STUDIES OF SHRIMP POPULATIONS IN SELECTED COASTAL BAYS OF TEXAS

Part I Investigation of Brown Shrimp (*Penaeus aztecus*) Populations in Texas Bays, 1979-1980

Part II Investigation of White Shrimp (*Penaeus setiferus*) and Pink Shrimp (*P. duorarum*) Populations in Texas Bays, 1978-1980

by Richard L. Benefield

Management Data Series, Number 41
1982

Texas Parks & Wildlife
Coastal Fisheries Branch

STUDIES OF SHRIMP POPULATIONS IN SELECTED COASTAL BAYS OF TEXAS

Part I Investigation of Brown Shrimp (*Penaeus aztecus*) Populations in Texas Bays, 1979-1980

Part II Investigation of White Shrimp (*Penaeus setiferus*) and Pink Shrimp (*P. duorarum*) Populations in Texas Bays, 1978-1980

by

Richard L. Benefield

Management Data Series
No. 41

1982

Texas Parks and Wildlife Department
Coastal Fisheries Branch

INVESTIGATION OF BROWN SHRIMP (*PENAEUS AZTECUS*) POPULATIONS IN TEXAS BAYS 1979-1980

by

Richard L. Benefield

TEXAS PARKS AND WILDLIFE DEPARTMENT
Coastal Fisheries Branch
Austin, Texas
1982

ACKNOWLEDGEMENTS

I would like to thank each person assigned to collect data for the bay shrimp project. Charles Wilkes, Bill Baker, Frank Manigold, Mike Weixelman, Joe Kana, Mario Garcia, W. F. Neill, Art Crowe, Paul Hammerschmidt, Bill Mercer, Art Morris, Manuel Flores, Joe Breuer and Ken Rice participated in data collection either part-time or fulltime. Lanelle Hayes typed the manuscript and assisted with drafting figures. A special thanks is extended to Patricia Johansen, C. E. Bryan, Roy Johnson and Tom Heffernan for reviewing the manuscript. This study was conducted in cooperation with the U.S. Department of Commerce, NOAA, National Marine Fisheries Service, under P.L. 88-309 (Project 2-328-R-3).

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. Biological sampling during the spring of 1979 and 1980 indicated population levels to be low. Subsequent commercial landings supported these findings as the commercial harvests were poor each year. In 1979, water temperatures after 1 April were >20 C. Salinities were generally <10 o/oo in each bay except the lower Laguna Madre.

During March 1980, numbers of brown shrimp caught with marsh nets were the highest since 1976 in Galveston Bay. A cold front hit the Texas coast during 12-14 April and lowered water temperatures to 10-12 C. Subsequent bar seine samples in Galveston Bay did not detect the large waves of brown shrimp that were detected during March.

A 1 June closure of the Texas Gulf shrimping season was recommended in 1979 and 1980.

INTRODUCTION

The shrimp fishery is the most valuable commercial fishery in Texas. The 1979 harvest was 19.3 million kg (heads-off) valued at $152 million (U. S. Department of Commerce 1979). Landings of brown (Penaeus aztecus) and pink (P. duorarum) shrimp were 14.2 million kg valued at $117 million. The 1980 harvest was 21.1 million kg valued at $140 million. Brown and pink shrimp landings were 16.5 million kg valued at $114 million (preliminary-U. S. Department of Commerce 1980). Management studies have been conducted by the Texas Parks and Wildlife Department since 1958 to monitor the brown shrimp, the most valuable of the commercial shrimp occurring in Texas waters.

The 1979-80 monitoring program entailed sampling for brown shrimp in Galveston, Matagorda, San Antonio and Aransas Bays during February-December and 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 objective of determining 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.

MATERIALS AND METHODS

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

Sampling with marsh nets was conducted during 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 17.9-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 1.27-cm 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 sub-adult shrimp.

A 3.0-m trawl of 3.2-cm stretched mesh with a liner of 1.27-cm mesh in the cod end was pulled for 15 min at stations in minor[1] and major bays to monitor brown shrimp migrations. The 1.8-m bar seine and 3.0-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.

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. References of shrimp sizes 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 (>140 mm).

At each sample site, bottom salinity (o/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.

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

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

x = length of individual shrimp or hydrological data point

n = number of shrimp or hydrological data points

---

[1] In 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.

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

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

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

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

RESULTS

Galveston Bay

During 1979 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 to 45.0 on 30 May (Table 2). The same general trend was evident in 3.0-m trawl samples except that no shrimp were caught until 24 April (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/d (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.

In 1980, postlarval brown shrimp were first caught with marsh nets on 10 March (Table 1). Subsequent weekly samples yielded catches per drag of 196.0 and 164.6 shrimp. Bar seine catches per drag were low (3.0-34.4 shrimp per drag) during April and increased to 32.0-149.8 shrimp per drag during May (Table 2). The large influx of postlarval shrimp detected with marsh nets during March was not reflected in later barrseine catches. Few shrimp were collected with 3.0-m trawls during 31 March-12 April (Table 3). Catches per drag during May increased from 20.0 on 5 May to 137.7 on 20 May. The number of brown shrimp caught with 6.1-m trawls indicated movements to major bays primarily during June and to a lesser degree during late July (Table 4).

Lengths of young-of-the-year shrimp caught with bar seines and 3.0-m trawls were combined to illustrate sizes during April and May 1980. The estimated growth rate of brown shrimp from

7 April to 27 May was 1.8 mm /d (Figure 1). Shrimp ranged in length from a minimum of 8 mm on 7 April to a maximum of 118 mm on 27 May. Recruitment of young shrimp was evident through April and May as minimum size ranged from 8 to 18 mm each week.

Matagorda Bay

During 1979 brown shrimp were first collected on 5 April with 3.0-m trawls (Table 3) and on 10 April 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-d period for a growth rate of 1.6 mm /d. Mean sizes of shrimp were similar (87.0 and 89.1 mm, respectively) in May and June (Table 4).

Juvenile brown shrimp were caught with bar seines each week during April and May 1980 (Table 2). Bar seine samples yielded a low catch of 4.0 shrimp per drag the first week of April; yield increased to a high of 109.0 shrimp per drag during the last week of April. Numbers of shrimp caught with 3.0-m trawls were low (62.5 and 22.2 shrimp per drag) during the first two weeks of April and reached a peak of 573.5 shrimp per drag on 29 April. Brown shrimp were caught with 6.1-m trawls only during April-July (Table 4). Catches per drag were highest during May (54.9) and June (55.7) indicating movements of brown shrimp into major bays.

The estimated growth rate of brown shrimp from 1 April to 20 May was 2.0 mm /d (Figure 1). Shrimp lengths varied from 8 mm on 1 April to 123 mm on 20 May. Minimum sizes of $\leq$ 18 mm each week indicated continual recruitment of small shrimp during April and May.

San Antonio Bay

Brown shrimp were caught during the first week of April 1979 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-d period for an average growth rate of 1.8 mm /d.

Brown shrimp were caught each week of bar seine sampling during 1980 (Table 2). Catches varied from a low of 3.5 shrimp per drag on 7 April to a high of 60.5 shrimp per drag on 12 May. Samples taken with 3.0-m trawls yielded shrimp each week; the weeks of 12 May and 19 May yielded peak catches of 161.0 and 151.5 shrimp per drag, respectively (Table 3). Peak catches of brown shrimp occurred during May-June with 6.1-m trawls (Table 4). The catch per drag was highest (68.2) on 21 May indicating movements into major bays.

The estimated growth rate of brown shrimp from 31 March to 19 May was 1.3 mm /d (Figure 1). Shrimp lengths varied from 8 mm on 31 March to 128 mm on 19 May. Minimum sizes of $\leq$ 28 mm each week indicated continual recruitment of small shrimp during April and May.

Aransas Bay

Juvenile brown shrimp were first detected on 26 February 1979 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 /d (Figure 1).

During 1980 postlarval shrimp were caught with marsh nets each week during March (Table 1). The initial sampling on 3 March yielded only 4 shrimp but each successive week's yield increased to reach a peak of 332 shrimp on 24 March. Brown shrimp were caught with bar seines each week with the highest catch per drag (84.2) recorded on 5 May (Table 2). The mean size of shrimp ranged from 26.1 mm during early April to 56.0 mm during late May. Few juvenile shrimp (72) were caught with 3.0-m trawls during 2-23 April (Table 3). Catches increased on 29 April and during May, particularly during the last 3 weeks when samples yielded 113.8, 101.0 and 95.6 shrimp per drag, respectively. Increased availability of brown shrimp during late May indicated a general migration into major bay areas. Mid-May and early June 6.1-m trawl samples confirmed the presence of large numbers of brown shrimp in major bays. From February to September, 78.5% of the brown shrimp were caught during May and June (Table 4).

The estimated growth rate of brown shrimp from 31 March to 20 May was 1.76 mm /d (Figure 1). Shrimp ranged in length from 13 mm on 31 March to 123 mm on 20 May. The larger size of shrimp caught with 3.0-m trawls represented overwintering brown shrimp and was not used in growth calculations. Recruitment of young shrimp was evident through April and May as minimum sizes ranged from 13 to 23 mm.

Additional brown shrimp catch data by bay system and gear type are presented in Appendix C.

Hydrology

A summary of mean monthly temperatures and salinities recorded during 1978-80 is presented in Figure 2. Water temperatures in March 1979 were below 20 C in Galveston, San Antonio and Aransas Bays; the average Matagorda Bay temperature was 20.9 C. April 1979 temperatures were above 20 C in each bay. Water temperatures ranged from 13.3 C during December 1979 in Galveston Bay to 30.9 C during August 1979 in Matagorda Bay.

Mean salinities were highest (14.5 o/oo) during November 1979 in San Antonio Bay and lowest (5.0 o/oo) during September 1978 in San Antonio Bay. March 1979 salinities exceeded 10 o/oo in each bay except San Antonio Bay. April-May 1979 salinities fell below 10 o/oo in all four bays. Salinities remained at these low levels through September 1979 except in Aransas Bay where salinities rose slightly above 10 o/oo in July and August 1979.

Monthly mean water temperatures were similar (23.1-26.4 C) in each bay during October 1980 (Figure 2). November 1980 temperatures declined to 9.0 C in Galveston Bay and 7.7 C in Matagorda Bay. Water temperatures were consistent in December 1980 ranging from 11.1 C in Aransas Bay to 13.3 C in San Antonio Bay. March-May 1980 water temperatures were uniform coastwide with San Antonio Bay having the largest extremes (16 C in March-26.9 C in May). A strong cold front struck the Texas coast on 12 April 1980 with northerly winds continuing until the 14th. Minimum air temperatures on 13-14 April were below 10 C near Galveston, Matagorda, San Antonio and Aransas Bays (U.S. Dept. of Comm. 1980). Water temperatures on 14 April were 13.3 C at Seabrook (Galveston Bay), 10.0 C at Seadrift (San Antonio Bay) and 11.0-12.0 C at Rockport (Aransas Bay). Summer water temperatures ranged from 29.0 to 30.0 in the four bays sampled.

Mean monthly 1980 salinities were lowest during October, ranging from 5.3 o/oo in Matagorda Bay to 10.2 o/oo in San Antonio Bay. Peak salinities were recorded during August 1980, ranging from 15.8 o/oo in Matagorda Bay to 21.8 o/oo in Aransas Bay. Coastwide, mean salinity increased from 8.3 o/oo in October 1979 to 16.4 o/oo in March 1980. Bar seine salinity data taken on 15-16 April 1980 ranged from 8.6 o/oo in Galveston Bay to 19.8 o/oo in Aransas Bay. A slight decrease in mean salinity occurred from April 1980 (16.0 o/oo)through June 1980 (12.7 o/oo).

Additional hydrological data by bay system and gear type are in Appendix F.

DISCUSSION

Hydrological conditions in Texas bays were less than optimal for brown shrimp production during spring 1979. Water temperatures during the spring 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 o/oo whereas temperatures <18 C and salinities <8 o/oo could lead to poor survival of small brown shrimp. Gunter et al. (1964) described 10-20 o/oo as optimal salinities for brown shrimp and 0-5 o/oo 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. Studies by Barrett and Gillespie (1973) in Barataria Bay, Louisiana indicated that the brown shrimp harvest was correlated with the number of hours water temperatures were <20 C after 8 April. They determined that if the number of hours with temperature <20 C exceeded 33, shrimp harvests were reduced. They also found that salinities >14 o/oo were favorable for brown shrimp. Hunt et al. (1980) noted the effect of temperature and salinity conditions in April and May on the brown shrimp harvest in Pamlico Sound, N.C.. They determined that water temperatures >20 C and salinities >10 o/oo were condusive to brown shrimp harvests with catches exceeding 0.9 million kg each time these conditions were met. Most bay mean salinities did not exceed 10 o/oo during April and May 1979 and, as in 1973, are thought to be primarily responsible for the poor brown shrimp harvest.

Although hydrological conditions during 1980 appeared to be favorable for brown shrimp production along the coast, preliminary landings data indicates the harvest will be only slightly higher than in 1979. Marsh net samples in March yielded the highest catch per effort of postlarval shrimp since 1976 in Galveston Bay, but the apparent large wave of small shrimp was not detected in subsequent bar seine samples in April. Bar seine salinity data taken on 15-16 April ranged from 8.6 o/oo in Galveston Bay to 19.8 o/oo in Aransas Bay. The 13.3 C temperature and 8.6 o/oo salinity found in Galveston Bay fall within the conditions described by St. Amant et al. (1966) as being unfavorable for brown shrimp. The low temperature-low salinity condition was apparently a factor in the poor Galveston Bay shrimp production. Water temperatures were not recorded for Matagorda Bay on 14 April; however, on 15 April bar seine temperatures averaged 20.4 C and salinities averaged 11.8 o/oo. Water temperatures were low in San Antonio and Aransas Bays but salinities were moderate (15.3 and 19.8 o/oo, respectively). The low temperature-moderate salinity condition in Matagorda, San Antonio and Aransas Bays did not appear to influence survival of shrimp populations as did the low termperature-low salinity condition in Galveston Bay.

The low salinities in coastal bays during 1979 and unseasonably low temperatures experienced along the upper Texas coast during 1980 contributed to the poor brown shrimp harvests of the past two years.

Growth rates of young-of-the-year shrimp were obtained from bar seine and 3.0-m trawl data. Mean sizes of the year class shrimp present in late April were projected for late May using average growth rates as determined each year. Both years projections indicated that most shrimp would be in the 80-100 mm size range by late May. A normal 1 June Gulf season closure was recommended each year. The movement to the Gulf was confirmed by catches of brown shrimp with 6.1-m trawls in major bays as catches increased during May and early June in bay systems each year. Subsequent Gulf trawl sampling by Department biologists indicated numerous subadult brown shrimp in the shallow Gulf during June-July (Terry Cody, TPWD, personal communication).

LITERATURE CITED

Barrett, B. B. and M. Gillespie. 1973. Primary factors which influence commercial shrimp production in coastal Louisiana. La. Wildf. Fish. Comm. Tech. Bull. 9:1-28.

Hunt, J. H., R. J. Carroll, V. Chinchilli and D. Frankenberg. 1980. Relationship between environmental factors and brown shrimp production in Pamlico Sound, North Carolina. N. Car. Dept. Natl. Res. Comm. Devel., Div. Mar. Fish., Sci. Rept. No. 33:1-29.

Gunter, G., J. Y. Christmas and R. Killibrew. 1964. Some relations of salinity to population distributions of mobile estuarine organisms, with special reference to penaeid shrimp. Ecology 45(1):181-185.

Moffett, A. W. and L. W. McEachron. 1973. Shrimp populations in Texas (1973). Coastal Fish. Proj. Rept. Tx. Pks. Wildlf. Dept. 26 p.

Pullen, E. J., C. R. Mock and R. D. Ringo. 1968. A net for sampling the intertidal zone of an estuary. Proc. Am. Soc. Limnol. Oceanog. 13:200-202.

Renfro, W. L. 1964. Life history stages of Gulf of Mexico brown shrimp. Bur. Comm. Fish. Biol. Lab., Galveston, Tex. Cont. No. 183:94-98.

St. Amant, L. S., J. G. Broom and T. B. Ford. 1966. Studies of the brown shrimp, Penaeus aztecus, in Barataria Bay Louisiana, 1961-1965. Proc. 18th Ann. Sess. Gulf Carrib. Fish. Inst. 1965:1-17.

U. S. Department of Commerce. 1979. Trends and conditions of the fisheries of Texas. N.O.A.A. Natl. Mar. Fish. Ser. Preliminary. Dec. 3 p.

_____. 1980. Climatological data. Texas 1980. N.O.A.A. Envr. Data and Info. Ser., Natl. Climatic Ctr., Asheville, Md. 85 (4) 39p.

Williams, A. B. 1955. Contribution to the life histories of commercial shrimp (Penaeidae) in North Carolina. Bull. Mar. Sci. Gulf Carib. 5:116-146.

Table 1. Number, catch per drag and mean size of brown shrimp caught with marsh nets during Feb-Mar. 1979 and Feb.-Mar. 1980 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
3 Mar. 1980	0	0.0	
10 Mar.	172	57.3	12.9
17 Mar.	588	196.0	13.6
24 Mar.	494	164.6	14.0
	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
3 Mar. 1980	4	0.8	20.5
10 Mar.	50	10.0	13.0
17 Mar.	212	42.4	13.6
24 Mar.	332	66.4	13.1

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 and Mar.-May 1980 in Galveston, Matagorda, San Antonio and Aransas Bays and lower Laguna Madre.

Sample Date 1979	Number Shrimp Caught	Catch Per Drag	Mean Size (mm)	Sample Date 1980	Number Shrimp Caught	Catch Per Drag	Mean Size (mm)
				GALVESTON BAY			
2 Apr.	14	2.8	15.9	31 Mar. 1 Apr.	31	6.2	18.0
9 Apr.	42	8.4	16.7	7 Apr.	78	15.6	15.1
16 Apr.	52	10.4	28.8	15 Apr.	15	3.0	24.2
23 Apr.	114	22.8	32.2	22 Apr.	160	32.0	29.5
30 Apr.	57	11.4	40.2	28 Apr.	172	34.4	32.3
7 May	131	26.2	38.9	5 May	160	32.0	34.6
14 May	152	30.4	38.1	12 May	324	64.8	40.2
21 May	223	44.6	31.6	20 May	749	149.8	37.5
30 May	180	45.0	33.1	27 May	227	45.4	38.5
				MATAGORDA BAY			
5 Apr.	0	0.0		1 Apr.	16	4.0	16.8
10 Apr.	32	8.0	23.3	8 Apr.	146	73.0	22.3
18 Apr.	98	24.5	32.7	15 Apr.	64	16.0	23.7
24 Apr.	356	89.0	31.0	23 Apr.	374	93.6	28.7
2 May	380	95.0	34.5	29 Apr.	436	109.0	32.5
8 May	44	11.0	38.0	6 May	322	80.5	34.5
16 May	218	54.5	34.9	13 May	281	70.3	39.8
22 May	142	35.5	45.2	20 May	361	90.3	26.7
30 May	62	15.5	45.1	26 May	67	16.8	35.5
				SAN ANTONIO BAY			
4 Apr.	40	10.0	22.1	31 Mar.	114	28.5	20.8
9 Apr.	130	32.5	26.2	7 Apr.	14	3.5	25.1
16 Apr.	122	30.5	35.5	16 Apr.	100	25.0	30.2
23 Apr.	68	17.0	40.8	22 Apr.	176	44.0	19.7
1 May	44	11.0	39.4	28 Apr.	148	37.0	25.8
7 May	188	47.0	30.8	5 May	132	33.0	30.2
15 May	32	8.0	41.4	12 May	242	60.5	31.6
21 May	134	33.5	42.5	19 May	79	19.8	44.0
29 May	84	21.0	44.3	27 May	29	7.3	39.4

Table 2. (Cont'd.)

Sample Date 1979	Number Shrimp Caught	Catch Per Drag	Mean Size (mm)	Sample Date 1980	Number Shrimp Caught	Catch Per Drag	Mean Size (mm)
			ARANSAS BAY				
2 Apr.	6	1.2	21.3	31 Mar.	29	5.8	26.1
9 Apr.	35	7.0	26.1	7 Apr.	199	26.6	35.4
16 Apr.	163	32.6	36.2	15 Apr.	144	28.8	31.5
23 Apr.	195	39.0	40.4	22 Apr.	293	58.6	33.3
30 Apr.	257	51.4	43.3	28 Apr.	175	35.0	37.0
7 May	380	76.0	41.6	5 May	421	84.2	35.3
14 May	230	46.0	43.3	12 May	360	72.0	49.8
21 May	202	40.4	49.2	19 May	194	38.8	50.7
29 May	80	16.0	54.1	27 May	227	45.4	56.0
			LOWER LAGUNA MADRE				
2-4 Apr.	136	45.3	42.7	28 Mar.	19	6.3	38.5
16-17 Apr.	405	135.0	42.7	14 Apr.	121	40.3	40.1
30 Apr.	64	21.3	40.9	29 Apr.	799	266.3	40.8
15 May	33	11.0	59.8	12-13 May	342	114.0	42.8
				26-28 May	135	45.0	47.1

Table 3. Number, catch per drag and mean size of brown shrimp (P. aztecus) caught with 3.0-m trawls during Mar.-June 1979 and Mar.-May 1980 in Galveston, Matagorda, San Antonio and Aransas Bays and lower Laguna Madre.

Sample Date 1979	Number Shrimp Caught	Catch Per Drag	Mean Size (mm)	Sample Date 1980	Number Shrimp Caught	Catch Per Drag	Mean Size (mm)
				GALVESTON BAY			
4 Apr.	0	0.0		31 Mar.	2	0.7	60.5
12 Apr.	0	0.0		9 Apr.	0	0.0	
19 Apr.	0	0.0		15 Apr.	0	0.0	
24 Apr.	38	12.7	26.3	23 Apr.	10	3.3	19.0
1 May	31	10.3	33.8	28 Apr.	1	0.3	28.0
8 May	14	4.7	50.5	5 May	60	20.0	44.3
15 May	12	3.0	50.9	12 May	133	44.3	47.5
22 May	160	53.3	70.5	20 May	395	137.7	61.3
31 May	362	120.7	62.5	27 May	332	110.7	67.6
				MATAGORDA BAY			
5 Apr.	55	13.8	20.0	1 Apr.	250	62.5	17.0
10 Apr.	152	38.0	24.4	8 Apr.	216	22.2	54.0
18 Apr.	484	121.0	27.3	15 Apr.	619	154.8	23.1
24 Apr.	373	93.3	35.8	23 Apr.	606	151.5	27.7
2 May	187	46.8	40.2	29 Apr.	2294	573.5	30.6
8 May	276	69.0	39.2	6 May	1506	376.5	41.3
16 May	143	35.8	42.7	13 May	1699	424.8	50.2
22 May	369	92.3	45.9	20 May	883	220.8	61.6
30 May	351	87.8	59.3	26 May	522	130.5	54.1
				SAN ANTONIO BAY			
4 Apr.	25	6.3	21.2	31 Mar.	80	20.0	22.1
9 Apr.	173	43.3	24.7	7 Apr.	140	35.0	20.7
16 Apr.	125	31.3	32.1	16 Apr.	220	53.8	31.6
23 Apr.	141	35.3	34.8	22 Apr.	189	46.5	36.1
30 Apr. 1 May	386	96.5	41.0	28 Apr.	216	59.0	40.0
7 May	194	48.5	46.8	5 May	141	35.3	60.8
15 May	151	37.5	51.9	12 May	644	161.0	65.9
21 May	303	75.8	72.5	19 May	606	151.5	76.5
29 May	194	48.5	70.0	27 May	220	55.0	77.7

Table 3. (Cont'd.)

Sample Date 1979	Number Shrimp Caught	Catch Per Drag	Mean Size (mm)	Sample Date 1980	Number Shrimp Caught	Catch Per Drag	Mean Size (mm)
			ARANSAS BAY				
4 Apr.	3	0.6	89.7	2-3 Apr.	1	0.2	93.0
10 Apr.	2	0.4	90.5	9 Apr.	3	0.6	48.0
17 Apr.	9	1.8	40.8	16 Apr.	34	6.8	69.5
24 Apr.	43	8.6	48.7	23 Apr.	34	6.8	49.5
1 May	290	58.0	58.3	29 Apr.	218	43.6	54.9
8 May	836	167.2	65.1	6 May	78	15.6	61.3
15 May	270	54.0	73.4	13 May	569	113.8	70.1
23 May	246	49.2	79.3	20 May	505	101.0	80.6
1 June	420	84.0	83.1	28 May	478	95.6	85.3
			LOWER LAGUNA MADRE				
2-4 Apr.	42	14.0	40.9	28-31 Mar.	62	20.7	71.3
16-17 Apr.	313	104.3	49.9	14 Apr.	77	25.7	49.2
30 Apr.	245	81.6	65.0	29 Apr.	229	76.3	69.1
15 May	22	3.1	69.4	12-13 May	890	296.7	63.4
				26-28 May	890	296.7	65.4

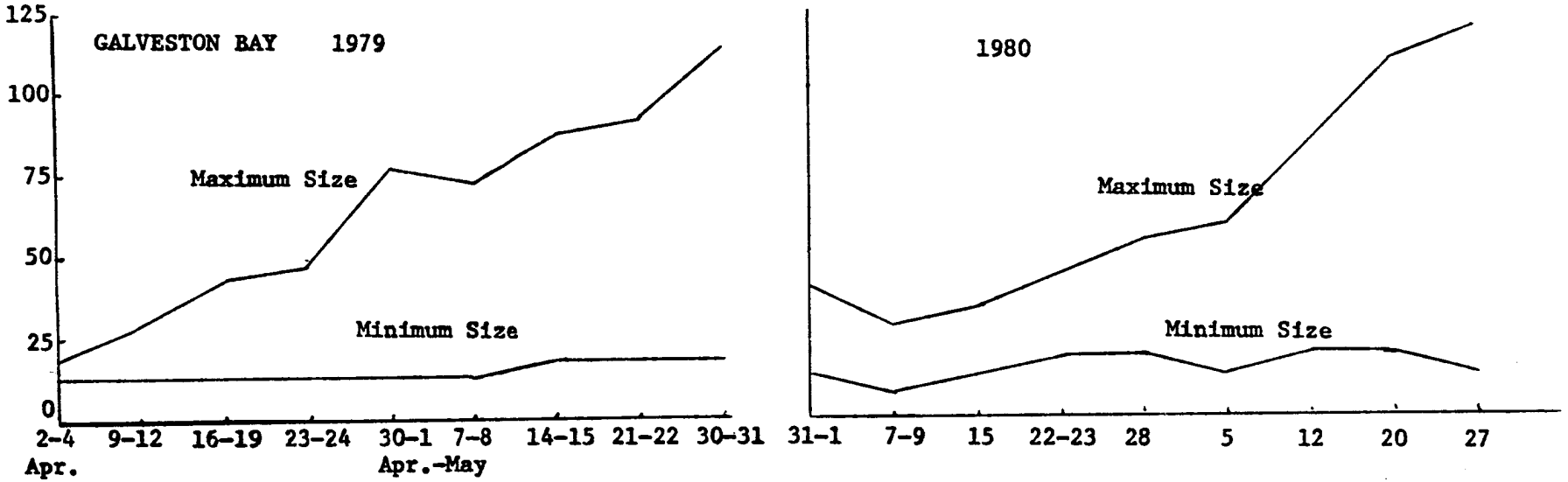
Table 4. Number, catch per drag and mean size of brown shrimp (P. aztecus) caught with 6.1-m trawls during Apr.-Aug. 1979 and 1980 in Galveston, Matagorda, San Antonio and Aransas Bays.

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
	GALVESTON BAY		
12-13-23 Apr. 1979	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
16-17-22 Apr. 1980	29	1.6	99.6
13-14-21 May	291	16.2	89.8
10-11-12 June	2612	145.1	87.0
23-24-27 June	1541	85.6	93.2
7-8-9-10 July	377	20.9	97.6
21-24-28-29 July	1288	76.6	103.0
6-12 Aug.	534	29.7	102.7
16-19-20 Aug.	98	5.4	98.9
8-9-10 Sept.	26	1.4	94.0
22-23-24 Sept.	51	2.8	90.5
	MATAGORDA BAY		
25-26 Apr. 1979	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	
29 Apr. 1980	142	15.8	86.3
22-23 May	494	54.9	83.5
17 June	501	55.7	93.7
15 July	206	22.9	89.4
13 Aug.	0	0.0	
19 Sept.	0	0.0	

Table 4. (Cont'd.)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
	SAN ANTONIO BAY		
17 Apr. 1979	12	1.2	100.9
14 May	238	23.8	88.8
4 June	305	30.5	98.3
14 June	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
25 Apr. 1980	87	7.9	97.4
21 May	750	68.2	90.4
5 June	674	61.3	91.9
18 June	555	50.5	89.6
3 July	211	19.2	89.0
21 July	190	17.3	101.0
6 Aug.	190	17.3	99.4
19 Aug.	215	19.5	93.7
3 Sept.	41	3.7	101.4
18 Sept.	42	3.8	89.0
	ARANSAS BAY		
18-19 Apr. 1979	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	8	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
17-18 Apr. 1980	60	5.0	77.8
21.22 May	1259	104.9	84.6
3-4 June	1665	138.8	83.2
16-17 June	774	64.5	89.8
2-8-9 July	91	7.6	91.4
15-16 July	262	21.8	98.0
5 Aug.	41	3.4	97.1
19-20 Aug.	452	37.7	86.4
3-5-8 Sept.	40	3.3	88.5
16-17 Sept.	54	4.5	88.8

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 and 1980 in Galveston, Matagorda, San Antonio and Aransas Bays.



