

NOTES ON DISTRIBUTION, SIZE, AND OVARIAN DEVELOPMENT OF SOME PENAEID SHRIMPS IN THE NORTHWESTERN GULF OF MEXICO, 1961-62¹

Harold A Brusher, William C. Renfro,² and Richard A. Neal

*Fishery Biologists, National Marine Fisheries Service Biological Laboratory
Galveston, Texas 77550*

ABSTRACT

Between January 1961 and December 1962, shrimp were taken monthly using commercial shrimping gear at a series of offshore stations in the northwestern Gulf of Mexico. The general distribution of nine species not presently utilized commercially was determined. The relative abundance of these shrimp in various depths and areas are noted. General seasonal changes in catch per hour were reported for the more abundant species, and size distributions for each species were presented. Examination of ovaries revealed "ripe" females in nearly every month at all depths occupied by a species. Seasonal increases in the percentages of ripe females were noted for some species. As a result of these collections the recorded range of *S. atlantidis* was extended westward into the northwestern Gulf of Mexico.

INTRODUCTION

To gain better understanding of the distribution and biology of penaeid shrimp in the northwestern Gulf of Mexico, a field survey was conducted from January 1961 to December 1962. During this survey, nine species not extensively utilized commercially were taken in trawl samples in addition to commercially important species. The non-utilized species were: *Sicyonia brevirostris* Stimpson, *Sicyonia dorsalis* Kingsley, *Sicyonia stimpsoni* Bouvier, *Trachypenaeus similis* (Smith), *Trachypenaeus constrictus* (Stimpson), *Solenocera vioscai* Burkenroad, *Solenocera atlantidis* Burkenroad, *Xiphopenaeus kroyeri* (Heller) and *Parapenaeus longirostris* (Lucas). This report contains information concerning their distribution, size and ovarian development during the 2-year period.

PROCEDURES

Sampling station locations during the survey are shown in Figure 1. Stations were established so that sampling would be conducted in areas and depths (14 to 110 m) representative of off-

¹ Contribution No. 328, National Marine Fisheries Service Biological Laboratory, Galveston, Texas 77550.

² Present address: International Atomic Energy Agency Laboratory of Marine Radioactivity, Musee Oceanographique, Monaco.

