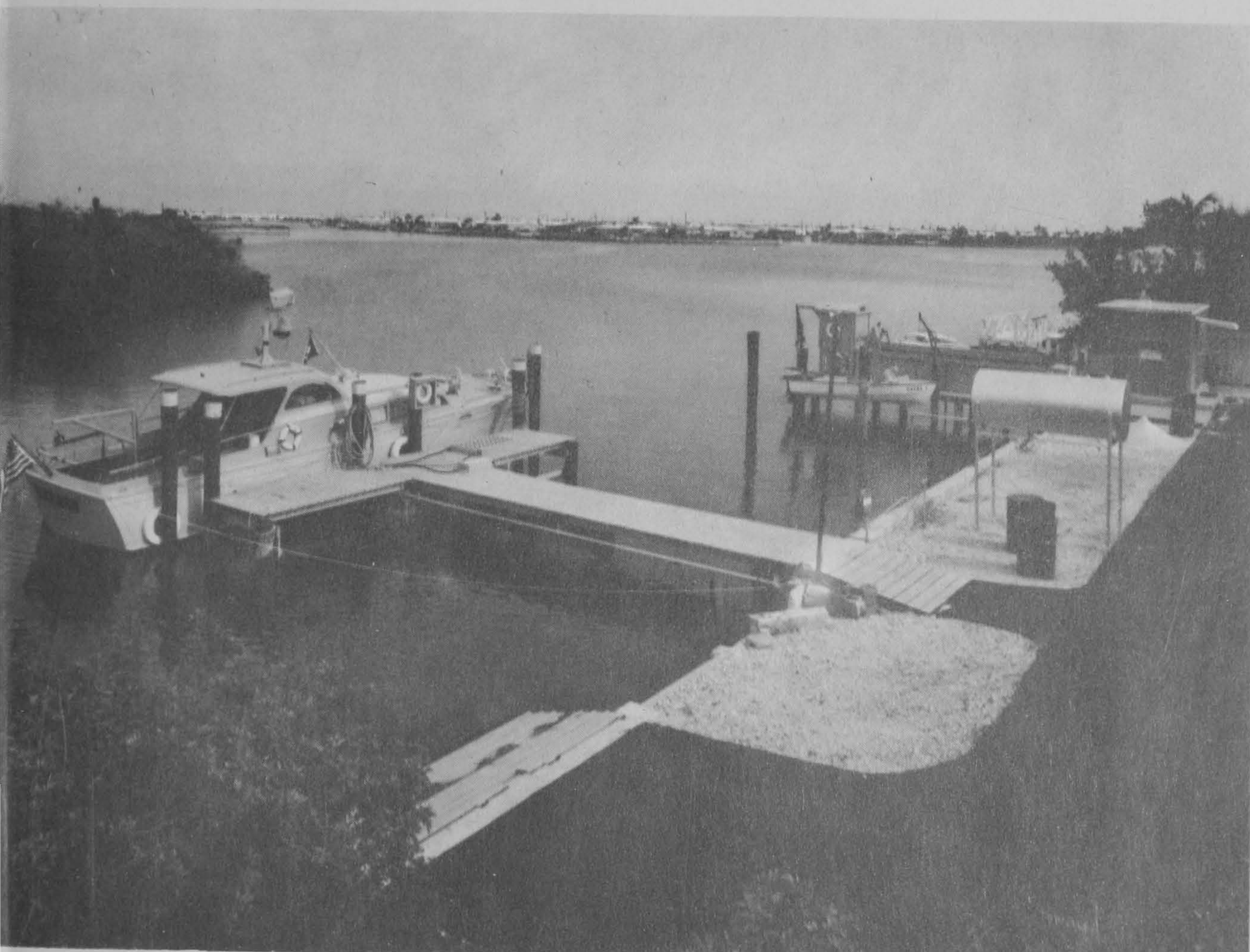
REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL STATION, ST. PETERSBURG BEACH, FLORIDA

Fiscal Year 1965



UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

BUREAU OF COMMERCIAL FISHERIES

Circular 242

UNITED STATES DEPARTMENT OF THE INTERIOR
Stewart L. Udall, *Secretary*
John A. Carver, Jr., *Under Secretary*
Stanley A. Cain, *Assistant Secretary for Fish and Wildlife and Parks*
FISH AND WILDLIFE SERVICE, Clarence F. Pautzke, *Commissioner*
BUREAU OF COMMERCIAL FISHERIES, Donald L. McKernan, *Director*

REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL STATION, ST. PETERSBURG BEACH, FLORIDA

Fiscal Year 1965

James E. Sykes, Chief

Contribution No. 25, Bureau of Commercial Fisheries
Biological Station, St. Petersburg Beach, Florida

Circular 242

Washington, D.C.
April 1966

CONTENTS

REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL STATION, ST. PETERSBURG BEACH, FLORIDA

Fiscal Year 1965

REPORT OF THE STATION CHIEF

James E. Sykes

PROGRAM SCOPE AND PROGRESS

In fiscal year 1965, research dividends began to result from estuarine and red-tide investigations. The report of the Biological Station at St. Petersburg Beach for fiscal years 1962-64 set forth program aims and results of survey-type projects conducted in the formative period of the Station. During fiscal year 1965 some of the basic knowledge acquired was applied to practical problems related to portions of estuaries scheduled to undergo damaging engineering alteration by dredging and filling.

The scientific mission of the Biological Station is to evaluate estuarine biological production in a changing environment and to provide data for use in maintaining and improving the marine resource. Some of the data compiled thus far show the quality, quantity, and value of resident marine organisms, when possible the identification of those portions of the resources that have been lost or are in danger of being lost, and methods of retaining and increasing commercial species. We are in the early phases of understanding the physical, chemical, and biological complex of estuarine zones. We have observed, however, that the results of these studies have application in the conservation of estuaries by illustrating that the dollar, food, and esthetic value can indeed compete well with other values.

During the year, the Station staff was called upon to report estuarine biological data to: The Bureau of Sport Fisheries and Wildlife; the U.S. Army, Corps of Engineers; the Florida Board of Conservation; the Florida Game and Fresh Water Fish Commission; the Pinellas County Commission; the Tampa Port Authority; and the Southwest Florida Water Development District. The reports concerned a proposed 500-acre, dredge-fill operation in lower Tampa Bay and a proposed 11,000-acre impoundment in Old Tampa Bay that would create a freshwater lake. Both of those proposals affect high-fertility areas and will be catastrophic to the present marine resources if implemented. Our reports on the subjects encompass numbers and quantities of species living and reproducing in the threatened areas, pounds of vegetative production, sediment types, the importance of certain species of animals to the fishing industry both in the immediate areas and in the Gulf of Mexico, and estimates of potential production through artificial cultivation. We have also pointed out that additional protein from marine waters will be needed in coming years as the human population continues to increase.

An encouraging trend is that dredge-fill permits are not being so readily issued now. Developers in Florida are becoming aware that most proposals involving massive engineering will be examined closely by conservation agencies and possibly challenged on the basis of estimable biological damage. Similarly, the Nation's conservation forces are recognizing that the destruction of estuaries is increasing and is affecting the near-shore seafood supply. These effects are subtle, and even now their sources often go unchecked.

Results of our studies are being applied to protect the estuaries of one State, and we are developing principles that can be applied to a variety of other estuarine situations. For instance, we have investigated effects of the now familiar fingers of land that are created by dredging and filling. In spite of land developers' statements to the contrary, our studies reveal that the interfinger zones do not return to biological productivity even after a period of 10 yr. (years). These types of observations should prove useful in estimating probable effects of similar dredging and filling in other states.

One of the major research goals of the Estuarine Program is to continue the procurement of basic knowledge on estuaries and on the effects of changes in the environment. Another goal is to set principles whereby these areas may be controlled so that the productivity of the marine resource can be increased. Related to our goals is the need to help the fishing industry block enough destructive alteration so that other industries will be convinced they must negotiate with conservationists before planning or making harmful modifications of aquatic habitat. Once it is recognized that such negotiations are mandatory, it will be possible for conservation agencies to help design positive and beneficial forms of estuarine modification that will be acceptable to both the developer and the resource manager. This coordination will be possible only after a series of unsatisfactory engineering proposals are blocked as a result of the evidence from biological research coupled with support from the fishing industry and an enlightened public.

The Red-Tide Program is responsible for determining factors influencing blooms of Gymnodinium breve, the Florida red-tide organism. This program includes studies of associated plankton populations and oceanographic conditions in areas of blooms.

During the past year the major accomplishments included: (1) Completion of data collection for a study of estuarine and offshore plankton succession; (2) sponsorship of a symposium in which high-priority research needs were established; and (3) completion of computer analysis showing that 61 percent of the variability in abundance of G. breve is associated with variations in four measurable factors. In addition, vertical plotting of data from Gulf of Mexico transects was begun by the National Oceanographic Data Center for creation of an atlas describing oceanographic conditions off west central Florida.

WORK CONFERENCES

In October 1964, the Station held a symposium on red tide. Purposes were to review progress on red-tide research in recent years, to exchange views on the nature of current investigations, and to determine where emphasis should be placed in further studies. Fourteen scientists presented talks. Eleven areas of red-tide research were cited as needing attention in continuing studies. Mimeographed copies of presentations were distributed, and the abstracts were accepted for publication.

The Station Chief attended the Laboratory Directors' Meeting in La Jolla, Calif. Other meetings were held by staff members with: Fishing industry representatives and scientists of the North Carolina Institute of Fisheries, Morehead City, N.C.; Bureau of Commercial Fisheries Biological Laboratories at Oxford, Md., and Milford, Conn.; Narragansett Marine Laboratory, Kingston, R.I.; Duke University Marine Laboratory, Beaufort, N.C.; the Universities of Alabama, Florida, South Florida, Florida State, and Miami; the Presbyterian College in St. Petersburg; and the Florida Board of Conservation Marine Laboratory in St. Petersburg.

PRESENTATIONS

Talks were given by staff members at: The Red-Tide Symposium in St. Petersburg Beach; Gulf States Marine Fisheries Commission Meeting in Mobile; Meeting of the Southern Division, American Fisheries Society, Clearwater; and Florida Academy of Sciences, Gainesville. One staff member served as a member of an estuarine panel at the American Fisheries Society Meeting in Atlantic City and was responsible for the organization of a Marine Fisheries Session at the Meeting of the Southern Division of the Society.

TRAINING

Staff members enrolled in the following training courses: Management Institute for Supervisory Scientists and Engineers, Washington, D.C. (1); Report Writing Course, Tampa, Fla. (1); Department of the Interior Librarians' Conference, Washington, D.C. (1); and Automatic Data Processing Orientation for Management, Dallas, Tex. (1).

SPECIAL SERVICES

Alexander Dragovich provided translations of two scientific papers for staff use: "Natürliche und künstliche 'red water' mit anschliessenden Fischsterben im Meer" ("Natural and artificial 'red water' with associated fish mortalities in the sea") by Wilhelm Nümann, and "La determination rapide du calcium et du magnesium dans l'eau de mer" ("A rapid determination of calcium and magnesium in sea water") by Arthur de Sousa. Copies were deposited in the Bureau's Translation Clearinghouse in Seattle.

CONTRACTS

The Station supervised Bureau of Commercial Fisheries contracts given to the University of Alabama for computation and interpretation of red-tide data, the University of South Florida for sediment analysis, and the National Oceanographic Data Center (NODC) for vertical plotting of oceanographic transects. Contracts were completed in fiscal year 1965 except for the one with NODC.

STAFF

James E. Sykes, Station Chief

Administration

Mary Jo Greer	Administrative Assistant
Dorothy M. Hartswick	Clerk-Stenographer
Dorothy L. Gustafson	Clerk-Typist (Temporary)
Winifred H. Myers	Clerk-Stenographer (Temporary)

Library

Annemarie P. Rempel	Librarian

Vessel

John D. McCormick	Master-Engineer, R/V Kingfish

Estuarine Program

John H. Finucane	Project Leader, Faunal Production
Gordon R. Rinckey	Fishery Biologist (Resigned Feb. 26, 1965)
John C. Thompson	Fishery Aid (Resigned Aug. 21, 1964)
Ralph W. Campbell, II	Fishery Technician
John L. Taylor	Project Leader, Benthic Communities
Carl H. Saloman	Fishery Biologist
Orlando Villot	Fishery Aid (Cooperative Work-Study Student, University of South Florida, terminated Dec. 24, 1964)
John Jensen	Fishery Aid (Cooperative Work-Study Student, University of South Florida, terminated April 23, 1965)
Robert G. Ernest	Fishery Aid (Cooperative Work-Study Student, University of South Florida)
Billie Z. May	Project Leader, Chemical Environment
Lucius Johnson, Jr.	Physical Science Aid
David M. Jones	Physical Science Aid (Resigned 10/16/64)
Charles M. Fuss, Jr.	Project Leader, Biogeochemical Alteration

Red-Tide Program

Alexander Dragovich	Project Leader, Plankton Ecology
John A. Kelly, Jr.	Fishery Biologist
Robert D. Kelly	Fishery Aid

Summer Employees

Stephen C. Henry	Fishery Aid
Susan K. Soltau	Fishery Aid
George A. Robinson	Fishery Technician
Harry J. Ettell	Summer Trainee
Kathleen A. Adams	Fishery Aid

BENTHIC PROJECT

John L. Taylor and Carl H. Saloman

The Benthic Project was added to the Estuarine Program in June 1963. A study of bottom-dwelling animals in Tampa Bay began the first summer and was followed by other investigations on dredged bay bottoms, exposed beaches, and submerged land proposed for development. By winter 1964, field work for these studies was completed.

