

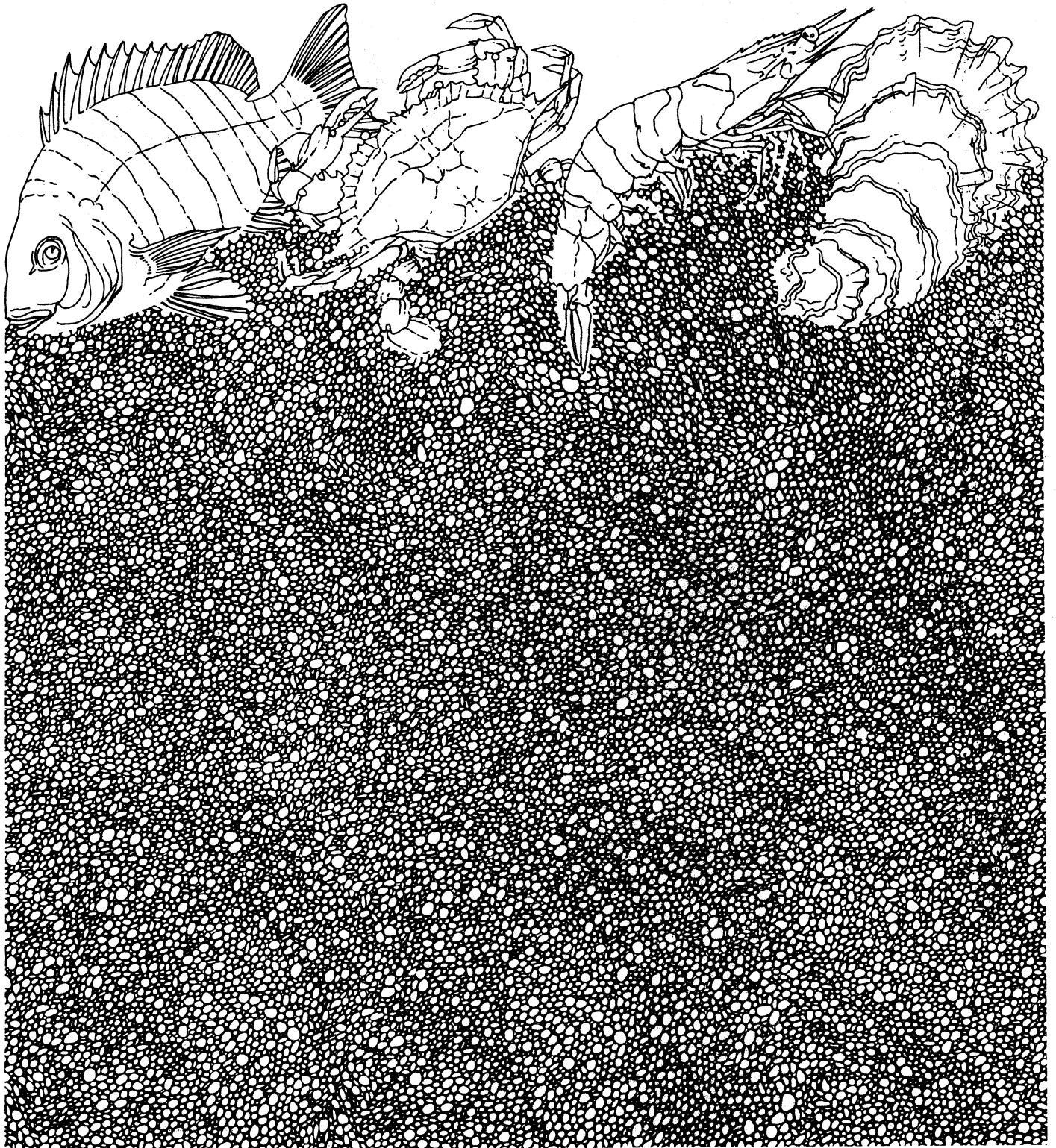
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Comparison of Shrimp Catches off Aransas Pass and Mansfield Pass, Texas May-August 1980-1981

by Billy E. Fuls and Terry J. Cody

Management Data Series Number 120
1988

Texas Parks and Wildlife Department
Coastal Fisheries Branch



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I would like to thank the various crews aboard the R/V Western Gulf for collection of shrimp samples during 1980 and 1981. Appreciation is extended to C. E. Bryan, Gary Saul, Tom Heffernan, Ed Hegen and Lynn Benefield with a special thanks to Larry McEachron, for reviewing the manuscript. Special thanks to Jeff Doerzbacher for invaluable statistical comments and guidance. This study was conducted with partial funding from the U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, under P.L. 88-309.

ABSTRACT

Catch rates (no./h) and mean lengths of penaeid shrimp caught off Mansfield Pass and Aransas Pass, Texas during May-August 1980-1981 were analyzed by depth zone, area, month and year. Brown shrimp (Penaeus aztecus) mean length increased as depth increased. Initial mass emigrations of 0-year-class brown shrimp into gulf waters occurred between end of May and end of June. Therefore, the Texas Closure during 1980 and 1981 protected major emigrations of small brown shrimp until they reached a larger more valuable size. There was a significant ($P \leq 0.05$) difference in brown shrimp catch rate between years and among months, and a significant difference in mean length between areas. The effect of month on mean length of brown shrimp was dependent on the depth and year. There was a significant difference in pink shrimp (P. duorarum), and white shrimp (P. setiferus) catch rates between areas.

INTRODUCTION

Penaeid shrimp are Texas' most valuable commercial fishery. Brown shrimp (*Penaeus aztecus*) constitute 70-80% of the total Texas shrimp landings with white (*P. setiferus*) and pink (*P. duorarum*) shrimp comprising most of the remaining landings. It is, therefore, important that Texas monitor this resource.

From 1975 to 1979 the Texas Parks and Wildlife Department (TPWD) seasonally sampled penaeid shrimp off the central (Aransas Pass) Texas coast to determine relative abundance and size of shrimp by depth and time period (Cody and Fuls 1984). During summers 1980 and 1981, the TPWD included the lower Texas coast (Mansfield Pass) in gulf sampling to consider if separate shrimp management strategies might be appropriate for the central and lower coasts. The objective of the present study was to determine if there were differences in brown shrimp, white shrimp and pink shrimp abundance and size off the central and lower Texas coasts during May-August 1980 and 1981.

MATERIALS AND METHODS

Brown shrimp, white shrimp and pink shrimp were collected with 4.3-, 13.7- and 14.3-m wide trawls off Aransas Pass and Mansfield Pass during May-August 1980-1981 (Figure 1; Appendix A). Trawls had a stretched mesh of 5.1 cm and were equipped with tickler chains. Samples were collected at night in depth zones 1 (9-18 m), 2 (19-27 m), 3 (28-37 m) and 4 (38-46 m) with tows ranging from 10 to 30 minutes in duration. Shrimp were separated by species and weighed en masse. Up to 50 randomly selected individuals of each species were measured (TL to nearest mm); occasionally >50 shrimp were measured. Total number of each species of shrimp in samples with >50 individuals of a single species was estimated using the following formula:

$$N = (T/S)(n)$$

where: N = total number of a specific species in sample
T = total weight of specific species
S = weight of specific species measured
n = number of specific species measured

Sample catches were extrapolated to no./h for a standardized catch per unit effort (CPUE).

CPUE and mean TL were compiled by month, year, area and depth for analysis (Appendix A). Brown shrimp CPUE for the 4.3-m trawl sample collected on 5 August 1981 off Mansfield Pass was extrapolated to the expected CPUE of a 13.7-m trawl for analysis using the regression equation derived by Cody and Fuls (1985). This equation was also used for pink shrimp because no other equation was available.