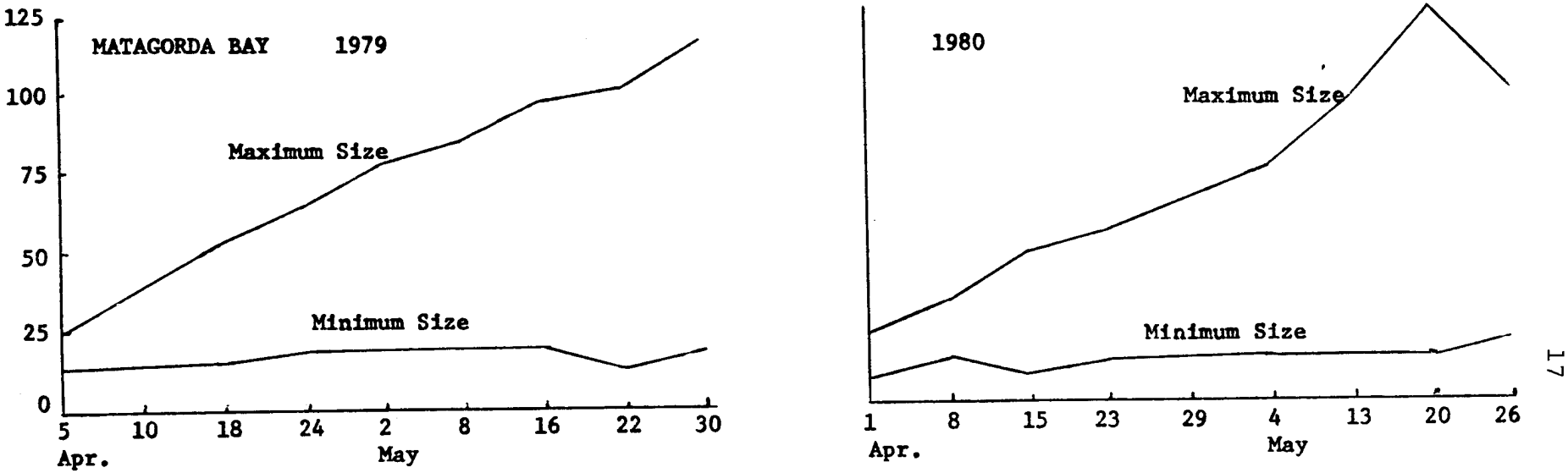
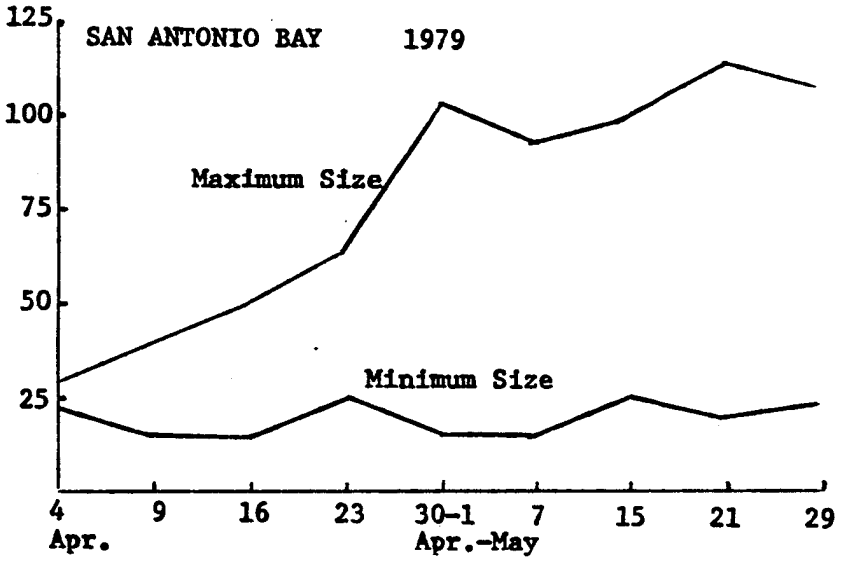
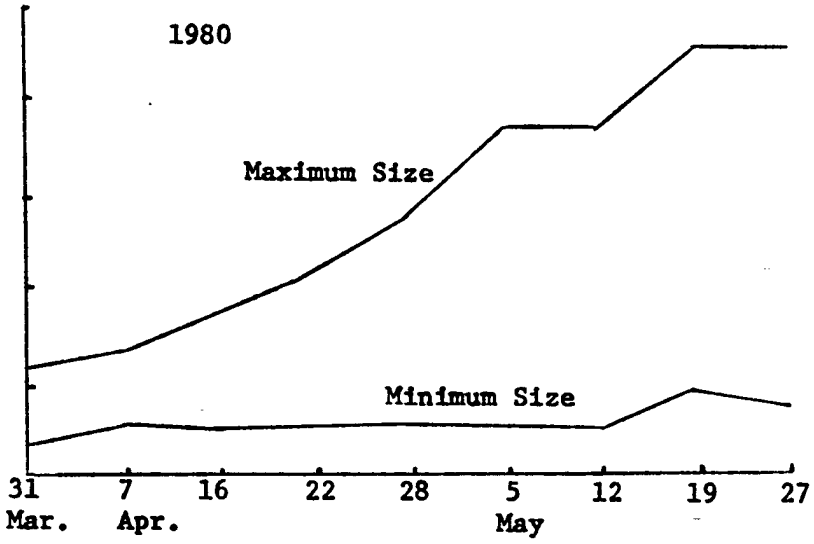
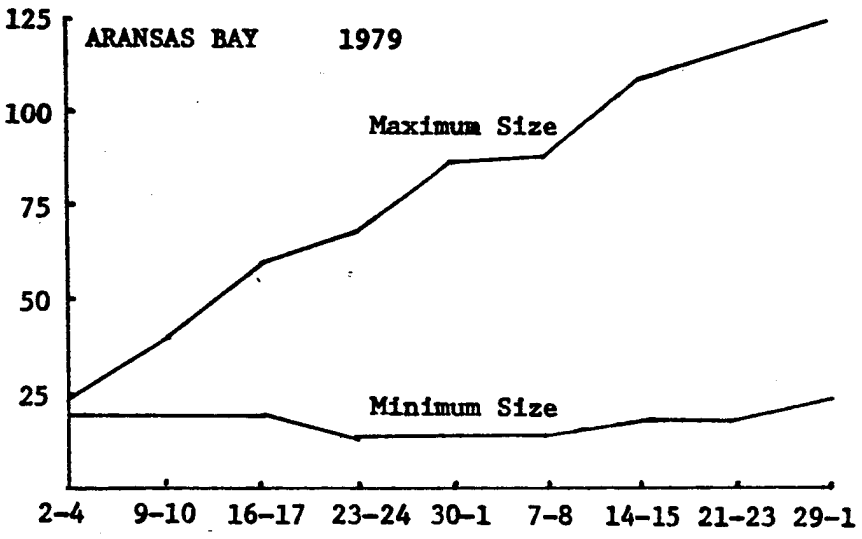


Figure 1. (Cont'd.)







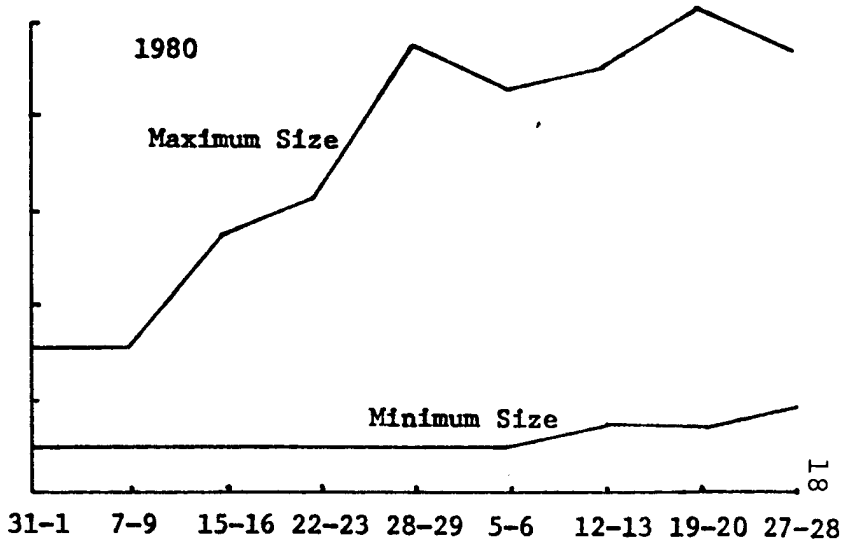


Figure 2. Monthly mean temperatures and salinities during Oct. 1978-Dec. 1980 in Galveston, Matagorda, San Antonio and Aransas Bays.

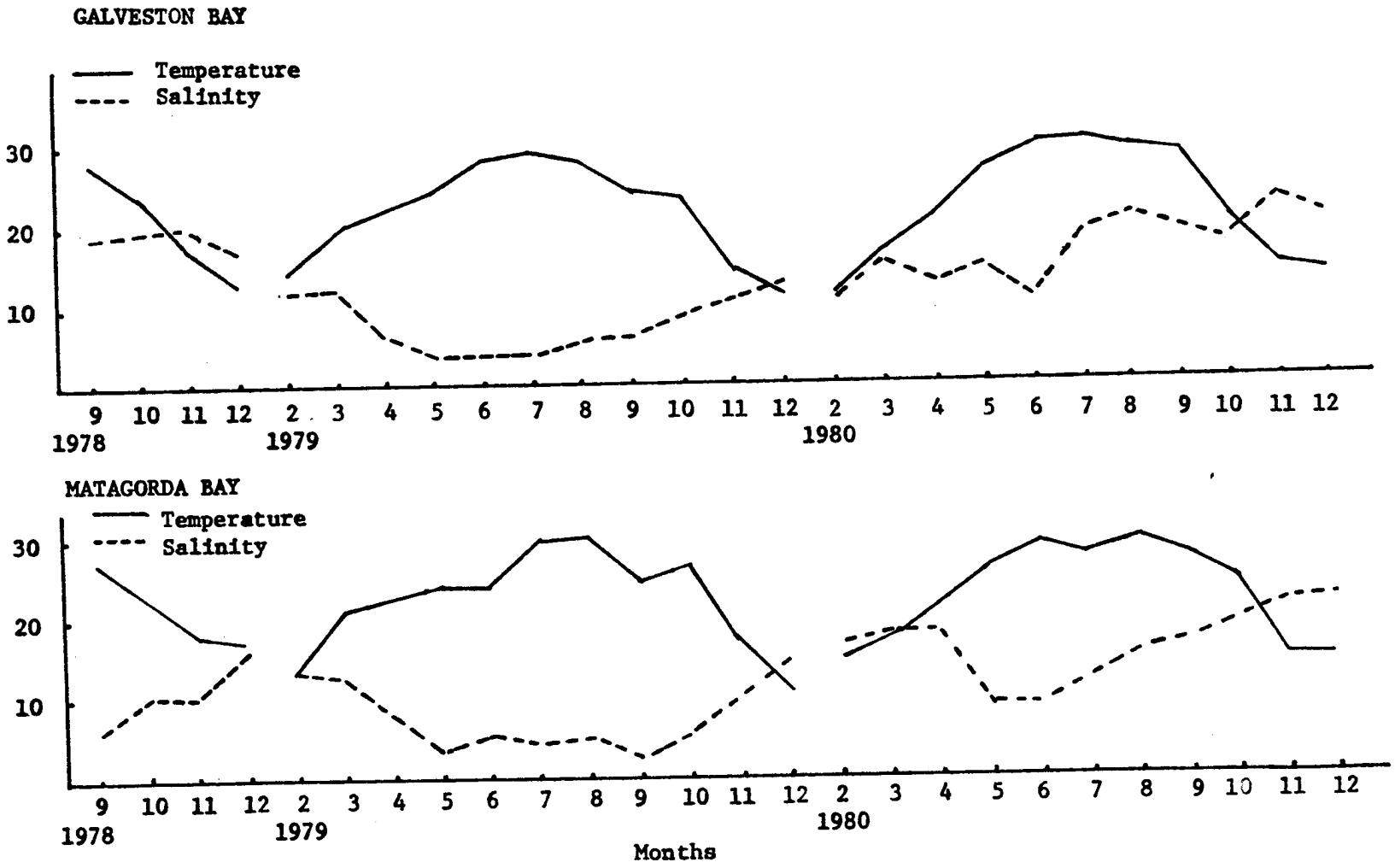
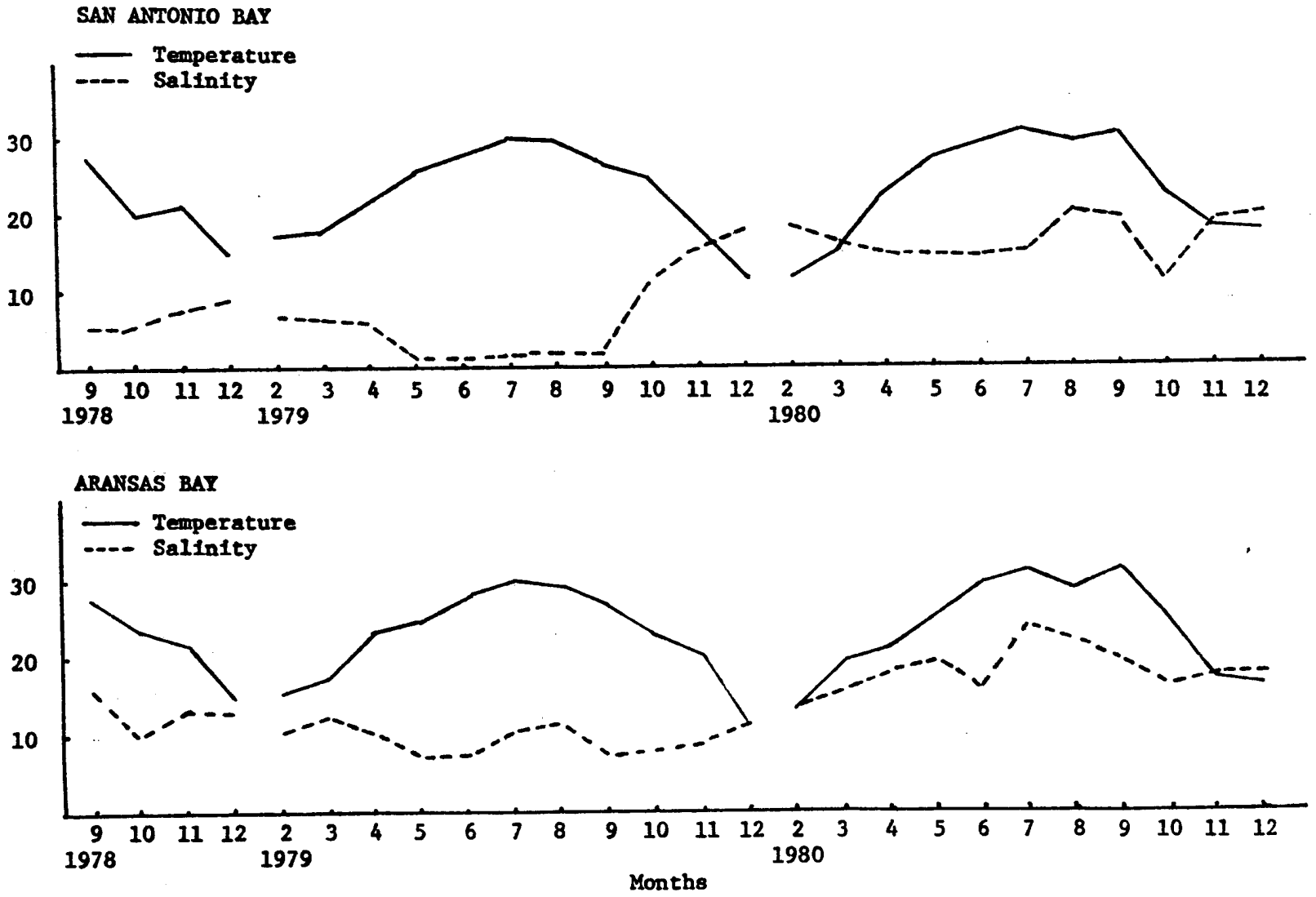


Figure 2. (Cont'd.)



INVESTIGATION OF WHITE SHRIMP (PENAEUS SETIFERUS) AND PINK SHRIMP (P. DUORARUM) POPULATIONS IN TEXAS BAYS, 1978-80

by

Richard L. Benefield

TEXAS PARKS AND WILDLIFE DEPARTMENT
Coastal Fisheries Branch
Austin, Texas
1982

ACKNOWLEDGEMENTS

I would like to thank each person assigned to collect data for the bay shrimp project. Charles Wilkes, Frank Manigold, Mike Weixelman, Joe Kana, Mario Garcia, W. F. Neill, Paul Hammerschmidt, Art Crowe, Bill Mercer, Art Morris, Manuel Flores, Joe Breuer and Ken Rice participated in data collection either part-time or fulltime. Lanelle Hayes typed the manuscript and assisted with drafting figures. A special thanks is extended to Patricia Johansen, C. E. Bryan, Roy Johnson and Tom Heffernan for reviewing the manuscript. This study was conducted in cooperation with the U. S. Department of Commerce, NOAA, National Marine Fisheries Service, under P. L. 88-309 (Project No. 2-328-R-3).

ABSTRACT

From September 1978 through December 1980, the Texas Parks and Wildlife Department (TPWD) studied penaeid shrimp populations in Galveston, Matagorda, San Antonio and Aransas Bays and lower Laguna Madre. The studies were designed to provide abundance, growth and migration data concerning white shrimp (Penaeus setiferus) and pink shrimp (P. duorarum) populations in Texas bays.

Overwintering white shrimp of the previous year class were more abundant in Galveston and Matagorda Bays during late winter and spring than in middle and lower coastal bays. Postlarval and juvenile white shrimp were most abundant during June-July and September-October. Fall trawl catches generally yielded more white shrimp than did summer samples. White shrimp caught in major bays were larger than those taken in minor bays 70.4% of the time. Catch rates in minor bays exceeded those in major bays 68.4% of the time.

Subadult pink shrimp were caught primarily in Aransas Bay during September-December and February-April. Peak catches occurred in Aransas Bay during fall 1980.

Abnormal rainfall during 1979 influenced white shrimp availability in Galveston Bay. The average monthly rainfall was 41.2 cm in July and 34.6 cm in September. July and September flooding lowered middle and upper bay salinities to 0.0 o/oo and forced small white shrimp from shallow nursery areas into major bays. Average salinities were generally higher during 1980 than during the two previous years. Water temperatures followed expected seasonal trends.

INTRODUCTION

The shrimp fishery is the most valuable commercial fishery in Texas. Commercial landings of shrimp ranged from 18.9 million kg in 1964 to 29.1 million kg in 1967 (U.S. Department of Commerce 1964-1980). Values of these landings ranged from $26.1 million in 1964 to $152.3 million in 1979 (Table 1). White shrimp catches have averaged about 21.9% of the total landings since 1964. The majority of white shrimp are caught in bays and the shallow Gulf by bay shrimpers, thus being the more economically important penaeid species for bay fishermen.

Biological monitoring of bay shrimp populations was initiated in 1958 by the Texas Parks and Wildlife Department (TPWD). The current monitoring studies of white shrimp (Penaeus setiferus) and pink shrimp (P. duorarum) were conducted in Galveston, Matagorda, San Antonio and Aransas Bays during February-December. Migration, growth and abundance data were collected to provide biological data for making recommendations on present and future shrimp conservation laws. Data collected from these bays were used to meet the following objectives:

(1) Determine the relative abundance, movements and growth rates of white shrimp during 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.

(2) Determine and compare size distributions of white shrimp on commercial (major bays) and bait (minor bays) shrimping grounds in Texas bays.[1]

(3) Determine the occurrence and growth of white shrimp and pink shrimp in late winter and spring to investigate the possibility of special spring bay shrimping seasons.

---

[1] In 1978 commercial shrimping was legal in "major bays", defined by law as the deeper bay areas of the inside water 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, Ares 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 areas.

MATERIALS AND METHODS

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

Postlarval white shrimp were sampled with a marsh net and a trawl twice each month during June-December at shoreline stations. The marsh net used (Pullen et al. 1968) had 1-mm square mesh and a 52.1 x 17.9-cm mouth opening and was pulled 30.5 m at each station. A 3.0-m trawl of 3.2-cm stretched mesh with a liner of 1.27-cm mesh in the cod end was pulled for 5 min near each marsh net station. A 6.1-m trawl with 3.8-cm stretched mesh was pulled at designated stations once each month during February-May and twice each month during June-December to provide growth and movement data.

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. References to shrimp sizes in this report follow those described for brown shrimp by Renfro (1964); i.e., postlarval shrimp (<25 mm), juvenile 25-89 mm), subadult (90-139 mm) and adult (≥ 140 mm).

At each sample site, bottom salinity (o/oo) was determined with a refracto-meter 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 formulae:

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

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

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

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

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

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

RESULTS

White Shrimp

Galveston Bay

Marsh net samples yielded 1091 shrimp (Table 2) during September 1978-December 1980. More postlarval white shrimp (532) were collected during September-December 1978 than during corresponding periods in 1979 (123) and 1980 (98). Catches of postlarval shrimp during June-August 1979 and 1980 contrasted sharply. During 1979, 51 postlarval shrimp were caught as compared with 287 shrimp taken during 1980. Monthly mean sizes ranged from 13.6 mm during 7-9 July 1980 to 61.3 mm 17-18 September 1979.

Drags with 3.0-m trawls yielded 12,453 white shrimp during September 1978-December 1980 (Table 3). Samples collected during November 1978 and September 1979 yielded the highest monthly catches per drag (294.8 and 221.5 respectively). June 1979 trawls yielded the smallest catch per drag (0.7) of any month. Shrimp sizes fluctuated from 14 to 148 mm; however, mean sizes were more consistent, varying from 45.8 to 88.0 mm. Mean sizes were larger during fall 1978 and 1980 than during 1979.

Samples collected with 6.1-m trawls yielded 25,858 white shrimp during September 1978-December 1980 (Table 4). Fall 1978 catches yielded 10,250 shrimp or 39.6% of the 3-y catch. During 1979, young-of-the-year white shrimp were first caught during 21-22 June. Peak summer catches (1316) occurred during 30-31 July. Catches remained low during September and peaked during October and November when 5248 shrimp were collected. White shrimp catches during June-December 1980 totaled 6952 or 26.9% of the 3-y catch. Catches were depressed during each month with the exception of October when 3503 shrimp or 50.4% of the June-December 1980 catch was recorded.

Growth rates calculated by comparing mean sizes varied from 0.2 to 0.8 mm/d in 1978 and 0.1 to 0.8 mm/d during 1979 (Table 5). Growth rate calculations based on maximum size ranged from 0.4 to 0.7 mm/d in 1978 and 0.3 to 0.7 mm/d in 1979.

Mean sizes of white shrimp caught in major bays during summer and fall (September 1979-December 1980) were larger than those taken in minor bays (Table 6). Larger shrimp were caught in major bays 100% of the time in 1978, 71.4% of the time in 1979 and 57.1% of the time in 1980. Larger white shrimp were caught in minor bays during September and early October 1979 and during July and September 1980. The largest young-of-the-year shrimp were usually present in major and minor bays during August and September.

Matagorda Bay

Marsh net samples yielded 377 shrimp (Table 2) during September 1978-December 1980. Catches per drag were similar each year, 9.4 in 1978. 5.6 in 1979 and 7.0 in 1980. More small shrimp were collected during September-December 1978 (113) than during the same period in 1979 (108) and 1980 (47). Mean sizes ranged from 19.9 mm in July 1980 to 49.2 mm in October 1978.

Drags with 3.0-m trawls yielded 3069 white shrimp during September 1979-December 1980 (Table 3). Trawl samples collected during September-December 1978 yielded 189 shrimp as compared with 492 in 1979 and 890 in 1980. Peak catches per drag occurred during August 1979 (190.0) and September 1980 (197.7). Fall catches progressively declined each year and no shrimp were caught during December.

During summer and fall (September 1978-December 1980), 5569 white shrimp were collected with 6.1-m trawls (Table 4). September-December 1978 samples yielded 620 shrimp. Samples taken during the same period during 1979 and 1980 yielded 687 and 986 white shrimp, respectively. June-August 1979 and 1980 samples yielded 2205 and 1071 white shrimp, respectively. Young-of-the-year shrimp were caught during June 1979 and July 1980. Mean sizes of shrimp ranged from 50.3 mm in June 1979 to 121.5 mm in September 1980.

Growth rates of white shrimp caught during February-May 1979-80 are presented in Table 5. Growth rates calculated using mean size were 0.7 mm/d in 1979 and varied from 0.3 to 1.0 mm/d in 1980. Growth rates calculated using maximum size ranged from 0.7 to 0.8 mm/d in 1979 and 0.2 to 0.9 mm per day in 1980.

During September 1978-December 1980, larger shrimp were caught in major bays than in minor bays 80% of the time (Table 6). Catch rates in minor bays exceeded those in major bays 93.3% of the time.

San Antonio Bay

Marsh net samples yielded 264 small white shrimp during September 1978-December 1980 (Table 2). About 88% of these shrimp were caught during fall (September-December). Mean sizes varied from 8.0 mm during October 1979 to 78.0 mm during August 1979.

Samples collected with 3.0-m trawls yielded 967 white shrimp during September 1978-December 1980 (Table 3). June and December samples yielded few (61) shrimp. August (162) and October (179) 1979 catches were generally higher than those of other sample periods. Mean sizes of shrimp varied from 45.5 mm in November 1980 to 93.0 mm in September 1979.

During September 1978-December 1980, 6.1-m trawl samples yielded 4264 white shrimp (Table 4). June-December 1979 catches represented 54.7% of all shrimp caught. Catches were lowest in 1980 when 787 shrimp

(18.5%) were taken. Mean sizes of young-of-the-year shrimp ranged from 61.3 mm in December 1979 to 108.5 mm in August 1979.

Growth rates calculated using mean size ranged from 0.6-0.9 mm/d in 1979 to 0.7-1.2 mm/d in 1980. Growth rates calculated using maximum size ranged from 0.2-1.1 mm/d in 1979 to 0.7-1.1 mm/d in 1980.

White shrimp caught in major bays were larger than those in minor bays 63.5% of the time (Table 6). Catch rates of shrimp in minor bays exceeded those in major bays 58.1% of the time.

Aransas Bay

Marsh net samples yielded 1065 white shrimp during September 1978-December 1980 (Table 2). Postlarval and juvenile shrimp were most numerous during September-December 1978 when 390 shrimp were taken. Catches decreased during the same period in 1979 (264) and 1980 (92). June-August catches yielded 230 shrimp in 1979 as compared with 89 in 1980. Mean sizes of shrimp ranged from 15.7 mm during early June 1979 to 53.0 mm during December 1980.

Samples collected with 3.0-m trawls yielded 3202 white shrimp during September 1978-December 1980 (Table 3). Catches were higher during summer (315) and fall (1183) 1979 as compared with summer (181) and fall (510) 1980. Mean sizes of young-of-the-year shrimp ranged from 31.9 mm in December 1978 to 87.2 mm in September 1978.

Catches with 6.1-m trawls yielded 11,403 white shrimp during September 1978-December 1980 (Table 4). Peak catches (5544) occurred during September-December 1979 while the same period in 1980 yielded 1061 shrimp. Mean sizes of young-of-the-year shrimp ranged from 44.4 mm in July 1980 to 116.6 mm in September 1980.

Growth rates calculated using mean size varied from 0.2-0.9 mm/d in 1979 to 0.2-1.1 mm/d in 1980. Growth rates calculated using maximum size ranged from 0.3-1.2 mm/d in 1979 to 0.1 to 0.5 mm/d in 1980.

White shrimp caught in major bays were larger than those in minor bays 62.2% of the time (Table 6). Catch rates of shrimp in minor bays were higher than those in major bays 57.6% of the time.

White shrimp catch data by bay system and gear type are presented in Appendix D Table 1-16.

Pink Shrimp

Galveston Bay

During 1980, only four pink shrimp were caught in Galveston Bay. The shrimp were taken with 6.1-m trawls during March and May.

San Antonio Bay

In April 1980, 13 pink shrimp ranging from 58 to 103 mm were collected with 3.0-m trawls. During March-May, 6.1-m trawl samples yielded 41 shrimp ranging from 58 to 123 mm.

Aransas Bay

Postlarval and juvenile shrimp were caught with marsh nets during October 1979 and September-December 1980. The mean size of shrimp varied during each sample period (37.1-43.5 mm during October 1979 and 25.5-48.4 mm during September-December 1980).