During the past year, the Benthic Project emphasized laboratory work on (1) invertebrate taxonomy, (2) analyses of sediment and hydrographic data, and (3) economic evaluation of the estuarine resource in Tampa Bay. A considerable amount of time was spent on the third item to provide information helpful in curtailing further destruction by dredging and pollution.

Tampa Bay Invertebrates

Collections and observations for this study were made on 20 transects at 400 stations in the estuary and to 6 miles offshore. Biological samples were obtained with qualitative and quantitative samplers of several types geared to environmental conditions (fig. 1). Physical

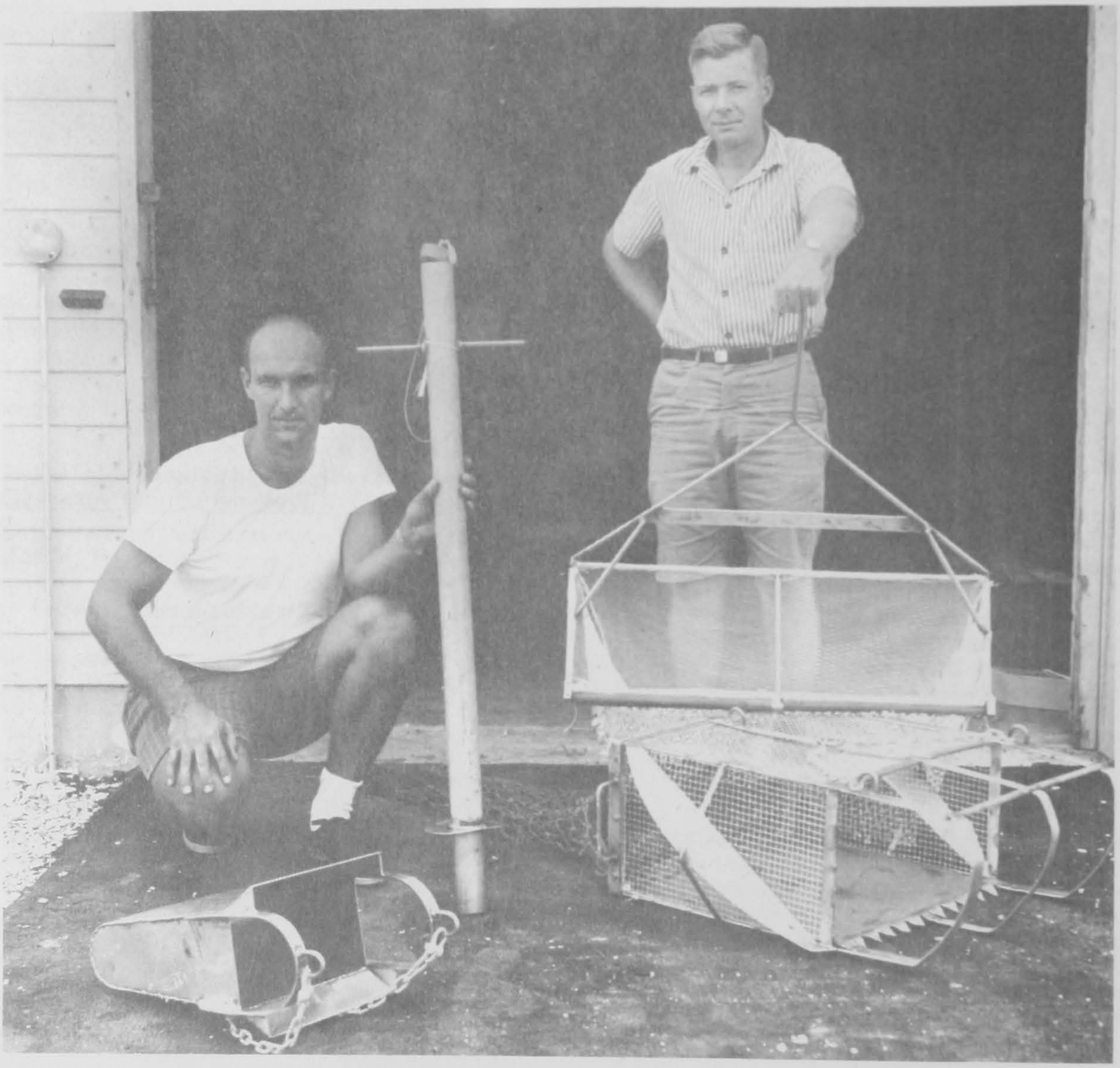


Figure 1.--Qualitative and quantitative samplers used for bottom studies in Tampa Bay.

and chemical data from the survey included sediment features, temperature, salinity, and pH values for surface and bottom water. Faunal collections were sorted into general groups, and specific determinations were begun. Identification was made for mollusks (186 species in 68 families), polychaete worms (105 species in 38 families), and crustaceans (60 species in 25 families). Identification was also completed for taxonomic groups represented by one or a few species, i.e., comb jellies, phoronids, and lamp shells.

Special attention was given to a study of the lancelet, Branchiostoma caribaeum Sundeval (fig. 2), because this primitive vetebrate represents a potential fishery in the estuary. It serves as human food in parts of Asia and Europe. It is found in shelly-sand in the central and northwest portions of Tampa Bay, and offshore to at least 6 miles. Publications on B. caribaeum show that it occurs in dense but sporadic concentrations along the coast of the northern and eastern Gulf of Mexico. Productive areas contain as many as 700 per square foot. Nutritional data show that lancelets are rich in iodine and have the following percentage composition[1] by weight:

Protein	8.50
Moisture	90.00
Oil	1.00
Ash	0.50

Boca Ciega Bay

This study was begun so that physical and biological effects of extensive dredging in Boca Ciega Bay could be determined (fig. 3). Data were collected from dredged and undisturbed areas at 28 stations. Seven stations were established previously by the Florida Board of Conservation in 1955. We occupied these quarterly during a faunal survey, and the resulting data served as a basis for comparing preengineering and postengineering conditions.

[1] Nutritional analyses by the Bureau of Commercial Fisheries Technological Laboratory, Pascagoula, Miss.

Figure 2.--Studying lancelets, B. caribaeum, from Tampa Bay.

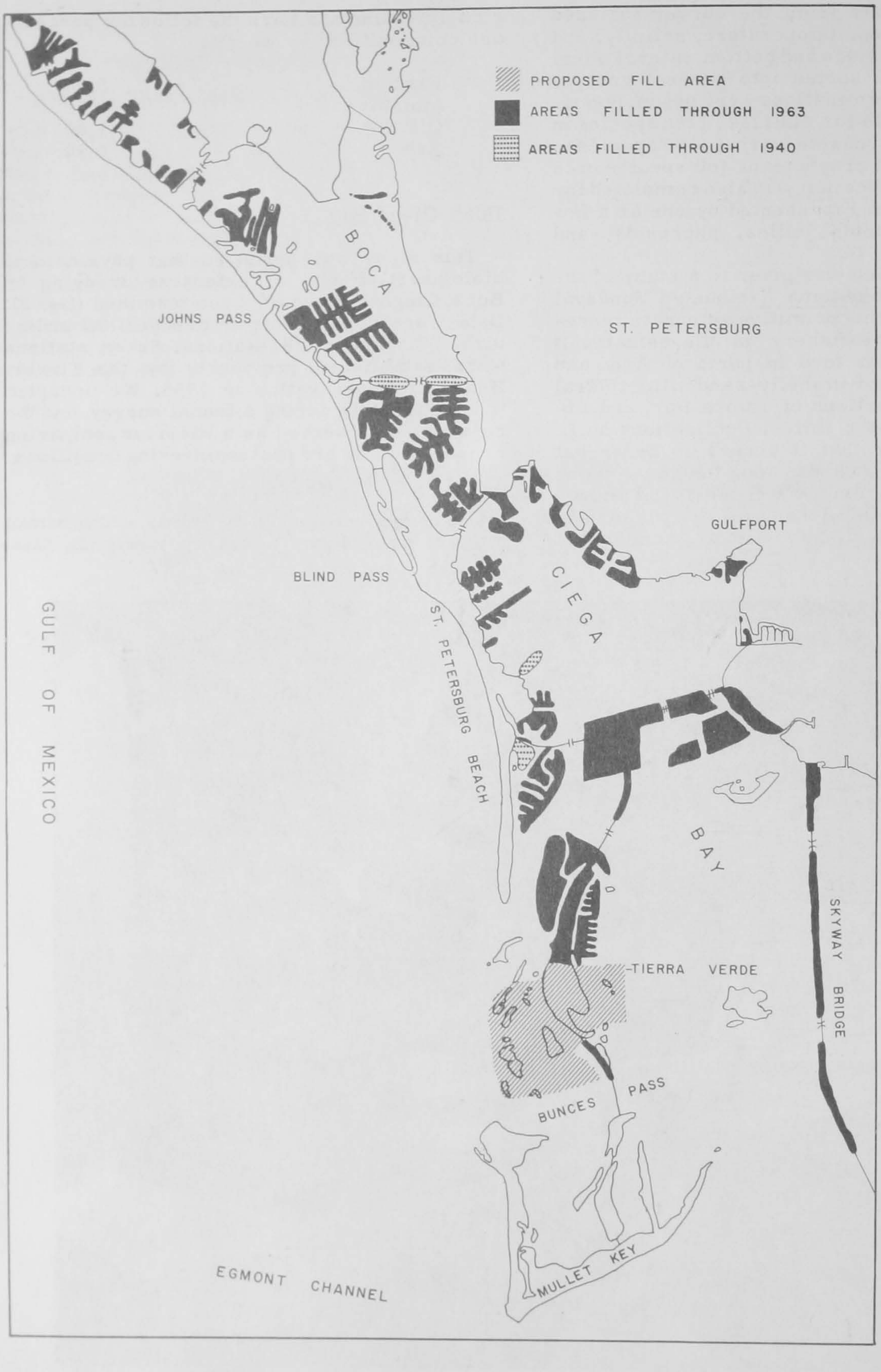


Figure 3.--Land mass created by dredging and filling through 1963 and contemplated filling in Boca Ciega Bay.

Sediments and hydrographic data were analyzed, and specimens were examined and sorted.

The bottom-dwelling organisms in dredged canals consisted only of a few worms; however, stations on undisturbed bottom produced an abundant and diverse invertebrate assemblage similar to that found during the 1955 survey and encountered elsewhere in shallow areas near the mouth of the estuary. Comparison of sediments also showed differences between dredged and natural bottom (table 1). Landfill dredging in Boca Ciega Bay has created access canals 12 to 15 ft. (feet) deep. One end of each canal is closed so that a pocket of water with reduced circulation exists (fig. 3). Under these conditions siltation occurs, hydrogen sulphide accumulates, and almost all but anaerobic forms of life are eliminated.

Exposed Beaches

The sediments on two exposed beaches were surveyed to determine the identity and seasonal occurrence of bottom-dwelling organisms. Intertidal sampling began early in 1964 at St. Petersburg Beach and on spoil banks at Johns Pass (fig. 3). For 1 year collections were made monthly at the Beach station and quarterly on the spoil banks. The monthly series of samples was completed, but because of winter storm erosion, only spring, summer, and fall collections were obtained at Johns Pass. Sediment analyses, completed for both localities, showed that substrates were composed almost exclusively of sand and coarse shell. Biological data from Johns Pass were analyzed, but comparable information from the Beach station is not yet available.

Quantitative biological samples from spoil banks in Johns Pass contained 26 invertebrate species representing 5 phyla. Mollusks, annelids, and arthropods comprised 98 percent of the animals. Polychaete worms were dominant during spring and summer when numbers of all beach animals were relatively high. In the fall, all members of the infauna (bottom-dwelling organisms) declined, and crustaceans appeared in equal numbers with polychaetes (fig. 4).

Table 1.--Composition of sediment in dredged canals and natural bottoms at stations in Boca Ciega Bay

Stations	Sand	Silt and clay
Dredged canal	Percent	Percent
PB-2	8	91
D-4	7	93
D-7	5	95
D-8	60	40
D-14	7	93
D-15	6	94
D-16	14	86
Mean percentage	15	85
Natural bottom		
PB-1	99	1
PB-3	75	25
D-1	98	2
D-2	98	2
D-3	88	12
D-5	97	3
D-6	96	4
D-9	96	4
D-10	88	12
D-11	92	8
D-12	99	1
D-13	83	17
D-17	95	5
D-18	85	15
Mean percentage	92	8

Tierra Verde

We collected near the island development of Tierra Verde during winter and summer (fig. 3). Because additional dredging was about to begin, a bottom survey was initiated to measure the importance of an endangered grass-bed community. Specimens from quantitative samples at 45 stations were sorted, counted, and weighed. From this information, estimates of standing crop were calculated and presented in a joint report with the Bureau of Sport Fisheries and Wildlife in opposition to engineering plans. In the fall of 1964, an analysis of 360 sediment samples from the Tierra Verde survey showed that bottom material in that area is at least 90 percent sand and that heavily silted conditions exist only in bottom areas adjacent to completed landfills.

Clam Survey

During the summer portion of the Tierra Verde study, three species of edible clams were found: southern hard-shell, sun-ray, and surf (figs. 3, 5).

