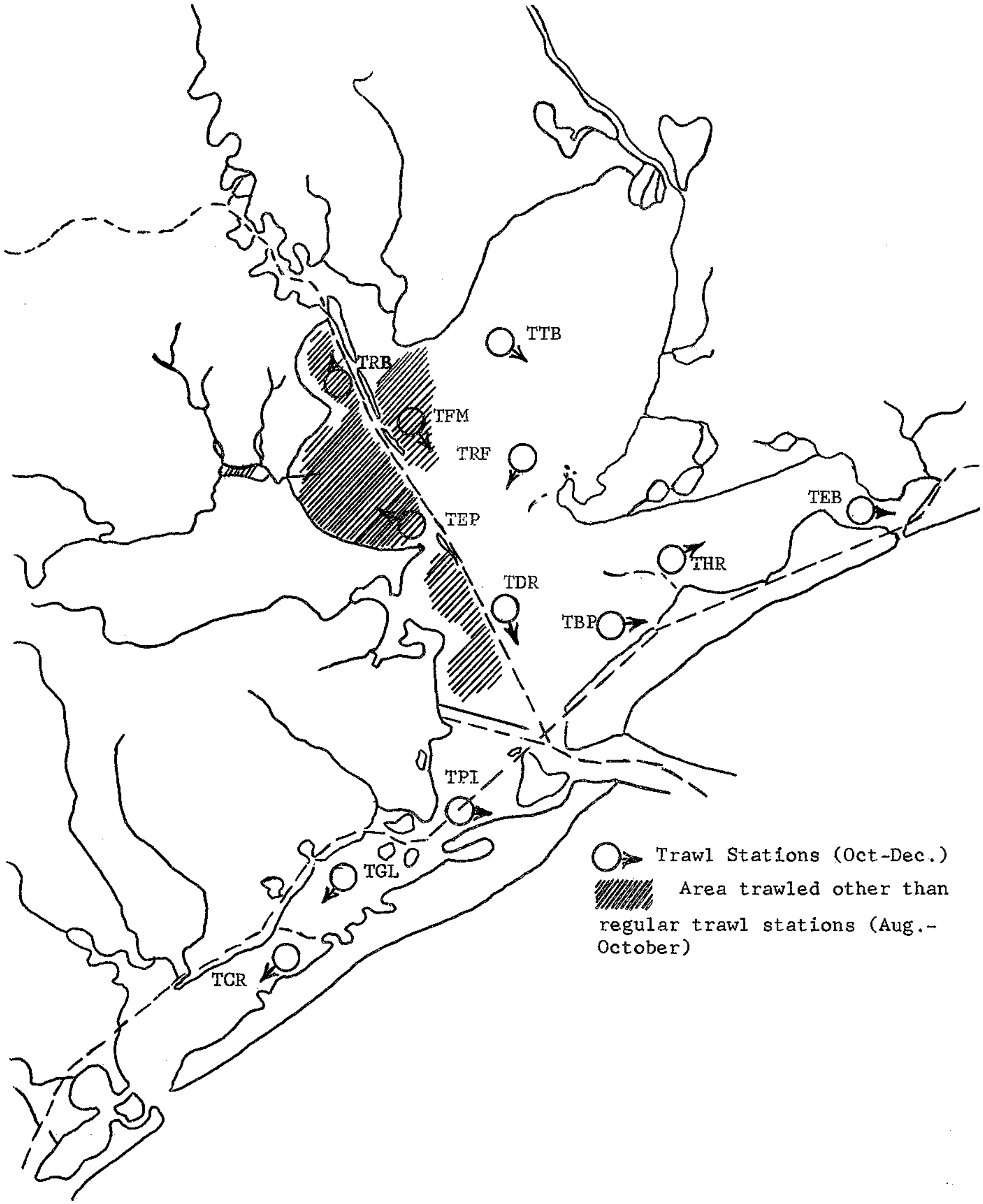


FIGURE II

Comparison of Rank of Abundance of Organisms in Areas M-2 and M-3.

