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MARINE BIOLOGY OF THE GOVERNMENT JETTIES IN THE GULF OF MEXICO BORDERING THE TEXAS COAST

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THESIS

Presented to the Faculty of the Graduate School of The University of Texas in Partial Fulfillment of the Requirements

For the Degree of

MASTER OF ARTS

By

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CHAPTER I

INTRODUCTION

This thesis should be considered as a preliminary survey of the biology of the government jetties of Texas, which may help to create interest in the various types of ecological problems not yet investigated. Nothing has been written about the fauna of the jetties, and very little concerning the open beach itself. In the words of Dr. Shoemaker, of the United States National Museum, "As far as I am aware, almost no collecting has been done on the Texas coast, and we know almost nothing of its amphipod fauna."[1]

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[1]Personal letter from Dr. Shoemaker, May 31, 1940.

Probably the most recent check list of any part of the area is a bulletin of the Texas College of Arts and Industries, Kingsville, Texas, by J. C. Cross and Hal B. Parks, entitled "Marine Fauna and Sea-Side Flora of the Nueces River Basin and the Adjacent Islands." This bulletin presents a good cross-section of the great number of forms present in a small, definite area, but it does not deal with the animals quantitatively.

The only other publications directly centered around the Gulf coast are bulletins of the United States Bureau of Fisheries and the works of Evermann and Kendall. The Fish-

eries Bulletins are concerned only with shrimp, oysters and a few fishes, while Evermann and Kendall limit their discussion to fishes of the region, about one hundred of which are salt water species.[2]

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[2]Game, Fish and Oyster Commission, Bulletin 5, "Fishes of Texas," (Austin, Texas, 1932), 5.

Various marine publications and keys were used in preliminary identification, but for final verification of many species, the writer is indebted to experts connected with the Smithsonian Institution. Their names and departments are listed in Chapter III, and the specimens classified by the Museum are indicated in the check list in the appendix.

Maps and necessary information concerning the jetties have been received from the office of the United States Engineer, Galveston, Texas, and elsewhere. The writer wishes to express his thanks to these organizations, and to individuals who have helped in various ways, including the members of the thesis committee.

CHAPTER II

GEOGRAPHY AND TOPOGRAPHY OF THE JETTIES

There are numerous geographical and topographical conditions peculiar to the Gulf coast of Texas. Probably the most noteworthy of these conditions is the chain of islands separated from the mainland by several bays. These islands are also separated from each other by eight passes, distributed throughout the four hundred miles of coast line. It may be mentioned in passing that the fluctuating salinity in the bays, notably in Laguna Madre, destroys thousands of pounds of fish and other marine life at intervals.[1] For this reason, the dredging of new

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[1] Annual Report of the Game, Fish and Oyster Commission of Texas, (Austin, Texas, fiscal year 1937-38), 31.

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artificial passes is being considered at present.

The United States Government has constructed five sets of rubble-stone jetties along the Texas coast within the past sixty years. These jetties serve as breakwaters, and are located at the passes referred to above, except the Freeport jetties, which extend from the mainland. The other jetties are located at Sabine, Galveston, Aransas Pass and Port Isabel. Although there are several municipally-owned jetties, or breakwaters such as the one at Corpus Christi, this thesis deals only with the government jetties, all of

which are located in the Gulf proper. These five sets of jetties are maintained by the government to protect the shipping channels along the coast.

Another ecological problem which at once presents itself is that of comparing the life forms of the jetties within the bays with those on the Gulf. This problem has not yet been undertaken by the writer because there are many factors such as salinity, pollution, and turbidity, which would need much more consideration than that given them in this thesis. It is hoped, however, that this comparison will be made some time in the near future.

Due to wave action, settlement and scouring along the "toes of slope", or bases of the jetty rocks, repair work has been carried on almost continually during the past sixty years. These changes, however, affect the fauna of the jetties only slightly, since the stones are never removed from their original positions. At the present writing, the north jetty at Port Isabel and the south jetty at Sabine are undergoing repairs at the extreme gulfward ends. During recent years concrete caps have been placed on portions of the jetties at Sabine, Galveston, Freeport, and Aransas Pass. Also, a section of the south jetty at Galveston has been covered with an asphaltic-concrete material as an experiment.

A better understanding of the physical nature of the jetties may be had by referring to the maps preceding each chapter. The five maps included are reproduced by permission of the War Department of the United States, and are known

as project maps. From these maps it is possible to secure such information as the following; range of tide, mean low tide, streams affecting salinity, relation of jetties to surrounding land, length and structure of jetties, and location of points, or stations. Most of the information pertinent to this investigation will be included in the discussion of each station.

The stations are not only helpful in referring to the maps, but while in the field they are invaluable in determining one's exact position. In most cases, the station numbers are painted on the jetty rocks or concrete caps, and are easily seen. For this reason, the station numbers used in the maps will be used in this thesis, as well as other map information that is found to be practicable. The writer has attempted to divide all the jetties into ecologically similar areas, or sections. Each of these sections is located between two of the so-called stations, and each section usually has topographical differences described in the discussion. The stations are simply points on the jetty marked off in tens and hundreds of feet, separated by plus signs. For example, "Station 11+50" indicates a point on the jetty located at a distance eleven-hundred-fifty feet from the shoreward end. "Stations 11+50 to 11+60" simply means a section of the jetty ten feet long, located eleven-hundred-fifty feet from shore.

The jetties themselves present an ecological condition even more outstanding than any of the other factors involved.

There is an absence of rocky shores in Texas, and the jetties form an artificial habitat for many species of animals and plants which might even be absent from our outer coast if the typical sandy beaches alone were present.

On the other hand, from an economic standpoint, the jetties might interfere with the shrimp and fish industries to some extent. It is probable that some shrimp and fish spawn in the Gulf near the passes, and the larvae make their way into the bays to feed and to seek protection from wave action and their natural enemies in the animal kingdom. If so, it is the opinion of the writer that this migration is often checked or prevented entirely by the jetties extending into the Gulf, sometimes a distance of five miles. If these animals spawn in the bays, the adults have the same problem in gaining entrance to these bays. In many cases, however, the animals have no difficulty in finding crevices between the rocks, at least during high tide. This is evident after each receding tide, as one may find an abundance of larval forms left in small pools beyond the seemingly impenetrable jetty walls.

Still another condition resulting from the building of the jetties is evidenced in the fauna of the passes. Formerly these passes were shallow inlets to the bays, acted upon by the rough surf. Now, the passes between jetties are dredged to an average depth of thirty-four feet, for use as shipping channels. The species of animals in-

habiting these channels are necessarily different from those found in shallow water washed by waves of the open Gulf. Reference to this fact will necessarily be made elsewhere.

CHAPTER III

COLLECTION AND CLASSIFICATION OF SPECIMENS

In preparation for the writing of this thesis, specimens were collected during the months of June and July of the years 1938, 1939 and 1940. The collecting of the first two summers was done primarily to secure type specimens for taxonomic work. The field work of the present season was devoted mainly to observation of physical conditions and distributions, as well as collecting. In all cases an attempt has been made to treat the material from an ecological standpoint, and to consider the taxonomic work of secondary importance.

Although the physical and chemical factors affecting a region are of great ecological importance, they are only of relative significance in this investigation, because no comparisons have been made over a period of years. Unless otherwise specified, all observations were made on average days in June, 1940, as far as weather, salinity and other factors were concerned. The water temperature at the surface ranged between twenty-nine and thirty-one degrees centigrade, during daylight hours. The turbidity of the water at the time of collecting was about the same at all jetties except at Port Isabel, where turbidity was greater. "The average salinity of Aransas Bay, (and similar bays), throughout the year is 16 0/00, which means that one thousand parts of water contain 16 parts of salt.

The salinity increases during July because of increased evaporation."[1] Chemical analyses of the water were not

[1] Annual Report of the Game, Fish and Oyster Commission of Texas, (Austin, Texas, fiscal year 1937-38), 34.

made by the writer. All collecting was done during daylight hours unless otherwise stated. Results of storms and unusual disturbances were taken into account.

Collections and observations of specimens were limited to the area on top of, and around, the jetties; and beneath the water to a point about five feet below mean low tide level. Dredging of the lower strata obviously would reveal forms not mentioned in this work, but the writer was unable to secure dredging equipment suitable for use in such rocky areas. Various kinds of dip-nets were used, as well as round shrimp nets, regular shrimp nets and minnow seines. Some of the seining was done with the assistance of bait fishermen in motor boats. This was necessary in collecting fish near the ends of the jetties where the water was rough.

The specimens collected during the two previous years were preserved in formalin, and arranged according to the station numbers at which they were collected. Then as already indicated, a preliminary classification was made by the writer, who used keys and check lists such as those listed in the bibliography.

During the past year, type specimens of the major part

of the invertebrates collected were sent to the Smithsonian Institution for verification. Below are names of the various experts connected with the various departments of the museum, who personally classified the groups following their names:

Dr. Paul Bartsch, Curator of Mollusks, mollusks.

Mr. Milton J. Lindner, of the United States Bureau of Fisheries, shrimp.

Dr. C. Mc Lean Fraser, hydroids.

Dr. Waldo L. Schmitt, decapods.

Dr. Clarence R. Shoemaker, Assistant Curator, Division of Marine Invertebrates, jellyfish and amphipods.

Mr. J. O. Maloney, isopods.

Dr. Olga Hartman, annelids.

Dr. R. S. Bassler, Head Curator of Geology, bryozoa.

Mr. E. C. Leonard, plants.

Mr. Austin H. Clark, Curator of Echinoderms, echinoderms.

Mr. I. E. Cornwall, barnacles.

Mr. A. Wetmore, Assistant Secretary of the Smithsonian Institution, supervisor.

The specimens identified by the Museum staff are indicated in the check list in the appendix, and a number of specimens sent to the Smithsonian Institution have not been classified to date. A complete classified set of specimens has been retained and may be used as proof in any question of identification. The writer will be responsible for all other errors in taxonomy.[2]

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[2]Several coelenterates sent to the Museum have not been sent out for verification because the specialist in that field is now in the war zone of Europe.

In the study of the plants found, the only forms considered were the Sargassum plants left stranded among the rocks, and the dominant species of algae actually growing. No attempt was made to classify the secondary algae, as only small patches were found, and a thorough search was not made for these less common forms. A master's thesis was written at the University of Texas in 1938, by Beulah S. Smith, entitled "A Study of the Algae of the Gulf Coast of Texas." Her thesis is a survey of the algae of the entire region, and may be consulted on questions of both classification and distribution.

The only fish considered to be true jetty forms are those which were found inhabiting regions between the rocks in comparatively large numbers, because few fish actually inhabit the jetties. This is due to the fact that most of these fish prefer quieter waters, or water deeper than that investigated. It is true that many of the hundred or more salt water species found on the coast may be caught near the jetties, but they are usually only swimming around the rocks, or seeking shelter in lower strata. Hence, such fish cannot be said to inhabit the jetties, since their life histories substantiate the fact. The writer has seined many areas bordering the jetties with a shrimp net, and has caught various species ordinarily found only in open water, (limnetic communities). These have been omitted as irrelevant in cases where they are known to be strictly deep-water forms.

The jetsam deposited on the jetties, consisting of

the gulfweed, Sargassum, logs wedged between the rocks, and other debris has been included. Thus the reader may expect to find forms listed which are not permanent inhabitants, and others which are only seasonal. These include certain hydroids, goose barnacles, pipefish, and many more species discussed later.

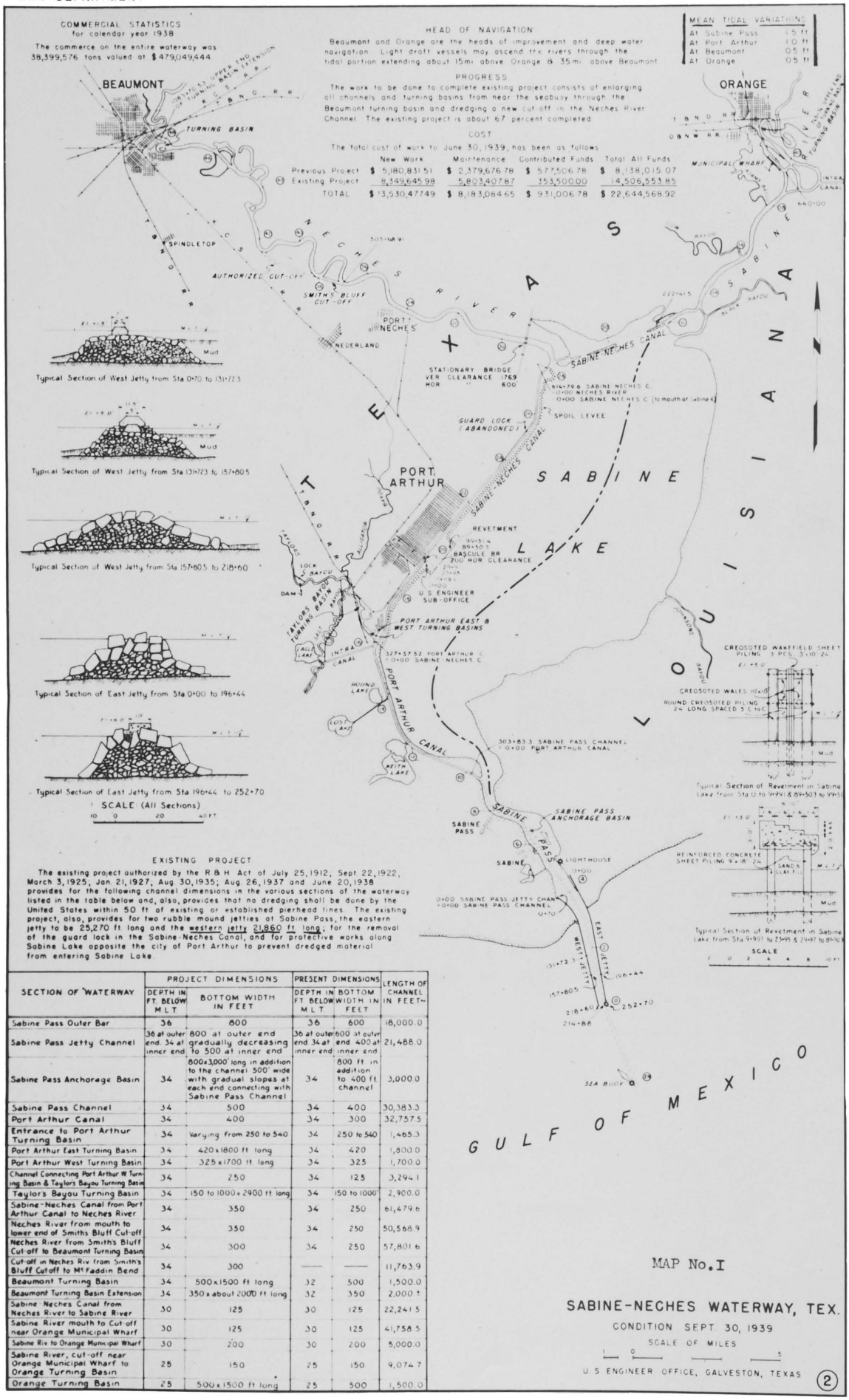
Other specimens ordinarily associated with sandy beaches are necessarily listed, because the animal and plant communities formed by some jetties include parts of the sandy areas. This is clearly shown in the photograph of the Port Isabel south jetty, figure X.B. Some of these seashore forms were the sand dollar, starfish, certain bivalved mollusks, the "sea pen", some algae, and others. Insects and birds of this region are also listed if actually observed in comparatively large numbers on the jetties, or if found to be regular influents. The main interest, however, is centered on marine invertebrates.

FIGURE I

WEST JETTY, SABINE
Station 30+00

FIGURE II

Camp Trailer Used on Collecting Trip



SECTION OF WATERWAY	PROJECT DIMENSIONS		PRESENT DIMENSIONS		LENGTH OF CHANNEL IN FEET
	DEPTH IN FT. BELOW M L T	BOTTOM WIDTH IN FEET	DEPTH IN FT BELOW M L T	BOTTOM WIDTH IN FEET	
Sabine Pass Outer Bar	36	800	36	600	18,000.0
Sabine Pass Jetty Channel	36 at outer end, 34 at inner end	800 at outer end gradually decreasing to 500 at inner end	36 at outer end 34 at inner end	600 at outer end 400 at inner end	21,488.0
Sabine Pass Anchorage Basin	34	800x3000' long in addition to the channel 500' wide with gradual slopes at each end connecting with Sabine Pass Channel	34	800 ft. in addition to 400 ft. channel	3,000.0
Sabine Pass Channel	34	500	34	400	30,383.3
Port Arthur Canal	34	400	34	300	32,757.5
Entrance to Port Arthur Turning Basin	34	Varying from 250 to 540	34	250 to 540	1,465.3
Port Arthur East Turning Basin	34	420x1800 ft. long	34	420	1,800.0
Port Arthur West Turning Basin	34	325x1700 ft. long	34	325	1,700.0
Channel Connecting Port Arthur W Turning Basin & Taylors Bayou Turning Basin	34	250	34	125	3,294.1
Taylors Bayou Turning Basin	34	150 to 1000x2900 ft. long	34	150 to 1000	2,900.0
Sabine-Neches Canal from Port Arthur Canal to Neches River	34	350	34	250	61,479.6
Neches River from mouth to lower end of Smiths Bluff Cut-off	34	350	34	250	50,568.9
Neches River from Smith's Bluff Cut-off to Beaumont Turning Basin	34	300	34	250	57,801.6
Cut-off in Neches Riv from Smith's Bluff Cutoff to Mc Faddin Bend	34	300	——	——	11,763.9
Beaumont Turning Basin	34	500x1500 ft. long	32	500	1,500.0
Beaumont Turning Basin Extension	34	350 x about 2000 ft. long	32	350	2,000.*
Sabine-Neches Canal from Neches River to Sabine River	30	125	30	125	22,241.5
Sabine River mouth to Cut-off near Orange Municipal Wharf	30	125	30	125	41,758.5
Sabine Riv to Orange Municipal Wharf	30	200	30	200	5,000.0
Sabine River, cut-off near Orange Municipal Wharf to Orange Turning Basin	25	150	25	150	9,074.7
Orange Turning Basin	25	500x1500 ft. long	25	500	1,500.0

FIGURE III

CHAPTER IV

THE SABINE WEST JETTY

To the casual observer, the west jetty at Sabine, with its eroded concrete surface, would present very little of interest to the ecologist, as shown in figure I. On closer examination, however, even the section illustrated in the photograph is teeming with life. On this jetty alone, forty-odd species of marine fauna have been identified.

This jetty extends southward into the Gulf a distance of 21,860 feet. Between it and the east jetty in Louisiana, is located Sabine Pass. Water in this pass comes from Sabine Lake, a large body of water fed by the Sabine and Neches Rivers. The Sabine jetties are almost one-half mile apart, and the average depth of the channel between is thirty-six feet.

The granite rocks of the jetties, which remain above low tide level, are cover rocks, ranging in weight from eight to twelve tons. The width of the jetties above sea level is only four to eight feet, while at the base, or toes of the jetties, the width is forty to eighty feet. (See cross-section of jetty in figure III). The range of tide along the Sabine west jetty is approximately one and one-half feet. Wave action varies at individual stations, as described in the discussion.