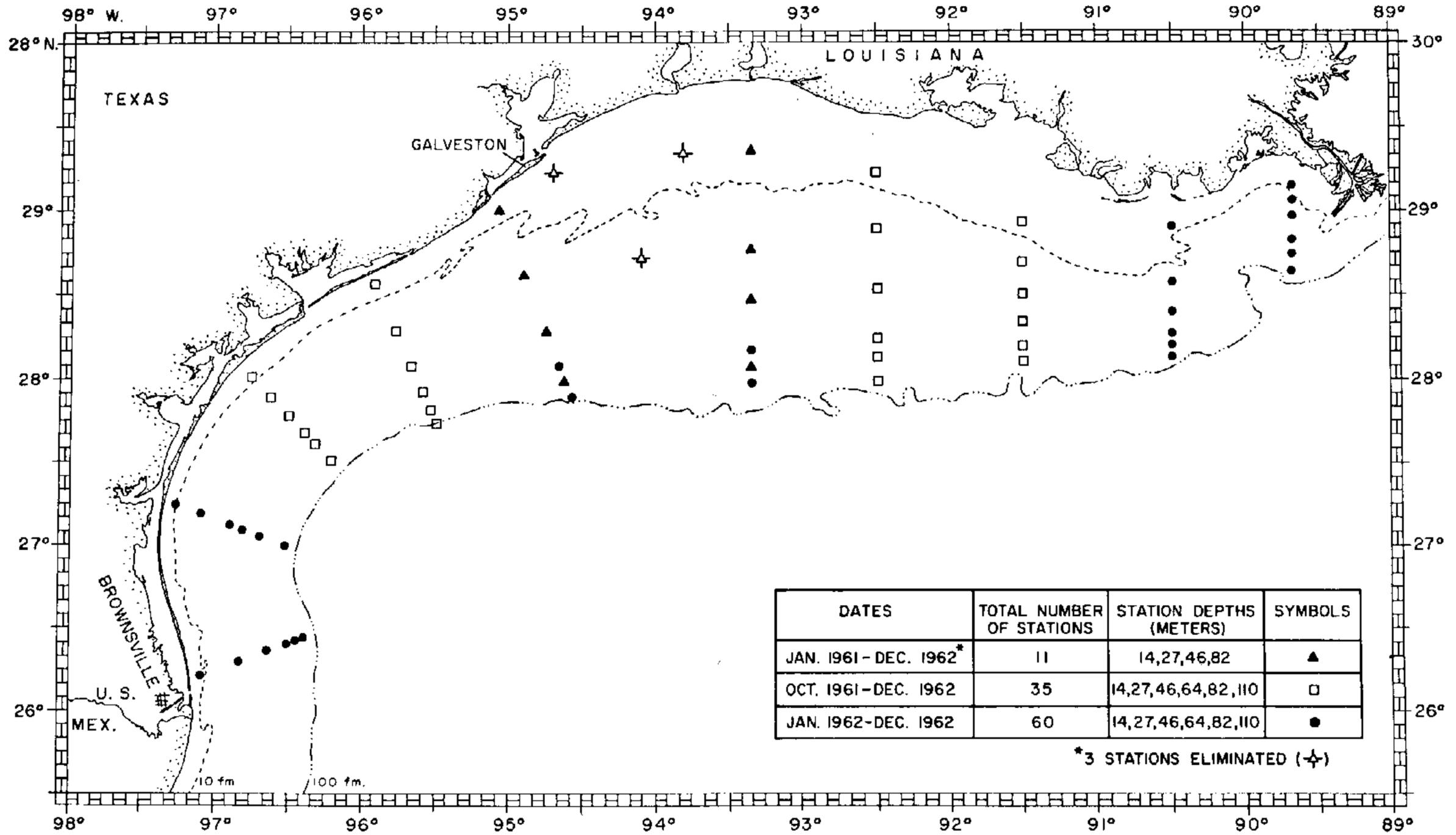


Fig. 1. Station locations at which shrimp were collected in 1961 and 1962.

shore shrimp habitat. Trawling was done from commercial shrimp-fishing vessels using 13.7-m flat trawls with 5.1-cm stretched mesh. The trawl was towed for 1 hour at each station. Cruises were made every 3 to 4 weeks, and collections were made upon arrival at a station regardless of time of day.

If fewer than 50 specimens of *S. brevirostris* or fewer than 25 of any other penaeid species were taken at each station, sexes and total lengths (tip of rostrum to tip of telson) were recorded for all specimens. If larger numbers were taken, sexes and total lengths were recorded for a minimum of 50 *S. brevirostris* and 25 of each of the other species. Sex was determined by examining the external reproductive organs. Portions of ovaries from the females that were measured were fixed in Bouin's solution which was replaced with 50% alcohol after 24 hours. In the laboratory the tissues were dehydrated in alcohol, embedded in paraffin, sectioned in thicknesses of 10 to 15 μ , and stained differentially with hematoxylin and eosin.

The developmental stages of ovaries reported by King (1948) were used to describe the histological condition of ovaries examined. The proportion of females in the ripe stage was used as an index of spawning activity. Based on King's description, the ripe stage is characterized by the presence of prominent rodlike bodies embedded in the egg cytoplasm, the size and shape of the ovary, and the acidophilic nature of the cytoplasm.

ANALYSIS

To facilitate analysis, data are grouped in several different ways. Average catches in individuals per hour of each species are presented by station number in Table 1. Because sampling was done both at night and during the day, all catches were used to describe bathymetric distribution (Table 2). Some indication of the differences in average catches between day and night, however, can be seen in Table 3 in which day and night catches are summarized. Monthly catches (Table 4) are presented only for the four most abundant species and because each of these is more vulnerable to the fishing gear during the night than during the day, only night catches are used as indices of seasonal abundance.