CPUE for brown, pink and white shrimps were transformed to $\ln(\text{no./h} + 1)$. STATGRAPHICS (STSC, Inc. 1985) and SAS software

programs (SAS Institute Inc. 1985) were used for analyses ($P \leq 0.05$). Mean TL in all analyses was unweighted. CPUE and mean brown shrimp TL were analyzed using a four factor analysis of variance (AOV) with no replication (Sokal and Rohlf 1981). The four factors were: 1) area, at two levels - Aransas Pass and Mansfield Pass; 2) depth, at four levels - zone 1, zone 2, zone 3 and zone 4; 3) month, at four levels - May, June, July, August; year, at two levels - 1980, 1981. An estimate of mean brown shrimp TL during July 1981 in depth zone 1 off Mansfield Pass was not available. This missing cell was filled with a regression estimate based on mean TL available in the remaining months for that year, area and depth.

A three factor AOV was used to analyze pink shrimp CPUE and mean TL with main effects of area, month and year. Only pink shrimp caught in depth zones 1 and 2 were used for analysis and combined into a single zone (9-27 m) because of insufficient data and missing cells. A two factor AOV was used to analyze white shrimp CPUE and mean TL with main effects of year and area. Month and depth zones 2, 3 and 4 were not used in the analyses for white shrimp because of insufficient data and missing cells. Differences in main effect means were evaluated with Duncan's multiple-range test. When significant 1st-order interactions were found, comparisons were made within levels of the interacting factors using the mean square error (MSE) from the AOV.

RESULTS

The 1981 brown shrimp CPUE was significantly higher than in 1980 (Table 1; Appendix B). The May CPUE was significantly lower than during June-August for both years (Appendix B).

Mean brown shrimp TL differed significantly between areas, with significant 1st-order interactions of month X depth, and month X year, revealing effect of month on mean TL depends on depth and year (Appendix B). Brown shrimp were larger off Aransas Pass than off Mansfield Pass by approximately 6 mm overall (Table 1; Appendix B). May and August mean TL's were significantly larger in 1980 than during 1981, but TL's did not differ between years during June and July (Appendix B). Mean TL's generally increased with depth (May-August) and time (June-August). May mean TL's differed in each depth zone sampled with the smallest found inshore and the largest found offshore, whereas June-August mean TL's were not different in each depth zone sampled but were smallest inshore and increased in length at offshore depths (Appendix B and Appendix C). Mean brown shrimp TL's in depth zones 3 and 4 were greatest during May, decreased in June, then increased through August (Appendix B).

Length-frequency histograms for depth zones 1-3 off Aransas and Mansfield Passes indicate possible earlier movement of small shrimp off Mansfield Pass during May (Appendix C). May 1980 and 1981 length-frequency histograms for both areas indicate two separate size

groups of shrimp; one group approximately 45-120 mm TL and one group >120 mm TL.

Pink shrimp CPUE was significantly higher off Mansfield Pass than off Aransas Pass (Table 1; Appendix B). Mean pink shrimp TL in Zones 1 and 2 did not differ between areas, years or months.

White shrimp CPUE was significantly higher off Aransas Pass than Mansfield Pass (Table 1; Appendix B). Mean white shrimp TL did not differ between areas or years.

DISCUSSION

The Texas Closure during 1980 (1 June-15 July) and 1981 (22 May-15 July) protected major emigrations of 0-year-class brown shrimp off Aransas and Mansfield passes until they became a larger more valuable size. The significant differences in mean brown shrimp TL among months and the increase of mean TL as depth increased support similar findings by Matthews (1981, 1982), and Cody and Fuls (1984, 1986). Although length-frequency histograms in this study indicated some earlier movement of brown shrimp off Mansfield Pass during May, it could not be determined if peak movement out of bays occurred at different times within the two areas. Bryan (1986) indicated that during May-June 1983 brown shrimp emigrated earlier through the Brazos Santiago Pass than from passes on the middle and upper Texas coast.

Larger brown shrimp during May compared to June was the result of few small (45-120 mm) shrimp and numerous large (>125 mm) shrimp during May in both areas. During May it appears shrimp from 45-120 mm TL are 0-year-class shrimp which recently emigrated to the shallow gulf; those >125 mm are previous-year-class over-wintering shrimp (Matthews 1982). The decrease in mean TL of brown shrimp during June in both areas is due to mass emigrations of 0-year-class brown shrimp to the gulf, which appear to have begun between end of May and end of June. Because there was no significant difference in overall mean CPUE between June-August for the two areas, the increase in mean TL from June-August can be explained by growth and movement of 0-year-class shrimp within the gulf.

In Texas, smallest brown shrimp are found off the lower coast (Matthews 1981, Pullen 1962). This is consistent with findings in the present study. Stokes (1974) suggested that smaller shrimp on the lower Texas coast may be the result of higher salinities or lack of extensive primary bay areas.

Gulf floor substrate and coastal environmental conditions can affect geographic and spatial distributions of pink shrimp and white shrimp (Perez-Farfante 1969). Compared to Aransas Pass, the gulf floor off Mansfield Pass has more hard substrate which pink shrimp

favor (Springer and Bullis 1954; Hildebrand 1954, 1955), and is probably the major factor causing higher pink shrimp CPUE off Mansfield Pass. White shrimp require sufficient freshwater inflow into coastal bays for good survival (Gunter and Edwards 1969, Williamson 1977). Because bays adjacent to Aransas Pass receive more freshwater inflow than the bay adjacent to Mansfield Pass it is not unexpected that abundance of white shrimp is greatest off Aransas Pass. The majority of white shrimp in the present study were overwintering adults (TL >140 mm).

The Texas Closure is designed to reduce harvest of small brown shrimp recruited to the gulf until most exceed 112 mm. The yield in weight and value could potentially be increased by closing all or part of the gulf longer than has historically been done. If the smaller size of shrimp off Port Mansfield were used to set the closure date for the entire gulf, a date earlier than the normal 1 June closure date would result. However, the opening date would still have to be based on the size of shrimp off Aransas Pass and the upper Texas coast, resulting in a longer closure period. Additional research is needed to determine the effect of a longer closed season on shrimp yield. On 1 January 1986 the TPWD began a routine coastwide gulf trawl monitoring program within Texas territorial waters to assess penaeid shrimp abundance and size distributions (Hammerschmidt and McEachron 1986). This program is designed to provide information needed to effectively manage Texas shrimp populations.

