FLORIDA.

STATE BOARD

OF

CONSERVATION.

TECHNICAL SERIES

Number 1-16

[Tallahassee]
1949 - 1956

STATE OF FLORIDA

BOARD OF CONSERVATION

CHARLIE BEVIS, *Supervisor*

TECHNICAL SERIES

NO. 8

A Survey of The Tampa Bay Area

by

CHARLES E. DAWSON, JR.

Division of Oyster Culture

Tallahassee

June, 1953

CONTENTS

Summary 5
Introduction 6
Methods 6
General Description of Tampa Bay 6
Area I 8
Salinity and temperature observations, biological observations, boundaries of pollution.
Area II 12
Salinity and temperature observations, biological observations, oyster growth, oyster leases, boundaries of pollution.
Area III 19
Salinity and temperature observations, biological observations, oyster leases, boundaries and pollution.
Area IV 23
Salinity and temperature observations, biological observations, oyster leases, boundaries and pollution.
History and Recent Production 31
Discussion 33
Bibliography 36
Appendix 37

FOREWORD

THE STATE OF FLORIDA produces a greater variety of salt water products, including game and food fish than any other part of the country. The total commercial catch is over 200,000,000 pounds, with a value of more than $39,000,000 and more than 75,000 persons are solely dependant upon the industry for their daily bread. The auxiliary occupations such as boat-building and the numerous persons indirectly and directly connected with the charter-boat and sports fishing greatly exceed this total and bring the actual value of the sea fisheries to a figure which probably exceeds $200,000,000.

The State Board of Conservation is charged with the supervision, conservation and development of this important industry. In order to carry out these responsibilities it is necessary to engage in research whereby accurate information is gained upon which may be based sound methods of scientific management and control such as those which have long existed in other states with salt water fisheries of lesser magnitude.

The result of all research conducted by the State will be published for the information and benefit of all concerned. It is hoped that this will lead to more intelligent appreciation of the State's saltwater resources as well as to the adoption of sound conservation measures, and to willing cooperation in their enforcement.

Additional copies for fishermen, schools, wild-life clubs, civic groups and individuals may be obtained from the Supervisor, State Board of Conservation, Tallahassee, Florida.

A list of publications in this series appears at the end of this book.

SUMMARY

1. A survey of the oyster resources together with observations on other biological and physical conditions of the inshore waters of Greater Tampa Bay was conducted during July and August, 1951.

2. The offshore waters were not examined, but it is possible that certain of these bottoms, particularly between depths of three and six feet, could prove suitable for commercial production. Cultch was generally absent and no evidence of oyster growth was noted in these depths.

3. Papys Bayou was the only locality with commercial production. The present production is estimated at approximately fifteen hundred bushels, but can readily be increased by the application of sound methods of oyster culture.

4. Salinity samples, though relatively high in the open waters, were all within the limits experienced in highly productive regions in Florida.

5. Temperature observations were all within the ranges common to inshore Florida waters during the months of July and August.

6. Oyster pests were widely distributed in Tampa Bay. The conchs *Melongena corona* and *Thais haemostoma floridana* were numerous throughout the region. The "leech" *Stylochus inimicus* was observed only in Papys Bayou, but this organism may be one factor responsible for the absence of commercial oysters in the open bay. The occurrence of these parasites may be associated with the high average salinities.

7. Throughout the region a scarcity of rocky bottom or natural cultch is probably the major reason for the absence of natural beds on bottoms below the low-tide mark. This is probably due indirectly to sedimentation consequent upon construction and industrial activity on the surrounding uplands.

8. A series of experimental oyster plots and a year-round study of the hydrographic conditions should be established in order that a more complete analysis of the potential oyster production can be made.

9. Construction of municipal sewage facilities and strict enforcement of the sanitary codes will be necessary if the extension of present pollution boundaries and the ultimate elimination of commercial oystering are to be prevented.

10. The stocks of commercial oysters in the pollution-free waters of Tampa Bay can be increased in Areas II, III and IV. Interested individuals can produce quality oysters in favorable portions of these Areas by following culture programs recommended by the Oyster Division.

INTRODUCTION

The Oyster Division, in a continuation of its established program of surveying the estuaries and protected inshore coastal waters of Florida, conducted a biological survey of Greater Tampa Bay during July and August, 1951. Oyster growth rate and further salinity and temperature observations were obtained from Papys Bayou until May, 1952.

The purpose of the survey was to examine the available oyster resources of the area, and to determine whether the existing oyster fishery could be expanded through the combined efforts of the Oyster Division and members of the industry. In addition to the study of the oyster resources, observations were made on the topography, salinity and temperature, and other pertinent biological and physical conditions throughout the area.

The original data on salinity, temperature and growth rate are too extensive to publish. Copies of this material, however, have been deposited in the library of the Marine Laboratory of the University of Miami and at the office of the State Board of Conservation.

A partial bibliography of geological, biological and hydrographic studies referring to Tampa Bay has been included as an aid to future investigators.

Grateful acknowledgement is made to all those who assisted in the conduct of the field work, and especially to Mr. L. F. Scott, General Agent, Florida State Board of Conservation, and Mr. J. W. Kirtsinger. The work was carried out under the direction of F. G. Walton Smith who also gave invaluable advice and assistance in preparing the report.

METHODS

The survey was conducted from both the shore and from shallow drafted skiffs. Bottoms were examined visually where depth permitted and by probing. Whenever practical a physical examination was made of exposed oyster bars.

Salinity was determined with a precision salinity hydrometer. Water temperature was determined with a Centigrade thermometer. Bottom samples were obtained with a Foerst water bottle.

Locations were in most cases determined from shore bearings or navigational aids.

GENERAL DESCRIPTION OF TAMPA BAY

Greater Tampa Bay includes, for the purposes of this survey, Old Tampa Bay, Tampa Bay, Hillsboro Bay, Boca Ciega Bay, Terra Ceia Bay, the Manatee River east to Redfish Point and all bays and tributaries adjoining these waters. It is located within Pinellas, Hillsborough and

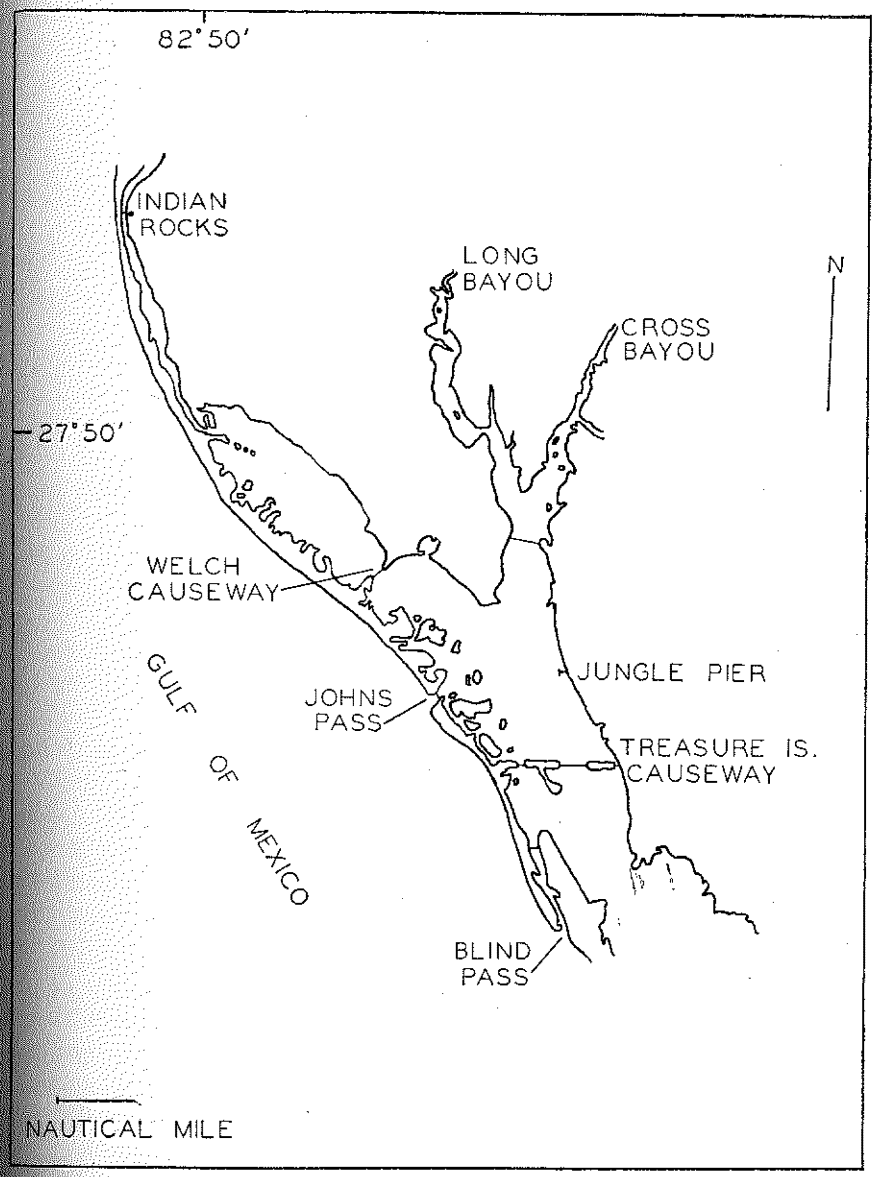

FIGURE 1. Area I—Boca Ciega Bay including Long Bayou and Cross Bayou.

Manatee Counties on the west coast of the state approximately 200 miles north of Cape Sable, the southwestern tip of the Florida peninsula.

Oriented in a north-northeasterly direction Greater Tampa Bay opens into the Gulf of Mexico to the southwest and has a maximum length of about 35 miles. It is relatively shoal, averaging less than 15 feet, and has an area of approximately 365 square miles.

The survey included all the inshore waters of Greater Tampa Bay with the exception of the shores of the Interbay Peninsula, the south portion of the Pinellas Peninsula and the waters between Piney Point and Cockroach Bay. The Interbay and southern Pinellas Peninsulas are the sites of concentrated municipal and industrial developments which preclude the successful prosecution of an oyster fishery in the adjacent waters. The Piney Point--Cockroach Bay area was omitted following difficulties in arranging for suitable transportation and guides. Local inhabitants report, however, that this shore is similar in all respects to that north of Cockroach Bay and south of Piney Point.

Since approximately 140 miles of coastal waters were included in the survey it is most convenient to establish four smaller subdivisions or *Areas*. These *Areas* will be described and the physical and biological observations within each will be treated separately.

AREA I

Boca Ciega Bay from the Indian Rocks Bridge south to the Blind Pass Bridge and the Corey Causeway, and including Long Bayou and Cross Bayou. (See Figure 1.)

Boca Ciega Bay connects directly with the Gulf of Mexico through Johns Pass and Blind Pass. To the north it continues into Clearwater Bay, and south of the Corey Causeway it opens into Tampa Bay and the Egmont and Pass-a-Grille channels. The Intracoastal Waterway has been dredged through this area to a controlling depth of five feet at mean low water. Aside from this channel the average depth of these waters is approximately 2.5 feet.

A few man-made clearings were noted along the eastern shore of this Area, but in general the banks are fringed with the dense mangrove swamp typical along the lower Florida coasts. A few small tidal marshes were noted at the entrance to Long and Cross Bayous. The waters within these bayous shoal rapidly from about three feet at the entrance to less than one foot in their upper reaches. A shallow (2 to 3 ft.) canal has been cut through Cross Bayou and across the St. Petersburg peninsula. A dam has been built across Long Bayou about 1.75 miles from its mouth, and a large shallow body of fresh water, Lake Seminole, has been impounded to the north of the dam.

