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Studies of Shrimp Populations in Selected Coastal Bays of Texas

by Richard L. Benefield and William B. Baker, Jr.

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ABSTRACT

Brown shrimp (Penaeus aztecus) populations were monitored with marsh nets, bar seines, 3.0-m trawls and 6.1-m trawls to determine relative abundance, growth and movement in Galveston Bay, Matagorda Bay, Aransas Bay and the lower Laguna Madre. April-May bar seine and 3.0-m trawl sample results indicated a normal emigration of brown shrimp and a June 1979 closed Gulf season was recommended. Water temperatures after 1 April were > 20 C. Salinities were generally < 10 ‰ in each bay except the lower Laguna Madre.

Abnormal rainfall in 1979 influenced brown and white shrimp (P. setiferus) availability in Galveston Bay. Average rainfall was 25.7 cm in April, 41.2 cm in July and 34.6 cm in September. Salinities were < 7 ‰ during April-September. July and September flooding lowered upper bay salinities to near 0.00 ‰ and forced small white shrimp from shallow nursery areas into major bays.

White shrimp were most numerous during fall and summer. Average sizes of white shrimp collected on commercial shrimping grounds were larger than those in bait bay areas with the exception of Galveston Bay where August and September bait catches were of a larger mean size.

February-June 1979, 6.1-m trawl samples indicated the presence of large white shrimp in bay areas. White shrimp were more abundant in March and April but the largest mean sizes were found during May and June.

INTRODUCTION

The shrimp fishery is the most valuable commercial fishery in Texas. The 1978 harvest was 24 million kg (heads-on) valued at \$141.1 million (U. S. Department of Commerce 1978). Management studies have been conducted by the Texas Parks and Wildlife Department since 1958 to monitor the three principal commercial species of shrimp-- brown shrimp (Penaeus aztecus), white shrimp (P. setiferus) and pink shrimp (P. duorarum).

The 1979 monitoring program entailed sampling for brown, white and pink shrimp in Galveston, Matagorda, San Antonio and Aransas Bays during February-December. Brown shrimp were also monitored in the lower Laguna Madre during April-May. Migration, growth and abundance data were collected in order to provide biological input into present and future shrimp conservation laws. Data collected from these samples were used to meet the following objectives.

- (1) Determine growth rates, movements and relative abundance of brown shrimp in order to estimate the time of egress from bays to the Gulf of Mexico and recommend starting and ending dates of the Gulf closed season.
- (2) Determine the relative abundance, movements and growth rates of white shrimp in summer and fall in order to forecast harvest prospects for the recreational and commercial bay fishery and to provide data for future shrimping season recommendations.
- (3) Determine and compare size distributions of white shrimp on commercial (major bays) and bait (minor bays) shrimping grounds to determine size differences between the two areas.¹
- (4) Determine the occurrence and growth of white and pink shrimp in late winter and spring to investigate the possibility of special spring bay shrimping seasons.

¹In 1978 commercial shrimping was legal in "major bays", defined by law as the deeper bay areas of the inside waters including Sabine Lake, Trinity Bay, Galveston Bay, East Galveston Bay, West Galveston Bay, Matagorda Bay (including Keller's Bay and East Matagorda Bay), Tres Palacios Bay, Espiritu Santo Bay, Lavaca Bay from the present causeway seaward, San Antonio Bay, Ayres Bay, Aransas Bay, Mesquite Bay and Corpus Christi Bay, all exclusive of tributary bays, bayous and inlets. Commercial bait shrimping only was allowed in "minor bays".

The 1979 Regular Session of the 66th Texas Legislature redefined major bays and established bait bays and nursery areas. In this report, "major bays" are considered commercial shrimping grounds and "minor bays" are commercial bait bays and nursery grounds.

MATERIALS AND METHODS

Biological samples were collected from Galveston, Matagorda, San Antonio and Aransas Bays during February-December and in the lower Laguna Madre during April-May. Marsh nets, bar seines and trawls were used to sample brown and white shrimp populations with emphasis placed on young-of-the-year brown shrimp during February-May, young-of-the-year white shrimp during June-December and overwintering white and pink shrimp during February-May. Station locations for all sampling gears are presented in Appendix A and B.

Sampling with marsh nets was conducted during late February and March in Galveston and Aransas Bays to determine when postlarval brown shrimp arrived in shallow bay nursery areas. The marsh net used (Pullen et al. 1968) had 1-mm square mesh and a 52.1 x 17.8-cm mouth opening and was pulled 30.5 m at each station each week.

Intensive monitoring of brown shrimp occurred during April-May. A 1.8-m bar seine with 12.7-mm stretched mesh was pulled 152.4 m each week at designated shoreline stations. The weekly sampling provided data that were used to determine growth and relative abundance of juvenile and subadult shrimp. A 3.0-m trawl of 3.2-cm stretched mesh with a liner of 12.7-mm mesh in the cod end was pulled for 15 min at stations in minor and major bays to monitor brown shrimp migrations. The 1.8-m bar seine and 3.9-m trawl were used each week except in the lower Laguna Madre where samples were collected every two weeks.

Brown shrimp caught during June-December were recorded but were not utilized in movement or growth analyses.

White shrimp were monitored during February-December in Galveston, Matagorda, San Antonio and Aransas Bays. Postlarval white shrimp were sampled with a marsh net twice each month during June-December at shoreline stations. A 3.0-m trawl was pulled for 5 min near each marsh net station twice each month. A 6.1-m trawl with 3.8-cm stretched mesh was pulled twice each month to provide growth and movement data.

The 6.1-m trawl was used during February-May to monitor populations of overwintering white shrimp. Samples were collected near the middle of each month at designated stations.

Shrimp caught were identified and counted. A minimum of 100 shrimp (when available) was selected at random and measured to the nearest mm from the rostrum tip to the end of the telson. Descriptions of various stages of shrimp growth as used in this report follow those described for brown shrimp by Renfro (1964)--postlarval shrimp (< 25 mm), juvenile (25-89 mm), subadult (90-139 mm) and adult (\geq 140 mm).

At each sample site, bottom salinity ($^{\circ}/\text{oo}$) was determined with a refractometer and bottom temperature (C) was determined with a hand-held thermometer.

Shrimp growth rates were estimated using the method described by Williams (1955). The size difference between the largest shrimp caught during the initial sampling period and the largest shrimp taken during subsequent sampling periods was divided by the number of days between periods to provide daily size increase. Growth rates were also estimated by comparing mean sizes between sampling periods.

Mean lengths, standard deviations and standard errors of shrimp and hydrological data were calculated using the following formula:

$$\text{Mean Length} = \frac{\sum x}{n}$$

x = length of individual shrimp or hydrological data point
n = number of shrimp or hydrological data points

$$\text{Standard Deviation} = \sqrt{\text{Variance}}$$

$$\text{Variance} = \frac{(\sum x^2 \cdot \frac{\sum x}{n})}{n-1}$$

$$\text{Standard Error} = \sqrt{\frac{\text{Variance}}{n}}$$

Standard deviation and standard error were not calculated when there were less than three data entries.

RESULTS

Brown Shrimp

Galveston Bay

Postlarval brown shrimp were first detected in marsh nets on 6 March (Table 1). A catch of 175 shrimp on 19 March was the only substantial catch during the 5-week sampling period. Bar seine catch per drag increased from 2.8 on 2 April (Week 1) to 45.0 on 30 May (Week 9) (Table 2). The same general trend was evident in 3.0-m trawl samples except that no shrimp were caught until 24 April (Week 4) (Table 3). Catches of brown shrimp with 6.1-m trawls are presented in Table 4. A substantial movement of brown shrimp was indicated by a catch of 1306 shrimp in early June.

The estimated growth of brown shrimp from early April to late May was about 1.7 mm per day (Figure 1). Lengths of shrimp from bar seine and 3.0-m trawl data were combined to illustrate sizes during April-May. Maximum sizes ranged from 18 mm in April to 118 mm in May. Continual recruitment of small shrimp (13-33 mm) was evident through May.

Matagorda Bay

Brown shrimp were first collected on 5 April (Week 1) with 3.0-m trawls (Table 3) and on 10 April (Week 2) with bar seines (Table 2).

About 94% of the brown shrimp caught in Matagorda Bay with 6.1-m trawls (Table 4) were taken during May and June.

The sizes of brown shrimp varied from 13-28 mm on 5 April to 18-118 mm on 30 May (Figure 1). Shrimp apparently grew 90 mm over a 55-day period for a growth rate of 1.6 mm per day. Mean sizes of shrimp were similar (87.0 and 89.1 mm, respectively) in May and June (Table 4).

San Antonio Bay

Brown shrimp were caught during the first week of April with 1.8-m bar seines and 3.0-m trawls. Bar seine catches ranged from a high of 188 shrimp in May to a low of 32 in May (Table 2). The peak catch with 3.0-m trawls occurred on 1 May--386 shrimp (Table 3). Substantial numbers of brown shrimp were collected with 6.1-m trawls during May-July with the peak catch (560) occurring on 18 July (Table 4).

Shrimp ranged in size from 18-28 mm on 4 April to 23-113 mm on 29 May in combined bar seine and 3.0-m trawl samples (Figure 1). Brown shrimp grew 85 mm over a 49-day period for an average growth rate of 1.8 mm per day.

Aransas Bay

Juvenile brown shrimp were first detected on 26 February in a marsh net sample (Table 1). A peak catch with marsh nets of 73 shrimp occurred on 13 March with catches decreasing during the following two weeks. Brown shrimp were present in bar seine samples each week with a peak catch of 380 shrimp in May (Table 2). Brown shrimp were scarce in 3.0-m trawl samples during April (Table 3). Movement of brown shrimp into major bays, however, was indicated by increased catches during May. The 6.1-m trawl samples confirmed this movement; catches during May and June were the highest recorded during the year (Table 4).

The sizes of brown shrimp ranged from 8-13 mm in marsh net samples during March to 13-88 mm in bar seine samples during April-May. Shrimp grew from 23 mm in early April to 128 mm in early June--a growth rate of 1.8 mm per day (Figure 1).

Individual bay and gear supplemental brown shrimp catch data including numbers of samples, number of shrimp caught, catch per drag, size range, mean size, standard deviation and standard error are presented in Appendix C.

White Shrimp

Galveston Bay

The 396 samples taken with three gear types yielded 19,369 white shrimp during fall and summer 1978-79: 48 marsh net samples yielded 13.4 shrimp per drag, 48 3.0-m trawl samples yielded 107.5 shrimp per drag and 300 6.0-m trawl samples yielded 45.2 shrimp per drag.

Marsh net samples yielded 497 shrimp (8-83 mm) from 5 September to 9 November (Table 5). Few shrimp (35) were found in the remaining samples through December. Marsh net catches during summer were low, including only 51 shrimp during June-August 1979. September catches were well below those of September 1978.

Drags with 3.0-m trawls yielded 3446 shrimp (23-148 mm) during September-December (Table 6). November samples yielded 1769 shrimp (38-113 mm), or 51.3% of the catch during September-December. June-August samples yielded 383 shrimp (18-133 mm). The catch in September 1979 was 1329 shrimp (29-139 mm) compared with 629 shrimp (28-138 mm) in September 1978.

The 6.1-m trawl samples yielded 13,568 white shrimp (23-178 mm) during 1978-79 (Table 7). Peak fall catches occurred in November (4951 shrimp, 43-153 mm). Except in September, fall catches exceeded 2000 shrimp per month. Summer catches were comparatively low: 20 shrimp (48-173 mm) were caught in June, 1499 (53-178 mm) in July and 1027 (33-143 mm) in August. The catch in September 1979 was 455 shrimp compared with 926 shrimp in September 1978.

White shrimp caught with 3.0-m trawls in summer grew 65 mm from 22 June to 21 August for an estimated growth rate of 1.1 mm per day (based on maximum size caught). Estimated growth rates of white shrimp from 6.1-m trawls in spring are shown in Table 8. Growth rates based on mean size ranged from 0.2 to 0.8 mm per day. Growth rates based on maximum size ranged from 0.4 to 0.7 mm per day.

The size distribution of white shrimp in 6.1-m trawl samples taken on major (commercial) and minor (bait) bay sampling grounds is presented in Table 9. Mean sizes of white shrimp caught during fall in major bays exceeded mean sizes of shrimp caught in minor bays. The largest mean size in major bays (122.2 mm) was found in early September. Sizes decreased steadily in minor bays to < 80 mm in the latter half of December.

Matagorda Bay

The 156 samples taken with three gear types yielded 4234 white shrimp ranging in size from 13 to 168 mm. Average catches included 5.1 shrimp per drag with marsh nets, 38.3 shrimp per drag with 3.0-m trawls and 29.5 shrimp per drag with 6.1-m trawls.

Marsh net samples yielded 123 shrimp (18-78 mm) during the fall and summer. Fall samples yielded 113 shrimp compared with 10 shrimp in the summer (Table 5). Samples during September 1978 accounted for 67% of the total fall catch.

Drags with 3.0-m trawls caught 920 shrimp (13-103 mm) (Table 6). Fall catches of shrimp (189) were less than summer catches (731). The mean sizes of shrimp during fall exceeded those during summer.

The 108 6.1-m trawl samples yielded 3191 white shrimp (Table 7). Fewer shrimp were caught during fall (620) than during summer (2368). July and August catches per drag totaled 132.8 and 108.1 shrimp, respectively.

White shrimp caught with 6.1-m trawls during summer grew 80 mm from 27 June to 29 August for an estimated growth rate of 1.3 mm per day (based on maximum size caught). During spring growth rates based on mean size averaged 0.7 mm per day (Table 8); growth rates based on maximum size ranged from 0.7 to 0.8 mm per day.

The size distribution of white shrimp in 6.1-m trawl samples taken on major (commercial) and minor (bait) bay shrimping grounds is presented in Table 9. Fall and summer catches indicated larger mean size shrimp in major bays with the exception of September 1978 when larger white shrimp were caught in minor bays.

San Antonio Bay

The 268 samples collected with three gear types yielded 3223 white shrimp (18-158 mm): 44 samples with a marsh net yielded 1.4 shrimp per drag, 44 samples with a 3.0-m trawl yielded 7.7 shrimp per drag and 180 samples with a 6.1-m trawl yielded 15.7 shrimp per drag.

Marsh net samples yielded 60 shrimp (18-03 mm) (Table 5). Small shrimp were caught in September and October; no recruitment was detected in November or December. Initial summer catches of shrimp (9) occurred in July (33-63 mm). August catches were slightly higher (15) and of a larger size (33-83 mm).

Drags with 3.0-m trawls yielded 339 shrimp (28-118 mm) (Table 6). The peak catch of white shrimp was in August when 162 shrimp (28-113 mm) were taken. Fall shrimp were of a larger mean size than summer shrimp.

The 6.1-m trawl samples yielded 2824 shrimp ranging in size from 33 to 158 mm (Table 7). Catch rates included 18.1 shrimp per drag during fall and 23.3 shrimp per drag during summer. Initial summer catches occurred in July and peak catches in August. The largest shrimp during the summer (mean: 108.5 mm) were caught in August.

White shrimp caught with 6.1-m trawls in summer grew 30 mm from 10 July to 13 August for an estimated growth rate of 0.9 mm per day (based on maximum size caught). During spring growth rates based on mean size ranged from 0.6 to 0.9 mm per day (Table 8); growth rates based on maximum size ranged from 0.2 to 1.1 mm per day.

The size distribution of white shrimp in 6.1-m trawl samples taken on major (commercial) and minor (bait) bay shrimping grounds is presented in Table 9. Mean sizes of shrimp taken in major bays exceeded those of shrimp taken in minor bays during fall. In major bays during fall mean size varied from 103.3 mm in September to 80.7 mm in December. In minor bays during fall mean size ranged from 87.8 mm in September to 71.1 mm in December.

Aransas Bay

The 315 samples taken with three gear types yielded 7292 white shrimp: 62 samples with a marsh net yielded 11.2 shrimp per drag, 48 samples with a 3.0-m trawl yielded 37.7 shrimp per drag and 205 samples with a 6.1-m trawl yielded 23.1 shrimp per drag.

Marsh net samples yielded a total of 697 white shrimp (Table 5). Fall sampling yielded 387 shrimp as compared with 230 in summer. September 1978 catches were less than those of September 1979.

Drags with 3.0-m trawls yielded 1809 shrimp (Table 6). More shrimp were caught during fall (964) than summer (516). December and June catches were the lowest of all months sampled. September 1978 catches included fewer shrimp but the shrimp were larger in size than during September 1979.

White shrimp were more abundant during fall (2565) than during summer (576) in 6.1-m trawl collections (Table 7). Fall catches averaged 42.8 shrimp per drag as compared with 10.1 shrimp per drag during summer. The largest mean size fall shrimp (111.9 mm) were caught in early September whereas shrimp caught during early June were the largest mean size summer shrimp (104.1 mm) collected.

Summer white shrimp caught with 3.0-m trawls grew 60 mm from 18 June to 16 July, a 28-day period, resulting in a growth rate of 2.1 mm per day (based on maximum size caught). During the same period a growth rate of 1.5 mm per day was calculated using mean sizes. During spring growth rates based on mean size ranged from 0.2 to 0.9 mm per day (Table 8); growth rates based on maximum size ranged from 0.3 to 1.2 mm per day.

The size distribution of white shrimp in 6.1-m trawl samples taken on commercial and bait shrimping grounds is presented in Table 9. Shrimp were generally of a larger mean size in major bays. However, October and June catches indicated larger mean size shrimp in bait bays.

Individual bay and gear supplemental white shrimp catch data including number of samples, number of shrimp caught, catch per drag, size range, mean size, standard deviation and standard error are presented in Appendix D.

Pink Shrimp

Overwintering pink shrimp were collected in Aransas Bay with 6.1-m trawls. November-December catches included ≤ 2.0 shrimp per sample. Sizes ranged from 48 to 103 mm. Catches increased from 19 shrimp in February to a peak of 128 shrimp in April. During February-April sizes ranged from 48 to 128 mm and mean size increased from 68.8 in February to 99.1 mm in April. No pink shrimp were then caught until 25-26 September. No trends of maximum size difference could be found to calculate growth; however, mean size from February to April increased 30.3 mm, or approximately 0.5 mm per day.

Small numbers of pink shrimp were caught during April and May in the lower Laguna Madre during intensive sampling for brown shrimp; 40 shrimp were taken in 3.0-m trawls.

Individual bay and gear supplemental pink shrimp catch data including number of samples, number of shrimp caught, catch per drag, size range, mean size, standard deviation and standard error are presented in Appendix E.

Hydrology

A summary of mean monthly temperatures and salinities is presented in Figure 2. Data in Appendix F provides a summary of hydrological conditions by gear type in sampled bays.

Water temperatures in March were below 20 C in Galveston, San Antonio and Aransas Bays; Matagorda Bay temperatures were 20.9 C. April temperatures were above 20 C in each bay. Water temperatures ranged from a high of 30.9 C during August in Matagorda Bay to a low of 13.3 C during December in Galveston Bay.

Mean salinities were highest (20.1 ‰) during November in Galveston Bay and lowest (5.0 ‰) during September 1978 in San Antonio Bay. March salinities exceeded 10 ‰ in each bay except San Antonio Bay. April-May salinities fell below 10 ‰ in all four bays. Salinities remained at these low levels through September except in Aransas Bay where salinities rose slightly above 10 ‰ in July and August.

DISCUSSION

Hydrological conditions in Texas bays were less than optimal for brown shrimp production during spring 1979. Water temperatures during the spring season were moderate but salinities were low in each area except the lower Laguna Madre. St. Amant et al. (1966) found that brown shrimp survived best when water temperatures exceeded 20 C and salinities exceeded 10 ‰ whereas temperatures < 18 C and salinities < 8 ‰ could lead to poor survival of small brown shrimp. Gunter et al. (1964) described 10-20 ‰ as optimal salinities for brown shrimp and 0-5 ‰ as least favorable. Moffett and McEachron (1973) observed that low salinities in bays during April and May 1973 were responsible for the poorest brown shrimp catch since 1964. Most bay mean salinities did not exceed 10 ‰ during April and May 1979 and, as in 1973, are thought to be primarily responsible for the poor brown shrimp harvest.

Using sizes of shrimp of the 1979 year class from samples in April and early May, a normal 1 June closure of the Gulf was recommended. Maximum sizes of shrimp were generally < 100 mm during April-early May. Increases in numbers of brown shrimp at major bay stations during May and June confirmed a movement from minor bays. Subsequent Gulf trawl sampling by Department biologists revealed that brown shrimp were numerous

in the shallow (7-22 m) Gulf off Port Aransas from late May to early August (Terry Cody, TPWD, personal communication). An extended emigration period was indicated by Gulf samples.