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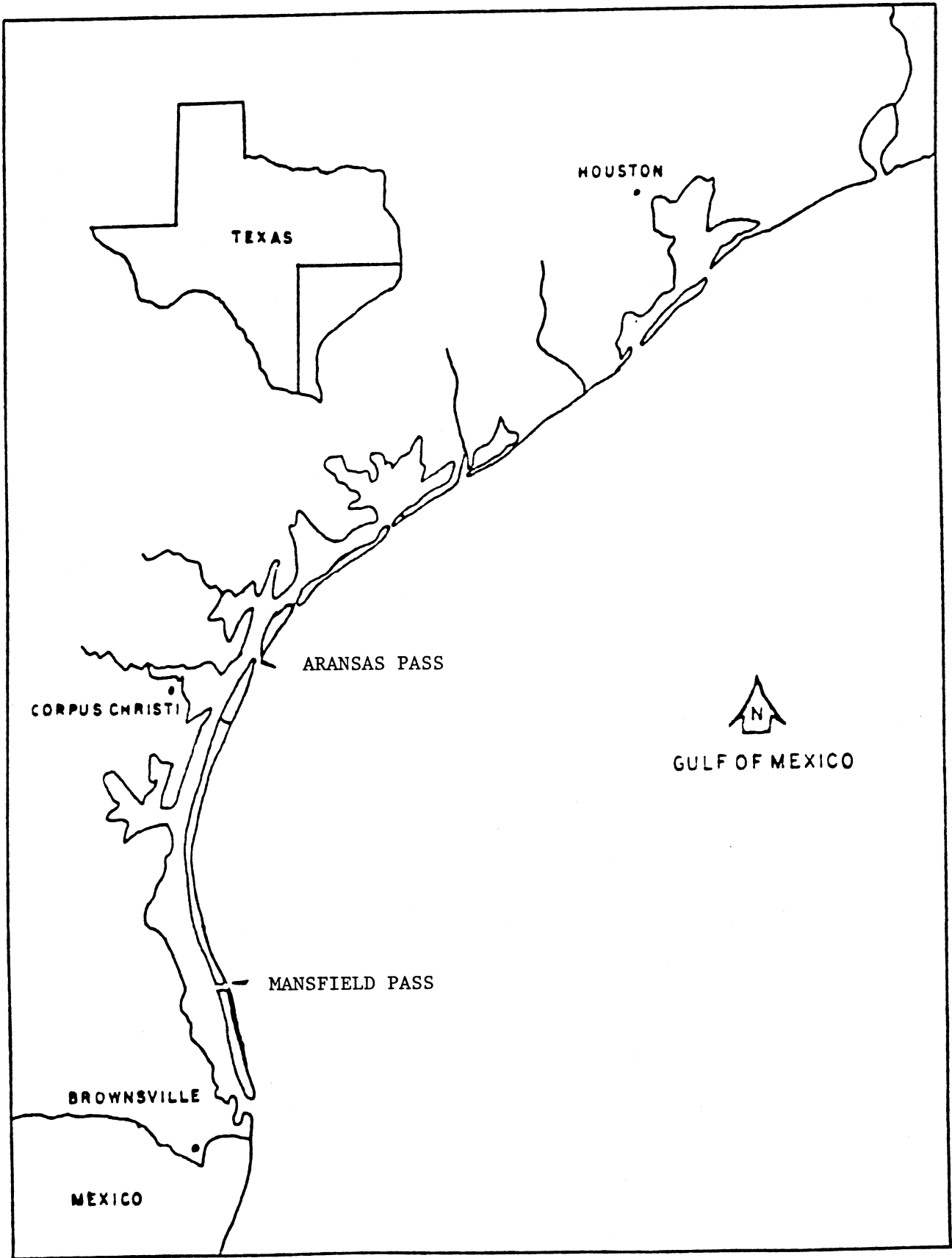
Table 1. Mean catch rate (no./h \pm 1SE) and weighted mean TL (mm \pm 1SE)^a for brown shrimp, white shrimp and pink shrimp collected in four depth zones within Gulf waters off Aransas Pass and Mansfield Pass, Texas during May-August 1980-1981.

Species	Aransas Pass			Mansfield Pass		
	1980	1981	1981	1980	1981	1981
Depth zone ^b	no./h	TL	no./h	TL	no./h	TL
Brown shrimp						
9-18 m	2161 \pm 115	102 \pm 1	1572 \pm 420	97 \pm 1	1501 \pm 746	93 \pm 1
19-27 m	388 \pm 133	117 \pm 1	1688 \pm 825	112 \pm 1	944 \pm 119	103 \pm 1
28-37 m	508 \pm 286	114 \pm 1	1108 \pm 342	120 \pm 1	851 \pm 489	114 \pm 1
38-49 m	322 \pm 194	126 \pm 1	793 \pm 341	119 \pm 1	208 \pm 104	130 \pm 1
Overall mean	845 \pm 334	108 \pm 1	1290 \pm 251	110 \pm 1	876 \pm 235	103 \pm 1
White shrimp						
9-18 m	19 \pm 3	160 \pm 1	62 \pm 59	163 \pm 1	2 \pm 1	185 \pm 6
19-27 m	2 \pm 2	164 \pm 1	1 \pm 1	169	0	0
28-37 m	0		0		1 \pm 1	170
38-49 m	0		0		0	0
Overall mean	5 \pm 2	160 \pm 1	16 \pm 15	163 \pm 1	1 \pm 1	179 \pm 4
Pink shrimp						
9-18 m	22 \pm 14	112 \pm 1	24 \pm 13	117 \pm 2	92 \pm 43	110 \pm 1
19-27 m	4 \pm 2	110 \pm 4	2 \pm 2	114 \pm 1	96 \pm 50	118 \pm 1
28-37 m	4 \pm 4	129 \pm 4	0		1 \pm 1	126
38-49 m	1 \pm 1	136	0		0	0
Overall mean	8 \pm 4	115 \pm 1	6 \pm 4	117 \pm 1	48 \pm 19	114 \pm 0
9-27 m	13 \pm 7	112 \pm 1	13 \pm 7	117 \pm 1	94 \pm 31	114 \pm 0
					186 \pm 83	121 \pm 1

^aIf only one shrimp caught, then no SE listed. If SE < 1 then 1 is listed.

^bZone 1 - 9-18 m, zone 2 - 19-27 m, zone 3 - 28-37 m, zone 4 - 38-47 m.

Figure 1. Aransas Pass and Mansfield Pass, Texas.



Appendix A. Summary of brown shrimp, pink shrimp and white shrimp catches off Aransas Pass and Mansfield Pass, Texas during May-August 1980-1981.

Table A.1. Date, location, catch rate (no./h) and mean TL (mm) of brown shrimp, white shrimp and pink shrimp collected in night trawls off Aransas Pass and Mansfield Pass, Texas during May-August 1980-1981. Blanks indicate no shrimp measured.

Date	Area	Effort (min.)	Trawl size (m)	Depth (m)	Brown shrimp		White shrimp		Pink shrimp	
					no./h	TL	no./h	TL	no./h	TL
1980										
May 19	Aransas Pass	30	13.7	40	48	156	0	0	2	136
	Aransas Pass	30	13.7	31	18	151	0	0	16	124
	Aransas Pass	30	13.7	22	14	136	8	164	8	100
20	Aransas Pass	30	13.7	13	16	95	14	157	60	108
	Mansfield Pass	30	13.7	40	44	167	0	0	0	0
21	Mansfield Pass	30	13.7	29	200	137	4	170	18	126
	Mansfield Pass	30	13.7	20	616	90	0	0	238	109
	Mansfield Pass	30	13.7	11	346	72	2	166	174	119
Jun 17	Mansfield Pass	30	13.7	40	38	158	0	0	0	0
18	Mansfield Pass	30	13.7	31	414	114	0	0	0	0
	Mansfield Pass	30	13.7	22	1186	90	0	0	80	130
	Mansfield Pass	30	13.7	13	80	76	0	0	38	128
	Aransas Pass	30	13.7	42	118	128	0	0	2	172
	Aransas Pass	30	13.7	31	1328	106	0	0	2	110
26	Aransas Pass	30	13.7	22	640	108	0	0	26	126
	Aransas Pass	30	13.7	13	5108	104	18	168	0	0
Jul 22	Aransas Pass	15	13.7	20	476	116	0	0	0	0
23	Mansfield Pass	15	13.7	38	472	120	0	0	0	0
24	Mansfield Pass	15	13.7	29	2308	108	0	0	0	0
	Mansfield Pass	15	13.7	20	988	98	0	0	68	134
	Mansfield Pass	15	13.7	11	2868	78	0	0	0	0
	Aransas Pass	15	13.7	38	892	120	0	0	0	0
	Aransas Pass	15	13.7	29	436	123	0	0	0	0
	Aransas Pass	15	13.7	11	696	96	16	174	0	0

Table A.1. (Cont'd.)

