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

FISCAL YEAR 1966

UNITED STATES DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

UNITED STATES DEPARTMENT OF THE INTERIOR
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Charles F. Luce, *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, Harold E. Crowther, *Acting Director*

Report of the Bureau of Commercial Fisheries Biological Laboratory St. Petersburg Beach, Florida

Fiscal Year 1966

James E. Sykes, Director

Contribution No. 32, Bureau of Commercial Fisheries
Biological Laboratory, St. Petersburg Beach, Fla. 33706

Circular 257

Washington, D.C.

August 1967

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Report of the Bureau of Commercial Fisheries Biological Laboratory St. Petersburg Beach, Florida

Fiscal Year 1966

ABSTRACT

This is the third fiscal report of the Bureau of Commercial Fisheries Biological Laboratory, St. Petersburg Beach, Fla. Progress in Estuarine and Red-Tide Research Programs is described by project. The application of biological information toward the maintenance and conservation of estuarine zones is stressed. The programs are designed to document the relatively unknown scope of biological productivity in the coastal zones of the eastern Gulf of Mexico, to measure the effect of changes in these zones, and to develop methods of increasing marine organisms which can be used by man.

REPORT OF THE LABORATORY DIRECTOR

James E. Sykes

RESEARCH STATUS AND TRENDS

In fiscal year 1966, the Bureau of Commercial Fisheries Biological Laboratory at St. Petersburg Beach, Fla., continued its assessment of estuarine productivity, investigation of factors influencing stability of the marine resource in coastal waters, and experiments with methods of increasing estuarine production. In addition to studies in Florida, plans were made to cooperate with other Federal and State laboratories in the scientific investigation of other Gulf of Mexico estuarine systems.

Research projects were principally concerned with bottom communities, fishes, shellfishes, sea grasses, plankton, and primary production. In addition, biological surveys were made in Tampa Bay to provide data essential to predicting the effects of proposed engineering projects, and offshore aerial observations furnished information on seasonal temperature regimes and movements of fish schools in coastal waters. In support of this and other work, 30 standard stations were established in the estuary to monitor hydrographic factors. Records from this routine sampling augment data accumulated over the past 14 years. Much of the earlier work was done in connection with red-tide research and forms a backlog of data submitted this year to NODC (National Oceanographic Data Center) for computer analysis. A contract was also arranged with the University of South Florida to characterize the toxin of the red-tide organism, Gymnodinium breve, an inhabitant of the estuarine zone.

Our most pressing tasks are to document thoroughly the capacity of coastal waters to produce harvestable seafood and to devise methods of channelling more of this potential production to the human consumer. Faced with insatiable demands by proponents of coastal development and with damages already caused by ill-conceived alterations, we are responsible for showing how the resources are being destroyed and for devising means of restoring the productive capacity of damaged estuaries wherever possible. Furthermore, avenues must be established and maintained for the exchange of viewpoints with business and industry in the effort to minimize damage to marine resources in the face of changes that are inevitable.

The national importance of Gulf of Mexico fisheries may be recognized by the fact that they now harvest about 36 percent of the Nation's total catch and are worth over $100 million annually to the fishermen. Over 90 percent of the species caught offshore live in estuaries during early life. Industry and residents are being attracted to the Gulf area at a rapid rate, and the demand for acreage adjacent to waterways is increasing. These pressures, if unchecked, will damage a number of estuaries including those not yet

seriously disturbed. Accordingly, Federal conservation agencies and some Gulf of Mexico States are accepting the challenge to protect the estuaries from some of the damaging effects of a growing human population. Recognition of the need for cooperative research has improved the exchange of information among Gulf research laboratories and created a desire to lend lateral support in solving mutual problems.

In late 1965, Bureau personnel from the Biological Laboratories at St. Petersburg Beach, Fla., and Galveston, Tex., met with the Estuarine Technical Coordinating Committee of the GSMFC (Gulf States Marine Fisheries Commission) and proposed a Gulf-wide estuarine inventory that would lead to a much needed atlas of four parts: area description, hydrology, sedimentology, and biology. The proposal was later accepted by the Committee at its March 1966 meeting in Biloxi, Miss. Some States are beginning the inventory with the aid of Federal funds (PL 88-309[1]). The BCF Biological Laboratory in St. Petersburg Beach will provide data from Florida waters and will also make studies in accordance with the GSMFC plan. The Laboratory is cooperating with the Estuarine Technical Coordinating Committee in formulating detailed plans for all phases of the inventory and in standardizing field and laboratory procedures.