Shrimp were caught during September-December 1980 with 3.0-m trawls. The 76 pink shrimp collected ranged from 28 to 83 mm. Catch rates were highest (10.7 shrimp per drag) on 15 September and lowest (0.7 shrimp per drag) on 1 December.

Pink shrimp were caught with 6.1-m trawls during fall and spring each year. Catches were generally low during fall; i.e., $\leq$ 2.0 shrimp per drag during November-December 1978 and $\leq$ 6.2 shrimp per drag during September-December 1979. Mean sizes varied from 66.6 mm (23-24 October 1979) to 90.6 mm (3-6 October 1980). Pink shrimp were present in late winter and spring (February-April 1979 and March-April 1980). Catch rates were $\leq$6.1 shrimp per drag in 1979 and $\leq$1.4 shrimp per drag in 1980. Pink shrimp were caught during 52.3% of the sample periods with 6.1-m trawls.

Lower Laguna Madre

Small numbers of pink shrimp were caught during April and May 1979 in the lower Laguna Madre during intensive sampling for brown shrimp; 51 pink shrimp were taken in 3.0-m trawls.

Only 20 pink shrimp were caught during March 1980 with bar seines and 3.0-m trawls; no shrimp were caught during April-May.

No growth data could be calculated due to small numbers of pink shrimp caught. Pink shrimp catch data by bay system and gear type are presented in Appendix E Tables 1-9.

HYDROLOGY

During fall 1978, water temperatures were similar in each of the four bay systems (Figure 1). September water temperatures were near 27 C and fell steadily through December to a low of 13 C in Galveston Bay. Matagorda, San Antonio and Aransas Bay temperatures varied between 15 and 17 C during December. Galveston Bay salinities ranged from 17 to 20 o/oo during the fall whereas the other bays' salinities varied between 5 and 16 o/oo.

In 1979, water temperatures during March were below 20 C in Galveston, San Antonio and Aransas Bays; the Matagorda Bay temperature was 21 C. April temperatures were above 20 C in each bay and increased each month until a peak of nearly 30 C was reached during July. Temperatures decreased throughout the remainder of the year, reaching a low of 10-12 C in each bay during December. Salinities were < 15 o/oo in each bay early in the year. Salinities declined during March and April and remained below 7 o/oo through September in Galveston, Matagorda and San Antonio Bays. 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 a 3-d period. Flooding and runoff were severe in areas on the west side of Galveston Bay and most tributaries entering West Galveston Bay. A similar pattern of heavy rainfall and flooding occurred on 19-20 September. The rainfall averaged 34.6 cm and the resulting flooding was less severe than during July. Salinities gradually increased after September and ranged from 10 to 20 o/oo in December.

During 1980, water temperatures ranged from 10 to 15 C during February in each bay. Temperatures increased, reaching maximum readings of nearly 30 C during July in each bay. A second maximum of about 30 C was recorded in San Antonio and Aransas Bays during September. Cooler fall weather reduced temperatures and lows ranging from 13 to 18 C were recorded in each bay. Salinities were moderate (10-20 o/oo) early in the year. During June, increasing salinities were recorded in Galveston and Matagorda Bays. Salinities remained near or above 20 o/oo during the fall. San Antonio Bay salinities remained between 10 and 20 o/oo throughout the year. Aransas Bay salinities reached a maximum of 25 o/oo during July and were between 15 and 20 o/oo from August through December.

Additional hydrological data as recorded by bay system and gear type are presented in Appendix F, Tables 1-22.

DISCUSSION

In order to forecast the prospects for the fall white shrimp season, several years of biological data should be correlated, if possible, with actual catches on the shrimping grounds. The present catch statistics are unavailable to make the necessary comparisons.

The 1979 data should be used with caution for predictive purposes. Major flooding in Galveston Bay caused by two tropical storms during July and September 1979 severely disrupted normal distribution patterns of white shrimp. The flooding occurred during critical periods for immigrating postlarval white shrimp into Galveston Bay nursery areas.

There are generally two major spawns of white shrimp (Moffett 1970). Postlarval shrimp entering the bays during June contribute to commercial catches during mid-August through September. A second major influx of postlarval shrimp appear during August and September and enter the fisheries during October and November. This factor must be taken into account when future harvest predictions are considered. Data collected during this and future projects combined with commercial catch data should provide some means to predict fall harvest prospects.

The purpose of nursery areas is to provide protection for smaller size shrimp. The significance of recently enacted nursery area legislation was indicated by comparison of catches in major and minor bay systems. White shrimp caught with 6.1 m trawls were more abundant 68 percent of the time in minor bays. Shrimp were more abundant in major bays in late fall after shrimp had migrated from shallow waters to the deeper waters of major bays and the Gulf. Mean sizes of shrimp caught in major bays exceeded sizes in minor bays 70 percent of the time.

Fall movements of white shrimp appeared to commence during November and continued through December. Low water temperatures were probably the impetus for these migrations. Moffett (1972) reported that northers in the fall often reduced water temperature and triggered migration of small shrimp to deeper water areas. Gaidry and White (1973) reported that sudden temperature drops offshore often trigger offshore movement of white shrimp. The suddeness and abruptness affected the magnitude of the migration. The small white shrimp which migrate from the bays during late fall and early winter are partially protected by a statuatory closed season (16 December-1 February) within the 12.8 m (7.0 fm) depth zone in the Gulf of Mexico.

The reappearance of overwintering shrimp in bays during spring was clearly indicated by sample catches in March-May and is well understood by fishermen who use bait fishing regulations as a means of harvesting the stock. This period should be considered as a possible harvest season. However, several factors should be considered before implementing a special spring shrimping season: (1) following the elimination of count restrictions after 1 November by the 66th Legislature, the 67th Legislature further liberalized the taking of small shrimp by reducing the minimum mesh size allowed during 1 November to 15 December from 44.6 mm to 33.9 mm stretch mesh. The reduction in mesh size will increase fishing pressure on shrimp prior to their overwintering and reappearing in the bays during the following spring. (2) the overwintering white shrimp that appear in early spring catches are of the same group that spawn in the shallow gulf during the summer and provide stocks for the fall season (Moffett 1970). (3) the Gulf of Mexico is generally closed 1 June to 15 July each year to protect small brown shrimp from capture, however shrimping for spawning white shrimp is still allowed during the daylight hours from the shoreline to the 7.3 m (4 fm) depth contour. (4) during April-June small brown shrimp generally move from nursery areas to major bays then to the gulf (Moffett and McEachron 1973). Discarding of small brown shrimp by fishermen seeking the larger, more valuable white shrimp during the migration period could lead to waste of subadult brown shrimp.

With these factors in mind it may be premature to recommend a spring shrimping season until the overwintering patterns of white shrimp are more fully understood and if in general the shrimp can withstand the additional fishing pressure. It is also necessary to evaluate the possibilities of a flexible season to avoid capture of juvenile brown shrimp as well as other possible management tools such as regulation of mesh size.

Pink shrimp were incidental to brown and white shrimp collected in trawl samples in Galveston and San Antonio Bays. Pullen (1962) reported that pink shrimp appeared to be stragglers in most bays other than the lower Laguna Madre. Aransas Bay 6.1 mm trawl sample results indicated pink shrimp were present during fall and spring. Peak catches during the fall of 1980 possibly indicate that salinity ranges were optimum for pink shrimp. Gunter et al. (1964) reported that pink shrimp were most abundant in salinities of $\geq$19.0 ppt. In general, pink shrimp are of relatively minor importance when compared to brown and white shrimp. Management should be directed toward the more valuable species in those areas where brown and white shrimp are predominant.

LITERATURE CITED

Gaidry, W. J. and C. J. White. 1973. Investigations of commercially important penaeid shrimp in Louisiana estuaries. La. Wildlf. Fish. Comm. Tech. Bull. 9:1-154.

Gunter, G., J. Y. Christmas and R. Killibrew. 1964. Some relations of salinity to population distributions of mobile estuarine organisms, with special reference to penaeid shrimp. Ecology. 45(1):181-185.

Johnson, R. B., Jr. 1976. A study of Texas shrimp populations (1976), Coastal Fish. Proj. Rept. Tx. Pks. Wildlf. Dept. 51 p.

Loesch, H. C. 1965. Distribution and growth of penaeid shrimp in Mobile Bay, Alabama. Publ. Inst. Mar. Sci., Univ. Texas 10:41-58

Moffett, A. W. 1970. The shrimp fishery in Texas. Bul. No. 50. Tx. Pks. Wildlf. Dept. 38 p.

_____ 1972. A study of brown shrimp (Penaeus aztecus) and white shrimp (P. setiferus) in coastal bays of Texas, 1972. Coastal Fish. Proj. Rept. Tx. Pks. Wildlf. Dept. 36 p.

_____ and L. W. McEachron. 1973. Shrimp populations in Texas (1973). Coastal Fish. Proj. Rept. Tx. Pks. Wildlf. Dept. 26 p.

Pullen, E. J., 1962. A study of the bay and Gulf populations of shrimp: Penaeus aztecus, Penaeus setiferus and Penaeus duorarum, Mar. Fish. Proj. Rept., 1961-62. Tx. Game Fish Comm., Rockport Tx. 53 p.

_____, C. R. Mock and R. D. Ringo. 1968. A net for sampling the intertidal zone of an estuary. Proc. Am. Soc. Limnol. Oceanog. 13:200-202.

Renfro, W. L. 1964. Life history stages of Gulf of Mexico brown shrimp. Bur. Comm. Fish. Biol. Lab., Galveston, Tx. Cont. No. 183:94-98.

U.S. Department of Commerce. Gulf Coast Shrimp Data. Annual Issues 1964-1979. N.O.A.A. N.M.F.S. Wash. D.C.

_____. 1980. Climatological Data. Texas 1980. N.O.A.A. Envr. Data and Info. Ser., Natl. Climatic Ctr., Asheville, Md. 85(4) p.

Williams, A. B. 1955. Contribution to the life histories of commercial shrimp (Penaeidae) in North Carolina. Bull. Mar. Sci. Gulf Carib. 5:116-146.

Table 1. Texas shrimp landings (heads-off) 1964-80 (x 10^6 kg) and value (x 10^6)

Year	Brown Shrimp		White Shrimp		Other		Total	
	Kilograms	Dollars	Kilograms	Dollars	Kilograms	Dollars	Kilograms	Dollars
1964	11.7	16.7	5.5	7.2	1.6	2.2	18.9	26.1
1965	15.6	22.2	4.2	5.7	2.1	3.3	21.8	31.2
1966	15.4	30.3	3.6	6.4	0.9	1.8	19.9	38.5
1967	25.2	39.2	2.9	5.0	1.0	2.1	29.1	46.4
1968	16.8	33.2	5.6	10.1	1.3	2.6	23.7	45.9
1969	13.7	29.7	5.4	10.8	1.1	2.4	20.2	42.9
1970	18.9	36.9	5.6	10.2	0.6	1.5	25.1	48.6
1971	20.0	51.9	4.2	11.1	0.5	1.3	24.7	64.3
1972	21.9	62.8	5.2	15.2	0.6	2.1	27.7	80.1
1973	15.2	59.2	6.8	23.0	1.4	4.7	23.3	86.9
1974	16.1	48.8	5.2	16.1	1.1	2.8	24.5	67.7
1975	15.2	70.2	4.3	16.2	0.5	1.5	20.1	87.9
1976	16.3	94.4	4.6	23.4	0.4	2.0	21.3	119.8
1977	20.4	101.7	5.7	24.7	0.1	0.5	26.3	126.9
1978	17.6	101.8	6.4	38.9	0.1	0.4	24.0	141.1
1979[a]	14.2	117.2	4.9	34.7	0.2	0.4	19.3	152.3
1980[a]	16.5	114.0	4.2	25.6	0.4	0.4	21.1	140.0

Source: Shrimp Landings, National Marine Fisheries Service, 1964-78

[a]1979 and 1980 Preliminary (unpublished), brown and pink shrimp combined.

[b]Other includes pink shrimp (1964-78), sea bobs (Xiphopenaeus kroyeri), royal red shrimp (Hymenopenaeus robustus) and rock shrimp (Sicyonia spp.)

Table 2. Number, catch per drag and mean size of white shrimp (P. setiferus) caught with marsh nets during Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980 in Galveston, Matagorda, San Antonio and Aransas Bays.

Sample 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	14.7
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
2-9 Oct.	19	6.3	24.3
24-30 Oct.	17	5.7	26.8
8-12 Nov.	6	2.0	27.2
29-30 Nov.	20	6.7	32.7
6-7 Dec.	0	0.0	
18-19 Dec.	1	0.3	28.0
10-11 June 1980	0	0.0	
23-24 June	73	24.3	13.6
7-9 July	74	24.7	22.5
24-28-29 July	34	11.3	22.3
5-6 Aug.	66	22.0	26.3
18-19 Aug.	40	13.3	23.9
8-9 Sept.	3	1.0	34.7
22-23 Sept.	14	4.7	15.5
7-9 Oct.	19	6.3	39.7
23-30-31 Oct.	27	9.0	38.7
13 Nov.	2	1.0	43.0
26 Nov.	0	0.0	
2-3-5 Dec.	14	4.7	24.1
17-22 Dec.	19	6.3	19.5

Table 2. (Cont'd.)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
	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	
17 Oct.	28	9.3	21.6
12 Nov.	80	26.7	24.0
20 Dec.	0	0.0	
12 June 1980	0	0.0	
11 July	54	18.0	19.9
15 Aug.	45	15.0	28.0
11 Sept.	31	10.3	27.4
16 Oct.	6	2.0	47.2
12 Nov.	5	1.7	32.0
10-11 Dec.	5	1.7	20.0
	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

Table 2. (Cont'd.)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
9-11 Oct. 1979	41	5.1	26.9
22-23-24-25 Oct.	1	0.1	8.0
7-8 Nov.	8	1.0	28.6
26-27 Nov.	14	1.8	16.6
7-10 Dec.	5	0.6	25.0
19-20 Dec.	0	0.0	
4-6 June 1980	0	0.0	
16-17 June	0	0.0	
1-2 July	2	0.3	38.0
17-18 July	4	0.5	11.8
1-7 Aug.	0	0.0	
18-20 Aug.	2	0.3	10.5
2-4 Sept.	99	12.4	16.5
22-23 Sept.	0	0.0	
6-8 Oct.	5	0.6	23.0
22-23 Oct.	17	2.1	39.8
5-6 Nov.	2	0.3	33.0
19 Nov.	1	0.1	43.0
1-2 Dec.	3	0.4	36.3
16-17 Dec.	0	0.0	
	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
9 Oct.	36	9.0	29.0
22 Oct.	90	22.5	23.3

Table 2. (Cont'd.)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
5 Nov. 1979	14	3.7	39.1
19 Nov.	44	11.0	24.4
3 Dec.	3	0.8	26.3
17-19 Dec.	0	0.0	
9 June 1980	0	0.0	
18 June	1	0.3	28.0
1 July	7	1.8	15.0
14 July	48	12.0	20.2
Aug.	NS	-	-
18 Aug.	33	8.3	31.0
2 Sept.	25	6.3	27.9
15 Sept.	11	2.8	25.3
1 Oct.	23	5.8	34.2
14 Oct.	28	7.0	31.6
3 Nov.	3	0.8	21.3
24 Nov.	1	0.3	33.0
1 Dec.	1	0.3	53.0
17 Dec.	0	0.0	

Table 3. Number, catch per drag and mean size of white shrimp (P. setiferus) caught with 3.0-m trawls during Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980 in Galveston, Matagorda, San Antonio and Aransas Bays.

Sample 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	76.7	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
20-21 Aug.	222	74.0	56.4
5-6 Sept.	133	44.3	50.7
17-18 Sept.	1196	398.7	59.2
2-9 Oct.	567	189.0	64.6
24-30 Oct.	368	122.7	68.0
8-12 Nov.	285	95.0	63.2
29-30 Nov.	447	149.0	63.3
6-7 Dec.	268	89.3	61.1
18-19 Dec.	15	5.0	63.7
10-11 June 1980	0	0.0	
23-24 June	16	5.3	45.8
7-9 July	301	100.3	58.1
24-28-29 July	308	102.7	71.4
5-6 Aug.	873	291.0	73.5
18-19 Aug.	128	42.7	70.0
8-9 Sept.	429	143.0	79.9
22-23 Sept.	1437	479.0	65.7
7-9 Oct.	504	168.0	79.7
23-30-31 Oct.	231	77.0	77.5
13 Nov.	568	284.0	88.0
26 Nov.	127	127.0	64.4
2-3-5 Dec.	315	105.0	85.8
17-22 Dec.	108	36.0	66.0

Table 3. (Cont'd.)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
	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	
17 Oct.	319	106.3	41.3
12 Nov.	173	57.7	41.9
20 Dec.	0	0.0	
12 June 1980	0	0.0	
11 July	312	104.0	55.1
15 Aug.	455	151.7	71.1
11 Sept.	593	197.7	65.0
16 Oct.	93	31.0	62.4
12 Nov.	204	68.0	60.9
11 Dec.	0	0.0	
	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	
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
9-11-12 Oct.	111	13.9	75.4
22-23-24-25 Oct.	68	8.5	57.1

Table 3. (Cont'd.)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
7-8 Nov. 1979	42	5.3	73.2
26-27 Nov.	32	4.0	58.3
7-10 Dec.	6	0.8	57.0
19-20 Dec.	1	0.1	63.0
4-6 June 1980	0	0.0	
16-17 June	0	0.0	
1-2 July	18	2.3	65.8
17-18 July	3	0.4	53.0
1-7 Aug.	33	4.1	81.3
18-20 Aug.	41	5.1	78.5
2-4 Sept.	16	2.0	48.3
22-23 Sept.	120	15.0	65.8
6-8 Oct.	50	6.3	85.3
22-23 Oct.	28	3.5	80.5
5-6 Nov.	3	0.4	61.3
19 Nov.	2	0.3	45.5
1-2 Dec.	22	2.8	73.0
16-17 Dec.	32	4.0	56.4
	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	65.5
14 Nov.	154	54.7	62.8
5 Dec.	42	13.0	34.1
18 Dec.	7	2.3	65.1
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
9 Oct.	232	77.2	61.6
22 Oct.	257	85.7	61.3

Table 3. (Cont'd.)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
5 Nov.	148	49.3	62.1
19 Nov.	51	17.0	62.2
3 Dec.	14	7.0	61.6
19 Dec.	0	0.0	
9 June 1980	0	0.0	
18 June	0	0.0	
1 July	2	0.7	55.5
14 July	119	39.7	38.0
Aug.	NS	-	-
18 Aug.	60	20.0	68.8
2 Sept.	89	29.7	74.2
15 Sept.	122	40.7	75.4
1 Oct.	149	49.7	64.4
14 Oct.	66	22.0	64.4
3 Nov.	67	22.3	68.2
24 Nov.	9	3.0	55.8
1 Dec.	1	0.3	69.0
17 Dec.	7	2.3	51.6

Table 4. Number, catch per drag and mean size of white shrimp (P. setiferus) caught with 6.1-m trawls during Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980 in Galveston, Matagorda, San Antonio and Aransas Bays.

Sample 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
14-14-23 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
2-3-9 Oct.	798	53.2	90.9
24-25-29-30 Oct.	1666	92.6	89.5
8-12-13 Nov.	1517	84.3	87.6
27-29-30 Nov.	1267	70.4	76.8
6-7-10 Dec.	307	17.1	78.4
18-19 Dec.	200	11.1	77.5
19-21 Feb. 1980	358	19.9	85.1
18-19-21 Mar.	184	10.2	87.3
16-17-22 Apr.	322	17.9	99.0
13-14-21 May	127	7.1	125.5
10-11-12 June	9	0.5	144.1
23-24-27 June	8	0.4	120.5
7-8-9-10 July	49	2.7	80.0
21-24-28-29 July	325	18.1	92.7
6-12 Aug.	661	36.7	103.8
16-19-20 Aug.	366	20.3	103.7
8-9-10 Sept.	347	19.3	110.5

Table 4. (Cont'd)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
	GALVESTON BAY		
22-23-24 Sept.	529	29.4	99.3
7-9-10 Oct.	973	54.1	99.4
22-23-30 Oct.	2530	140.6	89.4
5-13-15 Nov.	475	67.9	90.4
24-26 Nov.	27	4.5	71.6
3-4-5 Dec.	291	16.2	87.4
16-17-18-23 Dec.	362	20.1	91.9
	MATAGORDA BAY		
21-22 Sept. 1978	221	24.6	98.9
10 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
16-17 Oct.	186	20.7	85.1
20-21 Nov.	298	33.1	80.9
20 Dec.	0	0.0	
27 Feb. 1980	0	0.0	
28 Mar.	73	8.1	84.7
29 Apr.	457	50.8	104.0
22-23 May	131	14.6	129.6
17 June	18	2.0	151.9
15 July	156	17.3	85.4
13 Aug.	897	99.7	114.2
19 Sept.	118	13.1	121.5
15-22 Oct.	838	93.1	82.8
19 Nov.	30	3.3	80.3
18 Dec.	0	0.0	

Table 4. (Cont'd)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
	SAN ANTONIO BAY		
- Sept. 1978	-	-	-
15 Sept.	121	12.1	97.8
- Oct.	-	-	-
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
2 Oct.	84	7.6	95.6
15 Oct.	287	26.1	95.2
5 Nov.	191	17.4	85.4
19 Nov.	95	8.6	83.0
3 Dec.	17	1.5	79.2
18 Dec.	6	0.5	61.3
14 Feb. 1980	2	0.2	78.0
18 Mar.	3	0.3	74.7
25 Apr.	19	1.7	102.7
21 May	6	0.5	134.7
5 June	0	0.0	
18 June	0	0.0	
3 July	4	0.4	142.5
21 July	17	1.5	84.2
6 Aug.	103	9.4	98.4
19 Aug.	112	10.2	99.4
3 Sept.	16	1.5	105.5
18 Sept.	13	1.2	95.7
7 Oct.	69	6.3	94.2
30 Oct.	291	25.5	99.2
7 Nov.	81	7.4	81.4
24 Nov.	62	5.6	85.9
3 Dec.	17	1.5	75.7
18 Dec.	2	0.2	63.0

Table 4. (Cont'd)

Sample Date	No. Shrimp Caught	Catch Per Drag	Mean Size (mm)
	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	0.3	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	20.0	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
10-11-12 Oct.	1064	88.7	87.6
23-24 Oct.	2043	170.3	87.0
7-8 Nov.	796	66.3	84.0
20-21 Nov.	535	44.6	85.0
4-5 Dec.	119	9.9	81.7
18-20 Dec.	23	1.9	77.3
14-15 Feb. 1980	7	0.6	67.3
13-14 Mar.	25	2.1	72.4
17-18 Apr.	48	4.0	97.7
21-22 May	21	1.8	136.8
3-4 June	32	2.7	150.3
16-17 June	8	0.7	158.0
2-8-9 July	1	0.1	88.0
15-16 July	7	0.6	44.4
5 Aug.	7	1.2	84.4
19-20 Aug.	1034	86.2	94.9
3-5-8 Sept	80	6.7	110.8
16-17 Sept.	40	3.3	116.6
3-6 Oct.	166	13.8	96.6
20-22 Oct.	196	16.3	96.4
5-6 Nov.	73	6.1	95.1
18-19 Nov.	487	40.6	94.5
2-3 Dec.	16	1.3	81.1
15-16 Dec.	3	0.3	79.7

Table 5. Estimated growth rates of white shrimp (P. setiferus) caught with trawls during late winter and spring 1979 and 1980 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		
	Mean Size			
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	27.5	33	0.8
May-June	136.6-158.7[b]	22.1	36	0.6
	Max. Size			
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
	Mean Size			
1980 Feb.-Mar.	85.1-87.3	2.2	29	0.1
Mar.-Apr.	87.3-99.0	11.7	30	0.4
Apr.-May	99.0-125.5	26.5	25	1.1
May-June	125.5-144.1	18.5	28	0.7
	Max. Size			
Feb.-Mar.	128.0-138.0	10.0	28	0.4
Mar.-Apr.	138.0-158.0	20.0	29	0.7
Apr.-May	158.0-168.0	10.0	36	0.3
		MATAGORDA BAY		
	Mean Size			
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			
	Max. Size			
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			

Table 5. (Cont'd)

Sampling Period	Size (mm)	Increase in Size (mm)	No. of Days Between Periods	Estimated Growth Rate (mm/day)
		MATAGORDA BAY		
	Mean Size			
1980 Mar.-Apr.	103.0-104.0	1.0	33	0.3
Apr.-May	104.0-129.6	25.6	25	1.0
May-June	129.6-151.9	22.3	26	0.9
	Max. Size			
Mar.-Apr.	113.0-143.0	30.0	33	0.9
Apr.-May	143.0-158.0	15.0	25	0.6
May-June	158.0-163.0	5.0	26	0.2
		SAN ANTONIO BAY		
	Mean Size			
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			
	Max. Size			
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			
	Mean Size			
1980 Mar.-Apr.	74.7-102.7	28.0	39	0.7
Apr.-May	102.7-134.7	32.0	27	1.2
May-June	No estimate; year class absent from June samples			
	Max. Size			
Feb.-Mar.	88.0-93.0	5.0	34	0.1
Mar.-Apr.	93.0-138.0	45.0	39	1.1
Apr.-May	138.0-158.0	20.0	27	0.7
		ARANSAS BAY		
	Mean Size			
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

Table 5. (Cont'd)

Sampling Period		Size (mm)	Increase in Size (mm)	No. of Days Between Periods	Estimated Growth Rate (mm/day)
			ARANSAS BAY		
		Max. Size			
1979	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
		Mean Size			
1980	Feb.-Mar.	67.3-72.4	5.1	29	0.2
	Mar.-Apr.	72.4-97.7	25.3	36	0.7
	Apr.-May	97.7-136.8	39.1	35	1.1
	May-June	136.8-158.0	21.2	36	0.6
		Max. Size			
	Feb.-Mar.	73.0-103.0	30.0	29	1.0
	Mar.-Apr.	103.0-158.0	53.0	35	1.5
	Apr.-May	158.0-163.0	5.0	35	0.1
	May-June	163.0-168.0	5.0	37	0.1

[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 6. 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, 1978-80.