Date	Area	Effort (min.)	Trawl size (m)	Depth (m)	Brown shrimp		White shrimp		Pink shrimp	
					no./h	Tl.	no./h	Tl.	no./h	Tl.
1980 (Cont'd.)										
Aug 25	Mansfield Pass	30	13.7	44	280	137	0	0	0	0
	Mansfield Pass	30	13.7	35	482	135	0	0	0	0
	Mansfield Pass	30	13.7	26	990	131	0	0	0	0
	Mansfield Pass	30	13.7	16	2710	113	4	194	158	96
26	Aransas Pass	30	13.7	46	230	141	0	0	0	0
	Aransas Pass	30	13.7	37	248	134	0	0	0	0
	Aransas Pass	30	13.7	27	420	131	0	0	4	131
	Aransas Pass	30	13.7	18	2826	99	28	147	4	80
1981										
May 26	Aransas Pass	30	13.7	38	100	146	0	0	0	0
	Aransas Pass	30	13.7	29	190	125	0	0	0	0
27	Aransas Pass	30	13.7	20	510	109	2	169	6	114
	Aransas Pass	10	13.7	11	1440	73	240	162	60	107
	Mansfield Pass	10	13.7	11	3066	76	0	0	102	112
	Mansfield Pass	30	13.7	20	3876	95	0	0	242	98
28	Mansfield Pass	30	13.7	29	270	130	0	0	0	0
	Mansfield Pass	30	13.7	38	94	140	0	0	0	0
Jun 25	Aransas Pass	30	14.3	44	380	111	0	0	0	0
	Aransas Pass	30	14.3	35	1500	112	0	0	0	0
26	Aransas Pass	30	14.3	26	4118	107	0	0	0	0
	Aransas Pass	30	14.3	16	2232	97	4	184	16	123
30	Mansfield Pass	15	14.3	13	168	80	4	82	56	123
	Mansfield Pass	30	14.3	22	2282	98	0	0	4	132

Table A.1. (Cont'd.)

Date	Area	Effort (min.)	Trawl size (m)	Depth (m)	Brown shrimp		White shrimp		Pink shrimp	
					no./h	TL	no./h	TL	no./h	TL
1981 (Cont'd.)										
Jul 01	Mansfield Pass	30	14.3	31	3606	110	0	0	0	0
	Mansfield Pass	30	14.3	40	2108	96	0	0	502	131
23	Mansfield Pass	30	13.7	15	0	0	0	0	0	0
	Mansfield Pass	30	13.7	24	3592	107	0	0	0	0
24	Mansfield Pass	30	13.7	33	1890	121	0	0	0	0
	Mansfield Pass	30	13.7	42	704	121	0	0	0	0
29	Mansfield Pass	30	13.7	42	1090	119	0	0	0	0
	Aransas Pass	30	13.7	33	1002	128	0	0	0	0
30	Aransas Pass	30	13.7	24	1282	125	0	0	0	145
	Aransas Pass	30	13.7	15	2180	114	6	181	0	0
	Aransas Pass	30	13.7	42	2574	118	0	0	0	0
Aug 04	Mansfield Pass	30	13.7	33	1276	113	0	0	0	0
05	Mansfield Pass	30	13.7	24	3402	105	0	0	0	0
	Mansfield Pass	15	4.3	15	40	84	0	0	204	123
	Aransas Pass	30	13.7	40	1602	119	0	0	0	0
	Aransas Pass	30	13.7	31	1740	121	0	0	0	0
06	Aransas Pass	30	13.7	22	844	117	0	0	0	0
	Aransas Pass	30	13.7	13	436	87	0	0	16	145

Appendix B. Summary of results of analysis of variance (AOV) and Duncan's multiple range tests.

Table B.1. Summary of four-factor AOV of catch rates [$\ln(\text{no./h} + 1)$] and mean TL (mm) of brown shrimp collected off Aransas Pass and Mansfield Pass, Texas during May-August 1980-1981.

Dependent variable	Source of variation	df	Sums of squares	F
Catch rate	Total	63	171.226	
	Area	1	0.435	0.30
	Depth	3	10.074	2.34
	Year	1	11.876	8.29 *
	Month	3	24.950	5.80 *
	Area X Depth	3	12.930	3.01
	Area X Year	1	1.826	1.27
	Depth X Year	3	10.975	2.55
	Area X Month	3	12.427	2.89
	Depth X Month	9	14.606	1.13
	Year X Month	3	12.547	2.92
	Area X Depth X Year	3	5.759	1.34
	Area X Depth X Month	9	12.932	1.00
	Area X Year X Month	3	7.900	1.84
	Depth X Year X Month	9	19.095	1.48
Error	9	12.896		

Table B.1. (Cont'd.)

Dependent variable	Source of variation	df	Sums of squares	F
Mean TL	Total	63	29966.438	
	Area	1	1008.062	12.46**
	Depth	3	16059.312	66.17 ***
	Year	1	1242.562	15.36 **
	Month	3	1731.312	7.13 **
	Area X Depth	3	889.062	3.66
	Area X Year	1	3.062	0.04
	Depth X Year	3	627.562	2.59
	Area X Month	3	308.312	1.27
	Depth X Month	9	3651.812	5.02 *
	Year X Month	3	1597.562	6.58 *
	Area X Depth X Year	3	258.812	1.07
	Area X Depth X Month	9	730.562	1.00
	Area X Year X Month	3	376.062	1.55
	Depth X Year X Month	9	754.312	1.04
	Error	9	728.062	

* $P \leq 0.05$ ** ≤ 0.01 *** ≤ 0.001

Table B.2. Mean catch rate [ln (no./h + 1)] and mean TL (mm) by month, year and area for brown shrimp, pink shrimp, and white shrimp collected off Arkansas Pass (AP) and Mansfield Pass (MP), Texas during May-August 1980-1981. Means followed by the same letter in a row under a sub-heading are not significantly (P < 0.05) different. NS - not significant.

Species	Mean catch rate						Mean length		
	Month			Year		Area			
	May	Jun	Jul	Aug	1980	1981	AP	MP	
Brown shrimp	5.2B	6.6A	6.6A	6.8A	5.9B	6.7A	NS	117.3A	109.4B
Pink shrimp		NS				NS	1.7B	3.5A	NS
White shrimp		NS				NS	2.6A	0.5B	NS

Table B.3. Mean TL (mm) for significant 1st-order interactions of month X depth (m) and month X year, for brown shrimp collected off Aransas Pass and Mansfield Pass, Texas during May-August 1980-1981. Means followed by the same letter in a row under a heading are not significantly ($P < 0.05$) different.

Month	Month X Depth				Month X Year	
	9-18 ^a	19-27 ^a	28-37 ^a	38-46 ^a	1980	1981
May	79D	108C	136B	152A	126A	112B
Jun	89C	101CB	110AB	123A	110A	101A
Jul	92B	112A	120A	120A	107A	115A
Aug	96B	121A	126A	129A	127A	108B

^aZone 1 = 9-18 m; zone 2 = 19-27 m; zone 3 = 28-37 m;
zone 4 = 38-47 m

Table B.4. Mean TL (mm) for significant 1st-order interactions of depth (m) X month and year X month, for brown shrimp collected off Aransas Pass and Mansfield Pass, Texas during May-August 1980-1981. Means followed by the same letter in a row are not significantly ($P < 0.05$) different.

	Month			
	May	Jun	Jul	Aug
Depth X Month				
9-18 ^a	79B	89AB	92AB	96A
19-27 ^a	108AB	101B	112AB	121A
28-37 ^a	136A	110B	120B	126AB
38-47 ^a	152A	123B	120B	129B
Year X Month				
1980	126A	110B	107B	128A
1981	112AB	101B	115A	108AB

^aZone 1 = 9-18 m; zone 2 = 19-27 m; zone 3 = 28-37 m;
zone 4 = 38-47 m

Table B.5. Summary of three-factor AOV of catch rates [$\ln(\text{no.}/\text{h} + 1)$] and mean TL (mm) of pink shrimp collected in 9-27 m (zone 1 and 2) of water off Aransas Pass and Mansfield Pass, Texas during May-August 1980-1981.

Dependent variable	Source of variation	df	Sums of squares	F
Catch rate	Total	31	143.910	
	Month	3	31.076	2.44
	Year	1	0.017	0.00
	Area	1	27.432	6.45 *
	Month X Year	3	3.317	0.26
	Month X Area	3	1.217	0.10
	Year X Area	1	0.067	0.02
	Error	19	80.784	
Mean TL	Total	22	5697.652	
	Year	1	330.032	1.95
	Month	3	1687.346	3.32
	Area	1	50.863	0.30
	Year X Month	3	971.783	1.91
	Year X Area	1	163.451	0.97
	Month X Area	3	408.439	0.80
	Error	10	1693.717	

* $P \leq 0.05$

Table B.6. Summary of two-factor AOV of catch rates [$\ln(\text{no.}/\text{h} + 1)$] and mean TL (mm) of white shrimp collected in 9-18 m (zone 1) of water off Aransas Pass and Mansfield Pass, Texas during May-August 1980-1981.