STATIONS 0+70 to 80+70

The littoral region to the west of the first station is a typical mud flat during low tide. During high tides

and storms, water seeps under the concrete cap and around the west side of the jetty, converting the mud flat into a salt marsh. The fiddler crab-rush grass community, composed of the crabs Uca pugilator and Uca minax; and the seashore rush grass, Sporobolus virginicus, was found here. The jetty itself was not overlooked by these crabs, which could be seen scurrying from every crevice on the west wall to the more permanent shelter of holes in the mud among the rush grass. It may be mentioned that this was the only dominant strand plant found to be associated with either of the jetties. The situation at this station affords a good opportunity for inter-tidal plant growth, but only the single species of plant has persisted.

High on the leaf blades of approximately every twentieth plant could be found active specimens of the salt-marsh periwinkle, Littorina irrorata. On the west side of the jetty, there was a scattering of this large littorine in company with the more abundant but smaller Littorina ziczac Gmelin, on the jetty wall. The small littorines were numerous on both sides of the concrete cap, numbering as high as one-hundred-fifty per square meter.

Also numerous on both sides, in all strata of vertical distribution, was the swimming crab, Callinectes sapidus. At the writer's last visit to this jetty, young crabs measuring only two millimeters in length were so numerous on the west side of the jetty that a quart jar could easily be filled with them after two or three drags with

a small dip-net. Young shrimp, (mysids), of the species Penaeus brasiliensis and Xiphopenaeus kroyeri were found together in the same area, though not plentiful.

On the top and sides of the jetty near the shore regions, the large isopods, Ligyda exotica (Roux), were found to be abundant, their complete domination of the concrete cap being disturbed only by fishermen. At times, however, the robber flies, Erax rufibarbus; and horse flies, Tabanus, sp., almost outnumbered the isopods. At least, in any ecological work of this station, these insects should not be overlooked. This also applies to at least two species of birds which frequented the jetty wall at this point. The great blue heron, Ardea herodias; and the willet, Catoptrophorus semipalmatus; though not numerous, were always present, searching for food on the shore side, especially for mullet, Mugil cephalus (Linnaeus). These fish were taken in schools near this and other jetties, but they are not strictly jetty fish. Common minnows, Gambusia, sp., were always present in the brackish water of this region. A salt-water strider similar to Hydrometra was also present.

STATIONS 80+70 to 131+72

This area was somewhat like the preceding except for the absence of a muddy shore on the south side. The benthic area, a few feet below the surface at low tide, was easily explored, however, and it appeared that the dominant species of the past had been the oyster, Ostrea virginica Gmelin.

The empty shells of this oyster were abundant, but the mud and silt had covered and smothered them some time ago. Other mollusk shells found bordering the jetties were as follows: the jackknife clam, Tagelus gibbus Spengler; the red oyster, Spondylus americanus Lamarck; worn specimens of the bivalves Noetia ponderosa Say and Donax tumida; a few jingle shells, Anomia glabra; and the bay form of the moon snail, Natica duplicata.

On the walls of the jetty, washed by strong waves from both sides, the rock barnacles Balanus improvisus Darwin and Balanus eburneus Gould were making a desperate stand. Half of those examined proved to be empty shells, but in all, there were about fifty barnacles per square yard, most of which were above low tide level. Among these were only a few littorines, Littorina ziczac, and some of the small species Nerita versicolor Gmelin.

STATIONS 131+72 to 157+80

This area was undergoing repairs to the concrete cap of the jetty, and was not examined by the writer in 1940. It has only one dominant community above the benthic area, however, and that is the Balanus-Littorina community. These two forms become more and more numerous toward the end of the concrete cap, at station 157-80.

STATIONS 157+80 to 218+60, (End of Jetty)

Two species of gulfweed, Sargassum natans (L.) Meyen, and Sargassum fluitans Borg., are usually present as

jetsam on rocks of the jetties after the tide recedes. At this section of the Sabine jetty, they are found in summer in large numbers. These Sargassum plants, when examined this season, revealed many interesting specimens.

Two species of annelid worms, Nereis pelagica and Lumbrinereis tenuis, were the dominant forms in some of the Sargassum. Gelatinous masses, in which young worms were present, almost covered entire plants. Other gulfweeds were decorated with the beautiful hydroid Aglaophenia minuta Fewkes, interspersed with smaller growths of Clythia cylindrica Agassiz, and Sertularia versluysi Nutting. A few were encrusted with the bryozoan Acanthodesia savartii Savigny-Audouin.

Two types of nudibranch mollusks averaging one-half inch in length were rather numerous, as well as Sagartia luciae Verrill, a small gray sea anemone which was abundant. One of the nudibranchs was found to be Aeolis, sp., and the other has not been identified.

Algae are not common on this jetty, although a few species may be found, including Enteromorpha lingulata J. Ag., and Cladophora fascicularis (Mertens) Kützz, as primary inhabitants.

From an ecological viewpoint, the rocks of the area, as well as all other jetty rocks, may be considered as sub-climax communities, since they are relatively stable. The so-called cover rocks weigh from six to ten tons each, and have an average length and width of six feet. In a

climax community, an area of approximately two square yards is known as a lociation, and in many cases one of these rocks may be referred to as such. In other cases, the rock surface is small enough to include only one-half square yard, and such a community may be called a clan.

At the end stations of this jetty, lociations of the limpet, Siphonaria lineolata Orbigny, the barnacle Balanus improvisus Darwin, and the snail, Thais floridana Conrad, were found on each rock, with some algae present. There were often ten or more snails per lociation. The limpet was not abundant here, and was absent at most other stations on the Sabine jetty.

In the water among the jetty rocks, about ten mantis shrimp, Squilla empusa, were caught along with other more common shrimp. Mullet were present in large numbers, but no typical jetty fish were collected.

Five rock crabs, Menippe mercenaria, were observed in the area, wedged tightly between rocks just above water level. This number indicates that an abundance of this species was present. No other crabs and no isopods were collected at this end of the jetty above the benthic area, which is deep on both sides of the jetty.

The extreme end of this jetty is characterized by rough water at times, since it extends so far into the Gulf. In the past, no dredging of a scientific nature has been done near this jetty. For this reason, it would be desirable to dredge the lower strata and make comparisons.

No collecting was done on the east jetty, since this jetty is in Louisiana. A comparison would probably reveal habitats and specimens similar to those of the west jetty at corresponding stations, except for the absence of a salt marsh and mud area.

SUMMARY

Note: Figures to the right of the specific names refer to the average number of individuals per square meter, unless otherwise specified within the parentheses.

SABINE WEST JETTY

STATIONS 0+70 to 80+70, West Side, (Mud flat during low tide and salt marsh during high tide; Uca-Sporobolus community).

Species	Common Name	Number of Individuals Per Square Meter
Sporobolus virginicus.	Rush Grass	(dense growth)
Uca pugilator.	Fiddler Crab	20
Uca minax.	Fiddler Crab	15
Littorina irrorata.	Littorine	1
Littorina ziczac Gmelin.	Littorine	20
Callinectes sapidus.	Crabs	2
Penaeus brasiliensis.	Shrimp	1
Xiphopenaeus kroyeri.	Sea-Bob	1
Ligyda exotica Roux.	Isopod	30
Erax rufibarbus.	Robber Flies	0 to 20
Tabanus, sp.	Horse Flies	1
Ardea herodias.	Great Blue Heron	(2 birds per thousand ft.)
Catoptrophorus semipalmatus.	Willet	(1 per thousand ft.)
Mugil cephalus Linnaeus.	Mullet	1 to 20
Gambusia, sp.	Minnow	1

Hydrometra?, sp. Salt-Water Striders (groups of 15)

Mneiopsis, sp. Comb Jelly (few collected, 1938)

STATIONS 80+70 to 131+72, East Side, (Water three to six feet deep at toes of jetty rocks).

Empty Mollusk Shells found at Toes of Jetty:

Spondylus americanus Lamarck. Red Oyster

Ostrea virginica Gmelin. Common Oyster (abundant)

Tagelus gibbus Spengler. Jackknife Clam

Noetia ponderosa Say. Bivalve

Donax tumida. Bean Clam

Anomia glabra. Jingle Shell

Natica duplicata. Moon Snail

Jetty Forms found on Rocks of Jetty:

Balanus improvisus Darwin.	Rock Barnacle	30
Balanus eburneus Gould.	Barnacle	20
Littorina ziczac Gmelin.	Littorine	6
Nerita versicolor Gmelin.	Snail	1

STATIONS 157+80 to 218+60, Both Sides, (Rock area extending into the deep water of the Gulf; water eight to twenty feet deep at toes of jetty).

Specimens on Jetsam:

Nereis pelagica. Nereis Worm (abundant on Sargassum)

Lumbrinereis tenuis. Nereis Worm (30 collected)

Aglaophenia minuta Fewkes. Hydroid (the dominant species found in the Sargassum)

Clythia cylindrica Agassiz. Hydroid (scarce)

Sertularia versluysi Nutting. Hydroid (scarce)

Acanthodesia savartii Savigny-Audouin. Bryozoan (found on 3 plants)

Aeolis, sp. Nudibranch Mollusk (2 per plant)

Sagartia luciae Verrill. Sea Anemone. (1 per Sargassum plant examined)

Sargassum natans (L.) Meyen. Gulfweed (abundant)

Sargassum fluitans Borg. Gulfweed (abundant)

Jetty Forms:

Enteromorpha lingulata J. Ag. Alga (scarce)

Cladophora fascicularis (Mertens) Kütz. Alga (abundant)

Siphonaria lineolata Orbigny. Limpet 10

Balanus improvisus Darwin. Barnacle 30

Thais floridana Conrad. Snail 10

Squilla empusa. Mantis Shrimp (10 collected)

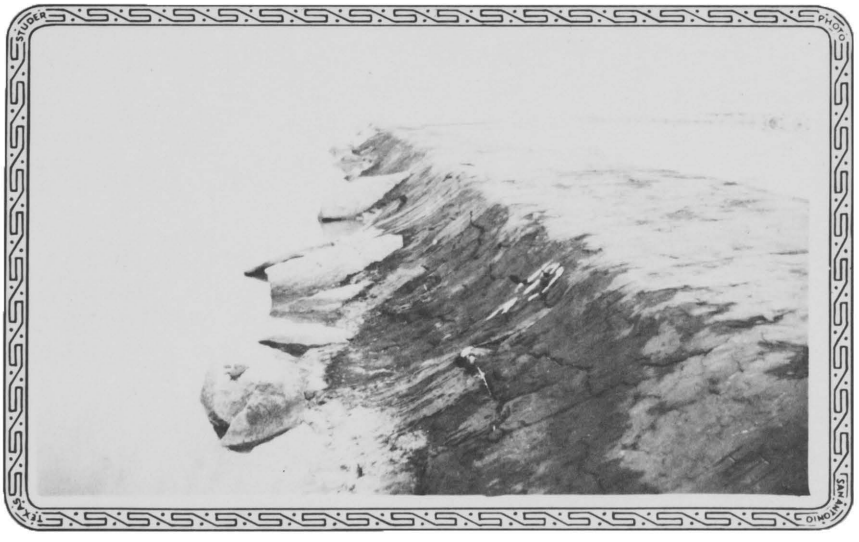
Mugil cephalus. Mullet (Fish) 1 to 10

Menippe mercenaria. Rock Crab 1

FIGURE IV,A

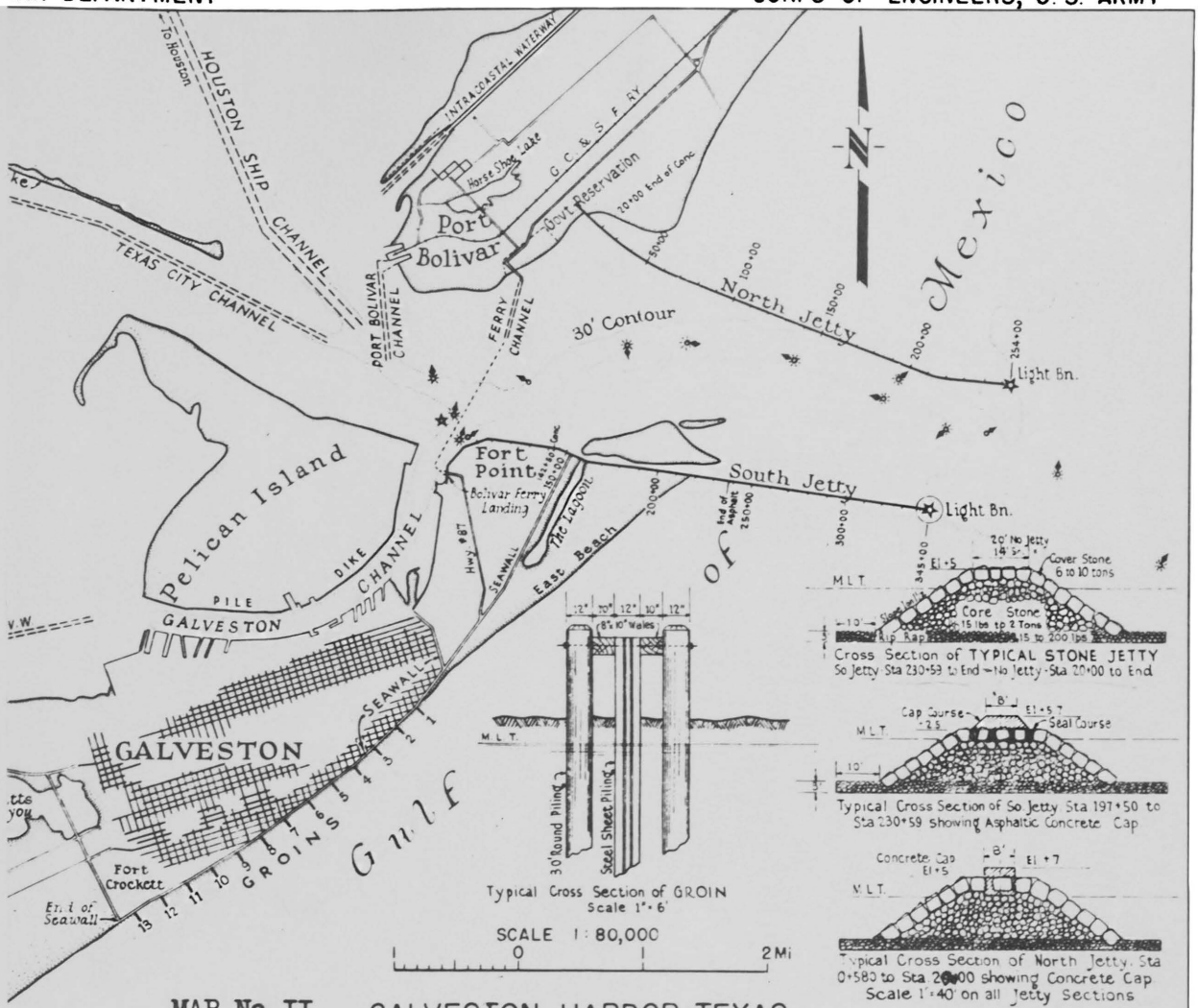
NORTH JETTY, GALVESTON
Station 30+00. Concrete Cap Extending from
Bolivar Peninsula is Shown in Background

FIGURE IV,B



SOUTH JETTY, GALVESTON
Station 160+00, Showing Asphaltic Concrete Cap

WAR DEPARTMENT CORPS OF ENGINEERS, U. S. ARMY



MAP No. II GALVESTON HARBOR, TEXAS

CONDITION OF SEPT. 30, 1939

PROJECT: Two rubble stone Jetties extending respectively from Galveston Island and Bolivar Peninsula gulfward to 30ft. contour. Channel 800 ft. wide, depth 34 ft. on Inner Bar and 36 ft. on Outer Bar. Maintenance Highway Ferry Channel 12 ft. deep at M.L.T.; 100 ft. wide and 2000 ft. long channelward of Harbor Lines at Bolivar Peninsula and Galveston Island. Construct Groins to protect Galveston Seawall.

PROGRESS: Project 100 % completed.

COSTS: To June 30, 1939 was		NEW WORK	MAINTENANCE	CONT. FUNDS	TOTAL
	previous project	$ 8,421,996.57	$ 86,126.72	$100,000.00	$8,608,123.29
	existing project	$ 2,867,886.03	$ 3,138,361.47	none	$6,006,247.00
	total	$11,289,882.60	$ 3,224,488.19	$100,000.00	$14,614,370.79

DEPTH: Available Sept. 30, 1939. Maintenance on Outer Bar 34.5 ft. below M.L.T. Maintenance on Inner Bar 33 ft. below M.L.T. Maintenance on Ferry Channel 14 ft. below M.L.T.

RANGE OF TIDE: 2 ft.

COMMERCE: For calendar year 1938 was 35,566,910 tons valued at $ 1,010,701,181.00

(5)

FIGURE V

CHAPTER V

THE GALVESTON JETTIES

NORTH JETTY

As illustrated in the accompanying photograph, figure IV, A, the Galveston north jetty has a new, wide, concrete cap, extending two thousand feet from Bolivar Peninsula. The picture was taken facing shoreward, in order to show the entire concrete area, (stations 0+00 to 20+00). The remainder of the 25,400-foot jetty is composed of large cover rocks placed as neatly as possible over the rubble-stone base beneath. The water to the south of this jetty comes from Galveston Bay, and the pass formed between Galveston Island and Bolivar Peninsula is two miles wide. This, of course, makes the Galveston jetties much farther apart than other jetties, and there is a slight difference in the fauna of the two. It may be well to note that there were more fishermen on the Galveston north jetty than on any other. This accounted for a larger number of dead fish, and a correspondingly large number of insects. Otherwise, the fauna of the jetties seemed to be affected little by fishermen.

The range of tide is two feet, which is slightly greater than that of any of the other government jetties. The action of the waves, however, is not rough except near

the end, where it is often severe. Only the so-called cover rocks of the jetty project above water, even at low tide level, and it is only among these rocks that the collector has access to specimens below low tide level. During high tides, the waves often go completely over the four-foot cover rocks. Although it is known as the "north jetty", this jetty extends from Port Bolivar in a south-easterly direction, and gradually curves until the last thousand-foot section faces due east, as shown in the map, figure V.

STATIONS 0+00 to 20+00, (End of Concrete)

The area on the south side of this station was found to be a sort of pocket, formed at the junction of the beach and jetty. Seemingly, all debris of the bay was deposited at this station among the rocks which extended from beneath the concrete cap. The beach at this point was more muddy than sandy, and pellets of oil from ships covered both beach and jetty, as well as all the collecting nets.

Among the jetsam on the jetty were found the following specimens, none of which are jetty forms: unidentified rock-sponges, ranging in size from three to sixteen inches in diameter; "sea beans" Entada gigas and Mucuna sloanei; gulfweed, Sargassum; a few colonies of the gorgonian coral Eunicea, sp., from deep water; and other broken pieces of the corals Astrangae danae and Astrangae, sp. Flying around

the dead fish and decaying seaweed were hoardes of green-eyed flies, Tabanus costalis; black blowflies, Mormia, sp., and house flies, Musca domestica Linné. Actually among the decaying material were Staphylinid scavenger beetles and flesh flies, Sarcophagus, sp. A large number of beach fleas, Orchestia agilis, were found among the wet seaweed.

This being the spawning season for many species, large numbers of their various egg cases were collected, many of which contained the young animals. Most abundant were the egg cases of the skates in the family Rajidae. One hundred of these were collected between rocks in an area of three square yards. Eight strings of Thais, sp., snail eggs were found in the same area. None of the young snails had emerged. A few empty cases of the moon snail, Polinices duplicata Say, were present also.

