

## A Study of Texas Shrimp Populations

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## A Study of Commercial Shrimp Populations in Coastal Bays of Texas, 1969

## ABSTRACT

In spring brown shrimp, Penaeus aztecus, abundance was low in upper coastal bays and high in lower coastal bays. The young, in upper coastal bays, were exposed to low water temperatures in March and low salinities in April and May. Emigration, from most bays, began in late May or early June. Apparently the Gulfward movement from the Laguna Madre began earlier.

Small juvenile white shrimp, P. setiferus, were captured in abundance in June at upstream stations of Chocolate Bayou (Galveston Bay system). They were abundant in Chocolate Bay in summer and fall.

Brown and white shrimp production, 42.1 million pounds, was the lowest since 1964. Brown shrimp landings, 30.1 million pounds, decreased 10.2 million pounds from 1968. White shrimp production 12 million pounds, was slightly less than the 1968 catch.

## INTRODUCTION

In 1969, 30.1 million pounds of brown shrimp, Penaeus aztecus, and 12 million pounds of white shrimp, P. setiferus, were landed at Texas ports. To manage this large annual fishery, Department personnel study shrimp migrations, growth rates, abundances and the estuarine environment (Leary and Compton 1960; Compton 1962; Pullen 1963; Moffett 1964, 1965, 1965, 1966, 1967 and 1968). This report presents findings in 1969.

## METHODS

Seven bay systems were sampled in March, April and May (Figure 1). Samples from the Laguna Madre and Sabine Lake were taken semi-monthly. Stations in Galveston, Matagorda, San Antonio, Aransas and Corpus Christi Bays were sampled semi-monthly in March and weekly in April and May.

Ten-foot trawls (1 1/4 inch mesh, lined with 1/2 inch mesh webbing) were used in primary and secondary bays.\* The sampling interval was 15 minutes. Six-foot bar-seines, 1/2 inch mesh webbing, were used in shallow areas. A standard sample was the catch in one 500 foot tow. Tertiary bays in the Corpus Christi Bay area were sampled with a 10-foot trawl. Shallows of the upper Laguna Madre were sampled with a 60-foot seine (3/4 inch mesh).

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\* Mesh sizes are stretch mesh

Shrimp were identified, measured in millimeters (tip of rostrum to end of telson), counted and weighed. When all shrimp captured were not measured or if short tows were made, samples were equated to the standard.

Water temperature, salinity, wind direction and turbidity values were recorded.

Shrimp size distributions were plotted (data not presented) for each species by date, bay type and bay system. Size modes (Figure 2) were selected from these graphs by the method of Leary and Compton (1960).

Growth rates, if measurable, were estimated by the method of Williams (1955), where growth was determined by using the difference between larger shrimp in periodic samples.

#### COMMERCIAL LANDINGS\*

The combined brown and white shrimp catch, 42.1 million pounds, declined 10.3 million pounds from 1968 (52.4 million pounds) and 19.3 million pounds from 1967 (61.4 million pounds). The peak production month was August when 7.0 million pounds were landed (Table 1). Although the white shrimp year-class was large and many new vessels have been added to the shrimp fleet since 1965, the 1969 total landings (which are preliminary) were the lowest since 1964 when 38.1 million pounds were reported.

Brown shrimp production, 30.1 million pounds, decreased 10.2 million pounds from 1968, 24.9 million pounds from 1967, and 3.9 million pounds from 1966 and 1965. There was, however, a 4.1 million pound increase over the 1964 catch. Landings during the spring bay season (May 15 to July 15) decreased about 24 percent from 1968 in central and lower coastal bays and about 40 percent in the Galveston Bay and Sabine Lake systems.

Because brown shrimp catches were below average, fishing pressure on white shrimp stocks intensified. The total white shrimp catch, 12 million pounds, nearly equalled the large annual catches of 1968 (12.1 million pounds) and 1964 (12.1 million pounds). When the fall bay season opened on August 15, white shrimp catches, perhaps due to the severe summer drought along the entire coast, were small. In September white shrimp catches (2.4 million pounds) were excellent from the shallow Gulf (especially near passes) from off Matagorda, Texas to off Cameron, Louisiana. The peak production month, however, was October when 2.7 million pounds were landed.

#### ANALYSES OF BROWN SHRIMP SAMPLES

Sabine Lake: For the first time since sampling began in 1964, juvenile brown shrimp were not caught in samples (Table 2). River shrimp, Macrobrachium sp. were common. The lack of brown shrimp and appearance of Macrobrachium took place during a low salinity period (Table 3). Salinity measurements in April and May ranged from 0 to 4.4 ppt. The highest was recorded at the Cameron Causeway station on April 1.

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\* Source 1969 Landings, Ormand Farley, Supervisor Fishery Reporting Specialist. All other landings from Shrimp Landings, Bureau of Commercial Fisheries. All landings values are heads-off.