Sample Date	MAJOR BAYS Catch Per Drag	MAJOR BAYS Size Range (mm)	MAJOR BAYS Mean Size (mm)	MINOR BAYS Catch Per Drag	MINOR BAYS Size Range (mm)	MINOR BAYS Mean Size (mm)
			GALVESTON BAY			
Sept. 1978	9.5	78-158	119.9	40.5	48-148	106.4
Sept.	31.3	68-163	104.2	79.5	43-163	98.3
Oct.	38.1	63-163	102.6	100.0	23-163	97.2
Oct.	84.1	38-153	97.9	127.5	43-143	95.0
Nov.	138.4	58-153	95.2	254.0	43-123	89.7
Nov.	138.8	43-148	92.1	221.2	53-123	88.6
Dec.	90.9	38-133	84.4	147.8	43-108	80.4
Dec.	43.6	53-138	79.9	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	0.7	48-53	50.5
July	2.5	53-88	75.6	37.5	48-98	73.5
July	83.3	73-138	102.4	100.0	58-128	85.5
Aug.	21.8	68-143	108.2	39.2	48-138	106.9
Aug.	22.6	53-143	110.1	95.2	33-143	103.3
Sept.	3.0	48-138	98.3	31.0	48-143	102.2
Sept.	17.8	48-153	88.5	25.5	28-148	98.6
Oct.	50.2	38-163	90.5	65.3	58-143	90.7
Oct.	88.4	48-143	90.1	138.0	38-133	87.4
Nov.	79.7	43-138	90.1	125.7	38-113	77.0
Nov.	83.1	33-128	78.9	27.0	43-103	69.2
Dec.	19.8	48-108	78.6	3.7	53-93	76.8
Dec.	13.6	48-103	77.9	3.3	43-103	70.0

Table 6. (Cont'd)

Sample Date	MAJOR BAYS Catch Per Drag	MAJOR BAYS Size Range (mm)	MAJOR BAYS Mean Size (mm)	MINOR BAYS Catch Per Drag	MINOR BAYS Size Range (mm)	MINOR BAYS Mean Size (mm)
			GALVESTON BAY			
June 1980	0.6	133-148	144.3	0.3	143	143.0
June	0.3	138-158	150.5	1.3	58-163	90.5
July	1.4	48-108	74.1	9.0	53-153	85.3
July	11.3	53-118	91.0	54.0	58-128	94.7
Aug.	34.3	58-143	105.0	54.5	63-143	101.8
Aug.	10.5	68-148	112.4	70.0	53-148	94.4
Sept.	15.0	53-153	110.3	45.3	43-173	110.7
Sept.	15.5	38-153	98.0	104.0	63-153	101.4
Oct.	43.4	53-153	99.7	91.5	53-143	99.1
Oct.	136.2	53-148	91.7	155.8	43.148	91.7
Nov.	10.0	73-128	96.9	110.5	43-123	89.7
Nov.	0.0			6.8	48-108	71.4
Dec.	85.3	53-153	88.2	24.3	48-113	85.9
Dec.	23.6	53-138	92.9	7.8	58-103	85.0
			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
Oct.	13.8	63-138	90.7	26.2	38-118	82.7
Nov.	2.5	78-118	96.5	57.6	43-133	79.8
Dec.	0.0			0.0		

Table 6. (Cont'd)

Sample Date	MAJOR BAYS Catch Per Drag	MAJOR BAYS Size Range (mm)	MAJOR BAYS Mean Size (mm)	MINOR BAYS Catch Per Drag	MINOR BAYS Size Range (mm)	MINOR BAYS Mean Size (mm)
			MATAGORDA BAY			
June 1980	0.3	158	158.0	3.4	138-163	151.5
July	2.3	78-113	91.3	29.4	58-143	85.0
Aug.	2.5	113-143	131.5	177.4	68-148	113.6
Sept.	2.5	88-148	112.5	21.6	73-163	122.3
Oct.	4.5	93-178	129.7	164.0	53-128	91.8
Nov.	2.0	68-108	79.3	4.4	38-98	80.7
Dec.	0.0			0.0		
			SAN ANTONIO BAY			
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

Table 6. (Cont'd)

Sample Date	MAJOR BAYS Catch Per Drag	MAJOR BAYS Size Range (mm)	MAJOR BAYS Mean Size (mm)	MINOR BAYS Catch Per Drag	MINOR BAYS Size Range (mm)	MINOR BAYS Mean Size (mm)
			SAN ANTONIO BAY			
Oct. 1979	9.4	43-153	94.5	6.0	63-123	96.6
Oct.	25.9	43-128	94.2	26.7	29-123	97.8
Nov.	13.4	43-128	88.6	28.0	43-123	81.4
Nov.	7.8	48-118	86.0	10.0	48-108	77.5
Dec.	1.9	68-123	83.3	0.7	43-53	48.0
Dec.	0.6	53-68	58.0	0.3	78	78.0
June 1980	0.0			0.0		
June	0.0			0.0		
July	0.5	63-185	142.3	0.0		
July	1.4	58-113	82.5	2.0	63-113	90.0
Aug.	4.0	58-138	93.8	23.7	58-153	100.5
Aug.	11.4	53-153	99.6	7.0	63-138	98.5
Sept.	0.6	113-123	116.0	3.7	88-128	100.7
Sept.	0.6	58-98	82.0	2.7	73-133	104.3
Oct.	3.5	78-128	96.2	13.7	63-113	92.9
Oct.	34.5	43-133	100.8	5.0	33-98	68.7
Nov.	6.0	38-123	98.2	11.0	68-118	93.8
Nov.	5.8	58-118	87.4	5.0	53-108	80.9
Dec.	0.9	63-108	86.6	3.3	48-83	62.7
Dec.	0.1	63	63.0	0.3	63	63.0

Table 6. (Cont'd)

Sample Date	MAJOR BAYS Catch Per Drag	MAJOR BAYS Size Range (mm)	MAJOR BAYS Mean Size (mm)	MINOR BAYS Catch Per Drag	MINOR BAYS Size Range (mm)	MINOR BAYS Mean Size (mm)
			ARANSAS BAY			
Sept. 1978	3.3	133-178	147.6	27.4	33-173	108.5
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	90.8
Nov.	51.8	43-128	88.8	32.7	33-163	73.1
Dec.	48.6	43-108	88.6	41.8	28-108	75.4
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	-	-	-	-	-
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
Oct.	66.4	33-158	86.1	104.6	48-153	88.9
Oct.	94.4	38-153	88.0	224.4	38-148	86.4
Nov.	53.4	43-133	85.2	75.6	43-113	83.2
Nov.	57.0	53-118	85.4	35.7	43-113	84.6
Dec.	16.6	53-108	80.5	5.1	63-108	84.4
Dec.	4.4	58-118	77.5	0.1	73	73.0

Table 6. (Cont'd)

Sample Date	MAJOR BAYS Catch Per Drag	MAJOR BAYS Size Range (mm)	MAJOR BAYS Mean Size (mm)	MINOR BAYS Catch Per Drag	MINOR BAYS Size Range (mm)	MINOR BAYS Mean Size (mm)
			ARANSAS BAY			
June 1980	1.8	148-163	152.4	3.3	128-173	149.5
June	1.4	148-168	158.7	0.1	153	153.0
July	0.0			0.1	88	88.0
July	0.2	83	83.0	0.9	23-68	38.0
Aug.	1.3	43-113	96.0	0.3	48-63	55.5
Aug.	18.6	43-153	87.9	134.4	58-143	97.6
Sept.	1.2	88-153	121.3	10.6	78-153	97.7
Sept.	0.8	103-158	124.3	5.1	73-148	94.8
Oct.	4.4	23-158	86.6	20.6	68-153	98.1
Oct.	23.6	38-148	93.4	11.1	53-138	100.7
Nov.	7.4	53-143	95.2	5.1	53-118	95.0
Nov.	88.8	43-128	90.5	6.1	38-123	81.9
Dec.	1.8	53-93	78.0	1.0	48-108	85.1
Dec.	0.2	83	83.0	0.3	63-93	78.0

Figure 1. Monthly mean temperatures and salinities during Oct. 1978-Dec. 1980 in Galveston, Matagorda, San Antonio and Aransas Bays.

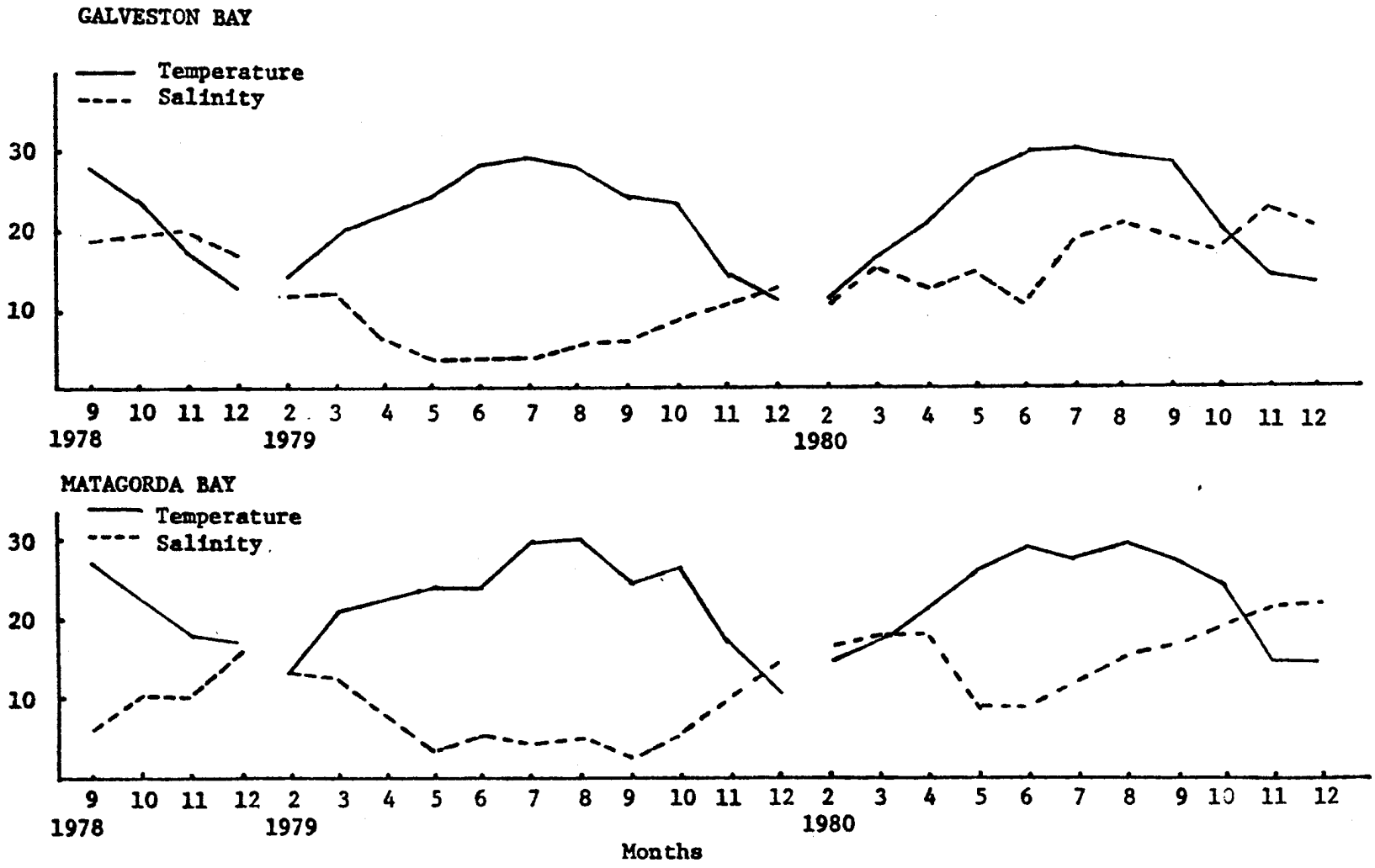
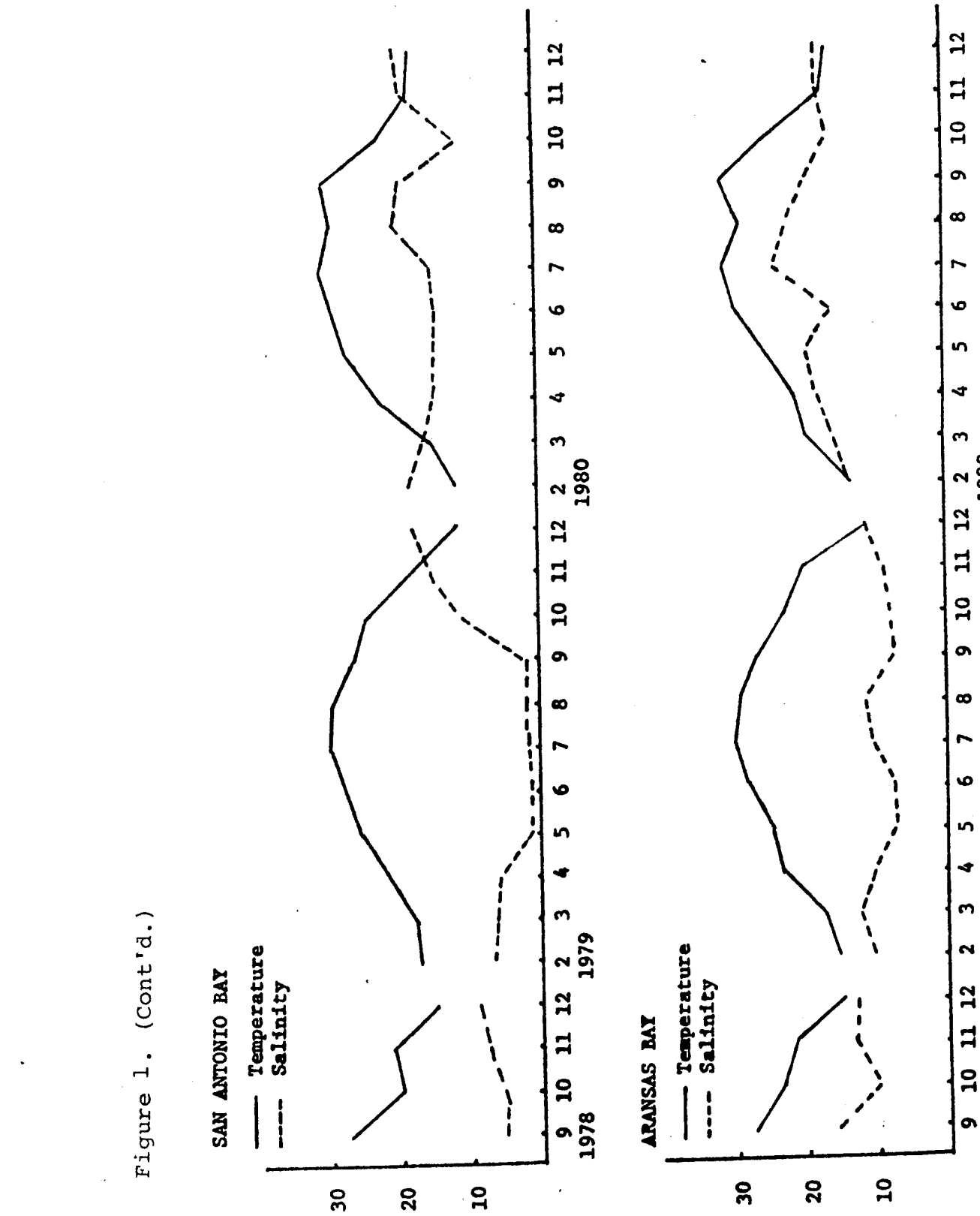


Figure 1. (Cont'd.)



Appendix A. Station names, gear types and sample types used in Galveston, Matagorda, San Antonio, Aransas Bays and lower Laguna Madre during 1979-80

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

Gear Type	Station Code	Station Name
Marsh Net-30.5 m Drag	2-802-301	Clear Creek
	2-810-302	Dickinson Bayou
	2-811-303	Double Bayou
	2-201-304	Jones Lake
	2-241-305	Moses Lake
	2-810-306	Dickinson Bayou
3.0 m Trawl-5 min Drag	2-802-404	Clear Creek
	2-810-405	Dickinson Bayou
	2-811-406	Double Bayou
6.1 m Trawl-15 min Drag	2-111-507	Clear Lake
	2-141-508	Dickinson Bay
	2-330-509	Double Bayou-Trinity Bay
	2-180-510	upper Galveston Bay
	2-180-511	5 Mile Pass
	2-330-512	Trinity Bay
	2-330-513	upper Trinity Bay
	2-180-514	lower Trinity Bay
	2-180-515	Sievers Cut
	2-150-516	lower East Bay
	2-150-517	upper East Bay
	2-350-518	upper West Bay
	2-350-519	middle West Bay
	2-350-520	lower West Bay
	2-100-521	Chocolate Bay
	2-180-522	B-76 Hou. Ship Channel
	2-180-523	B-44 Hou. Ship Channel
	2-350-524	GIWW-Choc.-West Bay
1.8 m Bar Seine-152.4 m Drag	2-201-601	Jones Lake
	2-241-602	Moses Lake
	2-810-603	Dickinson Bayou
	2-180-604	Surf Oaks
	2-330-605	West Trinity Bay Shore (replaces Double Bayou)
3.0 m Trawl-15 min Drag	2-111-701	Clear Lake
	2-180-702	Humble Camp
	2-180-703	Texas City Dike

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

Gear Type	Station Code	Station Name
Marsh Net-30.5 m Drag	3-800-301	Carancahua Bayou
	3-831-302	Turtle Bayou
	3-830-303	Tres Palacios River
3.0 m Trawl-5 min Drag	3-800-404	Carancahua Bayou
	3-831-405	Turtle Bayou
	3-830-406	Tres Palacios River
6.1 m Trawl-15 min Drag	3-060-507	Carancahua Bay
	3-340-508	Turtle Bay
	3-320-509	Tres Palacios Bay
	3-220-510	upper Lavaca Bay
	3-220-511	Lavaca Causeway
	3-220-512	Mitchell Point
	3-360-513	Sand Point
	3-360-514	Carancahua Pass
	3-360-515	Palacios Point
1.8 m Bar Seine-152.4 m Drag	3-820-616	Keller Creek
	3-800-617	Carancahua Creek
	3-831-618	Turtle Bayou
	3-830-619	Tres Palacios River
3.0 m Trawl-15 min Drag	3-220-720	Lavaca Bay
	3-060-721	Carancahua Bay
	3-340-722	Turtle Bay
	3-320-723	Tres Palacios Bay

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

Gear Type	Station Code	Station Name
Marsh Net-30.5 m Drag	4-030-301	B-67 GIWW
	4-300-302	Webb Pt. S.A. Bay
	4-822-303	Swan Lake Bayou
	4-200-304	Hynes Bay
	4-300-305	Mosquito Pt.
	4-170-306	The Lane-Espiritu Santo Bay
	4-170-307	Bayoucous Is. E.S. Bay
	4-052-308	Barroom Bay
3.0 m Trawl-5 min Drag	4-030-401	B-67 GIWW
	4-300-402	Webb Pt.
	4-822-403	Swan Lake Bayou
	4-200-404	Hynes Bay
	4-300-405	Mosquito Pt.
	4-170-406	The Lane-Espiritu Santo Bay
	4-170-407	Bayoucous Is. E.S. Bay
	4-052-408	Barroom Bay
6.1 m Trawl-15 min Drag	4-300-501	Swan Pt.
	4-300-502	Mosquito Pt.
	4-300-503	Beacon 7
	4-170-504	The Lane-Espiritu Santo Bay
	4-170-505	South Pass-Espiritu Santo Bay
	4-300-506	Panther Point
	4-300-507	Beacon 31
	4-300-508	Turtle Reef
	4-200-509	Austwell
	4-200-510	Grassy Pt.
	4-200-511	Seadrift
1.8 m Bar Seine 152.4 m Drag	4-200-601	Hynes Bay
	4-300-602	Swan Pt.
	4-300-603	Mosquito Pt.
	4-300-604	Webb Pt.
3.0 m Trawl-15 min Drag	4-200-701	Hynes Bay
	4-300-702	Swan Pt.
	4-300-703	Mosquito Pt.
	4-300-704	Webb Pt.

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

Gear Type	Station Code	Station Name
Marsh net-30.5 m Drag	5-120-301	Chiltipin Creek
	5-310-302	Twin Creek
	5-143-303	Dunham's Bay
	5-310-320	Big Tree
	5-120-321	Holiday Beach
	5-120-322	Bayside
	5-020-323	Little Bay
	5-020-324	Redfish Bay
	5-280-330	Redfish Bay
3.0 m Trawl-5 min Drag	5-120-404	Chiltipin Creek
	5-130-405	Twin Creek
	5-143-406	Dunham's Bay
6.1 m Trawl-15 min Drag	5-120-507	Copano Bay-Bayside
	5-310-508	St. Charles Bay
	5-143-509	Dunham's Bay
	5-240-510	Mouth of Mission Bay
	5-120-511	Copano Bay-LBJ Causeway
	5-020-512	Aransas Bay-Live Oak Pt.
	5-020-513	Aransas Bay
	5-020-514	Aransas Bay-GIWW Mk 43
	5-020-515	Aransas Bay-GIWW Mk 69
	5-250-516	Mesquite Bay
	5-120-517	Mouth of Port Bay
	5-270-518	Port Bay
1.8 m Bar Seine-152.4 m Drag	5-310-620	St. Charles Bay-W Shoreline
	5-120-621	Copano Bay-Shell Pt.
	5-120-622	Copano Bay Bayside
	5-020-623	Little Bay-Rockport Part of Aransas Bay
	5-280-624	Redfish Bay
3.0 m Trawl-15 min Drag	5-020-725	Aransas Bay-Mk 49
	5-020-726	Aransas Bay-Mk 19
	5-120-727	Copano Bay-LBJ Causeway
	5-120-728	Copano Bay-Mouth of Mission Bay
	5-120-729	Copano Bay-Turtle Pen

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

Gear Type	Station Code	Station Name
1.8 m Bar Seine-152.4 m	8-230-601	Three Islands
	8-262-602	Arroyo Colorado
	8-230-603	Pt. Mansfield Channel
3.0 m Trawl-15 min Drag	8-230-701	Three Islands
	8-262-702	Arroyo Colorado
	8-230-703	Port Mansfield

Appendix B. Station location maps of Galveston, Matagorda, San Antonio, Aransas Bays and lower Laguna Madre during 1979-80.

Figure 1. Sample station locations in Galveston Bay.

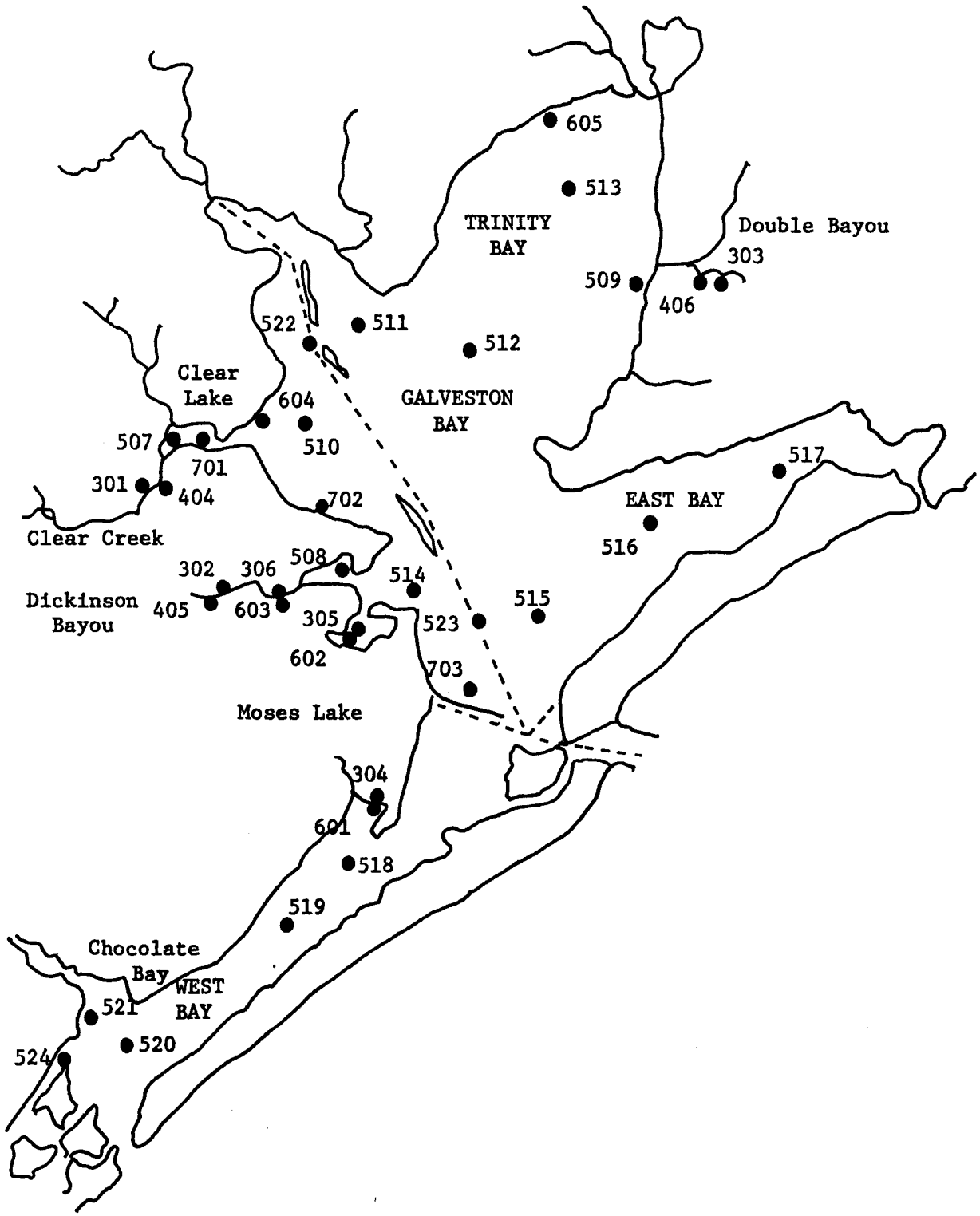
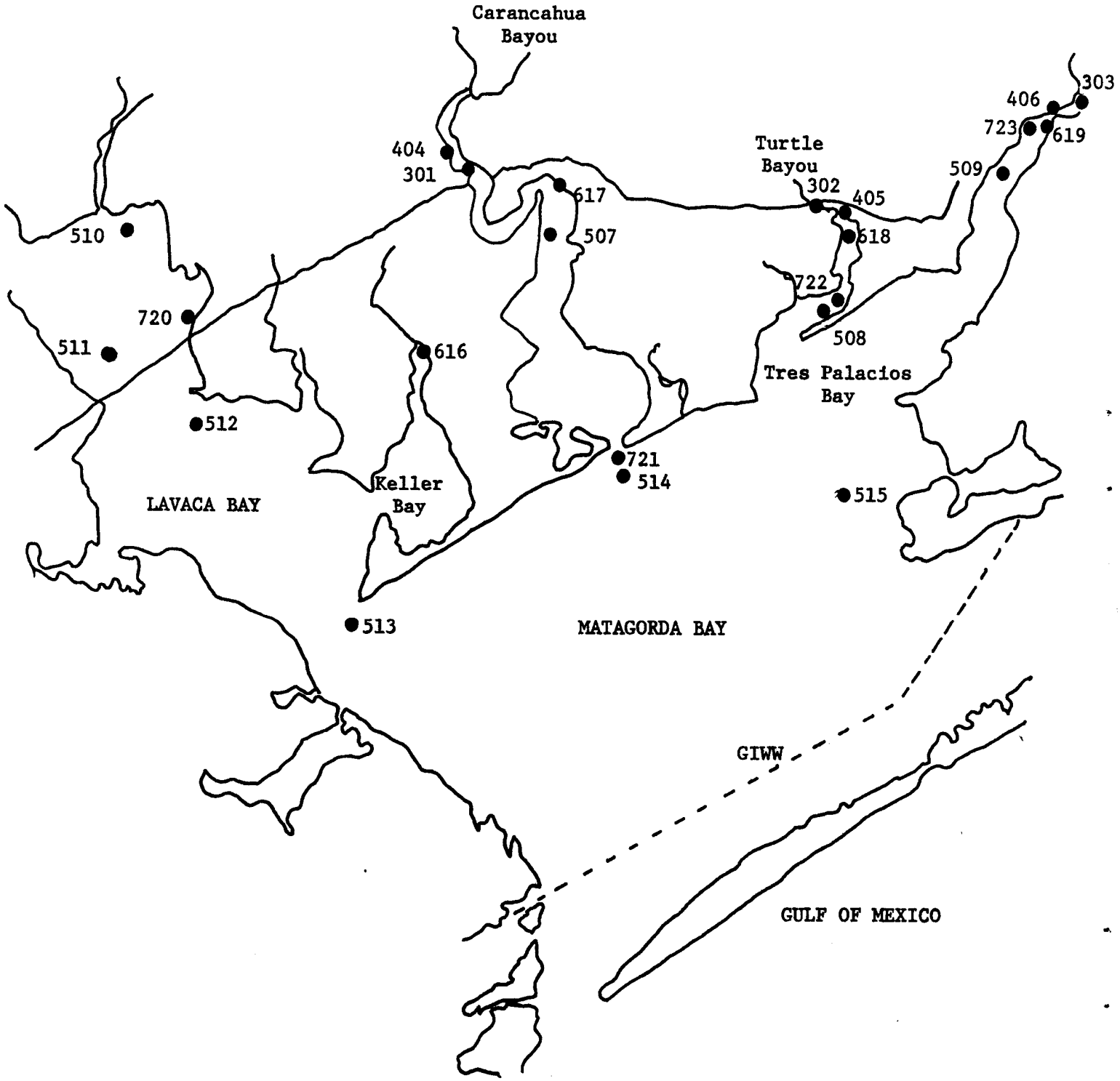


Figure 2. Sample station locations in Matagorda Bay.