The western shores of the Area present a distinctly contrasting picture. An increasing demand for real estate along the beaches has resulted in extensive dredging and pumping operations. Land areas, large enough for housing subdivisions were being built on what was formerly shallow bay bottom. At least three dredges were in operation during the period of this survey. Many of the islands along the west shore were being enlarged, and the channels between the islands and the beach mainland were being filled-in. Although there were still some scattered stretches of mangrove, it appeared that these would soon succumb to the land building program.

The mangroves, which once formed an almost unbroken thicket about the shores of Tampa Bay, are a natural filter of sediment. The extensive root systems retard the seaward movement of upland sediment and thereby do much to prevent the filling-in of the open bay bottoms.

The bottoms of the open bay consisted mainly of moderately firm mud and mixtures of mud and sand. The bottoms of Long and Cross Bayous were largely of brown or grey mud, but several areas of hard packed sand were also noted. Rock bottom was found only in a few small patches near the Indian Rocks Bridge.

Salinity and Temperature Observations

Eighty-four surface and nineteen bottom salinity observations were made in this area. Surface salinities ranged from a minimum of 30.9 ‰ to a maximum of 37.6 ‰, with an average of 35.5 ‰. Bottom observations ranged between 35.1 ‰ and 37.2 ‰. The average bottom salinity was 35.9 ‰. The maximum observed difference between simultaneous surface and bottom observations was 00.9‰. The average difference was 00.3 ‰. Repeated surface observations were made at two stations. The average and range is shown in Table 1.

TABLE 1

Station	No. Obs.	Salinity Range In o/oo	Average Salinity In o/oo	Temperature Range °C.	Average Temperature °C.
Indian Rocks Bridge	4	35.0-36.6	36.0	29.0-30.5	29.5
Intracoastal Mkr. No. 4	5	35.3-37.6	36.8	29.5-30.5	29.9

Observed surface temperatures ranged between 27.5°C. and 33.0°C. with an average of 29.7°C. Bottom temperatures lay between 29.0°C. and 31.0°C. and averaged 29.7°C.

TABLE 2

12-HOUR SERIAL SALINITY AND TEMPERATURE OBSERVATIONS

Station	Date	Salinity Range In o/oo	Average Salinity In o/oo	Temperature Range In °C.	Average Temperature In °C.
W. Bridge Treasure Island Causeway (S)	7-9-51	35.3-36.4	35.8	28.0-30.0	29.3
W. Bridge Treasure Island Causeway (B)	7-9-51	35.3-36.3	35.8	28.0-30.0	29.2
Welch Causeway (S)	7-11-51	36.4-37.5	37.1	28.0-31.5	30.0
Jungle Pier (S)	7-12-51	33.4-37.9	36.3	29.0-31.5	30.6

S—Surface sample.
B—Bottom sample.

Serial salinity and temperature observations over 12-hour periods were obtained at three stations: West Bridge of the Treasure Island Causeway, Welch Causeway, and the Jungle Pier. The data obtained from these series are presented in Figures 2, 3, 4, and Table 2.

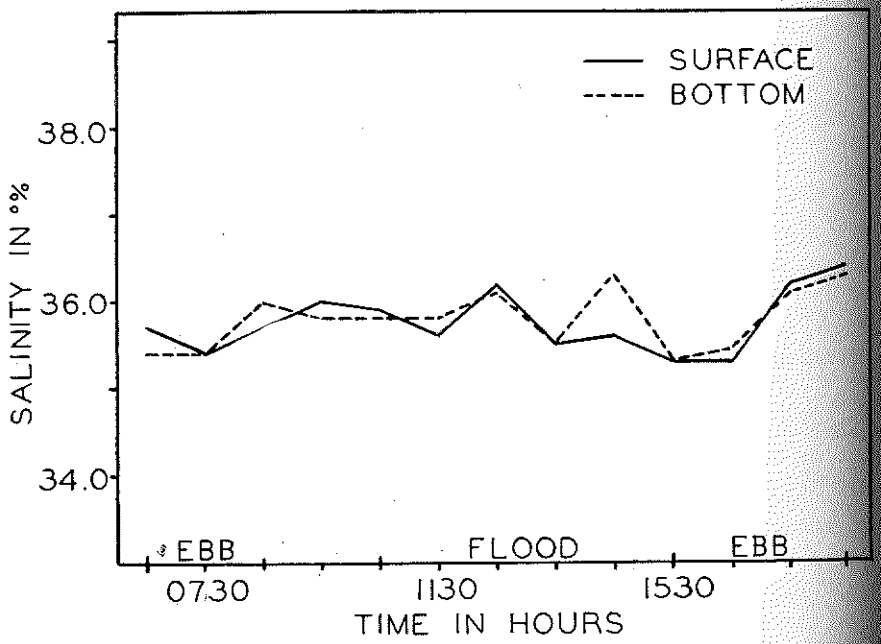

FIGURE 2. 12-hour salinity series, surface and bottom, at West Bridge of the Treasure Island Causeway. July 9, 1951.

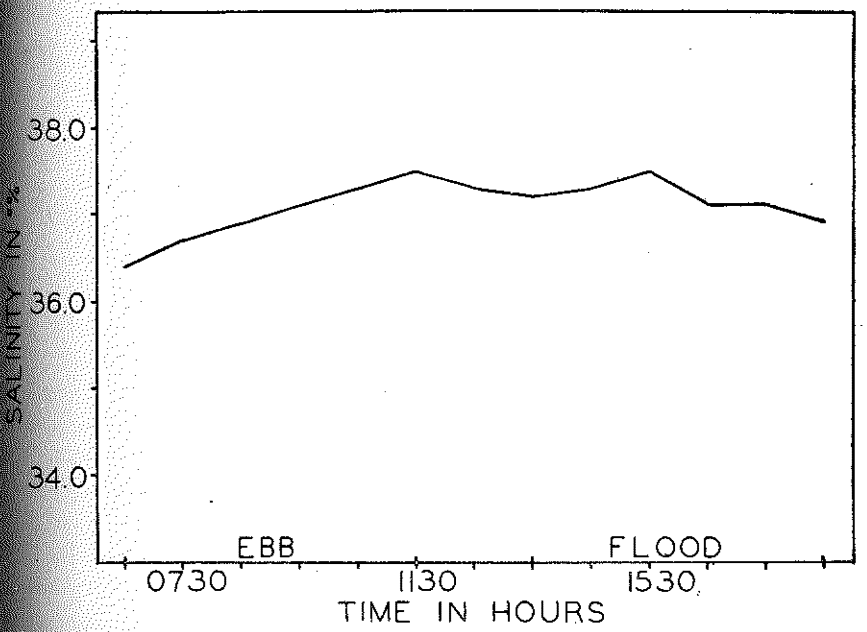

FIGURE 3. 12-hour salinity series, surface only, at Welch Causeway. July 11, 1951.

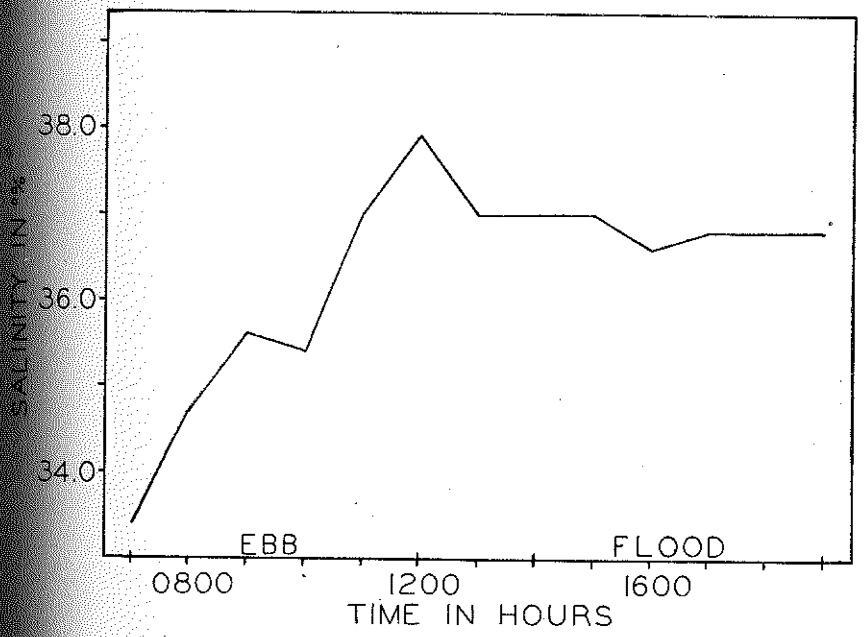

FIGURE 4. 12-hour salinity series, surface only, at Jungle Pier. July 12, 1951.
FIGURE 5. Area II—Smacks Bayou and Papys Bayou.

Biological Observations

No oysters of commercial size and quality were observed in Area I. A small number of coon oysters were found in the waters between the Indian Rocks Bridge and the Corey Causeway. These were generally less than 2.5 inches long, and were located on small bars or clumps so situated as to be exposed for long periods during the normal tide cycle. Heavy mortality, up to 75%, was evident in almost every case. A limited set of coon oysters was observed on sea walls, but, in many cases, piling and other objects placed in the water during the past two years supported no oyster growth.

Small isolated clumps of stunted coon oysters were found along the east shore to the north and south of the entrance to Long and Cross Bayous. These had suffered at least a 50% mortality and were daily exposed for several hours. A long narrow coon bar extended from the south shore to about three-quarters of the distance across the entrance to the bayous. A number of smaller bars were found along both sides of the bayou and scattered small lumps were located in the vicinity of the Seminole Bridge. Northeast of the railroad bridge both bayous were criss-crossed with numerous large coon bars which, as one proceeded up the bayous, were gradually replaced by small lumps and fringing bars. A limited set of small oysters was noted upon mangrove roots in the bayous. Practically all the oyster bars within these bayous were subject to long exposure during the tide cycle. The oysters were similar to those found in the open bay and were present in considerable numbers. The proportion of live to dead oysters was consistently greater than on the outside bars.

The conchs *Thais haemostoma floridana* and *Melongena corona* were present in considerable numbers on all oyster bars throughout this Area. On one small bar more than thirty conchs, ranging from one to five inches long, were counted within a circle six feet in diameter. The following animals were also noted in some numbers during the survey: *Busycon perversum, Fasciolaria tulipa, Pecten gibbus, Mennipe mercenaria, Lytechinus variegatus and Limulus polyphemus.*

Boundaries of Pollution

All the waters of Long and Cross Bayous are contaminated and are closed for the taking of oysters by the Florida State Board of Health.

AREA II

Smacks Bayou and Papys Bayou on the east side of the Pinellas Peninsula. The shore between these bayous and from Papys Bayou north to the Gandy Bridge. (See Figure 5.)