Dependent variable	Source of variation	df	Sums of squares	F
Catch rate	Total	15	38.493	
	Year	1	0.956	0.61
	Area	1	17.172	10.96 **
	Error	12	20.181	
Mean TL	Total	9	8712.500	
	Area	1	997.363	0.98
	Year	1	707.661	0.69
	Error	6	7144.720	

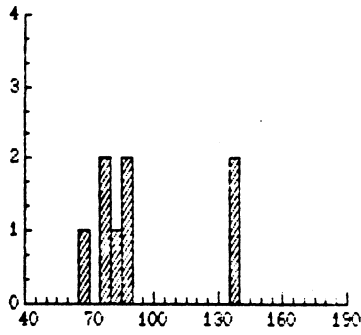
** $P \leq 0.01$

Appendix C. Brown shrimp length-frequencies for shrimp collected off Aransas Pass and Mansfield Pass, Texas during May-August 1980-1981. Zone 1 = 9-18 m; zone 2 = 19-27 m; zone 3 = 28-37 m; zone 4 = 38-47 m

May 1980

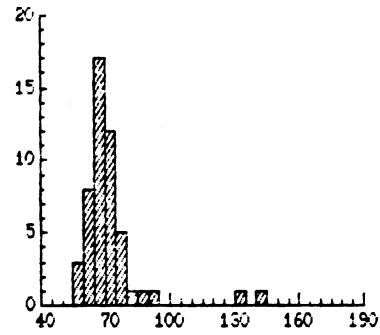
Aransas Pass

N=8 (no./h=16)



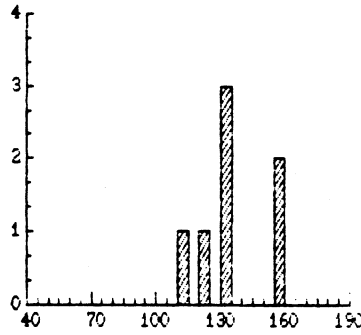
Mansfield Pass

N=50 (no./h=346)

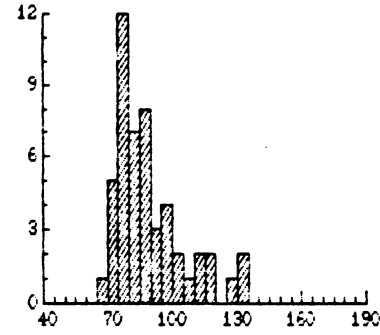


19-27 m

N=7 (no./h=14)



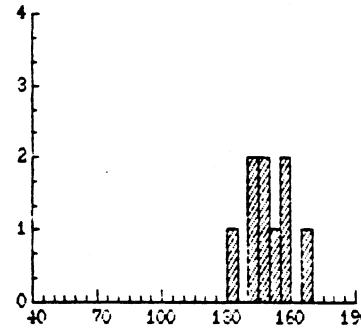
N=50 (no./h=616)



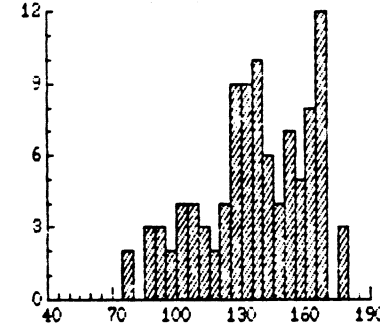
Frequency (no.)

28-37 m

N=9 (no./h=18)

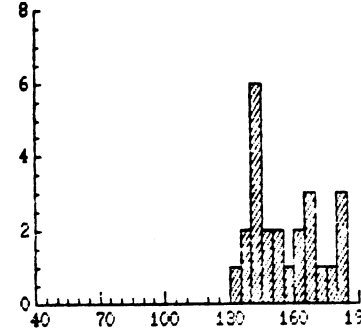


N=100 (no./h=200)

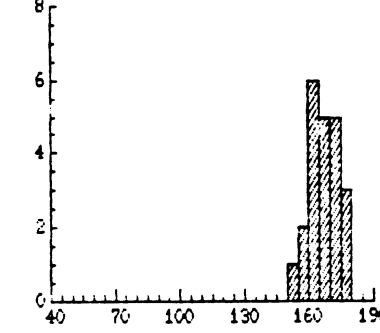


28-37 m

N=24 (no./h=48)



N=22 (no./h=44)



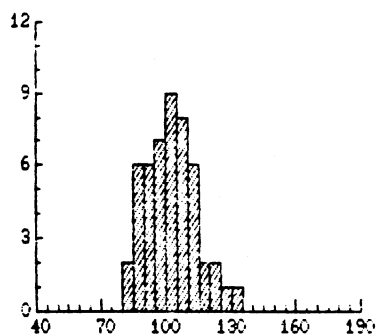
Total length (5 mm groups)

June 1980

Aransas Pass

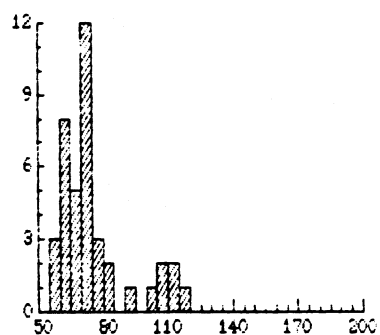
9-18 m

N=50 (no./h=5180)



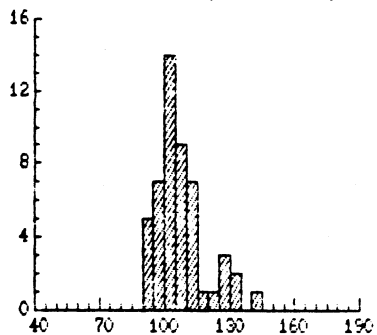
Mansfield Pass

N=40 (no./h=80)

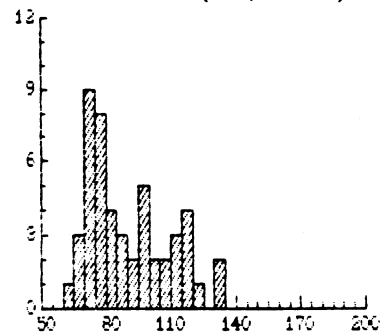


19-27 m

N=50 (no./h=640)

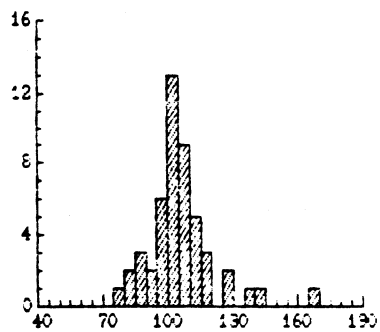


N=49 (no./h=1186)

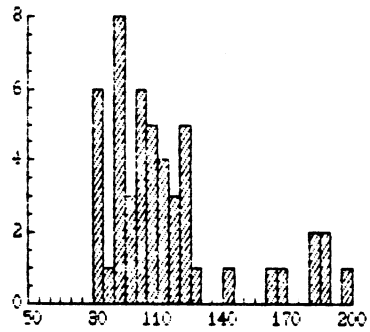


28-37 m

N=49 (no./h=1328)

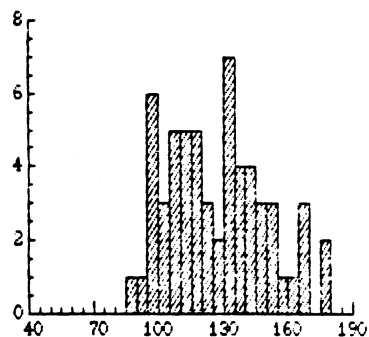


N=50 (no./h=414)