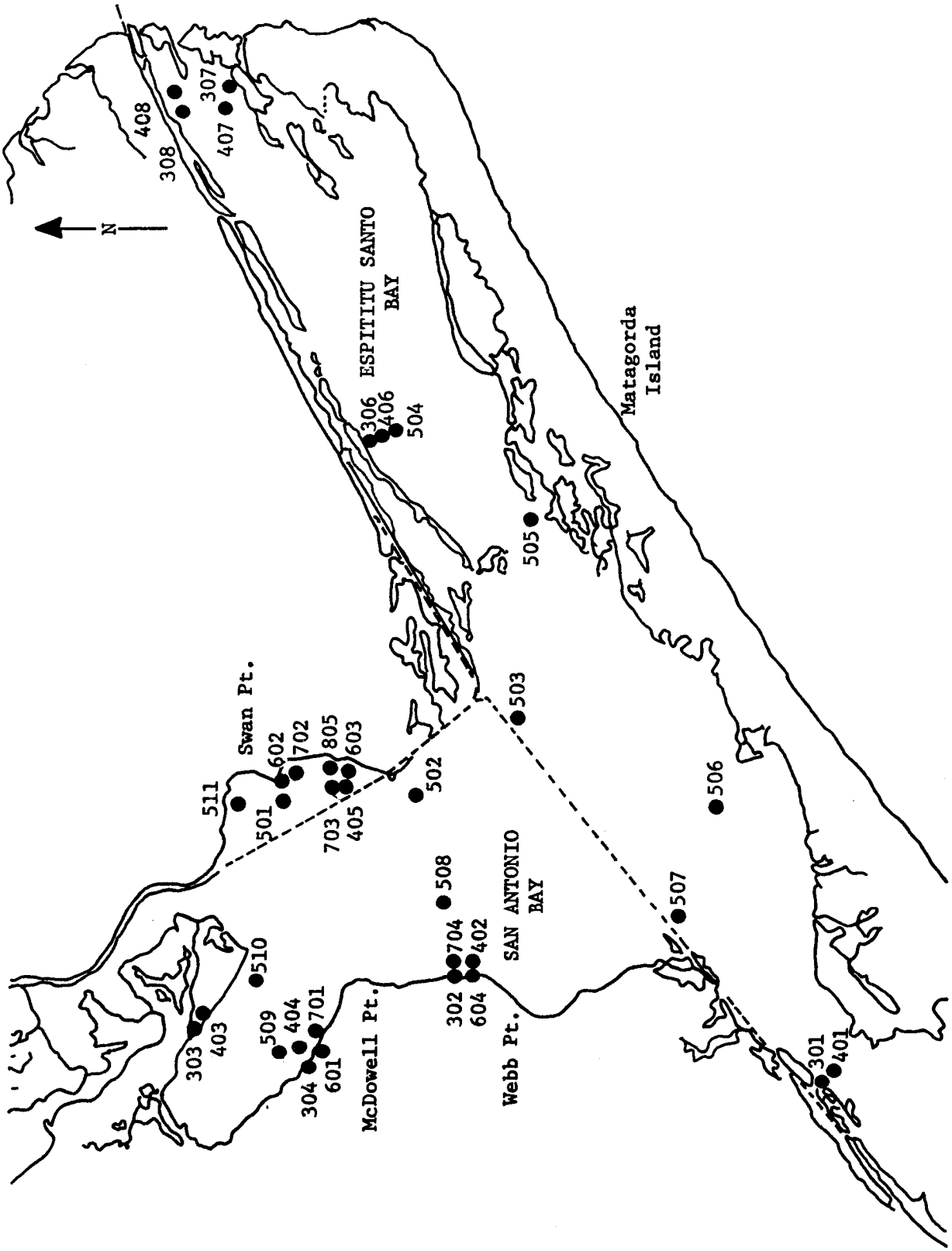


Figure 3. Sample station locations in San Antonio Bay

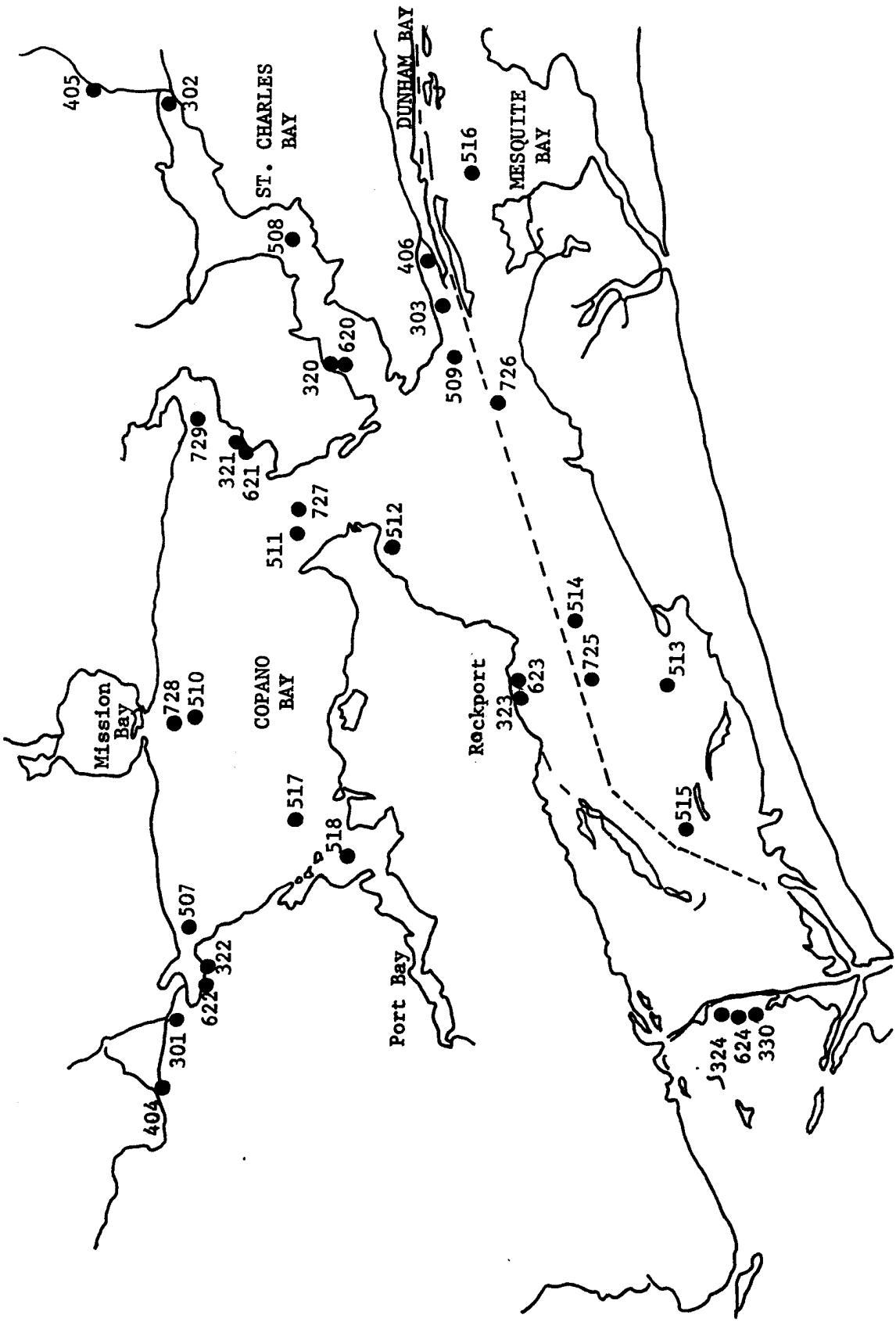
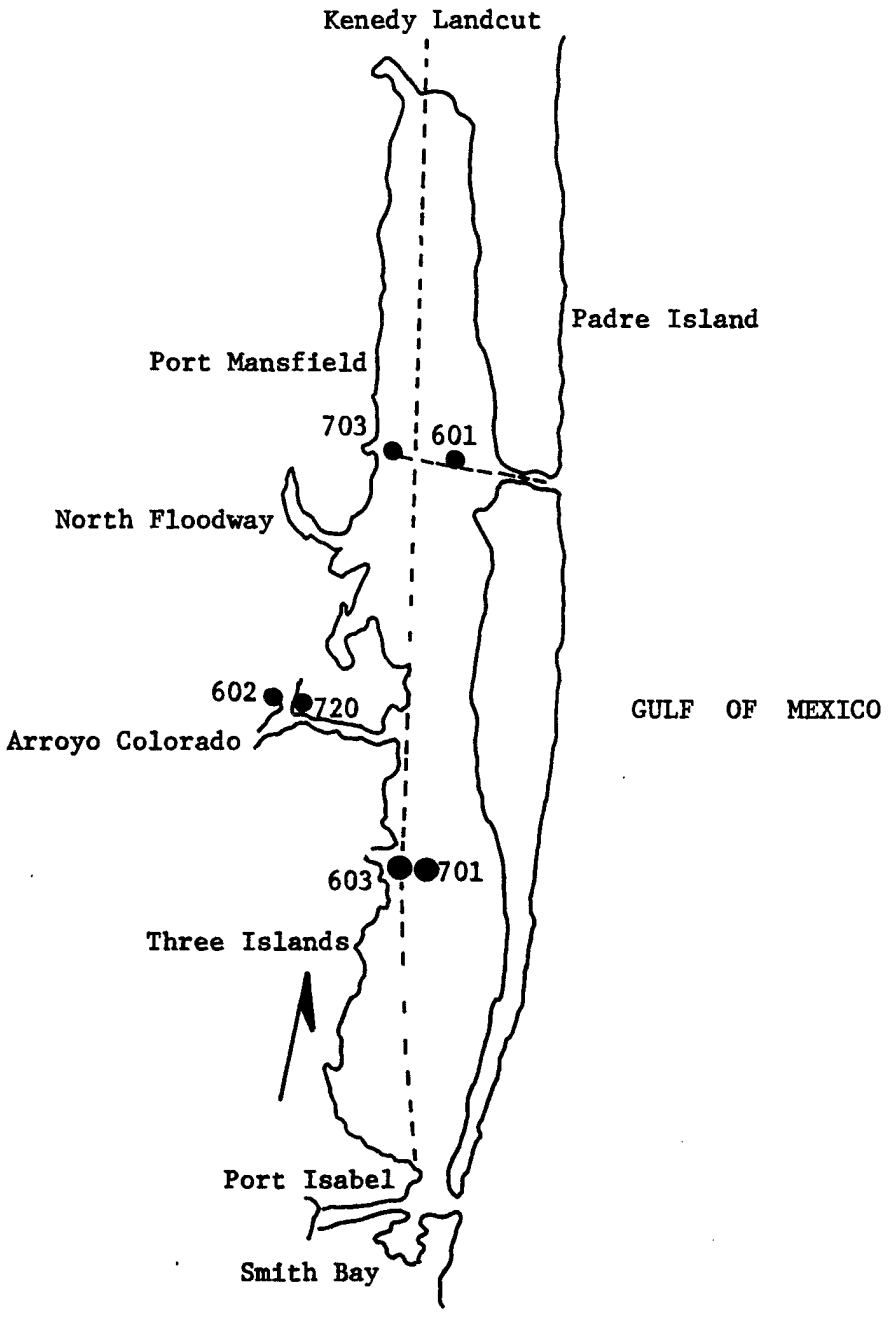


Figure 4. Sample station locations in Aransas Bay

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 1979-80.

Table 1. Number and sizes of juvenile brown shrimp (P. aztecus) caught with 1.8-m bar seines in Galveston Bay, Apr.-May 1979 and 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2 Apr. 1979	5	14	2.8	13-18	15.9	2.5	0.7
9 Apr.	5	42	8.4	13-28	16.7	5.2	0.8
16 Apr.	5	52	10.4	13-43	28.8	7.9	1.1
23 Apr.	5	114	22.8	13-48	32.2	7.4	0.7
30 Apr.	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 May	5	152	30.4	18-78	38.1	15.4	1.3
21 May	5	223	44.6	18-68	31.6	12.1	1.0
30 May	4	180	45.0	18-83	33.1	11.2	0.8
31 Mar. 1 Apr. 1980	5	31	6.2	13-38	18.0	5.1	0.9
7 Apr.	5	78	15.6	8-28	15.1	4.4	0.5
15 Apr.	5	15	3.0	18-33	24.2	4.0	1.1
22 Apr.	5	160	32.0	18-43	29.5	5.5	0.4
28 Apr.	5	172	34.4	18-53	32.3	6.8	0.5
5 May	5	160	32.0	13-58	34.6	8.4	0.7
12 May	5	324	64.8	18-73	40.2	12.1	0.7
20 May	5	749	149.8	18-83	37.5	12.2	0.7
27 May	5	227	45.4	13-83	38.5	13.4	0.9

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 and Mar.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 Apr. 1979	3	0	0.0				
12 Apr.	3	0	0.0				
19 Apr.	3	0	0.0				
24 Apr.	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 May	3	14	4.7	18-73	50.5	13.9	3.7
15 May	3	12	3.0	33-88	50.9	14.1	4.1
22 May	3	160	53.3	23-93	70.5	15.2	1.2
31 May	3	362	120.7	18-118	62.5	19.0	1.0
31 Mar. 1980	3	2	0.7	58-63	60.5	0.0	0.0
9 Apr.	3	0	0.0				
15 Apr.	3	0	0.0				
23 Apr.	3	10	3.3	13-28	19.0	5.4	1.7
28 Apr.	3	1	0.3	28	28.0	0.0	0.0
5 May	3	60	20.0	33-58	38.6	7.9	1.0
12 May	3	133	44.3	23-83	47.5	12.2	1.2
20 May	3	395	131.7	33-108	61.3	15.2	1.5
27 May	3	332	110.7	33-118	71.2	17.3	1.6

Table 3. Number and sizes of postlarval and juvenile brown shrimp (P. aztecus) caught with marsh nets in Galveston Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and Mar.-Dec. 1980

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				
2-9 Oct.	3	0	0.0				
24-30 Oct.	3	1	0.3	18	18.0	0.0	0.0
8-12 Nov.	3	3	1.0	28-33	29.7	2.4	1.4
29-30 Nov.	3	0	0.0				
6-7 Dec.	3	2	0.7	18-23	20.5	0.0	0.0
18-19 Dec.	3	0	0.0				
3 Mar. 1980	3	0	0.0				
10 Mar.	3	172	57.3	8-13	12.9	0.5	0.0
17 Mar.	3	588	294.0	13-18	13.6	1.6	0.1
24 Mar.	3	494	164.6	13-23	14.0	2.1	0.2
10-11 June	3	4	1.3	33-48	39.2	6.5	3.2
23-24 June	3	10	3.3	18-83	39.5	17.3	5.5
7-9 July	3	0	0.0				
24-28-29 July	3	0	0.0				
5-6 Aug.	3	0	0.0				
18-19 Aug.	3	3	1.0	13-78	36.3	29.5	17.0
8-9 Sept.	3	0	0.0				
22-23 Sept.	3	1	0.3	33	33.0	0.0	0.0
7-9 Oct.	3	0	0.0				
30-31 Oct.	3	1	0.3	28	28.0	0.0	0.0
13 Nov.	2	0	0.0				
26 Nov.	1	0	0.0				
2-3-5 Dec.	3	0	0.0				
17-22 Dec.	3	6	2.0	8-13	11.3	2.6	1.1

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, June-Dec. 1979, and June-Dec. 1980.

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
2-9 Oct.	3	4	1.3	28-78	40.5	21.7	10.8
24-30 Oct.	3	16	5.3	18-73	44.9	16.2	4.1
8-12 Nov.	3	36	12.0	28-83	54.0	15.5	2.6
29-30 Nov.	3	0	0.0				
6-7 Dec.	3	1	0.3	73	73.0	0.0	0.0
18-19 Dec.	3	1	0.3	58	58.0	0.0	0.0
10-11 June 1980	3	906	302.0	33-113	81.1	14.5	1.0
23-24 June	3	1040	346.7	53-113	82.2	12.5	0.9
7-9 July	3	701	233.7	53-118	83.3	12.4	0.8
24-28-29 July	3	204	68.0	68-133	94.5	14.0	1.4
5-6 Aug.	3	38	12.7	68-123	96.9	15.7	2.5
18-19 Aug.	3	23	7.7	68-113	87.3	16.9	3.5
8-9 Sept.	3	15	5.0	73-108	81.0	9.3	2.4
22-23 Sept.	3	47	15.7	63-93	65.7	17.6	1.0
7-9 Oct.	3	3	1.0	83-93	89.7	5.8	3.3
23-30-31 Oct.	3	0	0.0				
13 Nov.	2	0	0.0				
26 Nov.	1	0	0.0				
2-3-5 Dec.	3	0	0.0				
17-22 Dec.	3	0	0.0				

Table 5. Number and sizes of brown shrimp (P. aztecus) caught with 6.1-m trawls in Galveston Bay, Sept.-Dec. 1978, Feb.-Dec. 1979, and Feb.-Dec. 1980.

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
2-3-9 Oct.	15	6	0.4	58-78	72.2	7.3	3.0
24-25-29-30 Oct.	18	10	0.6	53-88	72.5	12.1	3.8
8-12-13 Nov.	18	9	0.5	63-88	75.8	7.5	2.5
27-29-30 Nov.	18	18	1.0	63-98	75.2	8.9	2.1
6-7-10 Dec.	18	13	0.7	58-88	70.7	8.0	2.2
18-19 Dec.	18	12	0.7	53-78	68.0	7.1	2.0
19-21 Feb. 1980	18	1	0.1	83	83.0	0.0	0.0
18-19-21 Mar.	18	5	0.3	68-78	78.0	8.4	3.7
16-17-22 Apr.	18	29	1.6	48-128	99.6	13.6	2.6
13-14-21 May	18	291	16.2	38-138	89.8	22.1	1.3
10-11-12 June	18	1361	75.6	48-133	87.0	13.6	0.4
23-24-27 June	18	1541	85.6	48-133	93.2	14.3	0.4
7-8-9-10 July	18	377	20.9	63-138	97.6	12.4	0.7
21-24-28-29 July	18	1288	71.6	68-148	103.0	11.5	0.4
6-12 Aug.	18	532	29.6	53-148	102.7	12.4	0.5
16-19-20 Aug.	18	98	5.4	63-148	98.9	16.6	1.7
8-9-10 Sept.	18	26	1.4	68-123	94.0	13.4	2.7
22-23-24 Sept.	18	51	2.8	63-108	90.5	10.8	1.5
7-9-10 Oct.	18	75	4.2	28-103	70.1	12.3	1.4
22-23-30-31 Oct.	18	28	1.6	58-103	83.4	10.1	1.9
5-13 Nov.	7	0	0.0				
24-26 Nov.	6	1	0.2	78	78.0	0.0	0.0
2-3-4-5 Dec.	18	3	0.2	88-93	89.7	2.9	1.7
16-17-18 Dec.	18	1	0.1	83	83.0	0.0	0.0

Table 6. Number and sizes of brown shrimp (*P. aztecus*) caught with 1.8-m bar seines in Matagorda Bay, Apr.-May 1979 and 1980.

Sample Date	No. of Sample	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 Apr.	4	0	0.0				
10 Apr.	4	32	8.0	18-28	23.3	3.3	0.8
18 Apr.	4	98	24.5	23-53	32.7	7.5	1.1
24 Apr.	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
1 Apr. 1980	4	16	4.0	13-23	16.8	3.3	0.8
8 Apr.	4	292	73.0	18-28	22.3	3.0	0.2
15 Apr.	4	64	16.0	13-33	23.7	5.3	0.7
23 Apr.	4	374	93.6	18-43	28.7	6.1	0.4
29 Apr.	4	436	109.0	18-58	32.5	8.7	0.5
6 May	4	322	80.5	18-68	34.5	9.7	0.7
13 May	4	281	70.3	18-73	29.8	12.4	0.9
20 May	4	361	90.3	13-68	26.7	9.3	0.7
26 May	4	67	16.8	18-58	30.5	9.4	1.2

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 and 1980.

Sample Date	No. of Sample	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 Apr. 1979	4	55	13.8	13-28	20.0	3.5	0.5
10 Apr.	4	152	38.0	13-38	24.4	4.8	0.4
18 Apr.	4	484	121.0	13-53	27.3	9.3	0.5
24 Apr.	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
1 Apr. 1980	4	250	62.5	8-23	17.0	3.6	0.2
8 Apr.	4	216	54.0	13-78	22.2	8.8	0.6
15 Apr.	4	619	154.8	8-98	23.1	8.8	0.5
23 Apr.	4	606	151.5	13-98	27.7	12.1	0.6
29 Apr.	4	2294	573.5	13-98	30.6	14.0	0.7
6 May	4	1506	376.5	13-98	41.3	16.3	0.8
13 May	4	1699	424.8	13-113	50.2	19.3	1.0
20 May	4	883	220.8	23-123	61.6	20.0	1.8
26 May	4	522	130.5	18-98	54.1	18.9	1.1

Table 8. Number and sizes of postlarval and juvenile brown shrimp (P. aztecus) caught with marsh nets in Matagorda Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
22 Aept. 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				
17 Oct.	3	0	0.0				
12 Nov.	3	0	0.0				
20 Dec.	3	0	0.0				
12 June 1980	3	18	6.0	23-83	34.9	16.6	3.9
8-11 July	3	6	2.0	18-63	43.0	14.4	5.9
15 Aug.	3	2	0.7	23-33	28.0	0.0	0.0
11 Sept.	3	0	0.0				
16 Oct.	3	1	0.3	23	23.0	0.0	0.0
12 Nov.	3	1	0.3	58	58.0	0.0	0.0
10 Dec.	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, June-Dec. 1979 and June-Dec. 1980.

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				
17 Oct.	3	0	0.0				
12 Nov.	3	0	0.0				
20 Dec.	3	0	0.0				
12 June 1980	3	602	200.7	23-98	60.3	13.7	0.8
11 July	3	151	50.3	28-93	67.6	11.2	0.9
15 Aug.	3	1	0.3	43	43.0	0.0	0.0
11 Sept.	3	4	1.3	43-63	53.0	7.9	4.0
16 Oct.	3	0	0.0				
12 Nov.	3	0	0.0				
11 Dec.	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, Feb.-Dec. 1979, and Feb.-Dec. 1980.

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
16-17 Oct.	9	0	0.0				
20 Nov.	9	0	0.0				
20 Dec.	9	0	0.0				
27 Feb. 1980	9	0	0.0				
28 Mar.	9	1	0.1	78	78.0	0.0	0.0
29 Apr.	9	142	15.8	38-133	86.3	25.9	2.2
22-23 May	9	494	54.9	38-133	83.5	17.3	1.0
17 June	9	501	55.7	43-143	93.7	15.0	0.7
15 July	9	206	22.9	63-148	89.4	32.7	2.3
13 Aug.	9	0	0.0				
19 Sept.	9	0	0.0				
15-22 Oct.	9	3	0.3	53-93	76.3	20.8	12.0
19 Nov.	9	0	0.0				
18 Dec.	9	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 and Mar.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 Apr. 1979	4	40	10.0	18-28	22.0	3.4	0.5
9 Apr	4	130	32.5	18-38	26.2	4.4	0.4
16 Apr.	4	122	30.5	18-48	35.5	7.1	0.6
23 Apr.	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
31 Mar. 1980	4	114	28.5	18-28	20.8	2.8	0.3
7 Apr.	4	14	3.5	23-28	25.1	2.5	0.7
16 Apr.	4	100	25.0	13-43	30.2	5.8	0.6
22 Apr.	4	176	43.5	13-38	19.7	7.5	0.6
28 Apr.	4	148	37.0	13-48	25.8	6.2	0.5
5 May	4	132	33.0	13-63	30.2	7.2	0.6
12 May	4	242	60.5	13-78	31.6	13.9	0.9
19 May	4	79	19.8	23-78	44.0	13.1	1.5
27 May	4	29	7.3	18-78	39.4	14.4	2.7

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 and Mar.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 Apr. 1979	4	25	6.3	18-28	21.2	3.1	0.6
9 Apr.	4	173	43.3	13-38	24.7	7.0	0.6
16 Apr.	4	125	31.3	13-48	32.1	8.1	0.7
23 Apr.	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
31 Mar. 1980	4	80	20.0	8-63	22.1	10.5	1.2
7 Apr.	4	140	35.0	13-68	25.3	11.7	1.0
16 Apr.	4	220	53.8	13-108	31.6	11.8	0.8
22 Apr.	4	189	46.5	13-113	36.3	14.8	1.1
28 May	4	216	59.0	13-108	40.1	13.5	0.9
5 May	4	141	35.3	23-118	60.8	15.6	1.4
12 May	4	644	161.0	18-123	65.9	21.3	1.1
19 May	4	606	151.5	28-128	76.5	18.2	1.1
27 May	4	220	55.0	28-113	77.7	17.2	1.3

Table 13. Number and sizes of postlarval and juvenile brown shrimp (P. aztecus) caught with marsh nets in San Antonio Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
Sept. 1978	NS						
19 Sept.	3	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				
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	0	0.0				
9-11 Oct.	8	60	7.5	13-53	24.8	10.5	1.4
22-23-24-25 Oct.	8	17	2.1	18-68	40.4	13.2	3.2
7-8 Nov.	8	5	0.6	28-73	52.0	16.6	7.4
26-27 Nov.	8	2	0.3	43-48	45.5	0.0	0.0
7-10 Dec.	8	0	0.0				
19-20 Dec.	8	1	0.1	48	48.0	0.0	0.0
4-6 June 1980	8	73	9.1	13-63	32.0	15.6	1.8
16-17 June	8	31	3.9	8-63	28.8	15.1	2.7
1-2 July	8	38	4.8	23-93	46.6	12.6	2.0
17-18 July	8	16	2.0	8-53	32.7	14.4	3.6
1-7 Aug.	8	20	2.5	53-113	93.8	13.5	3.0
18-20 Aug.	8	47	5.8	33-108	72.9	20.2	2.9
2-4 Sept.	8	93	11.6	8-73	25.1	13.3	1.4
22-23 Sept.	8	36	4.5	8-78	28.8	16.0	2.7
6-8 Oct.	8	59	7.4	8-73	23.7	12.9	1.7
22-23 Oct.	8	41	5.1	18-38	25.0	6.3	1.0
5-6 Nov.	8	34	4.3	13-58	27.9	10.2	1.7
19 Nov.	8	16	2.0	8-53	23.9	13.3	3.3
1-2 Dec.	8	26	3.3	13-38	22.2	5.0	1.0
16-17 Dec.	8	4	0.5	23	23.0	0.0	0.0

Table 14. 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, June-Dec. 1979, and June-Dec. 1980.

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	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
9-12 Oct.	8	20	2.5	33-98	49.8	13.9	3.1
22-25 Oct.	8	13	1.6	23-68	43.0	15.1	4.2
7-8 Nov.	8	4	0.5	38-93	71.8	20.7	10.4
26-27 Nov.	8	1	0.1	63	63.0	0.0	0.0
7-10 Dec.	8	0	0.0				
19-20 Dec.	8	0	0.0				
4-6 June 1980	8	73	9.1	13-63	32.0	15.5	1.8
16-17 June	8	31	3.9	8-63	28.8	15.1	2.7
4-6 July	8	170	21.3	23-118	78.0	17.0	1.3
16-17 July	8	272	34.0	38-108	74.8	12.6	0.9
1-7 Aug.	8	20	2.5	53-113	93.8	13.5	3.0
18-20 Aug.	7	47	6.7	33-108	72.9	20.2	2.9
2-4 Sept.	8	14	1.8	33-98	64.8	24.5	6.5
22-23 Sept.	8	29	3.6	43-93	72.7	11.7	2.2
6-8 Oct.	8	5	0.6	73-88	83.0	6.1	2.7
22-23 Oct.	8	5	0.6	73-83	78.0	3.5	1.6
5-6 Nov.	8	2	0.3	58	58.0	0.0	0.0
19 Nov.	8	3	0.4	53-63	58.0	7.1	5.0
1-2 Dec.	8	1	0.1	78	78.0	0.0	0.0
16-17 Dec.	8	2	0.3	63-98	80.5	0.0	0.0

Table 15. Number and sizes of brown shrimp (P. aztecus) caught with 6.1-m trawls in San Antonio Bay, Sept.-Dec. 1978, Feb.-Dec. 1979, and Feb.-Dec. 1980.

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	6	0.6	63-93	78.0	8.7	3.5
- Oct.	NS	-	-	-	-	-	-
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				
2 Oct.	10	11	1.1	83-108	93.4	8.7	2.6
15 Oct.	11	23	2.1	58-98	78.0	10.8	2.3
5 Nov.	11	1	0.1	83	83.0	0.0	0.0
19 Nov.	11	3	0.3	63-78	69.7	6.2	3.6
3 Dec.	11	4	0.4	68-78	74.2	4.1	2.1
18 Dec.	11	0	0.0				
14 Feb. 1980	11	0	0.0				
18 Mar.	11	12	1.1	63-93	82.2	9.1	2.6
25 Mar.	11	87	7.9	53-128	97.4	15.6	1.7
21 May	11	750	68.2	43-118	90.4	11.5	0.5
5 June	11	674	61.3	53-143	91.9	13.1	0.6
18 June	11	555	50.4	48-133	89.6	12.2	0.6
3 July	11	211	19.2	53-128	89.0	12.7	0.9
21 July	11	190	17.3	58-148	101.0	13.5	1.0
6 Aug.	11	190	17.3	48-143	99.4	16.9	1.2
19 Aug.	11	215	19.5	43-133	93.7	15.6	1.1
3 Sept.	11	41	3.7	58-148	101.4	17.6	2.8
18 Sept.	11	42	3.8	58-128	89.0	16.0	2.5
7 Oct.	11	53	4.8	68-113	90.4	9.4	1.3
30 Oct.	11	18	1.6	53-103	83.8	13.2	3.1
7 Nov.	11	12	1.1	43-103	84.7	16.7	4.8
24 Nov.	11	2	0.2	88	88.0	0.0	0.0
3 Dec.	11	4	0.4	68-78	74.3	4.8	2.4
18 Dec.	11	2	0.2	63-103	83.0	0.0	0.0

Table 16. Number and sizes of juvenile brown shrimp (P. aztecus) caught with 1.8-m bar seines in Aransas Bay, Apr.-May 1979 and Mar.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2 Apr. 1979	5	6	1.2	18-23	21.3	2.4	1.0
9 Apr.	5	35	7.0	18-38	26.1	5.2	0.9
16 Apr.	5	163	32.6	18-58	36.2	6.4	0.5
23 Apr.	5	195	39.0	13-68	40.4	11.8	0.9
30 Apr.	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
31 Mar. 1980	5	29	5.8	13-58	26.1	8.3	1.6
7 Apr.	5	199	35.4	13-58	26.6	5.3	0.4
15 Apr.	5	144	28.8	13-63	31.5	7.5	0.6
22 Apr.	5	293	33.3	13-63	33.4	8.2	0.5
28 Apr.	5	175	35.0	13-58	37.0	7.9	0.6
5 May	5	421	84.2	13-68	35.3	12.3	0.7
12 May	5	360	72.0	18-78	49.8	12.1	0.8
19 May	5	194	38.8	18-83	50.7	16.8	1.2
27 May	5	227	45.4	23-88	56.0	15.1	1.1

Table 17. Number and sizes of brown shrimp (P. aztecus) caught during 15-min drags of 3.0-m trawls in Aransas Bay, Apr.-1 June and Apr.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 Apr. 1979	5	3	0.6	78-98	89.7	8.5	4.9
10 Apr.	5	2	0.4	88-93	90.5	0.0	0.0
17 Apr.	5	9	1.8	33-48	40.8	5.8	1.9
24 Apr.	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
2-3 Apr. 1980	5	1	0.2	93	93.0	0.0	0.0
9 Apr.	5	3	0.6	28-63	48.0	14.7	8.5
16 Apr.	5	34	6.8	28-123	59.5	30.2	5.2
23 Apr.	5	34	6.8	23-108	49.5	22.3	3.8
29 Apr.	5	218	43.6	28-128	54.9	23.9	1.9
6 May	5	78	15.6	38-108	61.3	14.3	1.6
13 May	5	569	113.8	43-113	70.1	14.9	0.9
20 May	5	505	101.0	33-148	80.6	18.0	0.9
28 May	5	478	95.6	23-118	85.3	15.2	0.9

Table 18. Number and sizes of brown shrimp (P. aztecus) caught with marsh nets in Aransas Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and Mar.-Dec. 1980.