Between Papys Bayou and the Gandy Bridge there was a chain of typical mangrove keys separated from each other and from the mainland by a

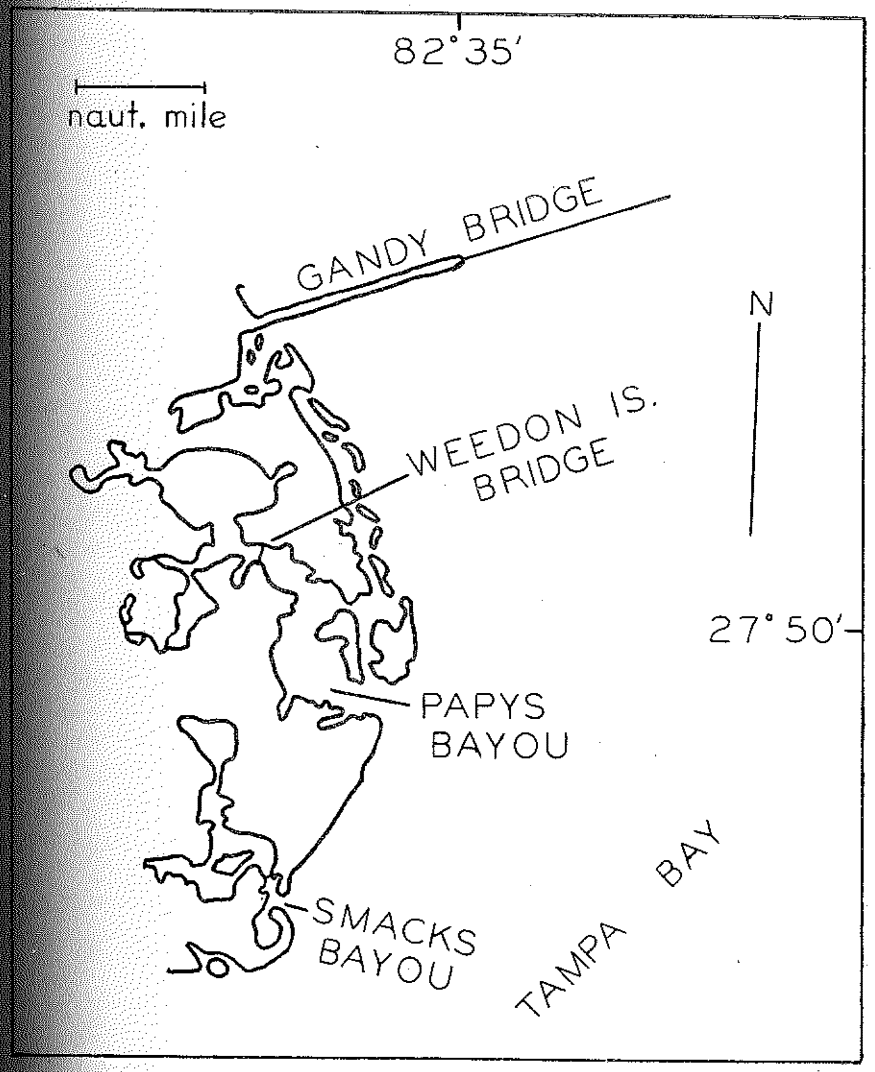

FIGURE 5. Area II—Smacks Bayou and Papys Bayou.

complex system of shallow channels. These channels had an average depth of 1.5 feet at low water, and the bottoms consisted mainly of hard-packed sand. To the east of these keys shallow sand flats extended from one to two miles offshore.

Papys Bayou consisted of several large basins joined by narrow channels. Several streams and drainage canals emptied into the bayou from the high land to the west. Except for a small stretch just west of Mermaid Point where a number of homes had been built, the shores of the bayou

were lined with almost unbroken stretches of mangrove. A channel of from 8 to 15 feet deep extended about one mile west of Mermaid Point. Throughout the bayou the average depth was about 2.5 feet but occasional holes, up to 15 feet in depth, were observed. From the mouth of the bayou west to the Weedon Island Bridge the bottoms consisted mainly of packed sand but small stretches of mud and of broken shell were also present. To the west of the bridge mud replaced the sand and was the predominant bottom in the upper channels and basins.

The exposed shore between Papys and Smacks Bayous was being developed for homesites, but some of the natural mangrove still remained near Mermaid Point. The bottoms in this region gradually sloped to a depth of about two feet and consisted principally of packed sand with limited amounts of grey mud restricted to the borders of occasional coon bars.

Smacks Bayou, though smaller than Papys Bayou, presented a similar system of connected basins. This is a very desirable real estate area and there had been considerable home construction on both north and south shores near the mouth of the bayou. The remaining shores were covered with a dense growth of mangrove. The small bay southeast of the Smacks Bayou Bridge had been recently dredged and the bottom here consisted of sticky grey mud. The remaining bottoms of this bayou were mainly of sand with small patches of mud confined to the vicinity of some coon bars along the edge of the mangrove.

Salinity and Temperature Observations

Thirty-seven surface and ten bottom salinity observations were made in Papys Bayou during the survey. Surface salinities averaged 20.0 ‰ and ranged from 26.0 ‰ to 30.2 ‰. Bottom salinities ranged between 29.2 ‰ and 29.8 ‰ and averaged 29.5 ‰. The maximum difference between surface and bottom observations was 1.9 ‰. Bottom salinities averaged 0.3 ‰ higher than the concurrent surface observations.

Nine surface and three bottom samples were taken in Smacks Bayou. Surface salinities averaged 29.5 ‰ and ranged from 29.0 ‰ to 30.1 ‰. Bottom observations averaged 29.3 ‰ and ranged from 29.1 ‰ to 29.5 ‰. Maximum difference between surface and bottom observations was 0.4 ‰ while the bottom salinities averaged 0.1‰ higher than the concurrent surface observation.

Eight surface salinity observations were made between Smacks and Papys Bayous and among the mangrove keys north to the Gandy Bridge. These ranged from a maximum of 29.7 ‰ to a minimum of 28.9 ‰. The average salinity was 29.2 ‰. Depth sufficient for a bottom sample was found at one station. Here the surface and bottom salinities were 29.7 ‰ and 30.3 ‰ respectively.

Repeated samples were obtained at three stations as shown in Table 3.

TABLE 3

Station	No. Obs.	Salinity Range In o/oo	Average Salinity In o/oo	Temperature Range °C.	Average Temperature °C.
Papys Bayou. Oyster House (S)	14	26.0-30.0	28.6	.....*	..*
Weedon Island Bridge (S)	3	29.6-29.8	29.7	27.5-30.0	28.8
Weedon Island Bridge (B)	3	29.4-29.8	29.6	27.5-30.0	29.0
Mermaid Point (S)	4	29.2-29.5	29.3	28.0-31.5	29.9
Mermaid Point (B)	4	29.3-29.7	29.5	28.0-32.0	29.8

*Laboratory determinations.
S—Surface samples.
B—Bottom sample.

Surface temperatures ranged from 27.0°C. to 31.5°C. with an average of 29.6°C. Bottom temperatures lay between 27.5°C. and 32.0°C. and average 29.5°C.

In addition to the samples taken during this survey the Oyster Division has obtained 38 salinity observations from the dock of the Papys Bayou Oyster House. These observations were made during the period from April, 1950 to July, 1952. When combined with the samples from this station during the present survey the salinity observations range from 24.0 ‰ to 31.2 ‰. The mean salinity is 29.6 ‰ and the standard deviation 0.4‰. Temperature figures are not significant since, in most cases, salinities were determined in the laboratory.

TABLE 4
12-HOUR SERIAL SALINITY AND TEMPERATURE OBSERVATIONS

Station	Date	Salinity Range In o/oo	Average Salinity In o/oo	Temperature Range In °C.	Average Temperature In °C.
Weedon Island Bridge (S)	7-18-51	29.2-29.9	29.6	28.0-30.0	29.1
Weedon Island Bridge (B)	7-18-51	29.5-30.1	29.7	28.0-30.0	29.1

S—Surface sample.
B—Bottom sample.

The results of a 12-hour serial observation at the Weedon Island Bridge are shown in Table 4 and Figure 6.

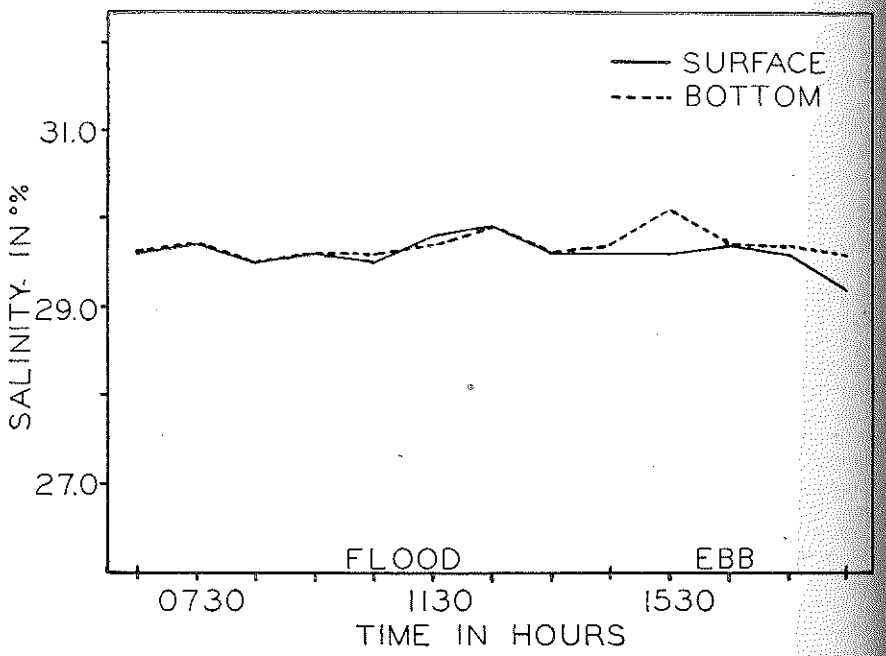

FIGURE 6. 12-hour salinity series, surface and bottom, at Weedon Island Bridge. July 18, 1951.

Biological Observations

A limited number of small coon oysters were found fringing the mangrove islands to the north of Papys Bayou. No oysters were observed on the offshore bottoms nor in the occasional deep holes to be found in the inshore channels. Although not crowded, the oysters appeared to be stunted and only a small portion of each bar consisted of live individuals. Practically all bars were so located as to be about 85% exposed on normal low water.

From the entrance to Papys Bayou westward to within approximately one-half mile of the Weedon Island Bridge similar conditions prevailed. From this point and up to the bridge an entirely different situation was found. Although there was a considerable amount of barren sand bottom, oysters were observed in relatively large numbers. Coon bars, as usual, fringed the shore and in some instances extended well into the bayou. In deeper water, 4-5 feet toward the middle of the bayou, oysters of commercial quality were observed in some numbers. Those examined ranged in length up to five inches with the average being estimated at approximately 3.5 inches. Although some crowding was in evidence, these oysters were generally well formed and appeared in good condition. The greater portion of these high quality oysters were located on leased bottoms. To the north of the Weedon Island Bridge and over the remainder of Papys Bayou the typical conditions, exposed, fringing coon bars and large areas of more or less barren bottom, were resumed.

The conchs *Melongena* and *Thais* were numerous on all oyster bars examined. The boring sponge *Chiona sp.* was observed on oysters taken from the deeper beds in Papys Bayou. The following animals were also noted in this Area: *Busycon perversum, Fasciolaria tulipa, Callinectes sapidus,* and *Echinaster sentus.*

The "leech" *Stylochus inimicus* was found in oysters taken from Papys Bayou during the 1952-53 oyster season. Shuckers in the oyster houses reported that up to ten oysters per bushel were infected by this pest.

There were considerably fewer coon bars in Smacks Bayou than had been observed elsewhere in Area II. A relatively good set of one to two and one-half inch oysters was noted on bridge abutments and on the mangrove roots.

Aside from the conditions on the leased beds, most of the coon bars examined were similar in that less than 50% of each was composed of live oysters.