White shrimp were sampled to determine abundance, distribution and growth. The data will allow shrimping forecasts for the 15 August-15 December season to be made, determination of shrimp distribution in major and bait bays, and evaluations of a possible spring season for overwintering white shrimp.

Peak abundance of white shrimp occurred during fall in Galveston and Aransas Bay; Matagorda and San Antonio Bays experienced peak abundance of shrimp during summer. Johnson (1976) found that fall catches of white shrimp (87% of total catch) in Galveston Bay exceeded summer catches (13% of total catch). Moffett (1972) reported that northerners in the fall often reduce water temperatures and small white shrimp migrate to larger and deeper bays where they are subject to shrimping. This migration could explain the higher fall catches in Galveston and Aransas Bays. Catches of white shrimp in Galveston Bay during summer were affected by heavy localized rainfall and flooding during 24-26 July. July rainfall in the Galveston Bay area averaged 41.2 cm (U. S. Department of Commerce 1979), but some areas received as much as 90.7 cm of rain, the majority of which fell during the 3-day period. Flooding and runoff were severe in areas on the west side of Galveston Bay and most tributaries entering West Galveston Bay. Sample catches of white shrimp in nursery area and bait bays were low on 30-31 July but catches in major bays were very high. This would indicate a flushing of shrimp out of nursery and bait bays into major bays. Moffett and McEachron (1973) stated that heavy rains could force small shrimp from back bays into major bays.

A similar pattern of heavy rainfall and flooding occurred on 19-20 September 1979. Average rainfall was 34.6 cm in September; resulting flooding was less severe than in July. Both floods occurred during critical periods for immigration of postlarval white shrimp into nursery areas of Galveston Bay.

Moffett and McEachron (1974) suggested that small white shrimp present during the fall could contribute heavily to spring catches when a mild winter occurs. Monitoring of white shrimp populations during late winter and spring should be continued to develop trend data in order to evaluate prospects for an early season. In 1979, 84% of the overwintering white shrimp in the four sampled bays were caught during March and April.

The determination of shrimp growth rates is important in predicting the movement of shrimp from bays to the Gulf (as in the case of brown shrimp) or in determining the time shrimp will first meet legal or preferred sizes. The method of estimating growth rates described by Williams (1955) was used in most cases because it eliminates the apparent depression of growth caused by recruitment of small shrimp into the population. The method is most useful when the year class of shrimp in question initially enters the estuary until emigration

from the estuary begins. The method is limited when shrimp begin large-scale emigration from the estuary and when large shrimp of a previous year class are present in the samples. Because the project year began in fall, a determination of growth rates for white shrimp of the 1978 year class was not possible. The calculation of growth rates of the 1978 year class which overwintered, however, was possible because movement to and from the bays was not evident.

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Table 1. Number, catch per drag and mean size of brown shrimp caught with marsh nets during Feb.-Mar. 1979 in Galveston and Aransas Bays.

Date	No. shrimp caught	Catch per drag	Mean size (mm)
Galveston Bay			
27 Feb. 1979	0	0.0	
6 Mar.	2	0.7	10.5
12 Mar.	0	0.0	
19 Mar.	175	58.3	12.9
26 Mar.	2	0.7	13.0
Aransas Bay			
26 Feb. 1979	1	0.2	33.0
5 Mar.	3	0.6	9.7
13 Mar.	73	14.6	12.4
19 Mar.	51	10.2	13.0
26 Mar.	23	4.6	14.5

Table 2. Number, catch per drag and mean size of brown shrimp (*P. aztecus*) caught with 1.8-m bar seines during Apr.-May 1979 in Galveston, Matagorda, San Antonio and Aransas Bays and lower Laguna Madre.

Sample Week	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
GALVESTON BAY				MATAGORDA BAY		
April 1	14	2.8	15.9	0	0.0	
2	42	8.4	16.7	32	8.0	23.3
3	52	10.4	28.8	98	24.5	32.7
4	114	22.8	32.2	356	89.0	31.0
5	57	11.4	40.2	380	95.0	34.5
May 6	131	26.2	38.9	44	11.0	38.0
7	152	30.4	38.1	218	54.5	34.9
8	223	44.6	31.6	142	35.5	45.2
9	180	45.0	33.1	62	15.5	45.1
SAN ANTONIO BAY				ARANSAS BAY		
April 1	40	10.0	22.1	6	1.2	21.3
2	130	32.5	26.2	35	7.0	26.1
3	122	30.5	35.5	163	32.6	36.2
4	68	17.0	40.8	195	39.0	40.4
May 5	44	11.0	39.4	257	51.4	43.3
6	188	47.0	30.8	380	76.0	41.6
7	32	8.0	41.4	230	46.0	43.3
8	134	33.5	42.5	202	40.4	49.2
9	84	21.0	44.3	80	16.0	54.1
LOWER LAGUNA MADRE						
April 1	136	45.3	42.7			
3	405	135.0	42.7			
5	64	21.3	40.9			
May 7	33	11.0	59.8			

Table 3. Number, catch per drag and mean size of brown shrimp (*P. aztecus*) caught with 3.0-m trawls during Apr.-May 1979 in Galveston, Matagorda, San Antonio and Aransas Bays and lower Laguna Madre.

Sample Week	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
GALVESTON BAY				MATAGORDA BAY		
April 1	0	0.0		55	13.8	20.0
2	0	0.0		152	38.0	24.4
3	0	0.0		484	121.0	27.3
4	38	12.7	26.3	373	93.3	35.8
May 5	31	10.3	33.8	187	46.8	40.2
6	14	4.7	50.5	276	69.0	39.2
7	12	3.0	50.9	143	35.8	42.7
8	160	53.3	70.5	369	92.3	45.9
9	362	120.7	62.5	351	87.8	59.3
SAN ANTONIO BAY				ARANSAS BAY		
April 1	25	6.3	21.2	3	0.6	89.7
2	173	43.3	24.7	2	0.4	90.5
3	125	31.3	32.1	9	1.8	40.8
4	141	35.3	34.8	43	8.6	48.7
May 5	386	96.5	41.0	290	58.0	58.3
6	194	48.5	46.8	836	167.2	65.1
7	151	37.8	51.9	270	54.0	73.4
8	303	75.8	72.5	246	49.2	79.3
9	194	48.5	70.0	420	84.0	83.1
LOWER LAGUNA MADRE						
April 1	42	14.0	40.9			
3	313	104.3	49.9			
May 5	245	81.6	65.0			
7	22	3.1	69.4			

Table 4. Number, catch per drag and mean size of brown shrimp (*P. aztecus*) caught with 6.1-m trawls during Apr.-Aug. 1979 in Galveston, Matagorda, San Antonio and Aransas Bays.

Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
GALVESTON BAY			
12-13-23 Apr.	2	0.1	40.5
15-16-17 May	261	17.4	81.6
6-7-8 June	1306	87.1	83.9
21-22 June	373	24.9	85.3
3-5-6 July	312	20.8	84.4
30-31 July	223	14.9	93.4
8-9-10 Aug.	56	3.7	97.0
20-21-22 Aug.	22	1.5	91.6
MATAGORDA BAY			
25-26 April	26	2.9	52.2
23-24 May	437	48.6	87.0
27 June	297	33.0	89.1
18-19 July	10	1.1	96.5
28-29 Aug.	0	0.0	
SAN ANTONIO BAY			
17 Apr.	12	1.2	100.9
14 May	238	23.8	88.8
4 June	305	30.5	98.3
14 July	211	21.1	95.6
2-10 July	147	14.7	98.7
18 July	560	56.0	98.6
13 Aug.	10	1.0	89.0
20 Aug.	7	0.7	84.4
ARANSAS BAY			
18-19 Apr.	86	7.8	41.3
15-17 May	2048	186.2	76.6
6-7-8 June	1881	171.0	84.4
19-20 June	1001	91.0	78.2
5 July	5	4.0	97.4
17-18 July	53	4.8	81.2
6-7 Aug.	59	5.4	91.3
21-22 Aug.	60	5.4	80.5

Table 5. Number, catch per drag and mean size of white shrimp (*P. setiferus*) caught with marsh nets during Sept.-Dec. 1978 and June-Sept. 1979 in Galveston, Matagorda, San Antonio and Aransas Bays.

Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
GALVESTON BAY			
5-6 Sept. 1978	194	64.7	23.4
18-19 Sept.	32	10.7	19.8
3 Oct.	141	47.0	22.6
24-25 Oct.	37	12.3	27.7
8-9 Nov.	93	31.0	27.0
20-21 Nov.	18	6.0	30.8
5-6-13 Dec.	14	4.7	27.3
27-28-29 Dec.	3	1.0	0.0
7-8 June 1979	0	0.0	
22 June	4	1.3	23.0
5-6 July	0	0.0	
30-31 July	0	0.0	
8-10 Aug.	4	1.3	16.8
20-21 Aug.	43	14.3	13.9
5-6 Sept.	56	18.7	23.1
17-18 Sept.	4	1.3	61.3
MATAGORDA BAY			
22 Sept. 1978	76	25.3	32.3
16 Oct.	13	4.3	49.2
13 Nov.	24	8.0	29.7
20 Dec.	0	0.0	
19 June 1979	1	0.3	23.0
17 July	3	1.0	36.3
6 Aug.	6	2.0	28.0
25 Sept.	0	0.0	

Table 5. (Cont'd).

Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
SAN ANTONIO BAY			
- Sept. 1978	NS	-	-
19 Sept.	33	16.5	29.4
11 Oct.	1	0.3	53.0
16 Oct.	1	0.3	23.0
1 Nov.	0	0.0	
14 Nov.	0	0.0	
5 Dec.	0	0.0	
19 Dec.	0	0.0	
8 June 1979	0	0.0	
18 June	0	0.0	
4 July	3	1.0	36.3
15 July	6	2.0	57.0
7 Aug.	4	1.3	56.6
21 Aug.	11	3.7	78.0
10 Sept.	0	0.0	
21 Sept.	1	0.3	68.0
ARANSAS BAY			
5 Sept. 1978	39	13.0	23.8
18 Sept.	9	3.0	21.9
5 Oct.	7	1.8	31.6
16 Oct.	53	13.3	43.8
31 Oct.	195	48.8	23.3
14-15 Nov.	84	21.0	31.4
5 Dec.	3	1.0	24.7
18 Dec.	0	0.0	
4 June 1979	13	3.3	15.7
18 June	43	10.8	29.9
3 July	23	5.8	25.2
16 July	79	19.8	26.1
3 Aug.	13	3.3	35.3
20 Aug.	59	14.8	24.4
5 Sept.	44	11.0	29.8
24 Sept.	33	8.3	22.5

NS = No sample taken

Table 6. Number, catch per drag and mean size of white shrimp (*P. setiferus*) caught with 3.0-m trawls during Sept.-Dec. 1978 and June-Sept. 1979 in Galveston, Matagorda, San Antonio and Aransas Bays.

Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
GALVESTON BAY			
5-6 Sept. 1978	69	23.0	79.6
18-19 Sept.	560	186.7	74.7
3 Oct.	783	261.0	71.9
24-25 Oct.	230	76.1	74.3
8-9 Nov.	1578	526.0	72.3
20-21 Nov.	191	63.7	65.5
5-6-13 Dec.	29	9.7	59.6
27-28-29 Dec.	6	2.0	71.3
7-8 June 1979	0	0.0	
22 June	4	1.3	53.0
5-6 July	46	15.3	62.7
30-31 July	1	0.3	68.0
8-10 Aug.	110	36.7	68.2
22-21 Aug.	222	74.0	56.4
5-6 Sept.	133	44.3	50.7
17-18 Sept.	1196	398.7	59.2
MATAGORDA BAY			
22 Sept. 1978	57	19.0	50.5
16 Oct.	94	31.3	49.2
13 Nov.	38	12.7	66.9
20 Dec.	0	0.0	
19 June 1979	63	21.0	34.5
17 July	98	32.7	45.9
6 Aug.	570	190.0	39.4
25 Sept.	0	0.0	

Table 6. (Cont'd).

Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
SAN ANTONIO BAY			
1 Sept. 1978	NS	-	-
19 Sept.	12	6.0	88.8
11 Oct.	5	1.7	78.0
16 Oct.	59	19.7	91.9
1 Nov.	48	16.0	92.2
14 Nov.	28	9.5	70.3
5 Dec.	0	0.0	
19 Dec.	0	0.0	
ARANSAS BAY			
5-8 June 1979	0	0.0	
18 June	0	0.0	
4 July	0	0.0	
15 July	14	4.7	77.6
7 Aug.	40	13.3	77.6
21 Aug.	122	40.7	75.3
10 Sept.	10	3.3	90.5
21 Sept.	1	0.3	93.0
ARANSAS BAY			
5 Sept. 1978	220	73.3	84.3
18 Sept.	12	4.0	87.2
5 Oct.	193	64.3	73.1
16 Oct.	214	71.3	74.6
31 Oct.	171	57.0	65.6
14 Nov.	154	54.7	62.8
5 Dec.	42	13.0	34.1
18 Dec.	7	2.3	65.1
ARANSAS BAY			
4 June 1979	0	0.0	
18 June	19	6.3	31.9
3 July	56	18.7	49.8
16 July	153	51.0	74.0
2 Aug.	87	29.0	76.7
20 Aug.	201	67.0	62.5
5 Sept.	262	87.3	58.1
24 Sept.	18	6.0	75.8

NS = No sample taken

Table 7. Number, catch per drag and mean size of white shrimp (*P. setiferus*) caught with 6.1-m trawls during Sept.-Dec. 1978 and June-Sept. 1979 in Galveston, Matagorda, San Antonio and Aransas Bays.

Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
GALVESTON BAY			
5-6-12 Sept. 1978	266	17.7	112.5
18-19-26 Sept.	660	44.0	101.1
2-3-12 Oct.	819	54.6	100.7
24-25-27 Oct.	1437	95.8	97.3
8-9-10 Nov.	2539	169.3	93.6
20-21-22 Nov.	2412	160.8	91.1
5-13-15 Dec.	1591	106.1	83.1
22-28-29 Dec.	526	35.1	79.0
14-15-23 Feb. 1979	0	0.0	
13-14-26 Mar.	87	5.8	103.0
12-13-23 Apr.	187	12.5	111.3
15-16-17 May	43	2.9	136.6
6-7-8 June	11	0.7	150.5
21-22 June	9	0.6	134.7
3-5-6 July	183	12.2	73.9
30-31 July	1316	87.7	101.6
8-9-10 Aug.	397	26.5	108.0
20-21-22 Aug.	630	42.0	107.6
5-6-7 Sept.	157	10.5	101.1
17-18-24 Sept.	298	19.9	90.3
MATAGORDA BAY			
21-22 Sept. 1978	221	24.6	98.9
18 Oct.	112	12.4	94.3
28-29 Nov.	287	31.9	84.9
19-20 Dec.	0	0.0	
26-27 Feb. 1979	0	0.0	
28-29 Mar.	63	7.0	103.6
25-26 Apr.	75	8.3	125.5
23-24 May	25	2.8	146.8
27 June	37	4.1	50.3
18-19 July	1195	132.8	85.5
28-29 Aug.	973	108.1	94.5
25-26 Sept.	203	22.6	87.8

Table 7. (Cont'd).

Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
SAN ANTONIO BAY			
- Sept. 1978	NS	-	-
15 Sept.	121	12.1	97.8
- Oct.	NS	-	-
23 Oct.	219	21.9	89.2
3 Nov.	147	14.7	85.8
15 Nov.	359	35.9	86.6
7 Dec.	274	27.4	83.4
18 Dec.	24	2.4	80.7
13-14 Feb. 1979	2	0.2	83.0
13 Mar.	0	0.0	
17 Apr.	20	2.0	119.5
14 May	5	0.5	143.0
4 June	0	0.0	
14 June	0	0.0	
2-10 July	131	13.1	82.4
18 July	434	43.4	92.2
13 Aug.	722	72.2	108.5
20 Aug.	113	11.3	102.8
5 Sept.	98	9.8	92.1
24 Sept.	155	15.5	92.7
ARANSAS BAY			
6-7 Sept. 1978	150	18.8	111.9
14-15 Sept.	763	95.4	95.9
3-4 Oct.	315	28.6	95.7
18-19 Oct.	431	39.2	96.3
1-2 Nov.	451	41.0	96.4
13-29 Nov.	455	41.4	82.1
6-7 Dec.	494	44.9	82.4
19-20 Dec.	74	6.7	81.8
14-15 Feb. 1979	3	3.7	71.3
14-16 Mar.	52	4.7	92.4
18-19 Apr.	35	3.2	121.7
15-17 May	23	2.1	139.1
6-7-8 June	9	0.8	104.1
19-20 June	11	1.0	72.5
5 July	0	0.0	
17-18 July	274	24.9	74.7
6-7 Aug.	230	20.9	98.6
21-22 Aug.	52	4.7	101.9
6-7 Sept.	110	10.0	88.9
25-26 Sept.	854	77.6	83.1

NS = No sample taken

Table 8. Estimated growth rates of white shrimp (*P. setiferus*) caught with trawls during late winter and spring in Galveston, Matagorda, San Antonio and Aransas Bays. Estimates are based on the increase in mean size and maximum size of shrimp between sampling periods.

Sampling Period	Size (mm)	Increase in Size (mm)	No. of Days Between Periods	Estimated Growth Rate (mm/day)	
GALVESTON BAY					
<u>Mean Size</u>					
1979	Mar.-Apr.	103.9-109.1 ^a	5.2	28	0.2
		102.8-122.3 ^a	19.5	27	0.7
	Apr.-May	109.1-136.6 ^b	27.5	33	0.8
	May-June	136.6-158.7 ^b	22.1	36	0.6
<u>Max. Size</u>					
	Mar.-Apr.	128.0-148.0	20.0	28	0.7
	Apr.-May	148.0-158.0	10.0	22	0.4
	May-June	158.0-173.0 ^b	15.0	36	0.4
MATAGORDA BAY					
<u>Mean Size</u>					
1979	Mar.-Apr.	103.6-125.5	21.9	33	0.7
	Apr.-May	125.5-146.8	21.3	29	0.7
	May-June	No estimate; year class absent from June samples			
<u>Max. Size</u>					
	Mar.-Apr.	128.0-153.0	25.0	32	0.8
	Apr.-May	153.0-173.0	20.0	28	0.7
	May-June	No estimate; year class absent from June samples			
SAN ANTONIO BAY					
<u>Mean Size</u>					
1979	Feb.-Apr.	83.0-119.8 ^c	36.8	63	0.6
	Apr.-May	119.8-143.0	23.2	27	0.9
	May-June	No estimate; year class absent from June samples			
<u>Max. Size</u>					
	Feb.-Apr.	83.0-153.0 ^c	70.0	63	1.1
	Apr.-May	153.0-158.0	5.0	27	0.2
	May-June	No estimate; year class absent from June samples			

Table 8. (Cont'd).

Sampling Period	Size (mm)	Increase in Size (mm)	No. of Days Between Periods	Estimated Growth Rate (mm/day)
ARANSAS BAY				
<u>Mean Size</u>				
1979 Feb.-Mar.	71.3-92.4	21.0	30	0.2
Mar.-Apr.	92.4-121.7	29.3	33	0.9
Apr.-May	121.7-139.1	17.4	27	0.6
May-June	139.1-156.0 ^d	16.9	21	0.8
<u>Max. Size</u>				
Feb.-Mar.	83.0-118.0	35.0	29	1.2
Mar.-Apr.	118.0-153.0	35.0	34	1.0
Apr.-May	153.0-163.0	10.0	29	0.3
May-June	163.0-183.0 ^d	20.0	20	1.0

- a Growth of shrimp collected in West Bay was estimated separately from that of shrimp collected in the remainder of Galveston Bay because of lapsed time between sampling dates.
- b Growth was estimated from shrimp caught during May sampling and shrimp caught during the second sampling period in June.
- c Growth was estimated between February and April. White shrimp were absent from samples during March.
- d Growth was estimated from shrimp caught during May and shrimp caught during the first sampling period in June. Little growth was indicated after the first sampling period in June.

Table 9. Size distribution of white shrimp on commercial (major) and bait (minor) shrimping grounds as indicated by 6.1-m trawl catches in Galveston, Matagorda, San Antonio and Aransas Bays, 1978-79.