Galveston Bay: A group of postlarval brown shrimp entered in March. This was followed by a larger wave in April (Baxter, personal communication). Late stage postlarval and early stage juvenile brown shrimp (13 to 28 mm) were first captured at nursery areas on April 8 (Table 3). Throughout spring bay salinity regimes were low (Table 3); thus the young were mainly restricted to the most saline nursery areas, e.g., Jones Lake, Moses Lake and Dickinson Bayou. Overall sampling indicated decreased abundance from 1967 and 1968 although the young were fairly abundant at some nursery areas in May (Table 2). They were not found in abundance at secondary and primary bay stations.

Brown shrimp growth was slow in early April, but as the bay warmed in late April, growth rates accelerated. Between April 8 and June 1 the calculated brown shrimp growth rate was 1.3 mm per day.

Matagorda Bay: The abundance of juvenile brown shrimp in samples decreased from 1967 and 1968, although some large samples were taken at secondary bay stations on May 1 and May 8 (Table 3).

Salinity levels, in general, were low and most juvenile brown shrimp were found in the more saline regions of the bay system. The young (8 to 28 mm) appeared first in samples on April 1 (Table 3). Between April 1 and May 15 they grew about 1.2 mm per day.

San Antonio Bay: With salinity regimes low (Table 3), brown shrimp were not taken in Guadalupe Bay nor were they found in abundance at secondary and primary bay stations (Table 2). The young (33 to 93 mm) first appeared in samples on April 15 (Table 3). Between April 23 and May 23 they grew about 1.1 mm per day.

Aransas Bay: Sample sizes were indicative of an abundant brown shrimp year class (Table 2). The young (5 to 63 mm) appeared first, in substantial numbers, on April 1 (Table 3) and they remained abundant at nursery areas throughout spring. On May 8, 747 brown shrimp (58-78 mm, modal length) were captured at Marker #43 in Aransas Bay.

Between April 1 and May 15 they grew about 1.6 mm per day.

Corpus Christi Bay: Salinity patterns were relatively high in Corpus Christi Bay and the Laguna Madre (Table 3).

In Corpus Christi Bay brown shrimp were abundant (Table 2). On April 15, the young (18 to 48 mm) were detected in Nueces Bay (Table 3). They remained abundant in the bay system but, due to heavy recruitment, their growth could not be measured.

Laguna Madre: Brown shrimp of the 1969 year-class were detected on March 15 (18 to 78 mm) in the Lower Laguna Madre and on April 8 (26 to 88 mm) in the Upper Laguna Madre (Table 3). For the past three years samples from both regions have been indicative of a large year-class (Table 2). The juveniles, however, leave this area at a relatively small size. In the 1969 spring emigration started in early May when shrimp were less than 68 mm long.

The calculated growth of brown shrimp in the Upper Laguna Madre, between April 23 and May 1 was 1.3 mm per day. Shrimp in the Lower Laguna Madre grew nearly 2.0 mm per day before April.

## BROWN SHRIMP SAMPLE SIZE --- COMMERCIAL YIELD RELATIONSHIP

In Figure 3 commercial brown shrimp landings and sample sizes are compared. April and May sample values were calculated by dividing the number of shrimp caught on the first of the month by the number of samples; fifteenth of the month data were treated the same. The monthly values are the total of the two average values. Commercial landings were extracted from Shrimp Landings.

The relationship for the years 1964 through 1968 agrees. In 1969, however, sample size values seem large. This reflects the large concentration of young shrimp in Aransas Bay (Figure 2) and possible selection of more productive sampling stations since 1966. During the record production year of 1967 young shrimp were abundant earlier in spring and a peak in sample size was not reached until June.

## ANALYSES OF WHITE SHRIMP SAMPLES (GALVESTON BAY SYSTEM)

Many white shrimp of the 1968 year-class spent the mild 1968-69 winter in Clear Lake and apparently migrated to Galveston Bay in April. Sample sizes of white shrimp caught at the Clear Lake and Humble Camp (Galveston Bay) stations in the spring of 1967, 1968 and 1969 are listed in Table 4. Numbers captured in 1969 reflect the large late fall winter shrimp wave of the 1968 year-class reported by Moffett (1968).

Data on the 1969 white shrimp year-class are available only from the Chocolate Bay-Hall's Lake areas of the Galveston Bay system (Figure 4). These data are the results of monthly samples from 17 trawl stations in Chocolate Bay, Chocolate Bayou (upstream to Pleasant Bayou), Wharton Bayou, New Bayou, Hall's Lake and Hall's Bayou (upstream to farm road number 2004).