The Laboratory programs have given attention when possible to methods of putting low-yield areas of estuaries back into full biological production. Restoration of grass beds, transplantation and establishment of shellfish populations, and use of oyster rafts in dredged areas that yield substantial plankton volumes but low benthic biomass are being studied. This aquicultural research is part basic and part applied.

Perhaps the greatest problem confronting planners and administrators of estuarine research is division of effort between fundamental and applied research. For instance, sophistication of scientists, instrumentation, and technique are required to produce in-depth knowledge of energy exchange, fertility, and other key estuarine mechanisms. Such studies are often long term but are of utmost value to the ultimate aim of protecting relatively unaltered coastal waters and rehabilitating those which have suffered from population and damaging engineering. On the other hand, rapid, short-term research and surveys are also necessary and have been valuable in combating man's unthinking and devastating activity in estuaries. This type of research has immediate application. Sound evaluation of biological production rates, standing crops, species diversity, bottom sediment composition, water chemistry, and other factors are essential to the retention of estuaries at or near existing conditions while more sophisticated answers are being sought. Otherwise even the estuaries with no previous record of scientific investigation are likely to be reduced in value as nurseries of marine organisms before any research is done on them.

The research programs of the Laboratory are planned and executed with a realization that the usually long-term fundamental approach must be taken, but also that, to prevent losses of productivity in estuaries, ecological facts must be available for immediate use. The research approach therefore is twofold. It is now weighted in favor of documenting the ecological status of estuaries with emphasis on pre- and post-alteration studies, but also includes basic long-term studies. The balance between fundamental and applied research will be observed constantly and adjusted as necessary.

We have noted that the release of requested data to official County and State agencies is often instrumental in the refusal of permits for engineering developments that will alter estuaries adversely; also that the effectiveness of scientific findings applied at the Federal level (U.S. Army Corps of Engineers) depends to a large degree upon local decisions. When there are no thorough biological data to present in response to permit applications at the local or Federal levels, no mechanism remains to impede estuarine destruction.

We find it encouraging that a Subcommittee on Ownership, Use and Disposition of State Lands has been formed in Florida. Members of this Subcommittee are now seeking ways to organize the legal authority for about 35 State agencies that own 1,441,545 acres in 67 counties. Present practices of selling State-owned submerged lands are also subject to examination by the Subcommittee to determine whether such disposition is compatible with the interests of all citizens or whether changes should be made. The multiplicity of activities occurring in bays and estuaries is also being examined critically.

At the invitation of the Chairman a staff member met with the Subcommittee to explain results of research compiled to date that show how estuarine modification affects elements of the marine resource. Findings were presented from Laboratory manuscripts and publications, which show differential values in phosphorus, oxygen, turbidity, sediments, and biota between disturbed and undisturbed estuarine areas. In instances such as this, Laboratory results can be used effectively by local agencies in their efforts to manage their resources wisely.

Biological data obtained by the Laboratory aided in setting a precedent in Florida during the past year. Results of studies and cooperation with the Bureau of Sport Fisheries

[1]Grant-in-aid to States to increase commercial fisheries.

and Wildlife, the Florida Board of Conservation, and other conservation groups helped prevent the granting of a permit for dredging and filling 500 acres of submerged land in lower Tampa Bay. Our field data proved that the area to be filled was one of the most fertile marine nurseries in the Bay system. Upon rejection of the plan at the County level, the developers asked the Bureau to assist them in reviewing alternate plans for dredging and filling adjacent to the area in question but removed from heavily vegetated bay bottom (figs. 1 and 2). As a result of the revised planning the two Bureaus of the Fish and Wildlife Service and the Florida Board of Conservation agreed to remove their objections provided that the developer would ensure