Although the sampling procedure used was not adequate to provide detailed information on bathymetric distributions, it permitted rough estimates of relative abundance at different sampling depths. In addition, the mesh size of the otter trawls used were designed for the capture of larger, commercially important shrimp. Thus, the actual abundances of the smaller less vulnerable species (i.e. shrimp less than 80 mm total length) are probably not accurately represented.

Length frequency distributions of the five most abundant species are illustrated in Figure 2 and those for the least abundant species are presented in Table 5. These data represent catches from all months and depths. Although evident, it should be mentioned that *S. brevirostris*, *S. dorsalis* and *X. kroyeri*, represent narrow sexula dimorphism. On the other hand, *Trachypenaeus sp.*, *S. vioscai* and *P. longirostris* appeared to exhibit wide sexual dimorphism with respect to size.

The data on development stages of ovaries were inadequate to show actual spawning seasons, but as indicated by the percentages of ripe females found each month, the portions of the females which were ready to spawn changed periodically (Table 6).

RESULTS

In the sections which follow, information derived during this survey is presented for each species. The order of discussion is based on total numbers caught as follows: *S. brevirostris*—32,218, *S. dorsalis*—17,674, *T. similis*—12,858, *S.*

TABLE 1

Average catch (individuals per hour) of nine species of penaeid shrimp taken with otter trawls in the northwestern Gulf of Mexico, 1961-62 (Stations 1-31—Texas coast and Stations 32-63—Louisiana coast)

Station number	Depth (meters)	Number of 1-hour trawl hauls	<i>Sicyonia brevirostris</i>	<i>Sicyonia dorsalis</i>	<i>Trachypenaeus similis</i>	<i>Solenocera vioscai</i>	<i>Xiphopenaeus kroyeri</i>	<i>Trachypenaeus constrictus</i>	<i>Parapenaeus longirostris</i>	<i>Solenocera atlantidis</i>	<i>Sicyonia stimpsoni</i>
1	14	13	1.0	0.0	0.6	0.0	2.2	0.2	0.0	0.0	0.0
2	27	12	15.2	72.8	12.8	0.0	0.0	0.0	0.0	0.0	0.0
3	46	12	86.0	5.5	8.1	5.8	0.0	0.0	0.0	0.0	0.1
4	64	10	7.8	0.0	0.5	4.2	0.0	0.0	0.0	0.0	0.0
5	82	9	3.7	0.0	0.0	2.1	0.0	0.1	0.0	0.0	0.0
6	110	8	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
7	14	11	1.7	0.0	1.6	0.0	3.9	2.1	0.0	0.0	0.0
8	27	12	0.2	82.3	28.2	0.0	0.0	0.0	0.0	0.0	0.0
9	46	13	0.5	40.0	32.9	4.1	0.0	0.0	0.0	0.0	0.0
10	64	11	0.5	1.6	1.3	4.0	0.0	0.0	0.0	0.0	0.0
11	82	12	4.5	0.0	0.0	10.6	0.0	0.0	0.0	0.0	0.0
12	110	10	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0.0
13	14	16	0.0	0.1	4.6	0.0	32.4	0.1	0.0	0.0	0.0
14	27	16	0.4	230.9	36.7	0.0	0.1	0.0	0.0	0.0	0.0
15	46	15	1.7	64.8	9.1	24.5	0.0	0.1	0.0	0.0	0.0
16	64	14	1.4	107.1	22.6	22.4	0.0	0.0	0.0	0.0	0.0
17	82	14	6.1	23.2	4.3	10.2	0.0	0.0	0.0	0.0	0.0
18	110	13	0.0	0.0	0.0	5.3	0.0	0.0	0.1	0.0	0.0
19	14	15	0.0	0.5	7.9	0.0	0.3	0.0	0.0	0.0	0.0
20	27	14	7.7	99.9	57.7	0.0	0.0	0.0	0.0	0.0	0.0
21	46	15	40.4	0.4	1.5	0.1	0.0	0.0	0.0	0.0	0.0
22	64	15	69.2	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0
23	82	16	3.7	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0
24	110	13	0.0	0.0	0.0	3.4	0.0	0.0	0.2	0.0	0.0