Results of the Chocolate Bay area study\* strongly indicate that early stage juvenile white shrimp inhabit upstream nursery areas long before they appear at peripheral marshes of secondary bays. In early June the young (20 to 50 mm, modal length) were abundant at trawl stations in Chocolate Bayou north of the bridge that crosses farm road number 2004. Substantial numbers of white shrimp were not found in Chocolate Bay before July.

As brown shrimp emigration progresses, white shrimp became the dominant crustacean in Chocolate Bay. In August a second white shrimp wave (20 to 50 mm, modal length) was detected in all bayous sampled.

Sampling results at predesignated stations in Chocolate Bay for the years 1968 and 1969 are shown in Table 5. Though white shrimp were abundant in 1969, the 1968 sample sizes (a record production year) were larger. As opposed to sampling results from adjacent bayous, the second white wave was not detected at the Nymph Point nursery area (in Chocolate Bay) until October.

## DISCUSSION

Shrimp samples were collected in March, April and May. These data provided adequate information on brown shrimp stocks during the critical estuarine phase of their life-cycle. Knowledge on white shrimp stocks, which use bays in summer and fall, was scarce. In 1970, shrimp work will be restricted to weekly sampling in Galveston and Matagorda Bays and semi-

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\* Data on file at Seabrook Marine Laboratory

monthly sampling in Aransas Bay and the Lower Laguna Madre between April 1 and June 1.

In 1969, brown shrimp were exposed to low water temperatures in March and low salinity patterns in April and May in upper coastal bays. Water temperature patterns from Aransas Bay south were adequate for brown shrimp growth and survival. In contrast, young white shrimp were exposed to high bay salinities during a severe summer drought along the entire coast.

The apparent decline in brown shrimp stocks may have occurred before post-larvae entered bays. I base this assumption on the relatively small number of postlarvae observed by biologists of the U.S. Bureau of Commercial Fisheries in plankton samples from passes connecting Galveston Bay with the Gulf. Their sampling, however, was limited in 1969. Bay water conditions in spring may also have been a limiting factor. St. Amant, Broom and Ford (1966) report that in Louisiana a small postlarval peak may develop into a maximum population if they enter estuaries when water temperatures are 18 to 20°C or higher; whereas a small year-class may result from a large postlarval peak if they enter when temperatures are low. Low water temperatures in March and low salinity patterns in April and May limited the available nursery space and probably increased brown shrimp mortality. Apparently the best brown shrimp seasons occur when spring bay salinities are high, e.g., 1967 when a record 55 million pounds were landed.

The bay to Gulf brown shrimp movement began in early May from the Lower Laguna Madre when shrimp were less than 68 mm long, and in late May or early June from central and upper coastal bays when they were about 80 mm long. In May, juveniles were concentrated in lower bays of the upper coast (probably to escape low salinity patterns of back bays) and 747 juvenile brown shrimp (58 to 78 mm, modal length) were captured at one primary bay station of the Aransas Bay system on May 8. Although this indicated a possible premature emigration, similar conditions occurred in the past without affecting the time of brown shrimp emigration. Using this knowledge and information collected in past years the Parks and Wildlife Commission closed the shallow Gulf to shrimp trawling for 45 days starting on June 1. This allowed a greater number of the juvenile shrimp to reach utilizable size as they passed through the shallow Gulf.

Poor brown shrimp catches in summer created economic problems of Gulf shrimpers and fishing pressure on white shrimp stocks increased in the Gulf. As a result the total white shrimp catch was high. Apparently large numbers of white shrimp left the drought affected bays of the upper coast early in fall.

Literature Cited

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Table 1: Shrimp landings, 1969 (preliminary)

<u>Month</u>	<u>Brown Shrimp</u>	<u>White Shrimp</u>
January	1,398,900	222,100
February	989,300	204,100
March	734,400	264,300
April	865,000	417,400
May	1,468,700	773,300
June	1,742,300	468,500
July	4,860,200	522,600
August	5,847,800	1,192,300
September	4,136,800	2,451,700
October	2,632,500	2,693,400
November	2,634,300	2,400,600
December	2,808,200	445,200
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TOTAL	30,118,400	12,054,000