Date	MAJOR BAYS				MINOR BAYS			
	Catch Per Drag	Size Range (mm)	Mean Size (mm)	Catch Per Drag	Size		Mean Size (mm)	
					Range (mm)	Range (mm)		
GALVESTON BAY								
Sept. 1978	9.5	78-158	122.2	40.5	48-148	106.3		
Sept.	31.3	68-163	103.7	79.0	43-163	99.2		
Oct.	38.1	63-163	105.0	100.0	23-163	95.9		
Oct.	84.1	38-153	99.1	127.5	43-143	93.9		
Nov.	138.4	58-153	96.4	254.0	43-123	89.3		
Nov.	138.8	43-148	92.4	221.2	53-123	88.3		
Dec.	90.9	38-133	84.5	147.8	43-108	80.4		
Dec.	43.6	53-138	79.5	11.5	53-93	74.5		
June 1979	0.8	143-158	149.9	0.7	153	153.0		
June	0.6	148-173	158.7	0.0				
July	2.5	53-88	73.8	37.5	48-98	73.9		
July	83.3	73-138	102.4	100.0	58-128	97.9		
Aug.	21.8	68-143	107.5	39.2	48-138	108.7		
Aug.	22.6	53-143	109.9	95.2	33-143	104.4		
Sept.	3.0	48-138	94.4	31.0	48-143	102.8		
Sept.	17.8	48-153	90.0	25.5	28-148	91.0		
MATAGORDA BAY								
Sept. 1978	28.3	58-163	93.0	21.6	58-158	105.2		
Oct.	5.0	68-123	98.0	18.4	68-128	93.5		
Nov.	25.0	38-123	95.0	37.4	48-123	80.0		
Dec.	0.0			0.0				
June 1979	0.8	48-58	53.0	6.8	33-68	50.0		
July	36.8	68-113	87.6	209.6	48-113	85.0		
Aug.	3.2	93-138	110.7	192.0	33-148	94.0		
Sept.	6.2	63-128	91.8	35.6	43-158	87.2		

Table 9. (Cont'd).

Date	MAJOR BAYS			MINOR BAYS		
	Catch Per Drag	Size Range(mm)	Mean Size(mm)	Catch Per Drag	Size Range(mm)	Mean Size(mm)
Sept. 1978	NS	-	-	-	-	-
Sept.	11.1	43-158	103.3	14.3	48-138	87.8
Oct.	11.7	43-153	94.6	63.0	38-133	69.1
Oct.	18.8	38-143	91.5	29.0	53-113	85.6
Nov.	9.3	58-128	92.5	18.3	53-103	77.7
Nov.	24.4	48-118	92.9	62.7	38-123	80.3
Dec.	38.0	43-133	83.8	2.7	58-88	71.1
Dec.	3.4	63-103	80.7	0.0		
June 1979	0.0			0.0		
June	0.0			0.0		
July	18.1	63-118	82.1	1.3	83-98	89.2
July	58.7	48-123	92.3	7.7	78-113	91.6
Aug.	93.7	43-148	109.6	22.0	68-128	100.2
Aug.	9.8	63-138	106.6	14.7	38-128	96.0
Sept.	11.1	33-138	92.0	6.7	43-128	92.8
Sept.	7.3	43-153	94.8	34.7	58-138	91.7

SAN ANTONIO BAY

Table 9. (Cont'd).

Date	MAJOR BAYS			MINOR BAYS		
	Catch Per Drag	Size Range (mm)	Mean Size (mm)	Catch Per Drag	Size Range (mm)	Mean Size (mm)
Sept. 1978	3.3	133-178	147.6	27.4	33-173	109.6
Sept.	26.7	58-158	96.8	136.6	23-163	95.7
Oct.	24.6	38-163	89.4	32.0	33-163	99.6
Oct.	35.0	43-148	93.1	42.7	38-143	98.5
Nov.	50.2	58-168	100.5	33.3	33-123	91.2
Nov.	51.8	43-128	88.8	32.7	33-163	73.1
Dec.	48.6	43-108	88.6	41.8	28-108	75.3
Dec.	9.4	63-103	81.8	4.5	38-103	81.7
June 1979	0.8	33-158	96.8	0.8	38-183	110.0
June	1.0	33-173	68.0	1.0	33-153	76.3
July	NS	-	-	NS	-	-
July	6.6	63-113	82.4	40.2	33-108	73.4
Aug.	6.8	58-133	100.5	32.7	38-128	98.2
Aug.	5.0	68-148	104.0	4.5	33-133	100.0
Sept.	5.4	58-133	105.4	13.8	23-138	83.5
Sept.	15.2	48-143	82.1	129.7	28-143	83.3

ARANSAS BAY

NS = No sample taken

Figure 1. Maximum and minimum sizes of brown shrimp (*P. aztecus*) caught during weekly 1.8-m bar seine and 3.0-m trawl sampling during Apr.-May 1979 in Galveston, Matagorda, San Antonio and Aransas Bays.

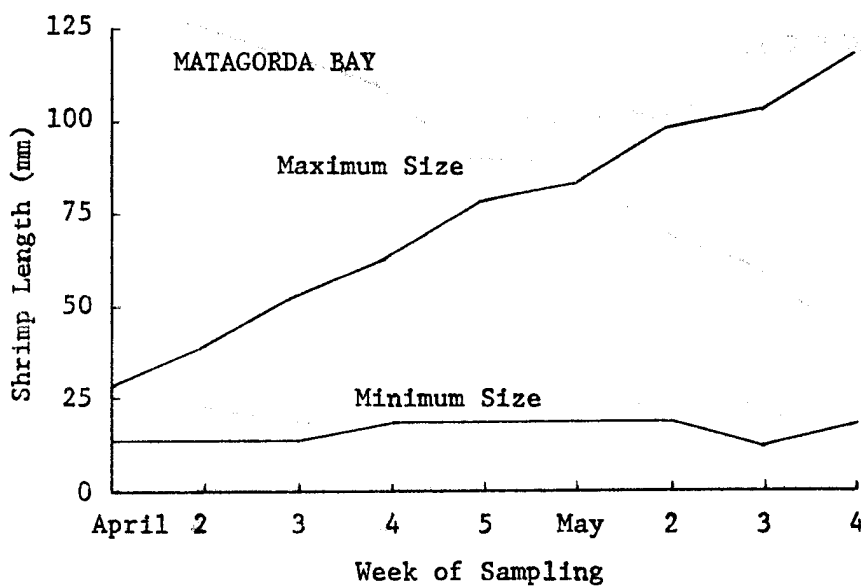
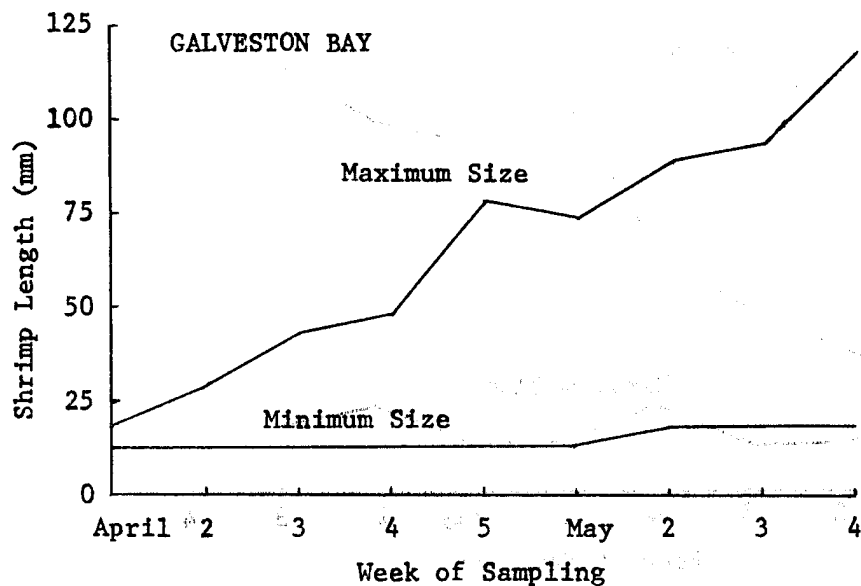


Figure 1. (Cont'd).

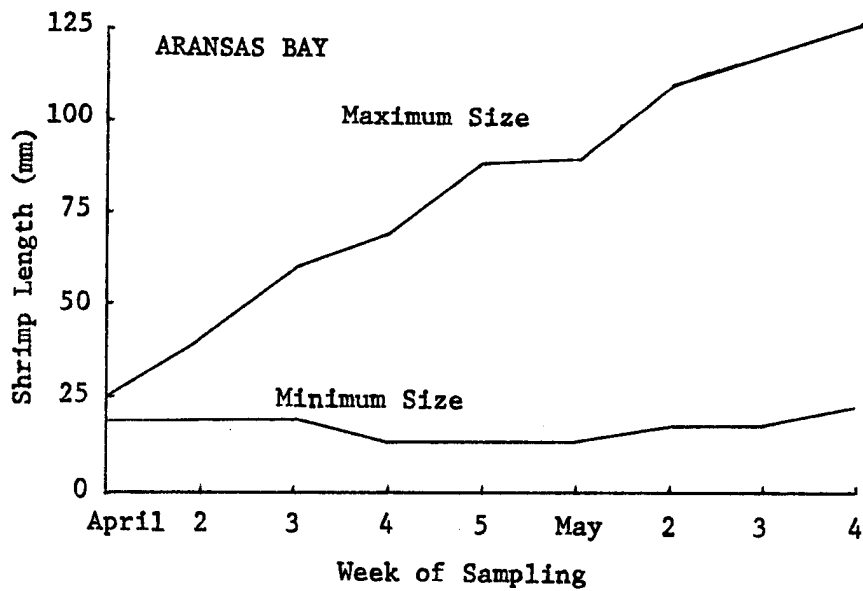
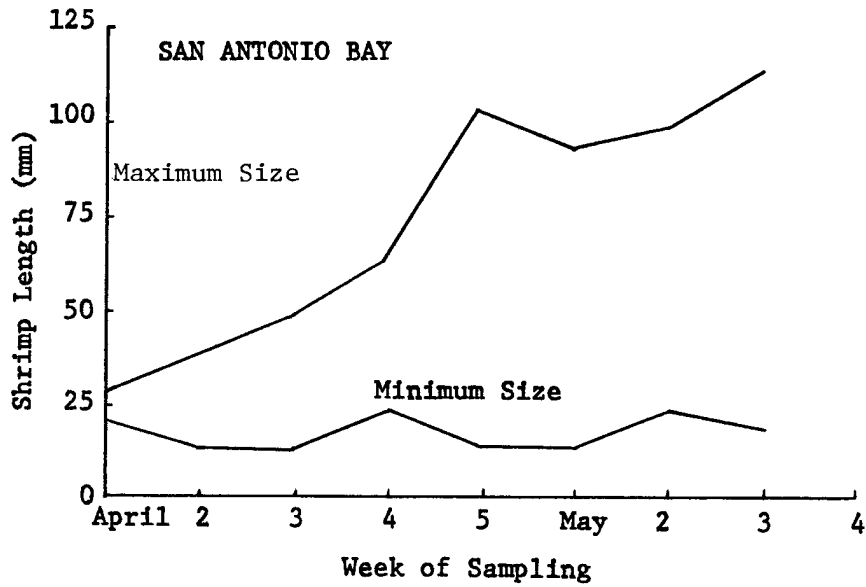


Figure 2. Monthly mean temperatures and salinities during Sept.-Dec. 1978 and Feb.-Sept. 1979 in Galveston, Matagorda, San Antonio and Aransas Bays.

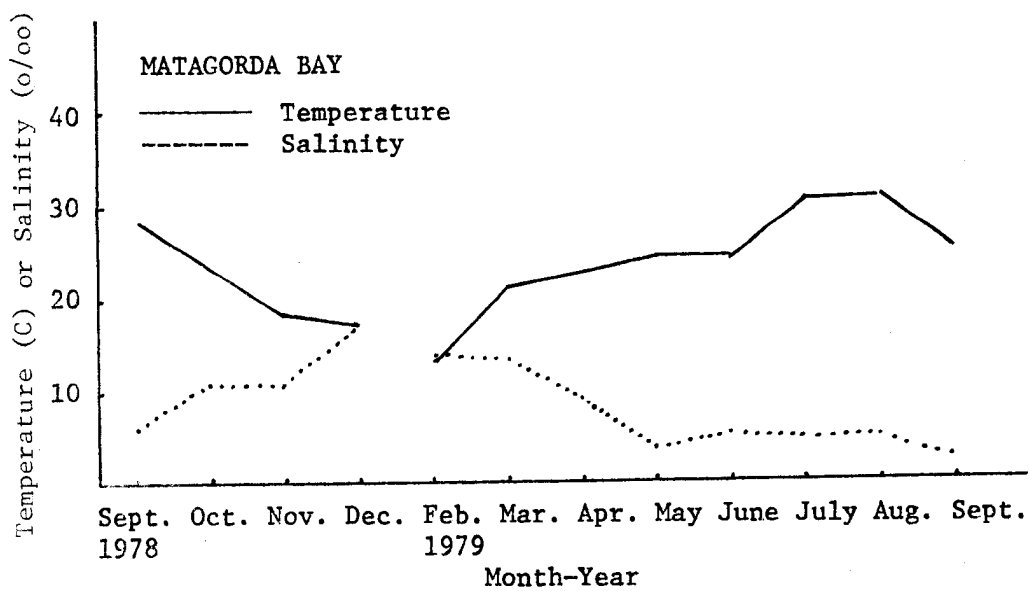
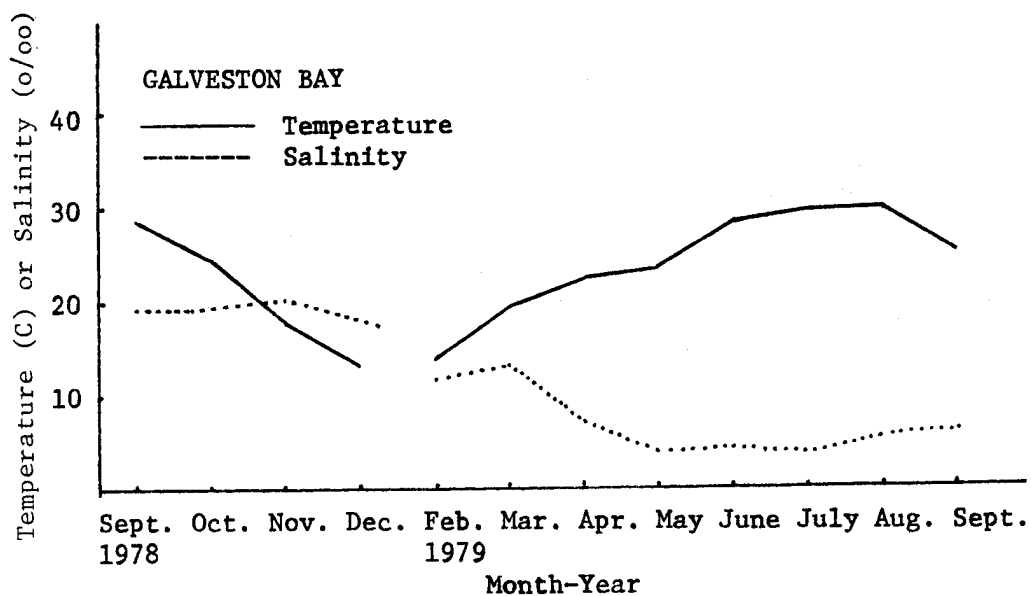
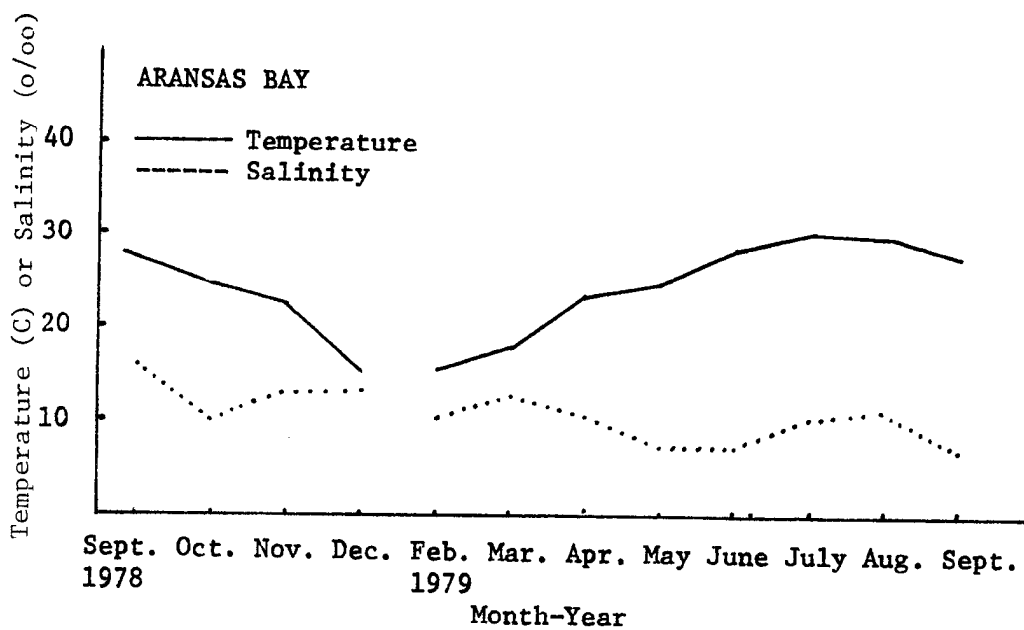
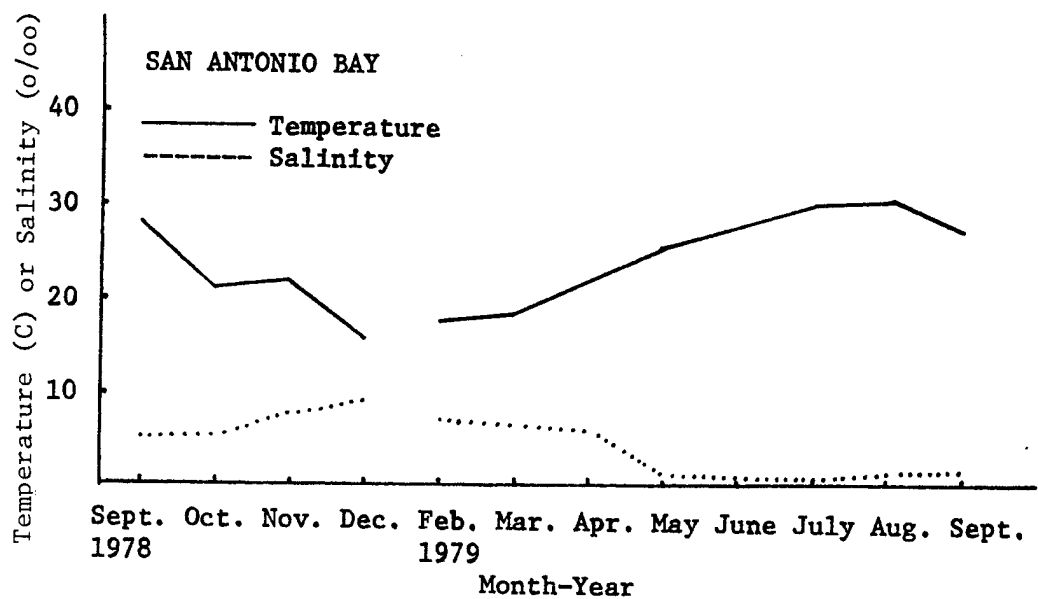


Figure 2. (Cont'd).



Appendix A. Station names, gear types and sample types used in Galveston, Matagorda, San Antonio, Aransas Bays and lower Laguna Madre during 1978-79.

Table 1. Galveston Bay sample station names, gear types and sample types.