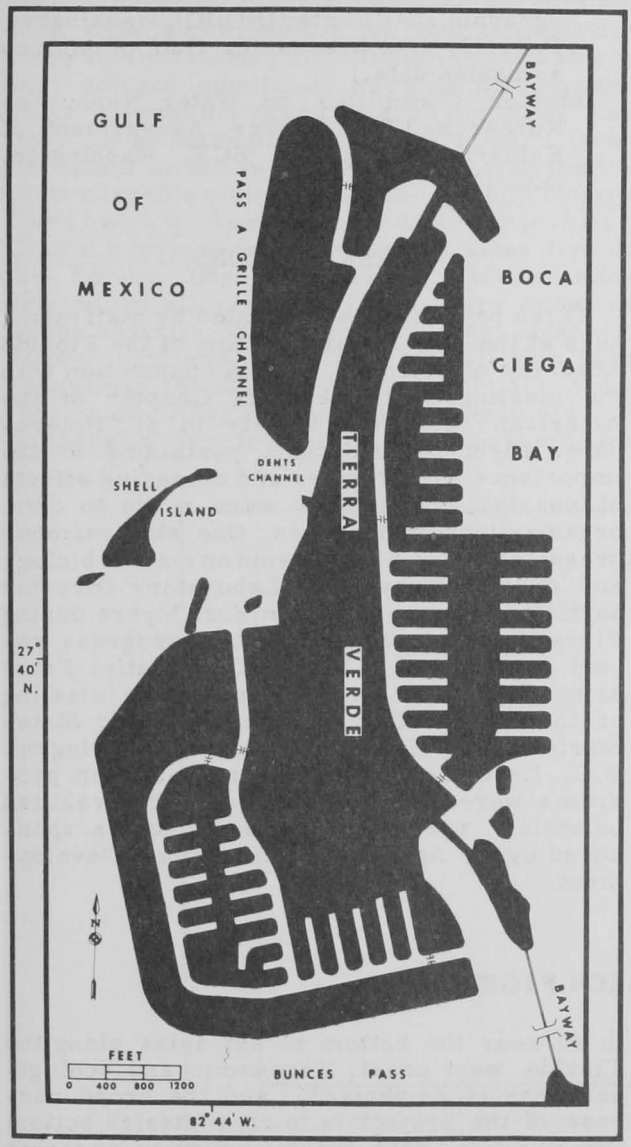


Figure 1.--Initially proposed development of real estate in Boca Ciega Bay by dredging and filling (development above Shell Island completed).

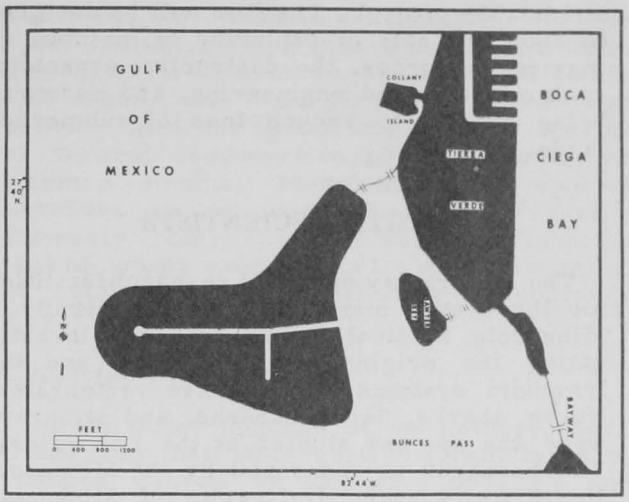


Figure 2.--Alternate proposal for lower portion of real estate development in Boca Ciega Bay.

continuation of adequate water circulation in the nursery area and prevent siltation during dredging. This success and the resolution of similar conflicts along the Atlantic coast should aid in proving that biological studies can be used effectively in protecting estuaries and the marine resource.

Biological data were also requested from the Laboratory by the Pinellas County Board of Commissioners and the Bureau of Sport Fisheries and Wildlife in connection with a proposed fresh-water lake in Old Tampa Bay. The lake would be created by impounding 11,000 acres (17 square miles) of the estuary. Bureau scientists are concerned about the loss of such a large nursery area and, especially, the certain damage to the oyster industry. The Bureau of Sport Fisheries and Wildlife and our Bureau submitted a joint report to the U.S. Army Corps of Engineers in objection to the proposal. Construction of the lake has been held in abeyance for about a year, but the fate of the area is not yet known.

REVIEW OF STATE RESEARCH PROPOSALS

Since the passage of PL 88-309 (Grant-in-aid to States to increase commercial fisheries), reviews of research proposals have been requested of BCF Laboratories by the Regional Director. The Laboratory staff has reviewed and made recommendations on nine project proposals for ecological studies in estuaries. We can perform this service with minimal expense to the Bureau, and, in doing so, keep staff scientists informed of estuarine studies being made by other agencies.

