

## THE FIELD PROGRAM

In March 1960 Commission biologists began an intensified field program of study on the bay populations of shrimp, extending the whole length of the coast. The inside areas of study are numbered M-1 to M-9. A tenth area of study in the Gulf was set up in Port Aransas area using the commercial trawls and a large boat.

In the bay waters various trawls and other collecting nets were used which could sometimes be pulled in very shallow water. These mostly had the common characteristic of a half-inch stretch mesh in the bag (quarter inch on the square). In lower Aransas Bay a larger mesh trawl was sometimes used. The shrimp were counted and weighed and a great many of them were measured. The temperatures and salinities of the water were taken and several other environmental factors were recorded at each station.

These data were turned over to the writer. The length data was plotted in percentages to give a graphical picture of the variations in shrimp sizes for the various months. In each area an attempt was made to do each round of stations twice a month. The program did not get evenly started all up and down the coast and in most of them a good start was not made until May.

Some preliminary plots of the data were first made. It was found that combinations of several areas of bay systems with a common pass to the Gulf gave the best length-frequency curves and this combination was used.

The area M-2 and M-3 were combined to give the graphic length-frequency plots of Galveston Bay. Similarly, the Matagorda, Espiritu Santo and San Antonio Bay areas, M-4 and M-5 were combined for the Matagorda Bay system. M-6 in Aransas Bay, M-7 in Redfish and Corpus Christi Bays and M-8, of the upper Laguna Madre were combined for the Aransas-Corpus Christi Area. Plots were made for both brown and white shrimp.

No plots were made for M-1, Sabine Lake and M-9, the lower Laguna Madre. This latter area is separated, so far as shrimp are concerned by a salinity block in the area of the Land Cut and the populations are separated from those of the Corpus Christi-Aransas Bay area. Similarly, the offshore shrimp taken off Port Aransas do not all come from the immediate inshore area, and additionally there is nothing to compare them to. The data will be useful later but there is not need to plot them at present.

### Some Information Derived From the Frequency Curves

#### WHITE SHRIMP

##### a. Galveston Bay

No white shrimp were taken in Galveston Bay in April. Only three were taken in May. These were 138 to 173 mm. long, and apparently were a remnant of the spring run of large white shrimp which enter the bays from the Gulf at that season, remaining only a few weeks and returning to the Gulf.

The curves show that shrimp of 18 mm. length were present from June to October, inclusive; in November no shrimp less than 23 mm. were present. In June 18-28 mm. shrimp were quite abundant. They fell off in July and apparently started to increase again in August. In September especially a great increase.

in shrimp of this size took place; in October the group was larger in size and in November it had almost disappeared. The June curves indicate that two peaks of larvae came in during the spring, one probably in early May, and possibly even in late April. It appears that a few small young came in during the whole summer and that a larger peak came in during late August and especially in September. Nothing but small whites, 68 mm. and less in length were taken in Galveston Bay in June, but they grew rapidly and from July to November the average lengths seemed to be at about 68 mm. The spread in size is shown by the upper lengths. From June to September these lengths, respectively, were 68, 128, 143 and 163 mm. Presumably, these shrimp all came from the bays and grew up there coming from either over-wintering shrimp or the spring spawning. However, the point is not fully proven and it will take more monthly curves to settle the fact. From September to November the upper sizes of the shrimp fell off and the monthly upper limits, respectively, were 163, 148, 133 mm. Presumably, this decline in numbers of larger shrimp is caused by movement of shrimp out of the bays as they grow up.

#### b. Matagorda-Espiritu Santo-San Antonio Bay System

A few hauls were made, but no white shrimp were taken in the Matagorda system in March. In April five white shrimp, 33 to 98 mm. long, were taken. These presumably came from the previous fall spawning wintered over in the bay. The curve for that month shows several larger shrimp 108 to 168 mm. long were taken. Apparently these shrimp are part of the spring run, noted in Galveston Bay in May. The May curve shows that a few of these shrimp, 148 to 163 mm. long, were also taken in the Matagorda Area in May.

The dominating feature of the May curves shows a group of incoming shrimp with a mode at 18 mm. and the smaller sizes at 13 mm. A second group existed with a mode at 48-53 mm. Probably this second group wintered over from a fall spawning, although they might have come from an April spawning. The point is uncertain.

The smaller sizes of shrimp by months show even more clearly than the Galveston area that there is an incoming group of small shrimp in the spring and again in the fall. The lower lengths of the shrimp by months from May to November, inclusive and respectively, were 13, 13, 18, 18, 13, 13 and 33 mm. The curves indicate that the greatest number of small shrimp came in during May and October.