Table 2: Average number of brown shrimp by sampling period

Date	Tertiary Bay			Secondary Bay			Primary Bay			
	1967	1968	1969	1967	1968	1969	1967	1968	1969	
SABINE LAKE										
April	1	-	0	-	69	0	0	11	-	0
	15	55	0	0	489	0	0	443	-	0
May	1	-	17	-	51	36	-	450	56	-
	15	514	58	-	615	108	0	257	660	0
GALVESTON BAY										
March	15	31	0	0	0	0	0	0	0	0
April	1	71	5	0	6	0	0	0	0	0
	8	267	18	18	36	0	0	5	0	0
	15	439	15	76	92	0	1	23	0	0
May	23	510	69	49	234	3	0	63	0	1
	1	382	65	117	542	3	2	174	4	1
	8	135	71	303	435	13	29	548	147	7
	15	132	402	114	559	27	11	308	109	8
	23	385	70	145	712	32	43	131	23	9
MATAGORDA BAY										
April	1	13	3	0	20	-	0	0	-	0
	8	36	11	18	-	0	0	-	0	0
	15	92	63	11	57	6	16	9	0	3
	23	-	70	49	85	16	10	-	4	2
May	1	80	107	10	43	22	148	75	34	49
	8	53	175	90	75	-	132	17	-	23
	15	70	40	63	97	222	11	140	133	23
	23	21	14	?	-	69	19	-	121	47
SAN ANTONIO BAY										
March	15	-	0	-	26	0	1	29	-	0
April	1	-	0	-	-	0	4	-	-	5
	8	7	0	-	10	0	9	39	-	3
	15	8	0	-	10	0	8	72	0	8
	23	-	0	-	-	19	19	-	35	10
May	1	16	-	-	96	52	85	259	140	93
	8	-	-	-	201	-	-	131	-	-
	15	-	0	-	45	47	0	70	315	108
	23	-	0	-	-	51	-	-	249	-

Table 2: (Cont.)

Date	Tertiary Bay			Secondary Bay			Primary Bay			
	1967	1968	1969	1967	1968	1969	1967	1968	1969	
ARANSAS BAY										
March	15	21	0	0	4	0	0	3	0	-
April	1	62	6	4	5	6	2	25	0	2
	8	281	0	77	-	0	2	-	0	4
	15	261	-	233	93	-	8	110	-	6
	23	205	19	1007	-	19	4	-	0	16
May	1	189	16	316	257	16	13	827	10	38
	8	256	-	384	-	-	72	-	-	473
	15	101	69	392	-	69	199	-	190	792
	23	1	156	-	-	156	-	-	300	-
CORPUS CHRISTI BAY										
April	1	-	-	2	-	-	0	-	-	0
	8	-	0	0	-	0	0	-	1	0
	15	145	-	7	0	0	0	54	0	1
	23	277	6	75	74	0	47	195	8	50
May	1	108	846	195	11	31	0	123	7	25
	8	172	-	401	744	600	52	128	-	142
	15	233	510	508	61	120	33	250	938	71
	23	293	561	1	155	211	120	89	403	328
UPPER LAGUNA MADRE										
March	15	2	0	-	8	0	-			
April	1	1	1	2	127	2	3			
	15	48	16	30	60	179	112			
May	1	106	21	-	355	792	107			
	15	60	65	76	247	877	587			
LOWER LAGUNA MADRE										
March	15	50	0	18	6	0	14			
April	1	74	137	124	77	112	19			
	15	75	259	823	541	63	128			
May	1	24	43	195	526	527	8			
	15	14	71	271	121	617	247			

Table 3: Size of brown shrimp at first appearance in samples (1966-1969)

Area	Date	Size* Range	March Temp. °C	April Temp. °C	March Salinity ppt	April Salinity ppt
<u>1966</u>						
Sabine Lake	April 22	13-33	18.0	20.0	1.7	10.8
Galveston Bay	April 1	13-23	18.0	21.8	9.2	17.5
Matagorda Bay	April 1	13-23	18.3	22.7	18.3	16.8
San Antonio Bay	April 1	18-28	16.6	21.4	15.8	17.1
Aransas Bay	April 1	13-23	18.5	22.7	20.9	22.5
Corpus Christi Bay	April 8	13-28	18.9	24.6	30.7	31.2
Upper Laguna	May 1	48-83	20.5	23.5	38.4	42.5
Lower Laguna	April 1	18-78	20.5	22.0	35.4	35.3
<u>1967</u>						
Sabine Lake	April 4	23-43	21.0	26.0	17.6	10.0
Galveston Bay	March 15	18-28	21.7	26.5	24.7	27.1
Matagorda Bay	April 1	13-38	19.6	25.8	26.7	27.2
San Antonio Bay	April 8	23-78	17.2	25.1	20.8	24.2
Aransas Bay	March 15	13-18	20.5	26.7	25.2	27.9
Corpus Christi Bay	March 15	23-108	21.7	25.6	34.8	26.7
Upper Laguna	March 15	18-78	22.8	25.5	44.0	46.0
Lower Laguna	March 15	13-28	23.5	25.9	37.7	38.3
<u>1968</u>						
Sabine Lake	May 2	28-68	19.5	22.3	12.2	1.5
Galveston Bay	April 1	13-18	14.7	19.9	13.3	8.2
Matagorda Bay	April 5	18-28	20.0	23.0	18.5	17.9
San Antonio Bay	May 1	28-83	15.1	21.9	8.9	9.5
Aransas Bay	March 15	28	17.6	23.6	11.8	17.5
Corpus Christi Bay	April 23	38-48	16.3	25.1	21.9	26.6
Upper Laguna	April 1	23-33	18.7	21.4	22.6	24.9
Lower Laguna	April 1	28-38	-	22.7	-	31.4
<u>1969</u>						
Sabine Lake	-	-	14.0	21.0	7.4	1.1
Galveston Bay	April 8	13-28	13.0	23.3	4.9	2.5
Matagorda Bay	April 1	8-28	16.0	23.0	9.0	10.0
San Antonio Bay	April 15	33-93	12.0	24.0	7.8	3.9
Aransas Bay	April 1	5-63	18.0	23.0	9.0	10.0
Corpus Christi Bay	April 15	18-48	16.0	23.0	22.0	28.0
Upper Laguna	April 8	26-88	15.0	16.2	31.0	35.1
Lower Laguna	March 15	18-78	15.5	24.8	22.8	25.8