Station	Sample Gear	Sample Type
1. Dickinson Bayou	Marsh net	Brown shrimp-postlarval
2. Moses Lake	" "	" " "
3. Jones Lake	" "	" " "
4. Jones Lake	1.8-m bar seine	Brown shrimp-juvenile
5. Moses Lake	" " "	" " "
6. Dickinson Bayou	" " "	" " "
7. Surf Oaks-Galv. Bay	" " "	" " "
8. Double Bayou	" " "	" " "
9. Clear Lake	3.0-m trawl	Brown shrimp-subadult
10. Humble Camp-Galv. Bay	" "	" " "
11. Texas City Dike-Galv. Bay	" "	" " "
12. Clear Creek	Marsh net	White shrimp-postlarval
13. Dickinson Bayou	" "	" " "
14. Double Bayou	" "	" " "
15. Clear Creek	3.0-m trawl	White shrimp-juvenile
16. Dickinson Bayou	" "	" " "
17. Double Bayou	" "	" " "
18. Clear Lake	6.1-m trawl	White shrimp-subadult, adult
19. Dickinson Bayou	" "	" " " "
20. Double Bayou	" "	" " " "
21. upper Galveston Bay	" "	" " " "
22. 5-Mile Pass upper Galv. Bay	" "	" " " "
23. Trinity Bay	" "	" " " "
24. upper Trinity Bay	" "	" " " "
25. lower Galveston Bay	" "	" " " "
26. Sievers Cut-lower Galv. Bay	" "	" " " "
27. lower East Bay	" "	" " " "
28. upper East Bay	" "	" " " "
29. upper West Bay	" "	" " " "
30. lower West Bay	" "	" " " "
31. Tire Reef-West Bay	" "	" " " "
32. Chocolate Bay	" "	" " " "

Table 2. Matagorda Bay sample station names, gear types and sample types.

Station	Sample Gear	Sample Type
1. Keller Creek	1.8-m bar seine	Brown shrimp-juvenile
2. Carancahua Bayou	" " "	" " "
3. Turtle Bayou	" " "	" " "
4. Tres Palacios River	" " "	" " "
5. Tres Palacios River	3.0-m trawl	Brown shrimp-subadult
6. Turtle Bayou	" "	" " "
7. Carancahua Bay	" "	" " "
8. Lavaca Bay	" "	" " "
9. Carancahua Bayou	Marsh net	White shrimp-postlarval
10. Turtle Bayou	" "	" " "
11. Tres Palacios River	" "	" " "
12. Carancahua Bayou	3.0-m trawl	White shrimp-juvenile
13. Turtle Bayou	" "	" " "
14. Tres Palacios River	" "	" " "
15. Carancahua Bay	6.1-m trawl	White shrimp-subadult, adult
16. Turtle Bay	" "	" " " "
17. Tres Palacios Bay	" "	" " " "
18. upper Lavaca Bay	" "	" " " "
19. Lavaca Causeway-Lavaca Bay	" "	" " " "
20. Mitchell Point-Lavaca Bay	" "	" " " "
21. Sand Point-Matagorda Bay	" "	" " " "
22. Carancahua Pass-Matagorda Bay	" "	" " " "
23. Palacios Point-Matagorda Bay	" "	" " " "

Table 3. San Antonio Bay sample station names, gear types and sample types.

Station	Sample Gear	Sample Type
1. Hynes Bay	1.8-m bar seine	Brown shrimp-juvenile
2. Swan Point	" " "	" " "
3. Mosquito Point	" " "	" " "
4. Webb Point	" " "	" " "
5. Hynes Bay	3.0-m trawl	Brown shrimp-subadult
6. Swan Point	" " "	" " "
7. Mosquito Point	" " "	" " "
8. Webb Point	" " "	" " "
9. Townsend Bayou	Marsh net	White shrimp-postlarval
10. Hog Bayou	" " "	" " "
11. Swan Lake Bayou	" " "	" " "
12. Towsend Bayou	3.0-m trawl	White shrimp-juvenile
13. Hog Bayou	" " "	" " "
14. Swan Lake Bayou	" " "	" " "
15. Towsend Bayou	" " "	" " "
16. Hog Bayou	6.1-m trawl	White shrimp-subadult, adult
17. Swan Lake Bayou	" " "	" " " " "
18. Swan Point	" " "	" " " " "
19. Turtle Reef	" " "	" " " " "
20. Mosquito Point	" " "	" " " " "
21. Beacon 31	" " "	" " " " "
22. Beacon 7	" " "	" " " " "
23. Panther Point	" " "	" " " " "
24. Espiritu Santo Bay	" " "	" " " " "

Table 4. Aransas Bay station names, gear types and sample types.

Station	Sample Gear	Sample Type
1. Big Tree-St. Charles Bay	Marsh net	Brown shrimp-postlarval
2. Holiday Beach-Copano Bay	" "	" " "
3. Egery Flats-Chiltipin Creek	" "	" " "
4. Little Bay-Aransas Bay	" "	" " "
5. Redfish Bay	" "	" " "
6. Big Tree-At. Charles Bay	1.8-m bar seine	Brown shrimp-juvenile
7. Holiday Beach-Copano Bay	" " "	" " "
8. Egery Flats-Chiltipin Creek	" " "	" " "
9. Little Bay-Aransas Bay	" " "	" " "
10. Redfish Bay	" " "	" " "
11. Chiltipin Creek	3.0-m trawl	Brown shrimp-postlarval
12. Twin Creek	" "	" " "
13. Head of Dunham Bay	" "	" " "
14. Mouth of Chiltipin Creek	Marsh net	White shrimp-postlarval
15. Mouth of Twin Creek	" "	" " "
16. Mouth of Dunham Bay	" "	" " "
17. Redfish Bay	" "	" " "
18. Marker 49 (GIWW)-Aransas Bay	3.0-m trawl	White shrimp-juvenile
19. Marker 19 (GIWW)-Aransas Bay	" "	" " "
20. LBJ Causeway-Copano Bay	" "	" " "
21. Mouth of Mission Bay-Copano Bay	" "	" " "
22. Turtle Pen-Copano Bay	" "	" " "
23. Bayside Bridge-Copano Bay	6.1-m trawl	White shrimp-subadult, adult
24. Little Devil-St. Charles Bay	" "	" " " "
25. Mouth of Dunham Bay	" "	" " " "
26. Mouth of Mission Bay-Copano Bay	" "	" " " "
27. LBJ Causeway-Copano Bay	" "	" " " "
28. Fulton Beach-Aransas Bay	" "	" " " "
29. Ranch House-Aransas Bay	" "	" " " "
30. Marker 43-Aransas Bay	" "	" " " "
31. Mud Island-Aransas Bay	" "	" " " "
32. Mesquite Bay at Beldons Dugout	" "	" " " "
33. Mouth of Port Bay	" "	" " " "
34. Port Bay	" "	" " " "

Table 5. Lower Laguna Madre sample station names, gear types and sample types.

Station	Sample Gear	Sample Type
1. Port Mansfield Channel	1.8-m bar seine	Brown shrimp-juvenile
2. Arroyo Colorado	" " "	" " "
3. Three Islands	" " "	" " "
4. Port Mansfield	3.0-m trawl	Brown shrimp-subadult
5. Arroyo Colorado	" " "	" " "
6. Three Islands	" " "	" " "

Appendix B. Station Location maps of Galveston, Matagorda, San Antonio, Aransas Bays and lower Laguna Madre during 1978-79.

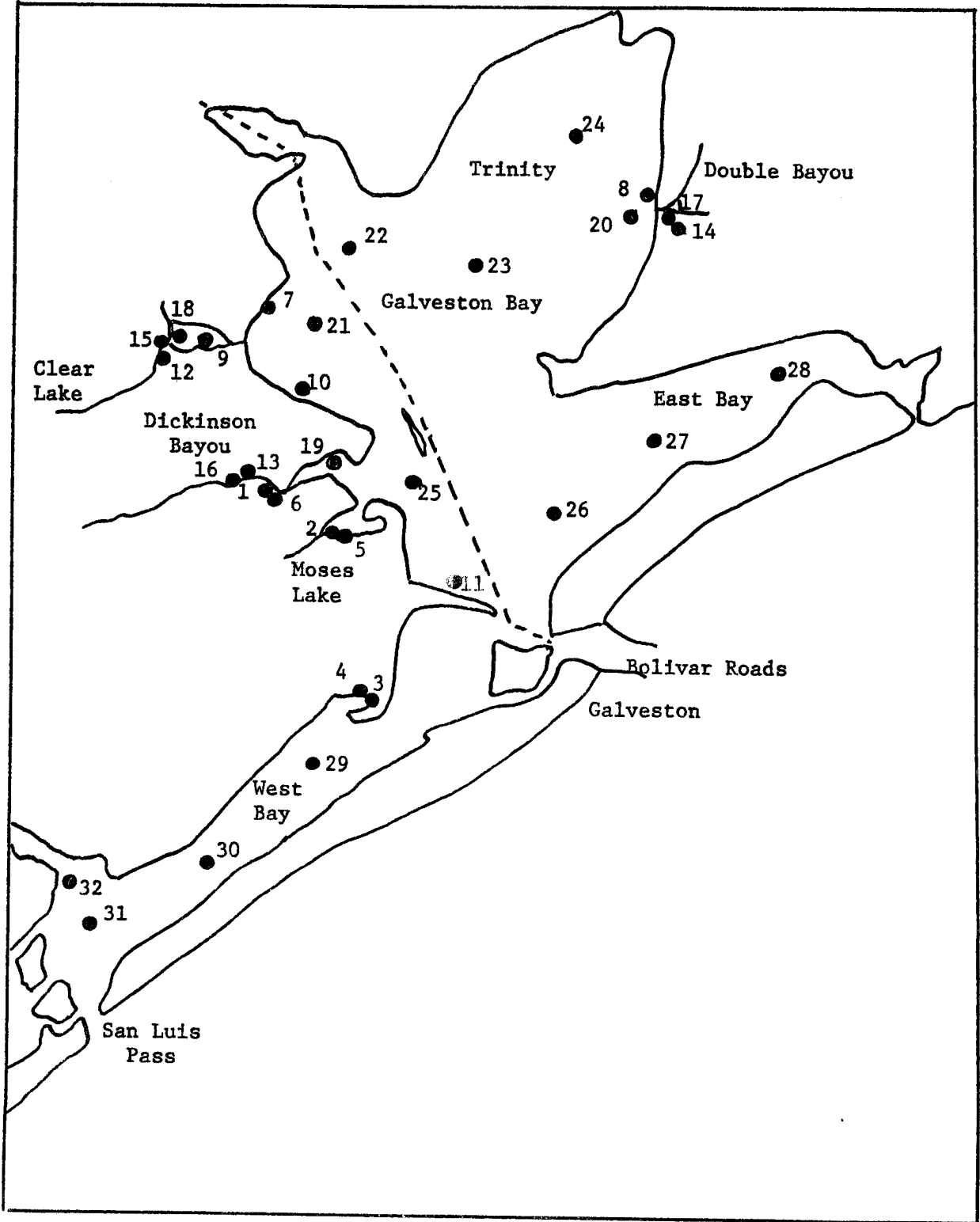


Figure 1. Sample station locations in Galveston Bay.

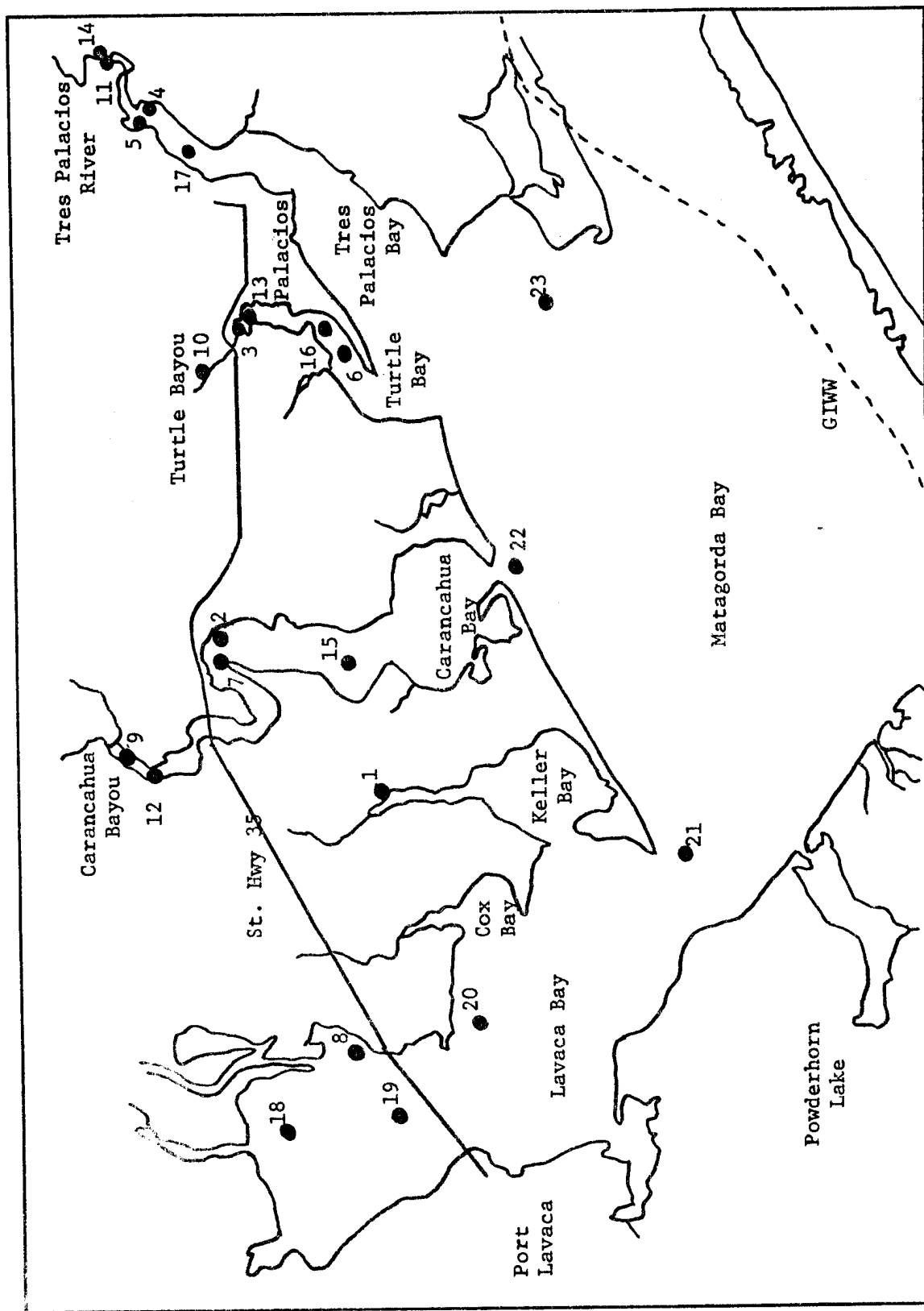


Figure 2. Sample station locations in Matagorda Bay.

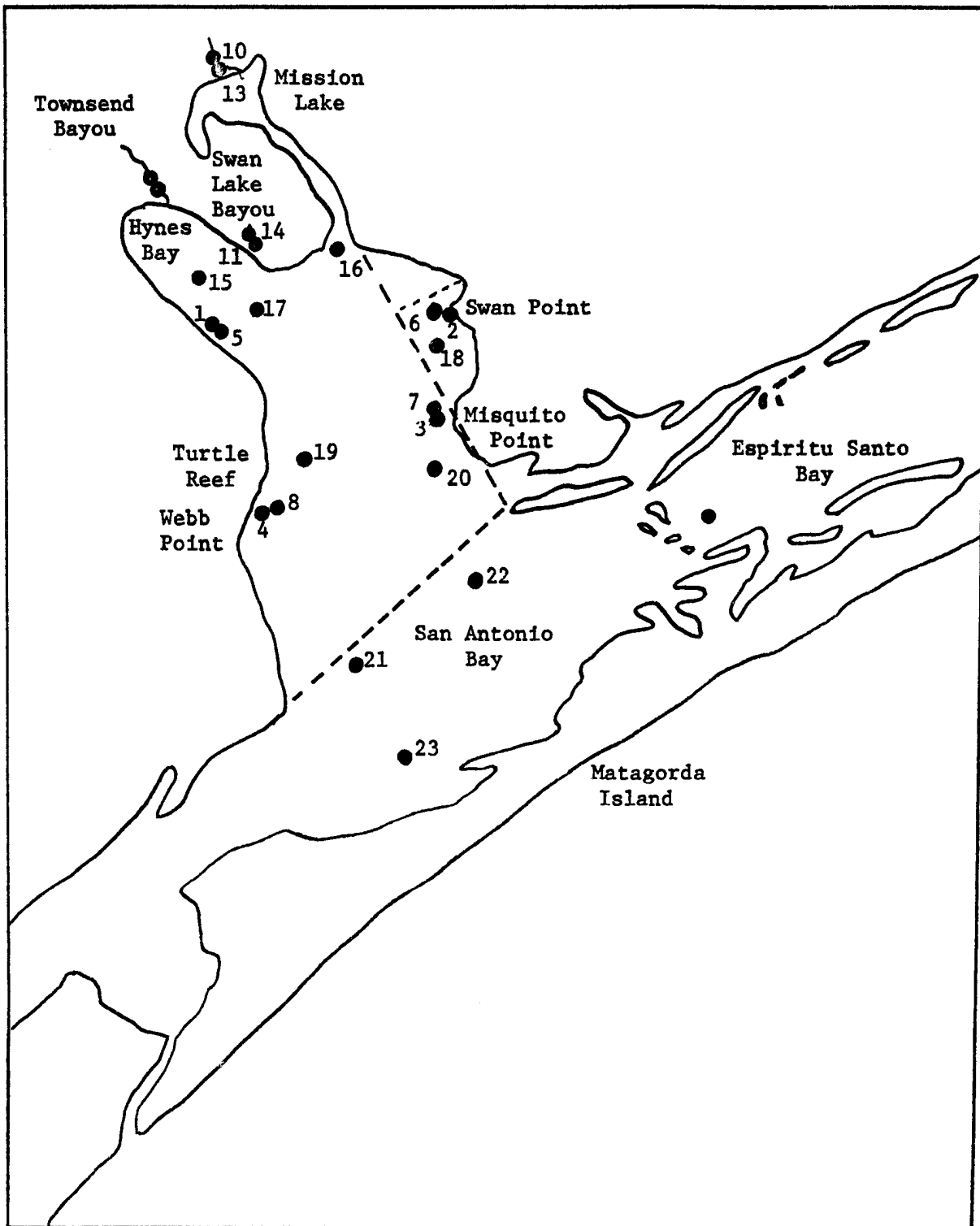


Figure 3. Sample station locations in San Antonio Bay.

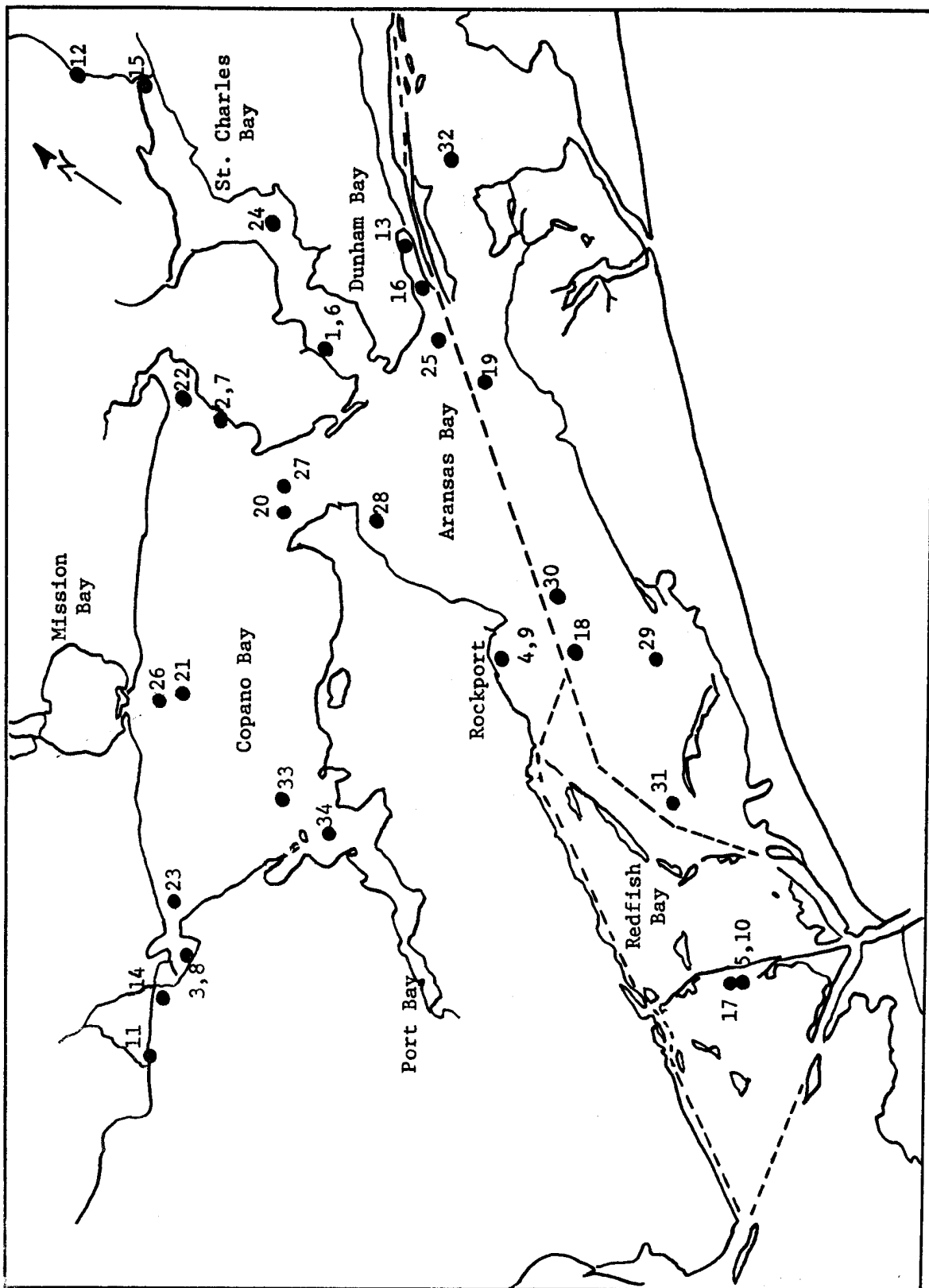


Figure 4. Sample station locations in Aransas Bay.

