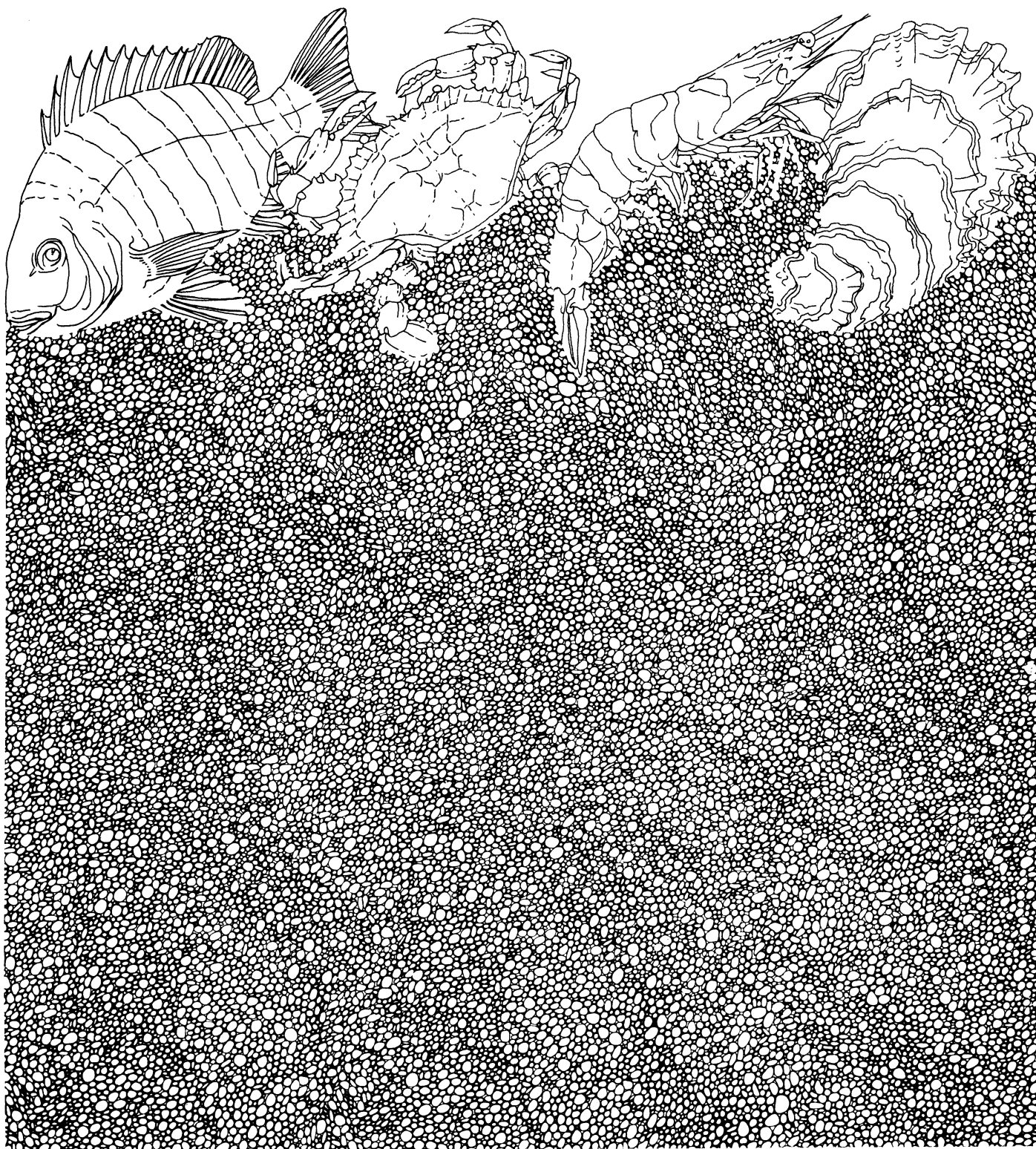


# Penaeid Shrimp Sampling Off The Central Texas Coast: 1981

by Terry J. Cody and Billy E. Fuls

Management Data Series Number 109  
1986

Texas Parks and Wildlife Department  
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## ACKNOWLEDGMENTS