\* Total length in millimeters

Table 4: Number of white shrimp in samples from Clear Lake and Humble Camp, Galveston Bay 1967-69.

Date	Clear Lake			Humble Camp		
	1967	1968	1969	1967	1968	1969
March 1	38	6	346	1	3	15
15	4	6	116	1	0	55
April 1	6	1	53	1	28	56
8	20	10	192	1	63	524
15	22	9	82	2	94	48
23	1	28	17	4	22	204
May 1	0	7	24	6	45	10
8	1	2	16	4	-	28
15	0	0	3	2	76	42
23	0	0	3	0	1	2

Table 5: Number of shrimp caught per sample (Chocolate Bay, 1968-69)

Month	Monsanto Channel		White Shrimp		Temperature		Salinity	
	Brown Shrimp 1968	1969	1968	1969	1968	1969	1968	1969
March	0	0	0	24	15.0	15.0	21.1	11.1
April	2	2	11	1	24.0	26.0	8.9	1.1
May	85	147	0	0	26.5	26.0	1.1	6.7
June	557	438	4	0	30.0	30.0	13.3	15.5
July	1	303	148	0	30.0	30.5	13.9	28.9
August	0	3	1,026	81	29.0	30.0	15.5	33.3
September	2	0	1,234	0	27.0	29.5	14.4	29.4
October	0	6	624	183	22.0	28.0	12.0	15.5
November	0	6	6,201	48	21.0	18.0	20.0	26.0
December	0	0	132	2,457	12.0	14.0	22.8	26.6

Month	Nymph Point		White Shrimp		Temperature		Salinity	
	Brown Shrimp 1968	1969	1968	1969	1968	1969	1968	1969
March	0	0	0	0	15.0	22.0	11.1	7.2
April	24	21	0	0	23.0	26.0	1.1	0.1
May	56	45	0	0	27.0	26.0	1.1	0.0
June	89	8	41	15	27.5	33.0	9.4	16.1
July	0	2	2	5	29.0	29.5	3.3	17.8
August	0	0	3	0	30.0	30.0	9.4	16.7
September	7	1	17	18	26.0	32.0	8.9	15.5
October	4	3	825	321	22.0	28.0	13.3	9.9
November	5	0	12	0	22.0	18.0	11.1	17.2
December	0	0	0	10	17.0	12.0	14.0	13.3