The upper limits of shrimp lengths do not increase by months quite so regularly in Galveston Bay, nor do they show the fall off in lengths after September. Disregarding the spring run in May, the increase in maximum lengths by months from May to November were 73, 78, 118, 158, 163 and 168 mm. The curves themselves, however, show a general decrease in numbers of shrimp above 103 mm. (four inches) from August on.

#### c. Aransas-Corpus Christi Bay

Two shrimp were taken in June, 163 and 193 mm. long. These are remnants of the spring run of outside shrimp. The June curve is much like that of the Matagorda area, and those for the remaining months are fairly similar to the other two areas except that there was a larger proportion of large shrimp. This result is expected because of the hauls in lower Aransas Bay with a large mesh net.

The lower limits of the size of small shrimp show even more clearly than the other two areas that there is an influx of small shrimp during the spring and in the fall. In June, July and August the lower limits were 18, 33 and 28 mm. In September, October and November the lower sizes were 13, 8 and 25 mm.

A considerable decline of small shrimp in the area took place from October to November.

#### Matters of Conservation Significance

Shrimp of four inches in length (sixty to a pound) or more occurred in all areas in small numbers in July. In Galveston Bay these increased in number through August and September, but declined in October to a few in November.

In the Matagorda area shrimp at the four inch and greater size were in greatest numbers in August and declined in September and October but became somewhat more numerous in November.

In the Aransas area the four inch shrimp were in greatest abundance in August and October, but declined in the succeeding months.

These conclusions are derived purely from visual inspection of the curves. Actual percentages, which have not been calculated, would show a more precise figure.

The most outstanding feature of these curves is the fact that from July through November there are large numbers of small shrimp present just below the sizes of four inch shrimp. These are potentially available to shrimp trawlers and it would be best if these shrimp were not caught. It would appear that the open season beginning the fifteenth of August is not incorrect, but that there is little reason to prolong the season beyond November 30. Furthermore, it would conserve shrimp to have all nets, bait shrimpers and all, with a mesh of not less than two inches stretched.

#### BROWN SHRIMP

The maximum and minimum sizes of brown shrimp taken in all three areas are shown in Table 1.

The curves for all three areas show generally the same thing for April, a population of small shrimp 53 mm and less in length, with lower lengths around 18 mm. In general the following months also showed a similar course - a spread of the population with an average increase in size until July or August and then a general decrease in size.

In September a second large influx of small shrimp came in. This is shown clearly by the curves and by Table 1. The spring and fall influxes of white shrimp are closer together than the browns by about two months. Thus there is some difference in the life history which is not yet clear.

The curves and Table 1 show that the maximum sizes of browns in the bays was much less than the whites and it is clear that they leave the bays at a smaller size.

The curves show that large numbers of small browns below 103 mm. (four inches) are present in the bays from May to September. These shrimp are catchable and should be preserved from molestation. As a matter of fact practically no brown shrimp are available in the bays of a length above four inches, 60 to a pound.

#### PINK SHRIMP

Only 465 pink shrimp were taken in the inside waters. One shrimp was taken in M-4 and three were taken in M-5 in April and May. These were 58-123 mm. long.

In September, October and November 139 pinks were taken at M-6. They were 53 to 108 mm. long. One group of 128 shrimp taken in September had a mode at 73 mm.

In April and May 302 shrimp were taken at M-8. They were 68 to 123 mm. long. Twenty shrimp 38 to 103 mm. long were taken in November.

Fifty-one pink shrimp were taken in the Gulf during the months of June, July, August and October. They were 78 to 173 mm. long.

The pink shrimp were all taken at medium to high salinities and only 7 were taken at salinities below 20.0. They were taken only on the middle and southern part of the coast.

The commercial pink shrimp catch of Texas amounts to slightly more than 0.1 per cent of the total. In this survey the biologists have taken pink shrimp in numbers amounting to 0.8 per cent of all shrimp caught.

#### Movements of Shrimp

Table II shows the average number of shrimp taken per haul by months in the three major areas under discussion. From this table, Figures I, II and III were derived. They show essentially the same things.

The brown shrimp increased to a peak in May and June, but during June and July they largely moved out of the bays and by September they were practically gone.

Conversely, the whites began to increase greatly in the catches from June on to a peak in September, but declined sharply thereafter in October and November, as the shrimp moved into the Gulf. Galveston Bay was a little different from the other two areas for reasons unknown.

It is clear that two large populations of the two shrimp at the same sizes (such as is caught by the gear used) do not occur in the bays at the same time. The browns appear first and as they decline the whites increase.