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## ABSTRACT

During 1981 the Texas Parks and Wildlife Department made 111 trawl tows off Port Aransas, Texas to gather trend information on the size and relative abundance of penaeid shrimp and to evaluate the closure dates of the Gulf closed season. In each depth zone the mean length of brown shrimp (Penaeus aztecus) decreased immediately after the closure indicating recruitment from the bays. Sampling revealed catches >1000 brown shrimp/h in late May corresponding with the Texas Closure date of May 22. Maximum catches of 2400 to 4100/h occurred between 17 June and 16 July. By early August the only catches exceeding 1000/h were in the 29-37 and 38-46 m zones. Maximum catches of small white shrimp (P. setiferus) were made during November and December. Mean lengths were smallest during the winter closed season (16 December-1 February). During 1981 both closed seasons in the Gulf protected large numbers of small shrimp.

## INTRODUCTION

During 1981 reported landings of marine shrimp nationwide were 161 million kg worth \$463 million (U.S. Department of Commerce 1982). Gulf landings during the same period were 122 million kg. Shrimp constituted Texas' most valuable commercial fishery with reported landings of 43.5 million kg worth \$165 million during 1981 (Hamilton and Saul 1984). The shrimp landings consisted of 82% brown shrimp (Penaeus aztecus), 17% white shrimp (P. setiferus) and 1% pink shrimp (P. duorarum).

The three shrimp species have similar life cycles but movements occur at different times of the year. The major immigration of postlarval brown shrimp into Texas bays is February through April (King 1971). They usually migrate offshore during May and June. The peak immigration of postlarval white shrimp is May-October (Baxter and Renfro 1967) with subsequent movement back into Gulf waters between October and February (Cody and Fuls 1984).

The Texas Parks and Wildlife Department (TPWD) has two closed seasons in Gulf waters to protect emigrating shrimp. The Texas territorial sea is closed from 1 June through 15 July, but the closing and opening dates may be altered by the Texas Parks and Wildlife Commission to provide for an earlier, later or longer season. The dates are based on weekly sampling of juvenile brown shrimp collected in selected bay systems along the Texas Coast (Benefield and Baker 1980). Recommendations are based on growth, relative abundance, environmental conditions, tidal duration and other factors that influence the movement of juvenile shrimp from the bays. A winter closure to protect emigrating white shrimp closes the offshore waters within seven fathoms from 16 December through 1 February.

During 1981 TPWD implemented a monitoring program to provide information on the relative abundance and size of shrimp along the central Texas coast. Studies were initiated during 1981 to: (1) compare catch rates in three different sized trawls (Cody and Fuls 1985); (2) determine the direction of movement of emigrating shrimp from Aransas Pass, Texas (Cody and Matlock 1986); and (3) compare shrimp catches off Port Aransas and Port Mansfield, Texas (Fuls and Cody 1986).

The objectives of this report were:

- o to develop and compare trend information on the relative abundance and size of penaeid shrimp by month in designated depth zones and
- o to evaluate the closure date of the Gulf closed season by monitoring the emigration of brown shrimp off Port Aransas.

## MATERIALS AND METHODS

Sampling was conducted in the Gulf near Port Aransas (Fig. 1) from the 21.9-m RV WESTERN GULF. Samples were collected with 12.2, 13.7 or 14.3-m wide otter trawls with 5.1-cm stretched mesh. Trawls were equipped with tickler chains 1.1 m shorter than the footrope and spread by wooden doors 0.9 m by 2.1 m.