The Laboratory staff cooperated with Regional personnel and Gulf States representatives in planning a film on estuaries (also a

PL 88-309 project). The film will be designed to show the role of estuaries in maintaining marine resources, the destructive aspects of contamination and engineering, and research being applied to reduce loss of submerged lands.

VISITING SCIENTISTS

The Laboratory provided research facilities for three staff members of the University of Minnesota Medical School who are investigating the origins of immunity and the lymphoid systems of primitive vertebrates. Nurse sharks, lemon sharks, and stingrays were the species studied at the Laboratory. The research is sponsored by the Minnesota Heart Association, University of Minnesota Medical Foundation, American Cancer Society, and the Arthritis and Rheumatism Foundation.

Research facilities were also provided for a University of Georgia staff member, who studied parasites of the marsh hen.

TRAINING

Two staff members attended a GSA (General Services Administration) course in report writing at the BCF Biological Laboratory, Galveston, Tex.; two completed a graduate course in ichthyology and one a graduate course in the identification of algae at the University of South Florida; two attended a statistical workshop at North Carolina State University; and one continued working toward the Ph.D. degree at the University of Florida.

MEETINGS AND WORK CONFERENCES

Figures in parentheses show the number of persons attending.

American Fisheries Society, Portland, Oreg. (1)
Southern Division, American Fisheries Society, Tulsa, Okla. (2)
Executive Committee, American Fisheries Society, Pittsburgh, Pa. (1)
Gulf and Atlantic States Marine Fisheries Commissions, Miami, Fla. (1)
Biological Committee, Atlantic States Marine Fisheries Commission, Washington, D.C. (1)
Gulf and Caribbean Fisheries Institute and International Conference on Tropical Oceanography, Miami, Fla. (1)
Gulf States Marine Fisheries Commission, Biloxi, Miss. (1)
BCF Interlaboratory Meeting, Galveston, Tex. (2)
Florida Academy of Sciences and Florida Chapter, American Fisheries Society, St. Petersburg, Fla. (5)
Estuarine Technical Coordinating Committee, GSMFC, New Orleans, La. (1)
Scientific Exploration of the Atlantic Shelf (SEAS Committee), Washington, D.C. (1)
Conferences with staff of National Oceanographic Data Center (NODC), Washington, D.C. (2) [On processing Gulf of Mexico estuarine data.]
Interior Committee on Water Resources Research (Task Force Assessment of Estuarine Pollution), BCF, Washington, D.C. (1)

PRESENTATIONS

Three papers were presented by staff members at the 13th Annual Meeting of the Florida Academy of Sciences, held in conjunction with the meeting of the Florida Chapter of the American Fisheries Society in St. Petersburg. Eight presentations pertaining to the importance of estuaries and damaging effects of coastal development were made to civic organizations in the area. One staff member presented a radio discussion on marine biology and oceanography. The Laboratory Director participated on a panel in Fort Myers during Florida Conservation Week. A progress report on the Gulf of Mexico Cooperative Estuarine Inventory was presented at a meeting of the Biological Committee, Atlantic States Marine Fisheries Commission, Washington, D.C. Lectures on Laboratory research programs were given to a delegation of Brazilian scientists and fishery administrators sponsored by the Agency for International Development.

ESTUARINE RESEARCH PROGRAM

BENTHIC PROJECT

John L. Taylor and Carl H. Saloman

Benthic research at the Laboratory is primarily concerned with the identity, abundance, and distribution of plants and animals living in or near the bottom of estuaries along the Florida west coast. Taxonomic and ecological work is emphasized, and the broad purpose of the project is to characterize bottom communities, with special attention to forms that support commercially important species or enter commercial fisheries.

In the past year, we have continued a physical and biological analysis of benthic organisms in the Tampa Bay estuary. Other activities included: (1) study of damage to marine resources by hydraulic dredging, (2) evaluation of proposals for coastal alteration, and (3) further observations on growth rate of the southern hard-shell clam (Mercenaria campechiensis) and experimentation to determine growth and survival of the species in the estuary.