Figure 1. The Texas Coast

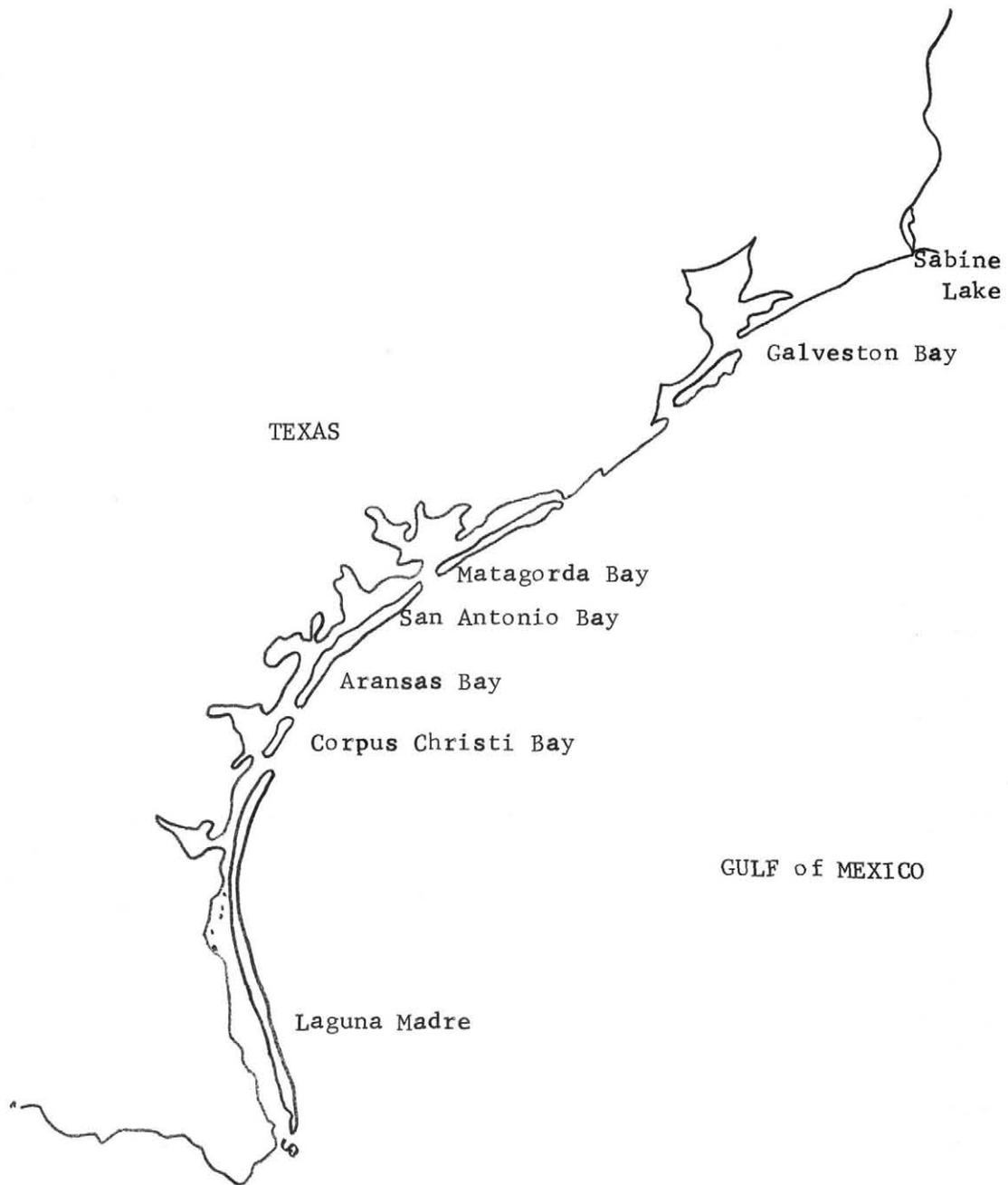
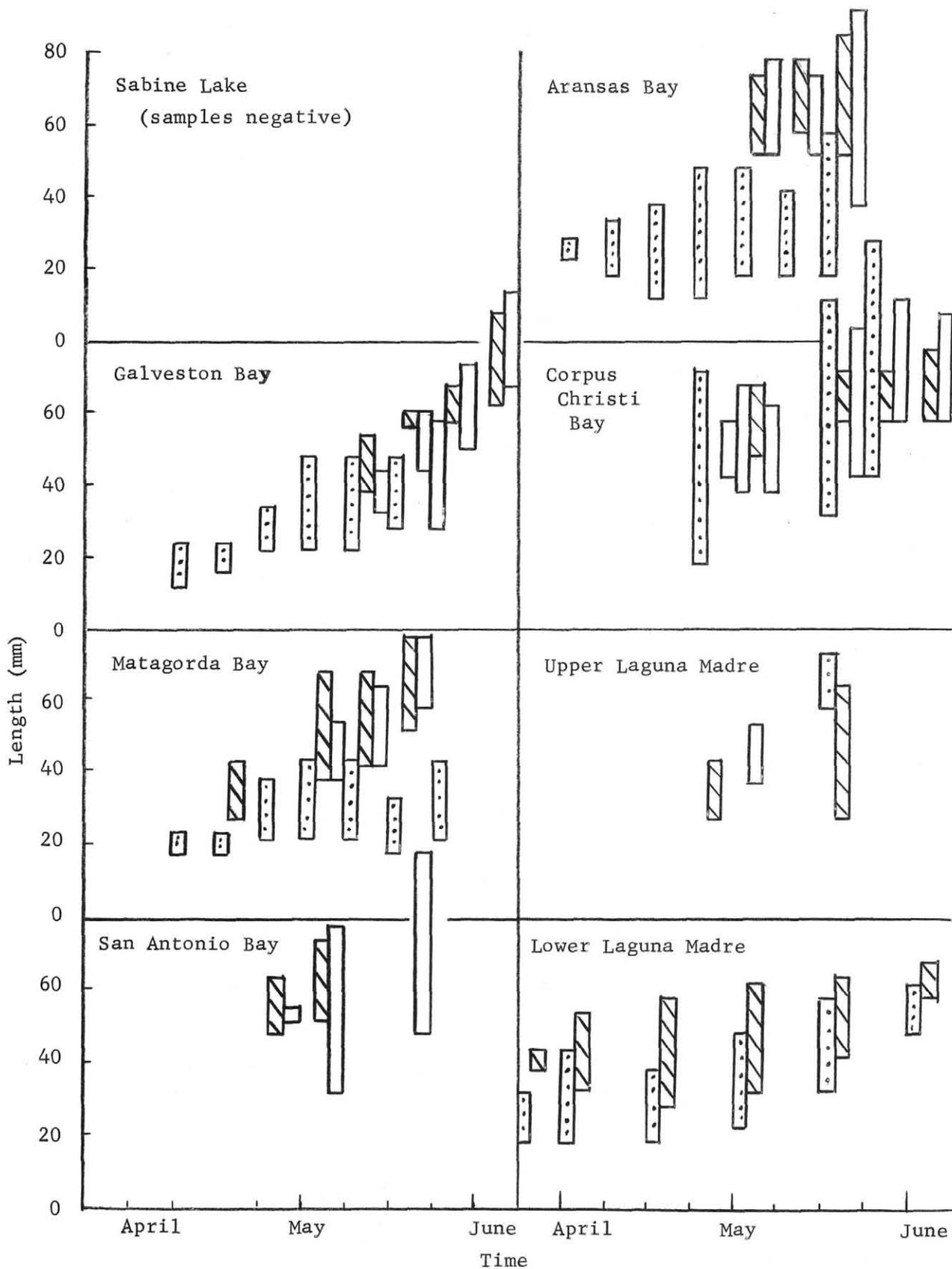