Night samples were collected twice a month, from May through December, along a 4-station transect (11-46 m) off Port Aransas. Day samples were collected monthly in 7-m and 11-m areas north and south of the jetties at Port Aransas from January through March and weekly from May through mid-July. Samples from mid-October through December were collected bi-monthly. Tow time ranged from 10 to 30 minutes. Sixty-two trawls were made during the day and 49 during the night. All penaeid shrimp were culled from the catch and sorted by species. If  $\leq 50$  shrimp were captured all were divided by sex, weighed en masse, and individually measured. If  $> 50$  shrimp of a species were caught, a subsample of at least 50 shrimp was divided by sex, weighed en masse and individually measured. The remainder of the species was weighed and a ratio used to estimate the total number of shrimp caught:

$$N = \frac{T}{S} \times n$$

where: N = total number of shrimp caught  
 T = total weight of species  
 S = weight of shrimp measured  
 n = number of shrimp measured

Catch rates (no./h) for each species were calculated using the ratio estimator (Cochran 1977):

$$A = \frac{N}{H}$$

where: A = catch rate in number per hour  
 N = total number of shrimp caught  
 H = total hours fished (to nearest 0.1h)

Mean lengths (mm) were calculated using (Sokal and Rohlf 1981):

$$\bar{Y}_w = \frac{\sum_{i=1}^n w_i Y_i}{\sum_{i=1}^n w_i}$$

where:  $\bar{Y}_w$  = weighted mean length  
 $w_i$  = sample catch rate  
 $\bar{Y}_i$  = sample mean length

For purposes of this report a catch rate of >1000 shrimp/h with a mean length of 60-100 mm TL was considered a "major" movement. Temperature, salinity and depth were recorded at each station.

Day white shrimp catch rate and mean lengths for 1981 were compared to the average for the November-February emigration period during the previous 6 years. Brown shrimp catch rates and mean lengths for 1981 night samples were compared to a 5-year average for May-August. An F-test was used to test for homogeneity of variances and a t-test or approximate t-test was used to test the equality of means (Sokal and Rohlf 1981). Day catches of pink shrimp and brown shrimp and night catches of white shrimp and pink shrimp were not tested because of inadequate catches.

## RESULTS

### Day Trawls

No significant differences were found for white shrimp catch rate ( $t_s = 0.187$ ) or mean length ( $t_s = 0.07$ ) between 1981 and the most recent 6-year average for the November-February emigration period (Table 1).

Monthly mean catch rates for white shrimp were highest during October, November and December; brown shrimp catches were highest during May, June and July; and pink shrimp catches peaked during March (Table 2). Mean water temperature and salinity are summarized in Appendix A.

Monthly mean lengths for white shrimp were smallest (99-117 mm) during the 15 December-1 February closed season (Table 2). Mean lengths increased through June (171 mm) then decreased from mid-October (124-133 mm) through December (99-108 mm) as small shrimp emigrated from the bays (Table 2).

### Night Trawls

No significant differences were found in catch rate ( $t_s = -0.24$ ) for 1981 data compared to the most recent 5-year average for the May-August period (Table 3). Mean brown shrimp lengths during May and June were smaller in 1981 than in 1980, but not significantly different ( $t_s = -1.17$ ) than the most recent 5-year averages. Mean lengths of brown shrimp generally increased with depth in 1981; monthly mean lengths

in 38-46 m were smaller than those in 28-37 m during June-September.

Monthly mean catch rates for brown shrimp were highest in 9-18 m during May, June and July and in 19-46 m during June, July and August (Table 4). Mean catch rates for white shrimp and pink shrimp were much lower than for brown shrimp (Table 4). Most of the samples containing white shrimp or pink shrimp were in the 9-18 and 19-27 m zones.

#### Gulf Closed Season

Several waves of brown shrimp apparently moved offshore during summer 1981. A major emigration of brown shrimp was detected on 21 May--the night before the Gulf waters were closed by the TPW Commission. Shrimp in 11-18 m averaged <90 mm and were captured at a rate >1000/h. Catch rates beyond 18 m were <400/h. In each depth zone mean length decreased immediately after the season closed, indicating movement of small shrimp into offshore waters. Catch rates did not exceed 1000/h in depths beyond 18 m until mid-June. Maximum catches (2400-4100/h) in all depth zones occurred between 17 June and 16 July. By early August, the only catch rates exceeding 1000/h were in depths >27 m. By late August all samples yielded <900/h.