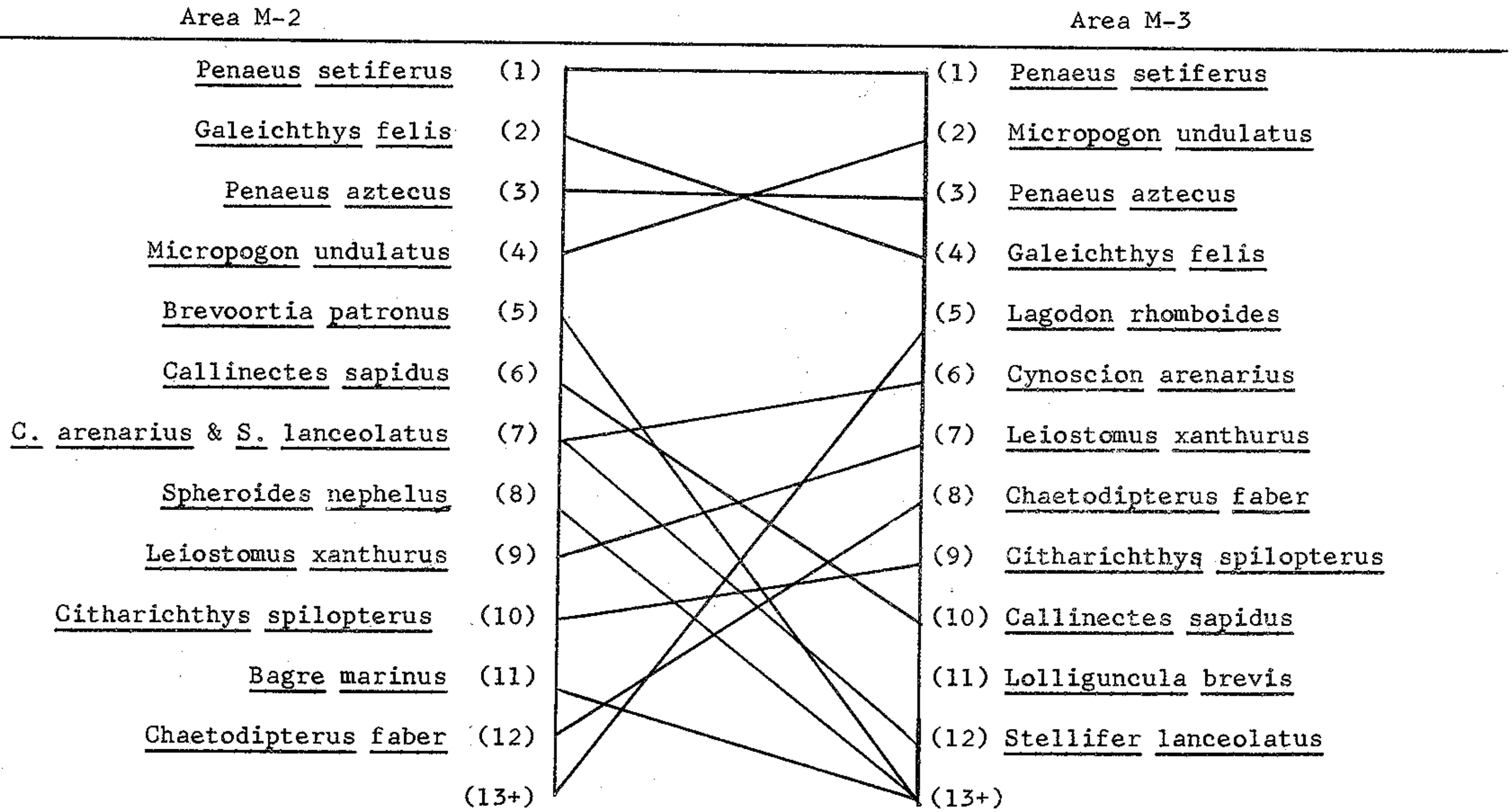


FIGURE III

Relative Abundance of Species of Swimming Organisms Trawled in Area M-2

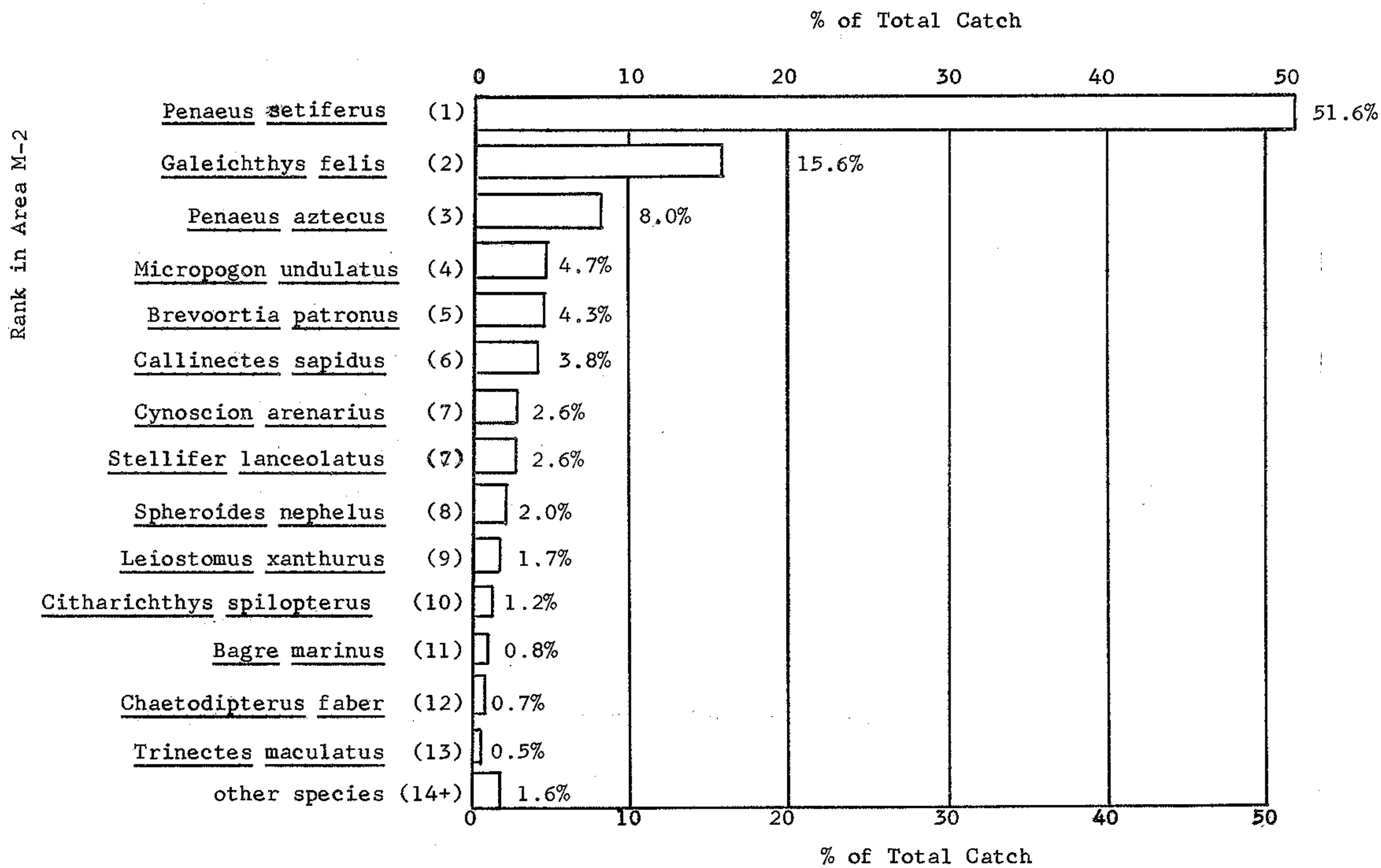