Oyster Growth

In conjunction with the state-wide growth studies conducted by the Oyster Division, a growth-rate station was established in Papys Bayou in February, 1952. This location was chosen in view of its accessibility and

TABLE 5
PAPYS BAYOU GROWTH TRAYS

Tray	Date	Size Range In mm.	No. Individuals	Average Length In mm.	Increment In mm.	Weekly Increment In mm.
	2-25-52	17.0—41.0	30	30.8	. .	. . .
1.	3-27-52	19.0—48.0	30	35.2	4.4	1.08
	5-16-52	23.0—55.0	30	42.9	7.7	1.08
	2-25-52	41.0—59.0	48	49.0	. .	. . .
2.	3-27-52	42.0—63.0	48	51.6	2.6	0.60
	5-16-52	47.0—68.0	46	56.4	4.8	0.67
	2-25-52	55.0—72.0	45	62.5	. .	. . .
3.	3-27-52	55.0—72.0	45	64.5	2.0	0.46
	5-16-52	55.0—78.0	45	69.0	4.5	0.63
	2-25-52	72.0—90.0	30	80.9	. .	. . .
4.	3-27-52	74.0—93.0	30	82.0	1.1	0.25
	5-16-52	75.0—93.0	30	82.5	0.5	0.07
	3-27-52	87.0- 107.0	25	97.2	. .	. . .
5.	5-17-52	87.0- 108.0	24	98.3	1.1	0.15
	2-25-52	103.0- 117.0	18	110.5	. .	. . .
6.	3-27-52	103.0- 123.0	18	111.0	0.5	0.11

the successful growth of the native oyster population. Plans for the year-round maintenance of this station were abandoned in May 1952, because of excessive fouling of the experimental oysters by spat and other organisms. The results based on the limited number of measurements taken before abandonment are shown in Table 5, and Figure 7. The extensive fouling may have been responsible for the reduced growth-rate as compared to that at Apalachicola.

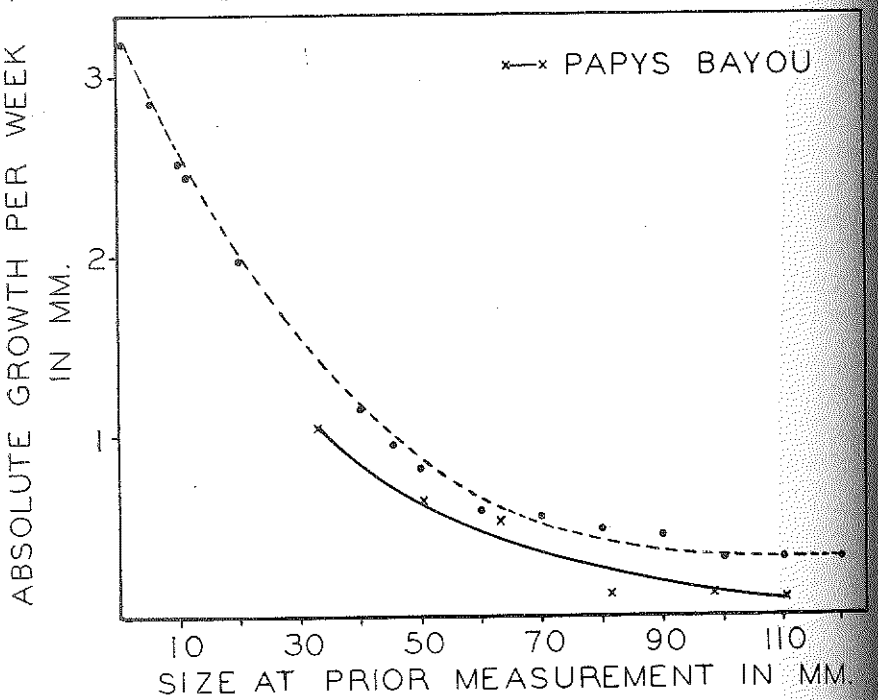

FIGURE 7. Average growth of Papys Bayou oysters compared to that of oysters at Apalachicola, Fla.

Oyster Leases

Six leased oyster beds totalling 31.53 acres were located in Papys Bayou. Only two leases, however, a total of 11.36 acres have been cultivated and in production during recent years. In 1952 these bottoms supplied the needs of two small oyster houses in St. Petersburg, but the total annual production is estimated at less than 1,000 bushels. The remaining four leases were virtually abandoned. They were neither cultivated nor fished and in most cases were improperly posted.

Boundaries of Pollution

Smacks Bayou is closed for the taking of oysters by the Florida State Board of Health.

AREA III

Old Tampa Bay from the west fill of the Gandy Bridge to the eastern end of the Davis Causeway. Included are the waters of Cooper Bayou, Safety Harbor, Mobbly Bay and Double Branch Bay. (See Figure 8.)

Old Tampa Bay is located between the Pinellas and Interbay Peninsulas. The maximum depth is approximately twenty-two feet and the average

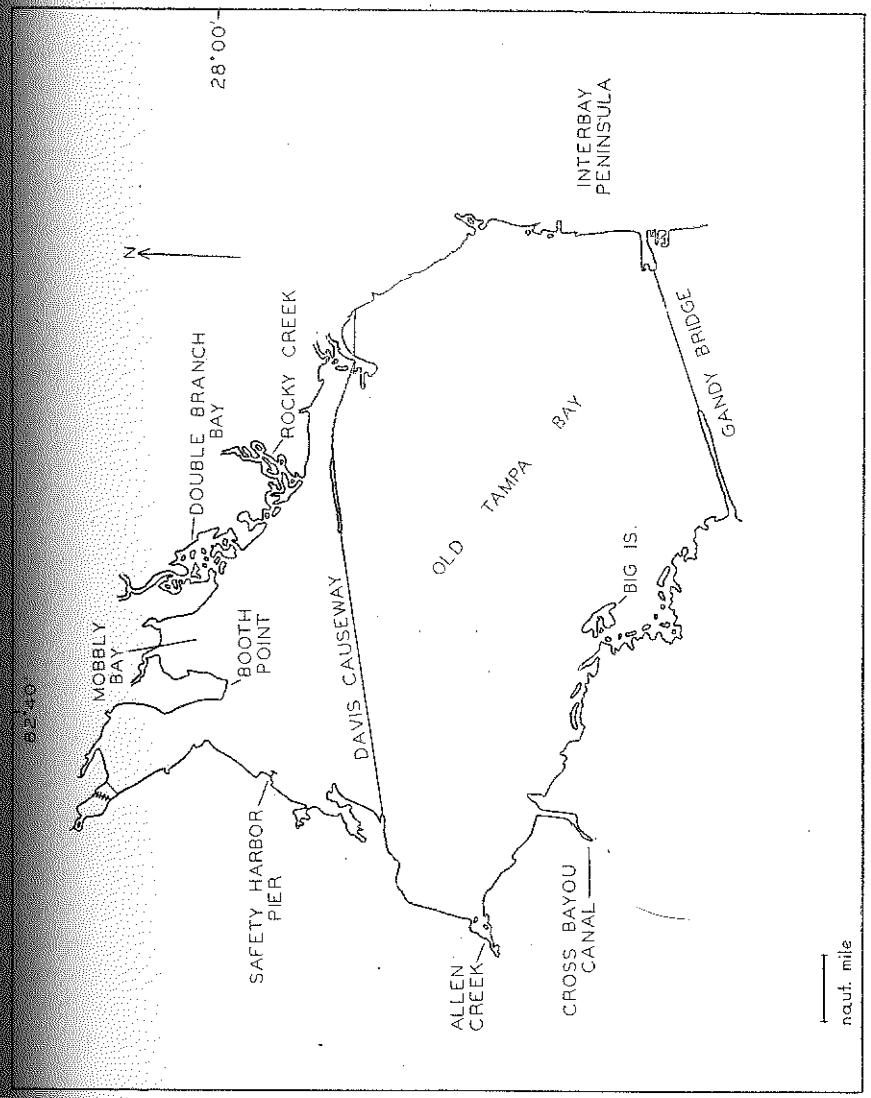

FIGURE 8. Area III—Old Tampa Bay from the west fill of the Gandy Bridge to the eastern end of the Davis Causeway.

is estimated at 12 feet. Roughly parallel to the shore are extensive areas of sand bottom which, except for the inshore regions, are at an average depth of four feet and may extend a distance of two miles offshore before reaching the six foot contour.

Between the Gandy Bridge fill and Big Island the shoreline was broken by many small bays and numerous mangrove islands. This region was uninhabited and supported a dense and unbroken mangrove thicket. These waters were very shoal and no deep channels were located. The bottoms along this inshore area were mainly of sand or mixed sand and mud. Mud bottom was found at the west end of the large bay southwest of Big Island.

Similar conditions were found from Big Island north to the Cross Bayou canal. This is the east end of the dredged channel previously mentioned in Area I. The mangrove had been cleared for about 1.5 miles south from the canal mouth to provide access to the nearby Pinellas Airport.

From the canal north to Allen Creek the shore is higher and the mangrove is almost completely replaced by pine land. Long stretches of sand beach were also noted. Although some grey mud was found in the upper reaches of Allen Creek, sand and mixed mud and sand were the predominant bottoms. Shoal water continued in this region.

A few houses were noted between Allen Creek and the Davis Causeway. The shore consisted of sand beach spotted with occasional mangrove clumps. Depth and bottom type were unchanged.

The shore of the west fill of the Davis Causeway was typically sandy with isolated clumps of mangrove. Narrow channels paralleled the fill on both north and south. Shoal water, sand bottom, and dense mangrove were the prevalent conditions north to Alligator Creek. This creek had been dammed and was a spillway for a fresh water lake above the dam.

From Alligator Creek north to Phillippi Point scattered mangrove and sand beach lined the shore. Beyond Phillippi Point to the railroad bridge across Safety Harbor dense mangrove was common. The bottoms were generally of sand, but small patches of mud were occasionally noted. The waters remained shoal and this factor prevented investigation of the area north of the bridge.

Mangrove thickets fringed the shores south to within a half-mile of Booth Point. Here the land had been cleared and was the site of a recently built electric power plant. Shallow sand flats extended southward from Booth Point for about a half mile, and much of these were exposed at low water. Depth and bottom types over the remainder of the region continued unchanged.

Two small creeks were found to empty into Mobbly Bay, and the

shores of the bay were fringed with dense mangrove. Some grey mud was noted in the creeks, but the remainder of the shallow bay bottom was principally sand.

Double Branch Bay was a large bay studded with numerous mangrove keys and fringed with dense mangrove. A few deep channels were noted, but the average depth was about 1.5 feet. Although some mud and shell were found the bottoms were generally of sand.

The remainder of the area surveyed consisted of the typical mangrove shore together with shoal and sandy bottom. Some mud and an occasional deep, up to 6 foot, channel were observed, however.

Salinity and Temperature Observations

Twenty-one salinity observations were made between the Gandy Bridge and the Davis Causeway. These ranged from 25.3 ‰ to 29.8 ‰ and averaged 27.9 ‰. Two bottom samples obtained in this region averaged 26.6 ‰, and each differed with the concurrent surface observation by 0.1‰.

Twenty-eight surface samples were taken over the remainder of this area. Surface salinities ranged from 13.3 ‰ to 27.1 ‰. The salinity of 13.3 ‰ and another of 14.8 ‰ were recorded from entrances to Alligator and Bishop Creeks, both of which drain large quantities of fresh water into the bay. Since these do not represent the normal conditions found in this area, they have been omitted in figuring the average surface salinity of 25.2 ‰. A single bottom salinity was obtained and was recorded at 26.4 ‰. The simultaneous surface salinity was 25.9 ‰.

Surface temperatures ranged from 26.0°C. to 31.5°C. and averaged 28.6°C. The bottom temperatures averaged 27.6°C.

TABLE 6

12-HOUR SERIAL SALINITY AND TEMPERATURE OBSERVATIONS

Station	Date	Salinity Range In o/oo	Average Salinity In o/oo	Temperature Range In °C.	Average Temperature In °C.
Safety Harbor Pier (S)	7-27-51	24.8-26.3	25.9	28.0-32.0	29.9
Safety Harbor Pier (B)	7-27-51	26.1-26.5	26.3	28.0-30.5	29.3

S—Surface sample.
B—Bottom sample.