#### DISCUSSION

For the first time Gulf waters in the Fishery Conservation Zone (FCZ) beyond the Texas territorial sea were closed to shrimping concurrently with state waters. This management measure (the Texas Closure) was adopted by the Gulf of Mexico Fishery Management Council (GMFMC) to increase the value of shrimp harvested from the Gulf and reduce waste caused by discarding of small shrimp (Center for Wetland Resources 1980).

Sampling by TPWD during 1981 indicated the May-July closed season in the Gulf protected large numbers of small, emigrating brown shrimp and, therefore, met the objectives of the closure. The closed season should have provided larger, more valuable shrimp when the closure ended in July. Data contained in this report and from a separate random sampling program conducted by the National Marine Fisheries Service to monitor the first year of the Texas Closure have been analyzed by Matthews (1982), Jones et al. (1982), Klima et al. (1982) and Poffenberger (1982). They report that the closed FCZ off Texas during 1981 protected small brown shrimp in the offshore waters and was a contributing factor in the second largest harvest in history. Klima et al. (1986) estimated the ban in the FCZ during 1981 increased the gulfwide yield by 1.9 million kg and value by \$9.7 million. Based on these studies the GMFMC voted to close the FCZ off Texas concurrently with the closure of Texas state waters in 1982.

Matthews (1982) compared data collected during the 1981 closure with historical data collected by TPWD. In five of nine cases the



closure CPUE's during 1981 were significantly greater than those of the 1975-1980 TPWD data set. He also reported differences in mean total lengths between the two data sets for some area and depth zone combinations. The analyses in this report did not indicate significant differences between 1981 TPWD samples and the previous 5-year averages. The reason for this disparity is unknown, but was probably influenced by different sampling strategies and a different breakdown of the depth zones for analysis. TPWD sampling was concentrated within 25 fathoms along transects off the central Texas coast while NMFS sites were randomly distributed along the entire Texas coast in depths out to 45 fathoms. Matthews used 10-fathom depth zones while these data were analyzed in 5-fathom increments.

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Table 1. Catch rates and mean length (mm) of white shrimp (*Penaeus setiferus*) caught in day trawls off Port Aransas, Texas, by month, year and depth (m), during 1975-1981. ND = no data.

Month	Depth				Month	Depth			
	5-9 m		10-18 m			5-9 m		10-18 m	
	No./h	Length	No./h	Length		No./h	Length	No./h	Length
<b>Jan</b>					<b>Jul</b>				
1975	60	94	0		1975	ND		ND	
1976	220	98	4	122	1976	14	177	20	179
1977	126	95	24	116	1977	112	174	0	
1978	26	85	ND		1978	0		2	181
1979	ND		251	107	1979	27	157	20	184
1980	238	97	148	118	1980	4	170	ND	
1981	108	110	27	117	1981	90	163	90	171
<b>Feb</b>					<b>Aug</b>				
1975	302	114	18	125	1975	ND		ND	
1976	140	127	40	136	1976	0		0	
1977	302	101	118	113	1977	80	156	12	135
1978	20	94	308	100	1978	18	151	0	
1979	ND		ND		1979	ND		34	118
1980	389	105	365	113	1980	ND		ND	
1981	6	118	291	109	1981	ND		ND	
<b>Mar</b>					<b>Sep</b>				
1975	208	121	700	129	1975	0		0	
1976	258	117	24	137	1976	24	145	10	141
1977	148	126	30	145	1977	6	116	2	121
1978	774	95	109	119	1978	71	151	104	155
1979	41	114	9	120	1979	ND		ND	
1980	ND		ND		1980	ND		ND	
1981	156	124	126	135	1981	ND		ND	
<b>Apr</b>					<b>Oct</b>				
1975	ND		ND		1975	64	162	6	161
1976	28	133	0		1976	72	132	560	135
1977	42	111	20	144	1977	10	139	64	137
1978	ND		ND		1978	ND		ND	
1979	ND		ND		1979	ND		ND	
1980	ND		ND		1980	ND		ND	
1981	ND		ND		1981	243	124	402	133
<b>May</b>					<b>Nov</b>				
1975	0		120	165	1975	90	116	1232	122
1976	0		2	165	1976	228	116	152	118
1977	2	170	124	173	1977	374	126	506	131
1978	0		7	166	1978	2605	109	388	110
1979	15	160	23	164	1979	ND		ND	
1980	ND		ND		1980	276	112	204	126
1981	137	164	141	163	1981	592	114	398	119
<b>June</b>					<b>Dec</b>				
1975	ND		ND		1975	620	94	206	107
1976	8	185	60	170	1976	470	103	98	117
1977	52	174	6	170	1977	728	118	111	132
1978	8	184	22	166	1978	2556	103	132	120
1979	ND		ND		1979	1128	90	716	101
1980	221	161	ND		1980	317	113	114	114
1981	46	171	83	171	1981	338	99	448	108