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	0.0
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	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	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
9 Oct.	4	39	9.8	28-68	41.6	9.7	1.6
22 Oct.	4	13	3.3	28-48	39.9	6.1	1.7
5 Nov.	4	5	1.3	18-48	33.0	11.0	4.9
19 Nov.	4	1	0.3	43	43.0	0.0	0.0
3 Dec.	4	0	0.0				
19 Dec.	4	0	0.0				
3 Mar. 1980	5	4	0.8	13-33	20.5	8.3	4.1
10 Mar.	5	50	10.0	13	13.0	0.0	0.0
17 Mar	5	212	42.4	8-38	13.6	3.5	0.3
24 Mar.	5	332	66.4	8-18	13.4	2.1	0.1
9 June	4	77	9.6	18-88	57.7	15.5	1.8
18 June	4	44	11.0	13-78	54.4	16.0	2.4
1 July	4	40	10.0	18-68	37.9	13.3	2.1
14 July	4	4	1.0	28-73	49.3	17.5	8.7
- Aug.	NS	-	-	-	-	-	-
18 Aug.	4	14	3.5	23-53	33.7	9.0	2.4
2 Sept.	3	9	2.2	33-58	45.2	7.9	2.6
15 Sept.	3	6	1.5	33-68	55.5	12.2	5.0
1 Oct.	4	3	0.8	41-53	48.3	6.4	3.7
14 Oct.	4	2	0.5	52-62	57.0	0.0	0.0
3 Nov.	4	0	0.0				
24 Nov.	4	0	0.0				
1 Dec.	4	0	0.0				
17 Dec.	4	0	0.0				

Table 19. Number and sizes of brown shrimp (P. aztecus) caught during 5-min drags of 3.0-m trawls in Aransas Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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				
9 Oct.	3	6	2.0	53-68	63.0	5.8	2.4
22 Oct.	3	16	5.3	38-73	50.2	8.7	2.2
5 Nov.	3	1	0.3	63	63.0	0.0	0.0
19 Nov.	3	4	1.3	63-78	68.0	6.1	3.1
3 Dec.	2	0	0.0				
19 Dec.	2	0	0.0				
9 June 1980	2	515	257.5	33-103	64.5	15.8	1.1
18 June	3	355	118.3	33-98	64.0	13.3	0.9
1 July	2	248	124.0	38-93	71.5	10.2	0.9
14 July	3	348	116.0	23-98	76.9	19.2	1.7
- Aug.	NS	-	-	-	-	-	-
18 Aug.	3	45	15.0	28-83	49.7	14.8	2.2
2 Sept.	3	5	1.7	48-78	63.0	10.0	4.5
15 Sept.	3	11	3.7	48-123	67.6	22.4	6.2
1 Oct.	3	3	1.0	53-88	64.7	20.2	11.7
14 Oct.	3	3	1.0	68-78	73.0	5.0	2.9
3 Nov.	3	1	0.3	48	48.0	0.0	0.0
24 Nov.	3	0	0.0				
1 Dec.	3	0	0.0				
17 Dec.	3	0	0.0				

Table 20. Number and sizes of brown shrimp (P. aztecus) caught with 6.1-m trawls in Aransas Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and Feb.-Dec. 1980.

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
10-11-12 Oct.	12	183	15.3	33-108	79.6	12.0	0.9
23-24 Oct.	12	153	12.8	48-123	75.7	10.7	0.9
7-8 Nov.	12	122	10.2	43-108	75.9	10.1	0.9
20-21 Nov.	12	39	3.3	53-93	73.2	8.1	1.3
4-5 Dec.	12	4	0.3	68-83	76.8	6.5	3.3
18-20 Dec.	12	1	0.1	88	88.0	0.0	0.0
14-15 Feb. 1980	12	0	0.0				
13-14 Mar.	12	31	2.6	28-103	67.5	20.0	3.6
17-18 Apr.	12	60	5.0	28-118	77.8	25.6	3.3
21-22 May	12	1259	104.9	33-138	84.6	14.0	0.5
3-4 June	12	1665	138.8	33-128	83.2	14.7	0.5
16-17 June	12	774	64.5	33-143	89.8	14.2	0.6
2-8-9 July	12	91	7.6	58-128	91.4	12.6	1.3
15-16 July	12	262	21.8	38-128	98.0	14.2	0.9
5 Aug.	6	41	6.8	48-128	97.1	22.3	3.5
19-20 Aug.	12	436	36.3	43-143	86.4	23.0	1.1
3-5-8 Sept.	12	40	3.3	48-128	88.5	15.9	2.5
16-17 Sept.	12	54	4.5	63-113	88.8	10.6	1.4
3-6 Oct.	12	269	22.4	68-133	91.4	10.5	0.7
20-22 Oct.	12	29	2.4	88-123	102.1	9.6	1.8
5-6 Nov.	12	10	0.8	68-108	90.5	13.4	4.2
18-19 Nov.	12	3	0.3	88-103	96.3	7.6	4.4
2-3 Dec.	12	4	0.3	78-113	83.0	15.8	7.9
15-16 Dec.	12	0	0.0				

Table 21. Number and sizes of brown shrimp (P. aztecus) caught with 1.8-m bar seines in lower Laguna Madre, Apr.-May 1979 and Mar.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2-4 Apr. 1979	3	136	45.3	23-78	42.7	12.3	1.2
17 Apr.	3	405	135.0	18-73	42.7	10.2	0.7
30 Apr.	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
28-31 Mar. 1980	3	19	6.3	18-68	38.5	12.3	2.8
14 Apr.	3	121	40.3	23-73	40.2	9.1	0.8
29 Apr.	3	799	266.3	18-78	40.8	13.1	0.7
12-13 May	3	342	114.0	23-73	42.8	11.5	0.8
26-28 May	3	135	45.0	18-68	47.1	11.1	1.0

Table 22. 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 and Mar.-May 1980

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2-4 Apr. 1979	3	42	14.0	23-78	40.9	13.0	2.0
16-17 Apr.	3	313	104.3	28-98	49.9	9.9	0.6
30 Apr.	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
28-31 Mar. 1980	3	62	20.7	28-98	71.3	14.3	1.8
14 Apr.	3	77	25.7	28-93	49.2	16.7	1.9
29 Apr.	3	229	76.3	38-103	69.1	13.5	0.9
12-13 May	3	890	296.7	33-108	63.4	11.7	0.7
26-27 May	3	890	206.7	33-98	62.2	11.8	0.7

Appendix D. Number and sizes of white shrimp collected in Galveston, Matagorda, San Antonio and Aransas Bays and lower Laguna Madre during 1978-80.

Table 1. Number and sizes of white shrimp (P. setiferus) caught during 15-min drags of 3.0-m trawls in Galveston Bay, Apr.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 Apr. 1979	3	17	5.7	78-138	99.5	16.37	3.97
12 Apr.	3	5	0.6	98-118	110.0	7.58	3.39
19 Apr.	3	6	2.0	98-143	115.5	18.10	7.39
24 Apr.	3	6	2.0	108-138	119.7	11.25	4.59
1 May	3	4	1.3	98-138	116.8	17.50	8.75
8 May	3	6	2.0	113-138	122.2	11.14	4.55
15 May	3	3	1.0	123	123.0	-	-
22 May	3	0	0.0				
31 May	3	1	0.3	168	168.0	-	-
31 Mar. 1980	3	28	9.3	58-108	71.2	10.1	1.9
9 Apr.	3	11	3.7	58-108	83.9	15.0	4.5
15 Apr.	3	29	9.7	53-103	82.3	12.2	2.3
23 Apr.	3	2	0.7	83-93	88.0		
28 Apr.	3	1	0.3	83	83.0		
5 May	3	3	1.0	103-123	114.7	8.5	4.9
12 May	3	0	0.0				
20 May	3	0	0.0				
27 May	3	0	0.0				

Table 2. Number and sizes of postlarval and juvenile white shrimp (P. setiferus) caught with marsh nets in Galveston Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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
2-9 Oct.	3	19	6.3	8-73	24.3	16.6	3.8
24-30 Oct.	3	17	5.7	8-63	26.8	17.2	4.2
8-12 Nov.	3	6	2.0	18-33	27.2	5.3	2.2
29-30 Nov.	3	20	6.7	23-48	32.7	7.8	2.0
6-7 Dec.	3	0	0.0				
18-19 Dec.	3	1	0.3	28	28.0		
10-11 June 1980	3	0	0.0				
23-24 June	3	73	24.3	8-43	13.6	6.9	0.8
7-9 July	3	74	24.7	13-53	22.5	6.5	0.8
24-28-29 July	3	35	11.7	8-78	22.3	15.0	2.6
5-6 Aug.	3	66	22.0	8-58	26.3	11.0	1.5
18-19 Aug.	3	40	13.3	8-58	23.9	14.7	2.3
8 Sept.	3	3	1.0	23-58	34.7	16.5	9.5
22 Sept.	3	14	4.7	8-38	15.5	7.5	2.0
7-9 Oct.	3	19	6.3	13-83	39.7	17.9	4.2
23-30-31 Oct.	3	27	9.0	13-73	38.7	15.7	3.0
13 Nov.	2	2	1.0	43	43.0		
26 Nov.	1	0	0.0				
2-3-5 Dec.	3	14	4.7	13-33	24.1	4.5	1.2
17-22 Dec.	3	19	6.3	8-33	19.5	7.2	1.8

Table 3. Number and sizes of white shrimp (P. setiferus) caught during 5-min drags of 3.0-m trawls in Galveston Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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	1578	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	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	1196	398.7	23-138	59.2	15.7	1.0
2-9 Oct.	3	567	189.0	28-123	64.6	16.3	1.2
24-30 Oct.	3	368	122.7	23-128	68.0	22.5	1.2
8-12 Nov.	3	285	95.0	28-103	63.2	18.4	1.4
29-30 Nov.	3	447	149.0	33-108	63.3	15.6	1.5
6-7 Dec.	3	268	89.3	33-98	61.1	12.3	1.1
18-19 Dec.	3	15	5.0	43-88	63.7	12.2	3.2
10-11 June 1980	3	0	0.0				
23-24 June	3	16	5.3	23-58	45.8	11.3	2.8
7-9 July	3	301	100.3	23-98	58.1	14.9	0.9
24-28-29 July	3	308	102.7	28-133	71.4	16.6	1.0
5-6 Aug.	3	873	291.0	28-128	73.5	15.0	1.0
18-19 Aug.	3	128	42.7	23-123	70.0	22.5	2.0
8-9 Sept.	3	429	143.0	33-138	79.9	22.2	1.6
22-23 Sept.	3	1437	479.0	28-138	65.7	17.6	1.0
7-9 Oct.	3	504	168.0	53-128	79.7	16.0	1.0
23-30-31 Oct.	3	231	77.0	33-118	77.5	20.1	1.4
13 Nov.	2	568	284.0	43-118	88.0	15.2	1.1
26 Nov.	1	127	127.0	28-98	64.4	12.3	1.1
2-3-5 Dec.	3	315	105.0	38-118	85.8	15.9	1.5
17-22 Dec.	3	108	36.0	28-93	66.0	13.4	1.3

Table 4 . Number and size of white shrimp (P. setiferus) caught with 6.1-m trawls in Galveston Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and Feb.-Dec. 1980.

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
2-3-9 Oct.	15	798	53.2	38-163	90.9	17.0	0.6
24-25-29-30 Oct.	18	1666	92.6	38-143	89.5	15.2	0.5
8-12-13 Nov.	18	1517	84.3	38-138	87.6	14.3	0.4
27-29-30 Nov.	18	1267	70.4	33-128	76.8	14.0	0.6
6-7-10 Dec.	18	307	17.1	48-113	78.4	11.7	0.7
18-19 Dec.	18	200	11.1	43-103	77.5	10.6	0.8
19-21 Feb. 1980	18	358	19.9	48-128	85.1	11.5	0.7
18-19-21 Mar.	18	184	10.2	53-138	87.3	13.7	1.0
16-17-22 Apr.	18	322	17.9	68-158	99.0	16.0	0.9
13-14-21 May	18	127	7.1	93-168	125.5	16.8	1.5
10-11-12 June	18	9	0.5	133-148	144.1	4.6	1.5
23-24-27 June	18	8	0.4	58-163	120.5	42.6	15.5
7-8-9-10 July	18	49	2.7	48-153	80.0	17.3	2.5
21-24-28-29 July	18	325	18.1	53-123	92.7	14.5	0.8
6-12 Aug.	18	661	36.7	53-143	103.8	15.9	0.6
16-19-20 Aug.	18	366	20.3	48-148	103.7	19.8	1.2

Table 4. (Cont'd.)

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
8-9-10 Sept.	18	347	19.3	43-173	110.5	20.5	1.1
22-23-24 Sept.	18	529	29.4	38-153	99.3	19.3	1.0
7-9-10 Oct.	18	973	54.1	53-153	99.4	15.1	0.6
22-23-30 Oct.	18	2530	140.6	43-148	89.4	4.8	1.8
5-13-15 Nov.	7	475	67.9	43-128	90.4	12.7	0.7
24-26 Nov.	6	27	4.5	48-108	71.6	15.2	2.9
3-4-5 Dec.	18	291	16.2	48-153	87.4	15.2	0.9
16-17-18-23 Dec.	18	362	20.1	53-138	91.9	11.2	0.7

Table 5. Number and sizes of white shrimp (P. setiferus) caught during 15-min drags of 3.0-m trawls in Matagorda Bay, Apr.-May 1979 and Apr.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
5 Apr. 1979	4	81	20.3	68-138	100.5	14.98	1.66
10 Apr.	4	25	6.3	78-133	104.4	12.87	2.57
18 Apr.	4	36	9.0	83-123	107.9	8.90	1.48
24 Apr.	4	19	4.8	103-138	122.2	10.71	2.46
2 May	4	1	0.3	113	113.0	-	-
8 May	4	2	0.5	123-128	125.5	3.53	2.50
16 May	4	0	0.0				
22 May	4	1	0.3	123	123.0	-	-
1 Apr. 1980	4	4	1.0	48-78	66.8	11.4	5.7
8 Apr.	4	11	2.8	63-98	78.0	10.4	3.1
15 Apr.	4	24	6.0	73-98	85.5	7.5	2.2
23 Apr.	4	21	5.3	68-123	86.1	11.4	2.5
29 Apr.	4	22	5.5	73-113	92.8	11.8	2.5
6 May	4	24	6.0	78-128	100.1	13.6	3.9
13 May	4	3	0.8	118-128	119.7	2.4	1.4
20 May	4	2	0.5	113-118	115.5		
26 May	4	0	0.0				

Table 6. Number and sizes of postlarval and juvenile white shrimp (P. setiferus) caught with marsh nets in Matagorda Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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		
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				
17 Oct.	3	28	9.3	13-53	21.6	9.2	1.7
12 Nov.	3	80	26.7	13-53	24.0	7.2	0.8
20 Dec.	3	0	0.0				
12 June 1980	3	0	0.0				
11 July	3	54	18.0	13-28	19.9	4.2	0.6
15 Aug.	3	45	15.0	8-28	14.6	2.8	0.4
11 Sept.	3	31	10.3	13-43	27.4	7.9	1.4
16 Oct.	3	6	2.0	28-68	47.2	15.6	6.4
12 Nov.	3	5	1.7	23-53	32.0	13.4	6.0
10-11 Dec.	3	5	1.7	13-28	20.0	5.7	2.5

Table 7. Number and sizes of white shrimp (P. setiferus) caught during 5-min drags of 3.0-m trawls in Matagorda Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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				
17 Oct.	3	319	106.3	13-83	41.3	19.1	1.3
12 Nov.	3	173	57.7	13-83	41.9	17.0	1.3
20 Dec.	3	0	0.0				
12 June 1980	3	0	0.0				
11 July	3	312	104.0	23-108	55.1	19.2	1.4
15 Aug.	3	455	151.7	33-113	71.1	16.2	1.1
11 Sept.	3	593	197.7	28-103	65.0	18.8	1.3
16 Oct.	3	93	31.0	18-98	62.4	19.3	2.0
12 Nov.	3	204	68.0	23-88	60.9	13.2	0.9
11 Dec.	3	0	0.0				

Table 8. Number and sizes of white shrimp (P. setiferus) caught with 6.1-m trawls in Matagorda Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and June-Dec. 1980.

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
16-17 Oct.	9	186	20.7	38-138	85.1	15.3	1.1
20-21 Nov.	9	298	33.1	43-133	80.9	11.7	1.0
20 Dec.	9	0	0.0				
27 Feb. 1980	9	0	0.0				
28 Mar.	9	73	8.1	63-113	84.7	9.3	1.1
29 Apr.	9	457	50.8	78-143	104.0	13.6	1.0
22-23 May	9	131	14.6	93-158	129.6	12.5	1.1
17 June	9	18	2.0	138-163	151.9	8.4	2.0
15 July	9	156	17.3	58-143	85.4	13.9	1.1
13 Aug.	9	897	99.7	68-148	114.2	15.6	0.9
19 Sept.	9	118	13.1	73-163	121.5	17.3	1.6
15-22 Oct.	9	838	93.1	53-178	82.8	34.3	1.7
19 Nov.	9	30	3.3	38-108	80.3	13.1	2.4
18 Dec.	9	0	0.0				

Table 9. Number and sizes of white shrimp (P. setiferus) caught during 15-min drags of 3.0-m trawls in San Antonio Bay, Apr.-May 1979 and Mar.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 Apr. 1979	4	0	0.0				
9 Apr.	4	0	0.0				
16 Apr.	4	6	1.5	108-128	120.5	7.58	3.10
23 Apr.	4	1	0.3	113			
30 Apr.-1 May	4	1	0.3	128			
7 May	4	0	0.0				
15 May	4	0	0.0				
21 May	4	0	0.0				
29 May	4	0	0.0				
31 Mar. 1980	4	4	1.0	53-63	56.8	4.1	2.1
7 Apr.	4	0	0.0				
16 Apr.	4	1	0.3	63	63.0		
22 Apr.	4	0	0.0				
28 Apr.	4	1	0.3	83	83.0		
5 May	4	0	0.0				
12 May	4	1	0.3	108	108.0		
19 May	4	0	0.0				
27 May	4	0	0.0				

Table 10. Number and sizes of postlarval and juvenile white shrimp (P. setiferus) caught with marsh nets in San Antonio Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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		
16 Oct.	3	1	0.3	23	23.0		
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		
9-11 Oct.	8	41	5.1	13-73	26.9	12.5	2.0
22-23-24-25 Oct.	8	1	0.1	8	8.0		
7-8 Nov.	8	8	1.0	18-63	28.6	14.4	5.1
26-27 Nov.	8	14	1.8	13-33	16.6	6.4	1.7
7-10 Dec.	8	5	0.6	18-43	25.0	9.8	4.4
19-20 Dec.	8	0	0.0				
4-6 June 1980	8	0	0.0				
16-17 June	8	0	0.0				
1-2 July	8	2	0.3	38	38.0		
17-18 July	8	4	0.5	8-13	11.8	2.2	1.1
1-7 Aug.	8	0	0.0				
18-20 Aug.	8	2	0.3	8-13	10.5		
2-4 Sept.	8	99	12.4	8-33	16.5	5.2	0.5
22-23 Sept.	8	0	0.0				
6-8 Oct.	8	5	0.6	8-73	23.0	28.1	12.5
22-23 Oct.	8	17	2.1	23-103	39.8	23.0	5.6
5-6 Nov.	8	2	0.3	28-38	33.0		
19 Nov.	8	1	0.1	43	43.0		
1-2 Dec.	8	3	0.4	28-43	36.3	7.6	4.4
16-17 Dec.	8	0	0.0				

Table 11. 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, June-Dec. 1979 and June-Dec. 1980.

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		
9-11-12 Oct.	8	111	13.9	33-118	75.4	19.9	1.9
22-25 Oct.	8	68	8.5	23-123	57.1	26.6	3.2
7-8 Nov.	8	42	5.3	23-103	73.2	17.3	2.7
26-27 Nov.	8	32	4.0	33-83	58.3	13.2	2.3
7-10 Dec.	8	6	0.8	43-88	57.0	17.1	7.7
19-20 Dec.	8	1	0.1	63	63.0	0.0	0.0
4-6 June 1980	8	0	0.0				
16-17 June	8	0	0.0				
1-2 July	8	18	2.3	48-158	65.8	23.2	5.5
17-18 July	8	3	0.4	38-63	53.0	10.8	5.2
1-7 Aug.	8	33	4.1	48-108	81.3	13.1	2.3
18-20 Aug.	8	41	5.1	33-113	78.5	15.9	2.5
2-4 Sept.	8	16	2.1	23-113	48.3	27.6	6.9
22-23 Sept.	8	120	15.0	38-98	65.8	13.6	1.3
6-8 Oct.	8	50	6.3	58-133	85.3	16.4	2.3
22-23 Oct.	8	28	3.5	38-118	80.5	21.5	4.1
5-6 Nov.	8	3	0.4	43-73	61.3	16.1	9.3
19 Nov.	8	2	0.3	43-48	45.5		
1-2 Dec.	8	22	2.8	58-93	73.0	11.6	2.7
16-17 Dec.	8	32	4.0	38-78	56.4	10.5	1.9

Table 12. Number and sizes of white shrimp (P. setiferus) caught with 6.1-m trawls in San Antonio Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and Feb-Dec. 1980.

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		
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
2 Oct.	11	84	7.6	43-153	95.6	18.5	2.0
15 Oct.	11	287	26.1	28-128	95.2	19.0	1.1
5 Nov.	11	191	17.4	43-128	85.4	19.7	1.4
19 Nov.	11	95	8.6	48-118	83.0	15.9	1.6
3 Dec.	11	17	1.5	43-123	79.2	17.7	4.3
18 Dec.	11	6	0.5	53-78	61.3	9.0	3.7
14 Feb. 1980	11	2	0.2	68-88	78.0		
18 Mar.	11	3	0.3	58-93	74.7	14.3	8.3
25 Apr.	11	19	1.7	78-133	102.7	15.9	3.8
21 May	11	6	0.5	123-158	134.7	13.4	5.5
5 June	11	0	0.0				
18 June	11	0	0.0				
3 July	11	4	0.4	63-185	142.5	46.9	23.4
21 July	11	17	1.5	58-113	84.2	18.7	4.5
6 Aug.	11	103	9.4	58-138	98.4	19.4	1.9
19 Aug.	11	112	10.2	53-153	99.4	17.2	1.6
3 Sept.	11	16	1.5	38-128	105.5	20.7	5.2
18 Sept.	11	13	1.2	68-98	95.7	20.7	5.8
7 Oct.	11	69	6.3	63-128	94.2	12.5	1.5
30 Oct.	11	291	25.5	33-133	99.2	18.0	1.1
7 Nov.	11	81	7.4	38-123	81.4	38.9	4.4
24 Nov.	11	62	5.6	53-118	85.9	16.2	2.1
3 Dec.	11	17	1.5	48-108	75.7	15.9	3.9
18 Dec.	11	2	0.2	63	63.0		

Table 13. Number and sizes of white shrimp (P. setiferus) caught during 15-min drags of 3.0-m trawls in Aransas Bay, Apr.-June 1979 and Apr.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
4 Apr. 1979	5	11	2.0	48-123	105.3	19.4	5.8
10 Apr.	5	12	2.4	103-128	114.7	10.7	3.1
17 Apr.	5	5	1.0	103-143	0.0		
24 Apr.	5	2	0.4	123	123.0		
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		
1 June	5	1	0.2	28	28.0		
2 Apr. 1980	5	0	0.0				
9 Apr.	5	10	2.0	53-118	93.0	19.4	6.1
16 Apr.	5	6	1.2	58-108	91.3	16.2	6.6
23 Apr.	5	9	1.8	73-113	100.2	11.6	3.9
29 Apr.	5	8	1.6	98-143	122.4	13.3	4.7
6 May	5	29	5.8	83-138	107.7	12.2	2.3
13 May	5	0	0.0				
20 May	5	7	1.4	128-158	142.3	10.8	4.1
28 May	5	0	0.0				

Table 14. Number and sizes of postlarval and juvenile white shrimp (P. setiferus) caught with marsh nets in Aransas Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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	8-63	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
9 Oct.	4	36	9.0	18-53	29.0	9.4	1.6
22 Oct.	4	90	22.5	13-78	23.3	9.2	1.0
5 Nov.	4	14	3.7	18-73	39.1	14.4	3.9
19 Nov.	4	44	11.0	8-33	24.4	5.9	0.9
3 Dec.	4	3	0.8	18-43	26.3	11.8	6.8
17-19 Dec.	4	0	0.0				
9 June 1980	4	0	0.0				
18 June	4	1	0.3	28	28.0		
1 July	4	7	1.8	13-18	15.0	2.4	1.1
14 July	4	48	12.0	8-53	20.2	10.5	1.6
Aug.	NS	-	-	-	-	-	-
18 Aug.	4	33	8.3	13-63	31.0	11.0	1.9
2 Sept.	4	25	6.2	13-103	30.1	17.3	3.5
15 Sept.	4	11	2.8	18-43	25.3	7.2	2.2
1 Oct.	4	23	5.8	13-73	34.2	21.1	4.6
14 Oct.	4	28	7.0	23-73	31.6	11.7	2.2
3 Nov.	4	3	0.8	13-38	21.3	14.4	8.3
24 Nov.	4	1	0.3	33	33.0		
1 Dec.	4	1	0.3	53	53.0		
17 Dec.	4	0	0.0				

Table 15. Number and sizes of white shrimp (*P. setiferus*) caught during 5-min drags of 3.0-m trawls in Aransas Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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
9 Oct.	3	232	77.2	23-103	61.6	17.7	1.3
22 Oct.	3	257	85.7	18-98	61.3	18.9	1.2
5 Nov.	3	148	49.3	23-118	62.1	19.8	1.6
19 Nov.	3	51	17.0	33-83	62.2	14.0	2.0
3 Dec.	2	14	7.0	38-78	61.6	12.7	3.4
19 Dec.	2	0	0.0				
9 June 1980	2	0	0.0				
18 June	3	0	0.0				
1 July	3	2	0.7	53-58	55.5		
14 July	3	119	39.7	18-83	38.0	13.5	1.2
Aug.	NS	-	-	-	-	-	-
8 Aug.	3	60	20.0	28-93	68.8	11.0	1.4
2 Sept.	3	89	29.7	23-108	74.2	17.6	1.9
15 Sept.	3	122	40.7	23-153	75.4	22.7	2.1
1 Oct.	3	149	49.7	28-118	64.4	19.1	1.6
14 Oct.	3	66	22.0	23-113	64.4	23.5	2.9
3 Nov.	3	67	22.3	23-108	68.2	23.3	2.8
24 Nov.	3	9	3.0	28-83	55.8	16.0	5.3
1 Dec.	3	1	0.3	69	69.0		
17 Dec.	3	7	2.3	38-73	51.6	11.8	4.5

Table 16. Number and sizes of white shrimp (P. setiferus) caught with 6.1-m trawls in Aransas Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and Feb.-Dec. 1980.