One 12 hour salinity and temperature series was obtained from the Safety Harbor Pier. The observations are presented in Table 6 and Figure 9.

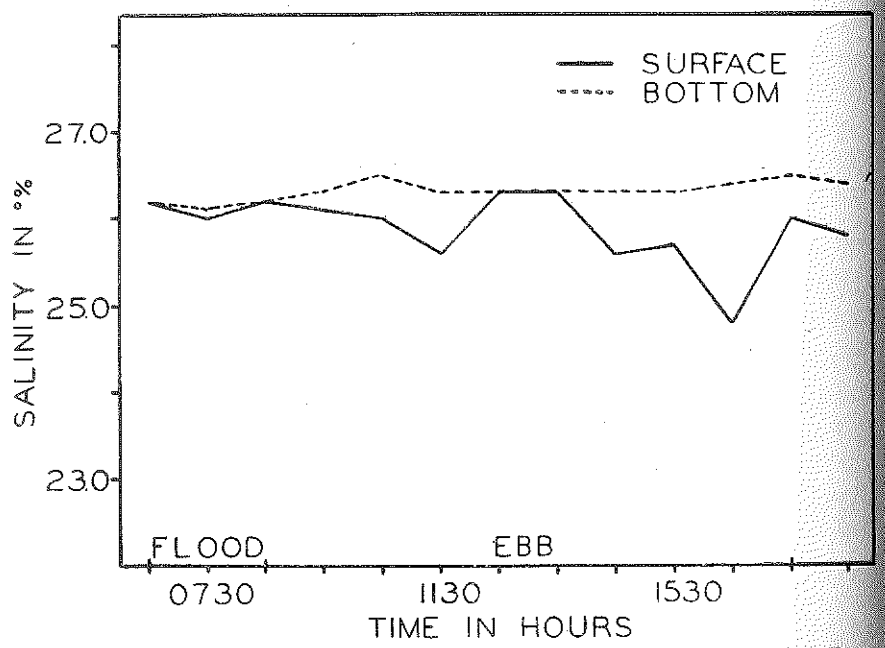

FIGURE 9. 12-hour salinity series, surface and bottom, at Safety Harbor Pier, July 27, 1951.

Biological Observations

Numerous small coon bars were noted from the Gandy Bridge north to Big Island. An estimated sixty percent of each bar consisted of old shell and dead oysters.

In the large bay southwest of Big Island coon bars of a similar type were common. In this case, however, a small number of commercial quality oysters were found in the deeper water surrounding the bars. These were well formed single oysters, up to four inches in length, and were usually found about half buried in the mud or sand bottom. These oysters were limited in numbers and apparently confined to the bottoms surrounding coon bars.

From Big Island north to Allen Creek the size and number of coon bars gradually diminished until, at the mouth of Allen Creek, only small scattered lumps were observed. The percentage of live oysters on each bar diminished toward the north until, on bars opposite the Pinellas Airport, almost no live individuals could be found. In the vicinity of Allen Creek, however the lumps were composed mainly of live oysters. Oysters were scarce from here north to Cooper Point and were confined to a few scattered coon bars of small extent. A set of small oysters was noted on the mangrove in Cooper Bayou.

Several completely dead coon bars were found in the vicinity of Alligator Creek and northward to Safety Harbor. This mortality appears to have resulted from sand silting over the bars and the flow of fresh water from Alligator Creek.

Coon oysters in small clumps were present in limited numbers northward to the railroad bridge and southeastward to Booth Point. Several isolated offshore coon bars were noted south of Booth Point. These bars, however, were approximately 80% exposed at normal low tide and supported few live oysters.

Typical small, largely dead scattered coon bars prevailed throughout the remainder of Area III. A small quantity of commercial quality oysters was found in a deep (6 foot) hole adjacent to a coon bar in Rocky Creek. A moderate set of small oysters was observed on mangrove roots throughout this region.

Conchs were found throughout this Area in greater numbers than elsewhere in Tampa Bay. The bay southwest of Big Island appeared to be most heavily attacked. A rough count of twenty-three conchs on a clump of coon oysters, less than one foot in diameter, was made in this bay. No portion of the Area was found to be free of these oyster pests. Moderate numbers of *Busycon perversum*, *Limulus polyphemus* and *Callinectes sapidus* were also noted within the Area.

Oyster Leases

The one oyster lease in this region was located on the west side of Old Tampa Bay just north of the Davis Causeway fill. This lease was improperly posted and had an area of 35.6 acres. The lessee stated that he had never taken any oysters from these bottoms, nor had he cultivated it at any time. A careful examination of the lease showed that the bottoms were almost entirely barren of oysters. No trace of any bar was found and only a small amount of dead shell was tonged from the lease.

Boundaries of Pollution

The Florida State Board of Health does not report any of these waters as being closed to the taking of oysters.

AREA IV

Hillsboro Bay and Tampa Bay from the McKay Causeway south to Cockroach Bay and from Piney Point south to the Braden and Manatee Rivers. (See Figures 10 and 11.)

Hillsboro Bay is located between the Interbay Peninsula on the west and the mainland of Hillsborough County on the east. The maximum depth is approximately 25 feet and the estimated average depth is 10 feet. A number of channels have been dredged through the bay, the deepest of

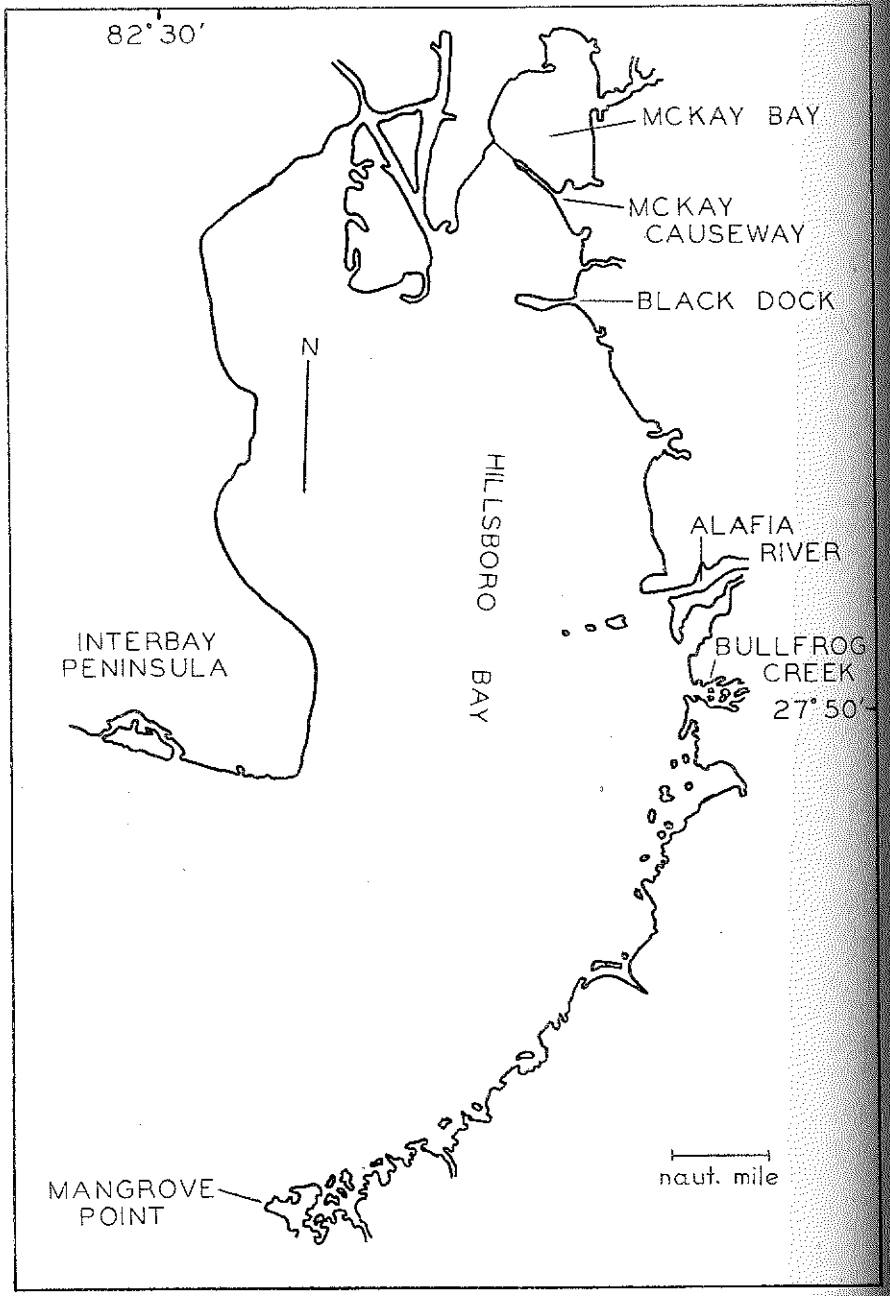

FIGURE 10. Area IV—McKay Causeway south to Mangrove Point.

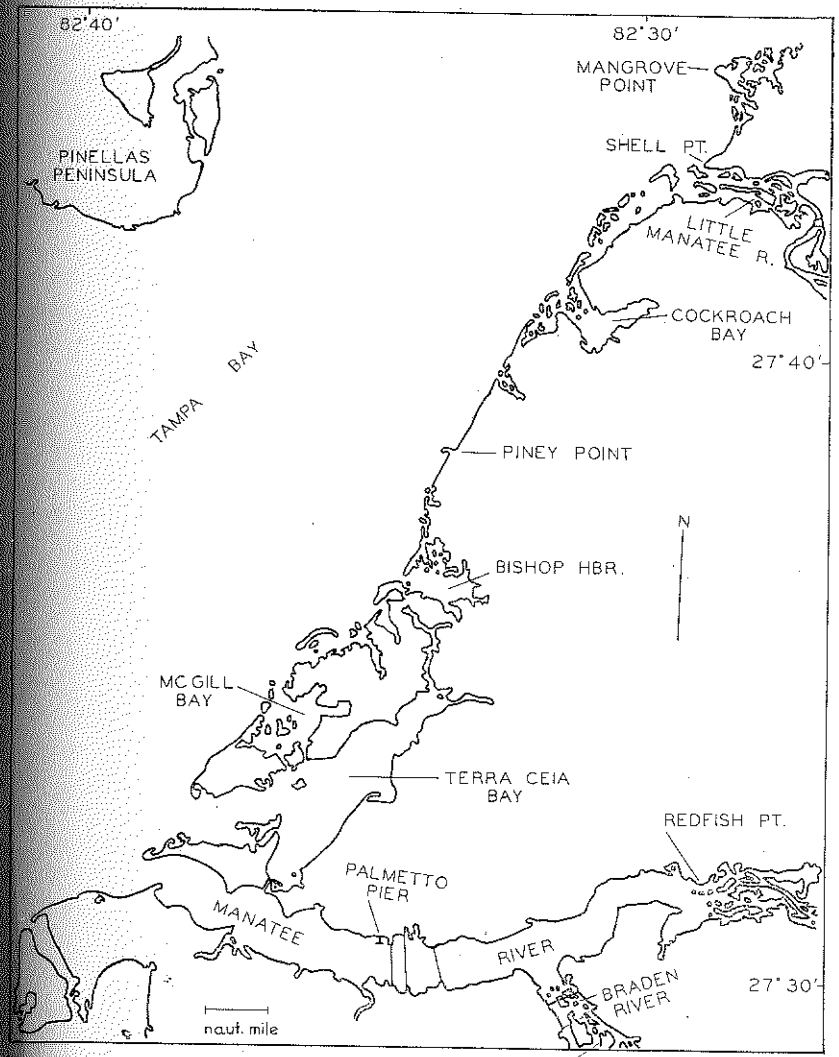

FIGURE 11. Area IV—Mangrove Point south to Manatee and Braden Rivers.

which is the main ship channel to Tampa Harbor with a controlling depth of 24.5 feet. The six foot depth contour was usually located about one mile offshore. The bottoms along the east shore of the bay were generally of sand and had an estimated average depth of 2.5 feet.