The southern hard-shell clam or southern quahog, Mercenaria campechiensis Gmelin, was more abundant than the others and occurred in commercial quantities at several stations. Random sampling revealed clam concentrations as great as 6 per square foot in beds of "cherrystones" and 1 per square foot in beds containing "chowder" clams (3 in. or more in length). Growth rates of two populations were investigated--one from a bed of

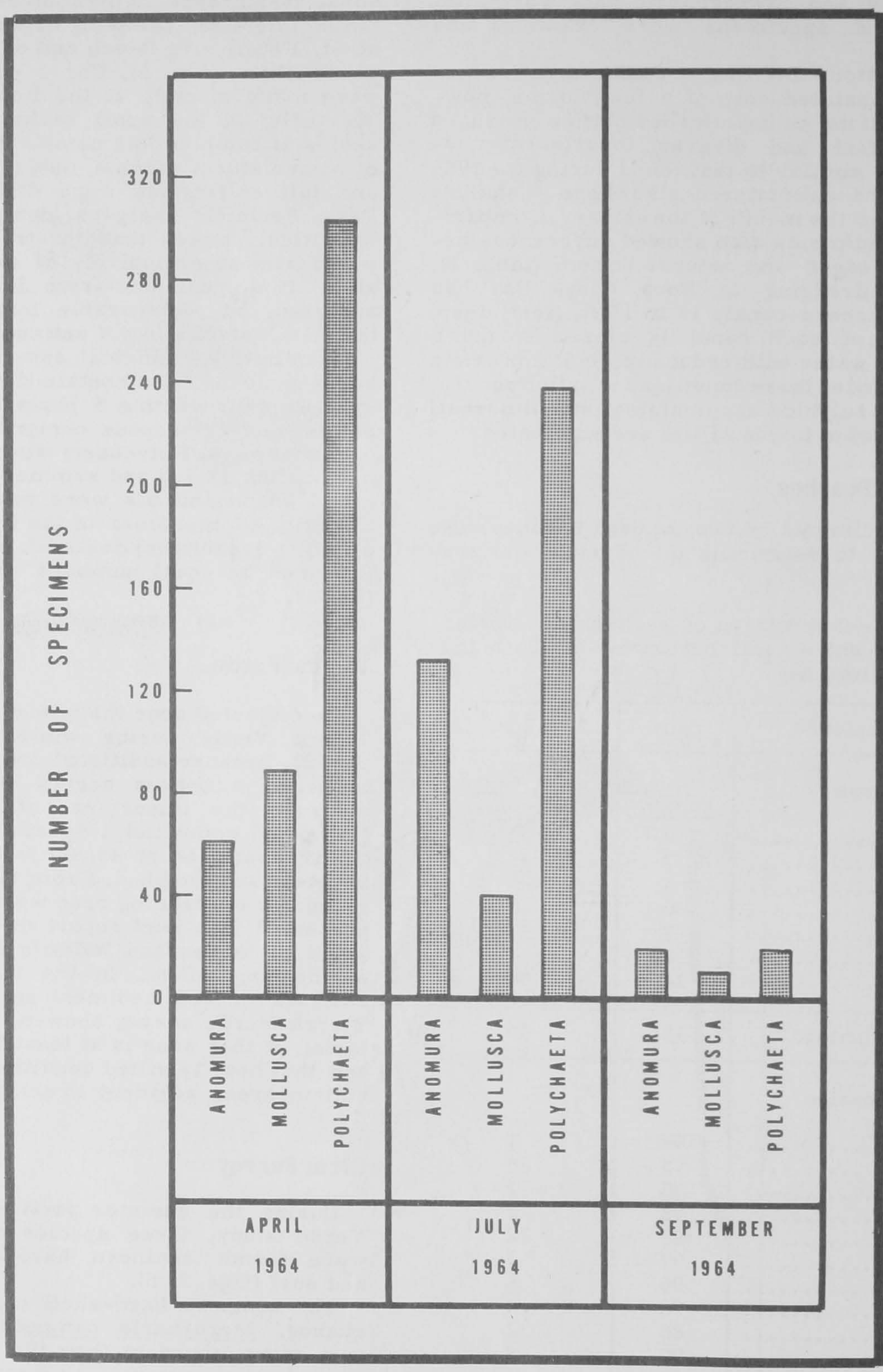


Figure 4.--Relative seasonal abundance of dominant sand beach animals from spoil banks near Johns Pass, Fla.

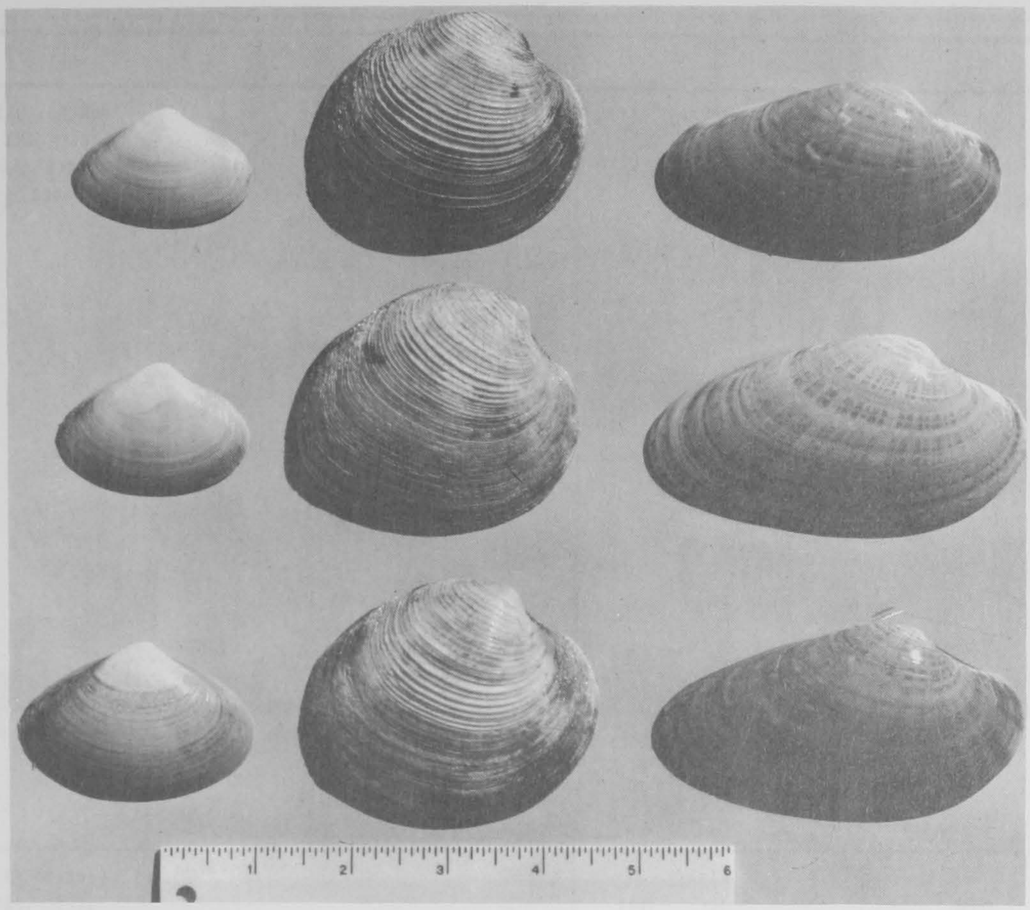


Figure 5.--Clams of potential commercial interest found near the mouth of Tampa Bay estuary. From the left, surf clam, Spisula solidissima similis; sun-ray clam, Marcrocallista nimbosa; and the southern hard-shall clam, Mercenaria campechiensis.

"cherrystone" clams adjacent to Tierra Verde (Jackass Key) on the Boca Ciega Bay side and the other from a bed of less uniform clams near the edge of Bunces Pass. A sample of 100 clams was collected each quarter from both areas for 1 yr. Graphs constructed from initial and final length measurements were superposed to show growth trends (fig. 6). A shift to the right of the mean length in clams from Jackass Key indicates a population growth of about 25 mm. (1 in.) in 12 mo. (months). At Bunces Pass, growth was nearly equal among clams in the smaller size classes but slower among clams longer than 100 mm. (4 in.). The absence of current year class clams at both stations suggests that larval set may be sporadic and undependable in the Bay.

Vegetation Survey

Natural beds of marine vegetation form one of the most prominent features of undisturbed estuarine habitat in shallow waters of the west Florida coast. Several species of grass are still abundant shoreward of the 1-fath. (fathom) line in Tampa Bay but in two sections, Hillsborough Bay and northern Boca Ciega Bay, flourishing beds have disappeared. We surveyed the remaining beds and charted them for further reference (fig. 7).

BIOGEOCHEMICAL ALTERATION AND EFFECT PROJECT

Charles M. Fuss, Jr.

This project was initiated during the reporting year for the study of modification in estuarine habitat resulting from coastal engineering activities. The objectives are to establish techniques for the revitalization of disturbed areas and to provide methods of preserving productive habitats despite increasing demands for other uses, such as building sites and causeways. Efforts are concentrated in an experimental approach toward the improvement of productivity and the general well-being of selected environments.

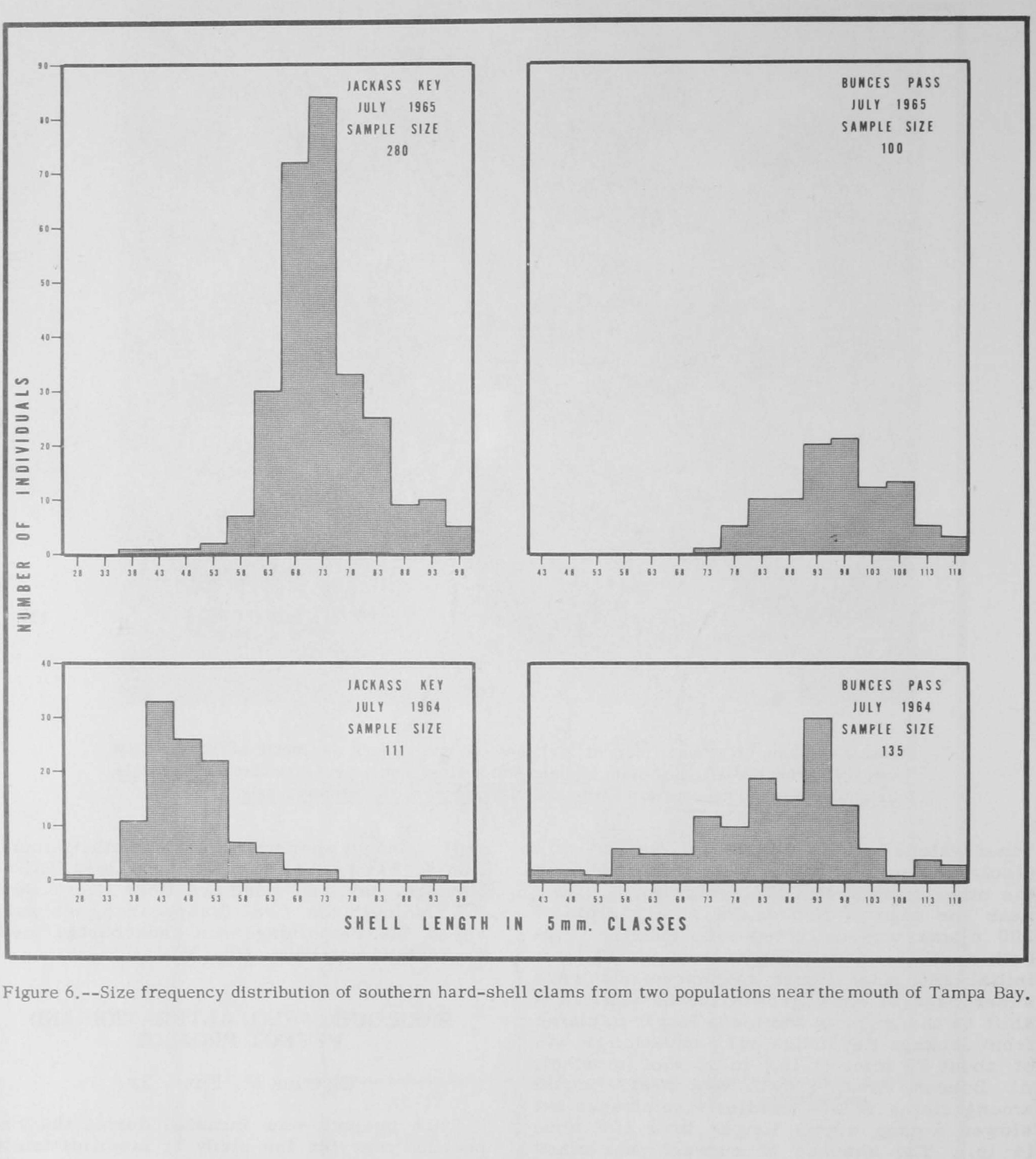


Figure 6.--Size frequency distribution of southern hard-shell clams from two populations near the mouth of Tampa Bay.