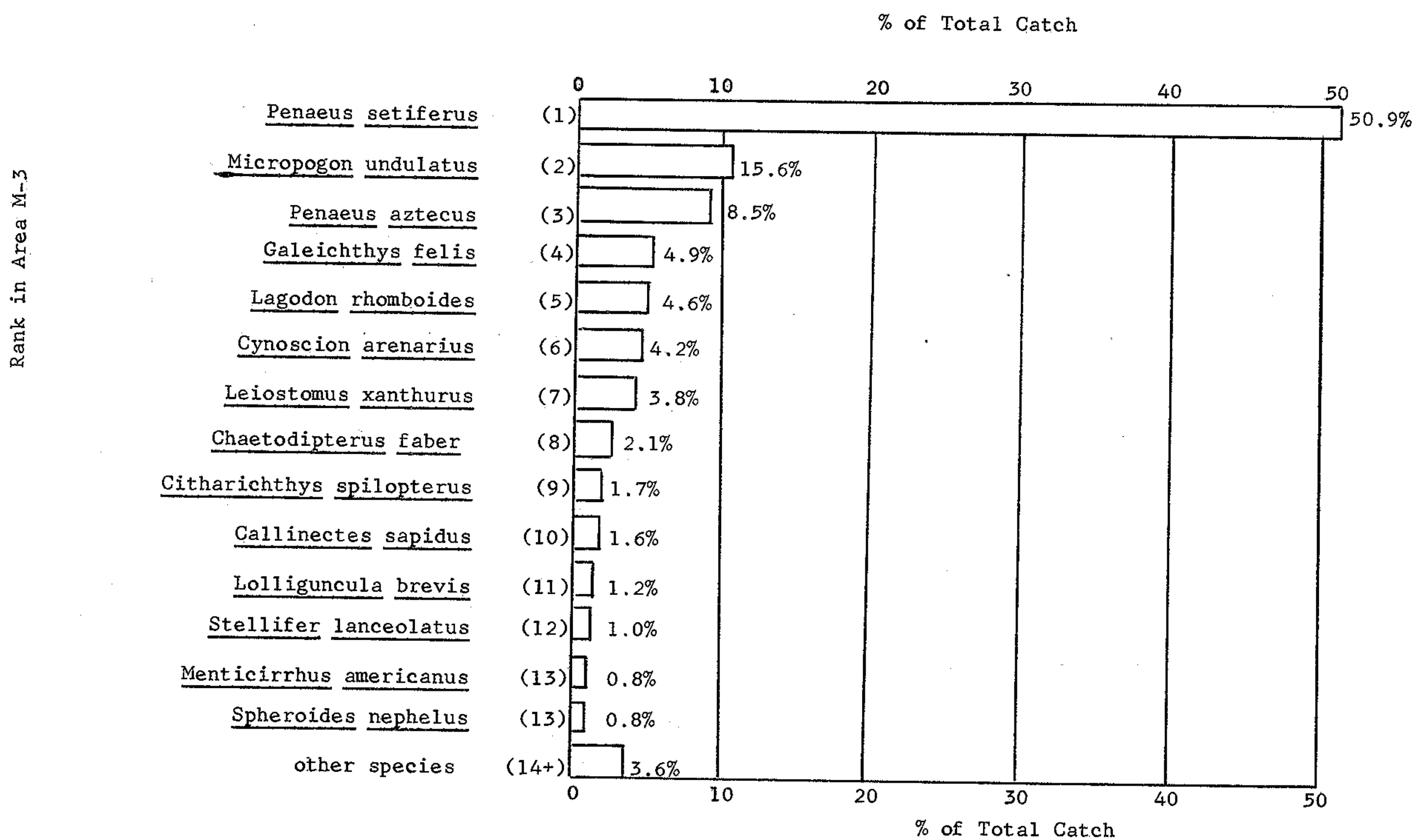
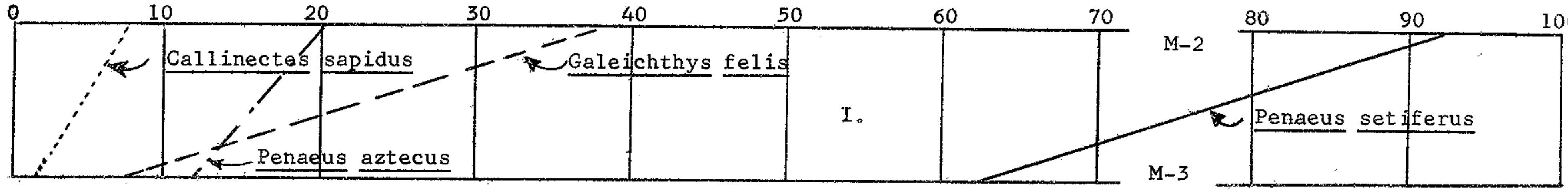


FIGURE IV

Relative Abundance of Species of Swimming Organisms Trawled in Area M-3.