Two species of mollusk shells which had floated to rest among the higher rocks were the land snail, Polygyra texasiana (Moric.); and a pelagic mollusk, Spirula spirula Linné. These were both abundant, and to many of the Spirula tubes were attached small goose barnacles, Lepas pectinata Spengler. This barnacle, and the larger Lepas anatifera Linnaeus, were found on a ten-foot plank washed ashore at this station, and also on bottles and on sections of bamboo cane. The barnacles were all alive and in water when collected, but neither species was found on any of the jetty rocks. "Sails" of the jellyfish Velella velella (Linné.), were found in the same area.

Fragments of empty Omphid worm tubes, composed of broken Donax shells, were washed ashore, but none of the annelids still remained inside. Another worm, Lepidonotus, sp., was found on several occasions at this first station. It is not a tube builder.

Dipping up the sediment from between the boulders of this and the next area, (to station 100+00), revealed the following species of mollusk shells, mostly broken fragments: the scallop, Plagioctenium gibbus Linné; the fan shell, Pinna seminuda Lamarck; the snails Thais floridana Conrad and Polinices duplicata Say; the ear shell Sigaretus perspectivus Say; the olive shell, Oliva litterata; the bivalves Asaphis deflorata Linné, Anatina plicatella Lamarck, and Dosinia elegans Conrad; the pink sun shell, Tellina alternata Say; the ark shells Arca campechiensis Gmelin, and Arca transversa Say; the dog whelk, Nassa acuta; and the lightning shells Busycon perversum Linné, and Busycon pyrum Dillwyn.

The dominant animal of this area was Ligyda exotica. These isopods were more abundant, by far, at this station than at any other the collector studied. When disturbed, they move slowly to keep from falling, and in this way crawl over one another. If pursued, they pile up, and whole handfuls fall off together into the water. Once under water, however, they do not mind remaining there, holding to rocks, until the intruder has gone. It was interesting to note that over half of this isopod popula-

tion was composed of young individuals, only five millimeters in length.

Other inhabitants of the area were hermit crabs, Pagurus pollicaris and Clibinarius vittatus, occupying the shells of Nassa acuta and Thais floridana. These crabs, the snail Thais floridana, and the mussel Brachidontes (Ischadium) recurvus Raf., were the components of small clans scattered throughout the area on bare rock surfaces. These clans seemed rather unstable, however, and the motile members were continually changing their positions to secure better footing. Farther out on the jetty, these clans were more stable because of a dense growth of algae. The mussel Brachidontes is not exactly sessile, as it can attach itself to an object by silken threads called byssii, and later shift its location by fixing new byssii and drawing itself forward. It has the advantage over such animals as the littorines, by being able to withstand rougher waves, but at the same time, it falls prey to the moon snail, which attacks the mussel by boring through its shell.[1] In the

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[1]William Crowder, Dwellers of the Sea and Shore, (New York, 1935), 35.

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area being considered, it was necessary to remove the Thais shells from the rocks to determine whether they were occupied by the snails or by hermit crabs. In only a few of the shells, hermit crabs were found. Other crabs had made use of Polinices duplicata shells.

STATIONS 20+00 to 100+00

Past the concrete cap, the jetty was much the same to the end. Therefore, the remaining portion was divided into only two areas, which could have been worked as one unit, except for the fact that some deep-water forms were collected in the last location, (station 254+00). The waves were also much rougher in this last section.

Thais-Brachidontes-Littorina lociations were present on every rock of this area. Secondary forms were two species of algae, Enteromorpha lingulata and Cladophora fascicularis; the limpet, Siphonaria lineolata; and the rock barnacles, Balanus glandula and Balanus eburneus. Nearer station 100+00, Balanus became the principal dominant, replacing the mussel, Brachidontes. The littorines present were the same species as those found at Sabine, namely, Littorina irrorata and Littorina ziczac, with a scattering of Littorina angulifera Lamarck.

Cladophora was growing on the shells of all the Thais snails, and in this algae-covered area were a few specimens of the amphipod Carinogammarus mucronatus. This amphipod is typically a brackish-water species, and is found near several of the passes. Another amphipod found in larger numbers than the preceding species was the "skeleton shrimp" Caprella acutifrons, Latr., and also a similar species identified only as Caprella, sp. This unidentified species was green and perfectly camouflaged in the algae. It was smaller than the other species.

Immature shrimp, Penaeus aztecus Ives., were caught in water between the jetty rocks, as well as a brown species of Palaemonidae sargassum-shrimp. Other decapods always present in large numbers were the crabs Arenaeus cribrarius Lamarck and Callinectes sapidus; and the rock crab Menippe mercenaria. Young fish of the following species were easily caught in this entire area and beyond: sheepshead, Archosargus probatocephalus Walbaum; redfish, Sciaenops ocellatus Linnaeus; and drum, Pogonias cromis (Linnaeus).

On the north side of this jetty, a few living specimens of the beautiful comb jelly, Bolinopsis microptera (L. Agassiz)?, were collected. They were absolutely colorless; although an effort was made to preserve them properly, only fragments of the specimens survived the trip in a trailer, which was by no means smooth riding, at times. For this reason, they were only tentatively classified. Ten dead jellyfish, Stomolophus meleagris, were found among the rocks of this region. This is a large species called a "cabbage head" jellyfish, which is a pelagic form, often found dead on beaches. "Sails" of the purple jellyfish Velella velella (Linn.) were also found, blown in by the wind.

STATIONS 100+00 to 254+00, (End of Jetty)

The principal dominants of this section of the jetty were similar to those of the last, namely, Balanus and Siphonaria; with Thais and Littorina irrorata as important subdominants. Probably Cladophora and Enteromorpha should

be classed as subdominants also. Concerning marine communities, Shelford makes this statement:

> In both the intertidal and subtidal areas of the littoral belt plants are not ordinarily dominant; they should be classed as subdominants in the areas with which the writer [Shelford] is familiar, for the following reasons:
>
> 1. They are not present throughout the year, and often constitute seasonal societies only.
>
> 2. They do not control the presence of the dominant animals but merely influence their numbers in some cases.
>
> 3. They are not uniformly distributed but occur locally in small areas.
>
> 4. Very few or no animals are limited to them; those commonly found upon them are also on eel grass (Zostera). The influence of large plants is even less in the intertidal than in subtidal areas.[2]

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[2] V. E. Shelford, "Geographic Extent and Succession in Pacific North American Intertidal (Balanus) Communities," Contributions from the Zoological Laboratory of the University of Illinois, 363. (Puget Sound, 1929), 219

The swimming crabs and rock crabs were still abundant, as well as a few mantis shrimp, Squilla empusa; and the crab Portunis panamensis. Two other species of crabs were found in the lower strata. The first of these was abundant, and belonged to the genus Pachygrapsus. The other was a "calico" crab of the genus Lopholithodes, but different from the common "calico" crab. Only five of this species were caught, and they have not been identified. No mollusk shells were collected hear this station because of a lack of dredging equipment for use in deep water.

Seining the area near the end of this jetty with a shrimp net revealed the following fish: the blowfish, Spheroides spengleri (Bloch); the lookdown, Selene vomer; the needlefish, Strongylura marina; the ribbonfish, Trichiurus lepturus Linnaeus; the sea robin, Prionotus pectoralis (Nichols and Breder); the porgy, Calamus arctifrons Goode and Bean; the spiny boxfish, Chilomycterus schoepfin (Walbaum); and the mullet, Mugil cephalus Linnaeus. Six small squids, Stenoteuthis bartramii Lesueur, were also collected.

Sargassum, floating in from the Gulf, if collected in a dip-net before it was deposited on the rocks, contained many pipefish, Syngnathus floridae (Jordan and Gilbert), less than six centimeters in length. Other fauna of the gulfweed were the sea anemones Sagartia luciae Verrill; and the hydroids Sertularia versluysi and Aglaophenia minuta Fewkes. A few plants examined carried goose barnacles, Lepas pectinata Spengler; and bryozoans, Acanthodesia, sp.

Great blue herons, Ardea herodias, were always present on the jetty rocks wherever there were few fishermen. These large birds were more numerous in early morning and late afternoon, seeking small fish and crabs. The laughing gull, Larus atricilla, is the most common gull during the summer months. It is found in large numbers near, and on, the Galveston north jetty, but its main object there is to eat dead fish and bait left on the rocks, rather than to eat jetty animals.

SOUTH JETTY

STATIONS 0+00 to 142+50, (End of Concrete)

This part of the south jetty is similar to the Galveston seawall. It borders the land area around Fort Point, on Galveston Island. The entire area to the south of this section of the jetty is sandy land, averaging four feet above sea level. Thus, no marine forms were found except on the north side of the jetty.

The dominant forms of this entire north side were hermit crabs, Thais snails, littorined, and the large and beautiful sea anemones, Tealia crassicornis. These species were not plentiful enough to form clans in any one section, but all were distributed evenly over the entire area except the sea anemones. These anemones were found at least one foot below low tide level, and usually in clans. They were in crevices and between rocks in inconspicuous places, although abundant. These anemones were tolerant of wave action, but seemed to avoid the direct grinding action of sand against the outside rocks. Collecting was necessarily done during extreme low tide periods. A few Ligyda isopods were observed, and some of the mollusks Nassa acuta, but no barnacles nor limpets. Swimming crabs, Callinectes sapidus; and young fish of several species were collected all along this area. In lower strata, empty shells of the oyster, Ostrea virginica, were found in large numbers, but no living oysters were found. The shells were small, indicating that for some reason, these oysters had never been

able to get a good start on the jetty rocks.

An interesting specimen of rock-boring mollusk was found in several small limestone rocks below water level along the jetty. None of these mollusks were found in any of the granite rocks of the jetty itself, since they cannot penetrate rock of this texture. This species was the date mussel, Lithophaga plumula, which is so named because of its shape and color. It is not found on the exposed coast. The unusual characteristic of the date mussel is its ability to produce an acid which dissolves calcareous rocks. "By means of this acid, secreted by a special gland, the animal excavates a home having a high degree of protection. Covering the date mussel's shell is a thick, brown layer of horny material which is resistant to the acid."[3] The lime-

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[3] Edward F. Ricketts and Jack Calvin, Between Pacific Tides, (Stanford University, California, 1939), 177.

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stone rocks examined were honeycombed with these animals.

Several wooden piles in the area, which formerly had served as a foundation for a pier, were attacked by at least two wood-boring mollusks, Bankia (Bankiella) gouldi Bartsch, and Martesia cuneiformis Say. A boring isopod, Sphaeroma quadridentatum Say, was abundant in the same piles. Although a wood borer, this species sometimes may be found in sandstone or clay banks. Another related species of isopod, Ancinus, sp., was caught in large numbers in open water

nearby. A dip-net was used for collecting Ancinus in the surf at Galveston north beach, and these isopods were found to be the same species.

In the jetsam of this region were found beach hoppers, Orchestia agilis in large numbers. As many as thirty specimens were counted under one slowly decaying clump of Sargassum. There were small and large specimens, all of which were probably the same species. Insects present were robber flies, Erax rufibarbus; flesh flies, Sarcophagus, sp.; and Staphylinid scavenger beetles. Snowy egrets, Egretta thula; and Louisiana herons, Hydranassa tricolor, were regular visitors in the area at their feeding times each morning and night. The great blue heron still proved to be the most common bird of the Galveston jetties.

STATIONS 142+50 to 230+00, (Asphalt Section)

The second area studied presented many new ecological situations. The asphaltic concrete cap which covers the section is shown in the accompanying photograph, figure IV,B; as well as a shallow body of water to the south, known as The Lagoon. To the north of the jetty is a low flat island, only a few feet away from the toes of the jetty rocks.

The area on the lagoon side of the jetty was an Ostrea community, composed of both living and dead oysters in clumps, with quite a few Callinectes crabs and the sand fiddlers Uca minax and Uca pugilator. Crabs on the bay side were

the shore crab, Planes minutus, and the crab Ovalipes ocellatus. Holes in the sand indicated that a sand crab was the most abundant crab of the area. At night these crabs, Ocypode albicans Bosc., could be seen scurrying across long distances on the sandy areas. They were found on the jetties only at night, but at that time they were the most numerous species.

The top of the jetty was dominated by the tiger beetle, Cicindelia dorsalis. Nearby, in the ground, one could find holes in which the insects pass the larval stage. Both larvae and adult insects are distinguished by their sickle-like jaws, and both depend on other insects as their primary source of food. There were approximately ten beetles per square yard, and when disturbed, they flew only a few feet and came to rest facing the intruder. A few robber flies, Erax rufibarbus, were also found here.

Hundreds of empty tubes of Omphid worms were found on the north side of the jetty. Some tubes contained worms, but the writer is not very familiar with their life history nor species, and apparently none of the specimens found were permanent residents of the area.

Hermit crabs of the genus Pagurus were found in clans both in this, and in the next section, especially on the bay side. Here, too, were a few salt-marsh periwinkles, Littorina irrorata; and barnacles, Balanus improvisus Darwin. The periwinkles were on the lagoon side, and the barnacles on both sides, attached to rocks but never to the asphalt.

The only jellyfish found in the region was the comb jelly, Bolinopsis microptera?, and the five specimens collected were too fragile to preserve. A few of the anemones, Tealia crassicornis, were collected. This section of the jetty was characterized by a variety of species, few of which were in stable communities. The writer considers this station different in this way because of the asphalt which fills most of the spaces between the boulders, and thus creates a different situation from that found elsewhere.

STATIONS 230+00 to 345+00, (End of Jetty)

Except for the Port Isabel jetties, this section of the Galveston south jetty is no doubt the roughest of all. Waves lashing the south side of the rocks create a spray of water most of the time, and during high tide, the big waves go over the jetty, making collecting possible only part of the day.

Although rougher than others, this section had the same dominant motile species as the north jetty at corresponding stations. These were the rock crab, Menippe mercenaria, which was abundant; the common crab, Callinectes sapidus; and the "sea bob", Xiphopenaeus kroyeri. On the rocks were lociations of Balanus, sps. and Siphonaria limpets, with secondary dominants Littorina irrorata and algae, Cladophora, sps.

No dredging nor seining was done here but specimens caught around the end of the north jetty would probably have been found at this section. Rough water prevented

the discovery of any sea anemones, if present. The swellfish, floating upside down until disturbed, were numerous at the surface of the water, and schools of needlefish were constantly seen here. Young fish of many kinds were observed far out in the Gulf, swimming back and forth between the rocks with each wave.

Birds of this region were the common tern, Sterna hirundo; the laughing gull; and, during low tide, the great blue heron.

SUMMARY

GALVESTON NORTH JETTY

STATIONS 0+00 to 20+00, (Beach area on south side; jetty capped with concrete; water on north side one to six feet deep at the beginning of the jetty, and finally becoming deep near toes of jetty rocks).

Species	Common Name	Number per Square Meter
Unidentified	"Rock Sponges"	(15 collected)
Eunicia, sp.	Coral	(3 colonies collected)
Entada gigas.	"Sea Beans"	2
Mucuna sloanei.	"Sea Beans"	1
Sargassum, sps.	Gulfweed	1
Astrangia, sp.	Coral	(4 pieces collected)
Astrangia danae.	Coral	1
Tabanus costalis.	Green-Eyed Fly	0 to 30
Musca domestica Linné.	Housefly	3
Staphylinid	Beetles	(20 on dead fish)
Mormia, sp.	Black Blowfly	(10 observed)

Sarcophagus, sp. Beetle (20 observed)

Orchestia agilis. Beach Flea 25

Rajidae family Skate eggs (27 in one locality)

Thais, sp. Snail eggs (8 strings collected)

Polinices duplicata Say. Moon Snail 1 (shells)

Polygyra texasiana (Moric.) Land Snail 1 (shells)

Spirula spirula Linné. Spirals 2 (shells)

Lepas pectinata Spengler. Goose Barnacle
(10 found on Spirula shells)

Lepas anatifera Linnaeus. G. Barnacle (200 on plank)

Velella velella (Linné). Jellyfish 1

Omphid, sp. Worm tubes 1

Lepidonotus, sp. Annelid Worms (3 collected)

Empty Mollusk Shells:

Plagioctenium gibbus Linné.	Scallop
Pinna seminuda Lamarck.	Fanshell
Thais floridana Conrad.	Snail
Polinices duplicata Say.	Moon Snail
Sigaretus perspectivus Say.	Ear Shell
Oliva litterata.	Olive Shell
Asaphis deflorata Linné.	Bivalve
Anatina plicatella Lamarck.	Bivalve
Dosinia elegans Conrad.	Dosinia
Tellina alternata Say.	Pink Sunshell
Arca campechiensis Gmelin.	Ark Shell
Arca transversa Say.	Ark Shell
Nassa acuta.	Dog Whelk

Busycon perversum Linné. Lightning Shell

Busycon pyrum Dillwyn. Lightning Shell

Jetty Forms:

Ligyda exotica Roux.	Isopod	0 to 60
Pagurus pollicaris.	Hermit Crab	8
Clibinarius vittatus.	Hermit Crab	2
Thais floridana.	Snail	6
Nassa acuta.	Dog Whelk	1
Brachidontes (Ischadium) recurvus Raf.	Mussel	2 to 8
Polinices duplicata.	Moon Snail	1
Gammarus, sp.	Gammarus; Scud	(4 collected, 1939)

STATIONS 20+00 to 100+00, Both Sides, (Comparatively quiet water ranging in depth from four feet to eight feet; deep water only a few feet away, on south side).

Thais floridana.	Snail	20
Brachidontes recurvus Raf.	Mussel	10
Littorina ziczac Gmelin.	Littorine	15
Enteromorpha lingulata.	Alga	(scarce)
Cladophora fascicularis.	Alga	(scarce)
Siphonaria lineolata.	Limpet	8
Balanus glandula.	Barnacle	10 to 50
Balanus eburneus.	Barnacle	4
Littorina angulifera Lamarck.	Littorine	1
Carinogammarus mucronatus.	Scud	1
Caprella acutifrons Latr.	Skeleton Shrimp	2
Caprella, sp.	Skeleton Shrimp	1

Penaeus aztecus Ives.	Shrimp	0 to 10
Palaemonidae, sp.	Sargassum Shrimp	(6 collected)
Arenaeus cribrarius Lamarck.	Crab	1
Callinectes sapidus.	Swimming Crab	1
Menippe mercenaria.	Rock Crab	(1 seen every six meters)
Archosargus probatocephalus Walbaum.	Sheepshead	0 to 10
Sciaenops ocellatus Linnaeus.	Redfish	0 to 20
Pogonias cromis (Linnaeus).	Drum	1
Bolinopsis microptera (L. Agassiz)?	Comb Jelly	(6 collected)
Stomolophus meleagris.	Jellyfish	(10 dead specimens)
Velella velella (Linné).	Jellyfish sails	1

STATIONS 100+00 to 254+00, (End of jetty in open Gulf washed by rough water on both sides; water ten to twenty feet deep).