From the northwest end of the McKay Causeway south to Delaney Creek the shore was of sand with some scattered small rock along the causeway fill. Dense mangrove was prominent along the banks of Delaney Creek. The waters were shoal and, except for limited amounts of grey

mud in this creek, the bottoms were of fine sand. A large sand-spit, known locally as "Black Dock", was located approximately one-half mile south of Delancy Creek.

Shoal water prevented inshore observation between "Black Dock" and the mouth of the Alafia River. The offshore bottoms were of sand with occasional patches of grey mud, and the shore was a sand beach broken by a few clumps of mangrove. A phosphate plant was located on the north bank at the mouth of the Alafia River. The examination of the river was terminated at the first railroad bridge.

The shore from the Alafia River south to Shell Point was lined with dense mangrove. Offshore the character of the bottom remained unchanged; shoal water over predominantly sand bottom. Considerable amounts of sticky dark grey mud were noted in the Alafia River and Bullfrog Creek.

The survey of the Little Manatee River was terminated at the first railroad bridge. The shores were covered with dense mangrove as were the numerous islands within the river. Although a few deep channels were present, the waters were generally shoal. Mud bottom was predominant.

Dense mangrove lined the shores of Little Cockroach and Cockroach Bays. These waters had an average depth of about 2.5 feet. In Little Cockroach the bottoms were mainly of sand, whereas mud was most common in Cockroach Bay.

Few houses or other signs of settlement were noted between the McKay Causeway and Cockroach Bay. Those houses and business establishments present were generally located along the rivers and near the highway bridges.

Inshore observation between Piney Point and Bishop Harbor was prevented by shoal water. The bottoms were of sand and no unusual geographic conditions were observed. Bishop Harbor had a maximum observed depth of 3 feet. Dense mangrove along the shores and islands and predominantly sand bottoms were noted. Similar conditions with respect to shore cover, depth and bottom type were found from Bishop Harbor to McGill Bay.

The central basin of Terra Ceia Bay had an average depth of approximately nine feet, and the bottoms were mainly of hard packed sand. Shoal water over sand bottom extends some distance offshore about the entire bay. A small patch of rock bottom was found off the SE point of Terra Ceia Island.

The shores near the mouth of the Manatee River were lined with the typical dense mangrove. Upstream, however, the shores were occupied by the towns of Palmetto, Bradenton, Manatee and Ellenton. Signs of habitation and industry were soon lost east of Ellenton on the north bank, and

on the south there were few buildings east of the Braden River. East of Ellenton and the Braden River the shores of the Manatee and the included islands were densely covered with mangrove. The survey of this river terminated in the vicinity of Redfish Point. A channel from the mouth of the river to Rocky Bluff, approximately one and one-half miles north of Ellenton, had a controlling depth of seven feet and a recorded maximum of twenty-two feet. Extensive areas of shoal water followed both shores. West of Palmetto the shore and the inshore bottoms were generally of sand. East of Palmetto grey or black mud was the most common bottom although a few large sand bars were observed. Bottoms within the channel were of sand or hard-packed mud.

The shore, islands and bottom-type of the Braden River were similar in all respects to that of the Manatee River east of Ellenton. The average depth was four feet. The survey of the Braden River terminated at an abandoned bridge approximately one mile from its mouth.

Salinity and Temperature Observations

A total of sixteen salinity samples were obtained between the McKay Causeway and the islands to the south of the Alafia River Channel. These ranged from 6.4 ‰ at the river mouth to 22.4 ‰ at Island No. 3 west of the Alafia. Eleven inshore samples were taken from the McKay Causeway to the north point at the mouth of the Alafia River. These ranged from 20.1 ‰ to 15.9 ‰ and averaged 18.5 ‰.

Eight surface samples and one bottom sample were taken in the Alafia River. Surface samples ranged from 4.2 ‰ to 12.1 ‰, and averaged 6.9 ‰. The bottom salinity was 21.1 ‰ as compared to the concurrent surface observation of 12.1 ‰.

Between Bullfrog Creek and Shell Point twenty-two surface samples were collected. These ranged from 4.9 ‰ off Bullfrog Creek to 24.7 ‰ at "Price Branch". The average salinity was 19.0 ‰.

Five surface samples from Bullfrog Creek and the Little Manatee River averaged less than 5.6 ‰.

Seven inshore samples taken from Little Cockroach Bay to, and including, Cockroach Bay ranged from 22.6 ‰ to 27.6 ‰ and averaged 25.7 ‰.

Surface samples from the outside waters between Piney Point and the mouth of the Manatee River ranged between 28.4 ‰ and 31.4 ‰ and averaged 30.0 ‰. Two bottom salinities, 30.4 ‰ and 29.7 ‰, were taken. These averaged 1.5 ‰ greater than the concurrent surface samples.

Three surface samples taken in Bishop Harbor averaged 29.9 ‰, and five inshore surface salinities taken from Bishop Harbor south to, and including, McGill Bay averaged 30.1 ‰.

Five surface and one bottom samples were taken in Terra Ceia Bay. The average surface salinity was 27.7 ‰, and the bottom salinity was 29.7 ‰ as compared to the concurrent surface observation of 28.4 ‰.

Five concurrent surface and bottom samples were taken in the Manatee River. The surface and bottom salinity averages were 21.1 ‰ and 22.9 ‰, respectively. The maximum difference between surface and bottom salinities was 3.5 ‰; the average difference was 1.8 ‰.

Twelve additional surface samples were taken in the Manatee and Braden Rivers. These ranged from 8.7 ‰ to 26.2 ‰.

Surface temperatures in Area IV ranged from 28.0°C. to 33.0°C. and averaged 30.2°C.; whereas bottom temperatures ranged from 29.5°C. to 31.0°C. and averaged 30.2°C.

Serial observations over 12-hour periods were made at two stations, Shell Point and the Palmetto Pier. The results of these observations are shown in Table 7 and Figures 12 and 13.

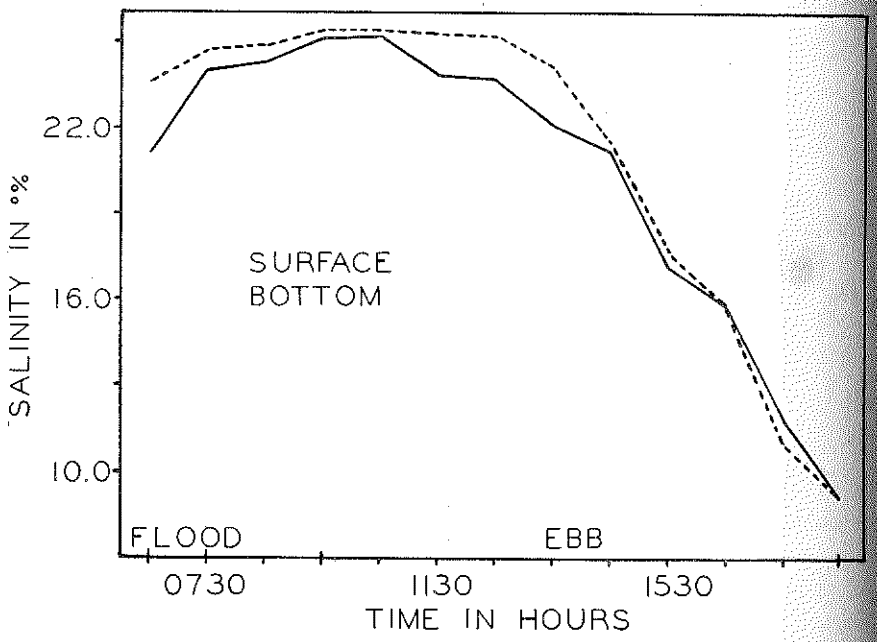

FIGURE 12. 12-hour salinity series, surface and bottom, at Shell Point. August 13, 1951.

TABLE 7

12-HOUR SERIAL SALINITY AND TEMPERATURE OBSERVATIONS

Station	Date	Salinity Range In o/oo	Average Salinity In o/oo	Temperature Range In °C.	Average Temperature In °C.
Shell Point (S)	8-13-51	9.1-25.2	20.3	29.5-33.0	31.7
Shell Point (B)	8-13-51	9.2-25.4	21.0	30.0-33.0	31.3
Palmetto Pier (S)	8-16-51	22.4-27.1	24.4	27.0-31.0	30.2
Palmetto Pier (B)	8-16-51	22.4-27.2	24.8	28.0-31.0	30.0

S—Surface sample.
B—Bottom sample.

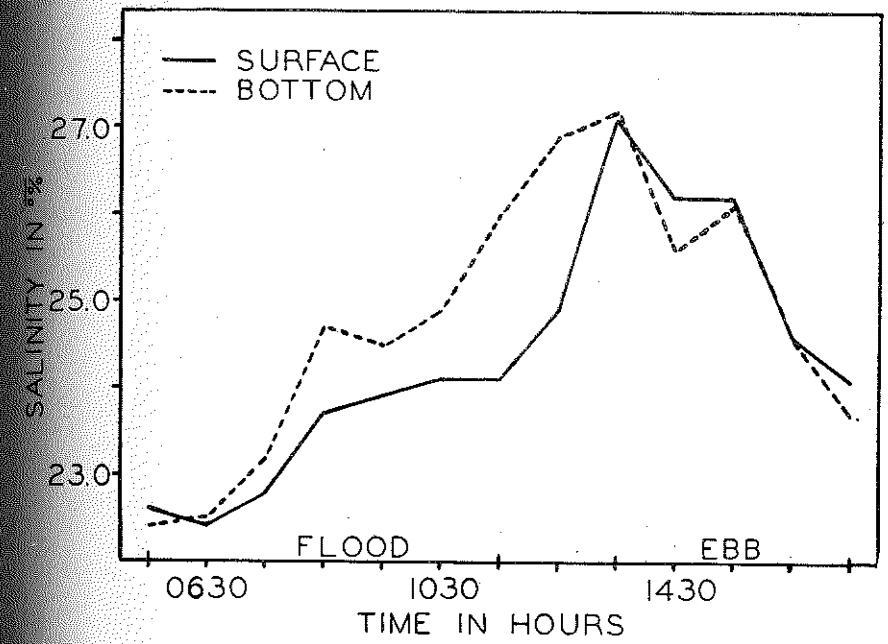

FIGURE 13. 12-hour salinity series, surface and bottom, at Palmetto Pier. August 16, 1951.

Biological Observations

In view of the extensive nature of Area IV it is not considered practical to describe here in detail the observations made along each section of the shore. The conditions were found to be essentially the same as in other portions of Tampa Bay. Large numbers of coon bars, few live oysters,and, in most cases, the bars were daily exposed for considerable periods. Commercial quality oysters were found in several localities, but in each case the extent of these beds was very limited.

A number of small beds of good quality oysters were found in Bullfrog Creek between the highway and railroad bridges in deep, three to five feet water.

Several beds of considerable size were found in the deep channels of the Little Manatee River. The oysters on these beds were well formed and ranged up to six inches in length. The majority of these oysters were, however, on leased bottoms.