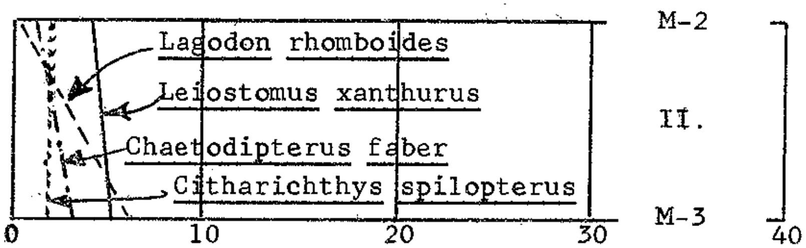
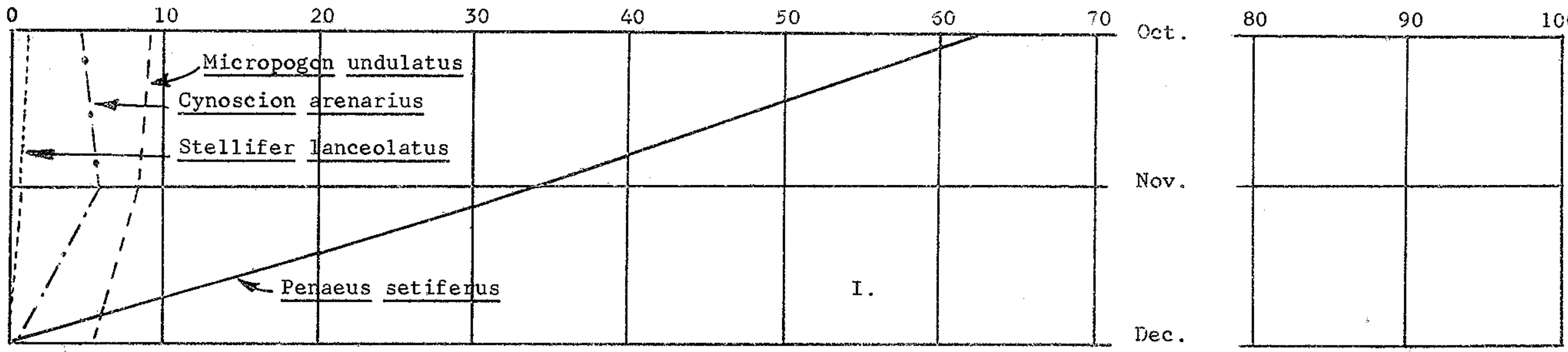


FIGURE V

Areas M-2 and M-3, October 1959.

I. Species more common in Area M-2
II. Species more common in Area M-3

Average Number of Individuals per 15 Minutes' Trawling Time.



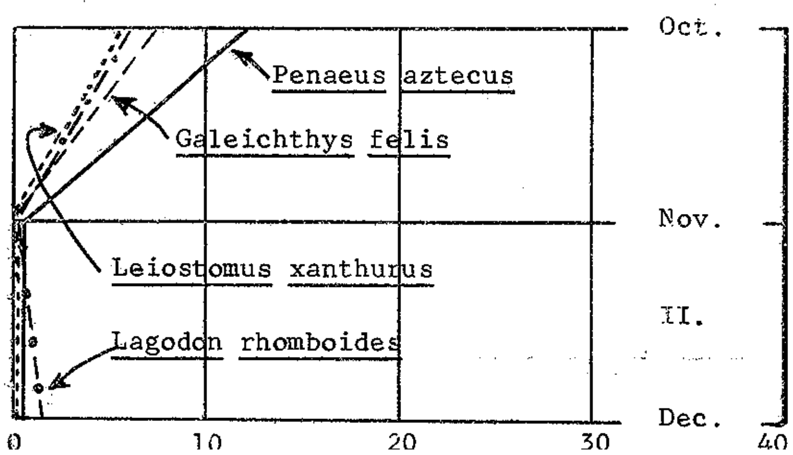


FIGURE VI

Area M-3, October to December 1959.