Balanus glandula.	Barnacle	40
Balanus eburneus.	Barnacle	10
Siphonaria lineolata.	Limpet	18
Thais floridana.	Snail	10
Littorina irrorata.	Littorine	10
Cladophora, sps.	Alga	(abundant)
Enteromorpha, sps.	Alga	(abundant)
Squilla empusa.	Mantis Shrimp	(10 collected)
Portunis panamensis.	Crab	1
Callinectes sapidus.	Swimming Crab	2
Menippe mercenaria.	Rock Crab	1
Pachygrapsus, sp.	Crab	1

Lopholithodes, sp. Crab (5 collected)

Sargassum, sps. Gulfweed (scarce)

Syngnathus floridae. Pipefish (20 among Sargassum)

Sagartia luciae Verrill. Sea Anemone (30 among Sargassum)

Sertularia versluysi. Hydroid (scarce)

Aglaophenia minuta Fewkes. Hydroid (very few)

Lepas pectinata Spengler. Goose Barnacle (10 collected from Sargassum)

Ardea herodias. Great Blue Heron (4 per thousand feet)

Larus atricilla. Laughing Gull (10 per thousand feet)

Stenotheuthis bartramii Lesueur. Squid (6 collected)

Stations 140+50 to 142+50, (Station at end of jetty).

Pelagic Fish Collected:

Spheroides spengleri (Bloch). Blowfish

Selene vomer. Lookdown

Strongylura marina. Needlefish

Trichiurus lepturus Linnaeus. Ribbonfish

Prionotus pectoralis (Nichols and Breder). Sea Robin

Calamus arctifrons Goode and Bean. Porgy

Chilomycterus schoepfin (Walbaum). Spiny Boxfish

Mugil cephalus Linnaeus. Mullet

GALVESTON SOUTH JETTY

Stations 0+00 to 142+50, (Concreted cap on jetty; shallow, quiet water on north side).

Thais floridana. Snail 20

Littorina ziczac Gmelin. Littorine 15

Tealia crassicornis. Sea Anemone (clans of 8)

Ligyda exotica Roux. Isopod 0 to 10

Nassa acuta. Dog Whelk 2

Callinectes sapidus. Crab 1

Ostrea virginica. Oyster (shells) (abundant)

Lithophaga plumula. Date Mussel (abundant in a few loose limestone rocks)

Bankia (*Bankiella*) *gouldi* Bartsch. Shipworm (20 collected)

Martesia cuneiformis Say. Boring Mollusk (10 collected)

Sphaeroma quadridentatum Say. Isopod (abundant in piling)

Ancinus, sp. Isopod 10

Orchestia agilis. Beach Flea 10

Erax rufibarbus. Robber Fly 3

Sarcophagus, sp. Beetle 1

Staphylinid beetle (10 found on a dead fish)

Egretta thula. Snowy Egret (1 per thousand feet)

Hydranassa tricolor. Louisiana Heron (1 per thousand ft.)

STATIONS 142+50 to 230+00, (Section of jetty covered with asphalt which fills crevices of rocks and prevents growth of flora and fauna; lagoon on south side).

Ostrea virginica. Oyster (abundant in lagoon only)

Callinectes sapidus. Crab 2

Uca pugilator. Fiddler Crab 6

Uca minax. Fiddler Crab 2

Planes minutus. Shore Crab (10 collected)

Ovalipes ocellatus. Crab 1

Ocypode albicans Bosc. Sand Crab 1

Cicindela dorsalis. Tiger Beetle 10 to 30

Erax rufibarbus. Robber Fly 1

Omphid, sp. Worm tubes 6

Pagurus, sp.	Hermit Crab	2
Littorina irrorata.	Littorines	10
Balanus improvisus.	Darwin. Barnacles	20
Bolinopsis microptera.	Comb Jelly	(5 collected)
Tealia crassicornis.	Sea Anemone	1 to 8

STATIONS 230+00 to 345+00, (End of jetty in open Gulf, washed by strong waves; water 15 to 25 feet deep near jetty).

Menippe mercenaria.	Rock Crab	2
Callinectes sapidus.	Crab	1
Xiphopenaeus kroyeri.	"Sea Bob" Shrimp	2
Balanus improvisus	Darwin. Barnacle	40
Siphonaria lineolata.	Limpet	20
Thais floridana.	Snail	5
Littorina irrorata.	Littorine	10
Cladophora, sps.	Alga	(abundant)
Various species of	Young Fish	10 to 30
Sterna hirundo.	Common Tern	(2 every thousand feet)
Larus atricilla.	Laughing Gull	(2 every thousand feet)
Ardea herodias.	Great Blue Heron	(daily visitant)
Spheroides spengleri (Bloch).	Swellfish	1
Strongylura marina (Walbaum).	Needlefish	(schools of 10)

Note: In 1938, the writer collected specimens of the sea pansy, Porpita linneana; and a large number of the Portuguese man-of-war "fish," Physalia physalis, near this jetty.

A few specimens of Gammarus were collected in the algae of the north jetty in 1939. These were sent to Dr. Shoemaker, of the National Museum, for identification. Regard-

ing these amphipods, Dr. Shoemaker has this to say:

> I can find no records of the occurrence of Gammarus on the coast of Texas, and we have no specimens in the national collection from that locality. . . You can see from this that any amphipods which you can send us from Texas will be very gratefully accepted. . . It appears to be a form of Gammarus which I have not seen before. . . unless I can obtain further material and information as to habitat, etc., I shall only be able to assign it to the genus Gammarus. . . the specimen No. 88 is the first specimen of Gammarus which has come to light [from Texas] . . . As so little collecting has been done west of Florida, it is not possible to say what species of amphipods occur on the Gulf coast. Any specimens which you can send will help to clear up the situation.[5]

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[5] Excerpts from personal letters from Dr. Shoemaker, May 23 and May 31, 1940.

Specimens of all amphipods collected this season have been forwarded to the Museum. Two species recently identified by Dr. Shoemaker, (July 17, 1940), are Hyale hawaiensis (Dana), and Melita nitida Smith. Both species were collected on the north jetty between stations 0+00 and 20+00.

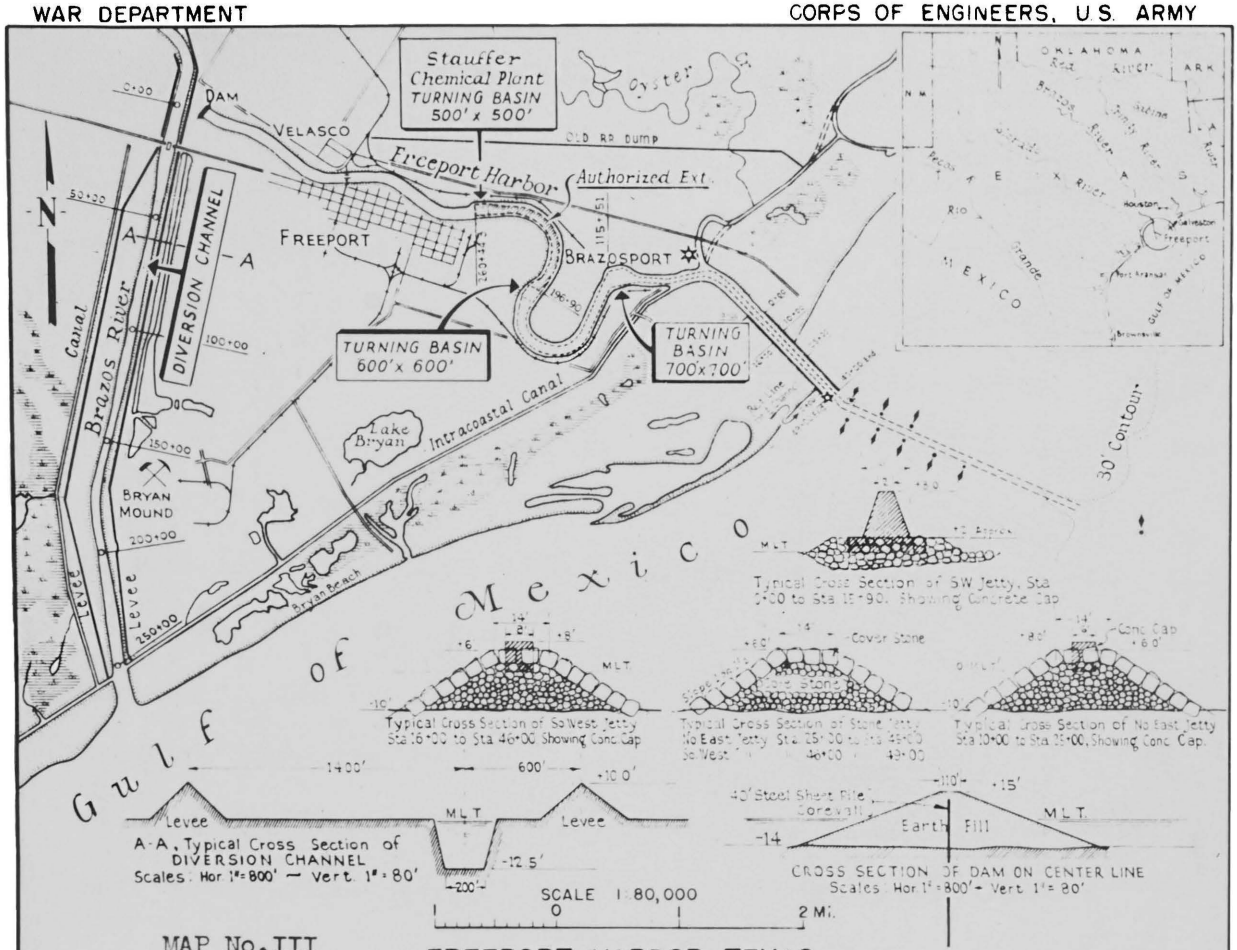
FIGURE VI,A

NORTH-EAST JETTY, FREEPORT
Station 26+00, Showing Algae on Rocks

FIGURE VI,B

SOUTH-WEST JETTY, FREEPORT
Station 47+00

WAR DEPARTMENT — CORPS OF ENGINEERS, U.S. ARMY



MAP No. III

FREEPORT HARBOR, TEXAS

CONDITION OF SEPT. 30, 1939

PROJECT: The existing project provides for the following channel dimensions in sections of the waterway listed below; Jetties at mouth of the river; a Diversion Channel and Dam and necessary auxillary works including construction of Lock in Dam.

SECTION OF WATERWAY	PROJECT DIMENSIONS		PRESENT DIMENSIONS		LENGTH OF CHANNEL IN FEET
	Depth in ft.	Width in ft.	Depth in ft.	Width in ft.	
Outer Bar	32	300	32	300	11,600
channel to Brazosport	32	200	32	200	10,851
Brazosport Turning Basin	32	700	32	700	700
Channel to Upper Basin	32	375	32	375	7,540
Upper Turning Basin	32	600	32	600	600
Channel to Stauffer Ch. Plant	30	200	25	200	5,854
Stauffer Turning Basin	30	500	25	500	500

COSTS: To June 30, 1939 was	NEW WORK	MAINTENANCE	CONT. FUNDS	TOTAL
Previous project	$ 147,098.43	none	$1,086,025.00	$1,233,123.43
Existing project	$1,217,636.63	$1,953,119.42	$ 758,302.79	$3,929,058.84
Total	$1,364,735.06	$1,953,119.42	$1,844,327.79	$5,162,182.27

PROGRESS: The project is 85% completed.

HEAD OF NAVIGATION: Diversion Dam, 2 miles above Freeport.

COMMERCE: For calendar year 1938 was 222,108 tons valued at $3,636,911.00

RANGE OF TIDE: 1.5 ft.

(21)

FIGURE VII

CHAPTER VI

THE FREEPORT JETTIES

The jetties at Freeport are comparatively short. The south jetty is the longer of the two, and lacks three-hundred-eighty feet being a mile long. These jetties are also closer together than any others, and the water between them is ordinarily smoother. At present, they are not frequented by fishermen, especially the south jetty, because of the laying of pipe lines across the road to this jetty. Although the coast line at this point extends somewhat into the Gulf, the jetties themselves are not often repaired, because they are so short. In this discussion, each jetty will be divided into two sections, the first section in each case being the part covered by a concrete cap.

NORTH-EAST JETTY

STATIONS 0+00 to 25+00, (End of Concrete)

This section extends only a little beyond the shore line, and the area to the south is sandy and slopes downward to the beach at station 20+00. Thus, only the rocks on the south side support any marine life. The water in this channel averages twenty-five feet in depth. Since the jetties are not far apart, the water near them is relatively deep, often reaching a depth of ten feet within six feet of the toes of the jetty rocks on the channel side. This situation was responsible for the fact that some deep-

water species were caught in this region.

The photograph preceding this chapter, figure VI,A, was included to show the abundance of algal vegetation found on the rocks at all stations. There was a denser growth on the channel side due to calmer water. Of the numerous species of algae present, the following formed the principal communities: Ulva lactuca L., Cladophora fascicularis, Enteromorpha lingulata J. Ag., Padina pavoni J. Ag., and several other species of these same genera. None grew in water deeper than one meter below low tide level.

In the algae-covered area were found Caprella-Carinogammarus lociations, on almost every rock. Only one species of Amphipod was identified by experts, although there was a green Caprella present which may have been a variant. Those identified were the "skeleton shrimp", Caprella acutifrons Latr.; and the "scud", Carinogammarus mucronatus. Males are much larger than females, and both hold to algae by prehensile hind legs. In moving about, they often proceed in measuring-worm fashion. Those collected were obtained by first removing the Cladophora from the rocks. These animals are among the most grotesque and unusual of those found on our Gulf coast.

Secondary dominants were the mussels, Brachidontes (Ischadium) recurvus Raf.; the periwinkles, Littorina ziczac Gmelin; star-shaped barnacles, Balanus glandula; limpets,

Siphonaria lineolata Orbigny; snails, Thais floridana Conrad; and hermit crabs, Pagurus pollicaris. There was a much larger number of species living in the same habitat at this station than at any other single station on any jetty, probably because of the abundance of algae.

Barnacles of this region were found at lower strata of the rocks than at other jetties where waves were stronger. That is to say, they were growing in the inter-tidal area only. The mussels had grown to only two centimeters in length at this place, and there were few present; while at other stations on this and other jetties they were the dominant species, and were older and larger individuals. This indicated that there was a succession in operation at the first station. The algae seemed to have little influence, however, as they were plentiful at all stations, even growing from the shells of all mollusks collected.

Three species of annelid worms were found among the algae in small numbers. They have been identified as Lepidonotus polynoe, Nereis virens and Lumbrinereis tenuis. These are not always found in algae, although the writer found hundreds of the Lumbrinereis worms in floating Sargassum.[1] One annelid, Serpula vermicularis, is a typical

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[1] It is regrettable that all the Nereis worms collected have not been identified by Professor Moore of the University of Pennsylvania, who is an authority on these worms.

---

beach worm which makes tubes on mollusk shells usually found

on beaches. This worm makes small, coiled, calcareous tubes which were usually empty when found. The worm, when observed, has feather-like gills which extend from the opening of its tube. Grinding action of the sand, caused by the waves, usually destroys these worms on open beaches. Those found were on the beach at station 20+00.

Other beach forms found on the north side of the jetty rocks were unattached Thais eggs; tests of the sand dollar, or key-hole dollar, Encope michelini (L. Agassiz); "sea bobs," Xylopenaeus kroyeri; Sargassum; sea beans; and empty mollusk shells.

At the toes of the jetty rocks were found three species of burrowing sand crabs. After each wave receded, small jets of water, or depressions in the moist sand, revealed the presence of one of these crabs or the bean clam, Donax variabilis Say. The most common crab was Emerita benedicti Schmitt, with a large number of Hippa talpoida interspersed among them. The Emerita is oval and cylindrical, so that it may quickly burrow into the sand after each wave. The best method of collecting these crabs is to drag a net through the waves, walking parallel to the shore. In this manner, these crabs and the Donax clams may be taken before they burrow in. Both are used as food by curlews and willets, (shorebirds); and by certain fish which are said to swim into the breakers near shore in search of these crabs.

The other crab, Lepidopa myops Stimpson, is called a spiny sand crab, and is shaped more like the well-known crab.

It has extremely long, feather-like antennules which are left extended, and parallel to each other while the animal is in the sand. These antennules thus form a breathing tube which may be seen above the sand.

STATIONS 25+00 to 45+00, (End of Jetty)

This last section was very similar to the first, except that both sides of the jetty were washed by waves which churned back and forth through large openings between rocks. In these spaces young fish of three species were caught: tarpon, Tarpon atlanticus (Cuvier and Valenciennes); mackerel, Scomberomorus maculatus (Mitchill); and redfish, Sciaenops ocellatus (Linnaeus). These fish were never observed over one meter below the water surface, although the area was sampled to the two-meter level. The water on both sides of the jetty at this section was approximately thirty feet deep.

The first "jetty fish" discovered by the writer was found on the rocks of this area. This was the rock skipper, Rupiscartes atlanticus (Cuvier and Valenciennes). Large numbers were caught in a dip-net, without any special effort being made on the part of the collector to find them. These fish are tropical forms ranging from eight to sixteen centimeters in length. Their ventral and pectoral fins are equipped for holding them to the seaweed and rocks, where they are always found, rather than in open water.

A beautiful purple coelenterate, the sea pansy,

Renilla amethystina Verrill, was found among the rocks at Freeport. The heart-shaped body, or rachis, of the colony contains about four hundred individuals. At night, if prodded, the coelenterate shows luminescence. When caught, the individuals draw themselves into the rachis in the same manner as the tentacles of sea anemones are retracted. The only other coelenterate found was the sea anemone, Tealia crassicornis, which occurred in clans by itself on inner rocks of this area.

Outside rocks had communities similar to those of the first station, except that the star-shaped barnacles became the dominant species. Insects were scarce on the Freeport jetties, and no isopods were found. The algal growth continued abundant to the end of the jetties.

A few large moon snails, Polinices duplicata Say, were found here, as were their shells, occupied by hermit crabs. When approached, the crabs dropped off into the water, leaving only the snails attached. In this way it was easy to determine which were snails and which were crabs. Those Polinices snails found here were in Balanus-Thais clans. It was interesting to observe that all communities were thickly populated. In some instances, clans of large Brachidontes mussels were found here as dominants on certain rocks, as already mentioned.

A few large purple sea urchins, Arbacia punctulata

(Lamarck), were found in deep crevices, one meter deep, between the rocks of station 40+00. Sea urchins were never numerous at any jetty.

SOUTH-WEST JETTY

STATIONS 0+00 to 46+00, (End of Concrete)

The sand in the area to the south of this jetty section was inhabited by the sand crab Ocypode albicans Bosc., but these crabs were seldom on the jetty, and then only at night. Callinectes crabs were numerous on the channel side.

The beach area at station 40+00 was similar to the corresponding area on the north jetty. The sand, which was even with the concrete top of the jetty at station 0+00 gradually sloped to the water's edge at station 40+00. From this point to station 46+00, the water increased in depth to thirteen feet on the north side and twenty feet on the south side.

Empty mollusk shells collected at the toes of the rocks were as follows: the jack-knife clam, Solen vagina; small angelwings, Petricola pholidiformis; many large angelwings, Barnea costata Linné; venus shells, Venus mercenaria Linné, and the larger venus, Venus campechiensis Gmelin; the heart shell, Trachycardium (Dinocardium) robustum Solander; the discus shells, Dosinia discus Linné and Dosinia ponderosa; and the turret shell, Turritella varigata, sometimes occupied by small hermit crabs.

Amphipods were abundant on rocks of this section as on the north-east jetty, but it was observed that they preferred the north (channel) side of the jetty. The "sea liver" Renilla was caught here, and several small hermit crabs on the jetty were found to be occupying mitre shells, Mitra cinctella; and turret shells, Turritella varigata.