#### Reasons for the Jiggly Curves

Even when a thousand to two thousand shrimp were measured and drawn up in the form of a percentage-length curve, more commonly called a total length frequency, the curves do not smooth out and resemble the relatively smooth figures given by Weymouth, Lindner and Anderson (1933). The reasons are several. For one thing those authors used large mesh collection gear which collected a

more compact population without the length spread shown by Gunter (1950), who also had some very wavy curves, quite different from those of Weymouth, Lindner and Anderson.

Aside from the wide length spread of the curves herewith presented, there are other reasons why there are numerous bumps or small peaks. For one thing there may be small waves and influxes of young throughout the season (aside from the two large influxes of the spring and fall, first noted by Gunter (1950) and later recognized as two to three by Lindner and Anderson (1956)) which would cause bumps on the curves. Actually, this matter is very uncertain as yet and we do not really know what the situation is.

A third factor causing wavy curves is the fact that samples were taken twice a month, generally about 15 days apart. During the warm months small shrimp increase in length at the rate of one millimeter a day or faster. Therefore, shrimp taken two weeks apart would show two peaks about 15 to 20 mm. apart. Weymouth *et al.* used bimonthly curves. Possibly the Texas data should be plotted bimonthly.

The males and females also have different peaks at larger sizes because of faster growth of the females.

Shrimp at different depths have different sizes, but this may be only the different waves or groups coming in, which, in a sense have already been considered.

#### Summary

1. A coastwide study of Texas shrimp populations, with special reference to bay waters was initiated in March 1960, and is continuing.
2. From March to November inclusive 516 hauls were made with small trawls and seines with half inch stretched mesh. Seven hundred and seventy-two pink shrimp were caught and all of them but 10 were measured. The brown shrimp caught numbered 48,132, of which 23,579 were measured. The whites caught numbered 49,172 of which 21,352 were measured.
3. These figures were used to make length frequency curves by months for the main bay systems of the coast, Galveston Bay, Matagorda and connecting bays and Aransas-Corpus Christi bay system. The curves showed remarkable similarity from area to area both for the whites and the browns.
4. A spring run of large white shrimp from the Gulf come into the bays in April and May. In May and June small white shrimp come into the bays; they grow rapidly and attain the minimum commercial size, four inches in length and run sixty to a pound in late August. They begin to leave the bays in great numbers during that month, but the population is reinforced by another influx of the young in late August and September and remains fairly abundant in some bays until November after which it is nearly all gone.
5. Small brown shrimp come into the bays in April and May. They grow rapidly and most of them leave the bays from June to July, before attaining the minimum commercial size. A second influx of small browns comes into the bays in September and October but it does not result in a large population.

6. The length frequency curves show that the average size of white shrimp in the bays in November is about 78 mm., a little longer than three inches, although a few up to six inches are still present. The abundance curves show decreased populations in November and certainly the season should be closed at the end of that month.

When the browns and whites are considered together it is seen that from May to November there are large numbers of small shrimp just under legal size in the bays. In fact the brown shrimp are practically always under commercial size and the fishery falls heaviest on the white shrimp. This means that it is impossible to protect small shrimp by closed seasons alone and some regulation of net size is important. A minimum mesh of two inches for all nets is recommended.

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Table 1

The Maximum and Minimum Size of Brown Shrimp Taken In The Three Major Texas Shrimp Areas by Months, 1960.

Measurements in mm.

	Minimum Sizes		
	Galv.	Mat.	Aran.
April	23	18	8
May	18	18	8
June	23	23	18
July	33	18	28
August	23	23	33
September	18	23	8
October	23	38	23
November	28	38	28

	Maximum Sizes		
	Galv.	Mat.	Aran.
April	53	78	73
May	108	138	123
June	133	118	108
July	123	113	118
August	113	108	133
September	93	93	148
October	118	83	123
November	98	78	108

Table 2

Average Yield (numbers of Shrimp) Per Haul on Texas  
Coast, April to November, 1960.