I. Species declining more rapidly November to December.
II. Species declining more rapidly October to November.

FIGURE VII

ABUNDANCE RELATED TO BOTTOM TYPE

I. Species more abundant in channels

II. Species more abundant over sand or mud bottom.

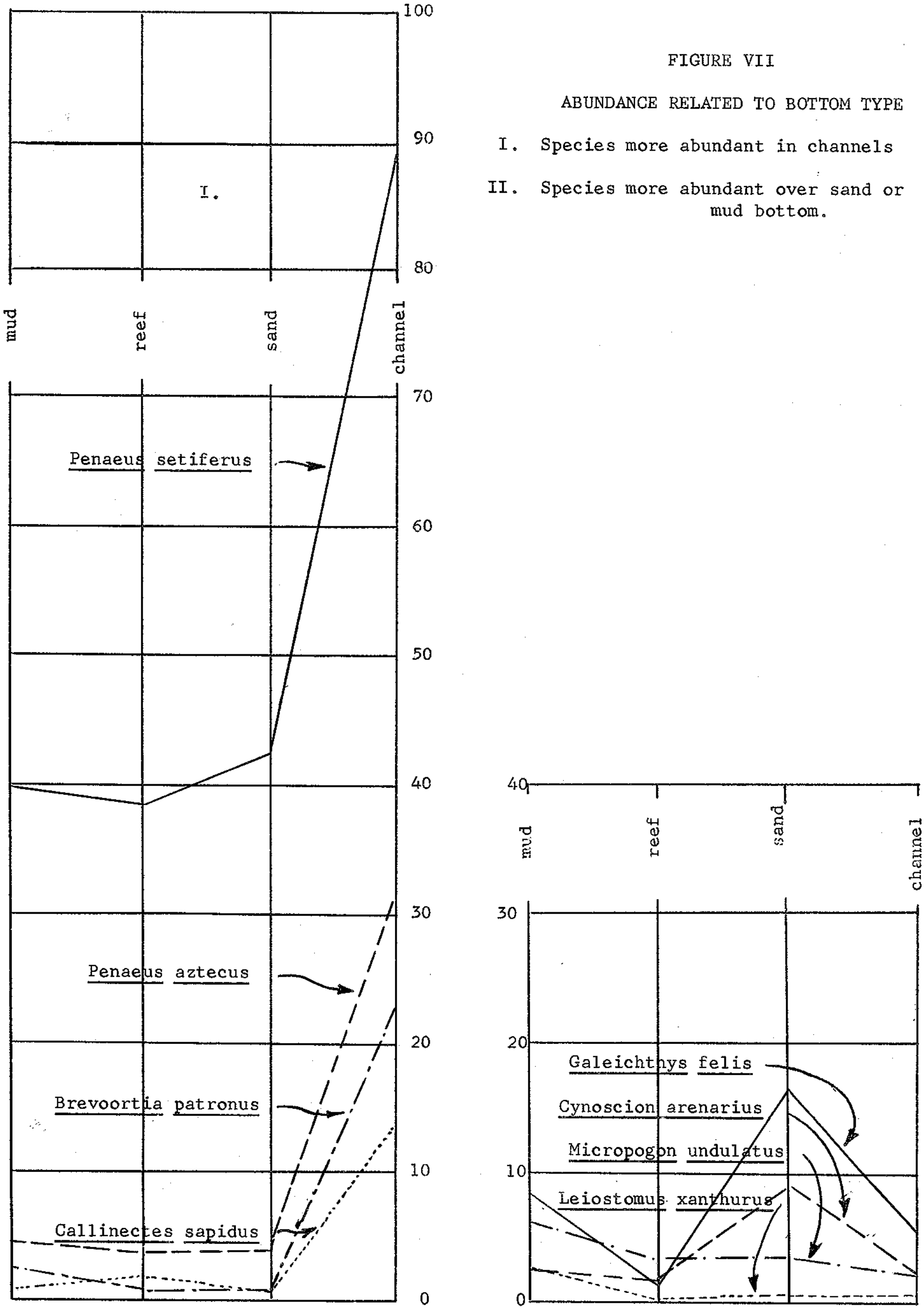
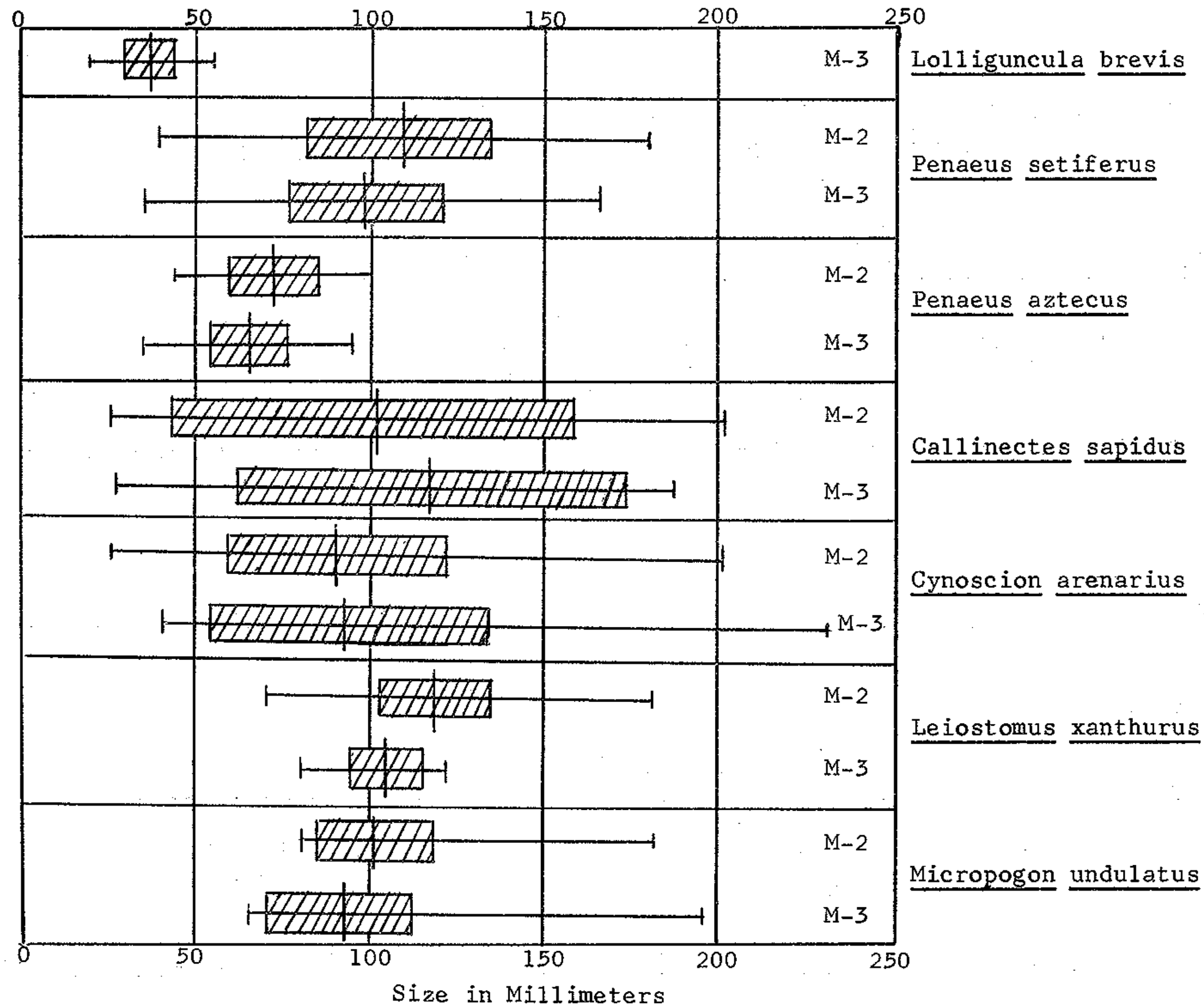


FIGURE VIII

Size Composition of Catches of Certain Species



The length of each horizontal line represents the size range.