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	0.3	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
10-11-12 Oct.	12	1064	88.7	33-158	87.6	20.0	0.7
23-24 Oct.	12	2043	170.3	38-153	87.0	17.6	0.6
7-8 Nov.	12	796	66.3	43-133	84.0	14.6	0.6
20-21 Nov.	12	535	44.6	43-118	85.0	13.0	0.6
4-5 Dec.	12	119	9.9	53-108	81.7	11.3	1.0
18-20 Dec.	12	23	1.9	58-118	77.3	13.9	3.0
14-15 Feb. 1980	12	7	0.6	58-73	67.3	5.0	1.9
13-14 Mar.	12	25	2.1	53-103	72.4	12.0	2.4
17-18 Apr.	12	48	4.0	73-158	97.7	17.0	2.5
21-22 May	12	21	1.8	108-163	136.8	14.6	3.2
3-4 June	12	32	2.7	128-173	150.3	9.2	1.7
16-17 June	12	8	0.7	148-168	158.0	5.6	2.0
2-8-9 July	12	1	0.1	88	88.0		
15-16 July	12	7	0.6	23-83	44.4	20.8	8.0
5 Aug.	6	7	1.2	43-113	84.4	29.4	11.1
19-20 Aug.	12	1034	86.2	43-153	94.9	20.7	1.1
3-5-8 Sept.	12	80	6.7	78-153	110.8	18.0	2.0
16-17 Sept.	12	40	3.3	73-158	116.6	19.6	3.1

Table 16. Cont'd.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
3-6 Oct.	12	166	13.8	22-158	96.6	19.9	1.6
20-22 Oct.	12	196	16.3	38-148	96.4	21.5	1.6
5-6 Nov.	12	73	6.1	53-143	95.1	18.7	2.2
18-19 Nov.	12	487	40.6	38-128	94.5	17.8	1.0
2-3 Dec.	12	16	1.3	48-108	81.1	15.2	3.8
15-16 Dec.	12	3	0.3	63-93	79.7	15.3	8.8

Appendix E. Number and sizes of pink shrimp collected in Galveston, San Antonio, Aransas Bay and lower Laguna Madre during 1978-80.

Table 1. Number and size of pink shrimp (P. duorarum) caught with 6.1-m trawls in Galveston Bay, Feb. through Dec. 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
19-21 Feb. 1980	18	0	0.0				
18-19-21 Mar.	18	1	0.1	103	103.0		
16-17-22 Apr.	18	0	0.0				
13-14-21 May	18	3	0.2	33-68	48.7	14.7	8.5
10-11-12 June	18	0	0.0				
23-24-27 June	18	0	0.0				
7-8-9-10 July	18	0	0.0				
21-24-28-29 July	18	0	0.0				
6-12 Aug.	18	0	0.0				
16-19-20 Aug.	18	0	0.0				
8-9-10 Sept.	18	0	0.0				
22-23-24 Sept.	18	0	0.0				
7-9-10 Oct.	18	0	0.0				
22-23-30 Oct.	18	0	0.0				
5-13 Nov.	7	0	0.0				
24-26 Nov.	6	0	0.0				
2-3-4-5 Dec.	18	0	0.0				
16-17-18-23 Dec.	18	0	0.0				

Table 2. Number and sizes of pink shrimp (P. duorarum) caught during 15-min drags of 3.0-m trawls in San Antonio Bay, Mar.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
31 Mar. 1980	4	0	0.0				
7 Apr.	4	0	0.0				
16 Apr.	4	9	2.3	58-103	90.2	12.9	4.3
22 Apr.	4	4	1.0	68-83	75.5	5.6	2.8
28 Apr.	4	0	0.0				
5 May	4	0	0.0				
12 May	4	0	0.0				
19 May	4	0	0.0				
27 May	4	0	0.0				

Table 3. Number and sizes of pink shrimp (P. duorarum) caught with 6.1-m trawls in San Antonio Bay, Oct.-Dec. 1979 and Feb.-Dec. 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2 Oct. 1979	10	0	0.0				
15 Oct.	11	0	0.0				
5 Nov.	11	0	0.0				
19 Nov.	11	0	0.0				
3 Dec.	11	0	0.0				
18 Dec.	11	0	0.0				
14 Feb. 1980	11	0	0.0				
18 Mar.	11	8	0.7	58-93	79.2	11.7	4.1
25 Apr.	11	32	2.9	83-123	107.7	8.7	1.5
21 May	11	1	0.1	118	118.0	0.0	0.0
5 June	11	0	0.0				
18 June	11	0	0.0				
3 July	11	0	0.0				
21 July	11	0	0.0				
6 Aug.	11	0	0.0				
19 Aug.	11	0	0.0				
3 Sept.	11	0	0.0				
18 Sept.	11	0	0.0				
7 Oct.	11	0	0.0				
30 Oct.	11	0	0.0				
7 Nov.	11	0	0.0				
24 Nov.	11	0	0.0				
3 Dec.	11	0	0.0				
18 Dec.	11	0	0.0				

Table 4. Number and sizes of pink shrimp (P. duorarum) caught during 15-min drags of 3.0-m trawls in Aransas Bay, Apr.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2-3 Apr. 1980	5	0	0.0				
9 Apr.	5	0	0.0				
16 Apr.	5	0	0.0				
23 Apr.	5	0	0.0				
29 Apr.	5	13	2.6	68-123	98.4	13.4	3.7
6 May	5	0	0.0				
13 May	5	0	0.0				
20 May	5	4	0.8	78-98	89.3	7.4	3.7

Table 5. Number and sizes of pink shrimp (P. duorarum) caught with marsh nets in Aransas Bay, Oct.-Dec. 1979 and Mar.-Dec. 1980

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
9 Oct. 1979	4	90	22.5	13-63	37.1	11.8	1.2
22 Oct.	4	10	2.5	26-68	43.5	11.9	3.8
5 Nov.	4	0	0.0				
19 Nov.	4	0	0.0				
3 Dec.	4	0	0.0				
17-19 Dec.	4	0	0.0				
9 June 1980	4	0	0.0				
18 June	4	0	0.0				
1 July	4	0	0.0				
14 July	4	0	0.0				
Aug.	NS	-	-	-	-	-	-
18 Aug.	4	0	0.0				
2 Sept.	4	35	8.8	28-63	38.1	8.7	1.5
15 Sept.	4	22	5.5	28-63	43.2	11.6	2.3
1 Oct.	4	23	5.8	28-73	48.4	10.9	2.3
14 Oct.	4	21	5.3	23-53	35.9	6.2	1.4
3 Nov.	4	2	0.5	13-38			
24 Nov.	4	9	2.3	28-48	39.1	7.8	2.6
1 Dec.	4	57	14.3	18-63	37.6	10.6	1.4
17 Dec.	4	22	5.5	13-48	31.9	10.1	2.2

Table 6. Number and sizes of pink shrimp (P. duorarum) caught during 5-min drags of 3.0-m trawls in Aransas Bay, Oct.-Dec. 1979 and June-Dec. 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
9 Oct. 1979	3	0	0.0				
22 Oct.	3	0	0.0				
5 Nov.	3	1	0.3	58	58.0		
19 Nov.	3	0	0.0				
3 Dec.	3	0	0.0				
19 Dec.	3	0	0.0				
9 June 1980	2	0	0.0				
18 June	3	0	0.0				
1 July	2	0	0.0				
14 July	3	0	0.0				
Aug.	NS	-	-	-	-	-	-
18 Aug.	3	0	0.0				
2 Sept.	3	10	3.3	43-83	55.5	12.3	3.9
15 Sept.	3	32	10.7	28-73	49.3	12.0	2.1
1 Oct.	3	4	1.3	43-53	48.0	3.5	1.8
14 Oct.	3	4	1.3	48-58	51.8	4.8	2.4
3 Nov.	3	15	5.0	33-73	49.7	11.3	2.9
24 Nov.	3	8	2.7	28-58	49.9	10.3	3.7
1 Dec.	3	2	0.7	48-63	55.0		
17 Dec.	3	5	1.7	38-58	51.0	7.6	3.4

Table 7. Number and sizes of pink shrimp (P. duorarum) caught with 6.1-m trawls in Aransas Bay, Sept.-Dec. 1978 thru Feb.-Dec. 1980.

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
11-12 Oct.	12	20	1.7	63-88	75.0	7.3	1.6
23-24 Oct.	12	21	1.8	43-88	66.6	11.2	2.5
7-8 Nov.	12	7	0.6	48-83	70.9	10.3	3.9
20-21 Nov.	12	1	0.1	73	73.0		
4-5 Dec.	12	10	0.8	63-88	76.0	9.3	2.9
18-20 Dec.	12	0	0.0				
14-15 Feb. 1980	12	0	0.0				
13-14 Mar.	12	22	1.8	68-103	81.2	10.5	2.2
17-18 Apr.	12	12	1.0	58-108	88.0	13.4	3.9
21-22 May	12	0	0.0				
3-4 June	12	0	0.0				
16-17 June	12	0	0.0				
8-9 July	11	0	0.0				
15-16 July	12	0	0.0				
5 Aug.	6	0	0.0				
19-20 Aug.	12	1	0.1	98	98.0		
5-6-8 Sept.	12	0	0.0				
16-17 Sept.	12	20	1.7	38-113	73.0	16.8	3.8
3-6 Oct.	12	148	12.3	38-113	90.6	12.7	1.0
20-22 Oct.	12	351	29.3	53-123	93.4	10.6	0.7
5-6 Nov.	12	22	1.8	43-103	78.2	18.6	4.0
18-19 Nov.	12	134	11.2	53-123	86.1	14.2	1.2
2-3 Dec.	12	10	0.8	53-98	69.5	16.2	5.1
15-16 Dec.	12	9	0.8	48-93	73.6	11.8	4.0

Table 8. Number and sizes of pink shrimp (P. duorarum) caught with 1.8-m bar seines in lower Laguna Madre, Mar.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
22 Mar. 1980	3	16	5.3	33-88	48.9	14.2	3.5
14 Apr.	3	0	0.0				
29 Apr.	3	0	0.0				
12-13 May	3	0	0.0				
26-28 May	3	0	0.0				

Table 9. 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 and Mar.-May 1980.

Sample Date	No. of Samples	No. Shrimp Caught	Catch Per Drag	Size Range (mm)	Mean Size (mm)	SD	SE
2-4 Apr. 1979	3	33	11.0	53-103	82.5	9.3	1.6
17 Apr.	3	16	5.3	68-108	84.9	10.1	2.5
30 Apr.	3	0	0.0				
15 May	3	2	0.7	88-103	95.5	0.0	0.0
28 Mar. 1980	3	4	1.3	68-93	80.5	10.3	5.2
14 Apr.	3	0	0.0				
29 Apr.	3	0	0.0				
12-13 May	3	0	0.0				
26-27 May	3	0	0.0				

Appendix F. Hydrological data associated with shrimp samples collected in Galveston, Matagorda, San Antonio, Aransas Bays and lower Laguna Madre during 1979-80.

Table 1. Hydrological data associated with 1.8-m bar seines in Galveston Bay, Apr.-May 1979 and Mar.-May 1980.

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	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
31 Mar. 1980	5	19.6-20.7	20.3	0.4	0.2	0.0-12.8	6.5	4.9	2.2
7 Apr.	5	20.0-20.3	20.1	0.1	0.1	0.0-15.5	5.5	5.9	2.5
15 Apr.	5	18.0-22.3	19.3	2.4	1.1	5.0-9.4	8.6	3.2	1.4
22 Apr.	5	21.0-28.0	25.8	2.5	1.1	7.2-17.8	10.2	4.3	1.9
28 Apr.	4-5	21.0-26.2	23.5	2.1	1.0	5.6-25.5	12.2	7.5	3.4
5 May	5	25.8-32.8	28.7	2.3	1.1	8.9-21.7	13.9	4.4	1.9
12 May	5	25.3-28.0	26.6	1.2	0.6	9.4-23.9	15.5	4.7	2.1
20 May	5	24.8-34.2	29.2	3.2	1.5	0.0-12.2	5.0	5.5	2.4
27 May	5	28.9-34.2	31.5	2.2	1.0	1.1-20.5	9.5	6.5	2.9

Table 2. Hydrological data associated with 15-min drags of 3.0-m trawls in Galveston Bay, Apr.-May 1979 and Mar.-May 1980.

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
31 Mar. 1980	3	17.7-19.5	18.9	0.8	0.5	3.9-17.8	10.6	5.7	3.3
9 Apr.	2-3	18.7-23.3	21.0			4.4-12.2	8.3	3.2	1.8
15 Apr.	3	17.3-18.5	17.8	0.5	0.3	7.2-24.4	13.5	7.7	4.5
23 Apr.	3	21.0-22.5	21.6	0.6	0.4	8.3-24.4	16.1	6.6	3.8
28 Apr.	3	19.2-20.3	19.8	0.4	0.3	11.7-28.3	18.3	7.2	4.1
5 May	3	15.5-26.8	21.9	4.7	2.7	10.5-23.9	16.5	5.6	3.2
12 May	3	23.4-27.0	25.6	1.6	0.9	14.4-30.5	20.3	7.2	4.2
20 May	3	24.9-25.9	25.5	0.4	0.3	9.9-15.5	13.3	2.4	1.4
27 May	3	27.7-30.4	29.9	1.7	1.0	8.9-18.9	13.0	4.3	2.5

Table 3. Hydrological data associated with marsh nets in Galveston Bay Sept.-Dec. 1978, Feb.-Dec. 1979 and June-Dec. 1980.

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	28.4-32.8	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
2-9 Oct.	2-3	27.0-27.5	27.3			0.5-3.9	1.8	1.5	0.9
24-30 Oct.	2-3	23.0-23.2	23.1			0.0-11.6	5.9	4.7	2.7
8-12 Nov.	3	17.5-19.4	18.7	0.9	0.5	3.3-6.7	4.8	1.4	0.8
29-30 Nov.	3	10.3-12.5	11.7	1.0	0.6	0.0-8.3	3.9	3.4	2.0
6-7 Dec.	3	14.2-14.8	14.4	0.3	0.2	4.4-10.0	7.6	2.3	1.4
18-19 Dec.	3	10.2-12.2	11.4	0.9	0.5	0.0-6.7	4.1	2.9	1.7

Table 3. Cont'd.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
3 Mar. 1980	3	6.8-8.8	7.9	0.8	0.5	8.8-15.5	11.1	3.1	1.8
10 Mar.	3	18.8-26.9	24.1	3.7	2.2	7.2-18.9	13.1	4.8	2.8
17 Mar.	3	18.8-28.5	22.1	4.5	2.6	11.1-20.0	14.6	3.9	2.2
24 Mar.	2-3	17.5-27.3	22.4			10.0-20.0	13.7	4.5	2.6
10-11 June	3	29.1-30.8	29.9	0.7	0.4	0.0-8.9	5.7	4.1	2.3
23-24 June	3	29.0-32.3	30.8	1.4	0.8	0.0-7.8	4.3	3.2	1.9
7-9 July	3	32.0-33.5	32.7	0.6	0.4	2.2-12.8	7.6	4.3	2.5
24-28-29 July	3	27.5-31.2	28.7	1.7	1.0	0.0-11.1	7.0	5.0	2.9
5-6 Aug.	3	30.0-32.0	30.7	0.9	0.5	2.8-15.0	9.8	5.2	3.0
18-19 Aug.	3	28.8-33.0	30.5	1.8	1.0	2.8-18.9	12.4	6.9	4.0
8-9 Sept.	3	26.5-30.5	29.0	1.8	1.0	0.0-16.7	10.6	7.5	4.3
22-23 Sept.	3	29.9-31.8	30.6	0.9	0.5	2.2-16.1	11.3	7.8	4.5
7-9 Oct.	3	23.0-25.4	25.4	1.3	0.8	5.0-14.4	10.5	4.9	2.8
23-30-31 Oct.	3	15.0-24.0	18.3	4.9	2.8	2.8-16.7	12.1	8.0	4.6
13 Nov.	2	19.5-20.6	20.1			17.8-22.2	20.0		
26 Nov.	1	8.0	8.0			18.3	18.3		
2-3-5 Dec.	3	14.3-16.6	15.3	1.2	0.7	2.8-20.0	13.9	9.6	5.6
17-22 Dec.	3	7.5-15.5	12.3	4.3	2.5	8.3-17.8	14.4	5.3	3.1

Table 4. Hydrological data associated with 5-min drags of 3.0-m trawls in Galveston Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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 Sept.	3	23.0-24.0	23.5	0.4	0.2	1.1-2.2	1.8	0.5	0.3
2-9 Oct.	2-3	26.5-27.0	26.8			0.0-3.9	1.7	1.6	1.0
24-30 Oct.	3	20.2-23.5	21.7	1.4	0.9	0.0-6.7	3.5	2.8	1.6
8-12 Nov.	3	16.3-19.2	18.1	1.3	0.7	4.4-5.5	4.8	0.5	0.3
29-30 Nov.	3	9.5-12.8	11.5	1.5	0.8	0.0-7.2	3.7	3.0	1.7
6-7 Dec.	3	14.0-14.4	14.1	0.2	0.1	6.1-11.1	8.7	2.0	1.2
18-19 Dec.	3	9.4-11.2	10.2	0.7	0.4	5.0-10.0	7.2	2.1	1.2

Table 4. Cont'd.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
10-11 June 1980	3	27.8-29.2	28.4	0.6	0.3	0.0-8.9	5.4	3.9	2.2
23-24 June	3	29.7-31.7	30.8	0.8	0.5	0.0-8.3	5.4	3.8	2.2
7-9 July	3-2	31.3-32.2	31.8	0.4	0.2	3.3-7.8	5.6		
24-28-29 July	3	28.0-30.0	28.9	0.8	0.5	0.0-20.5	10.2	8.4	4.8
5-6 Aug.	3	29.5-30.0	29.8	0.2	0.1	6.7-16.1	11.7	3.9	2.2
18-19 Aug.	3	29.2-31.0	30.1	0.7	0.4	7.2-23.9	15.5	6.8	3.9
8-9 Sept.	3	26.5-30.0	28.5	1.5	0.8	0.0-17.8	10.7	7.7	4.5
22-23 Sept.	3	29.1-31.4	30.0	1.0	0.6	11.1-20.1	16.0	3.7	2.1
7-9 Oct.	2	22.8-24.3	23.6			4.4-13.3	8.9		
23-30-31 Oct.	3	13.0-24.0	17.7	5.7	3.3	8.3-16.7	13.9	4.8	2.8
13 Nov.	2	18.0-20.2	19.1			17.8-22.2	20.0		
26 Nov.	1	9.0	9.0			21.1	21.1		
2-3-5 Dec.	3	14.2-18.3	16.0	2.1	1.2	10.0-22.8	17.2	6.6	3.8
17-22 Dec.	3	8.0-15.0	12.1	3.7	2.1	13.3-18.9	16.8	3.1	1.8

Table 5. Hydrological data associated with 6.1-m trawls in Galveston Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and Feb.-Dec. 1980

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
5-6-12 Sept. 1978	15	26.3-31.0	28.3	1.2	0.3	15.5-30.0	21.1	3.7	1.0
18-19-26 Sept.	15	24.7-30.1	27.9	1.7	0.4	13.9-24.4	20.7	3.5	0.9
2-3-12 Oct.	15	24.2-28.0	25.9	1.0	0.3	13.9-25.0	20.2	3.1	0.8
24-25-27 Oct.	15	21.8-24.1	22.7	0.7	0.2	17.2-26.6	21.7	3.1	0.8
8-9-10 Nov.	15	17.6-19.7	18.4	0.6	0.2	15.5-27.8	21.6	3.4	0.9
20-21-22 Nov.	15	16.6-17.8	17.4	0.4	0.1	16.7-26.6	21.6	3.1	0.8
5-6-13-15 Dec.	15	8.9-17.8	12.6	2.4	0.6	14.4-23.8	19.8	3.6	0.9
22-27-28-29 Dec.	15	11.5-16.7	13.3	1.3	0.3	14.9-26.6	20.1	3.6	0.9
14-15-23 Feb. 1979	15	11.8-17.1	14.0	1.7	0.4	5.0-19.4	11.6	4.9	1.3
13-14-26 Mar.	15	16.4-19.2	17.8	0.9	0.2	1.1-22.8	12.6	5.6	1.4
12-13-23 Apr.	15	21.5-23.6	22.3	0.7	0.2	0.0-17.2	9.5	6.0	1.6
15-16-17 May	15	22.5-26.5	24.4	1.0	0.3	0.0-12.2	4.7	4.2	1.1
6-7-8 June	15	27.5-29.0	28.0	0.4	0.1	0.0-23.7	4.9	6.5	1.7
21-22 June	15	26.5-32.0	28.4	1.2	0.3	0.0-12.8	5.8	5.1	1.3
3-5-6 July	15	27.5-30.0	28.5	0.6	0.2	0.0-18.9	7.0	6.1	1.6
30-31	15	27.5-30.5	28.9	0.8	0.2	0.0-8.9	3.6	3.3	0.9
8-9-10 Aug.	15	28.0-32.0	29.4	1.1	0.3	0.0-16.7	5.4	4.9	1.3
20-21-22 Aug.	15	28.0-31.5	29.6	0.8	0.2	0.5-18.9	9.4	5.2	1.3
5-6-7 Sept.	15	28.0-30.0	28.6	0.5	0.1	0.0-15.5	8.4	3.8	1.0
17-18-24 Sept.	15	22.5-25.0	23.8	0.8	0.2	1.7-16.1	8.2	3.7	1.0
2-3-9 Oct.	13-15	25.0-27.5	25.7	0.8	0.2	0.0-16.7	7.2	4.9	1.3
24-25-29-30 Oct.	18	19.8-23.7	21.8	1.5	0.3	1.1-23.9	14.6	7.0	1.6
8-12-13 Nov.	18-17	14.3-19.9	16.7	1.7	0.4	4.4-18.3	12.6	4.1	1.0
27-29-30 Nov.	18	9.2-16.3	12.6	2.2	0.5	0.0-21.7	11.8	6.6	1.6
6-7-10 Dec.	18	12.1-15.2	13.3	0.9	0.2	8.3-23.3	16.4	4.2	1.0
18-19 Dec.	18	8.5-10.8	10.0	0.6	0.1	3.3-22.2	14.0	5.7	1.3

Table 5. Cont'd.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
19-21 Feb. 1980	18	9.6-16.0	11.7	1.7	0.4	0.0-21.1	11.0	6.1	1.4
18-19-21 Mar.	18	15.3-21.1	16.2	1.3	0.3	5.0-25.0	15.4	5.9	1.4
16-17-22 Apr.	18	16.6-23.7	19.4	2.0	0.5	0.0-27.2	14.0	8.6	2.0
13-14-21 May	18	22.0-25.7	24.7	0.8	0.2	2.8-28.3	17.4	7.5	1.8
10-11-12 June	13-17	26.7-28.5	27.5	0.6	0.2	0.0-23.3	12.1	7.9	1.9
23-24-27 June	18	28.5-32.0	29.4	0.7	0.2	0.6-28.3	13.4	10.0	2.4
8-9-10 July	18	30.0-32.8	30.7	0.6	0.1	5.6-33.9	19.6	10.5	2.5
21-24-28-29 July	18	28.3-30.0	29.1	0.5	0.1	7.2-33.3	20.7	8.5	2.0
5-6-12 Aug.	13-18	28.5-30.5	29.4	0.6	0.2	8.3-33.3	22.3	8.1	1.9
16-18-19-20 Aug.	18	28.6-30.0	27.9	6.5	1.5	11.7-32.2	23.7	6.6	1.6
8-9-10 Sept.	18	28.0-30.0	28.9	0.7	0.2	13.9-27.8	21.6	4.9	1.2
22-23-24 Sept.	13-18	28.9-32.0	29.4	0.8	0.2	14.4-33.3	21.7	5.9	1.4
7-9-10 Oct.	18	22.2-24.3	23.1	0.7	0.2	13.3-26.7	19.9	3.9	0.9
22-23-30-31 Oct.	17	13.0-21.7	17.5	3.1	0.8	13.9-26.6	20.5	4.0	1.0
5-13 Nov.	7	14.0-20.2	15.8	2.5	0.9	18.9-26.6	23.7	2.6	1.0
24-26 Nov.	6	9.0-12.5	11.4	1.3	0.5	21.1-27.2	25.0	2.2	0.9
2-3-4-5 Dec.	18	12.6-18.5	14.4	1.5	0.4	15.0-28.9	23.0	4.6	1.1
16-17-18 Dec.	18	10.5-14.5	13.5	1.0	0.2	17.8-27.8	22.0	2.8	0.7

Table 6. Hydrological data associated with 6.1-m trawls in Matagorda Bay, Sept.-Dec. 1978, June-Dec. 1979 and Feb.-Dec. 1980.

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	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 July	6-9	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	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
16-17 Oct.	9	25.0-27.5	25.7	0.8	0.3	2.2-15.0	7.9	4.1	1.4
20-21 Nov.	9	19.7-21.4	20.6	0.7	0.2	8.3-22.2	14.6	4.7	1.6
20 Dec.	9	9.8-11.6	10.4	0.6	0.2	16.1-23.9	20.4	2.6	0.9
27 Feb. 1980	9	13.8-15.9	14.7	0.9	0.3	11.1-22.8	17.5	6.0	2.0
28 Mar.	9	17.3-18.5	17.9	0.4	0.1	15.0-23.9	19.0	2.8	0.9
29 Apr.	9	20.7-25.3	22.6	1.4	0.5	20.0-26.1	22.4	2.2	0.7
22-23 May	9	25.1-26.7	25.6	0.5	0.2	1.1-22.8	13.6	7.7	2.6
17 June	9	29.0-31.0	29.9	0.9	0.3	6.0-22.0	14.2	5.8	1.9
15 July	9	29.5-32.0	27.5	9.8	3.3	8.0-24.0	17.2	5.7	1.9
13 Aug.	9	29.0-32.0	30.4	1.0	0.3	16.0-29.0	20.9	4.6	1.5
19 Sept.	9	22.5-30.0	27.9	2.1	0.7	17.0-29.0	24.2	4.0	1.3
15-22 Oct.	9	22.0-25.5	23.1	2.1	0.7	18.0-29.0	22.6	3.5	1.2
19 Nov.	9	9.5-11.5	10.4	0.6	0.2	22.2-28.9	26.1	2.9	1.0
18 Dec.	9	15.0-18.0	16.6	1.0	0.3	23.0-28.0	26.1	1.8	0.6

Table 7. Hydrological data associated with 5-min drags of 3.0-m trawls in Matagorda Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
22 Sept. 1978	3	26.0-28.0	27.3	0.9	0.5	1.1-1.1	1.1	0.0	0.0
16 Oct.	3	24.0-27.0	25.3	1.3	0.7	2.2-7.8	4.8	2.3	1.3
13 Nov.	3	24.0-25.0	24.3	0.5	0.3	0.0-3.9	2.0	1.6	0.9
20 Dec.	3	19.0-20.0	19.3	0.5	0.3	11.7-13.9	13.0	0.9	0.5
19 June 1979	3	27.5-29.0	28.5	0.7	0.4	1.1-4.4	2.4	1.4	0.8
17 July	3	29.5-31.0	30.5	0.7	0.4	0.0-0.0	0.0	0.0	0.0
6 Aug.	3	31.0-35.0	32.7	1.7	0.9	0.0-0.0	0.0	0.0	0.0
25 Sept.	3	26.0-27.0	26.5	0.4	0.2	0.0-0.0	0.0	0.0	0.0
17 Oct.	3-2	27.0-28.0	27.3	0.5	0.3	1.1-2.2	1.7		
12 Nov.	3	14.0-17.0	15.7	1.2	0.7	0.0-6.1	4.1	2.9	1.7
20 Dec.	3	13.0	13.0	0.0	0.0	2.2-18.9	9.1	7.1	4.1
12 June 1980	3	27.0-29.0	28.0	0.8	0.5	0.0-4.4	1.8	1.9	1.1
11 July	3	29.0-31.0	30.0	0.8	0.5	1.1-12.2	5.4	4.9	2.8
15 Aug.	3	29.0-30.0	29.3	0.5	0.3	5.6-16.7	9.7	5.0	2.9
11 Sept.	3	27.0-30.0	29.0	1.4	0.8	2.8-14.4	7.6	4.9	2.9
16 Oct.	3	26.0	26.0	0.0	0.0	13.3-20.0	15.7	3.7	2.1
12 Nov.	3	20.0-23.0	21.7	1.5	0.9	15.5-20.0	17.8	2.3	1.3
11 Dec.	3	10.0-14.0	12.0	2.0	1.2	14.4-24.4	18.9	5.1	2.9

Table 8. Hydrological data associated with marsh nets in Matagorda Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
22 Sept. 1978	3	27.0-28.0	27.3	0.5	0.3	0.0-1.1	0.4	0.5	0.3
16 Oct.	3	23.0-25.0	24.2	0.9	0.5	1.1-6.7	4.3	2.3	1.4
13 Nov.	3	24.0-25.0	24.7	0.8	0.3	0.0-2.8	1.7	1.2	0.7
20 Dec.	3	18.5-20.5	19.7	0.9	0.5	6.1-13.9	10.4	3.2	1.9
19 June 1979	3	28.5-29.0	28.8	0.2	0.1	0.0-1.1	1.1	0.9	0.5
17 July	3	29.0-30.0	29.3	0.5	0.3	0.0-0.0	0.0	0.0	0.0
6 Aug.	3	32.0-34.0	33.3	0.9	0.5	0.0-0.0	0.0	0.0	0.0
25 Sept.	3	24.0-27.0	25.3	1.3	0.7	0.0-0.0	0.0	0.0	0.0
17 Oct.	3	27.0-29.0	27.7	0.9	0.5	0.0-0.0	0.0	0.0	0.0
12 Nov.	3	13.0-19.0	16.0	2.5	1.4	0.0-5.6	3.7	2.6	1.5
20 Dec.	3	13.0-17.0	14.3	1.9	1.1	0.0-13.3	5.2	5.8	3.4
12 June 1980	3	30.0-31.0	30.3	0.5	0.3	0.0-2.2	1.1	0.9	0.5
8-11 July	3	30.0-31.0	30.3	0.5	0.3	1.1-6.7	3.0	2.6	1.5
15 Aug.	3	30.0	30.0	0.0	0.0	2.2-11.1	6.7	3.6	2.1
11 Sept.	3	28.0-30.0	29.3	0.9	0.5	1.7-12.2	5.6	4.7	2.7
16 Oct.	3	26.0	26.0	0.0	0.0	4.4-16.7	11.1	6.2	3.6
12 Nov.	3	20.0-22.0	21.7	0.6	0.3	4.4-21.1	14.1	8.7	5.0
10 Dec.	3	12.0-15.0	13.3	1.5	0.9	8.8-22.2	15.9	6.7	3.9

Table 9. Hydrological data associated with 15-min drags of 3.0-m trawls in Matagorda Bay, Apr.-May 1979 and 1980.