MONTH	AREA					
	M-1	M-2 M-3	M-4 M-5	M-6 M-7 M-8	M-9	Gulf
MARCH						
hauls		6	3			
browns		0.0	1.3			
whites		0.0	0.0			
pinks		0.0	0.0			
APRIL						
hauls		7	11	4	4	
browns		26.5	8.3	85.2	855.5	
whites		0.0	5.8	0.0	11.3	
pinks		0.0	0.1	60.2	0.0	
MAY						
hauls	2	15	18	15	4	
browns	193.5	756.7	160.3	129.0	1234.8	
whites	13.5	0.2	26.5	0.1	0.0	
pinks	0.0	0.0	0.4	4.1	0.0	
JUNE						
hauls	2	16	15	21	4	7
browns	152.5	218.5	181.0	105.0	268.5	174.0
whites	4.5	22.3	3.7	58.9	0.0	0.1
pinks	0.0	0.0	0.0	0.0	0.0	0.9
JULY						
hauls	2	16	28	12	3	16
browns	1.5	23.3	37.6	25.8	89.3	149.6
whites	2.0	99.5	52.4	250.1	38.3	19.1
pinks	0.0	0.0	0.0	0.0	0.0	0.8
AUGUST						
hauls	1	14	30	20	1	10
browns	111.0	26.3	18.7	62.9	112.0	214.2
whites	152.0	250.0	66.0	293.8	14.0	59.1
pinks	0.0	0.0	0.0	0.0	0.0	2.7
SEPTEMBER						
hauls	2	16	23	17	0	14
browns	21.5	8.2	4.2	28.9		16.5
whites	65.5	155.6	747.0	422.3		14.4
pinks	0.0	0.0	0.0	7.5		0.0
OCTOBER						
hauls	2	16	12	27	6	6
browns	9.5	9.4	2.3	5.4	64.5	6.8
whites	63.5	215.4	40.8	117.2	70.0	193.0
pinks	0.0	0.0	0.0	0.6	0.0	1.0
NOVEMBER						
hauls	1	16	18	26	4	3
browns	5.0	4.1	26.1	15.7	69.5	7.7
whites	8.0	291.5	52.1	65.2	24.5	120.7
pinks	0.0	0.0	0.0	0.9	0.0	0.0

Figure I

Average Number of Shrimp Per Haul - Galveston Area (M-2 & M-3)  
March through November 1960.

solid line - browns

broken line - whites

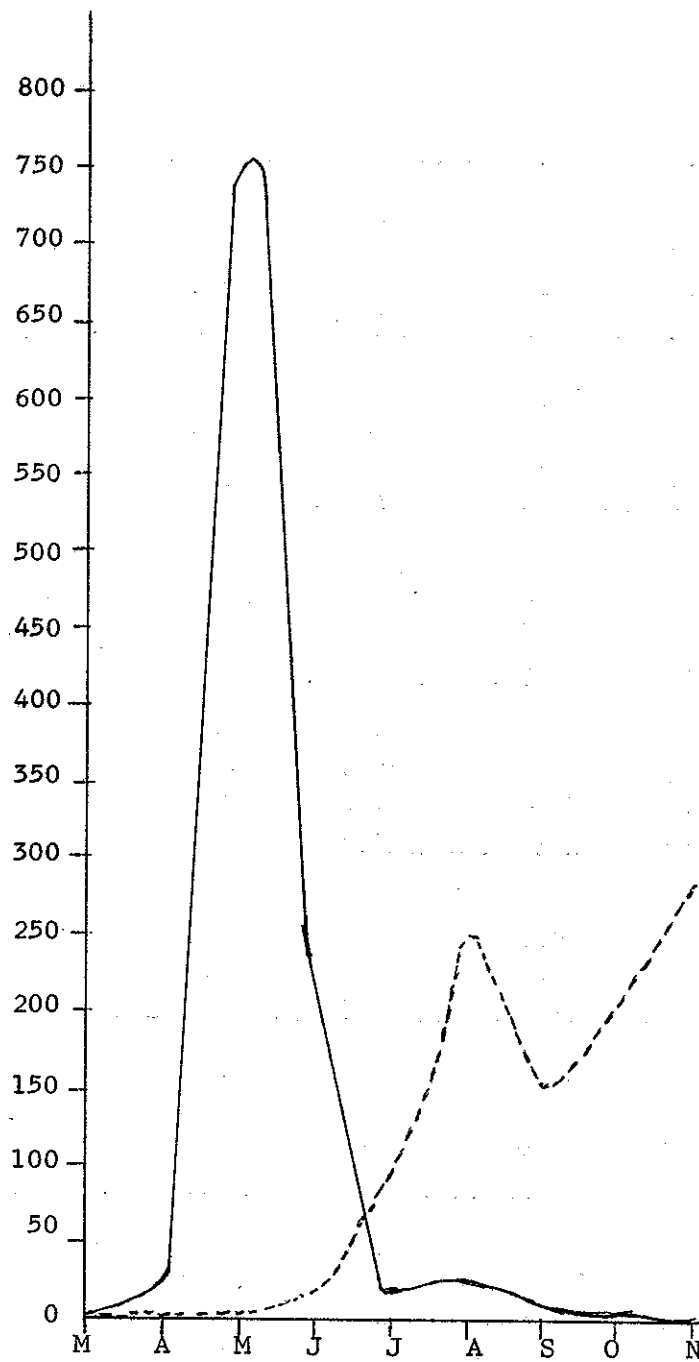




Figure II. Average Number of Shrimp Per Haul - Matagorda Area (M-4 & M-5)  
March through November 1960