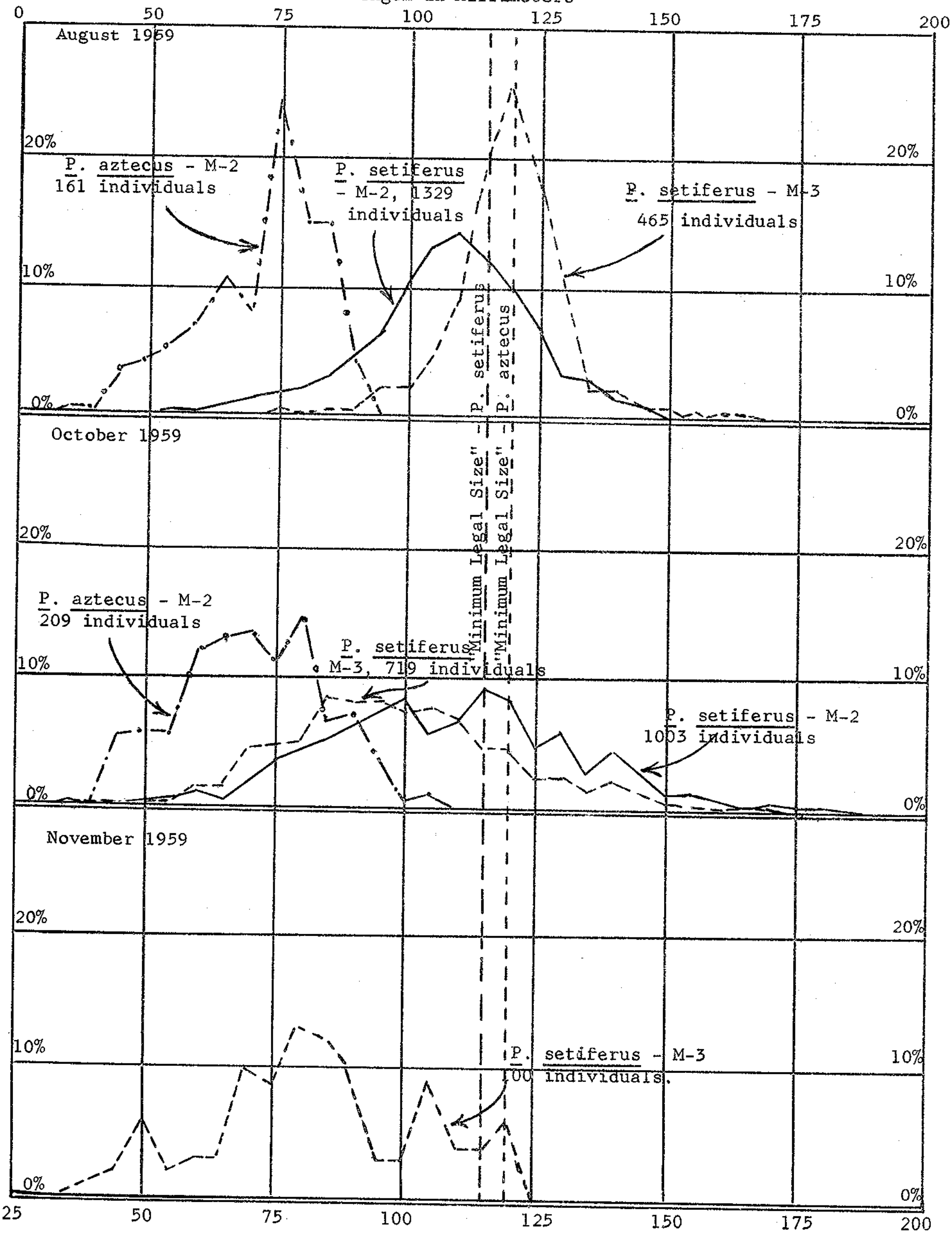
The vertical line near the center of each horizontal line represents the position of the arithmetic mean size.

The hatched horizontal bars measure one standard size deviation on each side of each mean.

(See also Table 4)