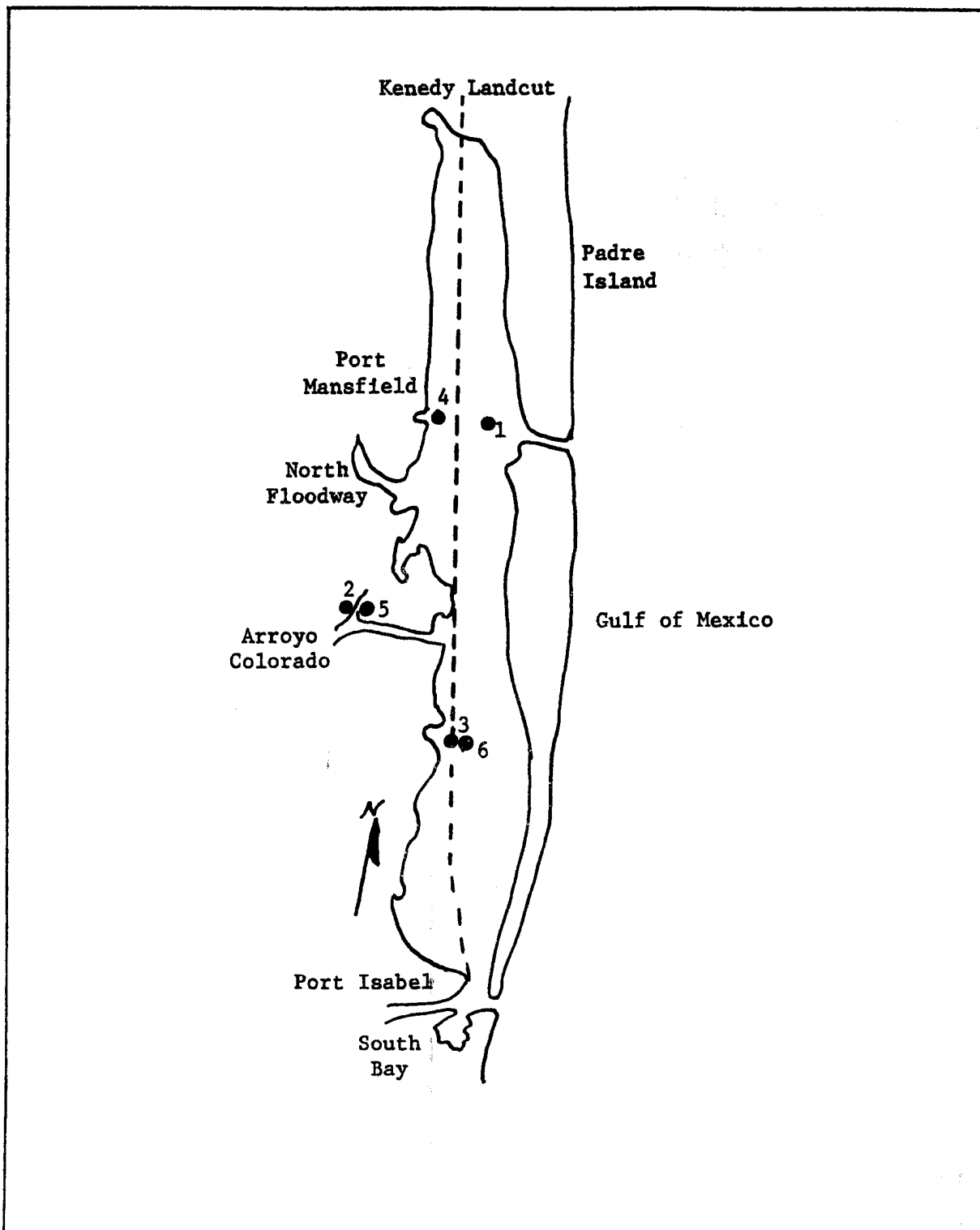


Figure 5. Sample station locations in lower Laguna Madre.

Appendix C. Number and sizes of brown shrimp collected in Galveston, Matagorda, San Antonio, Aransas Bays and lower Laguna Madre during 1978-79.

Table 1. Number and sizes of juvenile brown shrimp (P. aztecus) caught with 1.8-m bar seines in Galveston Bay, Apr.-May 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2 April 1979	5	14	2.8	13-18	15.9	2.5	0.7
9	5	42	8.4	13-28	16.7	5.2	0.8
16	5	52	10.4	13-43	28.8	7.9	1.1
23	5	114	22.8	13-48	32.2	7.4	0.7
30	5	57	11.4	28-53	40.2	8.0	1.1
7 May	5	131	26.2	13-73	38.9	14.7	1.3
14	5	152	30.4	18-78	38.1	15.4	1.3
21	5	223	44.6	18-68	31.6	12.1	1.0
30	4	180	45.0	18-83	33.1	11.2	0.8

Table 2. Number and sizes of brown shrimp (P. aztecus) caught during 15-min drags of 3.0-m trawls in Galveston Bay, Apr.-May 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 April 1979	3	0	0.0				
12	3	0	0.0				
19	3	0	0.0				
24	3	38	12.7	13-48	26.3	10.0	1.6
1 May	3	31	10.3	13-78	33.8	17.7	3.2
8	3	14	4.7	18-73	50.5	13.9	3.7
15	3	12	3.0	33-88	50.9	14.1	4.1
22	3	160	53.3	23-93	70.5	15.2	1.2
31	3	362	120.7	18-118	62.5	19.0	1.0

Table 3. Number and sizes of postlarval and juvenile brown shrimp (*P. aztecus*) caught with marsh nets in Galveston Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5-6 Sept. 1978	3	3	1.0	18-53	31.3	15.5	8.9
18-19 Sept.	3	0	0.0				
3 Oct.	3	0	0.0				
24-25 Oct.	3	12	4.0	18-73	45.5	13.3	3.8
8-9 Nov.	3	2	0.7	43-58	50.5	0.0	0.0
20-21 Nov.	3	18	6.0	13-83	31.3	16.6	3.9
5-6-13 Dec.	3	0	0.0				
27-28-29 Dec.	3	0	0.0				
27 Feb. 1979	3	0	0.0				
6 Mar.	3	2	0.7	8-13	10.5	0.0	0.0
12 Mar.	3	0	0.0				
19 Mar.	3	175	58.3	8-13	12.9	0.6	0.1
26 Mar.	3	2	0.7	13	13.0	0.0	0.0
7-8 June	3	19	6.3	13-73	22.7	17.1	3.9
22 June	3	3	1.0	48-83	61.3	15.5	8.9
5-6 July	3	9	3.0	23-68	36.3	13.7	4.6
30-31 July	3	0	0.0				
8-10 Aug.	3	0	0.0				
20-21 Aug.	3	0	0.0				
5-6 Sept.	3	0	0.0				
17-18 Sept.	3	0	0.0				

Table 4. Number and sizes of brown shrimp (*P. aztecus*) caught during 5-min drags of 3.0-m trawls in Galveston Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 Sept. 1978	3	12	4.0	28-88	72.6	15.3	4.4
18 Sept.	3	9	3.0	58-88	73.6	9.3	3.1
3 Oct.	3	6	2.0	43-78	67.2	12.7	5.2
24 Oct.	3	6	2.0	28-73	59.7	14.9	6.1
8 Nov.	3	6	2.0	68-88	79.7	7.5	3.0
20 Nov.	3	9	3.0	73-103	91.3	10.3	3.4
5 Dec.	3	0	0.0				
27 Dec.	3	0	0.0				
7 June 1979	3	99	33.0	38-108	65.1	14.5	1.5
22 June	3	269	89.7	43-103	77.1	11.4	0.8
5 July	3	169	56.3	38-103	77.8	8.8	0.7
30 July	3	0	0.0				
8 Aug.	3	2	0.7	73-78	75.5	0.0	0.0
20 Aug.	3	7	2.3	38-93	51.6	20.7	7.8
5 Sept.	3	3	1.0	43-48	44.7	2.4	1.4
17 Sept.	3	11	3.7	28-83	63.4	17.8	5.4

Table 5. Number and sizes of brown shrimp (*P. aztecus*) caught with 6.1-m trawls in Galveston Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 Sept. 1978	15	5	0.3	93-118	97.0	10.7	4.8
19 Sept.	15	3	0.2	33-98	69.7	27.2	15.7
3 Oct.	15	20	1.3	53-108	82.0	14.9	3.3
24-25 Oct.	15	88	5.9	48-103	81.4	10.7	1.2
9 Nov.	15	110	7.3	53-108	83.1	11.9	1.1
21 Nov.	15	126	8.4	33-108	84.9	16.3	1.5
5-13-15 Dec.	15	52	3.5	28-108	76.6	17.1	2.4
22-28-29 Dec.	15	34	3.3	63-103	84.0	11.2	1.9
14-15-23 Feb. 1979	15	0	0.0				
13-14-26 Mar.	15	0	0.0				
12-13-23 Apr.	15	2	0.1	38-43	40.5	0.0	0.0
15-16-17 May	15	261	17.4	53-103	81.6	10.9	0.7
6-7-8 June	15	1306	87.1	33-128	83.9	15.9	0.6
21-22 June	15	373	24.9	38-138	85.3	17.6	0.9
3-5-6 July	15	312	20.8	13-153	84.4	12.4	0.7
30-31 July	15	223	14.9	48-128	93.4	10.7	0.7
8-9-10 Aug.	15	56	3.7	73-118	97.0	9.4	1.3
20-21-22 Aug.	15	22	1.5	73-118	91.6	10.7	2.3
5-6-7 Sept.	15	8	0.5	58-93	73.0	13.2	4.7
17-18-24 Sept.	15	16	1.1	48-108	75.5	13.0	3.3

Table 6. Number and sizes of brown shrimp (*P. aztecus*) caught with 1.8-m bar seines in Matagorda Bay, Apr.-May 1979.

Sample Date	No. of Sample	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 April 1979	4	0	0.0				
10 April	4	32	8.0	18-28	23.3	3.3	0.8
18 April	4	98	24.5	23-53	32.7	7.5	1.1
24 April	4	356	89.0	18-58	31.3	7.4	0.6
2 May	4	380	95.0	18-63	34.5	9.6	0.8
8 May	4	44	11.0	23-53	38.0	11.0	1.7
16 May	4	218	54.5	18-78	34.9	12.2	0.8
22 May	4	142	35.5	18-83	45.2	16.1	1.4
30 May	4	62	15.5	18-83	45.1	13.8	1.8

Table 7. Number and sizes of brown shrimp (P. aztecus) caught during 15-min drags of 3.0-m trawls in Matagorda Bay, Apr.-May 1979.

Sample Date	No. of Sample	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 April 1979	4	55	13.8	13-28	20.0	3.5	0.5
10 April	4	152	38.0	13-38	24.4	4.8	0.4
18 April	4	484	121.0	13-53	27.3	9.3	0.5
24 April	4	373	93.3	18-63	35.8	10.1	0.7
2 May	4	187	46.8	18-78	40.2	12.8	1.0
8 May	4	276	69.0	18-83	39.2	13.9	1.1
16 May	4	143	35.8	18-98	42.7	17.7	1.5
22 May	4	369	92.3	13-103	45.9	19.2	1.0
30 May	4	351	87.8	18-118	59.3	26.1	1.6

Table 8. Number and sizes of postlarval and juvenile brown shrimp (*P. aztecus*) caught with marsh nets in Matagorda Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
22 Sept. 1978	3	0	0.0				
16 Oct.	3	0	0.0				
13 Nov.	3	0	0.0				
20 Dec.	3	0	0.0				
19 June 1979	3	5	1.7	18-63	36.0	20.2	9.0
17 July	3	0	0.0				
6 Aug.	3	0	0.0				
25 Sept.	3	0	0.0				

Table 9. Number and sizes of brown shrimp (*P. aztecus*) caught during 5-min drags of 3.0-m trawls in Matagorda Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
22 Sept. 1978	3	0	0.0				
16 Oct.	3	0	0.0				
13 Nov.	3	0	0.0				
20 Dec.	3	0	0.0				
19 June 1979	3	24	8.0	23-73	49.3	14.8	3.0
17 July	3	0	0.0				
6 Aug.	3	0	0.0				
25 Sept.	3	0	0.0				

Table 10. Number and sizes of brown shrimp (*P. aztecus*) caught with 6.1-m trawls in Matagorda Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
21-22 Sept. 1978	9	7	0.8	33-68	49.4	12.7	4.8
18 Oct.	9	0	0.0				
28-29 Nov.	9	2	0.2	68-83	75.5	0.0	0.0
19-20 Dec.	9	0	0.0				
26-27 Feb. 1979	9	0	0.0				
28-29 Mar.	9	0	0.0				
25-26 Apr.	9	26	2.9	33-63	52.2	7.4	1.5
23-24 May	9	437	48.6	33-113	87.0	12.4	0.6
27 June	9	297	33.0	53-138	89.1	15.2	0.9
18-19 July	9	10	1.1	68-148	96.5	24.2	7.7
28-29 Aug.	9	0	0.0				
25-26 Sept.	9	1	0.1	93	93.0	0.0	0.0

Table 11. Number and sizes of juvenile brown shrimp (*P. aztecus*) caught with 1.8-m bar seines in San Antonio Bay, Apr.-May 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 April 1979	4	40	10.0	18-28	22.0	3.4	0.5
9 April	4	130	32.5	18-38	26.2	4.4	0.4
16 April	4	122	30.5	18-48	35.5	7.1	0.6
23 April	4	68	17.0	23-63	40.8	10.7	1.3
1 May	4	44	11.0	23-68	39.4	11.0	1.7
7 May	4	188	47.0	18-73	30.8	12.1	0.9
15 May	4	32	8.0	23-73	41.4	13.8	2.4
21 May	4	134	33.5	23-83	42.3	12.9	1.1
29 May	4	84	21.0	28-88	44.3	13.2	1.4

Table 12. Number and sizes of brown shrimp (*P. aztecus*) caught during 15-min drags of 3.0-m trawls in San Antonio Bay, Apr.-May 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 April 1978	4	25	6.3	18-28	21.2	3.1	0.6
9 April	4	173	43.3	13-38	24.7	7.0	0.6
16 April	4	125	31.3	13-48	32.1	8.1	0.7
23 April	4	141	35.3	23-63	34.8	9.8	0.8
1 May	4	386	96.5	13-103	41.0	21.4	1.8
7 May	4	194	48.5	13-93	46.8	23.4	2.0
15 May	4	151	37.8	23-98	51.9	24.0	2.2
21 May	4	303	75.8	18-113	72.5	25.4	1.8
29 May	4	194	48.5	23-113	70.0	22.9	1.7

Table 13. Number and sizes of brown shrimp (P. aztecus) caught during 5-min drags of 3.0-m trawls in San Antonio Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
- Sept. 1978	NS ^a	-	-	-	-	-	-
19 Sept.	2	1	0.5	78	78.0	0.0	0.0
11 Oct.	3	0	0.0				
16 Oct.	3	0	0.0				
1 Nov.	3	0	0.0				
14 Nov.	3	0	0.0				
5 Dec.	3	0	0.0				
19 Dec.	3	0	0.0				
5-8 June 1979	3	0	0.0				
18 June	3	0	0.0				
4 July	3	0	0.0				
15 July	3	0	0.0				
7 Aug.	3	0	0.0				
21 Aug.	3	0	0.0				
10 Sept.	3	0	0.0				
21 Sept.	3	1	0.3	58	58.0	0.0	0.0

^a NS = No sample taken

Table 14. Number and sizes of brown shrimp (*P. aztecus*) caught with 6.1-m trawls in San Antonio Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
- Sept. 1978	NS ^a	-	-	-	-	-	-
15 Sept.	10	6	0.6	63-93	78.0	8.7	3.5
- Oct.	NS ^a	-	-	-	-	-	-
23 Oct.	10	3	0.3	78-98	88.0	8.2	4.7
3 Nov.	10	3	0.3	48-78	66.3	13.1	7.6
15 Nov.	10	18	1.8	68-98	82.2	8.7	2.1
7 Dec.	10	9	0.9	68-103	83.6	9.3	3.1
18 Dec.	10	2	0.2	83-88	85.5	0.0	0.0
13-14 Feb. 1979	10	2	0.2	68-83	75.5	0.0	0.0
13 Mar.	10	3	0.3	73-83	76.3	4.7	2.7
17 Apr.	10	12	1.2	78-118	100.9	9.5	2.7
14 May	10	238	23.8	58-108	88.8	10.5	0.8
4 June	10	305	30.5	38-123	98.3	13.8	0.8
14 June	10	211	21.1	48-133	95.6	13.6	1.0
2-10 July	10	147	14.7	63-138	98.7	13.2	1.1
18 July	10	560	56.0	58-133	98.6	11.7	0.7
13 Aug.	10	10	1.0	63-143	89.0	21.3	6.7
20 Aug.	10	7	0.7	53-103	84.4	19.4	7.3
5 Sept.	10	1	0.1	73	73.0	0.0	0.0
24 Sept.	10	0	0.0				

^a NS = No sample taken

Table 15. Number and sizes of juvenile brown shrimp (P. aztecus) caught with 1.8-m bar seines in Aransas Bay, Apr.-May 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2 April 1979	5	6	1.2	18-23	21.3	2.4	1.0
9 April	5	35	7.0	18-38	26.1	5.2	0.9
16 April	5	163	32.6	18-58	36.2	6.4	0.5
23 April	5	195	39.0	13-68	40.4	11.8	0.9
30 April	5	257	51.4	13-73	43.3	13.4	0.9
7 May	5	380	76.0	13-78	41.6	16.7	0.9
14 May	5	230	46.0	18-83	43.3	16.7	1.1
21 May	5	202	40.4	18-88	49.2	17.2	1.2
29 May	5	80	16.0	23-88	54.1	14.9	1.7

Table 16. Number and sizes of brown shrimp (*P. aztecus*) caught during 15-min drags of 3.0-m trawls in Aransas Bay, Apr.-1 June 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 April 1979	5	3	0.6	78-98	89.7	8.5	4.9
10 April	5	2	0.4	88-93	90.5	0.0	0.0
17 April	5	9	1.8	33-48	40.8	5.8	1.9
24 April	5	43	8.6	33-58	48.7	6.5	1.0
1 May	5	290	58.0	33-88	58.3	10.1	0.6
8 May	5	836	167.2	33-88	65.1	11.3	0.6
15 May	5	270	54.0	38-108	73.4	13.2	0.9
23 May	5	246	49.2	33-118	79.3	15.0	1.0
1 June	5	420	84.0	43-128	83.1	17.6	1.1

Table 17. Number and sizes of brown shrimp (*P. aztecus*) caught with marsh nets in Aransas Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 Sept. 1978	3	15	5.0	13-78	35.3	20.9	5.4
18 Sept.	3	54	18.0	8-63	20.6	14.2	1.9
5 Oct.	4	13	3.3	13-48	31.8	9.8	2.7
16 Oct.	4	4	1.0	33-53	44.3	11.4	5.7
31 Oct.	4	84	21.0	8-53	21.4	10.0	1.1
14-15 Nov.	4	7	1.8	33-68	46.6	9.9	3.7
5 Dec.	4	3	0.8	33-43	36.3	4.7	2.7
18 Dec.	4	0	0.0				
26 Feb. 1979	5	1	0.2	33	33	0.0	0.0
5 Mar.	5	3	0.6	8-13	9.7	2.4	1.4
13 Mar.	5	73	14.6	8-13	12.4	1.6	0.2
19 Mar.	5	51	10.2	13	13.0	0.0	0.0
26 Mar.	5	23	4.6	13-18	14.5	2.3	0.5
4 June	4	50	12.5	8-78	52.0	17.5	2.5
18 June	4	76 ^a	19.0	8-83	38-3	26.3	3.0
3 July	4	32	8.0	18-83	53.8	20.1	3.6
16 July	4	18	4.5	23-68	51.1	14.1	3.3
3 Aug.	4	17	4.3	18-73	42.7	18.9	4.7
20 Aug.	4	71 ^a	17.8	8-83	26.0	14.8	1.8
5 Sept.	4	49	12.3	8-63	26.7	13.8	2.0
24 Sept.	4	54	13.5	13-73	31.3	11.8	1.6

^a Most shrimp <33 mm were classified as brown shrimp although some small pink shrimp may have been present.