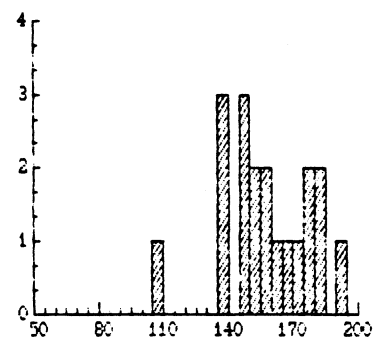


38-49 m

N=59 (no./h=118)



N=19 (no./h = 38)

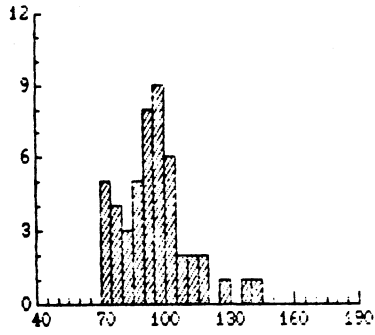


Total length (5 mm groups)

July 1980

Aransas Pass

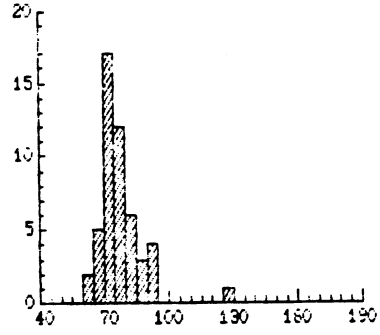
N=49 (no./h=696)



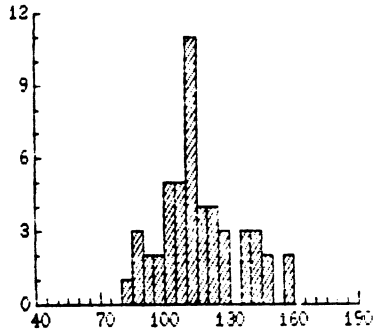
Mansfield Pass

9-18 m

N=50 (no./h=2868)

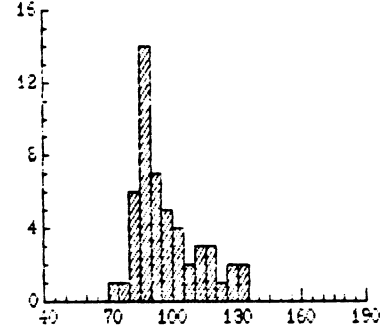


N=50 (no./h=476)

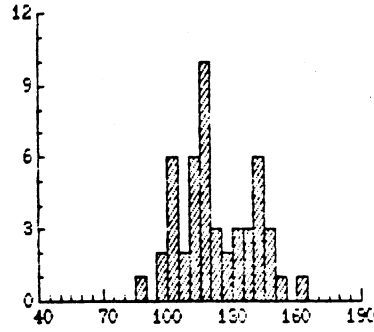


19-27 m

N=51 (no./h=988)

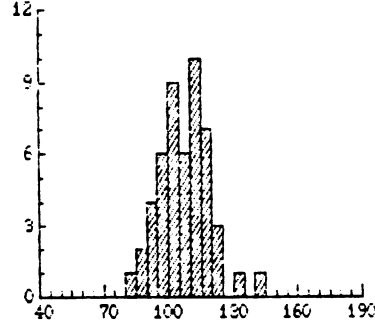


N=49 (no./h=436)

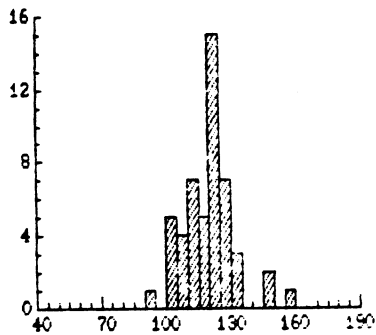


28-37 m

N=50 (no./h=2308)

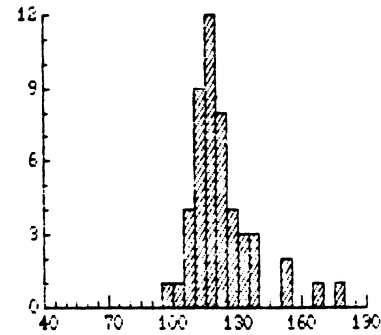


N=50 (no./h=892)



38-49 m

N=49 (no./h=472)



Frequency (no.)

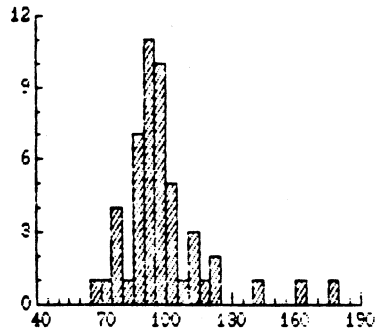
Total length (5 mm groups)

August 1980

Aransas Pass

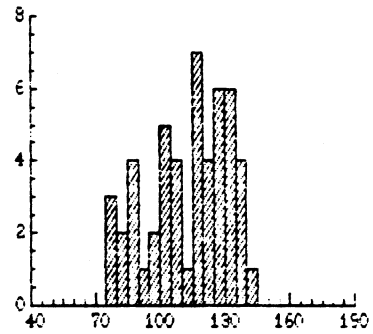
9-18 m

N=50 (no./h=2826)



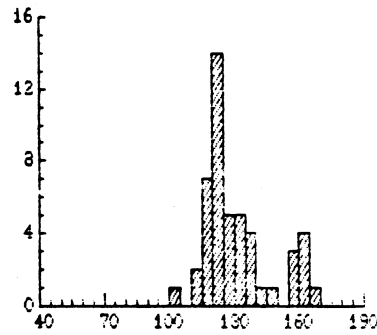
Mansfield Pass

N=50 (no./h=2710)

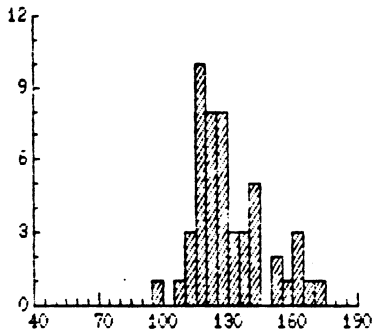


19-27 m

N=48 (no./h=420)



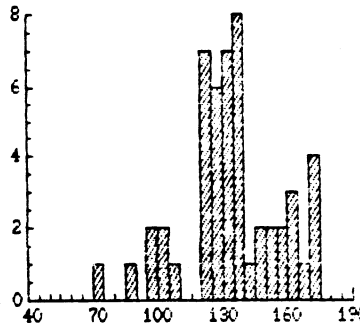
N=50 (no./h=990)



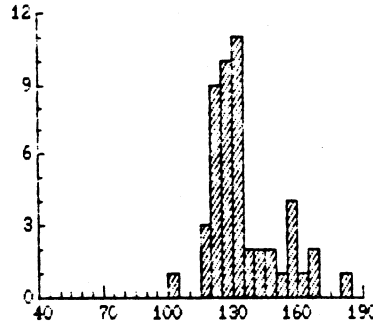
Frequency (no.)