Tampa Bay Invertebrates

Cooperating systematists have helped us resolve a number of taxonomic problems among major invertebrate phyla of Tampa Bay. As a result, more attention has been paid to correlating species and their numbers with sediment types and hydrographic conditions. Such data give qualitative and quantitative estimates of animal distribution in the estuary and indicate conditions suitable for maintenance of species found at each sampling station. As an example, sediment texture is an important factor in the density and distribution of two species--the lancelet, Branchiostoma caribaeum Sundeval, and the lampshell, Glottidia pyramidata (Stimpson)--that live in the bottom (figs. 3 and 4). This relation existed in all areas of the estuary occupied by the animals. In Hillsborough Bay, however, domestic and industrial pollution have apparently eliminated these animals from sediments otherwise suitable. Lancelets and lampshells are indicators of uncontaminated water and may occur in concentrations of over 1,000 individuals per square meter of bottom. The animals are eaten by demersal fishes and crabs, and their planktonic larvae also provide food for important pelagic species at several reproductive periods during the warmer months. These and other species sensitive to deterioration of water quality formerly contributed to valuable fisheries that no longer exist within the 40 square miles of estuarine area constituting Hillsborough Bay.

Estuarine Evaluation

In the lower reaches of the estuary, Boca Ciega Bay has undergone different types of changes caused by extensive dredging and filling to create waterfront homesites. Over 20 percent of that Bay has been filled, and recent work shows that plant and animal production has been substantially reduced by sedimentation and turbidity in the remaining area. Hydraulic dredging brought into suspension fine sediments that have settled in thin layers in shallow water. The deeply dredged pockets between landfills have deposits 9 to 11 feet thick so that turbidity is now a persistent feature in Boca Ciega Bay. Altered tidal currents, wind, and boat traffic constantly stir the shallow water and resuspend the load of silts and clays raised in dredging operations. Besides eliminating a significant percentage of productive near-shore biotopes such as mangrove forest, marsh, oyster reefs, flats, and submerged sea grass beds, dredging

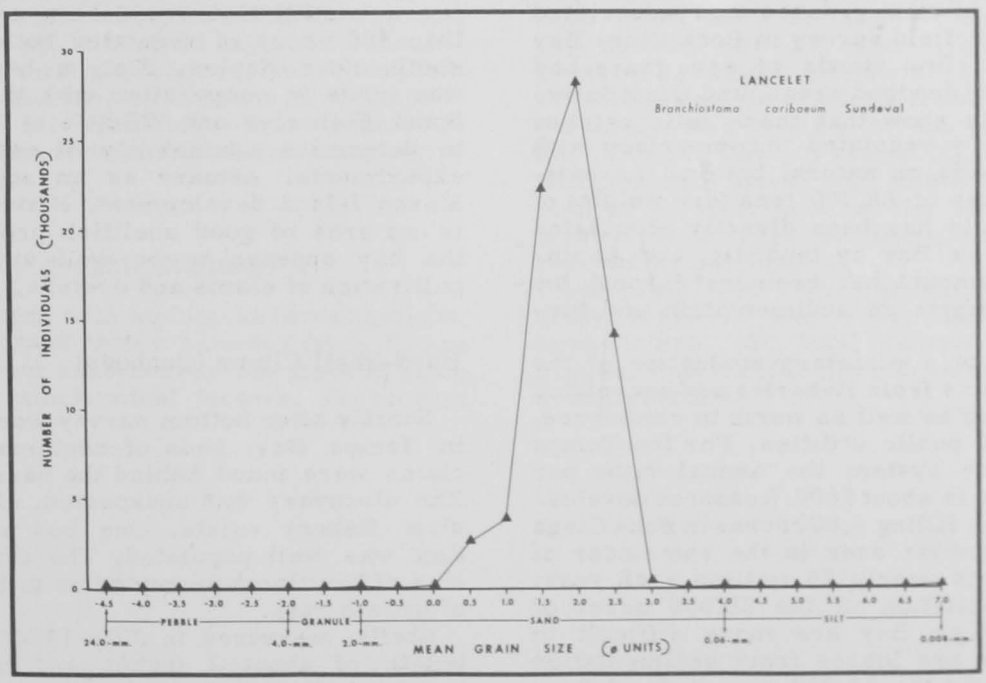


Figure 3.--Numbers of lancelets vs. mean grain size of sediments at stations where the animals were collected in Tampa Bay estuary.