solid line - browns      broken line - whites

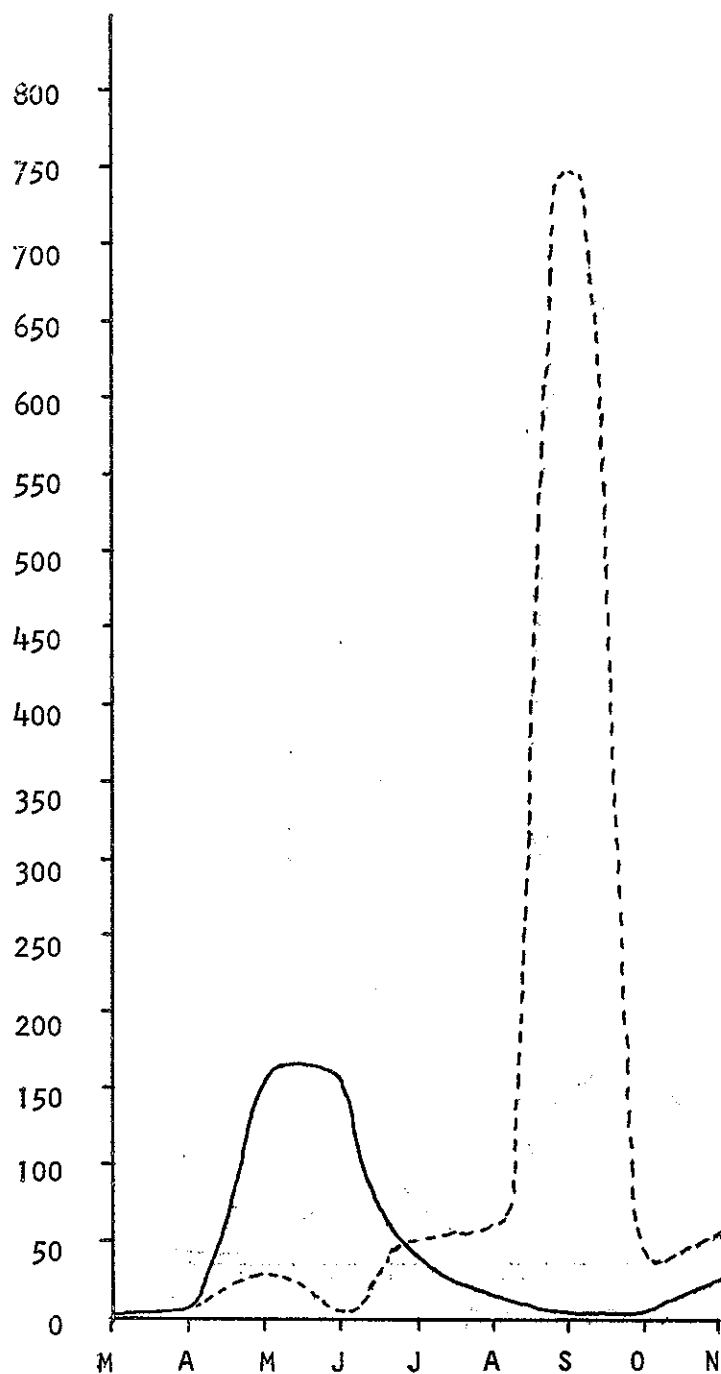


Figure III

Average Number of Shrimp Per Haul - Aransas-Corpus Area (M-6-8)  
March through November 1960.

solid line - browns

broken line - whites.