Table 18. Number and sizes of brown shrimp (*P. aztecus*) caught during 5-min drags of 3.0-m trawls in Aransas Bay, Sept.-Dec. 1978 and June-Dec. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 Sept. 1978	3	16	5.3	33-83	51.1	17.1	4.3
18 Sept.	3	6	2.0	28-58	49.7	11.1	4.5
5 Oct.	3	6	2.0	38-78	53.0	16.3	6.7
16 Oct.	3	8	2.7	38-83	53.4	13.6	4.8
31 Oct.	3	14	4.7	33-78	49.8	11.6	3.1
14-15 Nov.	3	15	5.0	38-73	63.3	10.2	2.6
5 Dec.	3	14	4.7	38-78	58.7	11.5	3.1
18 Dec.	3	0	0.0				
4 June 1979	3	390	130.0	38-118	62.1	13.2	0.8
18 June	3	401	133.3	43-123	68.9	11.6	0.7
3 July	3	465	155.0	53-133	73.3	9.4	0.6
16 July	3	37	12.3	38-93	69.2	13.5	2.2
3 Aug.	3	5	1.7	43-93	64.0	18.0	8.1
16 Aug.	3	24	8.0	38-83	59.9	14.5	3.0
5 Sept.	3	1	0.3	58	58.0	0.0	0.0
24 Sept.	3	0	0.0				

Table 19. Number and sizes of brown shrimp (*P. aztecus*) caught with 6.1-m trawls in Aransas Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
6-7 Sept. 1978	8	12	2.2	43-113	71.9	23.5	5.6
14-15 Sept.	8	82	10.2	43-143	89.3	17.2	1.9
3-4 Oct.	11	30	2.7	43-118	91.5	16.1	3.0
18-19 Oct.	11	15	1.4	13-128	80.0	22.6	5.8
1-2 Nov.	11	65	5.9	68-118	92.9	9.1	1.1
13-29 Nov.	11	21	1.9	73-103	89.2	8.7	1.9
6-7 Dec.	11	13	1.2	63-108	84.2	11.1	3.1
19-20 Dec.	11	0	0.0				
14-15 Feb. 1979	11	0	0.0				
14-16 Mar.	11	0	0.0				
18-19 Apr.	11	86	7.8	23-103	41.3	9.7	1.1
15-17 May	11	2048	186.2	33-108	76.6	11.8	0.4
6-7-8 June	11	1881	171.0	38-128	84.4	15.5	0.5
19-20 June	11	1001	91.0	23-138	78.2	16.1	0.6
5 July	2	8	4.0	88-113	97.4	9.5	3.4
17-18 July	11	53	4.8	48-143	81.2	19.2	2.6
6-7 Aug.	11	59	5.4	63-118	91.3	12.4	1.6
21-22 Aug.	11	60	5.4	43-108	80.5	14.4	1.9
6-7 Sept.	11	17	1.5	33-108	70.0	23.6	5.7
25-26 Sept.	11	94	8.5	33-133	78.4	18.7	1.9

Table 20. Number and sizes of brown shrimp (P. aztecus) caught with 1.8-m bar seines in lower Laguna Madre, Apr.-May 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2-4 April 1979	3	136	45.3	23-78	42.7	12.3	1.2
17 April	3	405	135.0	18-73	42.7	10.2	0.7
30 April	3	64	21.3	18-73	40.9	13.0	2.0
15 May	3	33	11.0	38-78	59.8	10.6	1.8

Table 21. Number and sizes of brown shrimp (P. aztecus) caught during 15-min drags of 3.0-m trawls in lower Laguna Madre, Apr.-May 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2-4 April 1979	3	42	14.0	23-78	40.9	13.0	2.0
16-17 April	3	313	104.3	28-98	49.9	9.9	0.6
30 April	3	245	81.6	38-83	65.0	9.3	0.7
15 May	3	22	3.1	48-93	69.4	13.3	2.8

Appendix D. Number and sizes of white shrimp collected in Galveston, Matagorda, San Antonio, Aransas Bays and lower Laguna Madre during 1978-79.

Table 1. Number and sizes of postlarval and juvenile white shrimp (*P. setiferus*) caught with marsh nets in Galveston Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5-6 Sept. 1978	3	194	64.7	8-83	23.4	10.9	0.8
18-19 Sept.	3	32	10.7	8-73	19.8	12.4	2.2
3 Oct.	3	141	47.0	8-63	22.6	12.0	1.0
24-25 Oct.	3	37	12.3	13-38	27.7	4.9	0.9
8-9 Nov.	3	93	31.0	13-43	27.0	6.1	0.7
20-21 Nov.	3	18	6.0	18-43	30.8	6.7	1.6
5-6-13 Dec.	3	14	4.7	13-43	27.3	9.6	2.6
27-28-29 Dec.	3	3	1.0	13-18	14.7	2.4	1.4
7-8 June 1979	3	0	0.0				
22 June	3	4	1.3	18-33	23.0	6.1	3.1
5-6 July	3	0	0.0				
30-31 July	3	0	0.0				
8-10 Aug.	3	4	1.3	13-18	16.8	2.2	1.1
20-21 Aug.	3	43	14.3	8-23	13.9	3.1	0.1
5-6 Sept.	3	56	18.7	8-38	23.1	9.0	1.3
17-18 Sept.	3	4	1.3	28-118	61.3	40.3	23.3

Table 2. Number and sizes of white shrimp (*P. setiferus*) caught during 5-min drags of 3.0-m trawls in Galveston Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5-6 Sept. 1978	3	69	23.0	38-123	79.6	22.5	2.7
18-19 Sept.	3	560	186.7	28-138	74.7	15.7	1.3
3 Oct.	3	783	261.0	23-148	71.9	21.5	1.4
24-25 Oct.	3	230	76.7	28-118	74.3	23.1	1.5
8-9 Nov.	3	1,578	526.0	38-108	72.3	14.3	0.9
20-21 Nov.	3	191	63.7	33-113	65.5	13.0	1.1
5-6-13 Dec.	3	29	9.7	28-93	59.6	13.2	2.5
27-28-29 Dec.	3	6	2.0	58-93	71.3	11.8	4.8
7-8 June 1979	3	0	0.0				
22 June 1979	3	4	1.3	38-68	53.0	11.2	5.6
5-6 July	3	46	15.3	38-93	62.7	15.3	2.3
30-31 July	3	1	0.3	68	68.0	0.0	0.0
8-10 Aug.	3	110	36.7	23-108	68.2	19.8	1.9
20-21 Aug.	3	222	74.0	18-133	56.4	33.6	2.9
5-6 Sept.	3	133	44.3	28-93	50.7	14.8	1.3
17-18 Sept.	3	1,196	398.7	23-138	59.2	15.7	1.0

Table 3. Number and size of white shrimp (*P. setiferus*) caught with 6.1-m trawls in Galveston Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5-6-12 Sept. 1978	15	266	17.7	48-158	112.5	20.3	1.2
18-19-26 Sept.	15	660	44.0	43-163	101.1	19.1	0.8
2-3-12 Oct.	15	819	54.6	23-163	100.7	20.4	0.9
24-25-27 Oct.	15	1437	95.8	38-153	97.3	17.3	0.6
8-9-10 Nov.	15	2539	169.3	43-153	93.6	15.3	0.5
20-21-22 Nov.	15	2412	160.8	43-148	91.1	13.3	0.5
5-13-15 Dec.	15	1591	106.1	38-133	83.1	12.6	0.5
22-28-29 Dec.	15	526	35.1	53-138	79.0	12.4	0.6
14-15-23 Feb. 1979	15	0	0.0				
13-14-26 Mar.	15	87	5.8	83-148	103.0	12.8	1.4
12-13-23 Apr.	15	187	12.5	73-148	111.3	16.1	1.2
15-16-17 May	15	43	2.9	118-158	136.6	8.4	1.3
6-7-8 June	15	11	0.7	143-158	150.5	4.6	1.5
21-22 June	15	9	0.6	48-173	134.7	45.5	15.2
3-5-6 July	15	183	12.2	53-178	73.9	8.7	0.7
30-31 July	15	1316	87.7	58-138	101.6	12.3	0.4
8-9-10 Aug.	15	397	26.5	48-143	108.0	15.4	0.8
20-21-22 Aug.	15	630	42.0	33-143	107.6	16.3	0.8
5-6-7 Sept.	15	157	10.5	48-143	101.1	18.5	1.5
17-18-24 Sept.	15	198	19.9	28-153	90.3	19.2	1.1

Table 4. Number and sizes of postlarval and juvenile white shrimp (P. setiferus) caught with marsh nets in Matagorda Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
22 Sept. 1978	3	76	25.3	23-58	32.3	8.8	1.0
16 Oct.	3	13	4.3	23-78	49.2	13.5	3.7
13 Nov.	3	24	8.0	18-78	29.7	16.2	3.3
20 Dec.	3	0	0.0				
19 June 1979	3	1	0.3	23	23.0	0.0	0.0
17 July	3	3	1.0	23-53	36.3	12.5	7.2
6 Aug.	3	6	2.0	23-33	28.0	4.5	2.0
25 Sept.	3	0	0.0				

Table 5. Number and sizes of white shrimp (P. setiferus) caught during 5-min drags of 3.0-m trawls in Matagorda Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range(mm)	Mean Size(mm)	SD	SE
22 Sept. 1978	3	57	19.0	23-88	50.5	19.0	2.5
16 Oct.	3	94	31.3	23-103	49.2	19.3	2.0
13 Nov.	3	38	12.7	33-98	66.9	14.0	2.3
20 Dec.	3	0	0.0				
19 June 1979	3	63	21.0	18-48	34.5	6.4	0.8
17 July	3	98	32.7	13-73	45.9	18.8	1.9
6 Aug.	3	570	190.0	18-93	39.4	15.2	1.3
25 Sept.	3	0	0.0				

Table 6. Number and sizes of white shrimp (*P. setiferus*) caught with 6.1-m trawls in Matagorda Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
21-22 Sept. 1978	9	221	24.6	58-163	98.9	18.5	1.3
10 Oct.	9	112	12.4	68-128	94.3	14.3	1.4
28-29 Nov.	9	287	31.9	38-123	84.9	16.7	1.0
19-20 Dec.	9	0	0.0				
26-27 Feb. 1979	9	0	0.0				
28-29 Mar.	9	63	7.0	78-128	103.6	11.0	1.4
25-26 Apr.	9	75	8.3	103-153	125.5	11.3	1.3
23-24 May	9	25	2.8	128-168	146.8	11.3	2.3
27 June	9	37	4.1	33-68	50.3	8.6	1.5
18-19 July	9	1195	132.8	48-113	85.5	10.5	0.5
28-29 Aug.	9	973	108.1	33-148	94.5	18.8	0.8
25-26 Sept.	9	203	22.6	43-158	87.8	17.3	1.2

Table 7. Number and sizes of postlarval and juvenile white shrimp (*P. setiferus*) caught with marsh nets in San Antonio Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
Sept. 1978	NS	-	-	-	-	-	-
19 Sept.	2	33	16.5	18-93	29.4	17.1	3.0
11 Oct.	3	1	0.3	53	53.0	0.0	0.0
16 Oct.	3	1	0.3	23	23.0	0.0	0.0
1 Nov.	3	0	0.0				
14 Nov.	3	0	0.0				
5 Dec.	3	0	0.0				
19 Dec.	3	0	0.0				
8 June 1979	3	0	0.0				
18 June	3	0	0.0				
4 July	3	3	1.0	33-43	36.3	4.7	2.7
15 July	3	6	2.0	43-63	57.0	7.4	3.3
7 Aug.	3	4	1.3	68-83	56.6	12.8	3.9
21 Aug.	3	11	3.7	33-68	78.0	6.1	3.1
10 Sept.	3	0	0.0				
21 Sept.	3	1	0.3	68	68.0	0.0	0.0

NS = No sample taken

Table 8. Number and sizes of white shrimp (*P. setiferus*) caught during 5-min drags of 3.0-m trawls in San Antonio Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
- Sept. 1978	NS	-	-	-	-	-	-
19 Sept.	2	12	6.0	38-118	88.8	22.9	6.6
11 Oct.	3	5	1.7	58-103	78.0	15.8	7.1
16 Oct.	3	59	19.7	58-103	91.9	8.6	1.1
1 Nov.	3	48	16.0	63-113	92.2	10.3	1.5
14 Nov.	3	28	9.3	43-103	70.3	13.1	2.5
5 Dec.	3	0	0.0				
19 Dec.	3	0	0.0				
5-8 June 1979	3	0	0.0				
18 June	3	0	0.0				
4 July	3	0	0.0				
15 July	3	14	4.7	33-103	77.6	17.8	4.8
7 Aug.	3	40	13.3	38-113	77.6	21.2	3.5
21 Aug.	3	122	40.7	28-113	75.3	23.3	2.1
10 Sept.	3	10	3.3	63-103	90.5	11.2	3.6
21 Sept.	3	1	0.3	93	93.0	0.0	0.0

NS = No sample taken

Table 9. Number and sizes of white shrimp (*P. setiferus*) caught with 6.1-m trawls in San Antonio Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
- Sept. 1978	NS	-	-	-	-	-	-
15 Sept.	10	121	12.1	43-158	97.8	22.0	2.0
- Oct.	NS	-	-	-	-	-	-
23 Oct.	10	219	21.9	38-143	89.2	18.7	1.3
3 Nov.	10	147	14.7	53-128	85.8	17.5	1.6
15 Nov.	10	359	35.9	38-123	86.6	13.9	0.8
7 Dec.	10	274	27.4	43-133	83.4	13.3	0.8
18 Dec.	10	24	2.4	63-103	80.7	9.6	2.0
13-14 Feb. 1979	10	2	0.2	83	83.0	0.0	0.0
13 Mar.	10	0	0.0				
17 Apr.	10	20	2.0	38-153	119.5	23.4	5.2
14 May	10	5	0.5	118-158	143.0	15.4	7.7
4 June	10	0	0.0				
14 June	10	0	0.0				
2-10 July	10	131	13.1	63-118	82.4	8.2	0.7
18 July	10	434	43.4	48-123	92.2	11.4	0.6
13 Aug.	10	722	72.2	43-148	108.5	16.4	0.7
20 Aug.	10	113	11.3	38-138	102.8	19.3	1.8
5 Sept.	10	98	9.8	33-138	92.1	23.6	2.4
24 Sept.	10	155	15.5	43-153	92.7	16.5	1.3

NS = No sample taken

Table 10. Number and sizes of white shrimp (*P. setiferus*) caught during 15-min drags of 3.0-m trawls in Aransas Bay, Apr.-June 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 April 1979	5	11	2.0	48-123	105.3	19.4	5.8
10 April	5	12	2.4	103-128	114.7	10.7	3.1
17 April	5	5	1.0	103-143	0.0	0.0	0.0
24 April	5	2	0.4	123	123.0	0.0	0.0
1 May	5	9	1.8	128-158	136.3	9.1	3.0
8 May	5	5	1.0	128-163	143.0	12.3	5.5
15 May	5	0	0.0				
23 May	5	2	0.4	148-158	153.0	0.0	0.0
1 June	5	1	0.2	28	28.0	0.0	0.0

Table 11. Number and sizes of postlarval and juvenile white shrimp (*P. setiferus*) caught with marsh nets in Aransas Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 Sept. 1978	3	39	13.0	8-68	23.8	16.8	2.6
18 Sept.	3	9	3.0	8-33	21.9	7.0	2.3
5 Oct.	4	7	1.8	18-38	31.6	7.4	2.8
16 Oct.	4	53	13.3	8-83	43.8	15.3	2.1
31 Oct.	4	195	48.8	8-68	23.3	12.3	0.9
14-15 Nov.	4	84	21.0	13-63	31.4	10.2	1.1
5 Dec.	4	3	1.0	18-33	24.7	6.2	3.6
18 Dec.	4	0	0.0				
4 June 1979	4	13	3.3	8-43	15.7	8.9	2.5
18 June	4	43	10.8	8-43	29.9	9.8	1.5
3 July	4	23	5.8	8-38	25.2	8.1	1.7
16 July	4	79	19.8	8-53	26.1	9.2	1.1
3 Aug.	4	13	3.3	13-83	35.3	24.8	6.9
20 Aug.	4	59	14.8	8-103	24.4	21.6	2.8
5 Sept.	4	44	11.0	8-88	29.8	18.1	2.7
24 Sept.	4	33	8.3	13-58	22.5	7.7	1.3

Table 12. Number and sizes of white shrimp (*P. setiferus*) caught during 5-min drags of 3.0-m trawls in Aransas Bay, Sept.-Dec. 1978 and June-Dec. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 Sept. 1978	3	220	73.3	28-128	84.3	15.0	1.3
18 Sept.	3	12	4.0	78-93	87.2	5.7	1.7
5 Oct.	3	193	64.3	18-138	73.1	15.5	1.2
16 Oct.	3	214	71.3	28-123	74.6	12.8	0.9
31 Oct.	3	171	57.0	18-93	65.5	12.6	1.0
14 Nov.	3	154	54.7	18-98	62.8	14.8	1.2
5 Dec.	3	42	13.0	18-63	34.1	9.4	1.4
18 Dec.	3	7	2.3	48-98	65.1	16.2	6.1
4 June 1979	3	0	0.0				
18 June	3	19	6.3	23-43	31.9	6.0	1.4
3 July	3	56	18.7	33-58	49.8	7.8	1.0
16 July	3	153	51.0	23-103	74.0	11.0	0.9
3 Aug.	3	87	29.0	28-103	76.7	11.7	1.3
20 Aug.	3	201	67.0	28-113	62.5	17.4	1.2
5 Sept.	3	262	87.3	33-113	58.1	17.1	1.5
24 Sept.	3	18	6.0	28-118	75.8	25.2	5.9

Table 13. Number and sizes of white shrimp (*P. setiferus*) caught with 6.1-m trawls in Aransas Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
6-7 Sept. 1978	8	150	18.8	33-178	111.9	29.6	2.4
14-15 Sept.	8	763	95.4	23-163	95.9	20.4	1.0
3-4 Oct.	11	315	28.6	33-163	95.7	24.1	1.4
18-19 Oct.	11	431	39.2	38-148	96.3	21.7	1.0
1-2 Nov.	11	451	41.0	33-173	96.4	19.0	0.9
13-29 Nov.	11	455	41.4	33-163	82.1	18.1	0.9
6-7 Dec.	11	494	44.9	28-108	82.4	14.1	0.7
19-20 Dec.	11	74	6.7	38-103	81.8	11.3	1.3
14-15 Feb. 1979	11	3	3.7	63-83	71.3	8.5	4.9
14-16 Mar.	11	52	4.7	53-118	92.4	13.7	1.9
18-19 Apr.	11	35	3.2	78-153	121.7	15.4	2.6
15-17 May	11	23	2.1	123-163	139.1	9.6	2.1
6-7-8 June	11	9	0.8	33-183	104.1	59.5	19.8
19-20 June	11	11	1.0	33-173	72.5	52.8	15.9
5 July	2	0	0.0				
17-18 July	11	274	24.9	33-113	74.7	14.0	0.9
6-7 Aug.	11	230	20.0	38-133	98.6	16.4	1.1
21-22 Aug.	11	52	4.7	33-148	101.9	21.9	3.0
6-7 Sept.	11	110	10.0	23-138	88.9	29.7	2.8
25-26 Sept.	11	854	77.6	28-148	83.1	19.9	0.9

Table 14. Number and sizes of white shrimp (P. setiferus) caught during 15-min drags of 3.0-m trawls in the lower Laguna Madre, Apr.-May 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2-4 April 1979	3	13	4.3	88-118	86.6	33.8	10.2
17 April	3	20	6.7	73-128	98.0	12.5	2.8
30 April	3	1	0.3	111	111.0	0.0	0.0
15 May	3	2	0.7	143-148	145.5	0.0	0.0

Appendix E. Number and sizes of pink shrimp collected in Aransas Bay and lower Laguna Madre during 1978-79.