TABLE 1—Continued

Station number	Depth (meters)	Number of 1-hour trawl hauls	<i>Sicyonia brevirostris</i>	<i>Sicyonia dorsalis</i>	<i>Trachypenaeus similis</i>	<i>Solenocera vioscai</i>	<i>Xiphopenaeus kroyeri</i>	<i>Trachypenaeus constrictus</i>	<i>Parapenaeus longirostris</i>	<i>Solenocera atlantidis</i>	<i>Sicyonia stimpsoni</i>
25	14	28	0.1	0.5	36.0	0.0	0.3	0.0	0.0	0.0	0.0
26	27	29	32.1	213.4	70.2	<0.1	0.0	4.9	0.0	0.1	0.0
27	46	29	275.2	0.6	2.2	0.2	0.0	0.2	0.0	<0.1	0.0
28	64	12	5.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
29	82	22	2.8	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
30	110	11	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
31	14	17	0.1	0.6	31.6	0.0	8.9	0.0	0.0	0.0	0.0
32	27	18	147.5	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
33	14	16	7.4	0.6	7.5	0.0	1.1	2.4	0.0	0.0	0.0
34	14	24	33.0	0.2	30.4	0.0	2.0	0.1	0.0	0.0	0.0
35	27	28	359.8	0.0	0.6	0.0	0.0	0.1	0.0	0.2	0.0
36	46	28	105.7	0.2	0.9	0.0	0.0	0.0	0.0	0.0	0.0
37	64	12	26.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	82	14	12.3	0.0	0.0	11.9	0.0	0.0	0.0	0.0	0.0
39	110	11	0.0	0.0	0.0	1.4	0.0	0.0	0.1	0.0	0.0
40	14	13	0.1	0.0	14.4	0.0	0.0	0.0	0.0	0.0	0.0
41	27	13	54.6	19.8	79.6	0.0	0.0	0.0	0.0	0.2	0.0
42	46	15	158.9	0.4	1.0	0.3	0.0	0.0	0.0	0.0	0.0
43	64	16	111.7	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
44	82	31	9.5	<0.1	0.0	0.7	0.0	0.0	0.0	0.0	0.0
45	110	12	0.1	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0
46	14	13	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0
47	27	16	2.4	27.1	117.9	0.0	0.0	0.0	0.0	0.0	0.0
48	46	16	9.0	27.2	33.4	45.8	0.0	0.0	0.0	0.0	0.1
49	64	18	11.1	0.4	0.0	2.1	0.0	0.0	0.0	0.0	0.0
50	82	18	0.6	0.0	0.2	0.9	0.0	0.0	0.0	0.0	0.0
51	110	14	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0

TABLE 2

Average catch per hour of nine species of penaeid shrimp by depth in offshore waters of Texas and Louisiana, 1961-62

Species	Depth (m) No. of 1-hour hauls	14	27	46	64	82	110
		98	100	84	62	72	54
Texas coast (longitude 94° 30' to 97° 30' W)							
<i>Sicyonia dorsalis</i>		0.3	130.4	19.2	24.7	4.5	0.0
<i>Sicyonia brevirostris</i>		0.3	39.3	113.5	19.4	4.2	0.0
<i>Trachypenaeus similis</i>		17.9	39.7	9.0	5.4	0.9	0.0
<i>Solenocera vioscai</i>		0.0	0.0	6.0	6.5	4.2	4.3
<i>Xiphopenaeus kroyeri</i>		7.7	<0.1	0.0	0.0	0.0	0.0
<i>Trachypenaeus constrictus</i>		0.1	1.6	0.1	0.0	0.0	0.0
<i>Sicyonia stimpsoni</i>		0.0	0.0	<0.1	0.0	<0.1	0.0
<i>Parapenaeus longirostris</i>		0.0	0.0	0.0	0.0	0.0	0.1
<i>Solenocera atlantidis</i>		0.0	<0.1	0.0	0.0	0.0	0.0
Louisiana coast (longitude 89° 30' to 94° 0' W)							
Species	Depth (m) No. of 1-hour hauls	14	27	46	64	82	110
		87	79	89	63	98	62
<i>Sicyonia brevirostris</i>		10.1	143.3	63.5	40.3	6.4	<0.1
<i>Trachypenaeus similis</i>		13.7	39.6	11.3	10.1	0.1	0.0
<i>Solenocera vioscai</i>		0.0	0.0	10.3	15.6	3.9	2.8
<i>Sicyonia dorsalis</i>		0.2	9.0	4.7	0.0	<0.1	0.0
<i>Parapenaeus longirostris</i>		0.0	0.0	0.1	1.2	0.1	0.1
<i>Xiphopenaeus kroyeri</i>		0.7	<0.1	0.0	0.0	0.0	0.0
<i>Trachypenaeus constrictus</i>		0.5	<0.1	0.0	0.0	0.0	0.0
<i>Sicyonia stimpsoni</i>		0.0	0.0	<0.1	<0.1	<0.1	<0.1
<i>Solenocera atlantidis</i>		0.0	0.1	0.0	0.0	0.0	0.0