A purple crab, Randallia ornata, was caught in comparatively large numbers in the deep water, (over two meters deep). This is a spider crab of the lower strata, collected exclusively at this station. It differs from most spider crabs in being purple. Although this species is not rare, the writer has not seen specimens from any other locality on the coast.

Besides the young fish already mentioned, the mullet, Mugil cephalus (Linnaeus), was found in schools near the surface.

STATIONS 46+00 to 49+00. (End of Jetty)

This last station was the shortest thus far considered. It was characterized by lociations of Balanus barnacles and Thais snails, with secondary dominants Littorina irrorata, and at times, Brachidontes (Ischadium) recurvus Raf. The limpet, Siphonaria lineolata Orbigny, was also abundant, as were the algae already discussed.

The rock skipper, Rupiscartes atlanticus, was most plentiful here, and could at least be classed as an important influent. Other full-grown fish collected were the

pompano, Trachinotus carolinus (Linnaeus); the swell-fish, Spheroides spengleri (Bloch); and a beautiful species known as the bank butterfly fish, Chaetodon ocellatus (Bloch), found only in the Gulf of Mexico, and collected by the writer only at this station.

Hermit crabs and some swimming crabs were present, as were three clans of large sea anemones, Tealia crassicornis. On a few rocks could still be found both species of Caprella. There, as at other stations, were several laughing gulls, Larus atricilla. The scarcity of bays and marshes accounted for the absence of shorebirds. Insects, (and dead fish), were absent in this region, as far as the fauna of the jetties was concerned.

SUMMARY

Note; In the summaries, every species found at a given station is listed. Some forms may be accidental or rare species. The word "abundant" following species of algae indicates that these plants completely covered the intertidal rock surfaces of the area.

FREEPORT NORTH-EAST JETTY

STATIONS 0+00 to 25+00, South Side, (Algae-covered rocks, forming Caprella-Carinogammarus lociations).

Species	Common Name	Number per Square Meter
Enteromorpha lingulata J. Ag.	Alga	(abundant)
Padina pavoni J. Ag.	Alga	(abundant)
Cladophora fascicularis.	Alga	(abundant)
Ulva lactuca L.	Sea Lettuce: Alga	(abundant)

Caprella acutifrons Latr. Skeleton Shrimp 40

Caprella, sp. Aunt Fanny; Skeleton Shrimp 10

Carinogammarus mucronatus. Scud 30

Brachidontes (Iscadium) recurvus Raf. 0 to 20
Mussel

Littorina ziczac Gmelin. Littorine 20

Balanus glandula. Barnacle 10

Siphonaria lineolata Orbigny. Limpet 10

Thais floridana Conrad. Snail 7

Pagurus pollicaris. Hermit Crab 0 to 10

Lepidonotus polynoe. Annelids (5 collected)

Nereis virens. Nereis Worm 1

Lumbrinereis tenuis. Nereis Worm 10

STATIONS 20+00 to 21+00, North Side, (Beach area).

Serpula vermicularis. Worm tubes (on 10 shells)

Eggs of Thais Snail (1 string)

Encope michelini (L. Agassiz). Sand Dollar 3 (tests)

Sargassum natans (L.) Meyen. Gulfweed 2

Sargassum fluitans Borg. Gulfweed 1

Entata gigas. Large "Sea Beans" 1

Mucuna sloanei. Small "Sea Beans" 1

Donax variabilis. Bean Clam 20

Emerita benedicti Schmitt. Sand Crab 6

Hippa talpoida. Sand Crab 2

Lepidopa myops Stimpson. Spiny Sand Crab 1

Empty Shells:

Petricola pholidiformis. Angelwing 2

Solen vagina. Jack-Knife Clam 1

Barnea costata Linné. Large Angelwing 2

Venus mercenaria Linné. Venus Shell 3

Venus campechiensis Gmelin. Venus 1

Trachycardium robustum. Heart Shell 2

Dosinia discus Linné. Discus Shell 4

Dosinia ponderosa. Heavy Dosinia 1

Turritella varigata. Turret Shell 3

STATIONS 25+00 to 45+00, Both Sides, (Rock area in open Gulf; water thirty feet deep in some areas not far from the toes of the jetty rocks themselves).

Tarpon atlanticus (Cuvier and Valenciennes). 5
Tarpon

Scomberomorus maculatus (Mitchill).(school of 20)
Mackerel

Sciaenops ocellatus (Linnaeus). Redfish (schools of 10)

Rupiscartes atlanticus (Cuvier and Valenciennes).
Rock Skipper 1

Renilla amethystina Verrill. Sea Pansy 1

Tealia crassicornis. Sea Anemone (clans of 6 to 10)

Polinices duplicata Say. Moon Snail 2

Arbacia punctulata (Lamarck). Sea Urchin 1

Carinogammarus mucronatus. Scud 10

Brachidontes recurvus Raf. Mussel 0 to 20

Littorina ziczac Gmelin. Littorine 15

Balanus glandula. Barnacle 30

Siphonaria lineolata Orbigny. Snail Limpet 5

Thais floridana Conrad. Thais Snail 5

FREEPORT SOUTH-WEST JETTY

STATIONS 0+00 to 46+00, South Side, (Sand area, ending at edge of beach).

Ocypode albicans Bosc. Sand Crab	1
Callinectes sapidus. Swimming Crab	1
Emerita benedicti Schmitt. Burrowing Crab	6
Empty Shells, etc.:	
Solen vagina. Jack-Knife Clam	3
Venus mercenaria Linné. Venus Shell	1
Dosinia discus Linné. Discus Shell	5
Dosinia ponderosa. Dosinia Shell	2
Astrangia, sp. Coral, small pieces	1
Sargassum, sps. Gulfweed, washed ashore	4

STATIONS 0+00 to 46+00, North Side, (Algae-Caprella-Carinogammarus lociations).

Mugil cephalus Linnaeus. Mullet (schools of	40)
Randallia ornata. Purple Crab	2
Tarpon atlanticus (Cuvier and Valenciennes). Tarpon	10
Sciaenops ocellatus (Linnaeus). Redfish	10
Callinectes sapidus. Swimming Crabs	1
Penaeus brasiliensis. Shrimp	3
Caprella, all species. Skeleton Shrimp	30
Carinogammarus mucronatus. Scud	25
Brachidontes recurvus Raf. Mussel	0 to 20
Littorina ziczac Gmelin. Littorine	25
Balanus glandula. Barnacle	20
Lumbrineréis tenuis. Nereis Worm	10

Thais floridana Conrad.	Snail	30
Pagurus pollicaris.	Hermit Crab	5
Various species of Algae		(abundant)

STATIONS 46+00 to 49+00, Both Sides, (Rock area in open Gulf; water thirteen to thirty feet deep).

Thais floridana Conrad.	Snail	30
Balanus glandula.	Barnacle	30
Littorina irrorata.	Littorine	3
Littorina ziczac Gmelin.	Littorine	20
Brachidontes recurvus Raf.	Mussel	10
Siphonaria lineolata Orbigny.	Limpet	20
Rupiscartes atlanticus.	Rock Skipper	3
Trachinotus carolinus (Linnaeus).	Pompano	1
Spheroides spengleri (Bloch).	Swell-Fish	2
Chaetodon ocellatus (Bloch).	Butterfly Fish	(2 collected)
Pagurus, sps.	Hermit Crab	3
Callinectes sapidus.	Swimming Crab	2
Tealia crassicornis.	Sea Anemone	2
Caprella acutifrons Latr.	Skeleton Shrimp	3
Larus atricilla.	Laughing Gull	2
Various species of Algae		(abundant)
Amphitoe, sp.	Amphipod	1
Jassa marmorata Holmes.	Amphipod	(10 collected)

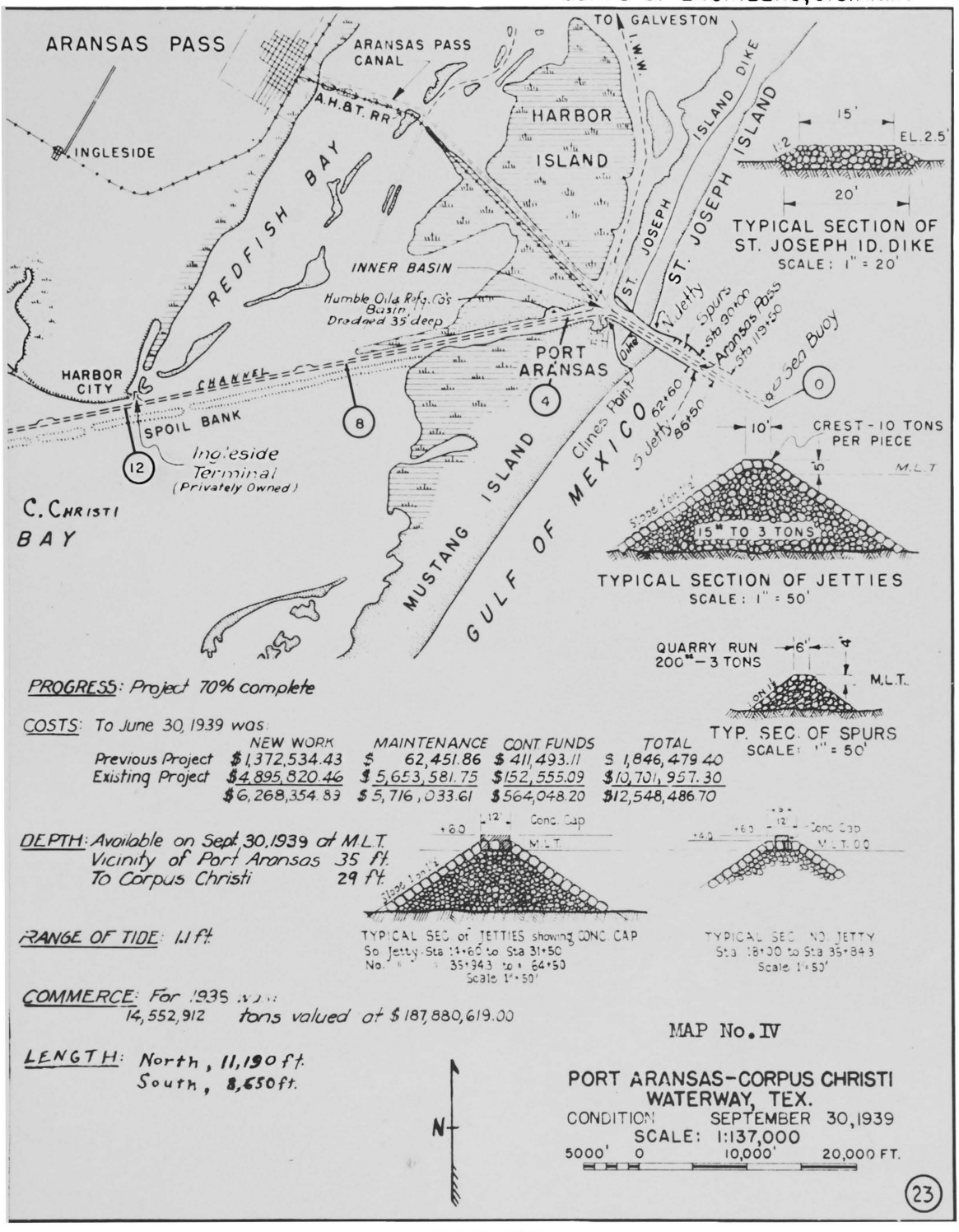
FIGURE VIII,A

NORTH JETTY, ARANSAS PASS
Station 90+50, on St. Joseph Island

FIGURE VIII,B

SOUTH JETTY, ARANSAS PASS
Station 20+00, on Mustang Island

CORPS OF ENGINEERS, U.S. ARMY



PROGRESS: Project 70% complete

COSTS: To June 30, 1939 was:

	NEW WORK	MAINTENANCE	CONT. FUNDS	TOTAL
Previous Project	$1,372,534.43	$ 62,451.86	$ 411,493.11	$ 1,846,479.40
Existing Project	$4,895,820.46	$ 5,653,581.75	$152,555.09	$10,701,957.30
	$6,268,354.89	$ 5,716,033.61	$564,048.20	$12,548,486.70

DEPTH: Available on Sept. 30, 1939 at M.L.T.
Vicinity of Port Aransas 35 ft.
To Corpus Christi 29 ft.

RANGE OF TIDE: 1.1 ft.

COMMERCE: For 1939 was:
14,552,912 tons valued at $187,880,619.00

LENGTH: North, 11,190 ft.
South, 8,650 ft.

FIGURE IX

CHAPTER VII

THE PORT ARANSAS JETTIES

The jetties at Port Aransas protect Aransas Pass, which separates St. Joseph Island from Mustang Island. The pass connects the Gulf with Aransas Bay, which is an important shrimp-fishing ground. The jetties, and the Aransas area in general, contain a greater variety of marine species, as a whole, than the other jetties discussed. This is partly due to the great number of inland bays of the area, shown in figure IX. These bays are the habitats of various animals, such as oysters, which are not found in the Gulf proper. Another factor is that Aransas Pass, being centrally located as it is, must necessarily be affected by many coastal storms and Gulf disturbances. Thus, many rare and "foreign" specimens are sometimes collected in this region.

NORTH JETTY

STATIONS 0+00 to 35+94, (Narrow Concrete Area)

In order to reach the north jetty, it is necessary to take a boat to St. Joseph Island, which borders the first section of the jetty on the north. Marine specimens were collected, therefore, only on the south side. The fauna of this area was limited to the barnacles Balanus improvisus Darwin, Balanus eburneus, and some Balanus balanoides (Stimp.); as well as the ubiquitous littorines, Littorina irrorata.

The Balanus community was small, however, and as usual, the number of specimens per unit area increased as one approached the end of the region.

A species of mollusk which had not been collected previously was abundant here. It was a small species called the bubble shell, Bulla occidentalis. It inhabited only rocks on which Cladophora was growing, but egg masses were found on loose stems of eelgrass, Zostera marina, which had floated in from another locality. This mollusk is one of the type which appears to have more body than it can draw back into its shell. In fact, as it grows older its body gradually engulfs the shell, which is well-formed, until this mollusk resembles the true nudibranchs, its near relatives.

A tube-dwelling annelid was collected from floating eelgrass blades, as well as from Sargassum fronds. This was the minute worm Spirorbis spirillum, whose coiled tubes were only one millimeter across. Often there were over one hundred tubes on a single leaf blade. On empty shells found in the area were empty tubes of another annelid, Serpula vermicularis. These are much larger and thicker tubes than those made by Spirorbis.

Some shells collected also had colonies of the bryozoan Acanthodesia savartii. These bryozoans belong to the phylum Molluscoidea, which contains many animals of uncertain classification. Another bryozoan, Membranipora tehuelcha, was found incrusted on a dead stem. A rock,

taken from between the boulders at a station much farther out on the jetty, was covered with live bryozoans classified as Membranipora membranaceae (Linnaeus). This colony was six centimeters in diameter, and had the texture of a sea anemone. It was the only living colony found.

Another interesting but rare species seen here was the small "wing-footed" pelagic mollusk, Clione papillionaceae. This species has no shell nor mantle, and is transparent. The wing-like appendages are lobes of the foot. Only three specimens were collected.

Sargassum washed in at this station contained many of the unidentified nudibranch mollusks found at Sabine, and also some eggs of the snails. Also abundant was the smaller nudibranch, Aeolis, sp. The small sea anemone, Sagartia luciae Verrill, was found on most of the Sargassum, as was the annelid Lumbrinereis tenuis.

The sea horse, Hippocampus stylifer (Jordan and Gilbert); the pipefish, Syngnathus floridae (Jordan and Gilbert); and the sargassum fish, Histrio histrio (Linn.), were all found in the gulfweed which was unusually abundant among the rocks. Pipefish were numerous, but only a few of the other fish listed were caught. All these fish are easily caught by bringing a fine-meshed dip-net up from beneath the water, collecting the gulfweed with the fish intact. Pipefish jerk themselves free from the Sargassum when it is raised out of the water, and resemble small arrows shot out in all directions. The sargassum fish is

a peculiar fish found only in Sargassum, and those specimens collected were small ; climbing about among the gulfweed and resembling frogs. Their fins are modified for this purpose. A related species is called the frog fish, Antennarius ocellatus. No other fish were caught at this station.

This section of the jetty was often the "landing field" for the brown pelican, Pelecanus occidentalis, although these birds do not feed near the jetties. Birds which were always present were the common tern, Sterna hirundo; and the laughing gull, Larus atricilla. Tiger beetles, Cicindela dorsalis, were common but were not as plentiful as they had been on the asphalt cap of the Galveston jetty.

STATIONS 35+94 to 64+50, (Wide Concrete Area).

The flora and fauna of this area were similar to that of the preceding section. The only condition of topography that was different in this area was the open water to the north replacing the sand on St. Joseph Island which was typical of that section. No new species were found, and the communities remained unchanged.

STATIONS 64+00 to 119+50, (Rock Area)

This large section was taken as a unit because the life forms were the same over the entire forty-five-hundred feet to the end. One difference in structure of the jetty at this point is a group of spurs, shown in figure IX. These spurs are of various lengths, the maximum being two-

hundred-fifty feet. The purpose of these small breakwaters is to protect the jetty proper, which was at one time threatened by the natural deepening of the channel too near the toes of the north jetty. These spurs are composed of the same granite rock that forms the main jetty, and therefore the fauna is not changed by them. There was considerably more drift on the spurs than on the jetty when the writer last collected there, but this was due to a recent squall on the Gulf. The greater abundance of Sargassum was also caused by this squall.

In this area were found purple floats of many Portuguese man-of-war jellyfish, Physalia physalis (Linn.). Those collected were still alive and ranged in length from four to sixteen centimeters. These coelenterates were more numerous on the beaches at Aransas Pass, along with the "cabbage-head" jellyfish, Stomolophus meleagris. Both of these species are pelagic forms. Other jellyfish collected included three species of Aurelia. The only one classified was Aurelia aurita (Linnaeus), which was found in quieter water between the rocks. The comb jelly, Bolinopsis microptera (L. Agassiz), was also found in small numbers.

Several tangled masses of red and yellow coral-like animals, (two species), commonly known as "sea whips" were found stranded among the rocks. These colonial sea whips had floated in, but many species of animals worthy of observation were found attached to them. Large goose barn-

acles, Lepas anatifera Linnaeus, which measured four centimeters in length, were collected. Lepas pectinata was growing on several of the "whips". One box-crab of the genus Lopholithodes, and several young crabs were engaged in freeing themselves from the tangled "whip". A few Omphid worm tubes had attached themselves to it.

Three echinoderms were collected in crevices of the jetty rocks. The most plentiful were the light-colored sand stars, Astropecten antillensis Lutken, which also covered the strand area after each high tide. The purple sea urchin, Arbacia punctulata (Lamarck), and living specimens of the sand dollar, Encope michelini (L. Agassiz), were found. Actually only the sea urchin lives on the jetty, while the other forms are brought in by the tides. Ecologically, this rocky area was a Balanus-Littorina community. Certain stations closely resembled the algae-covered rocks of Freeport. Besides the barnacles and littorines, the horse mussel, Mytilus hamatus; the limpet, Siphonaria lineolata Orbigny; and the abundant alga Padina pavoni, J. Ag., should be listed as secondary dominants.