FIGURE IX

Percentage Length - Frequency of Shrimp Catches by Months
Length in Millimeters



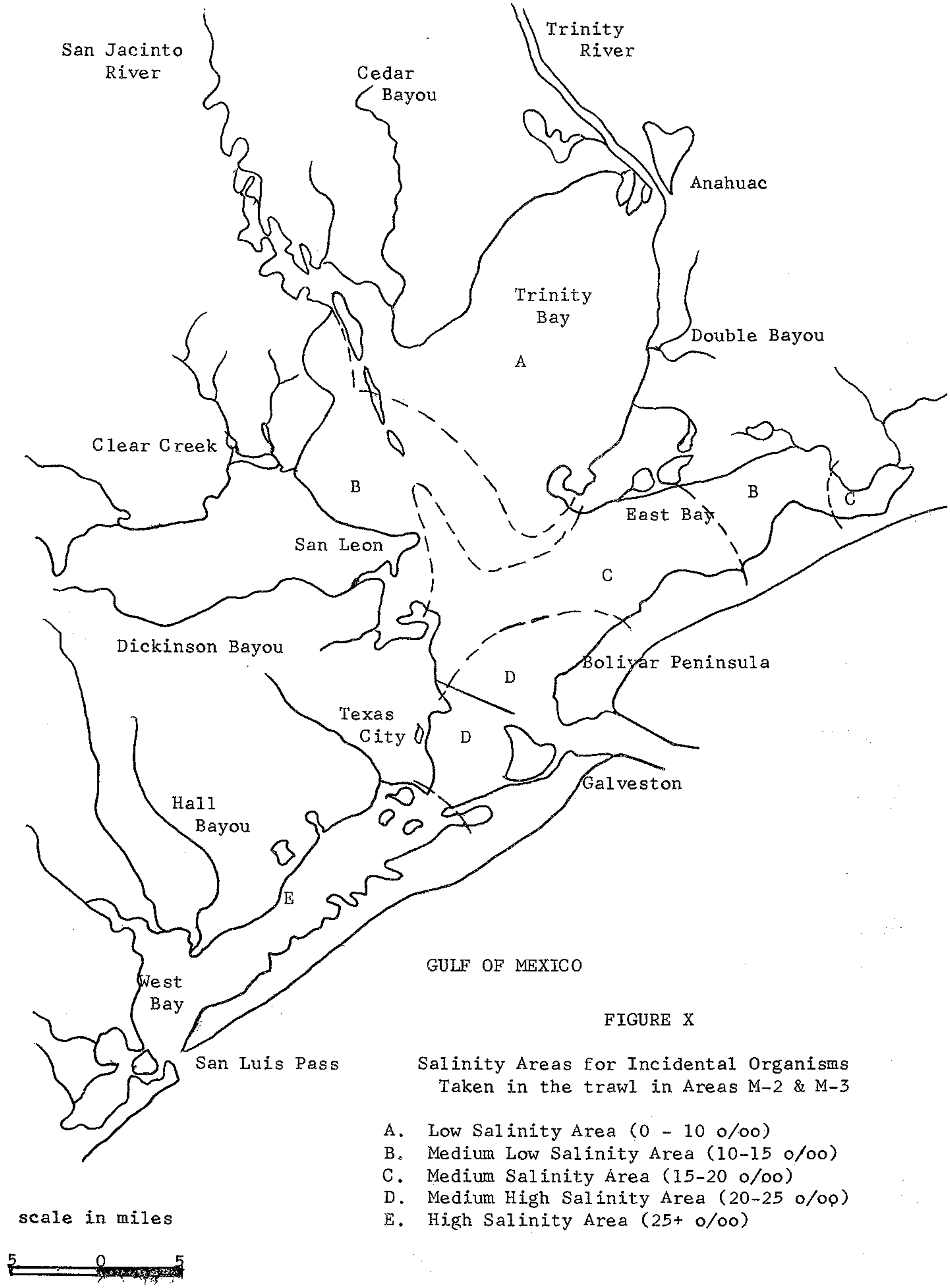


FIGURE X

Salinity Areas for Incidental Organisms Taken in the trawl in Areas M-2 & M-3

A. Low Salinity Area (0 - 10 o/oo)
B. Medium Low Salinity Area (10-15 o/oo)
C. Medium Salinity Area (15-20 o/oo)
D. Medium High Salinity Area (20-25 o/oo)
E. High Salinity Area (25+ o/oo)

Table 1

Comparison of Numbers of Species Trawled in Areas M-2 and M-3

	Swimming	Incidental	Total
Species encountered in M-2 only	9	5	14
Species common to both areas	22	19	41
Species encountered in M-3 only	14	18	32
Total species	45	42	87
Area M-2 Total	31	24	55
Area M-3 Total	36	37	73

Table 2

Species of Organisms Trawled in Areas M-2 and M-3

Species	Estimated Abundance		Total Specimens Taken
	M-2	M-3	
Brief Squid, *Lolliguncula brevis*		common	17
White Shrimp, *Penaeus setiferus*	Very abundant	abundant	2183
Brown Shrimp, *P. aztecus*	abundant	abundant	356
Shrimp, *Trachypeneus* sp?		scarce	1
Sea Bob, *Xiphopenaeus krøyeri*		scarce	1
Grass Shrimp, *Palaeomonetes* sp.	scarce		1
Blue Crab, *Callinectes sapidus*	abundant	common	135
Stingaree, *Dasyatis sabina*	scarce		2
Gafftopsail Catfish, *Bagre marinus*	common	scarce	24
Hardhead Catfish, *Galeichthys felis*	abundant	common	524
Gulf Menhaden, *Brevoortia patronus*	abundant	scarce	131
Lizardfish, *Synodus foetens*		scarce	4
Broad Killifish, *Cyprinodon variegatus*		scarce	1
Tidewater Silverside, *Menidia beryllina*	scarce		1
Striped Mullet, *Mugil cephalus*		scarce	8
Spanish Mackerel, *Scomberomorus maculatus*		scarce	1
Cutlassfish, *Trichiurus lepturus*	scarce	scarce	5
Moonfish, *Vomer setapinnis*		scarce	2
Bumper, *Chloroscombrus chrysurus*		scarce	1
Lookdown, *Selene vomer*	scarce		2
Leatherjacket, *Oligoplites saurus*	scarce		5