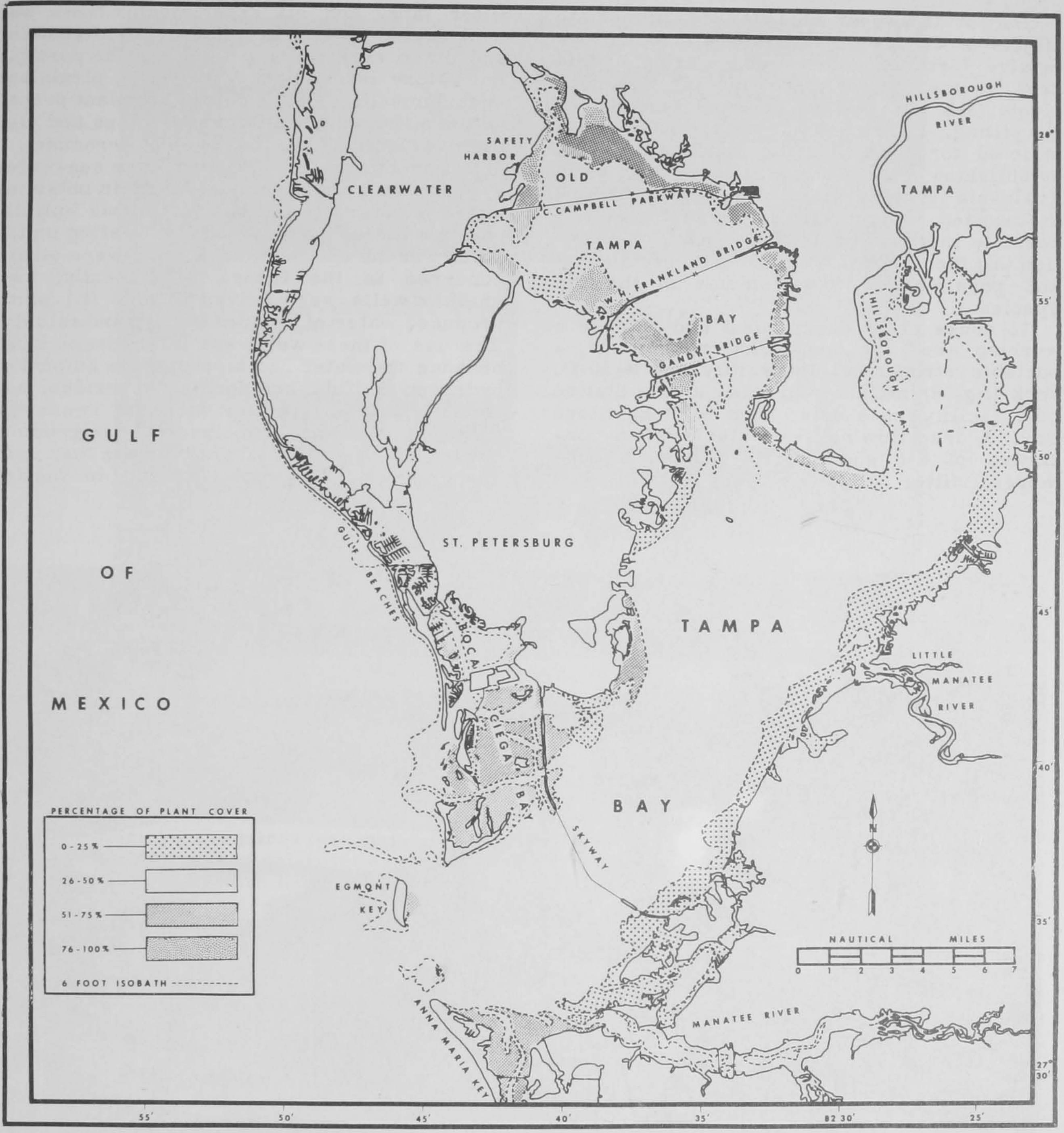


Figure 7.--Location and abundance of submerged vegetation in Tampa Bay.

One of the most obvious and immediate effects of dredge-and-fill operations, an extensive form of coastal engineering in this area, is the destruction of marine flowering plants (sea grasses) by physical removal or by silting. Initial efforts therefore are restricted to studies on the feasibility of reestablishing certain grasses (principally Thalassia testudinum and Diplanthera wrightii) on denuded bottoms. Experiments began with possible methods of artificial plant propagation and the determination of certain ecological and physiological requirements of the two species.

To house project equipment and provide a working area for controlled experiments, a portable stran-steel laboratory and a 30-ft. dock (fig. 8) were constructed at the Station boat facility on a small arm of Boca Ciega Bay. A free-flowing sea-water system consisting of two submersible pumps, a submerged filter intake unit, an aerating and filter tank, and six experimental tanks was constructed on a dock for light-attenuation and other experimental studies. The portable laboratory is equipped with large, plexiglass aquariums (fig. 9) for controlled plant propagation and productivity investigations and also provides office space for project personnel.

In our efforts to develop an open sea-water system, we encountered difficulty in obtaining water of adequate clarity. Water was initially pumped through a gravel filter resting on the bottom at the end of the dock, but severe silting occurred in the filter. Subsequently, two shallow wells were driven (2 to 8 ft.) which produced water of desired clarity and salinity. The use of these wells was later discontinued because the water had an excessive amount of hydrogen sulfide and formed a residue, apparently caused by sulfur bacteria. Two intake filters consisting of horizontal well points covered with sand and gravel were then used successfully. They are encased in wooden

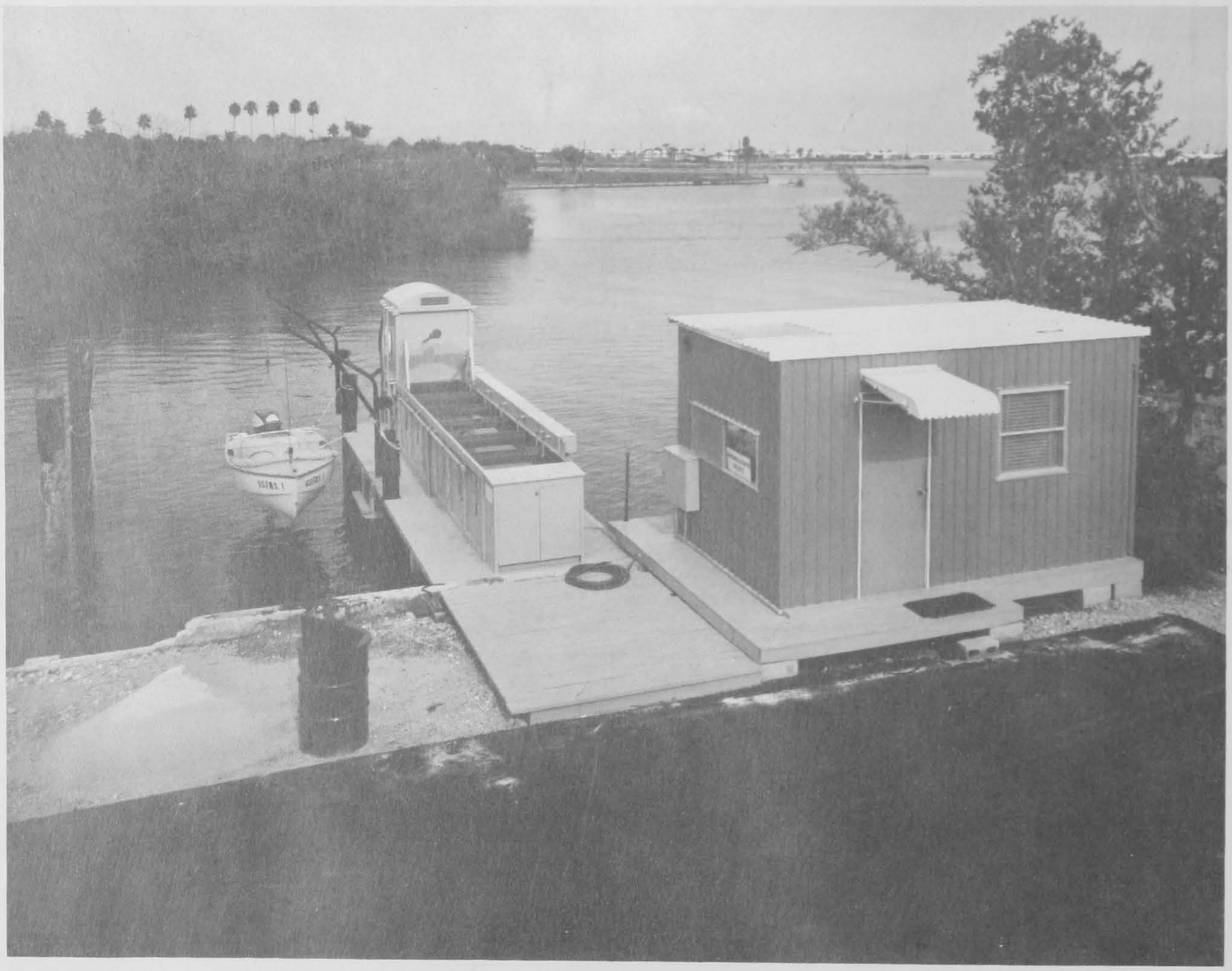


Figure 8.--Project facilities for experiments in revitalizing nonproductive bay bottoms.

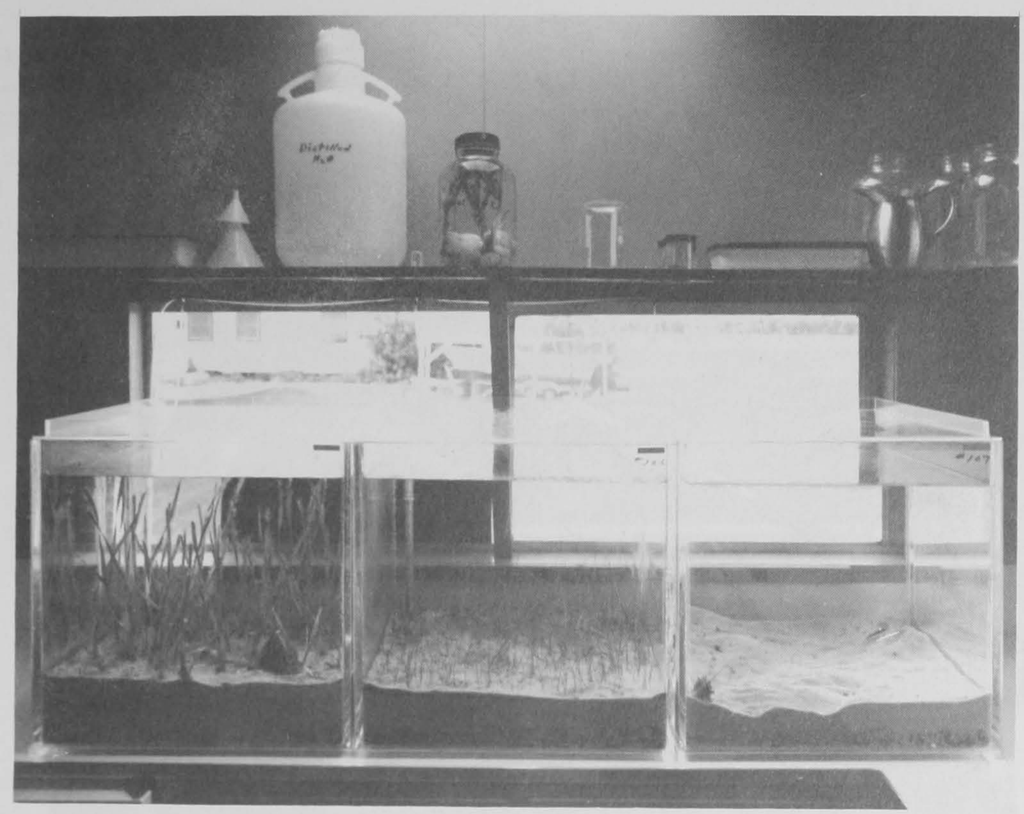


Figure 9.--Laboratory aquariums for sea-grass cultivation.

boxes and buried in the bottom. Intake filters require considerable back flushing when used with a natural water source that is rich in organic material but requires less maintenance than most elaborate internal-filter systems.

Preliminary field work consisted of reconnaissance surveys and general familiarization with an area of Boca Ciega Bay adjacent to a recently completed landfill. This area is typically modified from extensive dredge-fill operations and provides a natural laboratory for habitation experiments. In addition, it is near the Station and bordered in part by a relatively large undisturbed area. Sea grasses are prolific in the border area and were once well established in the modified area.

Sites with luxuriant growths of sea grasses were selected for the collection of experimental plants; core samples were taken to determine how deep the root systems grow. The root depths of Thalassia were about 8 to 18 in., and of Diplanthera about 5 to 10 in. We made a transplanting experiment, but results are not available for this report.

Laboratory work began with emphasis on transplanting and maintaining experimental plants in the open sea-water system (fig. 10) and laboratory aquariums. One of the first aims is to measure the comparative light requirements of available sea grasses.

SEA SURFACE TEMPERATURE

Charles M. Fuss, Jr.

An infrared radiation thermometer (IRT) is used for aerial temperature surveys of the southeastern Gulf of Mexico. The flight plan was developed in consultation with the Gulf Coast Research Laboratory, Ocean Springs, Miss., and the U.S. Coast Guard Air Station, St. Petersburg, Fla. The survey encompasses an area between the Florida Keys and Anclote Key and from shore to the 100-fath. curve. The Coast Guard supplies aircraft on a space-available basis.

The survey incorporates sightings of fish schools. Reports including the sample chart (fig. 11) are issued on completion of flights. About 887 nautical miles is traversed during each survey. School-fish records are made available to the Bureau of Commercial Fisheries Exploratory Fishing and Gear Research Base, Pascagoula, Miss. Heavy concentrations of fish (species undetermined) were seen during the April flight inside the 10-fath. curve between Tampa Bay and Sarasota, Fla. These schools were absent during the second flight when the only sighting was about 70 miles offshore from Tampa Bay between the 20- and 40-fath. contours.