Table 1. Number and sizes of pink shrimp (*P. duorarum*) caught with 6.1-m trawls in Aransas Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
6-7 Sept. 1978	8	0	0.0				
14-15 Sept.	8	0	0.0				
3-4 Oct.	11	0	0.0				
18-19 Oct.	11	0	0.0				
1-2 Nov.	11	8	0.7	63-98	85.5	12.0	4.2
13-29 Nov.	11	22	2.0	48-98	80.7	12.5	2.7
6-7 Dec.	11	7	0.6	53-103	90.1	17.3	6.5
19-20 Dec.	11	3	0.3	53-88	71.3	14.3	8.3
14-15 Feb. 1979	11	19	1.7	48-113	68.8	14.4	3.3
14-16 Mar.	11	54	4.9	58-108	77.8	10.0	1.4
18-19 Apr.	11	128	11.6	73-128	99.1	10.4	0.9
15-17 May	11	0	0.0				
6-7-8 June	11	0	0.0				
19-20 June	11	0	0.0				
5 July	2	0	0.0				
17-18 July	11	0	0.0				
6-7 Aug.	11	0	0.0				
21-22 Aug.	11	0	0.0				
6-7 Sept.	11	0	0.0				
25-26 Sept.	11	6	0.5	58-83	73.0	8.2	3.3

Table 2. Number and sizes of pink shrimp (*P. duorarum*) caught during 15-min drags of 3.0-m trawls in the lower Laguna Madre, Apr.-May 1979.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2-4 April 1979	3	33	11.0	53-103	82.5	9.3	1.6
17 April	3	16	5.3	68-108	84.9	10.1	2.5
30 April	3	0	0.0				
15 May	3	2	0.7	88-103	95.5	0.0	0.0

Appendix F. Hydrological data associated with shrimp samples collected in Galveston, Matagorda, San Antonio, Aransas Bays, and lower Laguna Madre during 1978-79.

Table 1. Hydrological data associated with 1.8-m bar seines in Galveston Bay, Apr.-May 1979.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
2 Apr. 1979	5	21.3-23.0	22.0	0.6	0.3	0.0-21.1	10.3	8.0	3.6
9 Apr.	5	20.2-21.9	21.3	0.6	0.3	0.0-16.7	7.7	6.2	2.8
16 Apr.	(2-5) ^a	24.5-25.5	25.0	0.0	0.0	0.5-13.3	7.3	4.5	2.0
23 Apr.	5	21.5-23.5	22.6	0.8	0.4	0.0-11.7	3.0	4.5	2.0
30 Apr.	5	15.0-24.0	20.3	3.5	1.6	0.0-7.8	3.0	3.1	1.4
7 May	5	17.0-25.0	22.0	2.5	1.1	0.0-8.9	2.3	3.5	1.5
14 May	5	21.1-28.0	25.1	2.3	1.0	0.0-7.8	1.7	3.1	1.4
21 May	5	25.0-27.5	26.6	0.7	0.4	0.0-10.0	3.2	3.6	1.6
30 May	5	22.5-29.0	26.9	2.6	1.3	2.2-10.5	4.7	3.4	1.7

^a Two temperatures and five salinity determinations were made.

Table 2. Hydrological data associated with 15-min drags of 3.0-m trawls in Galveston Bay, Apr.-May 1979.

Sample Date	No. of Samples	Water Temp Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
4 Apr. 1979	3	18.5-19.9	19.3	0.6	0.3	3.9-11.6	7.9	3.2	1.8
12 Apr.	3	21.8-25.3	23.6	1.4	0.8	6.7-11.7	8.9	2.1	1.2
19 Apr.	3	22.0-25.0	23.3	1.3	0.7	3.9-6.1	5.4	1.0	0.6
24 Apr.	3	22.5-24.0	23.2	0.6	0.4	0.6-3.3	1.7	1.2	0.7
1 May	3	17.5-18.5	18.0	0.4	0.2	1.1-14.4	5.9	6.0	3.5
8 May	3	23.0-24.5	23.8	0.6	0.4	1.1-13.9	5.7	5.8	3.3
15 May	3	23.5-27.0	25.2	1.4	0.8	2.2-10.5	5.2	3.8	2.2
22 May	3	23.0-25.0	24.0	1.1	0.6	1.1-12.2	5.5	4.8	2.8
31 May	3	26.0-27.0	26.5	0.4	0.2	2.2-13.3	6.3	5.0	2.9

Table 3. Hydrological data associated with marsh nets in Galveston Bay Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	Water		Mean Temp. (C)	SD	SE	Sal.		Mean Sal. (o/oo)	SD	SE
		Temp. Range (C)	Temp. (C)				Range (o/oo)	Range (o/oo)			
5-6 Sept. 1978	3	28.4-32.8	30.3	1.9	1.1	3.3-14.4	9.8	4.7	2.7		
18-19 Sept.	3	29.6-30.7	30.2	0.5	0.3	4.4-14.4	10.5	4.4	2.5		
3 Oct.	3	25.2-28.8	26.9	1.5	0.9	5.6-17.8	12.6	5.1	3.0		
24-25 Oct.	3	22.1-24.4	23.6	1.1	0.6	8.3-21.6	15.5	5.5	3.2		
8-9 Nov.	3	17.8-18.4	18.1	0.3	0.1	10.0-19.4	15.4	4.0	2.3		
20-21 Nov.	3	16.7-18.0	17.3	0.5	0.3	13.9-20.0	16.7	2.5	1.5		
5-6-13 Dec.	3	11.2-17.8	14.5	2.7	1.6	4.4-13.3	10.3	4.2	2.4		
27-28-29 Dec.	3	12.4-15.1	13.9	1.1	0.6	13.3-19.4	16.5	2.5	1.4		
27 Feb. 1979	3	12.0-13.0	12.5	0.4	0.2	11.1-16.7	13.0	2.6	1.5		
6 Mar.	3	17.7-20.5	19.2	1.2	0.7	7.7-19.9	12.9	5.1	3.0		
12 Mar.	3	15.6-19.5	17.1	1.7	1.0	9.4-19.9	13.8	4.4	2.6		
19 Mar.	3	19.8-20.5	20.2	0.3	0.2	12.8-23.9	16.7	5.1	3.0		
26 Mar.	3	23.1-26.4	24.3	1.5	0.9	6.1-16.7	11.5	4.3	2.5		
7-8 June	3	28.5-29.0	28.7	0.2	0.1	0.0-2.2	0.9	0.9	0.5		
22 June	3	28.0-31.5	29.3	1.6	0.9	0.0-5.5	1.8	2.6	1.5		
5-6 July	3	29.0-30.5	29.8	0.6	0.4	0.0-2.2	1.1	0.9	0.5		
30-31 July	3	31.5-32.5	32.0	0.4	0.2	0.0-0.0	0.0	0.0	0.0		
8-10 Aug.	3	30.0-32.0	30.7	0.9	0.5	0.0-1.7	0.6	0.8	0.5		
20-21 Aug.	3	29.0-31.0	29.8	0.9	0.5	0.0-2.2	0.7	1.0	0.6		
5-6 Sept.	3	28.5-32.5	30.2	1.7	1.0	0.0-0.0	0.0	0.0	0.0		
17-18 Sept.	3	23.0-24.5	23.7	0.6	0.4	0.5-2.2	1.6	0.8	0.5		

Table 4. Hydrological data associated with 5-min drags of 3.0-m trawls in Galveston Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
5-6 Sept. 1978	3	28.6-32.0	30.2	1.4	0.8	14.4-20.5	17.2	2.5	1.5
18-19 Sept.	3	28.5-30.4	29.7	0.9	0.5	13.3-22.2	16.8	3.9	2.2
3 Oct.	3	25.8-28.0	26.9	0.9	0.5	6.6-20.0	13.5	5.5	3.2
24-25 Oct.	3	22.1-24.4	23.3	0.9	0.6	8.3-23.3	16.1	6.1	3.5
8-9 Nov.	3	17.3-18.1	17.7	0.3	0.2	10.0-21.1	15.9	4.6	2.6
20-21 Nov.	3	16.4-17.1	16.8	0.3	0.2	16.1-20.5	17.9	1.9	1.1
5-6-13 Dec.	3	10.7-17.6	14.2	2.8	1.6	12.2-15.5	14.0	1.4	0.8
27-28-29 Dec.	3	12.4-15.2	14.0	1.2	0.7	13.3-20.0	16.7	2.7	1.6
7-8 June 1979	3	28.5-29.0	28.7	0.2	0.1	0.0-2.2	0.9	0.9	0.5
22 June	3	28.0-31.5	29.2	1.7	1.0	0.0-5.5	2.0	2.5	1.4
5-6 July	3	29.0-30.0	29.5	0.4	0.2	0.0-2.8	1.3	1.2	0.7
30 July	3	31.0-31.5	31.2	0.2	0.1	0.0-0.0	0.0	0.0	0.0
8-10 Aug.	3	30.0-32.0	30.5	1.1	0.6	0.0-2.2	0.7	1.0	0.6
20-21 Aug.	3	28.5-30.5	29.3	0.9	0.5	0.0-6.7	3.2	2.8	1.6
5-6 Sept.	3	28.0-29.5	28.8	0.6	0.4	0.0-2.2	0.7	1.0	0.6
17-18 Aept.	3	23.0-24.0	23.5	0.4	0.2	1.1-2.2	1.8	0.5	0.3

Table 5. Hydrological data associated with 6.1-m trawls in Galveston Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	Water			Sal.			SE	Mean Sal.		
		Temp. Range (C)	Mean Temp. (C)	SD	Temp. (C)	Range (o/oo)	SD		Sal. (o/oo)	SD	SE
5-6-12 Sept. 1978	15	26.3-31.0	28.3	1.2	15.5-30.0	21.1	0.3	3.7	1.0		
18-19-26 Sept.	15	24.7-30.1	27.9	1.7	13.9-24.4	20.7	0.4	3.5	0.9		
2-3-12 Oct.	15	24.2-28.0	25.9	1.0	13.9-25.0	20.2	0.3	3.1	0.8		
24-25-27 Oct.	15	21.8-24.1	22.7	0.7	17.2-26.6	21.7	0.2	3.1	0.8		
8-9-10 Nov.	15	17.6-19.7	18.4	0.6	15.5-27.8	21.6	0.2	3.4	0.9		
20-21-22 Nov.	15	16.6-17.8	17.4	0.4	16.7-26.6	21.6	0.1	3.1	0.8		
5-6-13-15 Dec.	15	8.9-17.8	12.6	2.4	14.4-23.8	19.8	0.6	3.6	0.9		
22-27-28-29 Dec.	15	11.5-16.7	13.3	1.3	14.9-26.6	20.1	0.3	3.6	0.9		
14-15-23 Feb. 1979	15	11.8-17.1	14.0	1.7	5.0-19.4	11.6	0.4	4.9	1.3		
13-14-26 Mar.	15	16.4-19.2	17.8	0.9	1.1-22.8	12.6	0.2	5.6	1.4		
12-13-23 Apr.	15	21.5-23.6	22.3	0.7	0.0-17.2	9.5	0.2	6.0	1.6		
15-16-17 May	15	22.5-26.5	24.4	1.0	0.0-12.2	4.7	0.3	4.2	1.1		
6-7-8 June	15	27.5-29.0	28.0	0.4	0.0-23.7	4.9	0.1	6.5	1.7		
21-22 June	15	26.5-32.0	28.4	1.2	0.0-12.8	5.8	0.3	5.1	1.3		
3-5-6 July	15	27.5-30.0	28.5	0.6	0.0-18.9	7.0	0.2	6.1	1.6		
30-31 July	15	27.5-30.5	28.9	0.8	0.0-8.9	3.6	0.2	3.3	0.9		
8-9-10 Aug.	15	28.0-32.0	29.4	1.1	0.0-16.7	5.4	0.3	4.9	1.3		
20-21-22 Aug.	15	28.0-31.5	29.6	0.8	0.5-18.9	9.4	0.2	5.2	1.3		
5-6-7 Sept.	15	28.0-30.0	28.6	0.5	0.0-15.5	8.4	0.1	3.8	1.0		
17-18-24 Sept.	15	22.5-25.0	23.8	0.8	1.7-16.1	8.2	0.2	3.7	1.0		

Table 6. Hydrological data associated with 1.8-m seines in Matagorda Bay, Apr.-May 1979.

Sample Date	No. of Samples	Water Temp.		Mean Temp. (C)	SD	SE	Sal.		Mean Sal. (o/oo)	SD	SE
		Range (C)	Range (C)				Range (o/oo)	Range (o/oo)			
5 Apr. 1979	4	18.5-23.0	18.5-23.0	20.9	1.8	0.8	0.0-12.2	5.7	4.4	2.2	
10 Apr.	4	23.0-24.0	23.0-24.0	23.5	0.5	0.3	2.2-10.0	7.4	3.1	1.5	
18 Apr.	4	23.0-25.0	23.0-25.0	23.9	0.7	0.4	5.6-11.1	9.5	2.2	1.1	
24 Apr.	4	24.0-27.0	24.0-27.0	25.4	1.1	0.5	0.0-8.9	4.9	3.6	1.8	
2 May	4	23.0-26.0	23.0-26.0	23.8	1.3	0.7	0.0-6.7	2.2	2.7	1.4	
8 May	4	24.0-26.0	24.0-26.0	25.0	0.7	0.4	0.0-1.1	0.3	0.5	0.2	
16 May	4	22.0-25.0	22.0-25.0	23.8	1.1	0.5	0.0-2.9	0.7	1.3	0.6	
22 May	4	24.0-27.5	24.0-27.5	25.4	1.3	0.7	0.0-4.4	1.7	1.8	0.9	
30 May	4	27.5-28.5	27.5-28.5	28.0	0.4	0.2	0.0-5.5	2.2	2.1	1.0	

Table 7. Hydrological data associated with 15-min drags of 3.0-m trawls in Matagorda Bay, Apr.-May 1979.

Sample Date	No. of Samples	Water		Mean Temp. (C)	SD	SE	Sal.		Mean Sal. (o/oo)	SD	SE
		Temp. Range (C)	Temp. Range (C)				Range (o/oo)	Range (o/oo)			
5 Apr. 1979	4	17.0-21.5	19.9	1.7	0.9	0.0-9.4	6.9	4.0	2.0		
10 Apr.	4	23.0-24.0	23.3	0.4	0.2	3.3-15.5	8.9	4.4	2.2		
18 Apr.	4	23.0-24.5	23.6	0.7	0.3	6.7-17.8	10.6	4.3	2.2		
24 Apr.	4	24.0-27.0	25.3	1.3	0.7	0.0-15.0	6.3	6.5	3.3		
2 May	4	23.0-24.0	23.5	0.4	0.2	0.0-16.1	4.6	6.7	3.3		
8 May	4	23.5-26.0	24.8	0.9	0.5	0.0-11.7	2.9	5.1	2.5		
16 May	4	23.0-24.5	23.8	0.6	0.3	0.0-8.9	2.5	3.7	1.9		
22 May	4	25.0-28.0	25.9	1.2	0.6	0.0-6.7	2.7	2.5	1.2		
30 May	4	27.5-28.5	28.0	0.4	0.2	0.0-9.4	3.3	3.7	1.9		

Table 8. Hydrological data associated with marsh nets in Matagorda Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	Water		Mean Temp. (C)	SD	SE	Sal.		Mean Sal. (o/oo)	SD	SE
		Temp. Range (C)	Temp. (C)				Range (o/oo)	Range (o/oo)			
22 Sept. 1978	3	27.0-28.0	27.3	0.5	0.3	0.0-1.1	0.4	0.5	0.3	0.3	
16 Oct.	3	23.0-25.0	24.2	0.9	0.5	1.1-6.7	4.3	2.3	0.5	1.4	
13 Nov.	3	24.0-25.0	24.7	0.8	0.3	0.0-2.8	1.7	1.2	0.3	0.7	
20 Dec.	3	18.5-20.5	19.7	0.9	0.5	6.1-13.9	10.4	3.2	0.5	1.9	
19 June 1979	3	28.5-29.0	28.8	0.2	0.1	0.0-1.1	0.7	0.5	0.1	0.3	
17 July	3	29.0-30.0	29.3	0.5	0.3	0.0-0.0	0.0	0.0	0.3	0.0	
6 Aug.	3	32.0-34.0	33.3	0.9	0.5	0.0-0.0	0.0	0.0	0.5	0.0	
25 Sept.	3	24.0-27.0	25.3	1.3	0.7	0.0-0.0	0.0	0.0	0.7	0.0	

Table 9. Hydrological data associated with 5-min drags of 3.0-m trawls in Matagorda Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	Water		Mean Temp. (C)	SD	SE	Sal.		Mean Sal. (o/oo)	SD	SE
		Temp. Range (C)	Temp. (C)				Range (o/oo)	Range (o/oo)			
22 Sept. 1978	3	26.0-28.0	27.3	0.9	0.5	1.1-1.1	1.1	0.0	0.5	0.0	
16 Oct.	3	24.0-27.0	25.3	1.3	0.7	2.2-7.8	4.8	2.3	0.7	1.3	
13 Nov.	3	24.0-25.0	24.3	0.5	0.3	0.0-3.9	2.0	1.6	0.3	0.9	
20 Dec.	3	19.0-20.0	19.3	0.5	0.3	11.7-13.9	13.0	0.9	0.3	0.5	
19 June 1979	3	27.5-29.0	28.5	0.7	0.4	1.1-4.4	2.4	1.4	0.4	0.8	
17 July	3	29.5-31.0	30.5	0.7	0.4	0.0-0.0	0.0	0.0	0.4	0.0	
6 Aug.	3	31.0-35.0	32.7	1.7	0.9	0.0-0.0	0.0	0.0	0.9	0.0	
25 Sept.	3	26.0-27.0	26.5	0.4	0.2	0.0-0.0	0.0	0.0	0.2	0.0	

Table 10. Hydrological data associated with 6.1-m trawls in Matagorda Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
21-22 Sept. 1978	9	27.4-30.4	28.9	1.1	0.4	0.0-21.1	9.6	8.5	2.9
18 Oct.	9	21.3-22.5	21.9	0.4	0.1	7.8-19.9	15.1	4.2	1.4
28-29 Nov.	9	12.6-16.7	14.4	1.0	0.3	11.6-25.5	18.6	4.2	1.4
19-20 Dec.	9	13.4-15.8	15.1	0.8	0.3	16.6-24.4	20.9	2.4	0.8
26-27 Feb. 1979	9	11.8-14.3	13.2	0.8	0.3	10.0-23.9	14.9	4.5	1.5
28-29 Mar.	8-9 ^a	20.2-21.5	20.8	0.4	0.2	6.7-20.5	13.7	4.5	1.5
25-26 Apr.	9	24.0-25.5	24.6	0.5	0.2	2.2-19.4	12.8	5.8	2.0
23-24 May	9	24.5-26.5	25.5	0.6	0.2	0.0-13.3	6.2	4.3	1.4
27 June	9	26.0-30.0	27.9	1.2	0.4	1.7-13.9	8.0	4.1	1.4
18-19 June	6 ^b -9	30.0-32.0	31.0	0.8	0.3	1.1-13.3	8.2	4.4	1.5
28-29 Aug.	9-8 ^c	28.5-30.5	29.5	0.6	0.2	2.2-16.1	8.2	4.9	1.7
25-26 Sept.	9	24.5-26.0	25.2	0.5	0.2	0.0-12.8	4.0	4.3	1.5

^a Six temperatures were recorded and three missed due to broken thermometer.

^b One salinity determination was made.

^c One temperature was not recorded.