The amphipod, Carinogammarus mucronatus was often present where Cladophora was growing. No isopods were found. Few hermit crabs were seen, but the rock crab Menippe mercenaria was abundant. On the average, one of these crabs was seen about every six meters of the entire rock area of the jetty. Swimming crabs, or blue crabs, Callinectes sapidus;

and Arenaeus cribrarius Lamarck, were seen at intervals. Both adult and young shrimp of several species could be taken with a dip-net. Among those collected were the less familiar mantis shrimp, Squilla empusa. One species of spider crab, not yet identified, was also caught.

This region contained an abundance of empty mollusk shells of the various species common to the beaches. Those collected from low pockets between rocks were as follows: the jingle shell, Anomia glabra; the bubble shell, Bulla occidentalis; the tooth shell, Dentalium entalis; the bivalves Barbatia barbata L., and Lucina pennsylvanica Linné; and the oyster, Ostrea virginica Gmelin. The following shells, when collected, usually contained hermit crabs: mitre shells, Mitra cinctella; turret shells, Turitella varigata; moon snails, Polinices duplicata Say; dog whelks, Nassa acuta; lightning shells, Busycon perversum Linné and Busycon pyrum Dillwyn; and the oyster drill shells Thais floridana Conrad, and Ursosalpinx cinerens. Beautiful floating shells of the purple snail were often collected in this area. The species Janthina communis was more abundant than the larger species, Janthina globosa. This is a pelagic mollusk, having a very thin shell. The snail secretes a bubble-like gelatinous raft which keeps it afloat. It is a gregarious animal, and one usually finds it either abundant or entirely absent in a given locality. Those collected were living, although empty shells were numerous on the nearby beach.

One large nudibranch, Navinax inermis, was found on a rock of the jetty, and another was caught with a net in the same locality by a shrimp fisherman. Both specimens were ten centimeters long, eight centimeters broad, and eight centimeters high.

On several occasions, the writer seined the water adjacent to both sides of the jetty at this section. This was done with the assistance of "Scotty" Ulch, a fisherman who was familiar with the fauna of the area. An effort was made to collect only the specimens near the jetties, but the following list of species collected includes several pelagic fish:

The most numerous species were the mullet, Mugil cephalus Linnaeus; the moonfish, Vomer setapinnis Mitchill; the porgy, Calamus arctifrons Goode and Bean; the pompano, Trachinotus carolinus (Linnaeus); and small specimens of drum, Pogonias cromis (Linnaeus), and tarpon, Tarpon atlanticus (Cuvier and Valenciennes). Other species represented by smaller numbers[1] were: the lookdown, Selene vomer; the

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[1]At least five fish of each of the species listed were collected at this station.

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triggerfish, Balistes capriscus (Gmelin); the batfish, Ogcocephalus, sp.; the striped sole, Achirus lineatus Linnaeus; the flounder, Paralichthys lethostigmus (Jordan and Gilbert); the angelfish, Chaetodipterus faber (Broussonet);

the ribbonfish, Trichinurus lepturus Linnaeus; the common skate, Raja erinacea Mitchill; the round stingray, Urobatis sloani (Blainville); the sea robin, Prionotus pectoralis (Nichols and Breder); the cowfish, Lactophrys tricornis Linnaeus; the spiny boxfish, Chilomycterus schoepfin (Walbaum); and the swellfish, Spheroides spengleri (Bloch).

Common arthropods in this collection included the red-tailed shrimp, Penaeus brasiliensis; the common shrimp, Penaeus setiferus; and other shrimp, Penaeus aztecus, and Xiphopenaeus kroyeri; and the crabs Callinectes sapidus, Arenaeus cribrarius, Ovalipes ocellatus, and Portunis panamensis.

Less familiar species were the small decorator crab, Oregonia gracilis; an unidentified species of "Calico" crab; a large red hermit in a Busycon shell; and the mantis shrimp, Squilla (Chlorodella) empusa.

Concerning the arthropods of the area, it is well to point out that the common shrimp is the only animal which has ever been scientifically investigated on the Gulf coast of Texas. For the past ten years the United States Bureau of Fisheries has carried on this investigation with the cooperation of the Game, Fish and Oyster Commission of Texas and similar commissions of other Gulf states. Most of the work has been done in the Aransas area. The other inside shrimp-fishing grounds are located at Matagorda Bay, San Antonio Bay, Corpus Christi Bay, and West Bay. This is important, since eighty per cent of the total catch of sea-

foods of the Gulf in 1937 were shrimp.[2]

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[2]United States Department of Commerce, Bureau of Fisheries Statistical Bulletins Nos. 1332 and 1344, (Washington, 1937).

The chief factor of the Fisheries investigation centered around the distribution of shrimp in relation to salinity of the water. The red-tailed shrimp, Penaeus brasiliensis, was a typical shrimp investigated, and probably more is known of its life history at present than of any other species of animal found in the Gulf of Mexico.

In Aransas Bay, young shrimp of this species come in from March until June, and then return to the Gulf by July. By June, young shrimp of the commercial species, Penaeus setiferus, are coming in. This species stays in Aransas Bay until fall. According to the technical investigations:

> (1) As shrimp grow larger, they seem to seek more and more salty water. This is what helps them in finding their way back to the Gulf which is their normal habitat as adults.
>
> (2) Only when actually moving from one place to another will they be found in any type of bottom except that in which mud predominates.[3]

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[3]Annual Report of the Game, Fish and Oyster Commission, (Austin, Texas, fiscal year 1937-38), 32.

The oyster situation is also being investigated, and results already obtained show that the oyster reefs have been

over-fished during the past thirty years.[4] The writer is

[4] Ibid., 29.

cognizant of this fact from observation of the deposits of empty shells in several regions, as already mentioned. The jetties are not the natural habitat of the oyster, since oysters prefer a muddy bottom, but some marine inhabitants of the jetties have certainly helped the fishermen in destroying oysters of the region. These are the various snails such as Thais and Busycon, which include oysters in their diets. Floods should not be under-estimated, since they lower the salinity in some of the bays until these bivalves are killed. Squalls, on the other hand, cover the oysters with mud and silt and suffocate them. It is evident that the oyster population will become diminished until steps are taken to cultivate oyster reefs as they should be.

SOUTH JETTY

STATIONS 0+00 to 31+50, (End of Concrete)

This section of the jetty on Mustang Island is bordered on the south by the sandy shore, and capped with concrete. The concrete is widest from stations 14+60 to 31+50, and this section extends into the Gulf. As on the north jetty, however, there was no great difference in the abundance of any species found on the concrete section when compared with the rock area.

The area capped with concrete was another typical tidal, or intertidal,[5] community composed of Balanus

[5]Shelford prefers the term "tidal", since such a community "is evidently adjusted to, and probably requires, tidal rhythm." Frederic E. Clements and Victor E. Shelford, Bio-Ecology, (New York, 1939), 324.

barnacles and Littorina irrorata snails. There were less than one hundred individuals of each genus per square meter. No algae were present, but other animals collected were the less common Littorina angulifera; the very small snail, Nerita versicolor Gmelin; and the limpet, Siphonaria lineolata Orbigny. There were never more than twenty individuals of these species per square meter.

A few large isopods, Ligyda exotica (Roux), were observed halfway out on this section, but otherwise there were no important influents. Small fish, such as mullet and drum; and young shrimp of several species, could be caught in net-fuls. Gulls and terns were doing their part of the fishing for these young animals. Holes of the sand crab, Ocypode albicans, were found to be approximately one meter apart in every direction over the entire sandy area to the south.

A few old wooden piles, protruding above water in this area, contained many holes, and when the wood was cut into with a knife, the mollusk, Martesia cuneiformis Say, was often found. A few specimens of the wood-boring isopod, Sphaeroma destructor, were also present. This was not the

same species as the one discovered at Galveston, but either species could probably be found in both localities, if a suitable type of wood were present.

On the beach area to the south were found shells similar to those collected between the rocks of the north jetty. Some shells were incrusted with the corals, Astrangia, sps. Tests of sand dollars and starfish were plentiful; and several floats of Physalia physalis and Velella velella were collected at the toes of the jetty.

There were several strings of capsules of the knobbed conch, Busycon, sp., and dry clumps of so-called "red-grass" egg masses of Ursosalpinx, sps. The small bean clam was plentiful. The species Donax variabilis, as its name suggests, was found in many color patterns. A few burrowing crabs, Emerita benedicti, were also collected.

As indicated by small, smooth holes near the hinges, several bivalves had fallen prey to the oyster drill snails, Ursosalpinx and Thais. A check-up revealed that the three genera most molested were Arca, sps., Dosinia, sps., and Tellina, sp. It was further observed that egg cases of Ursosalpinx, sp. were fastened to some of these shells. Two less common mollusk shells found in this region were the olive shell, Oliva sayana Ravenel; and the sun dial shell, Solarium granulatum Lamarck.

Insects formed a definite part of the animal population as far as station 31+50. Those found in appreciable numbers were green-eyed flies, Tabanus costalis; robber flies, Erax

rufibarbus; tiger beetles, Cicindela dorsalis; and house flies, Musca domestica.

STATIONS 31+50 to 86+50, (End of Jetty)

The growth of algae increased gradually as one proceeded toward the end of the jetty, the dominant species being Padina pavoni and Ulva lactuca. This was the first jetty where Ulva was found to be abundant. Some amphipods were found in the algae, and many small hermit crabs were present. Rocks of this area supported Balanus-Littorina-Mytilus lociations. It is interesting to note that one species of barnacle, Balanus balanoides Linné, is not found anywhere in the south except on rock jetties. All other species are commonly found on wood, as well as on rock surface. The principal inhabitants of rock crevices were the rock crab, Menippe mercenaria; and the sea anemone, Tealia crassicornis.

Sargassum and other jetsam contained the same flora and fauna discussed previously. Floating spiral shells, Spirula spirula Linné, were abundant in the debris. These empty shells were chambered in the same manner as the chambered nautilus. No living specimens were found, and some had floated so long that small goose barnacles had attached themselves to the shells.

A small number of Thais snails inhabited rocks of this whole area, and many of their shells were used by hermit crabs. Several annelids were collected, but the

writer was unable to have them properly classified. The only species found in significant numbers, however, was Lumbrinereis tenuis. A few small jellyfish, Gonionemus murbachii, were caught near station 70+50. A single species of striped jellyfish, Dactylometra quinquecirrha Desor, was also collected. This is a larger jellyfish having sixteen radiating, reddish-brown stripes. Free-swimming arthropods and fish of this area were similar to those found at the end of the north jetty. They are omitted here to avoid repetition.

SUMMARY

PORT ARANSAS NORTH JETTY

STATIONS 0+00 to 35+94, (Section of concrete-capped jetty having only the south side rocks exposed to water, five to fifteen feet deep).

Species	Common Name	Number per Square Meter
Balanus improvisus Darwin.	Barnacle	10 to 80
Balanus eburneus.	Barnacle	2 to 30
Balanus balanoides (Stimp.).	Barnacle	0 to 10
Littorina irrorata.	Littorine	60
Bulla occidentalis.	Snail	20
Cladophora, sps.	Alga	(scarce)
Spirorbis spirillum.	Annelid tubes	(100 tubes per leaf)
Serpula vermicularis.	Annelid tubes	(on 10 shells)
Acanthodesia savartii.	Bryozoan	(3 colonies)
Membranipora tehuelcha.	Bryozoan	(on 4 stems)
Membranipora membranaceae (Linn.)	Bryozoan	(on 1 rock)

Floating Specimens:

Clione papillionaceae.	Wing-Foot Mollusk	(3 collected)
Sargassum, sps.	Gulfweed	(abundant)
Unidentified	Nudibranch	5
Aeolis, sp.	Nudibranch	10
Sagartia luciae Verrill.	Sea Anemone	15
Lumbrinereis tenuis.	Nereis Worm	30
Hippocampus stylifer (Jordan and Gilbert).	Sea Horse	(3 collected)
Syngnathus floridae (Jordan and Gilbert).	Pipefish	10
Histrio histrio (Linnaeus).	Sargassum Fish	(1 collected)

Birds:

Pelecanus occidentalis.	Pelican	(occasional)
Sterna hirundo.	Tern	6
Larus atricilla.	Laughing Gull	6

Insects:

Cicindela dorsalis.	Tiger Beetle	10

STATIONS 35+94 to 64+50, [Section of wide concrete supporting identical life forms found in preceding area. Refer to above list of species, (Stations 0+00 to 35+94)].

STATIONS 64+50 to 119+50, (Rock area of north jetty extending into the open Gulf; water gradually increasing in depth from four feet to twenty-five feet at end of jetty).

Sargassum, sps.	Gulfweed	4
Physalia physalis (Linn.)	Man-of-War	(dead specimens)
Stomolophus meleagris.	Jellyfish	(dead specimens)
Aurelia aurita Linnaeus.	Jellyfish	1
Aurelia, sp.	Jellyfish	(4 collected)

Bolinopsis microptera (L. Agassiz). (Jellyfish;) Comb Jelly (1 collected)

Unidentified species, Sea Whip (3 large masses) 2 sps.

Lepas pectinata. Goose Barnacle (covered one side of plank which had washed ashore)

Lepas anatifera. Goose Barnacle (16 collected)

Lopholithodes, sp. Box Crab (1 collected)

Various species, young Crabs 1

Omphid, sp. Worm tubes 1

Astropecten antillensis Lutken. Sand Star 20

Arbacia punctulata (Lamarck). Sea Urchin 2

Encope michelini (L. Agassiz). (Sand Dollar;) Key-Hole Dollar (5 living specimens collected)

Balanus improvisus and B. eburneus. Barnacles 30 to 100

Littorina, sps., mostly L. irrorata. Littorines 10 to 80

Mytilus hamatus. Horse Mussel 10 to 50

Siphonaria lineolata Orbigny. Limpet 20

Padina pavoni J. Ag. Alga (abundant)

Carinogammarus mucronatus. Scud (10 per sq. meter in certain areas only)

Menippe mercenaria. Rock Crab (1 every six meters)

Callinectes sapidus. Swimming Crab 1

Arenaeus cribrarius Lamarck. Crab 1

Squilla empusa. Mantis Shrimp 1

Unidentified Spider Crab (1 collected)

Navinax inermis. Nudibranch (2 collected)

Oregonia gracilis. Decorator Crab 1

Penaeus brasiliensis. Shrimp 10

Hepatus epheliticus. Spotted Crab (5 collected)

Penaeus setiferus.	Shrimp	6
Unidentified, large Hermit Crab		(1 collected)

Empty Mollusk Shells:

Anomia glabra.	Jingle Shell
Bulla occidentalis.	Bubble Shell
Dentalium entales.	Tooth Shell
Barbatia barbata L.	Bivalve
Lucina pensylvanica Linné.	Bivalve; Lucine
Ostrea virginica Gmelin.	Oyster
Mitra cinctella.	Miter Shell; Mitra
Turritella varigata.	Turret Shell
Polinices duplicata Say.	Moon Snail
Nassa acuta.	Dog Whelk
Busycon perversum Linné.	Lightning Shell
Busycon pyrum Dillwyn.	Lightning Shell
Thais floridana Conrad.	Snail
Ursosalpinx cinereus.	Snail
Janthina communis.	Purple Floating Shell
Janthina globosa.	Large Purple Shell

Pelagic Fish, caught within three meters off the jetty:

Mugil cephalus Linnaeus.	Mullet
Vomer setapinnis Mitchill.	Moonfish
Calamus arctifrons Goode and Bean.	Porgy
Thachinotus carolinus (Linnaeus).	Pompano
Pogonias cromis (Linnaeus).	Drum
Tarpon atlanticus (Cuvier and Valenciennes).	Tarpon

Selene vomer. Lookdown

Balistes capriscus (Gmelin). Triggerfish

Ogcocephalus, sp. Batfish

Achirus lineatus (Linnaeus). Striped Sole

Paralichtys lethostigmus (Jordan and Gilbert). Flounder

Chaetodipterus faber (Broussonet). Angelfish

Trichiurus lepturus Linnaeus. Ribbonfish

Raja erinacea Mitchill. Common Skate

Urobatis sloani (Blainville). Round Stingray

Prionotus pectoralis (Nichols and Breder). Sea Robin

Lactophrys tricornis Linnaeus. Cowfish

Chilomycterus schoepfin (Walbaum). Spiny Boxfish

Spheroides spengleri (Bloch). Swellfish; Blowfish

PORT ARANSAS SOUTH JETTY

STATIONS 0+00 to 31+50, (Balanus-Littorina community on north side; sandy beach area on south side).

Callinectes sapidus.	Swimming Crab	1
Balanus improvisus.	Barnacle	80
Littorina irrorata.	Littorines	50
Littorina angulifera.	Littorines	10
Nerita versicolor Gmelin.	Snail	2
Siphonaria lineolata Orbigny.	Limpet	20
Ligyda exotica.	Isopod	1
Various species of young Shrimp		10
Various species of Gulls		3

Tealia crassicornis. Sea Anemone (few collected, 1938)

Arbacia punctulata. Sea Urchin (few collected, 1938, 1939)

Penaeus brasiliensis. Shrimp 6

Astropecten antillensis Lutken. Starfish 16

Mugil cephalus. young Mullet 12

Various species of Terns 2

Wood Borers:

Martesia cuneiformis. Isopod (10 per cubic foot of wood)

Sphaeroma destructor. Isopod (14 collected)

Empty Mollusk Shells:

Oliva sayana Ravenel. Olive Shell; Purple Olive

Solarium granulatum. Sundial Shell

Anomia glabra. Jingle Shell

Bulla occidentalis. Bubble Shell

Lucina pennsylvanica Linné. Lucine

Ostrea virginica Gmelin. Oyster

Mitra cinctella. Miter Shell

Turritella varigata. Turret Shell

Polinices duplicata Say. Moon Snail; Shark Eye

Nassa acuta. Dog Whelk Shell

Busycon perversum Linné. Lightning Shell; Oyster Drill

Thais floridana Conrad. Snail

Littorina irrorata. Littorine; Periwinkle

Ursosalpinx cinereus. Snail

Janthina communis. Small Purple Snail

Janthina globosa. Large Purple Snail

Beach Forms:

Donax variabilis. Bean Clam 30

Emerita benedicti. Burrowing Crab 1
(more plentiful in 1938)

Astropecten antillensis Lutken. (few living specimens)
Starfish; Sand Star

Encope michelini, Sand Dollar tests 3

Astrangia, sp. Coral (incrusted on 10 shells)

Physalia physalis. Man-of-War Jellyfish 1

Velella velella. Jellyfish floats 1

Busycon, sp. Snail eggs (15 strings observed)

Ursosalpinx, sp. Snail eggs (numerous)

Insects:

Tabanus costalis. Green-Eyed Fly 3

Erax rufibarbus. Robber Fly 3

Cicindela dorsalis. Tiger Beetle 10

Musca domestica. Housefly 0 to 60

STATIONS 31+50 to 86+50, (Rock area extending into the Gulf).