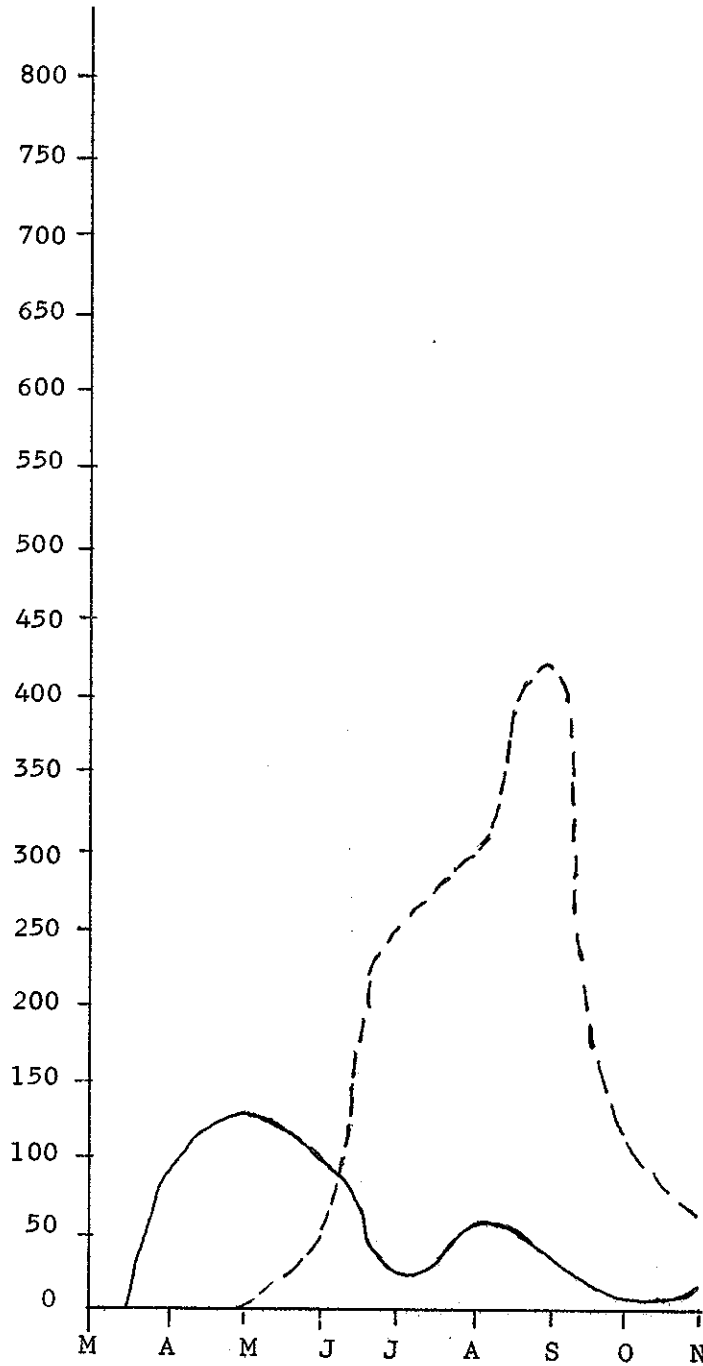




Figure IV

Size Composition of Brown Shrimp Populations - Based on Periodic Samples  
1960

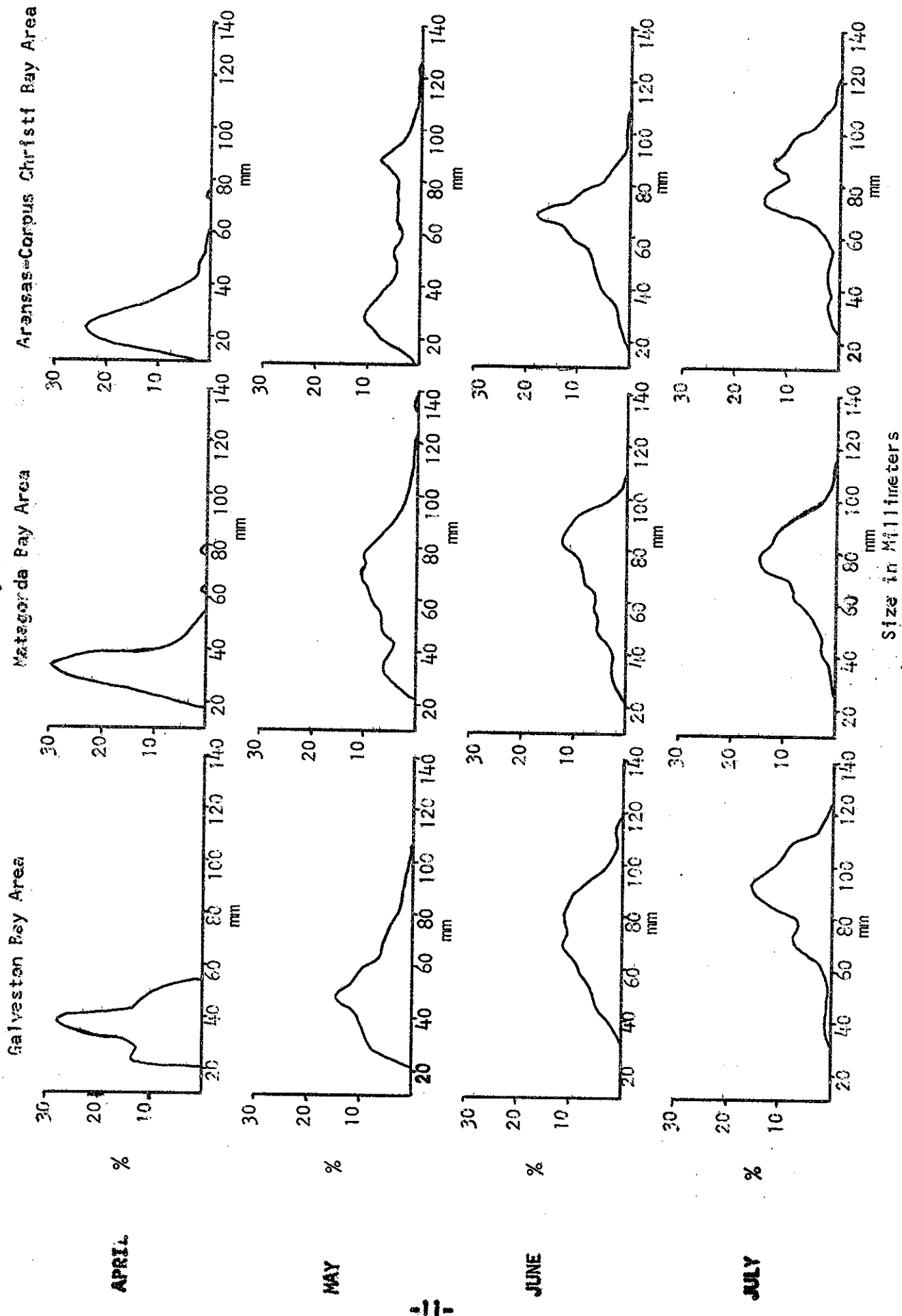