TABLE 3

Average catch per hour by day and night for nine species of penaeid shrimp, 1961-62

Species	Night (429 tows)	Day (520 tows)
<i>Sicyonia brevirostris</i>	76.6	6.1
<i>sicyonia dorsalis</i>	33.3	6.5
<i>Trachypenaeus similis</i>	22.6	6.0
<i>Solenocera vioscai</i>	8.5	0.5
<i>Xiphopenaeus kroyeri</i>	0.5	1.1
<i>Trachypenaeus constrictus</i>	0.2	0.3
<i>Parapenaeus longirostris</i>	0.2	<0.1
<i>Solenocera atlantidis</i>	<0.1	<0.1
<i>Sicyonia stimpsoni</i>	<0.1	<0.1

vioscai—3,887, *X. kroyeri*—823, *T. constrictus*—222, *P. longirostris*—103, *S. atlantidis*—12 and *S. stimpsoni*—8.

Sicyonia brevirostris, although not now utilized commercially, may be locally abundant enough to support a small fishery. This species was most abundant in the middle four transects at depths of 27, 46, and 64 m (Tables 1 and 2). Over 90% were taken from seven stations in depths of from 27 to 64 m between longitude 92° and 96° W. Only one individual was caught from 110 m and few were

TABLE 4

Average catch (individuals per hour) of four species of penaeid shrimp by month and depth (based on night tows only)

Month	Depth (m)							
	14	27	46, 64	82, 110	14	27	46, 64	82, 110
	<i>Sicyonia brevirostris</i>				<i>Sicyonia dorsalis</i>			
January	1	43	621	13	1	2	32	0
February	1	23	11	3	0	4	2	0
March	10	23	8	2	1	5	1	0
April	1	13	26	3	1	1	0	0
May	100	60	3	2	1	25	0	0
June	18	234	43	2	1	157	1	0
July	0	509	190	1	0	485	1	0
August	0	495	548	17	0	570	133	0
September	0	159	255	53	0	9	0	0
October	0	139	132	41	0	11	127	154
November	2	15	97	30	0	3	1	1
December	1	83	222	23	1	1	21	0
	<i>Trachypenaeus similis</i>				<i>Solenocera vioscai</i>			
January	38	8	10	0	0	0	4	4
February	4	65	21	1	0	0	2	6
March	49	38	24	4	0	0	11	13
April	11	23	3	1	0	0	2	13
May	36	247	7	22	0	0	3	23
June	24	348	82	1	0	0	119	28
July	1	77	10	0	0	0	13	5
August	16	100	8	12	0	0	1	22
September	1	12	1	0	0	0	1	5
October	1	11	3	17	0	0	0	6
November	4	11	5	1	0	0	5	12
December	18	59	1	1	0	0	53	14

collected from depths of 14 or 82 m. Lunz (1957) and Anderson (1956) reported similar bathymetric distributions for *S. brevirostris* off South Carolina. This evidence suggests that this species tends to remain within localized depth zones and coastal areas.