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 Apr. 1979	4	17.0-21.5	19.9	1.7	0.9	0.0-9.4	6.8	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
1 Apr. 1980	4	20.0-21.0	20.8	0.4	0.2	0.0-16.7	11.3	6.6	3.3
8 Apr.	4	19.5-22.0	20.6	1.0	0.5	1.7-16.1	8.3	5.6	2.8
15 Apr.	4	15.0-23.5	18.3	3.2	1.6	5.0-18.9	11.9	5.0	2.5
23 Apr.		21.5-25.0	22.9	1.3	0.7	6.7-21.1	15.9	5.5	2.8
29 Apr.	4	21.0-25.0	22.9	1.9	0.9	10.0-21.1	16.1	4.0	2.0
6 May	4	25.0-28.0	26.3	1.3	0.6	5.6-23.3	15.9	6.4	3.2
13 May	4	26.0-28.0	26.5	0.9	0.4	2.2-24.4	16.1	8.4	4.2
20 May	4	23.0-27.0	24.9	1.5	0.8	0.0-16.7	6.4	7.0	3.5
26 May	4	28.0-30.0	29.1	0.7	0.4	0.0-16.7	5.3	6.7	3.3

Table 10. Hydrological data associated with 1.8-m seines in Matagorda Bay, Apr.-May 1979 and 1980.

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 Apr. 1979	4	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	23.5	0.5	0.3	2.2-10.0	7.4	3.1	1.5
18 Apr.	4	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	25.4	1.1	0.5	0.0-8.9	4.9	3.6	1.8
2 May	4	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	25.0	0.7	0.4	0.0-1.1	0.3	0.5	0.2
16 May	4	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	25.4	1.3	0.7	0.0-4.4	1.7	1.8	0.9
30 May	4	27.5-28.5	28.0	0.4	0.2	0.0-5.5	2.2	2.1	1.0
1 Apr. 1980	4	20.0-21.0	21.5	0.9	0.4	0.0-22.0	5.1	5.9	3.0
8 Apr.	4	18.5-22.0	20.4	1.6	0.8	1.1-13.3	7.6	6.0	3.0
15 Apr.	4	17.0-26.0	21.0	3.2	1.6	7.8-18.9	11.8	4.6	2.3
23 Apr.	4	21.5-25.0	23.5	1.3	0.6	6.1-15.5	12.8	3.9	1.9
29 Apr.	4	20.0-24.0	22.6	1.6	0.8	5.6-22.0	14.5	5.3	2.6
6 May	4	24.8-29.0	26.5	1.6	0.8	6.7-17.8	13.3	4.1	2.1
13 May	4	25.0-29.0	26.5	1.5	0.8	1.1-15.5	8.3	5.8	2.9
20 May	4	24.0-28.0	26.0	1.6	0.8	0.0	0.0	0.0	0.0
26 May	4	28.0-30.5	29.3	0.8	0.4	0.0-2.2	0.8	0.9	0.5

Table 11. Hydrological data associated with 1.8-m bar seines in San Antonio Bay, Apr.-May 1979 and Mar.-May 1980.

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
31 Mar. 1980	4	22.0–24.0	23.3	0.8	0.4	7.8–16.7	12.9	3.4	1.7
7 Apr.	4	22.0–27.0	23.8	1.9	1.0	10.0–17.8	13.9	3.1	1.6
16 Apr.	4	20.0–26.0	22.8	2.4	1.2	12.8–19.4	15.3	2.6	1.3
22 Apr.	4	22.0–24.5	23.2	1.2	0.6	14.4–15.5	15.2	0.5	0.2
28 Apr.	4	17.0–27.0	21.5	3.6	1.8	6.7–11.1	9.5	1.8	0.9
5 May	4	25.0–28.0	26.5	1.5	0.8	11.1–15.5	13.5	1.7	0.8
12 May	4	26.0–28.0	26.8	0.8	0.4	16.7–20.0	18.4	1.2	0.6
19 May	4	25.0–29.0	26.5	1.7	0.8	8.9–16.7	13.9	3.2	1.6
27 May	4	28.0–29.0	28.5	0.5	0.3	4.4–12.8	8.5	3.6	1.8

Table 12. Hydrological data associated with 15-min drags of 3.0-m trawls in San Antonio Bay, Apr.-May 1979 and Mar.-May 1980.

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	20.1	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
31 Mar. 1980	4	21.0	21.0	0.0	0.0	7.8-17.2	13.8	3.7	1.9
7 Apr.	4	22.0-24.0	22.8	0.9	0.4	8.9-18.9	14.5	4.3	2.1
16 Apr.	4	20.0-24.0	22.4	1.7	0.9	12.2-18.9	15.0	2.6	1.3
22 Apr.	4	23.0-25.0	23.5	0.9	0.4	14.4-18.9	16.2	1.7	0.8
28 Apr.	4	20.0-22.0	20.8	1.3	0.6	9.4-12.2	10.7	1.1	0.5
5 May	4	25.0-28.0	26.8	1.3	0.6	8.9-15.0	12.8	2.4	1.2
12 May	4	26.0-28.0	26.8	0.8	0.4	16.7-20.0	18.6	1.2	0.6
19 May	4	25.5-27.0	26.3	0.8	0.4	8.9-17.8	14.2	3.5	1.7
27 May	4	28.0-29.0	28.5	0.5	0.3	4.4-12.8	8.3	3.4	1.7

Table 13. Hydrological data associated with marsh net samples in San Antonio Bay, Sept.-Dec. 1978, June-Dec. 1979, and June-Dec. 1980.

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			1.0-1.7	1.4		
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
9-11 Oct.	8	23.0-29.0	26.8	2.3	0.8	0.0-29.4	10.4	9.6	3.4
22-23-24-25 Oct.	8	18.0-25.0	20.4	2.2	0.7	1.1-30.0	12.8	10.5	3.7
7-8 Nov.	8	18.0-22.0	20.0	1.4	0.5	2.2-26.6	13.7	10.3	3.6
26-27 Nov.	8	12.0-19.0	16.8	2.9	1.0	1.7-26.6	15.2	9.4	3.3
7-10 Dec.	8	16.0-18.0	16.9	0.8	0.3	2.2-28.9	15.3	10.1	3.6
19-20 Dec.	8	8.0-13.0	10.5	1.6	0.6	8.3-28.3	18.0	7.9	2.8
4-6 June 1980	8	28.0-32.0	30.1	1.2	0.4	0.0-28.3	15.3	9.9	3.5
16-17 June	8	29.0-31.5	30.2	0.7	0.2	0.0-25.5	16.0	8.5	3.0
4-6 July	8	30.0-35.0	31.8	1.6	0.6	3.3-24.4	13.3	6.8	2.4
16-17 July	8	28.5-35.0	31.3	1.9	0.7	5.6-26.6	16.3	7.2	2.6

Table 13. Cont'd.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
1-7 Aug.	8	28.0-33.0	30.3	1.7	0.6	14.4-33.0	21.5	5.5	1.9
18-20 Aug.	8	28.0-31.0	29.5	1.0	0.4	6.7-31.1	18.9	7.8	3.0
2-4 Sept.	8	30.0-32.0	31.3	0.7	0.2	6.7-32.2	20.8	9.9	3.5
22-23 Sept.	8	28.0-32.0	30.0	1.2	0.4	4.4-30.0	19.6	9.9	3.5
6-8 Oct.	8	24.0-28.0	25.5	2.1	0.8	3.3-27.8	16.0	10.6	3.7
22-23 Oct.	8	22.0-26.0	22.9	1.4	0.5	5.6-30.0	16.0	10.2	3.6
5-6 Nov.	8	21.0-22.0	21.5	0.5	0.2	6.7-30.0	17.8	10.6	3.7
19 Nov.	8-7	13.0-15.0	13.8	0.9	0.3	7.8-32.2	22.3	10.5	4.0
1-2 Dec.	8	17.0-21.0	18.8	1.4	0.5	6.7-31.1	20.4	8.5	3.0
16-17 Dec.	8	16.0-19.0	17.3	1.2	0.4	7.8-30.0	19.7	8.7	3.1

Table 14. Hydrological data associated with 5-min drags of 3.0-m trawls in San Antonio Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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			1.0-1.1	1.1		
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
9-10 11 Oct.	8	24.0-29.0	26.6	1.6	0.6	0.0-28.3	9.9	9.1	3.2
22-23-24-25 Oct.	8	18.0-26.0	21.4	2.6	0.9	1.1-30.0	13.2	11.1	3.9
7-8 Nov.	8	18.0-22.0	19.9	1.3	0.5	2.2-26.6	13.4	10.5	3.7
26-27 Nov.	8	12.0-22.0	16.8	2.9	1.0	1.7-26.6	15.2	9.4	3.3
7-10 Dec.	8	15.0-17.0	16.2	0.7	0.3	2.2-28.9	15.7	10.3	3.7
19-20 Dec.	8	8.0-12.0	10.5	1.7	0.6	8.3-28.3	18.0	7.9	2.8
4-6 June 1980	8	29.0-30.0	29.8	0.8	0.3	0.0-28.3	15.6	10.3	3.6
16-17 June	8	29.0-31.0	30.0	0.5	0.2	0.0-25.5	15.8	8.4	3.0
1-2 June	8	30.0-34.0	31.4	1.2	0.4	3.3-30.0	15.1	8.3	2.9
17-18 July	8	28.5-33.0	31.3	1.2	0.4	5.6-26.6	16.2	7.6	2.7

Table 14. Cont'd.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
1-7 Aug.	8	28.0-33.0	30.3	1.7	0.6	14.4-30.0	21.5	5.5	1.9
18-20 Aug.	8	28.0-31.0	29.5	1.0	0.4	6.7-25.5	18.9	7.8	3.0
2-4 Sept.	8	30.0-32.0	31.1	0.6	0.2	6.7-32.2	20.8	9.8	3.5
22-23 Sept.	8	28.0-31.0	29.9	0.9	0.3	4.4-30.0	19.4	9.5	3.4
6-8 Oct.	8	23.0-27.0	25.4	1.4	0.5	3.3-28.9	16.4	10.8	3.8
22-23 Oct.	8	22.0-24.0	22.8	0.7	0.3	6.7-30.0	16.6	10.5	3.7
5-6 Nov.	8	21.0-23.0	21.5	0.8	0.3	6.7-31.1	18.0	10.9	3.8
19 Nov.	8	13.0-15.0	13.8	0.9	0.3	7.8-32.7	20.7	10.4	3.7
1-2 Dec.	8	16.0-19.0	17.9	1.1	0.4	6.7-31.1	20.3	8.9	3.1
16-17 Dec.	8	15.0-19.0	17.0	1.3	0.5	12.2-30.0	20.4	8.5	3.0

Table 15. Hydrological data associated with 6.1-m trawls in San Antonio Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and Feb.-Dec. 1980.

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
2 Oct.	10	26.0-28.5	27.2	0.8	0.3	0.0-12.2	5.9	4.2	1.3
15 Oct.	11-10	25.0-26.5	25.5	0.5	0.2	1.1-22.2	10.0	6.2	2.0
5 Nov.	11	20.0-21.0	20.1	0.3	0.1	3.3-28.9	15.3	9.0	2.7
19 Nov.	11	20.0-23.0	20.9	1.2	0.4	1.6-28.3	14.3	8.8	2.7
3 Dec.	11	11.5-13.0	12.0	0.4	0.1	5.6-26.6	15.7	7.1	2.1
18 Dec.	11	6.5-11.5	9.1	1.5	0.5	7.8-28.3	17.0	6.0	1.8

Table 15. Cont'd

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
14 Feb. 1980	11	11.0-15.5	11.5	3.2	1.0	5.6-26.6	18.2	7.4	2.2
18 Mar.	11	15.0-17.0	16.0	0.5	0.1	7.8-26.4	16.3	6.1	1.8
25 Apr.	11	23.0-27.0	24.5	1.3	0.4	13.3-26.6	18.5	6.3	1.9
21 May	11	25.0-28.5	26.4	1.1	0.3	5.6-30.5	17.1	8.5	2.6
5 June	11	27.0-29.0	28.3	0.7	0.2	3.9-26.1	12.9	6.6	2.0
18 June	11	29.5-32.0	30.6	1.0	0.3	2.8-22.2	13.4	6.0	1.8
3 July	11	30.0-32.5	31.3	0.9	0.3	4.4-23.9	14.7	6.0	1.8
21 July	11	30.0-32.0	31.2	0.7	0.2	9.4-23.9	17.5	5.0	1.5
6 Aug.	11	29.0-30.0	29.6	0.5	0.1	13.3-25.5	21.0	3.5	1.1
19 Aug.	11	29.0-31.0	29.8	0.7	0.2	6.7-31.1	19.8	6.9	2.1
3 Sept.	11	29.0-31.0	30.2	0.7	0.2	10.0-30.0	19.7	7.0	2.1
18 Sept.	11	30.0-32.0	30.9	0.7	0.2	6.7-26.6	16.3	7.3	2.3
7 Oct.	11	22.0-26.0	24.7	1.2	0.4	3.3-26.6	13.7	8.7	2.6
30 Oct.	10-11	13.0-16.0	14.7	1.0	0.3	4.4-27.8	16.3	7.7	2.3
7 Nov.	11	21.5-24.0	22.3	0.8	0.2	7.8-27.8	16.6	6.2	1.9
24 Nov.	11	14.0-16.0	14.8	0.8	0.2	8.9-30.0	20.3	7.3	2.2
3 Dec.	11	15.0-16.0	15.7	0.6	0.2	7.8-26.6	18.6	6.3	1.9
18 Dec.	11	18.0-20.0	18.7	0.9	0.3	12.2-26.6	18.4	6.9	2.1

Table 16. Hydrological data associated with 1.8-m bar seines in Aransas Bay, Apr.-May 1979 and Mar.-May 1980.

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	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
31 Mar. 1980	5	18.5-22.0	20.5	1.3	0.6	8.0-25.0	15.6	5.7	2.6
7 Apr.	5	21.0-24.8	22.2	1.4	0.6	8.0-26.0	16.8	5.9	2.6
15 Apr.	5	11.0-18.0	15.8	2.8	1.2	14.0-21.0	19.8	4.8	2.2
22 Apr.	5	20.0-23.0	22.0	1.2	0.6	10.0-33.0	18.8	8.0	3.6
28 Apr.	5	17.5-23.0	21.0	2.2	1.0	10.0-30.0	18.4	6.7	3.0
5 May	5	25.5-28.5	25.4	2.4	1.1	10.0-32.0	20.0	7.5	3.3
12 May	5	25.0-28.0	26.3	1.1	0.5	12.0-32.0	21.2	6.9	3.1
19 May	5	22.5-25.5	24.1	1.2	0.6	10.0-30.0	18.4	8.5	3.8
27 May	5	26.5-32.8	29.1	2.4	1.1	5.0-28.0	17.8	7.6	3.4

Table 17. Hydrological data associated with 15-min drags of 3.0-m trawl samples in Aransas Bay, Apr.-1 June 1979 and Apr.-May 1980.

Sampel 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
2-3 Apr. 1980	5	21.5-22.0	21.8	0.2	0.1	11.0-22.0	17.0	4.0	1.8
9 Apr.	5	19.0-20.5	19.5	0.6	0.3	12.0-21.0	17.2	3.5	1.6
16 Apr.	5	18.0-19.0	18.4	0.4	0.2	11.0-21.0	16.0	3.9	1.7
23 Apr.	5	22.0-22.8	22.2	0.3	0.1	11.0-27.0	17.8	5.4	2.4
29 Apr.	5	21.8-22.0	21.9	0.1	0.0	11.0-26.0	18.6	5.4	2.4
6 May	5	24.5-26.0	25.1	0.5	0.2	12.0-23.0	18.2	4.0	1.8
13 May	5	25.0-26.0	25.5	0.4	0.2	14.0-28.0	20.8	4.5	2.0
20 May	5	25.5-27.0	25.9	0.6	0.3	16.0-26.0	21.4	3.9	1.7
28 May	5	28.0-29.0	28.7	0.4	0.2	16.0-24.0	20.0	2.8	1.3

Table 18. Hydrological data associated with marsh nets in Aransas Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and June-Dec. 1980.

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 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
9 Oct.	4	24.5-30.0	26.9	2.1	1.1	1.0-23.0	8.3	9.0	4.5
22 Oct.	4	21.5-26.0	23.8	1.7	0.8	0.0-31.0	10.8	12.5	6.2
5 Nov.	4	20.0-24.0	21.5	1.7	0.8	1.1-25.0	9.3	9.8	4.9
19 Nov.	4	20.8-23.5	22.2	1.3	0.7	1.0-11.6	4.2	4.4	2.2
3 Dec.	4	10.5-14.8	12.7	1.8	0.9	1.0-26.0	11.8	10.0	5.0
17-19 Dec.	4	8.0-11.0	9.0	1.2	0.6	1.0-20.0	9.8	7.6	3.8

Table 18. Cont'd.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
3 Mar. 1980	5	7.0-12.8	10.1	2.1	1.0	6.0-20.0	11.8	5.3	2.4
10 Mar.	5	19.8-23.0	21.7	1.3	0.6	6.0-26.0	14.2	6.7	3.0
17 Mar.	5	19.0-20.5	19.9	0.6	0.3	8.0-27.0	16.0	6.4	2.8
24 Mar.	5	16.0-19.5	17.6	1.4	0.6	8.0-28.0	16.6	6.6	3.0
9 June	4	29.0-35.5	32.0	2.4	1.2	2.0-20.0	13.5	7.0	3.5
18 June	4	28.8-33.0	31.3	1.8	0.9	5.0-31.0	17.8	9.7	4.9
1 July	4	31.0-36.0	33.0	2.1	1.1	10.0-35.0	21.3	9.0	4.5
14 July	4	30.0-33.5	31.6	1.3	0.7	16.0-38.0	25.5	9.0	4.5
Aug.	NS	-	-	-	-	-	-	-	-
18 Aug.	4	28.0-32.0	29.8	1.5	0.8	1.0-34.0	16.8	14.4	7.2
2 Sept.	4	30.0-33.5	30.4	2.0	1.0	1.0-30.0	16.0	11.9	5.9
15 Sept.	4	28.0-37.0	32.1	3.3	1.7	2.0-30.0	17.0	11.4	5.7
1 Oct.	4	22.5-32.0	26.0	4.5	2.3	0.0-30.0	13.8	16.0	8.0
14 Oct.	4	24.0-26.5	25.4	1.1	0.6	0.0-30.0	14.8	13.0	6.5
3 Nov.	4	19.5-29.5	22.6	4.7	2.3	3.0-30.0	16.8	11.3	5.6
24 Nov.	4	13.0-17.0	14.6	1.8	0.9	5.0-27.0	17.0	9.6	4.8
1 Dec.	4	18.0-21.0	19.5	1.3	0.6	4.0-28.0	16.8	10.0	5.0
17 Dec.	4	14.0-21.0	18.0	3.2	1.6	2.0-28.0	16.0	11.0	5.5

Table 19. Hydrological data associated with 5-min drags of 3.0-m trawls in Aransas Bay, Sept.-Dec. 1978, June-Dec. 1979 and June-Dec. 1980.

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 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			3.0-10.0	6.5		
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
9 Oct.	3	24.5-27.0	25.6	1.1	0.6	0.0-8.0	3.3	3.4	2.0
22 Oct.	3	25.0-26.5	25.5	0.7	0.4	0.0-11.0	3.7	5.2	3.0
5 Nov.	3	18.0-20.5	19.3	1.0	0.6	0.0-9.5	3.5	4.2	2.5
19 Nov.	3	20.8-21.0	20.9	0.1	0.1	0.5-11.5	5.1	4.7	2.7
3 Dec.	2	11.5-12.0	11.8			0.0-4.0	2.0		
19 Dec.	2	8.0-11.5	9.8			0.0-4.0	2.0		

Table 19. Cont'd.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
9 June 1980	2	31.0–32.0	31.5			2.0–12.0	7.0		
18 June	3	28.5–32.8	30.3	1.8	1.1	3.0–23.0	13.7	8.2	4.7
1 July	2	31.0–32.0	31.5			6.0–18.0	12.0		
14 July	3	28.8–31.2	30.3	1.1	0.6	12.0–30.0	20.7	7.4	4.3
Aug.	NS	-	-	-	-	-	-	-	-
18 Aug.	3	28.0–30.0	29.2	0.9	0.5	1.0–25.0	10.7	10.3	6.0
2 Sept.	3	28.0–30.0	29.2	0.8	0.5	1.0–24.0	11.0	9.6	5.6
15 Sept.	3	28.5–32.0	30.2	1.4	0.8	2.0–24.0	12.0	9.1	5.2
1 Oct.	3	22.0–27.0	24.2	2.6	1.5	0.0–24.0	8.0	13.9	8.0
14 Oct.	3	24.5–26.0	25.5	0.9	0.5	2.0–18.0	9.3	8.1	4.7
3 Nov.	3	17.0–21.0	19.3	2.1	1.2	2.0–20.0	12.0	9.2	5.3
24 Nov.	3	13.0–14.5	13.7	0.8	0.4	3.0–22.0	13.3	9.6	5.5
1 Dec.	3	15.5–18.5	17.2	1.5	0.9	3.0–22.0	13.3	9.6	5.5
17 Dec.	3	14.0–17.0	15.0	1.7	1.0	2.0–18.0	10.0	8.0	4.6

Table 20. Hydrological data associated with 6.1-m trawls in Aransas Bay, Sept.-Dec. 1978, Feb.-Dec. 1979 and Feb.-Dec. 1980.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
6-7 Sept. 1978	8	26.8-28.5	27.6	0.7	0.2	16.0-33.0	25.0	4.9	1.7
14-15 Sept.	8	27.0-28.5	27.6	0.5	0.2	2.0-24.0	14.5	8.6	3.0
3-4 Oct.	11	26.0-28.0	26.6	0.7	0.2	4.0-22.0	10.7	5.4	1.6
18-19 Oct.	11	21.0-23.5	22.0	0.8	0.2	6.0-25.0	13.1	4.7	1.4
1-2 Nov.	11	22.5-29.5	23.6	1.9	0.6	8.0-25.0	14.2	5.5	1.7
13-29 Nov.	11	13.0-24.0	16.8	5.6	1.7	6.0-29.0	16.0	7.0	2.1
6-7 Dec.	11	16.0-18.5	16.4	2.9	0.9	11.0-26.0	14.5	4.6	1.4
19-20 Dec.	11	13.8-18.0	15.4	1.2	0.4	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	1.0-26.0	10.6	6.4	1.9
14-16 Mar.	11	17.0-20.0	18.4	0.8	0.2	7.0-28.0	13.5	2.0	6.7
18-19 Apr.	11	23.5-24.8	24.0	0.3	0.1	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	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	4.0-26.0	8.7	6.0	1.8
19-20 June	11	27.8-28.5	28.1	0.2	0.1	4.0-15.0	7.8	3.0	0.9
5 July	2	28.0-28.5	28.3			21.0-22.0	21.5		
17-18 July	11	29.0-32.0	29.8	0.9	0.3	4.0-21.0	10.8	5.8	1.8
6-7 Aug.	11	29.0-31.0	30.2	0.6	0.2	4.0-21.0	11.0	6.1	1.8
21-22 Aug.	11	29.0-30.2	29.4	0.5	0.1	6.0-28.0	13.7	7.6	2.3
6-7 Sept.	11	28.0-29.0	28.3	0.5	0.1	4.0-19.0	10.0	5.7	1.7
25-26 Sept.	11	24.0-28.0	25.3	1.2	0.4	0.0-12.0	6.2	3.7	1.1
10-11-12 Oct.	12	21.5-24.8	23.2	1.0	0.3	2.0-14.0	7.2	4.1	1.2
23-24 Oct.	12	19.0-21.5	20.4	0.8	0.2	2.2-20.5	9.0	6.3	1.8
7-8 Nov.	12	18.0-20.0	19.0	0.7	0.2	3.3-17.7	9.8	5.0	1.5
20-21 Nov.	12	20.0-22.8	21.6	0.8	0.2	4.4-23.8	11.2	6.2	1.8
4-5 Dec.	12	12.0-13.0	12.4	0.4	0.1	6.0-27.0	12.9	6.9	2.0
18-20 Dec.	12	7.0-12.0	10.1	1.5	0.4	7.0-25.0	12.3	5.2	1.5

Table 20. Cont'd.

Sample Date	No. of Samples	Water Temp. Range (C)	Mean Temp. (C)	SD	SE	Sal. Range (o/oo)	Mean Sal. (o/oo)	SD	SE
14-15 Feb. 1980	12	11.8-13.8	12.6	0.7	0.2	6.0-25.0	12.6	5.6	1.6
13-14 Mar.	12	18.0-21.5	19.2	0.8	0.2	8.0-25.0	15.0	6.1	1.8
17-18 Apr.	12	20.0-22.5	21.0	0.9	0.3	10.0-32.0	17.1	8.1	2.3
21-22 May	12	25.5-29.0	26.7	1.0	0.3	12.0-26.0	18.6	4.9	1.4
3-4 June	11	27.0-29.0	28.1	0.5	0.2	4.1-26.0	14.1	9.6	2.9
16-17 June	12	28.0-30.0	29.0	0.6	0.2	14.0-27.0	20.3	5.9	1.7
2-8-9 July	11	29.2-31.0	30.4	0.6	0.2	18.0-32.0	24.3	5.1	1.5
15-16 July	12	29.5-30.8	29.9	0.5	0.1	18.0-36.0	25.9	7.0	2.0
5 Aug.	6	29.0-30.0	29.5	0.4	0.2	25.0-28.0	34.5	4.5	1.8
19-20 Aug.	12	28.5-30.0	29.0	0.4	0.1	8.0-30.0	19.8	7.6	2.2
3-5-8 Sept.	12	28.5-30.0	29.3	0.4	0.1	12.0-30.0	22.5	6.8	2.0
16-17 Sept.	12	29.0-31.0	30.0	0.7	0.2	13.0-32.0	21.3	6.9	2.0
3-6 Oct.	12	24.5-27.0	26.0	0.7	0.2	8.0-28.0	18.4	6.5	1.9
20-22 Oct.	12	19.5-22.0	21.4	0.9	0.3	12.0-26.0	18.3	5.1	1.5
5-6 Nov.	12	18.0-22.5	19.5	1.1	0.3	12.0-24.0	18.5	4.4	1.3
18-19 Nov.	12	12.0-14.0	12.8	0.8	0.2	12.0-22.0	17.5	3.6	1.0
2-3 Dec.	12	13.0-17.5	15.2	1.6	0.5	12.0-30.0	19.3	6.1	1.8
15-16	12	14.0-15.5	15.2	0.4	0.1	15.0-25.0	19.2	3.8	1.1

Table 21. Hydrological data associated with 1.8-m bar seines in lower Laguna Madre, Apr.-May 1979 and Mar.-May 1980.

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	12.0-32.0	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
28-31 Mar. 1980	3	17.0-19.0	18.0	0.8	0.5	12.0-30.0	23.3	8.1	4.7
14 Apr.	3	15.0-19.0	16.3	1.9	1.1	13.0-30.0	23.0	7.3	4.2
29 Apr.	3	21.0-23.0	22.0	0.8	0.5	12.0-32.0	25.3	9.4	5.4
12-13 May	3	24.0-25.0	24.3	0.5	0.3	10.0-37.0	27.3	12.3	7.1
26-28 May	3	29.0-30.0	29.7	0.5	0.3	4.0-31.0	18.3	11.1	6.4

Table 22. Hydrological data associated with 15-min drags of 3.0-m trawls in the lower Laguna Madre, Apr.-May 1979 and Mar.-May 1980.

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
28-31 Mar. 1980	3	17.0-19.0	18.0	0.8	0.5	12.0-28.0	22.7	7.5	4.4
14 Apr.	3	15.0-19.0	16.3	1.9	1.1	11.0-28.0	21.7	7.6	4.4
29 Apr.	3	21.0-23.0	22.0	0.8	0.5	10.0-32.0	24.0	9.9	5.7
12-13 May	3	24.0-25.0	24.7	0.5	0.3	12.0-35.0	25.0	9.6	5.6
26-27 May	3	30.0	30.0	0.0	0.0	7.0-29.0	19.3	9.2	5.3

PWD 3000-143
May 1982