Figure IV - Continued

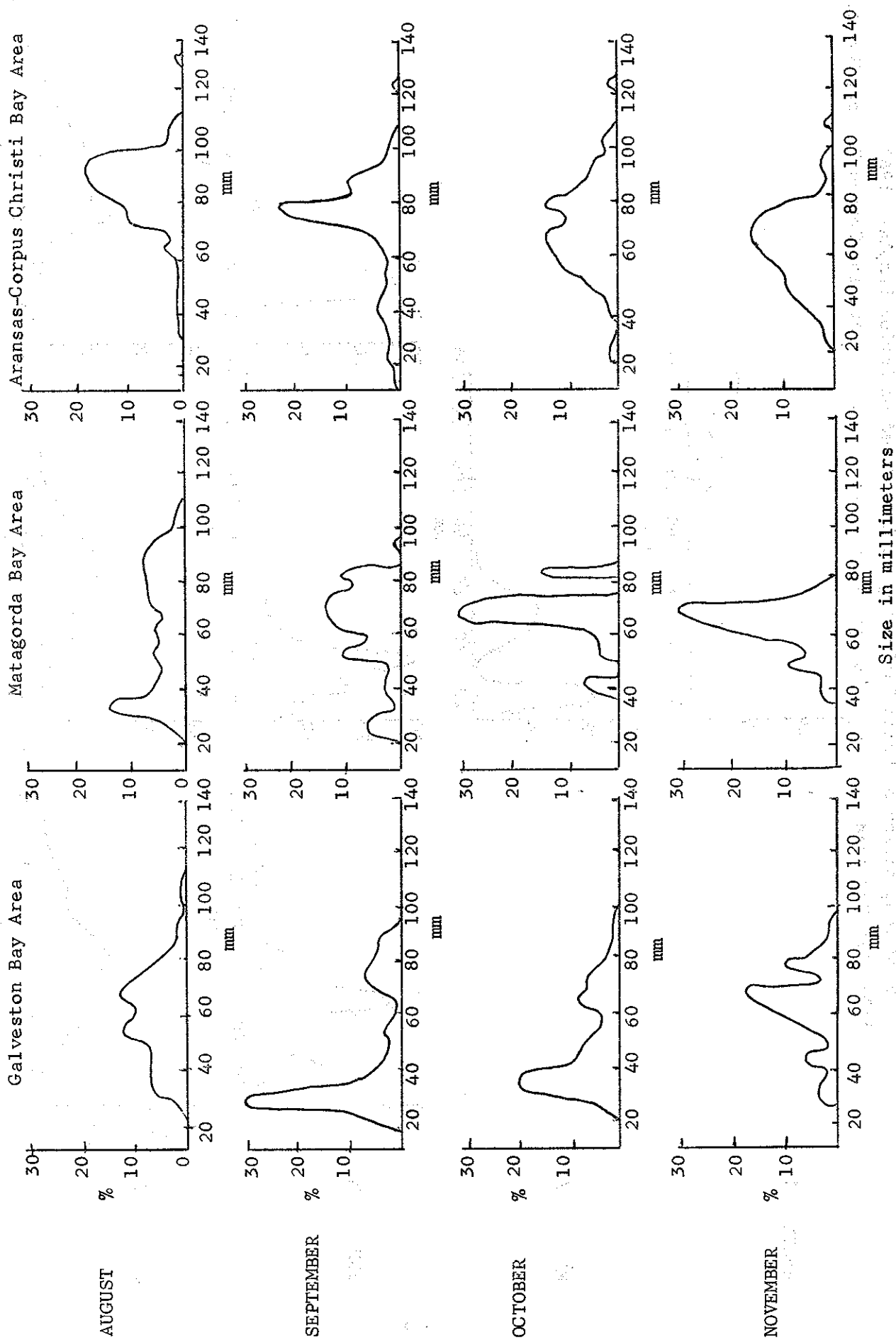


Figure V  
Size Composition of White Shrimp Populations Based on Period Samples, 1960  