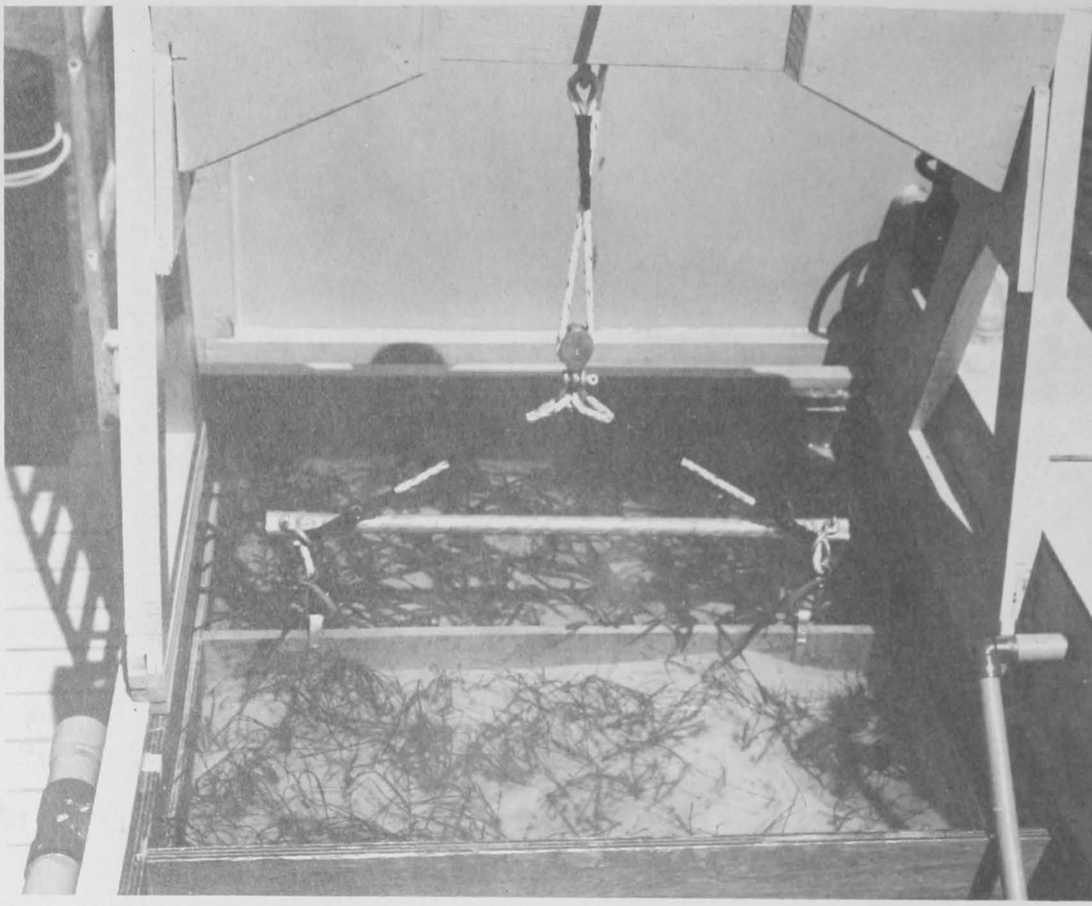


Figure 10.--Plants growing in trays suspended in experimental tanks.

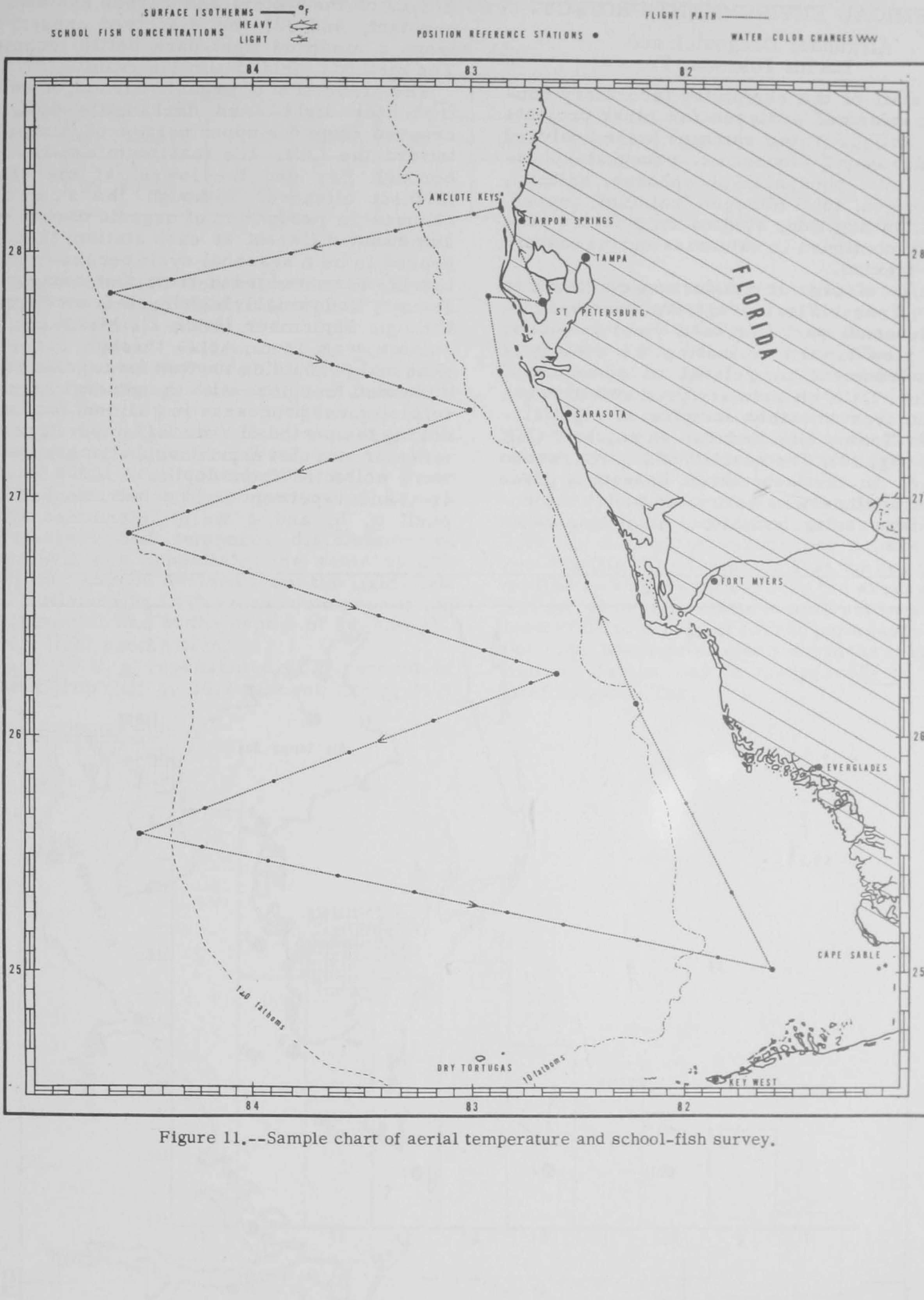


Figure 11.--Sample chart of aerial temperature and school-fish survey.

CHEMICAL ENVIRONMENT PROJECT

Alexander Dragovich and
Lucius Johnson, Jr.

The staff of the chemistry laboratory routinely performed analyses for other projects at the Station. Water samples were analyzed for chlorophyll, inorganic phosphate-phosphorus, total phosphate-phosphorus, salinity, iron, oxygen, total nitrogen, calcium, copper, and pH. In addition, studies on primary productivity continued in estuaries and the eastern Gulf of Mexico.

A study of organic production continued in waters of west Florida to determine magnitude, seasonal variation, and yield in carbon with a view toward evaluating the ecology of the environment as related to commercial fisheries. Data on primary productivity were obtained from monthly samples at eight stations in Tampa Bay and two in adjacent Gulf waters (fig. 12). The quantity of organic carbon produced in the sea water beneath a given area of surface was estimated by (1) chlorophyll data, solar radiation, extinction coefficient of the water, and carbon assimilation constant, and (2) the dissolved oxygen data from a modified light-dark bottle technique. The methods yielded similar results.

The production of organic carbon, estimated from the light- and dark-bottle data, decreased from the upper portion of Tampa Bay toward the Gulf. The maximum was in Hillsborough Bay and the lowest at the station farthest offshore. Although the seasonal changes in production of organic carbon were somewhat different at each station, there appeared to be a seasonal cycle because minimal levels were recorded from October through January and variably high levels from February through September (table 2). Maximum production was from April through June. The seasonal production rhythm for organic carbon coincided therefore with the general reduction in biological processes in resident organisms during the period of reduced temperatures.

Water samples for chlorophyll measurement were collected from depths of 100-, 50-, 25-, 10-, and 1-percent light penetration. Chlorophyll a, b, and c were determined with a

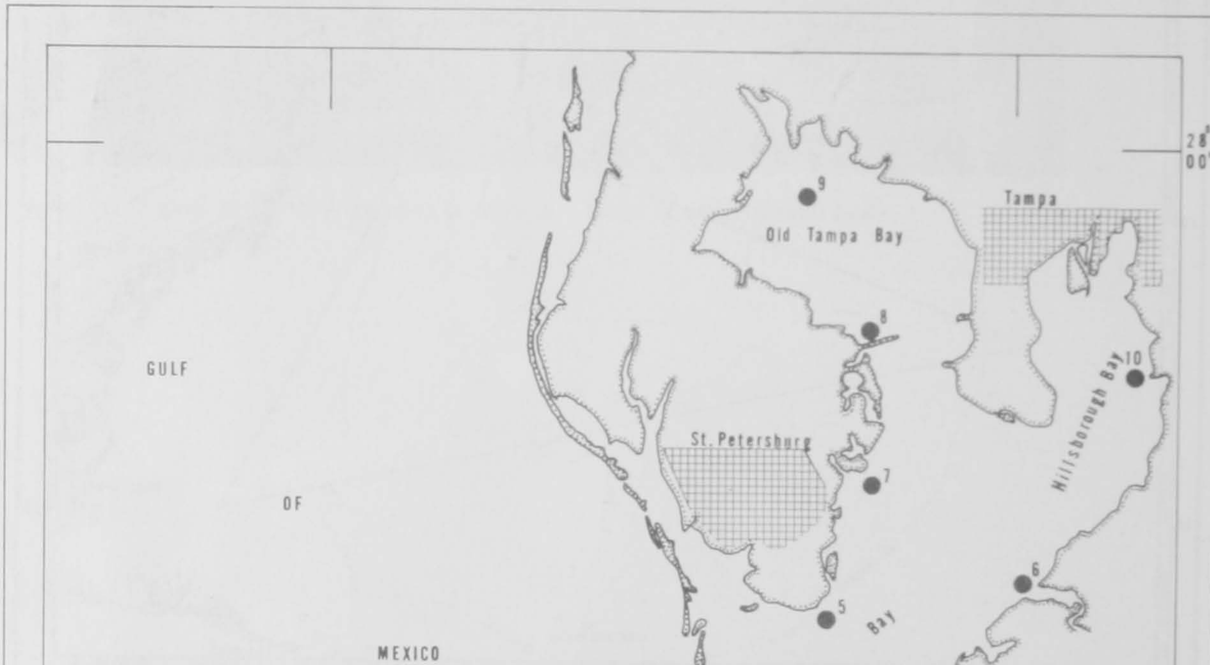


Figure 12.--Sampling stations in Tampa Bay area.

Table 2.--Mean values for primary productivity in Tampa Bay

[g. C/m.^{2}/day]

1964						1965					
July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
.96	1.19	1.23	.64	.74	.56	.48	1.25	1.00	1.46	1.32	1.66

spectrophotometer. Concentrations of chlorophyll a, the predominant chlorophyll pigment in phytoplankton, varied from 0.42 to 25.54 mg./m.^{3}. Mean chlorophyll a, b, and c values for Tampa Bay were 5.81, 5.00, and 3.00, respectively. The grand average of chlorphyll value for Tampa Bay was 3.7 times greater than that for adjacent offshore areas. The chlorophyll a values reported for Alligator Harbor, Fla., were considerably below those observed in the upper portion of Tampa Bay.

The areal and temporal distribution of chlorophyll was essentially the same as that of organic carbon derived from the light- and dark-bottle method. The maximum production of chlorophyll was at the depths of 50- and 25-percent light penetration.

Chlorophyll a represented 42.2 percent of total chlorophyll; b, 35.9 percent; and c, 21.9 percent. The percentage relationship of chlorophyll pigments suggests that the phytoplankton population consisted chiefly of diatoms, dinoflagellates, and Chlorophyceae. The high percentage of chlorophyll b suggested that Chlorophyceae were well represented.

The occurrence of ratios less than one of chlorophyll c to chlorophyll a is characteristic of inshore waters. Ratios were less than one in 89 percent of all observations.

The productivity values of organic carbon calculated from chlorophyll a data varied from 0.01 to 0.25 g. of carbon per square meter per day (fig. 3). Assuming that the dry organic matter is 50 percent carbon, the average production of organic matter for all stations varied from 0.02 to 0.50 g. of carbon per square meter per day. Average productivity in the upper portion of Tampa Bay is comparable to that of East Lagoon, Tex.