S. brevirostris was more readily captured during darkness than in daylight (Table 3). For this reason, estimates of seasonal abundance were based on night collections only. In Table 4, the mean number of individuals captured in 1-hour night tows indicates that this species reached peak abundance in July and August in depths of 27, 46 and 64 m.

Length-frequency of all *S. brevirostris* measured is presented in Figure 2. Females were, on the average, slightly larger than males. Most individuals measured 80 to 104 mm, suggesting that smaller *S. brevirostris* were not effectively captured by the otter trawls used.

The total numbers of *S. brevirostris* examined for ovary condition are presented in Table 6. Females with "developing" and "yellow" stage ovaries were most

TABLE 5

 Length distributions of *T. constrictus*, *P. longirostris*, *S. atlantidis*, *S. stimpsoni*
 caught during 1961-62

Total length mm	<i>T. constrictus</i>		<i>P. longirostris</i>		<i>S. atlantidis</i>		<i>S. stimpsoni</i>	
	Female	Male	Female	Male	Female	Male	Female	Male
	Number							
35-37	-	-	-	-	-	-	3	-
38-40	-	-	-	-	-	-	0	-
41-43	-	-	1	-	1	-	0	-
44-46	-	-	0	-	3	-	0	-
47-49	-	-	0	-	1	-	0	-
50-52	-	-	1	2	3	-	0	-
53-55	-	-	4	2	3	-	2	-
56-58	-	1	3	1	1	-	-	-
59-61	-	3	3	2	1	-	-	-
62-64	2	0	2	-	-	-	-	-
65-67	1	1	4	-	-	-	-	-
68-70	3	2	3	-	-	-	-	-
72-73	6	-	0	-	-	-	-	-
74-76	16	-	3	-	-	-	-	-
77-79	11	-	2	-	-	-	-	-
80-82	10	-	4	-	-	-	-	-
83-85	13	-	4	-	-	-	-	-
86-88	25	-	0	-	-	-	-	-
89-91	8	-	2	-	-	-	-	-
92-94	12	-	0	-	-	-	-	-
95-97	2	-	1	-	-	-	-	-
98-100	2	-	-	-	-	-	-	-
101-103	2	-	-	-	-	-	-	-
104-106	1	-	-	-	-	-	-	-
107-109	1	-	-	-	-	-	-	-

prevalent. However, females having "ripe" eggs were present year-round with highest percentages of ripe ovaries occurring from January through April.

Sicyonia dorsalis is a small rock shrimp taken mainly along the Texas coast at the 27-m stations (Tables 1 and 2). Trawl tows made at night yielded much larger catches than daylight tows (Table 3) and, thus, only night collections are used to indicate seasonal abundance. *S. dorsalis* was present in greatest abundance during July and August (Table 4).

Most *S. dorsalis* caught were 60 to 75 mm long (Fig. 2) and mean lengths differed little between sexes. Females with ripe eggs occurred throughout the year but were present in highest frequency from May through September.

Trachypenaeus similis, a small shrimp most abundant at the 27-m stations (Tables 1 and 2), was caught in smaller numbers in depths of 14, 46, and 64 m, rarely in 82 m and not at all in 110 m. Hildebrand (1954) reported *T. similis* to be second in abundance only to brown shrimp. Most of Hildebrand's collections were from depths of 18 to 44 m. This species was taken in largest numbers in