28-37 m

N=50 (no./h=248)

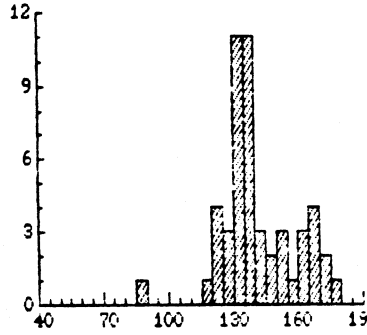


N=49 (no./h=482)

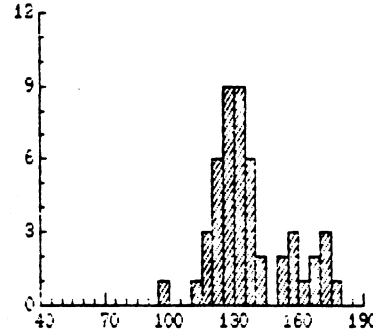


38-49 m

N=50 (no./h=230)



N=49 (no./h=280)



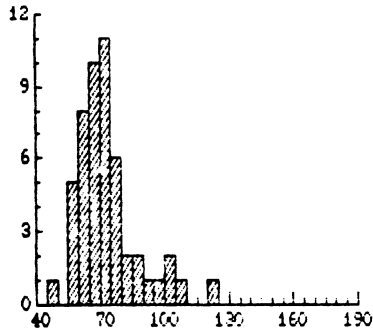
Total length (5 mm groups)

May 1981

Aransas Pass

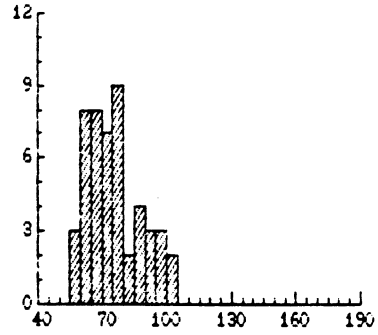
9-18 m

N=51 (no./h=1440)



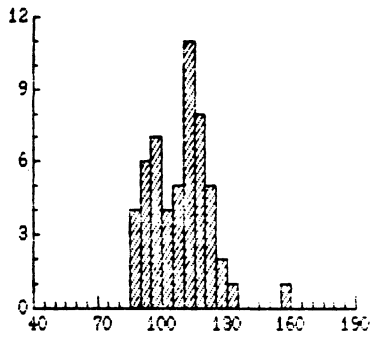
Mansfield Pass

N=49 (no./h=3066)

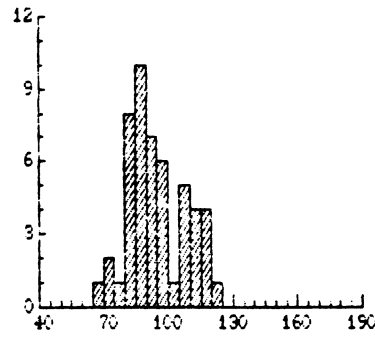


19-27 m

N=54 (no./h=510)



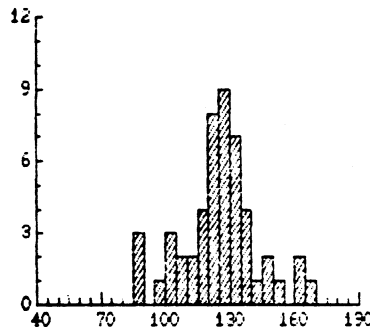
N=50 (no./h=3876)



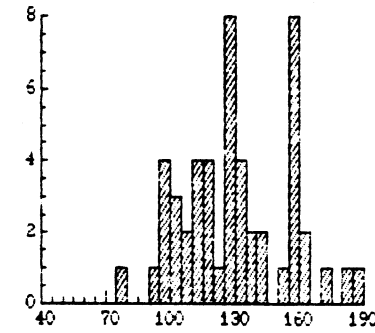
Frequency (no.)

28-27 m

N=50 (no./h=190)

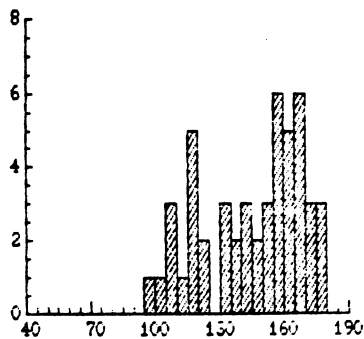


N=50 (no./h=270)

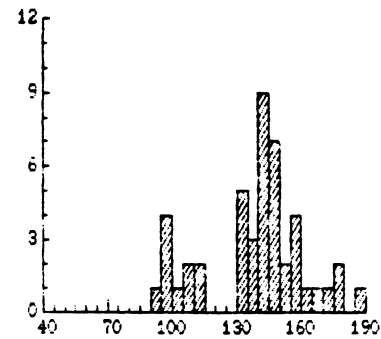


38-49 m

N=50 (no./h=100)



N=47 (no./h=94)



Total length (5 mm groups)

June 1981

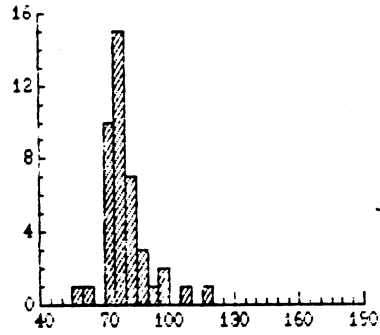
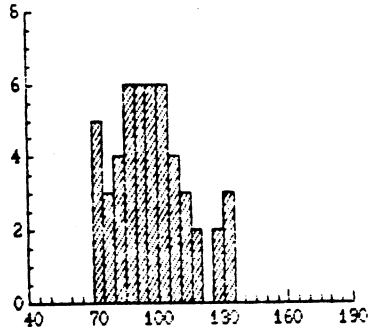
Aransas Pass

Mansfield Pass

9-18 m

N=50 (no./h=2232)

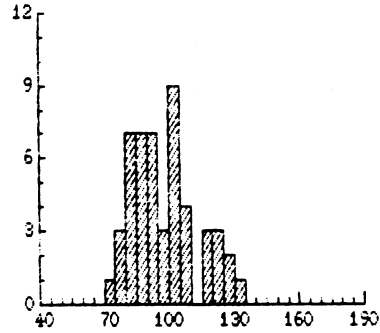
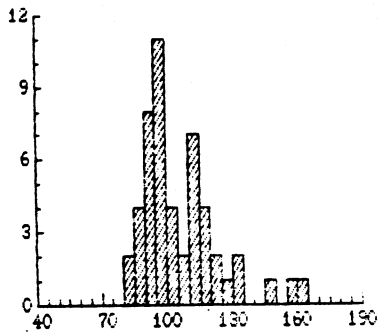
N=42 (no./h=168)



19-27 m

N=50 (no./h=4118)

N=50 (no./h=2282)

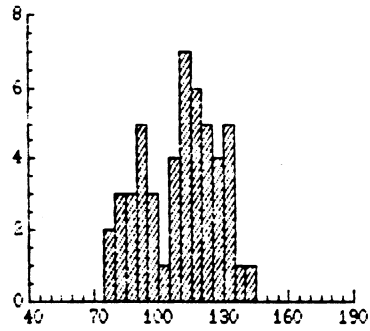
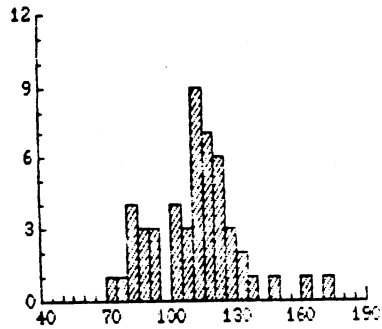


Frequency (no.)