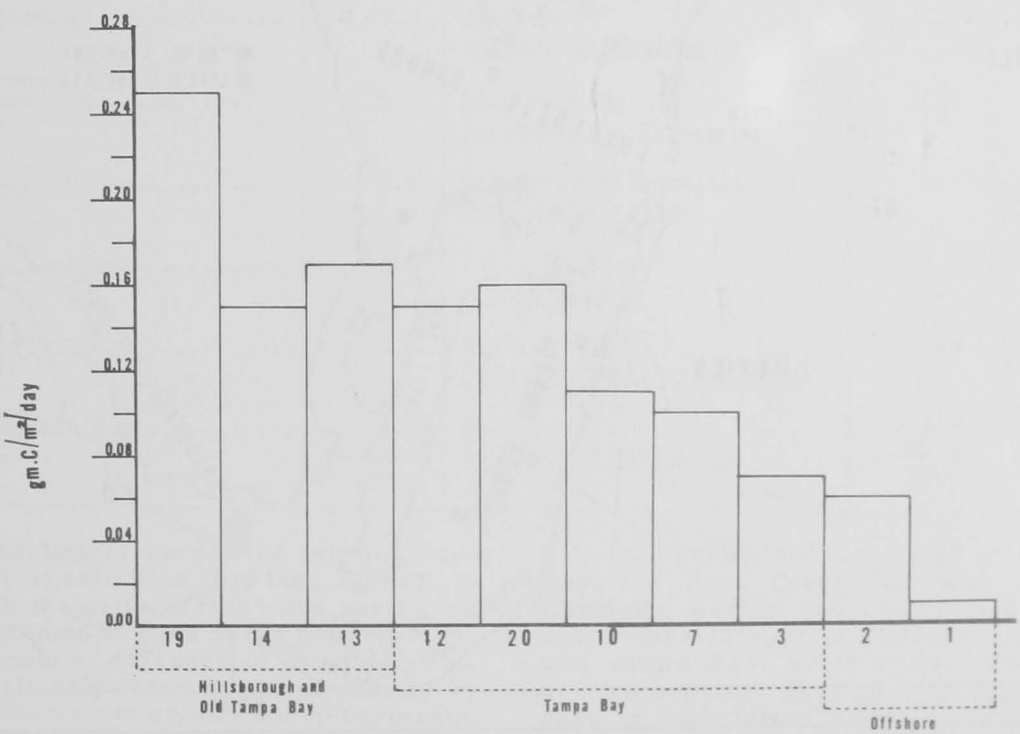


Figure 13.--Primary productivity values for Tampa Bay and adjacent Gulf waters--July 1964 through June 1965. (Numbers below bars represent stations)

FAUNAL PRODUCTION PROJECT

John H. Finucane

During the year, a comparative survey of finfishes was completed in Pine Island Sound, a high-salinity area, and Charlotte Harbor, an area of low salinity. The study yielded information on species composition, seasonal occurrence, and major ecological conditions of the estuaries. A comparison was also possible of numbers and species of fish caught in these areas with those taken in Tampa Bay.

Monthly sampling was conducted at 14 stations from January 1964 through January 1965 in Charlotte Harbor and Pine Island Sound (fig. 14). Five trawl and two beach seine stations were located in each area. We collected specimens in 39 families, 75 genera, and 89 species. The dominant families were Sparidae, Engraulidae, Gerridae, Sciaenidae, Atherinidae, Mugilidae, and Cyprinodontidae. Fifty-eight percent of the fish were caught in Charlotte Harbor, and 42 percent in Pine Island Sound. The bay anchovy, *Anchoa mitchilli*, accounted for 46.2 percent of the total fish caught in Charlotte Harbor, and the pinfish, *Lagodon rhomboides*, contributed 44.5 percent of the total catch in Pine Island Sound (table 3). The principal fishes collected by trawl in deep water were pinfish, bay anchovy, mojarra, spot, pigfish, and silver perch. The catch of the beach seines consisted mainly of silversides and cyprinodontids.

Most fish were widely distributed throughout the two areas, although 18 species were caught only in Pine Island Sound and 16 only in Charlotte Harbor. These fishes included species found in a limited salinity range. For example, the gag, *Mycteroperca microlepis*, and the permit, *Trachinotus falcatus*, were taken only in Pine Island Sound at salinities above 30 p.p.t. (parts per thousand) whereas the ocean pout, *Macrozoarces americanus*, and the rough silversides,

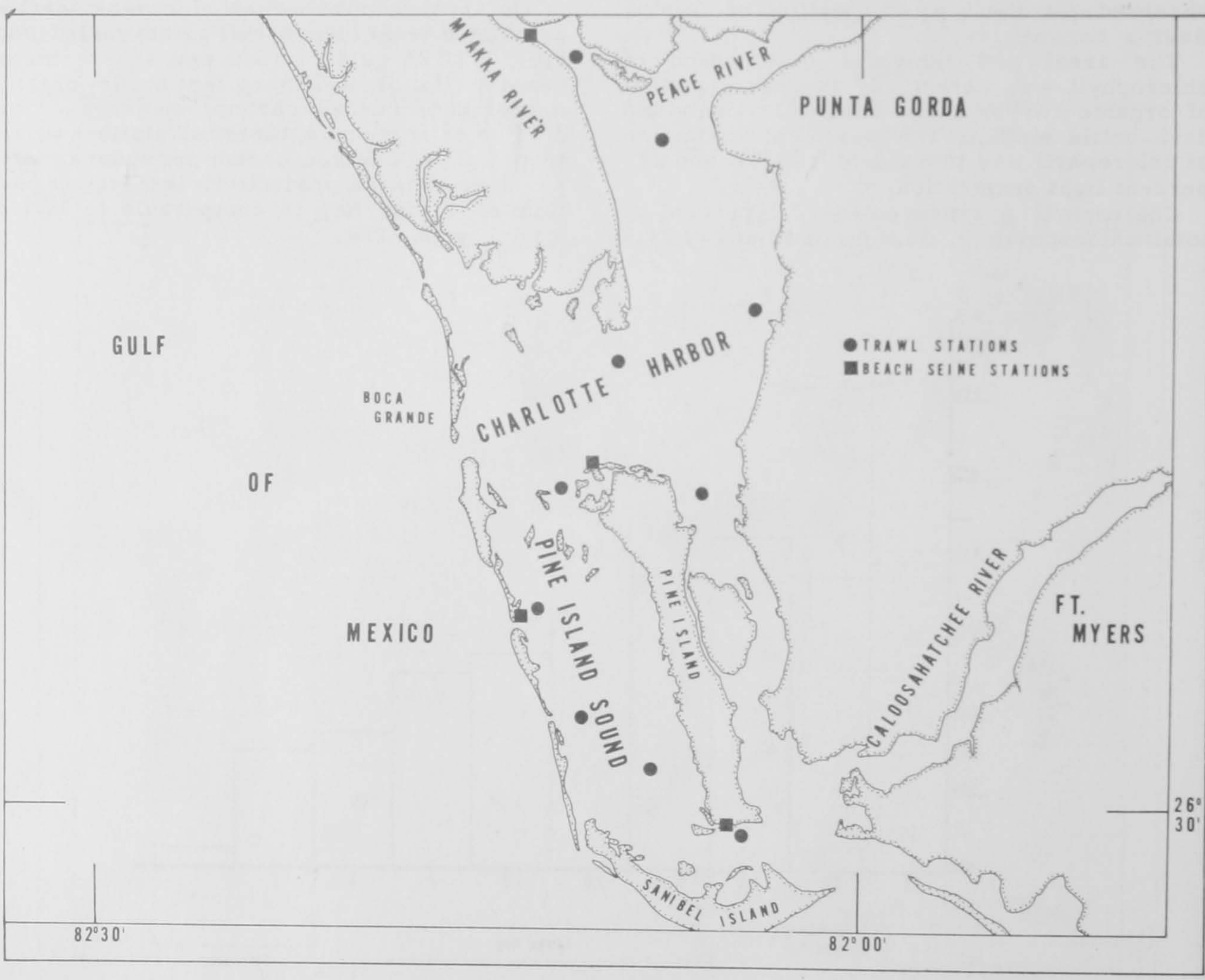


Figure 14.--Fish sampling stations in Pine Island Sound and Charlotte Harbor.

Table 3.--Dominant families and species of fish caught in Charlotte Harbor and Pine Island Sound, January 1964 through January 1965

[Percentage of catch taken from total number of fish caught monthly at five trawl and two beach seine stations in each area]

Families	Catch	Species	Catch
Charlotte Harbor			
	Percent		Percent
Engraulidae..........	47.9	Bay anchovy Anchoa mitchilli.	46.2
Sparidae.............	12.3	Pinfish Lagodon rhomboides.	12.2
Sciaenidae...........	10.6	Spot Leiostomus xanthurus.	6.5
Atherinidae..........	7.6	Silver jenny Eucinostomus gula.	5.4
Gerridae.............	6.0	Tidewater silversides Menidia beryllina.	5.0
Cyprinodontidae.......	4.1	Menhaden Brevoortia spp.	3.9
	88.5		79.2
Pine Island Sound			
Sparidae.............	45.6	Pinfish Lagodon rhomboides.	44.5
Gerridae.............	21.4	Silver jenny Eucinostomus gula.	20.2
Atherinidae..........	8.6	Tidewater silversides Menidia beryllina.	8.6
Sciaenidae...........	5.0	Cuban anchovy Anchoa cubana.	3.0
Mugilidae.............	4.4	Pigfish Orthopristis chrysopterus.	2.9
Engraulidae...........	3.3	Spot Leiostomus xanthurus.	2.8
	88.3		82.0

Membras martinica, were found only in Charlotte Harbor at salinities less than 30 p.p.t. In general, the majority of fish were euryhaline and were common to each of the two areas.

The seasonal occurrence of most fish followed a distinct pattern governed mainly by their migration from or into the embayments. Generally, the numbers of fish were smallest during the winter and the greatest during the summer and fall (table 4). The largest number of species was found in September 1964.

In comparing fish collected in Old Tampa Bay and Boca Ciega Bay with those from Charlotte Harbor and Pine Island Sound, we noted that most species preferred similar habitats within these study areas. Some fish such as the herring, Opisthonema oglinum, were rare in Pine Island Sound and Charlotte Harbor, and the pigfish, Orthopristis chrysopterus, was less abundant in Boca Ciega Bay than in Pine Island Sound. The greatest numbers of fish were taken in Old Tamp Bay; Boca Ciega

Table 4.--Catch per unit of effort at sampling stations in four estuarine systems

Date	Trawl	Beach seine	Total[1]	Trawl	Beach seine	Total
	(Old Tampa Bay)			(Charlotte Harbor)		
1964						
March	72.6	548.0	208.4	64.4	206.5	105.0
May	252.4	271.5	257.8	28.6	243.0	89.9
July	125.6	124.5	125.3	71.0	1,075.5	358.0
September	100.6	8,416.5	2,476.6	119.2	279.0	164.9
November	239.8	783.0	395.0	81.0	75.0	79.3
1965						
January	121.0	87.5	111.4	10.8	176.5	58.1
	(Boca Ciega Bay)			(Pine Island Sound)		
1964						
March	29.8	741.0	233.0	23.8	460.0	148.4
May	101.8	376.0	180.1	49.2	518.0	183.3
July	98.6	178.0	121.3	40.0	176.5	79.0
September	105.8	146.0	117.3	286.6	241.0	273.6
November	52.0	720.0	57.7	104.4	192.0	129.4
1965						
January	50.2	203.0	93.9	78.0	40.0	67.1

[1] Total catch per unit of effort is based on the average number of fish caught monthly from five trawls and two beach seine sampling sites.

Bay and Pine Island Sound yielded similar numbers. The bay anchovy was the most numerous species in the brackish waters of Old Tampa Bay and Charlotte Harbor. In the higher salinity of Pine Island Sound and Boca Ciega Bay, the pinfish was dominant.

Plankton Collections

Plankton was collected with high-speed samplers at a series of stations in four Florida estuaries and in the Gulf of Mexico from St. Petersburg south to Boca Grande. We separated fish eggs and larvae from the plankton and tentatively determined to which families the shrimp and crab larvae belonged. Some larval stages of the blue crab, Callinectes sapidus, were recorded. Identification of eggs and larvae permits us to determine which major species of fish and shellfish use Florida estuaries as nurseries.

Data from Old Tampa Bay and Hillsborough Bay showed that the largest number of pelagic fish eggs occurred in the spring and summer and the fewest in the winter. The seasonal pattern of abundance was similar for fish larvae in Old Tampa Bay, although they were almost absent throughout the year in Hillsborough Bay.

Most of the fish eggs in both areas belong to the following families: Engraulidae, Sciaenidae, Clupeidae, Solenidae, and Atherinidae. Presence of early cleavage and blastula stages in some of these groups indicates some spawning in Tampa Bay.

The dominant fish larvae in Old Tampa Bay were the seatrout, Cynoscion spp.; anchovy, Anchoa spp.; spot; and menhaden, Brevoortia spp. The presence and abundance of these commercial, sport, and forage species prove that the area is an important nursery. In contrast, few fish larvae were collected in Hillsborough Bay, which indicates poor fish productivity in this area.

The seasonal distribution of shrimp and crab larvae showed a wide variation between areas in the upper Bay. Larvae of shrimp and crab were more abundant during the fall and early winter as compared to Hillsborough Bay. Portunid crab larvae were found in both sampling areas but were most frequent in Old Tampa Bay. Early larval stages were caught in May, September, and November. Late zoea and megalops crab larvae were more common during the fall and winter.

Oyster Spatfall Study

A study of the spatfall of oysters, Crassostrea virginica, was begun in April 1964 to determine the incidence of setting above and below a proposed impoundment. If plans materialize, a 17-square-mile, fresh-water lake will be created in the upper part of Old Tampa Bay. The results of our work provide preconstruction and postconstruction data useful in evaluating the effects on the oyster industry. Oyster spat were collected on asbestos plates held in wooden racks and suspended above the bottom (fig. 15). Preliminary results showed continuously high spat production. The spatfall in May and June showed no tremendous change from week to week (table 5). During an 8-wk. period, 2,426,288 spat were counted on 94 plates. The highest average spat count was 62,877 per square foot, and the lowest was 149 per square foot. Counts averaged 60.5 percent on the outer rough surfaces of plates and 39.5 percent on the smooth inner surfaces. Oyster spat sometimes grew 0.1 in. in a week, although normally growth was less than 0.1 in. The 1-mo.-old animals averaged 0.5 in.

Very few oyster predators were seen on the plates. The flatworm, Stylochus ellipticus, was the most common but seldom exceeded one or two per plate. On commercial beds, however, these flatworms were numerous and caused some oyster mortality. Eggs of other Stylochus spp., snails, and fish were noted on the plates. Counts of barnacles often exceeded 150 per square inch. Bryozoans, tube worms, and other fouling organisms were rare.