Figure 2: Brown shrimp modal lengths vrs. time, based on 1969 samples.



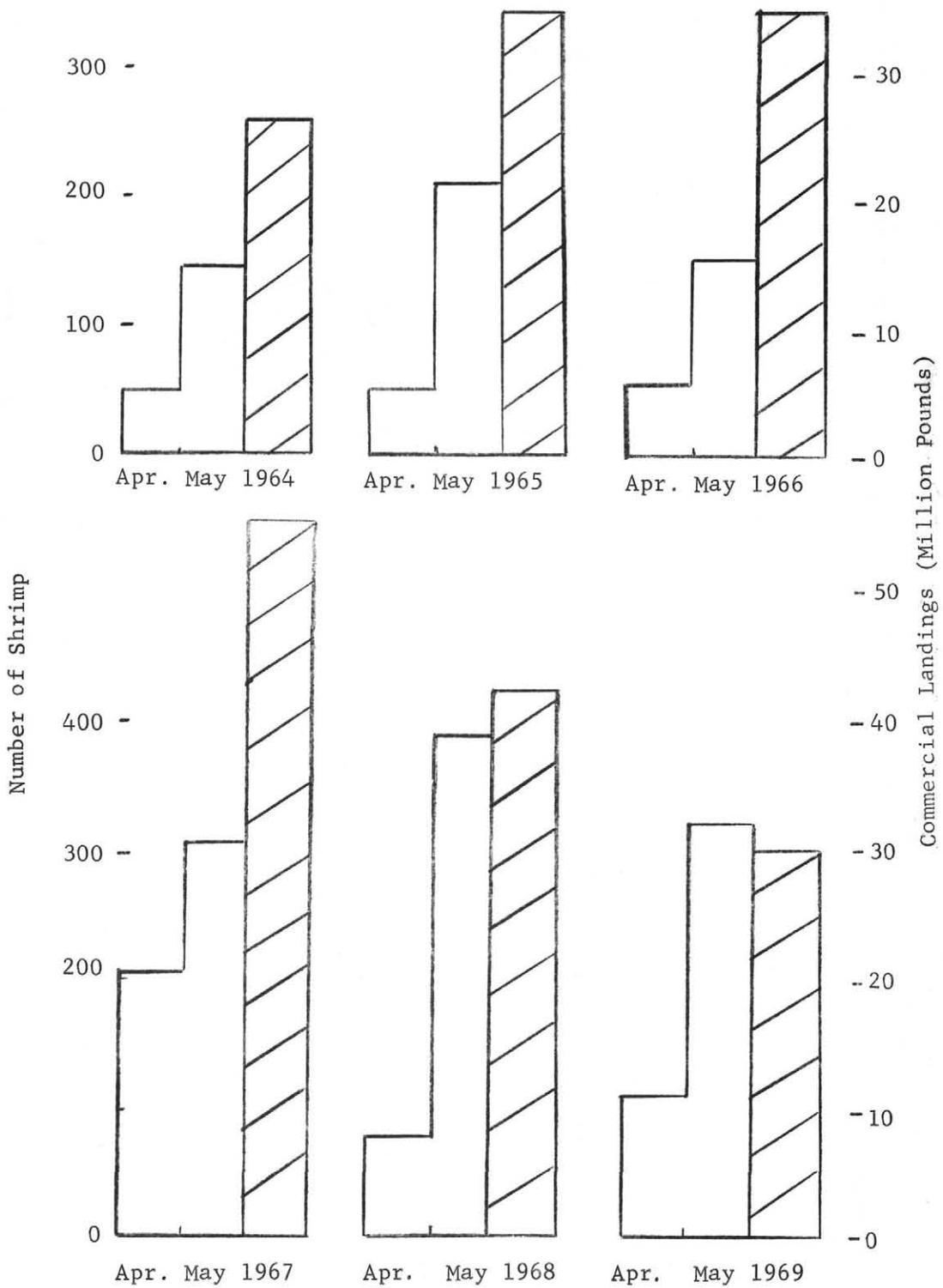
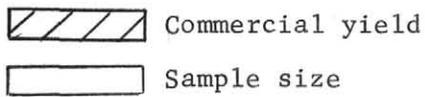