Table 2. Catch rates (No./h) and mean length (mm) of select penaeid shrimp caught in day trawls off Port Aransas, Texas by month and depth (m) during 1981. ND = no data.

Month	Depth (m)	No. samples	Brown shrimp		White shrimp		Pink shrimp	
			No./h	Length	No./h	Length	No./h	Length
<b>Jan</b>	5-9	2	0		108	110	0	
	10-18	2	0		27	117	0	
<b>Feb</b>	5-9	2	0		6	118	0	
	10-18	2	3	81	291	109	21	93
<b>Mar</b>	5-9	2	60	106	156	124	60	93
	10-18	2	24	124	126	135	120	101
<b>Apr</b>	5-9	0	ND		ND		ND	
	10-18	0	ND		ND		ND	
<b>May</b>	5-9	10	95	84	137	164	4	98
	10-18	10	1213	78	141	163	77	101
<b>Jun</b>	5-9	5	675	86	46	171	23	116
	10-18	5	1573	84	83	171	30	116
<b>Jul</b>	5-9	1	108	126	90	163	6	140
	10-18	1	1620	101	90	171	0	
<b>Aug</b>	5-9	0	ND		ND		ND	
	10-18	0	ND		ND		ND	
<b>Sep</b>	5-9	0	ND		ND		ND	
	10-18	0	ND		ND		ND	
<b>Oct</b>	5-9	2	3	81	243	124	0	
	10-18	2	0		402	133	0	
<b>Nov</b>	5-9	4	0		592	114	2	76
	10-18	4	45	86	398	119	36	91
<b>Dec</b>	5-9	3	0		338	99	2	70
	10-18	3	34	97	448	108	24	90

Table 3. Catch rates and mean length (mm) of brown shrimp (*Penaeus aztecus*) caught in night trawls off Port Aransas, Texas, by month, year and depth, during May-August<sup>a</sup> 1976-1981. ND = indicate no data.

Month Year	Depth							
	9-18 m		19-27 m		28-37 m		38-46 m	
	No./h	Length	No./h	Length	No./h	Length	No./h	Length
<b>May</b>								
1976	3810	88	94	135	28	150	58	156
1977	1159	85	523	101	100	113	128	101
1978	1262	92	1472	99	44	110	34	146
1979	505	91	45	121	19	154	21	160
1980	16	95	14	136	18	151	48	156
1981	1317	79	369	111	248	129	95	156
<b>Jun</b>								
1976	292	93	4747	97	44	110	48	137
1977	1196	102	2092	113	6336	92	380	130
1978	3372	88	2395	99	975	108	871	108
1979	4	135	358	120	94	122	80	132
1980	2607	104	1558	95	754	109	75	130
1981	1746	92	2368	109	1649	115	1874	104
<b>Jul</b>								
1976	2298	102	1913	107	2318	105	456	123
1977	3635	110	1693	112	1568	106	2312	105
1978	1112	97	3984	98	1126	109	1400	115
1979	850	109	1560	109	342	121	108	128
1980	2342	95	415	116	558	123	524	123
1981	2292	108	1977	121	1002	128	1090	119
<b>Aug</b>								
1976	268	110	0		0		0	
1977	952	86	1546	118	1406	130	1440	116
1978	214	99	498	120	236	115	636	120
1979	5366	92	729	115	269	130	214	137
1980	1533	98	463	122	167	135	337	139
1981	238	89	782	120	1114	125	1070	120