Balanus balanoides Linné. Barnacles 10

Balanus improvisus. Barnacles 90

Littorina irrorata. Littorines 80

Padina pavoni. Alga (abundant)

Ulva lactuca. Alga; Sea Lettuce (most abundant Alga)

Carinogammarus mucronatus. Scud 11

Pagurus, sps. Hermit Crabs 1

Menippe mercenaria. Rock Crab 1

Dactylometra quinquecirrha Desor. Jellyfish (1 collected)

Tealia crassicornis. Sea Anemone (clans of 8 to 10)

Astropecten antillensis. Sand Star tests 1

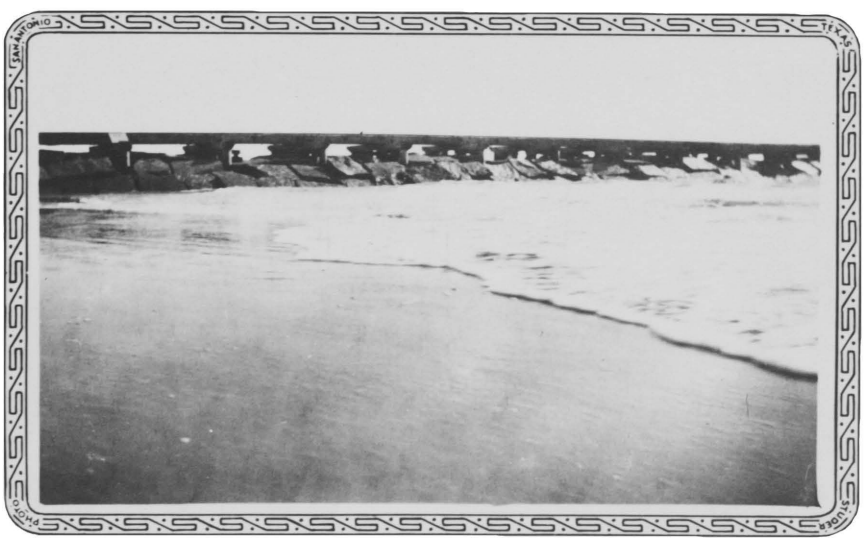
Spirula spirula Linné.	Spiral Shell	1
Thais floridana.	Snail	8
Lumbrinereis tenuis.	Nereis Worm	1
Gonionemus murbachii.	Jellyfish	(5 collected)
Unidentified Luminescent Bacteria or Protozoa (observed at night on jetty rocks)		

Note: This area was not seined, as was the corresponding area around the north jetty. Pelagic forms would probably be the same in both regions. In 1939, the writer caught six squids of the species Loligo brevipennis, in this area. In 1938, the colonial disc-shaped coelenterate known as "sea pansy", or "sea liver", Renilla amethystina, was present in small numbers in the Aransas area, but not in the immediate vicinity of the jetty. The writer found neither of these species in 1940 at any jetty, except the Renilla at Freeport.

FIGURE X,A

NORTH JETTY, PORT ISABEL
Station 30+00, on Padre Island
(Jetty Undergoing Repairs at Extreme End)

FIGURE X,B



SOUTH JETTY, PORT ISABEL
Station 25+00; Brazos Island Beach, Foreground

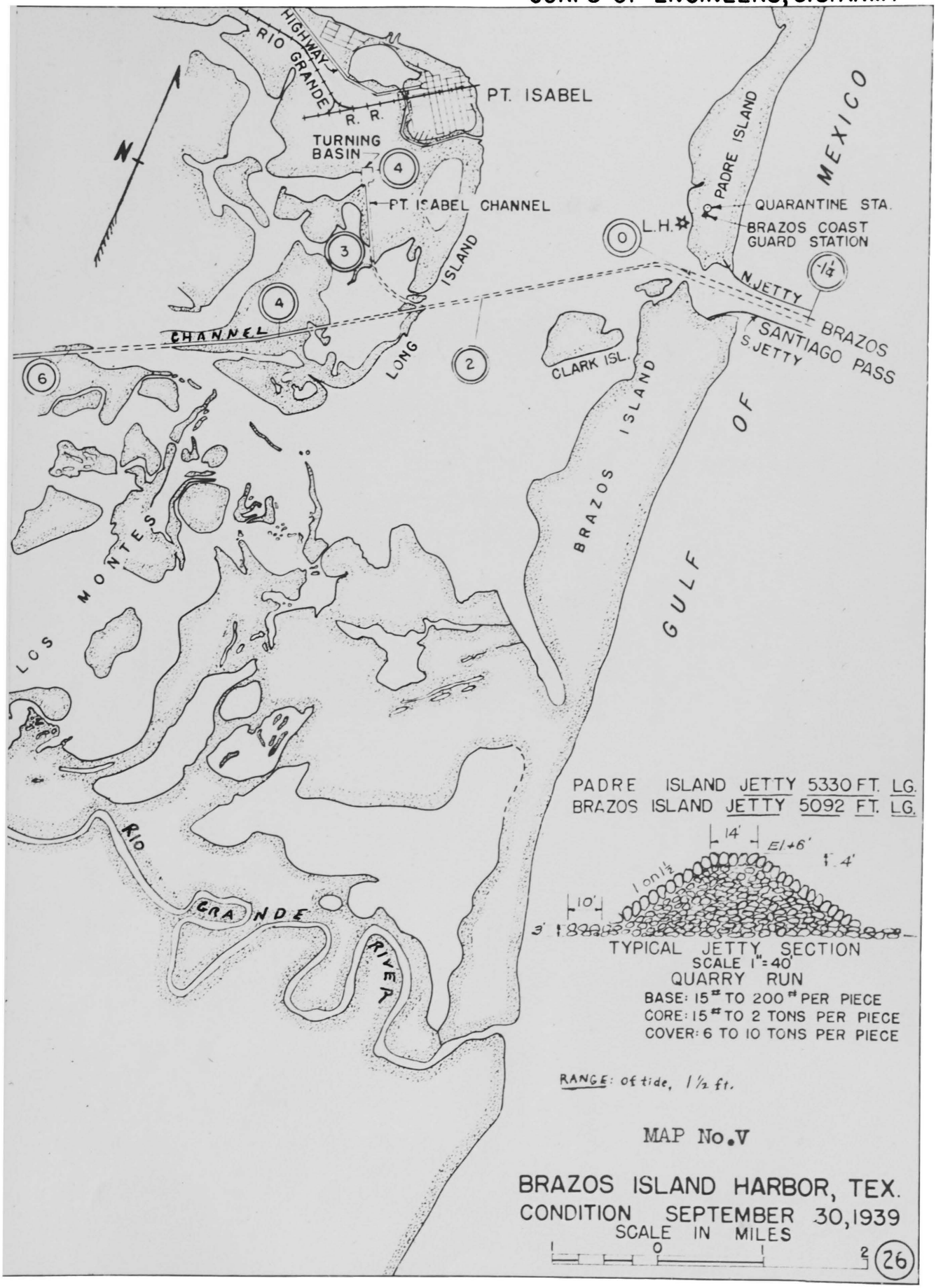

HIGHWAY
RIO GRANDE
R. R.
PT. ISABEL
TURNING BASIN
PT. ISABEL CHANNEL
PADRE ISLAND
MEXICO
QUARANTINE STA.
BRAZOS COAST GUARD STATION
L.H.
N. JETTY
BRAZOS SANTIAGO PASS
S. JETTY
CHANNEL
LONG ISLAND
CLARK ISL.
BRAZOS ISLAND
GULF OF
LOS MONTES
RIO GRANDE RIVER
PADRE ISLAND JETTY 5330 FT. LG.
BRAZOS ISLAND JETTY 5092 FT. LG.
14'
El+6'
4'
1 on 1½
10'
3'
TYPICAL JETTY SECTION
SCALE 1"=40'
QUARRY RUN
BASE: 15# TO 200# PER PIECE
CORE: 15# TO 2 TONS PER PIECE
COVER: 6 TO 10 TONS PER PIECE
RANGE: of tide, 1½ ft.
MAP No. V
BRAZOS ISLAND HARBOR, TEX.
CONDITION SEPTEMBER 30, 1939
SCALE IN MILES
0
2
26

FIGURE XI

CHAPTER VIII

THE PORT ISABEL JETTIES

The Port Isabel jetties are approximately one-hundred-fifty miles due south of the Port Aransas jetties. The Brazos-Santiago Pass, which these jetties protect, is located between Padre Island and Brazos Island. This is the first pass encountered south of Corpus Christi Bay, and is therefore the only southern pass between the Gulf of Mexico and Laguna Madre. Contrary to the popular belief of many people, the Rio Grande (River) does not flow into the Laguna Madre and thence through the Brazos-Santiago Pass. Instead, the mouth of this river is located on the Gulf itself, ten miles south of the Port Isabel jetties.

NORTH JETTY

As the accompanying map, figure XI, indicates, the north jetty is reached only by boat from Port Isabel or from Brazos Island. This jetty, extending due east into the Gulf, is approximately one mile long, and has no part capped with concrete. Both jetties have cross-ties and rails along their entire lengths, supported by creosoted piles, as shown in figures X,A, and X,B. At the time of this writing, the track on the north jetty is being used to carry new granite cover rocks to a station near the gulfward end of the jetty.

According to the engineer in charge of this repair

work, these jetties require more repairs than any of the others. It was easy to see why this was the case, because in general, the undertow action of the waves was greater here than anywhere else on the Texas coast. This was partly due to the fact that the Port Isabel jetties are geographically farther out in the Gulf. The range of tide was no greater than that of the other jetties, however, averaging one and one-half feet.

One of the worst results of the strong wave action was the extreme turbidity of the water. It was at once apparent that the flora and fauna would be affected greatly. It was also learned that the fishing done in the area was mostly off-shore fishing. When repairs were in progress, fishing from the jetties was prohibited. The species of fish usually caught were trout, mackerel, tarpon, flounder, jewfish and redfish.

STATIONS 0+00 to 10+00

The first thousand feet of the jetty borders Padre Island on the north, serving as a seawall. On the north side of the jetty, the only inhabitants of the sand were a few sand crabs, Ocypode albicans Bosc.; and some Staphylinid scavenger beetles found near a dead fish.

The area on the channel side was the most protected section of either of the Port Isabel jetties. The rocks, however, were acted upon by the sand in the extremely turbid water until they supported little life. A few periwinkles, Littorina ziczac Gmelin, were discovered,

high above the level of the average wave, probably seeking to keep themselves protected from the grinding action of the sandy water. The only other species at this station was the edible crab, Callinectes sapidus, which did not seem to mind the turbid water. On the backs of six of these crabs were found large ivory barnacles, never more than two per crab. These barnacles measured three centimeters across, and were possibly of the species Balanus eburneus.

STATIONS 10+00 to 10+15

This small section formed the beach area on the north side of the rocks. A dominant influent was the burrowing sand crab, Emerita benedicti (Schmitt). Young specimens comprised about half the sand crab population. Only this single species of crab was collected here. A few bean clams, Donax variabilis Say, were collected.

Three species of isopods were caught by seining the breakers as they washed the shore. These were Ancinus, sp., Sphaeroma destructor, and Sphaeroma quadridentatum Say. Neither species was abundant, and all had their characteristic folded-up appearance which was similar to that of the land species known as "pill bug". The writer made an effort to find these borers in the wooden parts of the railroad foundation, but since the piles were comparatively new, and had been creosoted, none were found.

Three Portuguese man-of-war jellyfish, Physalia physalis Linn., were stranded on the beach at this station; a few tests of the sand dollar, Encope michelini (L. Agassiz),

were also present; and a beer bottle washed ashore was covered on one side with barnacles, Lepas anatifera Linnaeus. On some empty mollusk shells were found the coral, Astrangia, sp.; while broken, loose pieces of another coral, Astrae argus, were dug out of the beach sand.

STATIONS 10+15 to 53+30, (End of Jetty)

The greatest difference in fauna of any region was observed at this section. Instead of the usual abundance of Balanus and Littorina, there were only a few, scattered individuals of each, and they were all on inside rocks. Many of the Balanus improvisus Darwin specimens examined were found to be only empty shells, but they were usually large.

On the entire jetty, only about thirty Thais snails were seen, and about the same number of hermit crabs, Pagurus pollicaris. At the end of the jetty there was a slight growth of Cladophora fascicularis (Mertens) Kütz. Repair work was in progress at the extreme gulfward end.

Two species of living mollusks were collected at this station which had not been seen at any other jetty. One is known as a helmet snail, Cassis sulcosa, and the other a bandshell, Fasciolaria distans Lamarck. Both are prized by souvenir collectors, and this is one reason why they are seldom seen on the beach. They are also less common than most species found near the shore.

Empty mollusk shells found on the beach and among

the jetty rocks, at intervals, were as follows: the moon shell, Polinices duplicata Say; the olive shell, Oliva sayana Ravenel; the bandshell, Fasciolaria distans, in broken fragments; the helmet, Cassis sulcosa; the conch shell, Thais floridana Conrad; the lightning shell, Busycon perversum Linné, and its egg capsules; the ear shell, Sigaretus perspectivus Say; the heart shell, Cardita floridana; dosinia shells, Dosinia discus Linné, Dosinia ponderosa, and Dosinia elegans Conrad; the ark shells, Arca transversa Say, Arca campechiensis Gmelin, and Arca elegans Conrad; and other bivalves, Lucina crenulata Conrad, Anatina plicatella Lamarck, Asaphis deflorata Linné, Lucina pensylvanica Linné, Noetia ponderosa Say, and Plagioctenium gibbus Linné.

SOUTH JETTY

The south jetty is approximately two thousand feet south of, and runs parallel with, the north jetty. The jetties are identical except that the south jetty is two-hundred-forty feet shorter. Examination of the life on this jetty indicated that it was similar to that on the north jetty, and although the writer made close observations, no new forms were found on the south jetty. For this reason, a repetition of the life forms of the north jetty will not be made here. Stations' numbers are comparable, except that the beach area of the south jetty is between stations 9+70 and 9+80.

SUMMARY

PORT ISABEL JETTIES

STATIONS 0+00 to 10+00, North Jetty, (Sandy area on north side and channel area on south side; water five to ten feet deep on channel side. STATIONS 0+00 to 9+70 form corresponding areas on South Jetty).

Species	Common Names	Number per Square Meter
Ocypode albicans.	Sand Crab	1
Staphylinid	Beetles	(25 observed)
Littorina ziczac Gmelin.	Littorine	5
Callinectes sapidus.	Swimming Crab	1
Balanus eburneus.	Barnacle	(10 collected)
Balanus improvisus Darwin.	Barnacle	1

STATIONS 10+00 to 10+15, North Jetty, (Beach area on north side. STATIONS 9+70 to 9+80 form corresponding areas on South Jetty).

Emerita benedicti (Schmitt).	Burrowing Crab	10
Donax variabilis Say.	Bean Clam	2
Ancinus, sp.	Isopod	6
Sphaeroma quadridentatum Say.	Isopod	1
Sphaeroma destructor.	Isopod	(3 collected)
Physalis physalis Linn.	Man-of-War Jellyfish.	(3 collected)
Encope michelini (J. Agassiz)	Sand Dollar	1
Lepas anatifera Linnaeus.	Goose Barnacle	(80 on floating bottle)
Astrangia, sp.	Coral	(on 17 shells collected)
Astrae argus.	Coral	(3 pieces collected)

Empty Mollusk Shells:

Lucina crenulata Conrad.	Lucine Shell

Anatina plicatella Lamarck.	Anatina Shell
Asaphis deflorata Linné.	Bivalve
Cardita floridana.	Heart Shell
Lucina pensylvanica Linné.	Lucine Shell
Sigaretus perspectivus Say.	Ear Shell
Noetia ponderosa Say.	Bivalve
Plagioctenium gibbus Linné.	Bivalve
Arca transversa Say.	Transverse Ark
Arca campechiensis Gmelin.	Ark Shell
Arca incongrua Say.	Ark Shell
Dosinia discus Linné.	Discus Shell
Dosinia ponderosa.	Heavy Dosinia
Dosinia elegans Conrad.	Dosinia Shell
Busycon perversum Linné.	Lightning Shell
Busycon, sp. egg capsules	Lightning Shell
Thais floridana Conrad.	Snail
Polinices duplicata Say.	Moon Snail
Oliva sayana Ravenel.	Olive Shell
Fasciolaria distans.	Bandshell fragments
Cassis sulcosa.	Helmet Shell

Two unidentified specimens of bivalves

Note: Arca and Dosinia were the only genera represented by great numbers of shells.

STATIONS 10+15 to 53+30, North Jetty, (Rock area in open Gulf; water ranging in depth from six to twenty feet. STATIONS 9+80 to 50+92 form corresponding areas on South Jetty).

Littorina ziczac Gmelin. Littorine 3

Balanus improvisus Darwin. Barnacle 8

Cladophora fasciolaris. Alga (scarce)

Cassis sulcosa. Helmet Snail 1

Fasciolaria distans Lamarck. Bandshell (10 collected)

Thais floridana Conrad. Snail (30 observed)

Pagurus pollicaris. Hermit Crab (20 observed)

CHAPTER IX

CONCLUSIONS

From the study of all available literature on the subject, one is forced to conclude that the ecological surveys of marine communities in North America have been confined largely to the Pacific coast. The surveys on the Atlantic coast have been made almost invariably in the north. These investigations have been carried on by Shelford, Allee, Beauchamp, Colton, Pearse, and others, using various methods of interpreting results. Shelford prefers the stressing of large units and their subdivisions, while others emphasize small units, or the habitat as a unit.[1] It is apparent

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[1] V.E. Shelford, "Some Marine Biotic Communities of the Pacific Coast of North America," Reprint from Ecological Monographs 5: 249-354, July 1935, p. 325.

---

that data taken from such investigators have proved difficult of comparison.

In the case of this thesis, the writer finds his own data hard to compare with those of other investigators for the following reasons:

1. The range of tide along the entire Texas coast is slightly above one and one-half feet. On the Pacific coast the range of tide is much greater, affording a large intertidal, or strand area.

2. The biotic communities on the Pacific coast include some natural rocky areas; while the jetties produce secondary, or man-made communities differing from any natural habitats found on the Gulf bordering Texas.

3. The coast of the Gulf of Mexico now being considered borders an inclosed gulf which differs from any other, especially in its wind currents and gulf-tide currents. Thus, the geographical and topographical conditions are very unlike those investigated by Shelford and others.

4. The jetties themselves are isolated units, which, although similar in construction, cannot be discussed in ecological terms which designate one entire region as a unit. Furthermore, the area of each jetty is too small to be expressed by an ecological term comparable to terms ordinarily applied to larger areas on the Pacific coast, for example.[2]

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[2]V. E. Shelford, "Basic Principles of Classification of Communities and Habitats and the Use of Terms," Reprint from Ecology, Vol. XIII, No. 2, April, 1932, p. 111.

The writer, therefore, has used only the term "community", unless the animals being considered were found in separate, small, tidal or subtidal areas. In such cases, the term "clan" and "lociation" have been used, and when used they include mainly sedentary and sessile forms.

5. The entire littoral region of the Gulf coast, if examined ecologically, would necessarily be discussed as a

sandy area; and in comparing it with another large region, the rocky jetties would play a minor part. This thesis, on the other hand, was written primarily to describe these rocky areas, and thus it must refer to beach forms as influents on the jetties, although they are dominant forms of the Texas coast.

With the above limitations in mind, the writer feels free to designate each jetty as a Balanus-Littorina community, which was in most cases stable. In time, these jetties may become climax communities composed of at least these two genera of animals. This is more probable in Texas than in many other places because of the range of tide. It is undoubtedly true that many sessile barnacles of other regions are killed by desiccation due to extreme tidal fluctuations; but the writer has concluded that those barnacles found dead on rocks of the jetties investigated had been killed by excessive turbidity caused by strong wave action on sand. This was especially noticeable on the Port Isabel jetties, where turbidity was greatest, and Balanus population smallest, of any jetty investigated.