Figure 3: Brown shrimp sample size - commercial yield relationship (1964-1969).

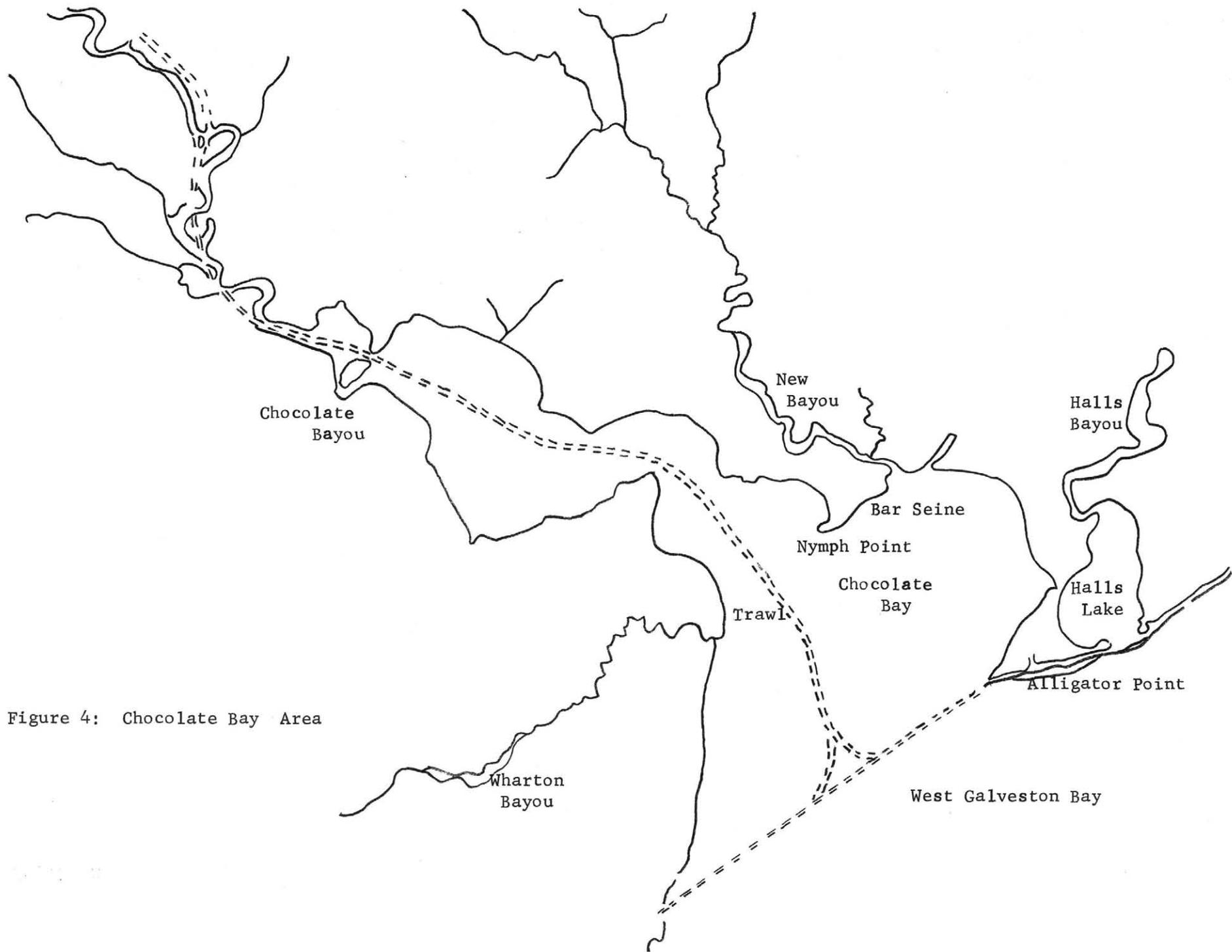


Figure 4: Chocolate Bay Area