Table 2 - Continued

Species	Estimated Abundance M-2	Estimated Abundance M-3	Total Specimens Taken
Pigfish, *Orthopristes chrysopterus*		scarce	3
Pinperch, *Lagodon rhomboides*	scarce	common	74
Sheepshead, *Archosargus probatocephalus*	scarce	scarce	3
Sand Trout, *Cynoscion arenarius*	common	common	138
Speckled Trout, *C. nebulosus*	scarce	scarce	2
Yellowtail Perch, *Bairdiella chrysura*	scarce	scarce	7
Star Drum, *Stellifer lanceolatus*	common	common	92
Spot Croaker, *Leiostomus xanthurus*	common	common	104
Croaker, *Micropogon undulatus*	abundant	abundant	283
Southern Whiting, *Menticirrhus americanus*	scarce	common	20
Black Drum, *Pongonias cromis*	scarce	scarce	3
Spadefish, *Chaetodipterus faber*	common	common	49
Common Filefish, *Monocanthus hispidus*		scarce	1
Florida Swellfish, *Spheroides nephelus*	common	common	70
Spiny Boxfish, *Chilomycterus schoepfi*	scarce		1
Southern Sea Robin, *Prionotus tribulus*	scarce	scarce	10
Ocean Goby, *Gobienellus oceanicus*		scarce	1
Naked Goby, *Gobiosoma bosci*	scarce		1
Midshipman, *Porichthys porosissimus*	scarce		1
Clingfish, *Gobiesox strumosus*		scarce	1
Striped Blenny, *Chasmodes bosquianus*		scarce	1
Southern Flounder, *Paralichthys lethostigmus*	scarce		2
Spotfinned Whiff, *Citharichthys spilopterus*	common	common	59
Hogchoker, *Trinectes maculatus*	common	scarce	17

Table 3

Average Surface Salinities and Temperatures

Area	October Sal.	October Temp.	November Sal.	November Temp.	December Sal.	December Temp.
M-2	12.0	25.1				
M-3	17.1	24.1	20.1	18.4	20.7	13.5

Salinity is in parts per thousand, temperature in degrees centrigrade.

Table 4

Size Data for Certain Species

Area M-2 measurements were made in October, 1959; Area M-3 measurements in October through December, 1959. (See also Figure 5).

Species	Size Range		Mean Size		Std. Deviation	
	M-2	M-3	M-2	M-3	M-2	M-3
Lolliguncula brevis		20- 55		37.3		8.14
Penaeus setiferus	40-180	35-165	108	96.3	24.8	22.2
P. aztecus	45-105	35- 95	71.9	64.5	12.9	11.3
Callinectes sapidus	25-200	25-185	99.0	116	57.5	55.6
Cynoscion arenarius	25-200	40-230	89.5	93.0	32.0	39.4
Leiostomus xanthurus	70-180	80-120	118	104	15.8	8.68
Micropogon undulatus	80-180	65-195	101	92.0	16.4	19.2

(Size Data in Millimeters.)

Table 5

Size Difference by Area and Time

Species		October		M-3		
		M-2	M-3	Oct.	Nov.	Dec.
Penaeus setiferus	Av	105.6	99.2	99.2	83.7	81.2
	R	41-182	33-167	33-167	40-121	6-100
Penaeus aztecus	Av	70.6	65.8	65.8	68	60.5
	R	43-105	34- 93	34- 93		52-66
Micropogon undulatus	Av	101.5	91.0	9.10	92.0	95.0
	R	80-180	65-195	65-195	75-130	75-115
Cynoscion arenarius	Av.	91.5	89.5	89.5	108.0	68.5
	R	25-200	40-180	40-180	45-230	65- 70
Callinectes sapidus	Av.	94.0	108.0	108.0		166.5
	R	25-200	25-180	25-180		145-185
Leiostomus xanthurus	Av	117	105.0	105.0		90
	R	70-180	80-120	80-120		
Lolliguncula brevis	Av		40.4	40.4	36.6	
	R		31- 53	31- 53	21- 47	

All measurements in millimeters.

Table 6

Incidental Organisms Taken in the Trawl (by salinity areas)

X -- living specimens were taken
0 -- dead specimens or their evidences only were taken

Species	A	B	C	D	E	All
	Areas (See text page 5)					
Unidentified algae	-	-	-	X	-	X
Dactylometra quinquecirrha	-	-	X	X	-	X
Stomolophus meleagris	-	X	-	-	-	X
unidentified medusa	-	-	X	X	-	X
Mnemiopsis mccradyi	X	X	X	X	X	X
Beroe ovata	-	-	-	X	-	X
unidentified bryozoan	-	-	X	-	-	X
Diopatra cuprea tubes	-	-	-	-	0	0
unidentified parchment worm tubes	-	-	0	0	-	0
unidentified terebellid worm	-	-	X	-	-	X
unidentified serpulid worm	-	-	X	-	0	X
Balanus eburneus	0	-	X	-	-	X
B. improvisus	-	X	X	-	-	X
Balanus sp.	-	-	-	X	-	X
Palaeomonotes sp.	-	-	-	X	-	X
Clibinarius vittatus	-	X	X	X	-	X
Pagurus pollicaris	-	-	-	X	-	X
P. longicarpus	-	-	-	X	-	X
Petrolisthes armatus	-	-	-	-	X	X
Eurypanopeus depressus	-	-	X	-	-	X
Rhithropanopeus harrisi	-	-	X	-	-	X
unidentified xanthid crab	-	-	-	X	-	X
Squilla empusa	-	-	-	X	-	X
Crepidula plana	-	-	X	-	X	X
Polinices duplicatus	0	X	0	0	X	X
Thais haemastoma floridana	-	0	X	X	X	X
Dentalium texasianum	-	-	-	-	0	0
Anadara campechiensis	-	-	-	0	-	0
Brachidontes recurvus	0	X	X	X	0	X
Ostrea equestris	-	-	-	-	X	X
Crassostrea virginica	0	X	X	X	X	X
Mercenaria mercenaria texana	-	-	-	-	0	0
Macoma constricta	-	0	p	0	-	0
M. mitchelli	X	0	-	-	-	X
Tagelus plebius	0	0	-	0	-	0
T. divisus	-	-	-	-	0	0
Mulinia lateralis	0	0	-	-	0	0
Rangia cuneata	X	0	0	-	-	X
R. flexuosa	-	0	-	-	-	0
Martesia smithi	-	-	X	-	-	X
Anchoa mitchelli	X	X	X	X	X	X
unidentified leptocephalus larva	X	-	-	-	-	X