Table 11. Hydrological data associated with 1.8-m bar seines in San Antonio Bay, April-May 1979.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal (o/oo)	SD	SE
4 Apr. 1979	4	18.0-23.0	20.6	2.4	1.2	0.0-8.9	4.6	3.8	1.9
9 Apr.	4	24.0	24.0	0.0	0.0	1.1-8.3	5.0	2.9	1.5
16 Apr.	4	25.0-27.0	25.8	0.8	0.4	2.2-5.0	3.1	2.0	1.0
23 Apr.	4	22.5-27.0	24.6	1.6	0.8	0.0-3.3	2.2	1.4	0.7
1 May	4	22.5-24.0	23.4	0.7	0.3	0.0-3.3	1.7	1.7	0.8
7 May	4	24.0-26.0	24.6	1.0	0.5	0.0-2.2	1.1	1.1	0.6
15 May	4	24.0-28.6	25.6	1.9	0.9	0.0-1.7	0.9	0.9	0.4
21 May	4	24.0-28.0	26.5	1.7	0.8	0.6-1.1	1.0	0.2	0.1
29 May	4	27.0-32.0	29.5	2.1	1.0	0.0-2.2	1.1	0.8	0.4

Table 12. Hydrological data associated with 15-min drags of 3.0-m trawls in San Antonio Bay, Apr.-May 1979.

Sample Date	No. of Samples	Water			Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
		Temp. Range (C)	Temp. (C)	Temp. (C)							
4 Apr. 1979	4	18.0-23.0	20.1	2.0	1.0	0.0-8.9	4.7	3.9	1.1		
9 Apr.	4	18.0-24.0	22.5	2.6	1.3	1.1-7.2	4.6	2.5	1.3		
16 Apr.	4	25.0-26.5	25.6	0.7	0.3	1.7-5.0	3.6	1.4	0.7		
23 Apr.	4	22.5-25.0	23.8	1.0	0.6	0.0-3.3	2.1	1.3	0.6		
30 Apr.-1 May	4	22.5-24.0	23.3	0.6	0.3	0.0-3.3	1.7	1.7	0.8		
7 May	4	23.5-25.0	24.4	0.7	0.3	0.0-2.2	1.1	1.1	0.6		
15 May	4	23.5-26.0	25.1	1.0	0.5	0.0-1.7	0.9	0.9	0.4		
21 May	4	26.0-27.0	26.5	0.5	0.3	0.0-1.1	0.7	0.5	0.2		
29 May	4	27-0-29.0	28.0	1.0	0.5	0.0-1.7	1.0	0.6	0.3		

Table 13. Hydrological data associated with marsh net samples in San Antonio Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal (o/oo)	SD	SE
NS Sept. 1978	-	-	-	-	-	-	-	-	-
2 Sept.	2	27.5-28.0	27.8	0.0	0.0	1.0-1.7	1.4	0.0	0.0
11 Oct.	3	24.5-25.0	24.8	0.2	0.1	1.1-1.7	1.3	0.3	0.2
16 Oct.	3	19.0-22.0	20.7	1.3	1.7	1.1	1.1	0.0	0.0
1 Nov.	3	23.0-24.0	23.3	0.5	0.3	1.1-2.8	2.0	0.7	0.4
14 Nov.	3	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0
5 Dec.	3	11.0-11.5	11.2	0.2	0.1	0.0-2.8	1.7	1.2	0.7
19 Dec.	3	16.0-18.0	17.2	0.9	0.5	1.1-3.3	2.6	1.0	0.6
5-8 June 1979	3	27.5-28.0	27.8	0.2	0.1	0.0	0.0	0.0	0.0
18 June	3	26.0	26.0	0.0	0.0	0.0	0.0	0.0	0.0
4 July	3	27.0-31.0	28.3	1.9	1.1	0.0	0.0	0.0	0.0
15 July	3	28.0-30.0	28.7	0.9	0.5	0.0	0.0	0.0	0.0
7 Aug.	3	30.0-32.0	31.0	0.8	0.5	0.0	0.0	0.0	0.0
21 Aug.	3	29.0-31.0	29.7	0.9	0.5	0.0	0.0	0.0	0.0
10 Sept.	3	25.0-26.5	25.5	0.7	0.4	0.0	0.0	0.0	0.0
21 Sept.	3	24.0-24.5	24.3	0.2	0.1	0.0	0.0	0.0	0.0

NS = No sample taken

Table 14. Hydrological data associated with 5-min drags of 3.0-m trawls in San Antonio Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
NS Sept. 1978	-	-	-	-	-	-	-	-	-
19 Sept.	2	27.0-27.5	27.3	0.0	0.0	1.0-1.1	1.1	0.0	0.0
11 Oct.	3	24.0-25.0	24.7	0.5	0.3	1.1-1.7	1.5	0.3	0.2
16 Oct.	3	19.0-21.0	20.3	0.9	0.5	1.1	1.1	0.0	0.0
1 Nov.	3	23.0-24.0	23.5	0.4	0.2	1.1-2.8	2.2	0.9	0.5
14 Nov.	3	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0
5 Dec.	3	11.0-11.5	11.2	0.2	0.1	0.0-2.8	1.7	1.2	0.7
19 Dec.	3	15.0-18.5	17.0	1.5	0.9	1.7-3.9	3.0	0.9	0.5
5-8 June 1979	3	28.0	28.0	0.0	0.0	0.0	0.0	0.0	0.0
18 June	3	26.0	26.0	0.0	0.0	0.0	0.0	0.0	0.0
4 July	3	27.0-31.0	28.3	1.9	1.1	0.0	0.0	0.0	0.0
15 July	3	28.0-32.5	29.7	2.0	1.2	0.0	0.0	0.0	0.0
7 Aug.	3	30.0-33.0	31.0	1.4	0.8	0.0	0.0	0.0	0.0
21 Aug.	3	28.0-31.0	29.2	1.3	0.8	0.0	0.0	0.0	0.0
10 Sept.	3	25.0-28.2	26.4	1.3	0.8	0.0	0.0	0.0	0.0
21 Sept.	3	24.5	24.5	0.0	0.0	0.0	0.0	0.0	0.0

NS = No sample taken

Table 15. Hydrological data associated with 6.1-m trawls in San Antonio Bay, Sept.-Dec. 1978 and Feb.- Sept. 1979

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
15 Sept. 1978	10	28.0-29.5	28.5	0.6	0.2	1.0-12.8	6.5	5.1	1.6
NS Sept.	-	-	-	-	-	-	-	-	-
NS Oct.	-	-	-	-	-	-	-	-	-
23 Oct.	10	23.0-24.0	23.5	0.4	0.1	2.2-22.2	10.5	6.6	2.1
3 Nov.	10	23.0-24.0	23.6	0.4	0.1	1.7-25.5	10.7	6.6	2.1
15 Nov.	10	24.0-25.0	24.4	0.5	0.2	0.0-23.3	11.5	6.5	2.1
7 Dec.	10	17.5-19.0	18.1	0.6	0.2	0.0-25.5	12.1	7.8	2.5
18 Dec.	10	12.5-15.0	13.9	1.1	0.4	3.3-27.8	12.8	8.2	2.6
13-14 Feb. 1979	10	16.0-19.0	17.3	1.1	0.4	0.0-18.9	6.6	6.0	1.9
13 Mar.	10	17.0-19.0	18.1	0.7	0.2	0.0-14.4	6.2	4.0	1.3
17 Apr.	10	24.0-25.0	24.1	0.3	0.1	0.0-23.3	8.4	7.9	2.5
14 May	10	23.0-25.0	23.9	0.7	0.2	0.0-11.7	3.4	4.1	1.3
4 June	10	27.5-29.0	28.1	0.6	0.2	0.0-2.9	1.6	0.9	0.3
14 June	10	27.0-28.5	27.7	0.6	0.2	0.0-2.2	0.7	0.9	0.3
2-10 July	10	28.5-31.0	29.8	0.7	0.2	0.0-1.1	0.2	0.4	0.1
18 July	10	29.0-32.0	30.6	1.4	0.5	0.0-1.6	0.4	0.6	0.2
13 Aug.	10	29.5-31.5	30.5	0.6	0.2	0.0-10.0	2.9	3.3	1.0
20 Aug.	10	29.0-31.0	30.1	0.7	0.2	0.0-7.8	2.4	2.6	0.9
5 Sept.	10	28.0-29.5	29.1	0.6	0.2	0.0-13.3	4.2	4.4	1.4
24 Sept.	10	26.0-28.0	26.6	0.8	0.2	1.7-16.1	8.3	5.7	1.8

NS = No sample taken

Table 16. Hydrological data associated with 1.8-m bar seines in Aransas Bay, Apr.-May 1979.

Sample Date	No. of Samples	Water			Sal.			SE	SD	SE
		Temp. Range (C)	Mean Temp. (C)	Temp. (C)	Temp. (C)	Range (o/oo)	Mean Sal. (o/oo)			
2 Apr. 1979	5	22.5-24.0	23.3	0.6	0.3	8.0-29.0	14.0	7.8	3.5	
9 Apr.	5	22.0-23.0	22.9	0.9	0.4	6.0-23.0	11.4	6.1	2.7	
16 Apr.	5	23.0-27.5	24.9	1.5	0.7	8.0-22.0	11.8	5.3	2.4	
23 Apr.	5	22.0-27.0	25.1	2.7	1.2	4.0-16.0	8.8	4.1	1.8	
30 Apr.	5	21.0-23.0	21.7	1.1	0.5	6.0-18.0	9.8	4.3	1.9	
7 May	5	22.0-24.0	23.4	0.8	0.4	2.0-15.0	8.2	4.3	1.9	
14 May	5	21.7-25.8	23.9	1.6	0.7	1.0-11.0	5.8	3.4	1.5	
21 May	5	24.0-27.0	25.7	1.1	0.5	2.0-16.0	6.6	5.1	3.3	
29 May	5	25.8-27.5	26.8	0.6	0.3	4.0-22.0	8.8	6.8	3.0	

Table 17. Hydrological data associated with 15-min drags of 3.0-m trawl samples in Aransas Bay, Apr.-1 June 1979.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
4 Apr. 1979	5	18.0-21.0	19.7	1.1	0.5	7.0-15.0	10.2	2.8	1.3
10 Apr.	5	22.0-23.0	22.3	0.4	0.2	8.0-14.0	11.2	2.4	1.1
17 Apr.	5	23.0-23.5	23.2	0.2	0.1	8.0-12.0	10.2	1.6	0.7
24 Apr.	5	23.0-25.0	24.0	0.6	0.3	6.0-12.0	9.2	2.0	0.9
1 May	5	23.0-24.0	23.2	0.4	0.2	8.0-11.0	9.4	1.0	0.5
8 May	5	23.5-25.0	24.1	0.5	0.2	7.0-10.0	8.4	1.0	0.5
15 May	5	23.0-24.0	23.7	0.4	0.2	6.0-8.0	7.2	0.8	0.3
23 May	5	24.0-26.0	25.1	0.7	0.3	5.0-8.0	6.4	1.0	0.5
1 June	5	27.5-28.0	27.8	0.2	0.1	6.0-16.0	9.2	3.7	1.7

Table 18. Hydrological data associated with marsh nets in Aransas Bay, Sept.-Dec. 1978 and Feb-Sept. 1979.

Sample Date	No. of Samples	Water			Mean Temp. (C)	SD	SE	Sal.			Mean Sal. (o/oo)	SD	SE
		Temp. Range (C)	Temp. (C)	Temp. (C)				Range (o/oo)	Range (o/oo)	Range (o/oo)			
5 Sept. 1978	3	27.2-31.0	29.0	1.6	0.9	9.0-18.0	15.0	4.2	2.5				
18 Sept.	3	27.0-29.5	28.2	1.0	0.6	0.0-17.0	5.7	8.0	4.6				
5 Oct.	4	26.0-30.5	27.9	1.7	0.8	2.0-19.0	7.3	7.0	3.5				
16 Oct.	4	22.0-26.8	24.1	2.1	1.1	2.0-20.0	8.5	7.4	3.7				
31 Oct.	4	23.0-29.0	25.5	2.6	1.3	2.0-20.0	9.8	6.9	3.5				
14 Nov.	4	24.5-25.5	24.9	0.4	0.2	2.0-28.0	12.0	10.1	5.0				
5 Dec.	4	13.5-19.0	15.8	2.2	1.1	6.0-27.0	13.3	8.6	4.3				
18 Dec.	4	12.5-19.0	15.1	2.4	1.2	4.0-22.0	11.0	6.7	3.4				
26 Feb. 1979	5	10.5-15.0	12.8	1.9	0.9	5.0-16.0	9.0	4.3	1.9				
5 Mar.	5	11.0-17.0	14.0	2.3	1.0	6.0-23.0	11.6	6.2	2.8				
13 Mar.	5	15.5-20.0	17.9	1.6	0.7	8.0-26.0	13.2	7.1	3.2				
19 Mar.	5	20.8-22.0	21.3	0.4	0.2	6.0-28.0	13.8	7.7	3.4				
26 Mar.	5	18.0-21.5	20.1	1.4	0.6	4.0-22.0	10.4	6.4	2.9				
4 June	4	26.0-31.8	28.7	2.1	1.1	0.0-20.0	6.8	7.8	3.9				
18 June	4	26.8-30.0	28.4	1.2	0.6	2.0-22.0	7.3	8.5	4.3				
3 July	4	27.0-33.8	30.4	2.6	1.3	3.0-28.0	10.8	10.1	5.1				
16 July	4	28.8-34.0	31.7	2.0	1.0	0.0-26.0	10.0	9.9	4.9				
3 Aug.	4	26.5-31.5	29.3	1.9	1.0	0.0-26.0	9.3	10.7	5.3				
20 Aug.	4	28.0-31.7	30.1	1.4	0.7	1.0-31.2	11.5	12.5	6.2				
5 Sept.	4	27.5-31.0	29.3	1.6	0.8	0.0-23.0	7.3	9.2	4.6				
24 Sept.	4	26.0-29.0	27.2	1.2	0.6	0.0-12.0	5.3	5.0	2.5				

Table 19. Hydrological data associated with 5-min drags of 3.0-m trawls in Aransas Bay, Sept.-Dec. 1978 and June-Sept. 1979.

Sample Date	No. of Samples	Water Temp.		Mean Temp. (C)	SD	SE	Sal. Range (o/oo)		Mean Sal. (o/oo)	SD	SE
		Range (C)	Range (o/oo)								
5 Sept. 1978	3	27.8-29.8		28.9	0.8	0.5	7.0-26.0	17.7	7.9	4.6	
18 Sept.	3	27.0-29.0		28.0	0.8	0.5	0.0-18.0	6.0	8.5	4.9	
5 Oct.	3	26.0-28.0		27.0	0.8	0.5	1.0-6.0	3.0	2.2	1.3	
16 Oct.	3	21.0-22.5		21.5	0.7	0.4	4.0-10.0	6.7	2.5	1.4	
31 Oct.	3	21.5-23.0		22.2	0.6	0.4	2.0-12.0	6.3	4.2	2.4	
14 Nov.	3	24.0-24.7		24.2	0.3	0.2	2.0-13.0	6.7	4.6	2.7	
5 Dec.	3	12.5-16.0		13.8	1.5	0.9	6.0-12.0	8.0	2.8	1.6	
18 Dec.	3	12.0-13.8		12.9	0.7	0.4	6.0-10.0	7.7	1.7	1.0	
4 June 1979	3	26.0-28.8		27.6	1.2	0.7	0.0-6.0	3.0	2.5	1.4	
18 June	3	26.8-29.5		28.1	1.1	0.6	0.0-4.0	2.3	1.7	1.0	
3 July	3	27.5-31.2		29.9	1.7	1.0	2.0-8.0	4.7	2.5	1.4	
16 July	3	28.5-31.0		29.4	1.1	0.6	0.0-8.0	4.0	3.3	1.9	
3 Aug.	3	26.8-30.5		28.8	1.5	0.9	0.0-4.0	2.0	1.6	0.9	
20 Aug.	2	27.2-30.0		28.6	0.0	0.0	3.0-10.0	6.5	0.0	0.0	
5 Sept.	3	27.0-31.5		28.8	1.9	1.1	0.0-5.0	1.3	0.9	0.5	
24 Sept.	3	25.5-26.5		26.0	0.4	0.2	0.0-6.0	2.0	2.8	1.6	

Table 20. Hydrological data associated with 6.1-m trawls in Aransas Bay, Sept.-Dec. 1978 and Feb.-Sept. 1979.

Sample Date	No. of Samples	Water			Sal.			SE	SD	SE
		Temp. Range (C)	Mean Temp. (C)	Temp. (C)	Temp. (C)	Range (o/oo)	Mean Sal. (o/oo)			
6-7 Sept. 1978	8	26.8-28.5	27.6	0.7	0.2	0.7	16.0-33.0	25.0	4.9	1.7
14-15 Sept.	8	27.0-28.5	27.6	0.5	0.2	0.5	2.0-24.0	14.5	8.6	3.0
3-4 Oct.	11	26.0-28.0	26.6	0.7	0.2	0.7	4.0-22.0	10.7	5.4	1.6
18-19 Oct.	11	21.0-23.5	22.0	0.8	0.2	0.8	6.0-25.0	13.1	4.7	1.4
1-2 Nov.	11	22.5-29.5	23.6	1.9	0.6	1.9	8.0-25.0	14.2	5.5	1.7
13-29 Nov.	11	13.0-24.0	16.8	5.6	1.7	5.6	6.0-29.0	16.0	7.0	2.1
6-7 Dec.	11	16.0-18.5	16.4	2.9	0.9	2.9	11.0-26.0	14.5	4.6	1.4
19-20	11	13.8-18.0	15.4	1.2	0.4	1.2	10.0-28.0	15.9	5.1	1.6
14-15 Feb. 1979	11	13.0-18.5	16.6	1.8	0.5	1.8	1.0-26.0	10.6	6.4	1.9
14.16 Mar.	11	17.0-20.0	18.4	0.8	0.2	0.8	7.0-28.0	13.5	2.0	6.7
18-19 Apr.	11	23.5-24.8	24.0	0.3	0.1	0.3	6.0-15.0	9.8	2.6	0.8
15-16-17 May	11	23.5-25.5	24.4	0.5	0.2	0.5	2.0-10.0	5.7	2.4	0.7
6-7-8 June	11	27.0-28.0	27.8	0.3	0.1	0.3	4.0-26.0	8.7	6.0	1.8
19-20 June	11	27.8-28.5	28.1	0.2	0.1	0.2	4.0-15.0	7.8	3.0	0.9
5 July	2	28.0-28.5	28.3	0.0	0.0	0.0	21.0-22.0	21.5	0.0	0.0
17-18 July	11	29.0-32.0	29.8	0.9	0.3	0.9	4.0-21.0	10.8	5.8	1.8
6-7 Aug.	11	29.0-31.0	30.2	0.6	0.2	0.6	4.0-21.0	11.0	6.1	1.8
21-22 Aug.	11	29.0-30.2	29.4	0.5	0.1	0.5	6.0-28.0	13.7	7.6	2.3
6-7 Sept.	11	28.0-29.0	28.3	0.5	0.1	0.5	4.0-19.0	10.0	5.7	1.7
25-26 Sept.	11	24.0-28.0	25.3	1.2	0.4	1.2	0.0-12.0	6.2	3.7	1.1

Table 21. Hydrological data associated with 1.8-m bar seines in the lower Laguna Madre, Apr.-May 1979.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
2-4	3	20.5-25.0	23.2	1.9	1.1	12.0-32.0	23.0	8.3	4.8
16 Apr.	3	22.0-25.0	23.2	1.3	0.8	12.0-30.0	24.0	8.5	4.9
30 Apr.	3	NS	-	-	-	10.0-30.0	22.7	9.0	5.2
15 May	3	23.0-27.5	25.2	1.8	1.1	8.0-27.0	19.7	8.3	4.8

NS = No samples taken

Table 22. Hydrological data associated with 15-min drags of 3.0-m trawls in the lower Laguna Madre, Apr.-May 1979.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
2-4 Apr. 1979	3	20.5-25.0	23.2	1.9	1.1	12.0-31.0	22.7	7.9	4.6
16-17 Apr.	3	22.0-25.0	23.2	1.3	0.8	22.0-25.0	24.0	8.5	4.9
30 Apr.	3	NS	-	-	-	10.0-30.0	21.3	8.4	4.8
15 May	3	24.0-27.5	25.5	1.5	0.9	8.0-24.0	18.7	7.5	4.4

NS = No samples taken

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