One small bed of commercial quality oysters was found off the southeastern point of Terra Ceia Island. These oysters were attached to small rocks and in water four to six feet deep.

In the Manatee River east of Rocky Bluff a large number of commercially acceptable oysters were found attached in large clusters to the mangrove. The individual oysters were well formed and averaged about four inches in length. In some locations oysters were found in the mud surrounding the mangrove, and it is assumed that these had broken loose from the hanging clusters.

A considerable number of large oysters, both singles and clusters, were found about the piling of the abandoned bridge one mile upstream from the mouth of the Braden River. Examination of the bottoms showed that these oysters were confined to the immediate vicinity of the bridge.

Despite careful examination of the entire region no other oysters of commercial value were found in Area IV.

Conchs were noted throughout the area surveyed except in the immediate vicinity of streams and rivers supplying large amounts of fresh water to the Bay. In general, however, they were less numerous than in the Areas previously described. *Callinectes sapidus*, *Busycon perversum* and *Fasciolaria tulipa* were also observed in some numbers.

Oyster Leases

The two oyster leases in this Area were located along the southern shore of the Little Manatee River just west of the first highway bridge. These bottoms, a total of 21.28 acres, were improperly posted and were in need of cultivation. A large number of crowded commercial quality oysters were found on both leases. These oysters were mainly used for personal consumption by the owners with but a small number being sold as shell-stock.

Boundaries of Pollution

Within Area IV there are two regions, each of considerable size, closed to the taking of oysters. The first includes the waters of McKay Bay and its tributaries-Hillsboro Bay and its tributaries north of a line drawn from

Catfish Point, on the Interbay Peninsula, east to the south bank of the Alafia River. The second includes all of the Braden River to the pilings of the abandoned railroad bridge; that portion of the Manatee River from its confluence with the Braden River east to include all waters bounded by a line drawn from Redfish Point to Branches Hammock.

HISTORY AND RECENT PRODUCTION

The fact that oysters were once plentiful in the Tampa Bay area is amply substantiated by the presence of large beds of dead shell in the deeper portions of the Bay. These beds, covered by an overlay of mud and silt, have been dredged for many years by companies operating out of Tampa and Bradenton. The dredged shell is used primarily for road construction and fill. A large percentage of "fine" or broken pieces renders this material unsuitable for cultch.

Commercial oysters were abundant throughout the region during the latter part of the 19th century, and, for a short period, Hillsboro County was second only to Nassau County in the production of Florida oysters. Smeltz (1898) reported, as follows, concerning a trip made in 1876 from Point Pinellas to Hillsboro Bay, Old Tampa Bay and south to the Alafia and the Big and Little Manatee Rivers: "On every hand I found the same condition - oysters, oysters everywhere". Ruge (1898) mentioned that a small oyster cannery had been recently opened on the Manatee River at Gulf City, and Townsend (1900) refers to a cannery in Hillsboro County.

Brice (1898) provided the following account of the oyster industry in Tampa Bay:

> "The principal oyster beds in the Counties of Hillsboro, Manatee and DeSoto are located in Hillsboro Bay, and near the mouth of the Manatee River, and—"
>
> "Opinions differ as to whether the oysters are becoming scarcer, although most of the dealers and oystermen think that they are decreasing each year. Some time ago Tampa drew most of its oyster supply from Old Tampa Bay, but the beds in that place are so depleted that it has not paid to work them for several years.
>
> "During the past few years some efforts at private oyster-culture have been made, consisting in the planting of seed oysters in Hillsboro Bay and on the worked-out Manatee beds, but this enterprise has thus far been unsatisfactory, owing to the robbery of the beds".

Production figures for the years 1889-1902 (Table 8) show a decided and continuing drop in production after the peak year of 1895. Although overfishing may account for much of this decline, it is doubted that the present scarcity of commercial oysters can be assigned to this cause alone.

TABLE 8

REPORTED OYSTER PRODUCTION IN POUND. DURING THIS PERIOD HILLSBORO INCLUDED WHAT IS NOW PINELLAS COUNTY.

Year	Hillsboro County	Manatee County
1889	357,070	525
1890	406,665	630
1895	492,688	....
1896	440,000	1,400
1897	313,500	1,280
1902	137,000	....

Danglade (1920) reported on the infestation of the Tampa Bay oyster beds by an unidentified flatworm during 1916 and 1917. Damage ranged from ten to fifteen percent to the destruction of an entire bar His inquiries revealed that similar attacks had occurred at more or less regular intervals during the previous ten to twenty years, but that it was most severe during

TABLE 9

REPORTED PRODUCTION IN GALLONS FOR THE YEARS 1941 THROUGH 1952.

Year	Hillsboro County	Pinellas County	Manatee County
1941	.....	700	..
1942	.....	16,629	..
1943	.....	2.340	..
1944	.....	1,759	..
1945	27	3,150	..
1946	.....	5,691	..
1947	.....	5,691	..
1948	.....	190	20
1949	12,996	114	..
1950	.....	.....	..
1951	55	92	..
1952*	.....	496	..

*The 1952 figures were obtained from unpublished data of the U. S. Fish and Wildlife Service, Statistical Section, Marine Laboratory, University of Miami.

the 1916-1917 period. Palombi (1931) originally described the "leech" *Stylochus inimicus* from Tampa Bay and this is presumably the same organism reported by Danglade. It is possible that successive mass attacks by *Stylochus* were a prime factor in the eventual destruction of the Tampa Bay commercial oysters.

Recent statistics (Table 9) show that the production is almost wholly limited to Pinellas County. The figures for Pinellas County, at least 1949,

are below the actual value. The major producers in the county handle only retail sales, and such sales do not appear on the statistical reports. The figure shown for Hillsborough County in 1949 is subject to question since, at that time, there were no certified oyster producers within the county.

DISCUSSION

Although a few scattered coon bars were found in the northern part of Boca Ciega Bay, the quality of these oysters, their limited numbers, and the scarcity of potentially good oyster bottom offers little encouragement for propagation in these waters. The large quantity of coon oysters in both Long and Cross Bayous could be used as seed for private beds in other parts of Tampa Bay. The existence of sewage contamination and the retarded growth of the oyster, even when not subject to regular exposure, permits the assumption that these bayous are not favorable for commercial production. The dredging of new channels and the filling-in of old waterways will change the normal tidal flow, particularly of the waters near Johns Pass and the Treasure Island Causeway. It is not expected that these changes will result in more favorable conditions for oyster propagation in Boca Ciega Bay.

The commercial oysters in Papys Bayou were confined to bottoms from three to five feet deep at low water. This relatively thick water layer maintains a more stable environment by restricting rapid salinity and temperature variations. Large areas of similar depth but barren of oyster growth were also found in Papys Bayou. These bottoms can be expected to produce if approved methods of oyster culture are instituted. The planting of cultch and seed oysters could be expected to result in an increase in the commercial production in the bayou of from two to four hundred percent within five years. This potential can be exploited to best advantage by private lessees. It must be recognize, however, that the future of the oyster industry in Papys Bayou depends largely upon rigid enforcement of the State and County sanitary codes governing new and existing private sewage facilities. If these regulations are enforced it is reasonable to expect the waters to remain free of pollution even if surrounded by commercial and real estate developments. The reduced salinity in the bayou following heavy rainfall serves as a deterrent to the ravages of such pests as conchs and leeches. Lessees in the bayou report that attacks by these predators coincide with periods of deficient rainfall.

The quantity of salable oysters found in Area III, though small, was sufficient to indicate that commercial oysters could be produced in at least two localities. With careful planting of seed oysters and proper distribution of cultch the cultivation of a small amount of commercial oysters should be successful in the small bay S. W. of Big Island and in Rocky

Creek. The economic feasibility of such propagation should first be established by small test plots in each locality. The large number of conchs in Area III would be of primary concern in any rehabilitation program. Quantitative data were not available but these pests were held responsible for a high mortality on and around the existing coon bars.

Residents of Safety Harbor reported that there has been a gradual filling in or silting of Old Tampa Bay north of the Davis Causeway during the past twenty-five years. No records were located during this investigation that would substantiate or disprove these claims.

In Area IV commercial oysters were found in Bullfrog Creek, the Little Manatee River, Terra Ceia Bay and the Manatee-Braden River system. The oyster populations of the Little Manatee River and the Manatee River east of Rocky Bluff, though small when compared to the major producing regions of Florida, were sufficiently large to support a profitable commercial fishery. According to the best available information, however, these beds have not been exploited on a commercial scale in recent years. The stocks of oysters in Bullfrog Creek and Terra Ceia Bay would not support even a casual fishery. The scarcity of natural cultch appeared to be the main factor limiting the quantity of oysters in each of these four localities. The adoption of sound oyster culture techniques will be necessary before these populations can be increased. The low salinities and deeper waters of Bullfrog Creek, Little Manatee and Manatee Rivers are particularly favorable for oyster growth. The reduced salinities also serve to limit the otherwise widespread occurrence of conchs and leeches.

Except in the vicinity of streams or rivers, salinities averaged more than 30.0 ‰ throughout the area sampled. It was not determined whether this constituted the normal condition of these waters. Examination of rainfall data shows that deficiencies were experienced in the Tampa-St. Petersburg region during the survey period. (Table 10.)

TABLE 10

JULY AND AUGUST RAINFALL IN INCHES INDICATING DEFICIENCIES DURING SURVEY PERIOD.

	St. Petersburg			Tampa		
	Average 1940-1950	1951	Deficiency	Average 1940-1950	1951	Deficiency
July	10.13	8.42	1.71	9.33	6.72	2.61
August	9.73	3.33	6.40	9.48	7.37	2.11

It can be assumed that normal precipitation during this period would have resulted in a decrease of the mean salinity. The magnitude of this decrease cannot be estimated from the available data.

Serial observations over a twelve hour period at Safety Harbor, Welch Causeway and the Treasure Island Causeway showed average tidal ranges of 1.2 ‰. Similar observations at the Weedon Island Bridge, Palmetto Pier and Shell Point resulted in ranges of 7.0, 4.8 and 14.1 ‰ respectively. The location of Shell Point at the mouth of the Little Manatee accounts for the wide tidal variation at this station. Continuing serial samplings over a 24 hour period would probably have resulted in slightly increased ranges. The tidal data do, however, indicate conditions comparable to producing areas of Apalachicola Bay where tidal salinity variations of 8-10 ‰ are not uncommon.

Whether the high mean salinity of the sampled waters resulted from the temporary effects of rapid evaporation and deficient precipitation cannot be determined without additional observations. Although generally high, all salinity observations were well within the ranges experienced on many of the producing beds in Apalachicola. Examination of the available data on the salinities of Greater Tampa Bay indicates that salinity alone is not responsible for the general absence of commercial oysters.

Water temperatures throughout the survey ranged from 26.0°C to 33.0°C and averaged 29.5°C. These temperatures are comparable to those found in inshore waters north of Tampa Bay during the same months. The water temperatures are, therefore, not considered excessively high for commercial oyster production.

Although the possibility of widespread attack by oyster pests, particularly *Stylochus* has not been disregarded, the absence of cultch on bottoms below the low-water mark was the most obvious factor which would prevent the development of natural, commercial quality oyster beds. Whether this is a valid assumption can only be established by test plots of cultch and seed oysters and the collection of more detailed hydrographic data. It should be noted however that the work of Ingle and others (unpublished) in this part of the state suggests that high incidence of oyster drills and leeches is associated with sustained high salinities.