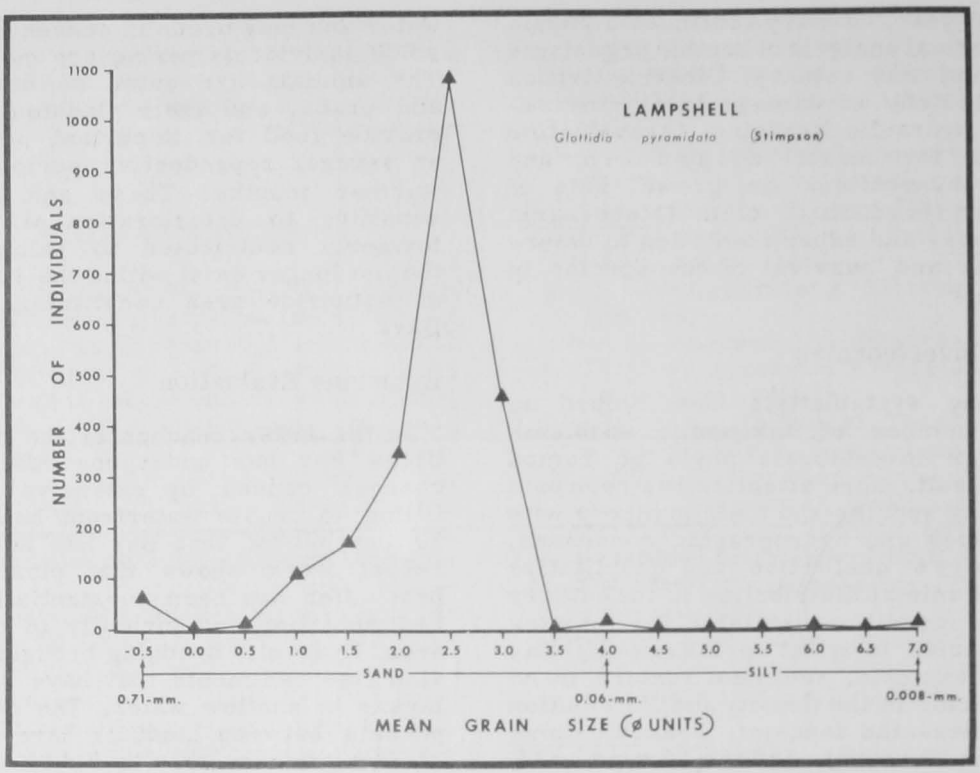


Figure 4.--Numbers of lampshells vs. mean grain size of sediments at stations where the animals were collected in Tampa Bay.

adversely affects the surrounding ecosystem, especially within semienclosed embayments where tidal exchange is restricted.

Deep deposits of fine sediments do not support a significant flora and fauna, and roiled water reduces light needed at the bottom for growth of sea grasses and associated marine life. A field survey in Boca Ciega Bay revealed that few stands of sea grass had survived near dredged areas, and quantitative measurements show that these relic patches are sparsely vegetated in comparison with sea grass beds on natural bottom. An estimated biomass of 68,000 tons (dry weight) of plant materials has been directly eliminated in Boca Ciega Bay by landfills, and an undetermined amount has been lost through the secondary effects of sedimentation and turbidity.

To arrive at a monetary evaluation of the estuary, income from fisheries and recreation has been used as well as worth to commerce, industry, and public utilities. For the Tampa Bay estuarine system the annual value per acre of water is about $600. Resource devaluation caused by filling 4,000 acres in Boca Ciega Bay and a similar area in the remainder of the estuary is nearly $5 million each year. Losses to pollution in the 25,000 acres of Hillsborough Bay are more difficult to measure, as are losses from sedimentation and siltation in the 10,000-acre area of Boca Ciega Bay.

Information on bottom life and resource values gained through the study of Tampa Bay has been useful in the review of recent plans for various types of coastal alterations. A survey of sea grass beds in lower Boca Ciega Bay was made as a guide for redesigning a landfill that would have covered more than 500 acres of vegetated bottom. Further south, near Naples, Fla., a benthic survey was made in cooperation with the Bureau of Sport Fisheries and Wildlife at Barfield Bay to determine advisability of establishing an experimental estuary as an adjunct to the Marco Island development. Historically, this is an area of good shellfish production, and the bay appears to be well suited for the cultivation of clams and oysters.