Galveston Bay Area      Matagorda Bay Area      Aransas-Corpus Christi Bay Area

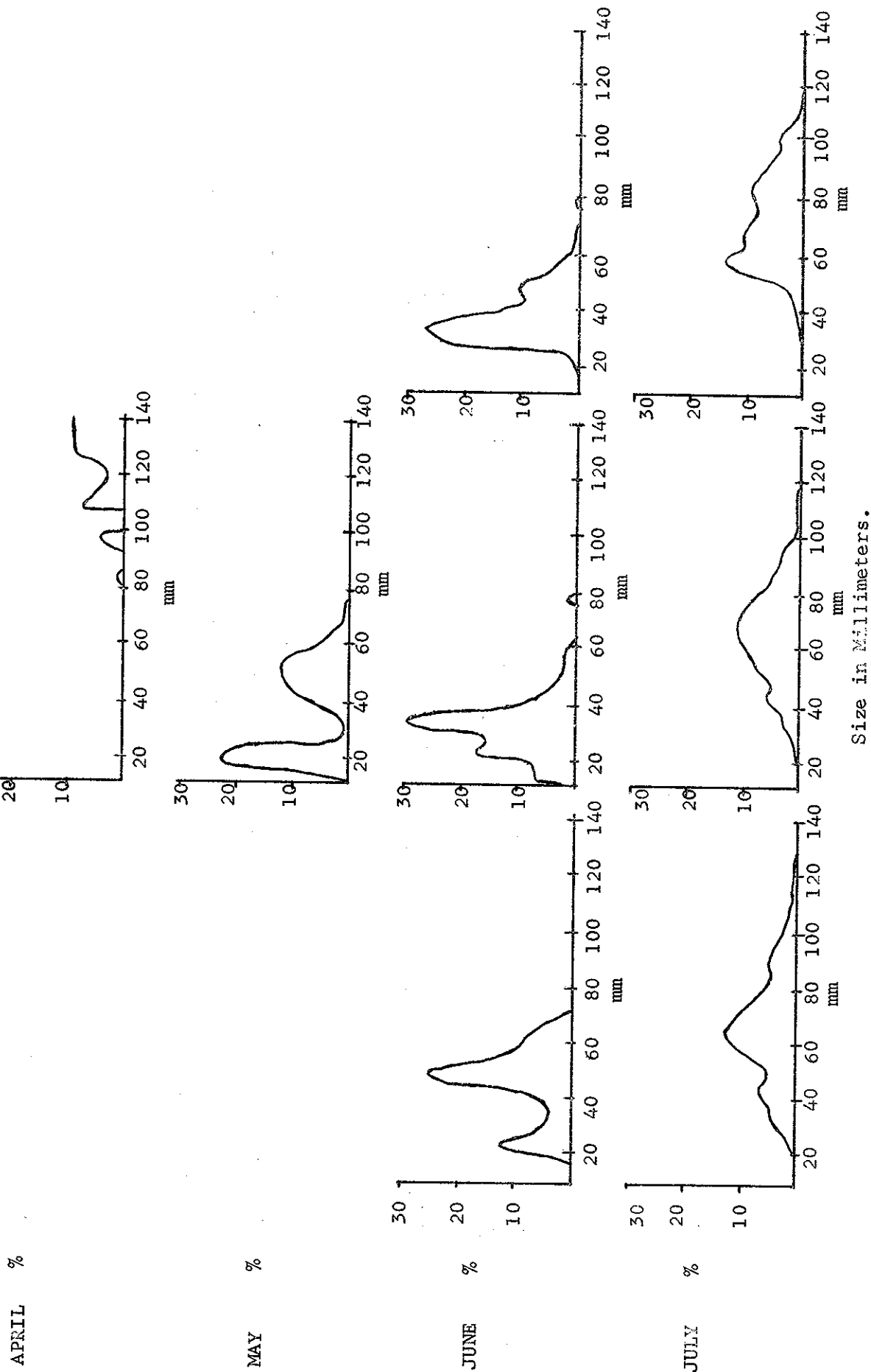


Figure V - Continued