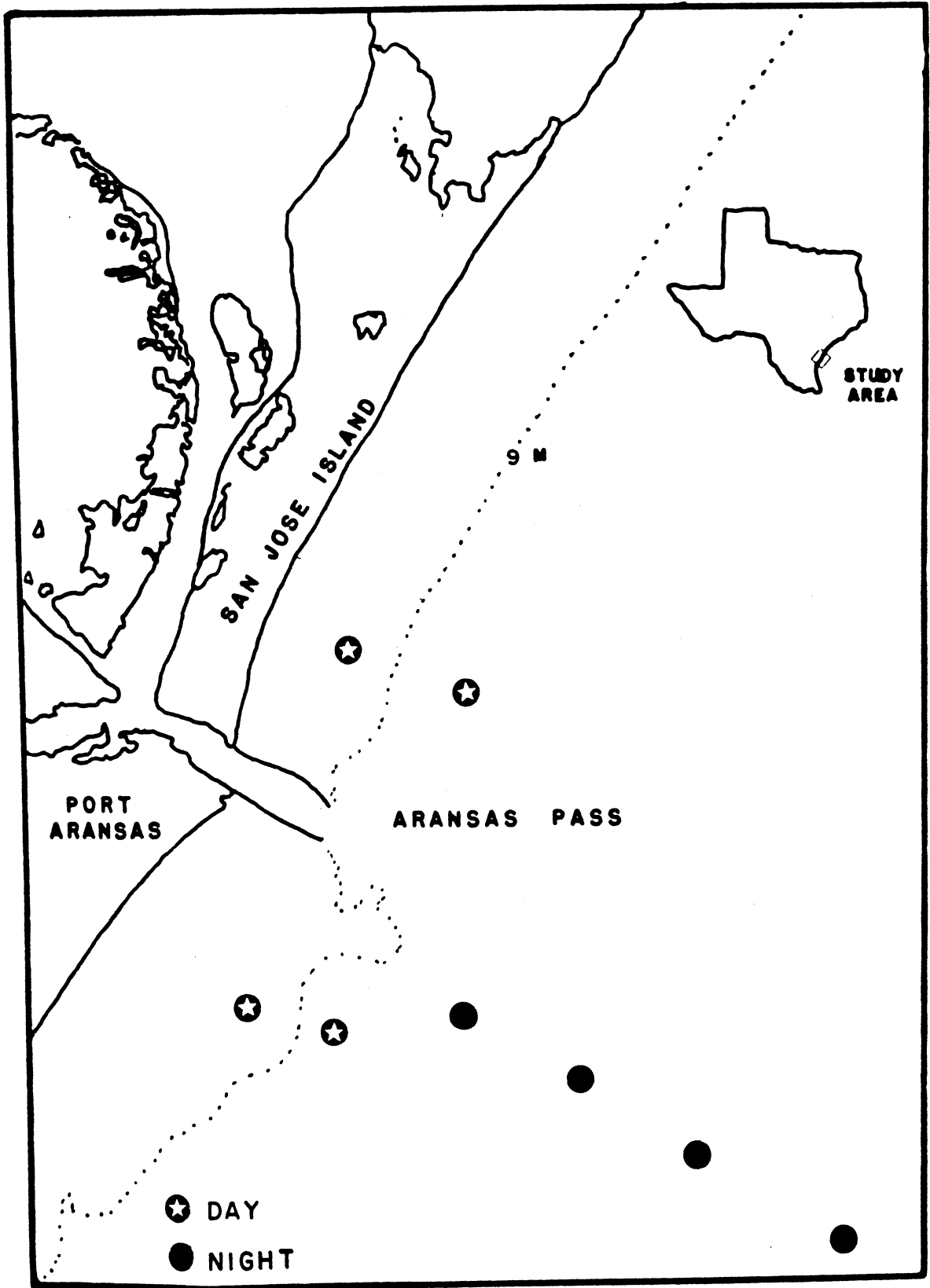
<sup>a</sup>Other months did not have sufficient number of samples for trend analysis.