Both water temperature and salinity followed the normal seasonal change, and hydrology varied little between the upper and lower parts of Old Tampa Bay. Temperature during the period April 1 to July 1 ranged from 65.8° to 89.6° F., and salinity from 23.28 to 30.25 p.p.t. The average temperature was 79.3° F., and the average salinity was 26.41 p.p.t.

Figure 15.--Collecting racks and plates used in determining spatfall of the oyster, Crassostrea virginica, in Old Tampa Bay.

Table 5.--Oyster spatfall in Old Tampa Bay, average counts per square foot at sampling stations and total number per week, by periods of exposure, 1965

Station locations	Sampling periods			
	April 29-May 6	May 6-May 13	May 13-May 20	May 20-May 27
Area A[1]				
Safety Harbor.................	1,581	1,051	911	4,306
Oldsmar......................	2,278	39,888	62,877	18,256
Courtney Campbell............	930	195	3,469	1,879
Area B				
Rocky Point..................	149	1,218	149	4,966
Howard Frankland.............	326	902	25,928	23,408
Gandy Bridge.................	1,144	6,584	10,416	5,833
Grand total plate count[2]........	25,166	199,941	415,450	235,123

Station locations	May 27-June 3	June 3-June 10	June 10-June 17	June 17-June 24
Area A[1]				
Safety Harbor.................	7,793	10,267	40,288	49,457
Oldsmar......................	18,358	13,978	59,799	48,992
Courtney Campbell	3,422	6,408	15,233	
Area B				
Rocky Point..................	5,989	2,511	4,594	4,138
Howard Frankland.............	12,908	6,529	4,324	16,377
Gandy Bridge.................	7,254	17,512	12,741	13,913
Grand total plate count[2]........	223,488	222,754	567,728	536,638

[1] Area A is in the proposed fresh-water lake impoundment area above Courtney Campbell Parkway, and Area B is below the impoundment.
[2] Shows total number of oyster spat counted per week.

PLANKTON ECOLOGY PROJECT

Alexander Dragovich and John A. Kelly, Jr.

Distribution and Occurrence of Gymnodinium breve on the West Coast of Florida

From February 1964 through February 1965 surface-to-bottom samples of water were collected monthly from 22 stations in Tampa Bay and Charlotte Harbor and on transects extending 20 miles offshore (fig. 16). The purpose was to obtain data on distribution of the Florida red-tide organism over a large portion of its range and throughout an entire year. Such a comprehensive study had not been accomplished previously. Associated phytoplankters were taken in water samples containing G. breve for qualitative and quantitative analysis of plankton succession. Oceanographic data were also recorded from each station.

Counts of G. breve varied from 0 to 200,000 cells per gallon. The organism was absent in Tampa Bay during the entire period of observation; in Charlotte Harbor, it appeared once in April and once in July, and both times samples contained less than 400 cells per gallon. It was present at all offshore stations; the greatest numbers per sample were off Venice Inlet and the least off Boca Grande Pass. Incidence of samples containing G. breve on transects off Tampa Bay and off Johns Pass was about the same. The greatest incidence was 15 miles offshore and the least 5 miles offshore.

G. breve was present at all depths sampled. The percentage of "positive" samples was highest at the surface and at 5 m. (16.4 ft.) and lowest at 20 m. (65.6 ft.). Concentrations of 4,000 cells or more per gallon were noted exclusively at the surface and at 5 m. The areal and vertical distribution of G. breve was patchy.

Except during February and September, cell counts of G. breve remained less than 4,000 per gallon. The highest counts were in September at the surface 5 miles off Anna Maria Inlet. Samples containing no G. breve occurred randomly at all stations throughout the year but were most numerous in October and November.

Occurrence of Gymnodinium breve in Relation to Temperature and Salinity

G. breve was observed within a temperature range of 56.8° to 87.1° F. The highest number of positive samples was at 57.2° to 60.6° F. and from 78.8° to 82.2° F. On the basis of previous research, temperature during most of the study was within the favorable range for proliferation of G. breve.

G. breve was noted at salinities from 33.68 to 37.01 p.p.t. and principally between 35.00 and 36.90 p.p.t. It was detected only once at salinity greater than 37.00 p.p.t. The highest percentages of occurrence and density were during periods of lower salinity in February and September. Past observations showed that the observed salinity range was favorable for lethal blooms of G. breve (1,000,000 or more cells per gallon), but no outbreaks occurred. Results support the concept that salinity alone is not the decisive factor in blooms and that G. breve is a marine, near-shore organism which occurs in low concentrations during nonred-tide years in the offshore waters of west Florida.

Life Forms of Gymnodinium breve

Dinoflagellates commonly vary in shape. G. breve is no exception, because at least four distinct forms of the organism occurred in our study (fig. 17). The microscopic studies were made with an inverted plankton microscope (fig. 18). Form A, which was found primarily in offshore waters, has not been known to occur in blooming proportions. Form B, usually dominant in blooms, was found throughout the area of study. Predivision stages (form DF) were observed in form B only. Form C also occurred throughout the area, usually offshore to 15 miles. At times, form C has been observed in red-tide blooms. Form D, which occurred throughout the study with the other forms, was never observed in bloom proportions. All observed forms of G. breve were taken at all offshore stations and depth levels. At times, all four forms were present in the same sample, but form C was more frequent than the others.

Hydrologic Characteristics of Florida West Coast Tributaries

Red tides throughout the world occur primarily in coastal areas and usually are associated with periods of heavy rainfall and increased river discharge. The presence and growth of phytoplankton in coastal waters depend largely on the quantity and quality of inorganic and organic nutrients, particularly trace metals and external metabolites. Usually

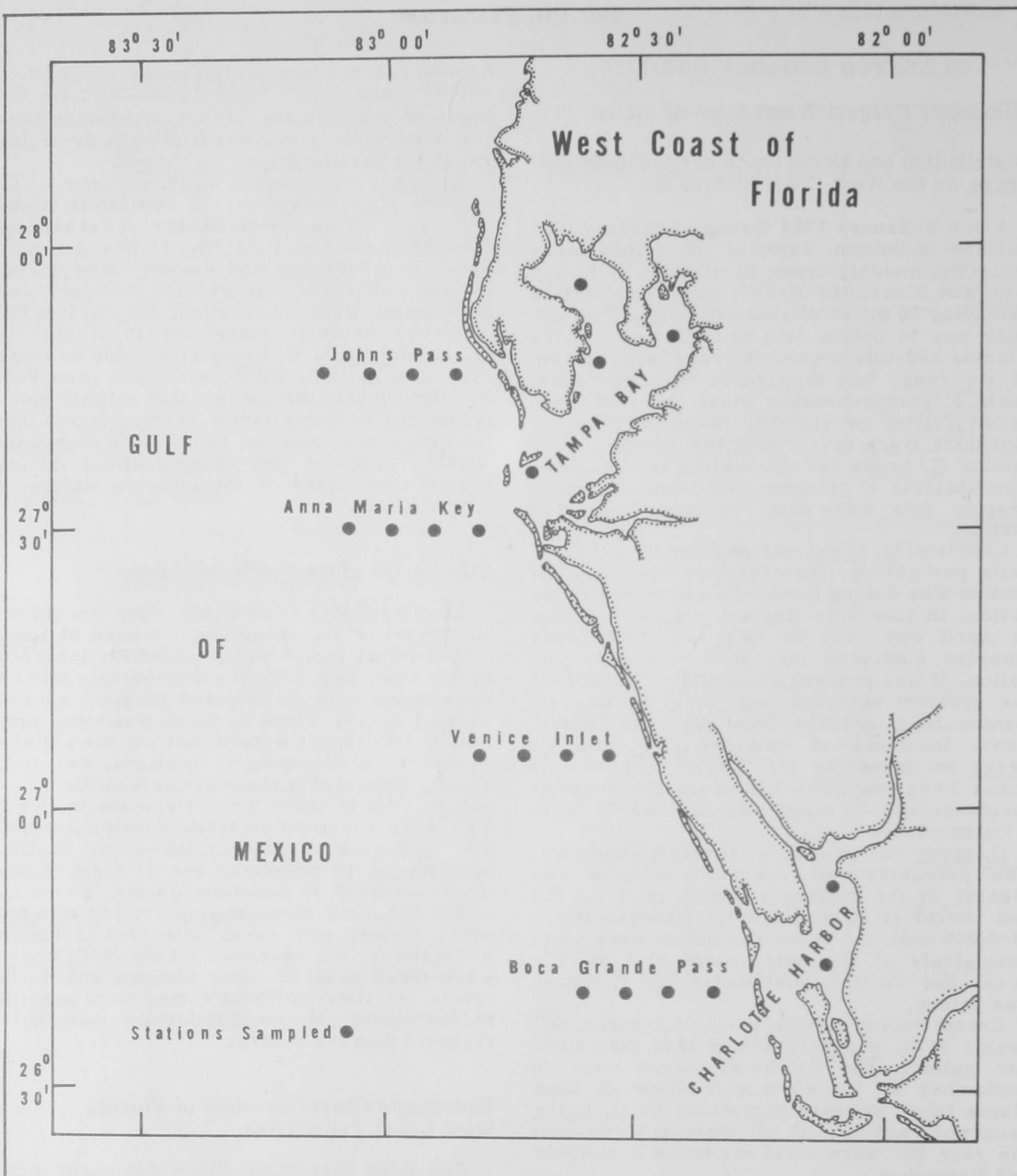


Figure 16.--Station locations in the coastal waters of west Florida.

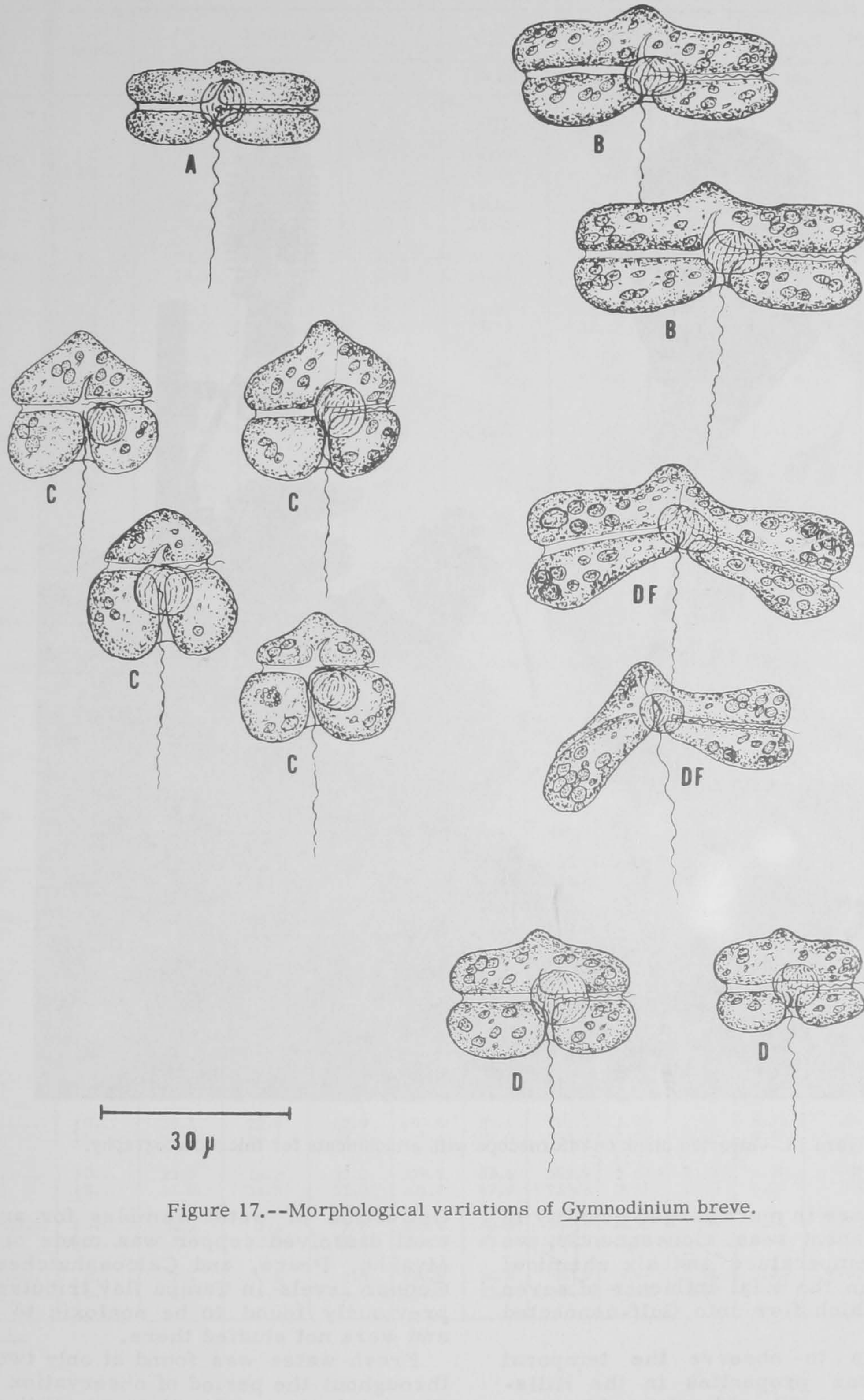


Figure 17.--Morphological variations of Gymnodinium breve.

Figure 18.--Inverted plankton microscope with attachments for microphotography.

these nutrients are in much larger quantity in rivers than adjacent seas. Consequently, we surveyed the temperature and six chemical properties within the tidal influence of seven major rivers which flow into Gulf-connected estuaries.