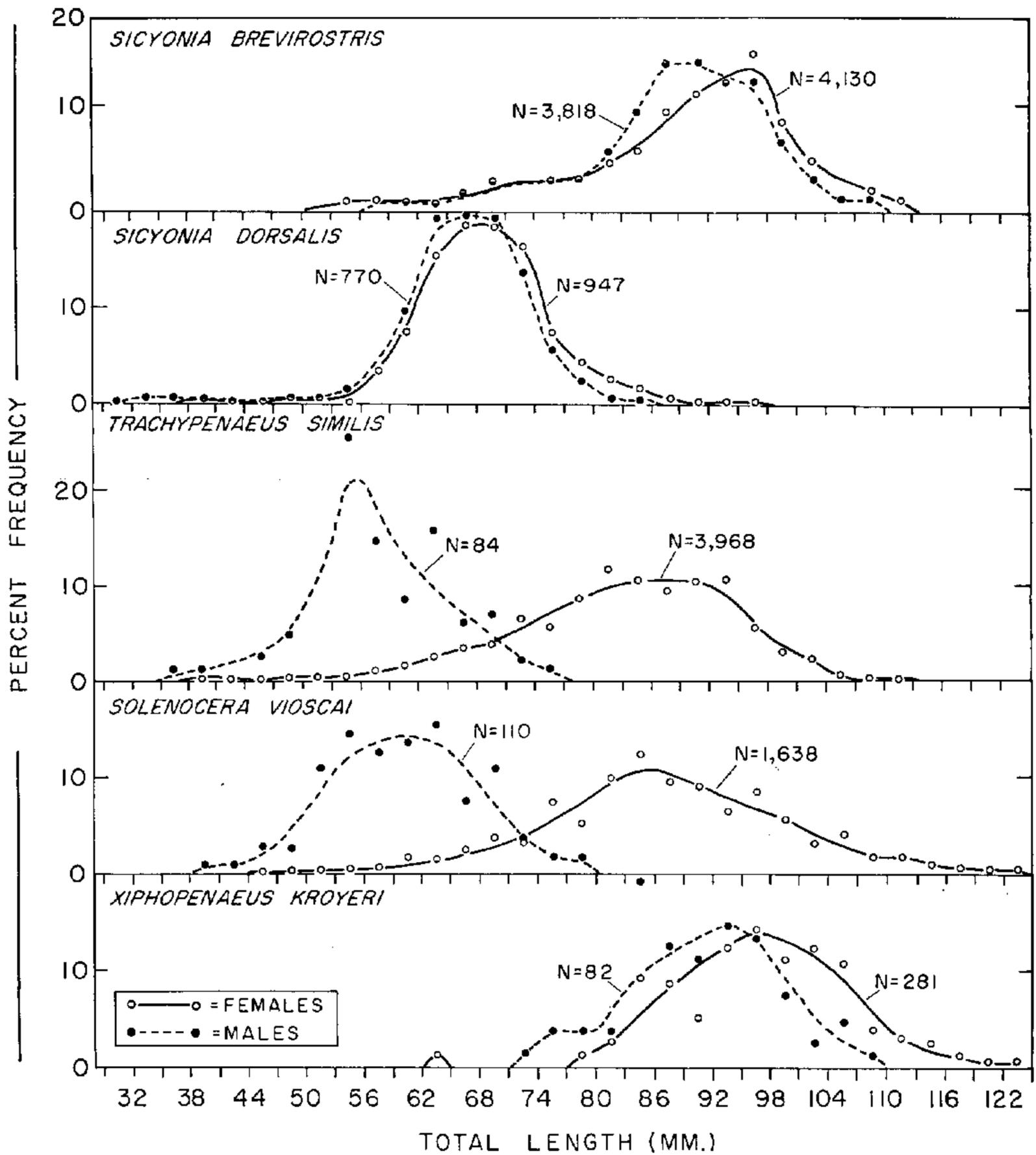


FIG. 2. Length distributions of *S. brevirostris*, *S. dorsalis*, *T. similis*, *S. vioscai* and *X. kroyeri* caught in the northwestern Gulf of Mexico, 1961-62. Curves are fitted by eye.

night trawls (Table 3) and appeared to occur in greatest abundance in May and June.

The differences in size between the sexes was striking. Most females were 70 to 95 mm long whereas the majority of males measured 50 to 70 mm (Fig. 2). Since only about one in every 50 *T. similis* caught were males, most were apparently not large enough to be retained in our nets. Spawning, as indicated by the percent frequency of "ripe" females, appeared to be more intense in June, July and September than in other seasons (Table 6).