Table 4. Catch rates (No./h) and mean length (mm) of select penaeid shrimp caught in night trawls off Port Aransas, Texas, by month and depth (m), during 1981. ND = no data.

Month	Depth (m)	No. samples	Brown shrimp		White shrimp		Pink shrimp	
			No./h	Length	No./h	Length	No./h	Length
<b>Jan</b>		0	ND		ND		ND	
<b>Feb</b>		0	ND		ND		ND	
<b>Mar</b>		0	ND		ND		ND	
<b>Apr</b>		0	ND		ND		ND	
<b>May</b>	9-18	2	1317	79	156	162	96	109
	19-27	2	369	111	4	161	3	114
	28-37	2	248	129	0		0	
	38-46	2	95	156	0		0	
<b>Jun</b>	9-18	2	1746	92	45	167	15	123
	19-27	2	2368	109	5	188	0	
	28-37	2	1649	115	0		0	
	38-46	2	1874	104	0		0	
<b>Jul</b>	9-18	2	2292	108	29	169	15	131
	19-27	2	1977	121	0		0	
	28-37	1	1002	128	0		0	
	38-46	1	1090	119	0		0	
<b>Aug</b>	9-18	2	238	89	7	153	33	122
	19-27	2	782	120	1	183	0	
	28-37	2	1114	125	0		0	
	38-46	2	1070	120	0		0	
<b>Sep</b>	9-18	2	151	95	86	140	37	133
	19-27	2	511	130	1	168	0	
	28-37	2	372	140	2	157	0	
	38-46	2	489	135	0		0	
<b>Oct</b>	9-18	0	ND		ND		ND	
	19-27	1	238	128	6	146	4	121
	28-37	1	96	150	0		0	
	38-46	1	148	160	0		0	
<b>Nov</b>	9-18	2	282	88	489	124	81	104
	19-27	2	175	133	40	158	1	178
	28-37	2	141	144	4	118	1	103
	38-46	2	137	151	0		0	
<b>Dec</b>		0	ND		ND		ND	

Figure 1. Sampling areas for penaeid shrimp off Port Aransas, Texas during 1981.





Appendix A. Monthly mean bottom water temperature (C) and salinity (o/oo) recorded at trawl stations off Port Aransas, Texas during 1981.



Table A.2. Mean bottom water temperature (C) and salinity (o/oo) recorded at daytime trawl stations, by month and depth, off Port Aransas, Texas during 1981. ND = no data.

Month	Depth zones			
	0-9 m		10-18 m	
	Sal	Temp	Sal	Temp
Jan	31.1	13.9	31.6	14.0
Feb	31.9	11.8	32.8	11.4
Mar	35.0	20.0	36.0	18.8
Apr	ND	ND	ND	ND
May	33.9	25.6	34.3	25.3
Jun	33.8	28.4	32.2	28.4
Jul	32.8	29.5	34.4	28.8
Aug	ND	ND	ND	ND
Sep	ND	ND	ND	ND
Oct	31.4	25.9	31.8	26.1
Nov	29.9	22.8	31.0	23.0
Dec	30.9	18.8	30.9	19.1