Our aim was to observe the temporal changes in those properties in the Hillsborough, Alafia, Little Manatee, Manatee, Peace, and Caloosahatchee Rivers. Temperature, salinity, dissolved oxygen, inorganic and total phosphate-phosphorus, iron, copper, and chlorophyll a were recorded for a year.

Collection of water samples for analysis of total dissolved copper was made only in the Myakka, Peace, and Caloosahatchee Rivers. Copper levels in Tampa Bay tributaries were previously found to be nontoxic to G. breve and were not studied there.

Fresh water was found at only two stations throughout the period of observation (table 6). The total range of salinity at all the remaining stations included oligohaline (< 0.5 p.p.t.), mesohaline (5 to 18 p.p.t.), and polyhaline (18 to 30 p.p.t.) conditions. The temporal changes in salinity were influenced by rainfall and river

Table 6.--Mean, minimum and maximum values of hydrologic properties in Florida west coast tributaries, January 1964 to January 1965

Rivers	Depth	Temperature			Salinity			Chlorophyll a		
		Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
		°F.	°F.	°F.	p.p.t.	p.p.t.	p.p.t.	mg./m.³	mg./m.³	mg./m.³
Hillsborough..... (downstream)	S...	77.7	64.4	89.1	4.58	0.07	27.79	12.41	1.15	71.40
	B...	77.5	64.2	89.6	10.75	.12	27.94	12.03	1.13	57.92
Alafia.......... (downstream)	S...	78.3	59.0	90.3	13.44	3.32	21.04	8.13	2.65	12.70
	B...	78.1	58.1	90.3	18.45	11.76	24.52	12.03	2.87	33.36
Little Manatee... (downstream)	S...	78.1	55.4	89.1	14.99	2.21	23.28	3.92	1.73	5.96
	B...	78.1	55.0	89.8	16.84	2.34	28.12	5.05	2.63	16.12
Manatee.......... (downstream)	S...	78.1	56.3	86.7	21.94	3.26	28.89	5.44	1.17	11.90
	B...	77.7	56.3	86.9	23.35	12.18	28.93	7.68	1.33	32.90
Myakka........... (upstream)	S...	76.3	60.1	83.3	.10	.07	.25	7.18	.96	18.08
	B...	76.3	58.5	84.7	.11	.06	.21	6.75	1.51	14.51
Myakka........... (downstream)	S...	75.7	58.6	88.7	5.27	.12	13.66	5.25	2.43	8.62
	B...	75.4	59.2	87.8	5.28	.17	13.75	5.79	2.80	11.11
Peace............ (upstream)	S...	76.8	59.5	86.2	.12	.06	.48	82.28	3.76	245.52
	B...	76.5	58.6	86.0	.14	.02	.32	49.92	12.12	124.72
Peace............ (downstream)	S...	75.7	59.2	88.2	17.91	1.60	24.88	8.73	2.11	17.16
	B...	75.6	59.4	87.8	18.65	1.60	24.88	9.89	3.94	18.75
Caloosahatchee... (upstream)	S...	76.8	62.6	88.7	5.04	.21	12.85	10.64	2.86	32.17
	B...	78.1	64.8	88.0	5.65	.12	16.18	13.53	2.34	28.95
Caloosahatchee... (downstream)	S...	76.1	61.3	88.0	10.91	.35	21.11	12.13	4.82	34.22
	B...	76.3	61.7	87.8	11.74	.35	23.19	17.93	5.84	89.84

Rivers	Depth	Total PO_4-P			Fe			O_2			Cu		
		Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
		µg.at./l.	µg.at./l.	µg.at./l.	µg./l.	µg./l.	µg./l.	ml./l.	ml./l.	ml./l.	µg.at./l.	µg.at./l.	µg.at./l.
Hillsborough..... (downstream)	S...	12.3	6.8	21.3	202.4	24.2	470.9	4.19	2.26	6.92	-	-	-
	B...	16.9	8.6	24.7	235.0	86.0	496.3	2.18	.44	4.30	-	-	-
Alafia.......... (downstream)	S...	27.5	14.3	35.4	216.6	78.8	893.7	4.05	1.94	6.60	-	-	-
	B...	28.7	9.2	61.6	381.0	148.5	713.3	3.31	1.13	5.86	-	-	-
Little Manatee... (downstream)	S...	22.7	15.3	30.1	187.5	54.5	422.8	3.53	1.57	6.20	-	-	-
	B...	22.0	16.2	29.9	219.0	60.6	830.2	3.46	1.78	6.36	-	-	-
Manatee.......... (downstream)	S...	15.2	10.1	18.1	217.0	52.7	560.4	3.82	2.10	5.39	-	-	-
	B...	15.7	12.9	21.9	251.6	87.9	413.3	3.71	2.74	5.39	-	-	-
Myakka........... (upstream)	S...	10.1	5.4	14.4	622.9	290.7	934.5	3.33	1.62	6.36	0.10	0.03	0.19
	B...	10.3	7.6	13.0	683.0	539.3	1,040.5	3.18	1.18	5.86	.10	.02	.23
Myakka........... (downstream)	S...	7.6	5.0	10.8	299.2	72.1	622.4	3.48	2.18	5.47	.04	.02	.12
	B...	8.2	5.4	12.7	434.3	70.9	1,540.4	3.52	2.10	5.31	.05	.02	.11
Peace............ (upstream)	S...	35.1	22.3	62.9	460.6	22.4	795.1	5.00	3.43	6.52	.04	.02	.08
	B...	33.3	29.4	47.5	490.4	197.0	810.2	5.09	3.19	7.56	.04	.01	.09
Peace............ (downstream)	S...	23.5	15.2	37.0	329.7	63.6	593.9	3.62	1.13	6.20	.05	-	.16
	B...	21.0	11.5	31.0	305.9	67.9	710.2	3.93	2.05	6.20	.04	-	.15
Caloosahatchee... (upstream)	S...	4.2	3.1	5.7	265.8	80.0	786.6	4.30	2.98	5.64	.04	-	.11
	B...	5.6	3.3	11.4	353.5	65.4	1,265.9	3.59	.76	5.39	.03	.02	.06
Caloosahatchee... (downstream)	S...	7.4	4.8	9.8	320.9	24.8	967.8	3.64	.91	5.80	.03	-	.09
	B...	8.7	5.0	19.5	414.3	73.9	1,004.1	3.48	2.10	5.15	.02	-	.11

S = Surface
B = Bottom

discharge. The instability of salinity presented ecological barriers to some organisms from both fresh-water and marine portions of the estuary. Since the favorable salinity range for the growth of G. breve under natural conditions lies between 21 p.p.t. and 37 p.p.t., observed conditions were favorable for the growth of G. breve only in certain situations.

The expected peaks in chlorophyll during spring or fall were not found at all stations. The data suggest, however, that this pigment may be produced throughout the year. Productivity in grams of carbon per square meter per day and quantity of organic dry matter were estimated through use of solar radiation, water transparency, and chlorophyll a data (table 7).

Iron was considered a possible factor in the investigation of variables which may be responsible for the bloom of G. breve. The relative dependence upon iron of several coastal and oceanic phytoplankters has been demonstrated by use of various quantities of Fe-EDTA in iron-deficient cultures. In view of the association of iron with river effluent, the possibility exists that this trace metal may be a factor in controlling the distribution of phytoplankton and particularly the blooms of G. breve in the coastal waters of west Florida.

Phosphorus was included in our study because it is important in the physiology of phytoplankton. The high phosphate levels in the rivers studied originate from the surface phosphate-bearing geological formations characteristic of the area (table 6). Inorganic phosphate-phosphorus exceeded organic phosphate-phosphorus in 83 percent of the observations. The quantity of phosphorus in rivers was high, phosphorus enrichment was evident in the bays, and concentrations decreased rapidly in a seaward direction.

Copper, in low concentration, is an essential trace metal for plankton; in higher concentrations it is toxic to plankton and other, higher forms of plants and animals; in concentrations between 0.8 and 1.6 μ g.at./l., it is toxic to laboratory cultures of G. breve. In 82 percent of our observations copper levels were below 0.10 μ g.at./l., and in no instance did they approach concentrations toxic to G. breve. The highest concentrations were recorded at a fresh-water station in the Myakka River (table 6). The mean value of copper (0.06 μ g.at./l.) for all rivers was higher than the corresponding value (0.03 μ g.at./l.) in Tampa Bay.

This survey has shown significant differences in the hydrologic properties among the rivers. The contribution of nutrients to the adjacent embayments depends much more on the volume of river discharges than on the concentrations of nutrients in the river. For example, in September during maximum discharges, the quantity of iron was 5.3 times greater than the combined quantity for the previous 7 mos. The minimum contribution of iron was at the period of low runoff during June. In view of the coincidental occurrences of red-tide outbreaks at or after periods of high river discharge, the information obtained should prove useful in further ecological studies of red tide.

DATA INTERPRETATION PROJECT

Recorded environmental and red-tide data were analyzed under a contract between the Bureau of Commercial Fisheries and the University of Alabama (Relation of Oceanographic Factors to the Florida Red Tide (Gymnodinium breve Davis) during 1954-61). George A. Rounsefell was the principal investigator.

Table 7.--Production of carbon and organic dry matter in Florida's west coast tributaries, January 1964 to January 1965

Rivers	Mean carbon	Mean dry organic matter
	G.C/m.²/day	G./m.²/day
Caloosahatchee (upstream)	2.5	5.0
Caloosahatchee (downstream)	2.0	4.0
Peace (upstream)	1.6	3.2
Peace (downstream)	11.0	22.0
Myakka (upstream)	.8	1.6
Myakka (downstream)	.9	1.8
Manatee (downstream)	.7	1.4
Little Manatee (downstream)	.8	1.6
Alafia (downstream)	2.9	3.8
Hillsborough (downstream)	2.0	4.0

Analysis of data spanning a 7-1/2-yr. period indicated clearly that the abundance of G. breve depends upon several oceanographic factors. A multiple curvilinear correlation showed that 61 percent of the monthly variability in abundance of G. breve is associated with variations in salinity, temperature, onshore winds of over 7 knots, and abundance of the organism during the previous month. No significant correlations were found between the residuals of this multiple correlation and nine variables, including inorganic phosphate-phosphorus, total phosphate-phosphorus, nitrate-nitrite nitrogen, copper, alkalinity, silicon, calcium, total organic nitrogen, and ammonia.

Temperature and salinity appear to interact so that lower temperatures are less unfavorable at higher salinities and vice versa. Medium to heavy blooms occurred only in months with average salinities between 28.9 and 34.6 p.p.t. The observed correlations both of total phosphorus and of the logarithm of nitrate-nitrites with G. breve abundance, although too low to be of statistical significance, were negative.

LIBRARY

Annemarie P. Rempel

Acquisition of library materials continued to increase during the year; 189 volumes of books and numerous issues of journals, monographs, reports, and reprints were received. Forty-nine scientific journals were subscribed to, and letters requesting publications were written to 230 institutions and individuals. New material was displayed on the journal rack for 1 mo. Lists of library acquistions continued to be distributed monthly to staff members and other marine laboratories in Region 2.

Interlibrary loan requests totaled 253; 156 of these items were received as Xeroxed copies for retention by this library. About 50 items were borrowed from local libraries, and 16 publications were lent to outside libraries and scientific personnel. Reprints of staff publications were sent to about 50 individuals and institutions as a result of direct requests and exchange agreements.

Shelf-list cards for all unbound material were made and filed with journal record cards. This listing supplies a rapid means of determining whether or not a specific item is held by the library. These cards together with shelf-list cards of bound volumes form a complete record of all material owned by the library and are used for inventories.

PUBLICATIONS

FINUCANE, JOHN H.
1964. Distribution and seasonal occurrence of Gymnodinium breve on the west coast of Florida, 1954-57. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 487, iv + 14 p.

MAY, BILLIE Z.
1964. Surface calcium-chlorinity relationships. Quart. J. Fla. Acad. Sci. 27(3): 177-185.

Manuscripts in Press

DRAGOVICH, ALEXANDER, JOHN A. KELLY, JR., and ROBERT D. KELLY.
A red water bloom of a dinoflagellate in Hillsborough Bay, Florida. Nature.

FINUCANE, JOHN H.
Threadfin shad in Tampa Bay, Florida. Quart. J. Fla. Acad. Sci.

FINUCANE, JOHN H., and GORDON R. RINCKEY.
A study of the African cichlid, Tilapia heudeloti Dumeril, in Tampa Bay, Florida. Proc. Southeast Game Fish Comm. 18th Annu. Sess., 1964.

ROUNSEFELL, GEORGE A., and WALTER R. NELSON.
Red-tide research summarized to 1964 including an annotated bibliography. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish.

SALOMAN, CARL H.
Bait shrimp (Penaeus duorarum) in Tampa Bay, Florida--biology, fishery economics,

and changing habitat. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish.

SYKES, JAMES E.
Multiple utilization of Gulf coast estuaries. Proc. Southeast Game Fish Comm. 17th Annu. Sess., 1963.

Bureau of Commercial Fisheries Symposium on red tide. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish.

Report of the Bureau of Commercial Fisheries Biological Station, St. Petersburg Beach, Florida, Fiscal Years 1962-1964. U.S. Fish Wildl. Serv., Circ.

SYKES, JAMES E., and JOHN H. FINUCANE.
Occurrence in Tampa Bay, Florida, of immature species dominant in Gulf of Mexico commercial fisheries. U.S. Fish Wildl. Serv., Fish. Bull. 65:

MS #1506

☆ U. S. GOVERNMENT PRINTING OFFICE : 1966 O - 216-265