28-37 m

N=50 no./h=1500)

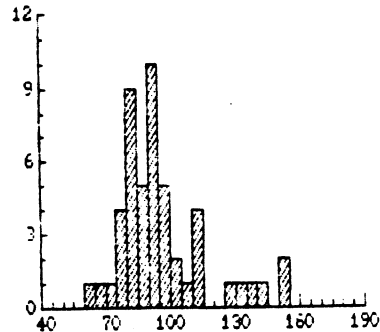
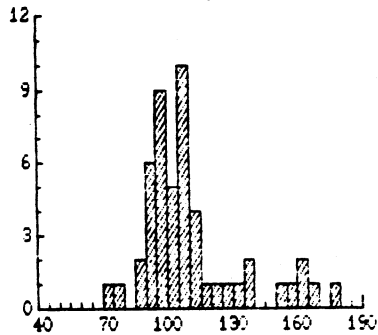
N=50 (no./h=3606)



38-49 m

N=50 (no./h=380)

N=49 (no./h=2108)



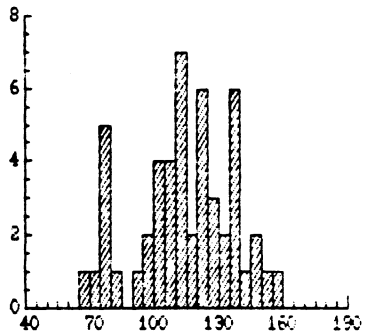
Total length (5 mm groups)

July 1981

Aransas Pass

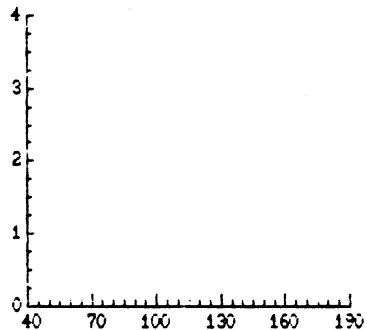
9-18 m

N=50 (no./h=2180)



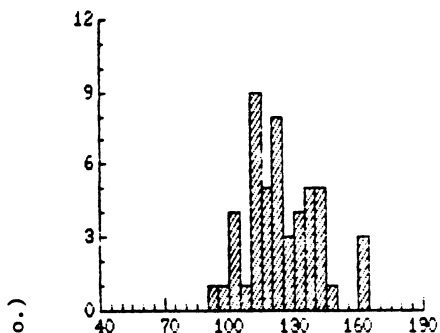
Mansfield Pass

NO CATCH

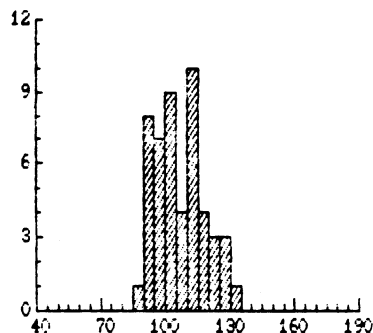


19-27 m

N=50 (no./h=1282)

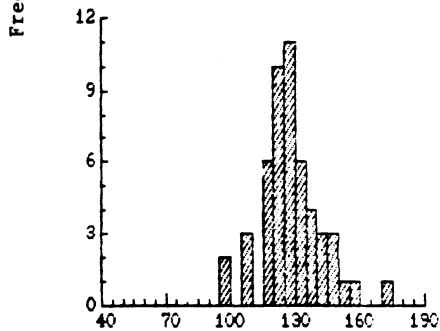


N=50 (no./h=3592)

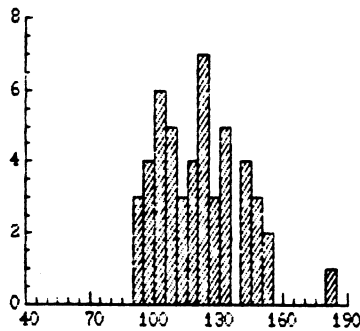


28-37 m

N=51 (no./h=1002)

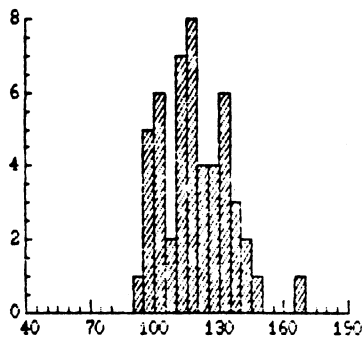


N=50 (no./h=1890)

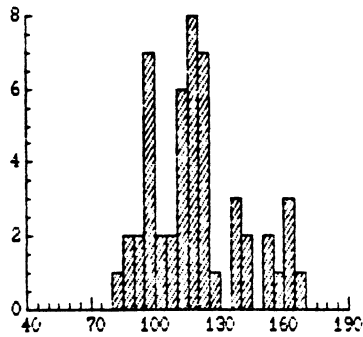


38-49 m

N=50 (no./h=1090)



N=50 (no./h=704)



Total length (5 mm groups)

August 1981

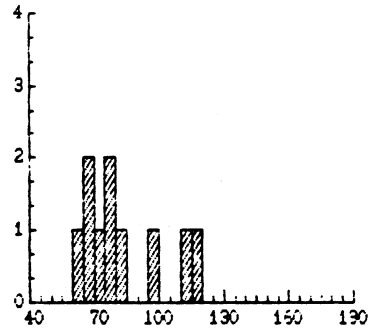
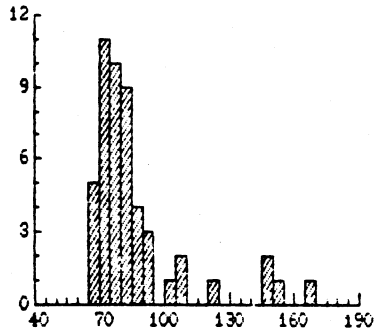
Aransas Pass

Mansfield Pass

9-18 m

N=51 (no./h=436)

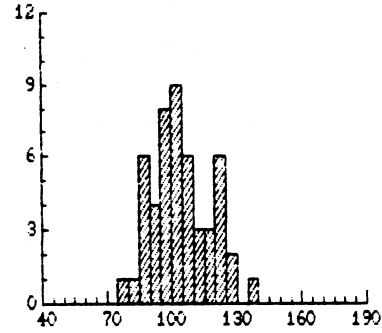
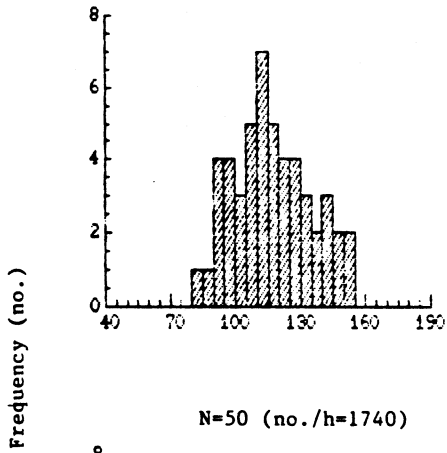
N=10 (no./h=40)



19-27 m

N=50 (no./h=844)

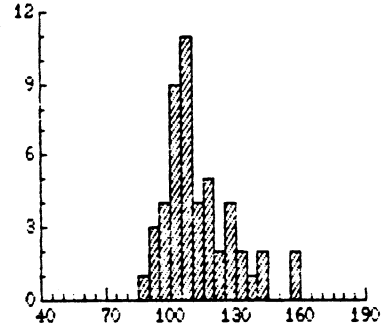
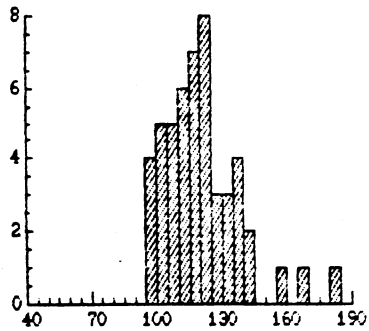
N=50 (no./h=3402)



28-37 m

N=50 (no./h=1740)

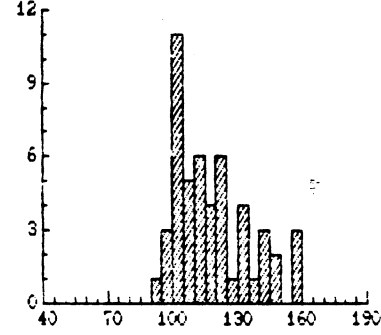
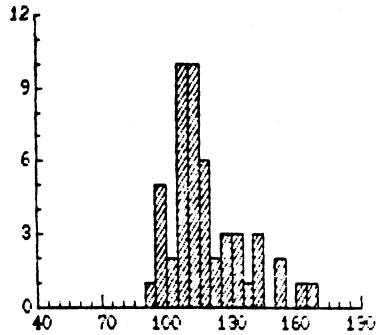
N=50 (no./h=1276)



38-49 m

N=50 (no./h=1602)

N=50 (no./h=2574)



Total length (5 mm groups)

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