Solenocera vioscai, often called "broken back" shrimp by the fishermen, was

TABLE 6

Monthly summary of the percentage of ripe ovaries for four species of penaeid shrimp, 1961-62 (all depths combined)

Month	Species							
	<i>S. brevistris</i>		<i>S. dorsalis</i>		<i>T. similis</i>		<i>S. vioscai</i>	
	Percent	Number examined	Percent	Number examined	Percent	Number examined	Percent	Number examined
January	15	191	20	20	0	43	4	47
February	22	101	0	11	1	157	14	57
March	17	110	15	13	4	181	12	95
April	25	104	11	9	8	103	6	71
May	9	134	33	30	1	123	5	63
June	7	164	18	73	2	124	12	76
July	8	126	16	56	6	95	13	38
August	13	225	16	89	13	119	10	61
September	8	237	31	74	5	57	10	39
October	9	258	11	68	4	50	7	55
November	17	308	6	17	0	36	14	78
December	7	257	5	19	2	57	6	121
Size range of ripe females	59-113 mm		58-83 mm		59-107 mm		56-107 mm	

never caught in 14- and 27-m depths (Table 1). Instead, this species appeared to be most prevalent at 46- and 64-m stations (Table 2). Based on night tows, which were much more productive than those made in daylight (Table 3), *S. vioscai* was most abundant in June and July. Males have much smaller average lengths than females (Fig. 2) and hence, were probably less vulnerable to the collecting gear used. Females with "ripe" eggs occurred most frequently during the period July-September (Table 6).

Xiphopenaeus kroyeri, commonly called the "seabob," is harvested on a limited commercial basis from Texas to northern Florida. Annual production in our survey area during 1961 and 1962 averaged about 2 million pounds (heads-off weight). This species occurs almost exclusively in near-shore areas, for more than 90% of the commercial catch is reported from depths of 9 m or less. In this survey, only two individuals from a total of 823 were captured in depths greater than 14 m. Almost all the seabobs were taken from September through January along the Texas coast (Tables 1 and 2). *X. kroyeri*, in contrast to previous species, was caught more readily in the daytime (Table 3). Males were apparently slightly shorter than females. Of the few ovaries examined histologically, none were ripe. However, Renfro and Cook (1963) reported gravid seabobs in the vicinity of Galveston from April through October.

Trachypenaeus constrictus is similar in size and superficial appearance to *T. similis*. For this reason, some misidentification of the two species in the field may have occurred. Burkenroad (1934) identified both species in Louisiana and noted that *T. similis* was caught more frequently than *T. constrictus*. Gunter (1950) listed 104 specimens from the vicinity of Aransas Pass as *T. constrictus*

TABLE 7

Station data for *Solenocera atlantidis* caught during 1961 and 1962

Date	Position	Depth in fathoms	Time of day	Number per standard tow
1961				
February 28	28° 40' N 94° 55' W	15	Night	3
March 23	28° 45' N 93° 20' W	15	Night	6
1962				
May 19	28° 54' N 92° 30' W	15	Night	3

with the qualification that some may have been *T. similis*. Hildebrand (1954) recognized only *T. similis* in his study of the brown shrimp grounds in the western Gulf of Mexico. During this survey we recognized *T. constrictus* only infrequently and usually in small numbers.

The small amount of data available from this study suggests that *T. constrictus* inhabits shallow waters (Tables 1 and 2) and may be equally available to day and night trawl tows (Table 3). Only eight individuals were taken at 46 m and one occurred at 82 m. Females had much greater average lengths than males (Table 5). No ripe ovaries were noted among the 49 examined.

Parapenaeus longirostris mainly inhabits the deeper areas in the eastern portion of the survey area (Tables 1 and 2). It was captured almost exclusively at night and females were generally larger than males (Table 5).

Solenocera atlantidis was described by Burkenroad (1939) from a sample of 369 specimens caught in a depth of 35 m and an 8-mm specimen taken by plankton net at a 37-m station off Mississippi. Springer and Bullis (1956) extended its known range eastward to Apalachicola, Florida. The *S. atlantidis* taken during this survey are tabulated in Table 7. These data extend its range westward into the northwestern Gulf of Mexico.

Sicyonia stimpsoni were identified from several collections made during the latter half of 1962. All were females and were caught at night from depths of 46 to 110 m.

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