In listing principal subdominants, those observed at various stations of the different jetties were found to fluctuate both quantitatively and qualitatively. It is possible, however, to list the following species as being "always present" as subdominants: the rock crab, Menippe mercenaria; the swimming crab, Callinectes sapidus; the

hermit crabs, Pagurus, sps.; the snail, Thais floridana; the limpet, Siphonaria lineolata; and several species of Cladophora and Enteromorpha algae. Occasional and rare species, although plentiful at times, play no important part in determining the fauna of large communities; but for the benefit of the reader, a complete check list of the species collected has been included in the appendix.

The "occasional" species mentioned above may be present because of recent storms, spawning periods, seasonal migrations, changes in direction of wind or tidal currents, and unusual abundance of Sargassum on the jetty rocks. Some of these forms may remain alive for weeks within pockets formed among the rocks, and one wonders whether or not it may be possible that a few have drifted from long distances, even as far as the Caribbean Sea.

A number of species included were those found in the ecotone, or transition community between the pelagic and benthic areas of the Gulf. Some animals in this category are the shrimp, which have already been discussed in regard to their migration at spawning time; and fish, many of which are in the larval stage when collected. Thus, ecotones may exist in both vertical and horizontal distributions, as indicated above; but the writer has used the term "tidal" to apply to all communities of non-motile forms which were found in the inter-tidal region. Few of the mollusk shells included in the lists belonged to littoral animals. Many

of them may have been washed in from long distances, or from great depths. These shells are included, however, because in some cases they are indicative of the mollusks inhabiting the benthic area surrounding the jetties. This also applies to the tests of certain echinoderms and worm tubes found on beaches.

The benthic area of the jetties, located in lower strata than the writer investigated, is a definite part of any complete survey, and the deep-water species included in the check-list are indicative of other similar forms which could be collected with dredging equipment suitable for use in water twenty feet deep. Methods of sampling the sea-bottom in our country are now largely in the experimental stage and expensive to undertake. The reader is referred to an article by Frances Kirsop, who makes the following statement:[3]

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[3]Frances Mullis Kirsop, "Preliminary Study of Methods of Examining the Life of the Sea Bottom," Publication of the Puget Sound Biological Station, Vol. 3, No. 64, p. 129.

> We know of few attempts in American waters to gain accurate knowledge of the quantity of life per unit area of sea bottom. A systematic survey for quantity would likely lead to results as valuable as those secured by the Danish Biological Station at which extensive studies have been carried on. . . Naturally this preliminary work is largely a matter of apparatus and methods.

It is hoped that the benthic areas of the Gulf coast of Texas may be investigated by use of diving suits and dredges; but as pointed out in the above article by Frances

Kirsop, unless definite contour lines are laid off, and samples taken under prescribed scientific directions, very little quantitative data can be obtained from benthic areas.[4]

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[4]Ibid., 131.

Bottom sampling is only one of the many fields waiting for investigation in the Texas area. Other studies for the ecologist include:

> Effects of salinity fluctuations on animals of the bays, including floods and Gulf disturbances.
>
> Salinity tolerance of fresh-water and brackish-water species encountered on the coast.
>
> Effects of turbidity on certain animals inhabiting the bays, especially the sessile forms.
>
> Effects of temperature and seasonal changes on the lives and activities of jetty forms.
>
> Life histories, including the spawning habits, of certain animals in the area, (such as the studies already made of the common shrimp, as already described).
>
> Life histories of animals found exclusively on rocks, such as Balanus balanoides.
>
> Comparisons of jetty habitats with Gulf and bay habitats.
>
> Advantages and disadvantages of the jetties to fish and other animals in the immediate vicinities.
>
> Interactions and coactions of the flora and fauna of the region.

All of these are broad subjects; any one would prove to be an interesting and useful piece of research which has not been undertaken in this area.

If and when a biological station is established on the

Texas coast for such investigations of marine life, the writer is inclined to prefer the Port Aransas area to any other on the Gulf proper. The greater number of species and individuals in the region is mainly due to the geography and topography of the area; especially noticeable in the number of bays and passes near at hand.

In conclusion, it is well to point out that the government jetties, although built by man, supply rocky habitats for certain communities of animals and plants which would otherwise find no rocks for attachment and growth. Even though the jetties were constructed in comparatively recent years, they are to be maintained as permanent breakwaters; and no doubt, they will remain the exclusive rock communities of the Texas outer coast for years to come. For this reason, it is logical to assume that many future ecological studies will be centered around these jetties; and it is the hope of the writer that these investigations will not be delayed further.

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APPENDIX

CHECK LIST OF SPECIES

Note: Species preceded by an asterisk (*) were verified by the Smithsonian Institution, Washington, D. C., 1940. Only specimens collected by the writer are listed.

ANIMAL KINGDOM

PHYLUM PORIFERA

(Unidentified "rock sponge")

PHYLUM COELENTERATA

Class Hydrozoa

Order Leptoliniae

Family Campanulariidae

Obelia dichotoma (L.) Hydroids
**Clythia cylindrica* Agassiz.

Family Sertulariidae

**Sertularia versluysi* Nutting. Hydroid

Family Plumulariidae

**Aglaophenia minuta* Fewkes. Hydroid

Order Trachomedusa

Family Petasidae

Gonionemus murbachii. Jellyfish

Order Siphonophorae

Family Velellidae

**Velella velella* (Linn.) Sail Jellyfish

Family Porpitidae

Porpita linneana. Sea Pansy

Family Physaliidae

**Physalia physalis* (Linn.) Portuguese Man-of-War Jellyfish.

Class Scyphozoa

Order Discophora

Family Pelagiidae

Dactylometra quinquecirrha Desor. Striped Jellyfish

Family Stomolophiidae

Stomolophus meleagris. Jellyfish
Stomolophus, sp.

Family Aureliidae

Aurelia aurita (Linnaeus). Jellyfish
Aurelia, sps.

Class Anthozoa

Order Pennatulacea

(Unidentified "sea pen" or "sea whip") Yellow and Purple Species.

Family Renillidae

Renilla amethystina Verrill. Sea Liver; Sea Pansy

Order Gorgonaceae

Family Plexauridae

Eunicea, sp. Gorgonian Coral

Order Actiniaria

Family Sagartidae

Tealia crassiformis. Sea Anemones
Tealia, sp.
Sagartia luciae Verrill?
Sagartia, sp.

Order Madreporaria

Family Astrangidae

Astrangia danae. Coral
**Astrangia*, sp.
Astrae argus

Class Ctenophora (PHYLUM CTENOPHORA)

Order Lobata

Family Bolinopsidae

Comb Jellies

Bolinopsis microptera (L. Agassiz)?
Mneiopsis, sp.

PHYLUM MOLLUSCOIDEA

Class Bryozoa (Polyzoa)

Order Chilostomata (Gymnolaemata)

Family Bicellariidae

Bugula turrita. Bryozoan

Family Membraniporidae

Membranipora membranaceae (Linnaeus)
Membranipora tehuelcha
**Acanthodesia savartii* Savigny-Audouin

PHYLUM ANNELIDA (ANNULATA)

Class Chaetopoda

Order Polychaeta

Family Nereidae

Lumbrinereis tenuis. Nereis Worms
Nereis pelagica
Nereis virens
Nereis, sps.

Family Polynoidae

Lepidonotus polynoe. Lepidonotus Worms
Lepidonotus, sps.

Family Leodicidae

**Omphid*, sp. (tubes). Tube Worm

Family Serpulidae

Serpula vermicularis. Spiral-Tube Worms
**Serpula*, sp.
**Spirorbis spirillum*?

PHYLUM MOLLUSCA

Class Pelecypode

Order Prionodesmacea

Family Ostreidae

*Ostrea virginica Gmelin. Common Oyster

Family Pectinidae

Pecten gibbus (Linné). Scallop
*Plagioctenium gibbus Linné

Family Aviculidae

Pinna seminuda. Fan Shell

Family Anomiidae

Anomia glabra. Jingle Shell
*Spondylus americanus Lamarck

Family Mytilidae

Mytilus hamatus. Horse Mussel
*Brachidontes (Ischadium) recurvus Raf.
Lithophaga plumula Henley. Date Mussel

Family Carditidae

Cardita floridana. Heart Shell

Family Cardiidae

*Trachycardium (Dinocardium) robustum Solander. Cockle Shell
Cardium magnum.
Cardium serratum.

Family Tellinidae

*Tellina alternata Say. Sun Shell

Family Vereridae

Dosinia ponderosa. Heavy Dosinia
Dosinia elegans Conrad.
*Dosinia discus Linné. Discus Shell
*Venus campechiensis Gmelin. Venus Shell
Venus mercenaria Linné.

Family Petricolidae

Petricola pholidiformis. Small Angelwing

Family Arcidae

**Arca campechiensis* Gmelin. Ark Shells
**Arca transversa* Say
**Arca incongrua* Say
**Barbatia barbata* L.
**Noetia ponderosa* Say

Family Donacidae

Donax tumida. Bean Clam
**Donax variabilis* Say
**Asaphis deflorata* Linné

Family Psammobiidae

**Tagelus gibbus* Spengler. Jack-Knife Clam

Family Solenidae

Solen vagina. Clam

Family Pholadidae

**Barnea costata* Linné. Large Angelwing
**Martesia cuneiformis* Say. Boring Mollusk

Family Teredidae

**Bankia (Bankiella) gouldi* Bartsch. Shipworm

Family Lucinidae

**Lucina pensylvanica* Linné. Lucine
Lucina crenulata Conrad

Suborder Anatinacea

Family Anatinidae

**Anatina plicatella* Lamarck

Class Scaphopoda

Family Dentaliidae

Dentalium entales. Tooth Shell

Class Gastropoda

Order Pteropoda

Family Clionidae

Clione papillionacea. Wing-Foot Mollusk

Order Opisthobranchiata

Family Bullariidae

Bulla occidentalis. Bubble Shell

Family Aglajidae

Navanax inermis (Cooper). Striped Mollusk

Suborder Nudibranchiata

Family Aeolidiadae

Aeolis, sp. Nudibranch
(Unidentified nudibranch)

Order Pulmonata

Suborder Geophila

Family Helicidae

Polygyra texasiana Moric. Land Snail

Suborder Orthodonta

Family Olividae

Oliva litterata (Lam.) Olive Shell
Olive sayana Ravenel

Family Mitridae

Mitra cinctella. Miter Shell
Anachis, sp.

Family Fasciolariidae

Fasciolaria distans Lamarck

Family Nassidae

Nassa acuta (S.) Dog Whelk

Family Cassididae

Cassis sulcosa. Helmet

Family Turbinellidae

**Busycon* (*Fulgar*) *perversum* Linné. Whelks
**Busycon* (*Fulgar*) *pyrum* Dillwyn

Family Muricidae

Purpura haemostoma. Oyster Drill Snail

Order Ctenobranchiata

Suborder Orthodonta

Family Muricidae

Ursosalpinx cinereus (Say). Oyster Drill
**Thais floridana* Conrad.

Suborder Streptodonta

Family Naticidae

Sigaretus perspectivus Say. Ear Shell

Family Janthinidae

Janthina communis. Violet Snail
Janthina globosa. Large Violet Snail

Suborder Pectinibranchiata

Family Turritellidae

Turritella varigata. Tower Shell

Family Cypraeidae

Cypraea gangraenosa Solander. Cowry

Family Littorinidae

Littorina irrorata. Littorine; Periwinkle
**Littorina ziczac* Gmelin
**Littorina angulifera* Lamarck

Family Crepidulidae

Crepidula plana. Slipper Shell

Family Naticidae

*Polinices duplicata Say. Moon Snail; Shark Eye.

Family Acmaeidae

Acmaea scabra Gould. Limpets
*Siphonaria lineolata Orbigny

Family Solariidae

Solarium granulatum Lamarck. Sun-Dial

Family Neritidae

*Nerita versicolor Gmelin

Class Cephalopoda

Order Dibranchiata

Family Sepiolidae

*Sthenotheuthis bartramii Lesueur. Squid

Family Loliguidae

Loligo brevipennis. Squid

Order Decapoda

Family Spirulidae

*Spirula spirula Linné. Spiral Shell

PHYLUM ARTHROPODA

Class Crustacea

Order Cirripedia

Family Lepadidae

*Lepas anatifera Linnaeus. Goose Barnacles
*Lepas pectinata Spengler.

Family Balanidae

*Balanus improvisus Darwin. Barnacles
*Balanus eburneus Gould.
Balanus balanoides.
Balanus glandula Darwin.

Order Amphipoda

Family Gammaridae

*Melita nitida Smith. Amphipod
*Gammarus, sp. Gammarus
Carinogammarus mucronatus. Scud

Family Talitridae

*Hyale hawaiensis (Dana). Amphipod
Orchestia agilis. Beach Flea; Beach Hopper

Family Amphithoidae

*Ampithoe, sp. Amphipods

Family Jassidae

*Jassa marmorata Holmes. Amphipod

Suborder Caprellidae

*Caprella acutifrons, Latr. Skeleton Shrimp; Aunt Fanny
Caprella, sp.

Order Isopoda

Superfamily Flabellifera

*Sphaeroma quadridentatum Say. Isopod; Wood Borer
Sphaeroma destructor.
*Ancinus, sp.

Superfamily Oniscoidea

*Ligyda exotica (Roux.) Isopod

Order Stomatopoda

Family Squillidae

Squilla (Chloridella) empusa. Mud Shrimp Mantis Shrimp

Order Decapoda

Family Penaeidae

*Penaeus aztecus Ives. Shrimp
Penaeus setiferus. Common Shrimp

Penaeus brasiliensis. Grooved Shrimp
Xylopenaeus kroyeri. Sea Bob

Family Palaemonidae

Palaemonetes vulgaris. Sargassum Shrimp; Grass Shrimp

Tribe Anomura

Family Paguridae

Pagurus hirsutiusculus. Hairy Hermit Crab
Pagurus pollicaris. Hermit Crab
Clibinarius vittatus. Green Hermit Crab
Holopagurus pilosus?

Family Lithodidae

Lopholithodes, sp. Box Crab

Family Hippidae

Emerita benedicti Schmitt. Burrowing Sand Crab
Hippa talpoida

Family Albuneidae

Lepidopa myops Stimpson. Spiny Sand Crab

Tribe Brachyura

Subtribe Oxystomata

Family Leucosiidae

Randallia ornata (Randall). Purple Crab

Subtribe Brachygnatha

Superfamily Oxyrhyncha

Family Inachidae

Oregonia gracilis Dana. Decorator Crab
Loxorhynchus, sp. Spider Crab

Superfamily Portunidae

Portunis xantusii (Stimpson)? Swimming Crab
Arenaeus cribrarius. Calico Crab
Ovalipes ocellatus. Lady Crab
Callinectes sapidus. Blue Crab

Family Grapsidae

Planes minutus Linnaeus. Pelagic Crab; "Shore Crab"

Family Ocypodidae

**Ocypode albicans* Bosc. Sand Crab
**Uca pugilator* (Bosc.) Fiddler Crab;
Uca minax. Sand Fiddler
Uca, sp.

Family Cancroidae

Menippe mercenaria. **Rock Crab**

Class Insecta

Cicindela dorsalis. Tiger Beetle

Staphylinid Scavenger Beetle

Hydrometra?, sp. Salt-Water Strider

Erax rufibarbus. Robber Fly

Tabanus, sp. Botfly; Horsefly
Tabanus costalis. Green-Eyed Fly

Musca domestica Linn. Housefly
Mormia, sp. Black Blowfly

PHYLUM ECHINODERMATA

Class Asteroidea

Order Phanerozonia

Family Astropectinidae

**Astropecten antillensis* Lutken. Sand Star;
Astropecten, sp. Starfish

Class Echinoidea

Order Demosticha (Regularia)

Family Arbacidae

**Arbacia punctulata* (Lamarck). Sea Urchin
Coeloplerus, sp.

Order Clypeastroida

Family Scutellidae

*Encope michelini (L. Agassiz). Sand Dollar; Key-Hole Dollar

PHYLUM CHORDATA

SUBPHYLUM VERTEBRATA

Class Elasmobranchii

Order Batoidea

Family Rajidae

Raja erinaceae Mitchill. Common Skate

Family Dasyatidae

Urobatis sloani (Blainville). Round Sting Ray

Class Pisces

Order Isospondyli

Family Megalopidae

Tarpon atlanticus (Cuvier and Valenciennes). Tarpon

Family Clupeidae

Brevoortia patronus (Goode). Gulf Menhaden

Order Colocephali

Family Muraenidae

Gymnothorax moringa (Cuvier). Spotted Moray

Order Synentognathi

Family Belonidae

Strongylura marina (Walbaum). Needle Fish

Order Thoracostei

Family Syngnathidae

Syngnathus floridae (Jordan and Gilbert). Pipe Fish
Hippocampus stylifer (Jordan and Gilbert). Sea Horse

Order Percomorphi

Family Mugilidae

Mugil cephalus (Linnaeus). Mullet

Family Cybiidae

Scomberomorus maculatus (Mitchill). Mackerel

Family Trichiuridae

Trichiurus lepturus (Linnaeus). Ribbon Fish

Family Carangidae

Vomer setapinnis (Mitchill). Moon Fish
Selene vomer. Lookdown
Trachinotus carolinus (Linnaeus). Pompano

Family Sparidae

Archosargus probatocephalus (Walbaum). Sheepshead
Calamus arctifrons (Goode and Bean). Porgy

Family Sciaenidae (Linnaeus)

Pogonias cromis (Linnaeus). Drum
Sciaenops ocellatus (Linnaeus). Redfish

Family Ephippidae

Chaetodipterus faber (Broussonet). Angel Fish
Chaetodon ocellatus Bloch. Butterfly Fish

Order Cataphracti

Family Triglidae

Prionotus pectoralis (Nichols and Breder). Sea Robin.

Order Plectognathi

Family Balistidae

Balistes capriscus Gmelin. Trigger Fish

Family Ostraciidae

Lactophrys tricornis (Linnaeus). Cow Fish

Family Diodontidae

Chilomycterus schoepfin (Walbaum). Spiny Boxfish

Family Tetraodontidae

Spheroides spengleri (Bloch). Swellfish; Blow Fish

Family Blenniidae

Rupiscartes atlanticus (Cuvier and Valenciennes). Rock Skipper

Order Pediculati

Family Antennaridae

Histrio histrio (Linnaeus). Sargassum Fish

Family Ogcocephalidae

Ogcocephalus vespertilio (Linnaeus). Bat Fish

Family Pleuronectidae

Paralichthys lethostigmus Jordan and Gilbert. Fluke

Paralichthys albiguttus Jordan and Gilbert. Gulf Fluke

Family Soleidae

Achirus lineatus (Linnaeus). Striped Sole

Class Aves

Hydranassa tricolor. Louisiana Heron

Ardea herodias. Great Blue Heron

Egretta thula. Snowy Egret

Catoptrophorus semipalmatus. Willet

Numenius longirostris Wils. Long-Billed Curlew

Larus atricilla. Laughing Gull

Sterna hirundo. Common Tern

Pelecanus occidentalis. Brown Pelican

PLANT KINGDOM

PHYLUM THALLOPHYTA

Sargassum fluitans Borg. Gulfweed
Sargassum natans (L.) Meyen. Gulfweed

Ulva lactuca L. Alga; Sea Lettuce

Cladophora fascicularis (Mertens) Kütz. Alga
Enteromorpha lingulata J. Ag. Alga
Padina pavoni J. Ag. Alga

PHYLUM SPERMATOPHYTA

Sporobolus virginicus. Rush Grass
Zostera marina. Eel Grass

Entada gigas. Large Sea Bean
Mucuna sloanei. Small Sea Bean.

VITA

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