In 1951 there were ten oyster leases, totalling 88.46 acres, in Tampa Bay. Eight of these, 67.18 acres, were located in Pinellas County. Only two leases, both in Papys Bayou, were under cultivation and producing oysters for commercial purposes. A few of the leases supported a casual fishery for personal consumption by the owner but the majority were barren of oysters and evidence of recent cultivation. A general apathy toward oystering was in evidence throughout the Tampa Bay area. With the exception of the small industry in Papys Bayou commercial oystering was non-existent in the region. It is felt that this disinterested attitude arises mainly from the availability of more highly renumerative and less

strenuous occupations in the Tampa — St. Petersburg — Bradenton area. The population that would normally be engaged in oystering has been captured by industrial and agricultural occupations.

Industrial and sewage pollution has resulted in the closure of large portions of Tampa Bay to oyster production. The enlightened attitudes recently shown by the major municipalities in planning or constructing sewage treatment facilities should, if continued, prevent extension of the condemned areas.

Destruction of much of the natural mangrove and the accompanying free flow of upland sediment together with dredging and filling of the bay bottoms have all contributed to the formation of extensive tidal flats and the sedimentation of formerly productive bottoms.

The changes wrought in the natural upland drainage pattern consequent upon the development of the municipal areas and surrounding farmlands are at least partially responsible for the high average salinities observed over most of the area.

Relatively few biological or allied studies have been made on the waters of Tampa Bay, and much of this work is difficult to locate in the literature. During the course of this study a number of references to the region have been assembled and have been included as an Appendix to this paper. Although incomplete, it is believed that this will be of assistance to future investigators in these waters.

BIBLIOGRAPHY

Brice, John J.
1898. Report on the fish and fisheries of the coastal waters of Florida. Rep. U. S. Comm. Fish. 22:263-342.

Danglade, Ernest
1920. The flatworm as an enemy of Florida oysters. Rep. U. S. Comm. Fish. for 1918, Appendix V, pp. 1-8.

Ingle, R. M. and Charles E. Dawson, Jr.
1950. Variation in salinity and its relation to the Florida oyster. Salinity variation in Apalachicola Bay. Proc. Gulf & Caribbean Fish. Inst. 3:35-42.
1952. Growth of American oysters in Florida waters. Bull. Mar. Sci. Gulf & Caribbean 2(2):393-404.

Palombi, Arturo.
1931. *Stylochus inimicus* sp. nov acotileo commensale di *Ostrea virginica* Gmelin delle Coste della Florida. Bull. Zool. (Naples) 2(6):219-226.

Ruge, J. G.
1898. The oysters and oyster-beds in Florida. Bull. U. S. Fish. Comm. 17:289-296.

Smeltz, H. A.
1898. The oyster-bars of the West Coast of Florida: their depletion and restoration. Bull. U. S. Fish Comm. 17:305-308.

Townsend, C. H.
1900. Statistics of the Fisheries of the Gulf States. Rep. U. S. Comm. Fish. 25:105-169.

APPENDIX

Adams, A. C. and W. C. Kendell
1891. Report upon an investigation of the fishing grounds off the West Coast of Florida. Bull. U. S. Fish Comm., 9:289-312.

Allen, John H.
1846. Some facts respecting the geology of Tampa Bay, Florida. Amer. Jour. Sci. ser. 2, 1:38-42.

Anderson, A. W. and E. A. Power
1949. Fishery statistics of the United States 1945. U. S. Fish Wildlife Service, Statistical Digest 18.

Bean, Barton A. and A. C. Weed
1911. An electric ray and its young from the West Coast of Florida. Proc. U. S. nat. Mus. 40:231-232.

Brice, John J.
1898. Report on the fish and fisheries of the coastal waters of Florida. Rep. U. S. Comm. Fish. 22:263-342.

Brown, D. J.
1952. Fifth progress report on marine borer activity in test boards operated during 1951. Report W. F. Clapp Laboratories No. 8088.

Collins, J. W.
1887. Report on the discovery and investigation of fishing grounds, made by the fish commission steamer *Albatross* during a cruise along the Atlantic Coast and in the Gulf of Mexico: with notes on the Gulf fisheries. Rep. U. S. Comm. Fish. 13:217-306.

Collins, J. W. and H. M. Smith
1893. A statistical report on the fisheries of the Gulf States. Bull. U. S. Fish Comm. 11:93-184.

Cooke, C. W.
1939. Scenery of Florida interpreted by a geologist. Bull. Fla. State Geol. Surv. 17:1-118.
1945. Geology of Florida. Bull. Fla. State Geol. Surv. 29:1-339.

Cooke, C. W. and Stuart Mossom
1929. Geology of Florida. Ann Rept. Fla. State Geol. Surv. 20:29-228.

Dall, W. H.
1884. On a collection of shells sent from Florida by Mr. Henry Hemphill. Proc. U. S. nat. Mus. 6:318-342.
1890. Contributions to the Tertiary fauna of Florida I. Gastropods. Trans. Wagner Free Inst Sci. 3(1):1-200.

1892. Contributions to the Tertiary fauna of Florida II. Streptodont and other Gastropods. Trans. Wagner Free Inst Sci. 3(2):201-473.
1895. Contributions to the Tertiary fauna of Florida III. Pelecypoda. Trans. Wagner Free Inst Sci. 3(3):483-570.
1898. Contributions to the Tertiary fauna of Florida IV. Prionodesmacea and Teleodesmacea. Trans. Wagner Free Inst Sci. 3(4):571-947.
1900. Contributions to the Tertiary fauna of Florida V. Teleodesmacea. Trans. Wagner Free Inst Sci. 3(5):949-1218.
1903. Contributions to the Tertiary fauna of Florida VI. Conclusion. Trans. Wagner Free Inst Sci. 3(6):1219-1654.
1915. A monograph of the Molluscan fauna of the Orthaulax Pugnax Zone of the Oligocene of Tampa, Florida. Bull. U. S. nat. Mus. 90:1-173.

Danglade, Ernest
1920. The flatworm as an enemy of Florida oysters. Rep. U. S. Comm. Fish. for 1918, Appendix V, pp. 1-8.

Evermann, B. W. and W. C. Kendall
1900. Check list of the fishes of Florida. Rept. U. S. Comm. Fish. 25:35-103.

Florida State Board of Conservation
1948. Observed rainfall in Florida; monthly totals from beginning of records to 31 Dec. 1947. Fla. Bd Cons., Div. Water Survey and Research.

Gunter, Herman
1948. Elevations in Florida. Bull. Fla. Geol. Surv. 32:1-1158.

Heilprin, Angelo
1887. Explorations on the West Coast of Florida and in the Okeechobee wilderness. Trans. Wagner Free Inst. Sci. 1:134.

Henshall, J. A.
1895. Notes on fishes collected in Florida in 1892. Bull. U. S. Fish Comm. 14:209-221.

Idyll, C. P.
1949. Preliminary report on shrimping in Tampa Bay. (Mimeo) Marine Lab.,Univ. of Miami.

Ingersoll, Ernest
1882. On the fish mortality in the Gulf of Mexico. Proc. U. S. nat. Mus. 4:74-80.

Mansfield, W. C.
1937. Mollusks of the Tampa and Suwanee Limestones of Florida. Bull. Fla. State Geol. Surv. 15:1-334.

Maury, C. J.
1920. Recent Mollusks of the Gulf of Mexico and Pleistocene and Pliocene species from the Gulf States, Part I, Pelecypoda. Bull. Amer. Paleontology vol. 8, No. 34, 113 pp.
1922. Recent Mollusca of the Gulf of Mexico and Pleistocene and Pliocene species from the Gulf States, Part II. Scaphoda, Gastropoda, Amphineura, Cephalopoda. Bull. Amer. Paleontology vol. 9, No. 38,142 pp.

Mills, H. R.
1944. The log of Whiskey Stump: Water-fowl ecology. Florida Nat. Oct. 1944.

Palombi, Arturo
1931. *Stylochus inimicus* sp. nov acotilco commensale di *Ostrea virginica* Gmelin delle Coste della Florida. Bull. Zool (Naples) 2(6):219-226.

Ruge, J. G.
1898. The oysters and oyster-beds in Florida. Bull. U. S. Fish Comm. 17: 289-296.

Smeltz, H. A.
1898. The oyster-bars of the West Coast of Florida: their depletion and restoration. Bull. U. S. Fish Comm. 17:305-308.

Smith, F. G. W.
1949. Probable fundamental causes of Red Tide off the West Coast of Florida. Quart. J. Fla Acad. Sci. 11(1):1-6.

Stearns, Silas
1887. Fisheries of the Gulf of Mexico. The Fisheries and Fishery Industries of the United States, Section II, Part 15, pp: 546-548.

Townsend, C. H.
1900. Statistics of the fisheries of the Gulf States. Rep. U. S. Comm. Fish. 25:105-169.
1902. Sturgeon fishery of Florida. Rep. U. S. Comm. Fish. 27:155.

U. S. Coast and Geodetic Survey
1936. United States Coast Pilot Gulf Coast-Key West to the Rio Grande. Second (1936) Edition. U. S. Coast & Geodetic Survey Serial No. 590.
1949. Density of sea water at Coast and Geodetic Survey tide stations: Atlantic and Gulf Coasts. U. S. Coast and Geodetic Survey Spec. Publ. 279. Revised 1949 edition.
1951. Surface water temperatures at tide stations Atlantic Coast North and South America. U. S. Coast Geodetic Survey Spec. Publ. 278. Revised 1951 edition.
1952. Current tables Atlantic Coast North America 1953. U. S. Coast and Geodetic Survey Serial No. 761.
1952. Tide tables East Coast North and South America for 1953. U. S. Coast and Geodetic Survey Serial No. 731.

W. F. Clapp Laboratories
1950. Harbor reports on marine borer activities. Res. Divn U.S.N. Bur. Yards and Docks NavDocks, P-43.
1951. Fourth progress report on marine borer activity in test boards operated during 1950. Rep. W. F. Clapp Laboratories No. 7550.

Walker, S. T.
1884. Fish mortality in the Gulf of Mexico. Proc. U. S. nat. Mus. 6: 105-109.

Williams, R. H.
1947. Relation of birds to plankton and fish in Tampa Bay. Paper No. 37 Read at the annual meeting of the Fla. Acad. Sci. 11-21-47.

LIST OF PUBLICATIONS

EDUCATIONAL SERIES

No. 1. The Red Tide ..... November, 1948
No. 2 The Sponge Industry of Florida ..... January, 1949
No. 3 How can Statistics Increase the Catch? ..... February, 1949
No. 4 Check List of Florida Sport and Commercial Fishes With Common Names ..... June, 1949
No. 5 Oyster Culture in Florida ..... March, 1949
No. 6 The Commercial Shrimp Industry of Florida ..... March, 1950
No. 7 Florida Seaweeds and Their Commercial Use ..... July, 1950

TECHNICAL SERIES

No. 1 The Gulf of Mexico Sponge Investigation ..... March, 1953
No. 2 Investigations on Florida Spiny Lobster *Panulirus argus* (Latreille) ..... July, 1951
No. 3 Stopnetting on the West Coast of Florida ..... June, 1949
No. 4 A High Speed Manual Commercial Fishing Reel ..... January, 1952
No. 5 Studies on the Effects of Dredging Operations Upon Fish and Shellfish ..... October, 1952
No. 6 The Biscayne Bay Commercial Fishery ..... January, 1953
No. 7 Investigations on the Black Mullet: *Mugil cephalus* L. in Northwest Florida ..... May, 1953

STATE OF FLORIDA

BOARD OF CONSERVATION

CHARLIE BEVIS, *Supervisor*

TECHNICAL SERIES

NO. 9

A Survey of The Cedar Key Area

by

ROBERT M. INGLE

and

CHARLES E. DAWSON, JR.

Division of Oyster Culture

Tallahassee September, 1953