Hard-Shell Clams (Quahogs)

Shortly after bottom survey work was begun in Tampa Bay, beds of southern hard-shell clams were found behind the barrier islands. The discovery was unexpected, since no local clam fishery exists. One bed near Jackass Key was well populated. The small uniform size of the clams prompted us to begin a study of growth rate.

Shells measured in July 1964 had a mean length of about 2 inches and increased to nearly 3 inches by July 1965. The reduced increment of about 1/2 inch by May 1966 still

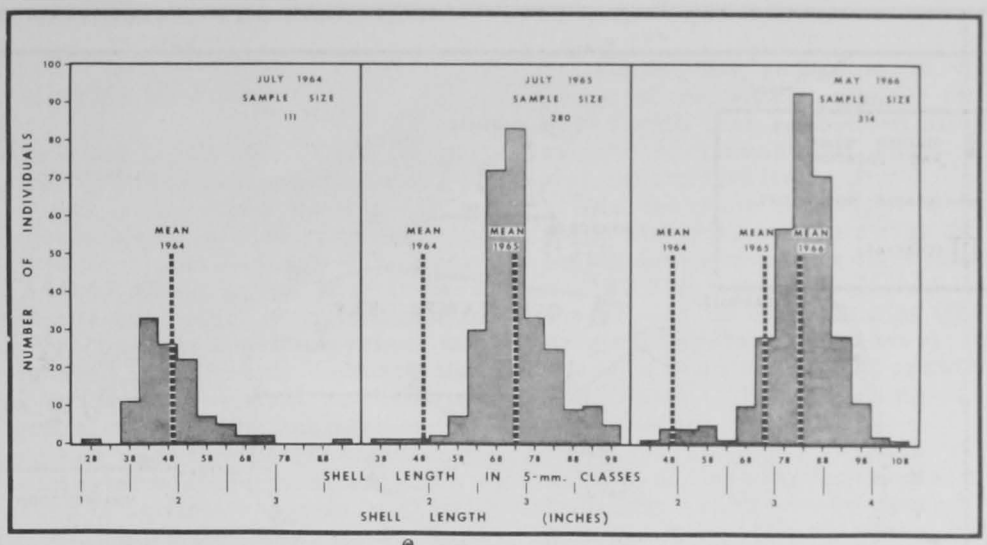


Figure 5.--Mean shell length of clams from lower Boca Ciega Bay (Tampa Bay estuary), showing progressive increase in average size between 1964 and 1966.

may be considered good for clams of this size (fig. 5).

Commercial growers from other areas have become interested in the possibility of culturing native quahogs and northern quahogs (Mercenaria mercenaria L.) in the bay. Hatchery stock of 2.5 mm. (1/10 inch) and seed clams of less than 2 inches have been stocked in the lower bay for studies of growth and mortality of northern quahogs; native quahogs have been distributed at 20 locations throughout the bay for the same purpose. At all stations, sediments have been analyzed and monthly water samples taken for salinity, temperature, pH, dissolved oxygen, total soluble nitrogen, total phosphorus, and chlorophyll a. After 12 months, each group of clams will be evaluated and correlated with environmental factors to provide information for prospective clam culture.

Standard Hydrographic Stations

In connection with biological investigations, several thousand water samples from Tampa Bay have been analyzed by the Bureau since 1954 for physiochemical factors. These data provide a history of hydrographic conditions and serve far beyond their original purpose in work at this Laboratory and other institutions. Gaps appear in the long-term record, however, because the data collected were limited to the needs of the contributing studies. To eliminate further gaps in data, 30 standard stations have been established to monitor hydrographic conditions throughout Tampa Bay.

Salinity gradient was the criterion on which the location of permanent sampling stations was based. Over 4,200 salinity determinations were used as a guide in dividing the bay system into 12 areas (fig. 6). A progressive gradient of about 2 p.p.t. (parts per thousand) is evident from one area to the next, beginning at the headwaters of the Tampa Bay system (Old Tampa and Hillsborough Bays) and continuing into the Gulf of Mexico. Most of the 30 stations are located at bridges or piers, and all can be reached by automobile.

Sampling and chemical analysis for this study began in May 1966. Salinity, water temperature, pH, total phosphate, nitrogen, oxygen, and turbidity are determined monthly at each station.

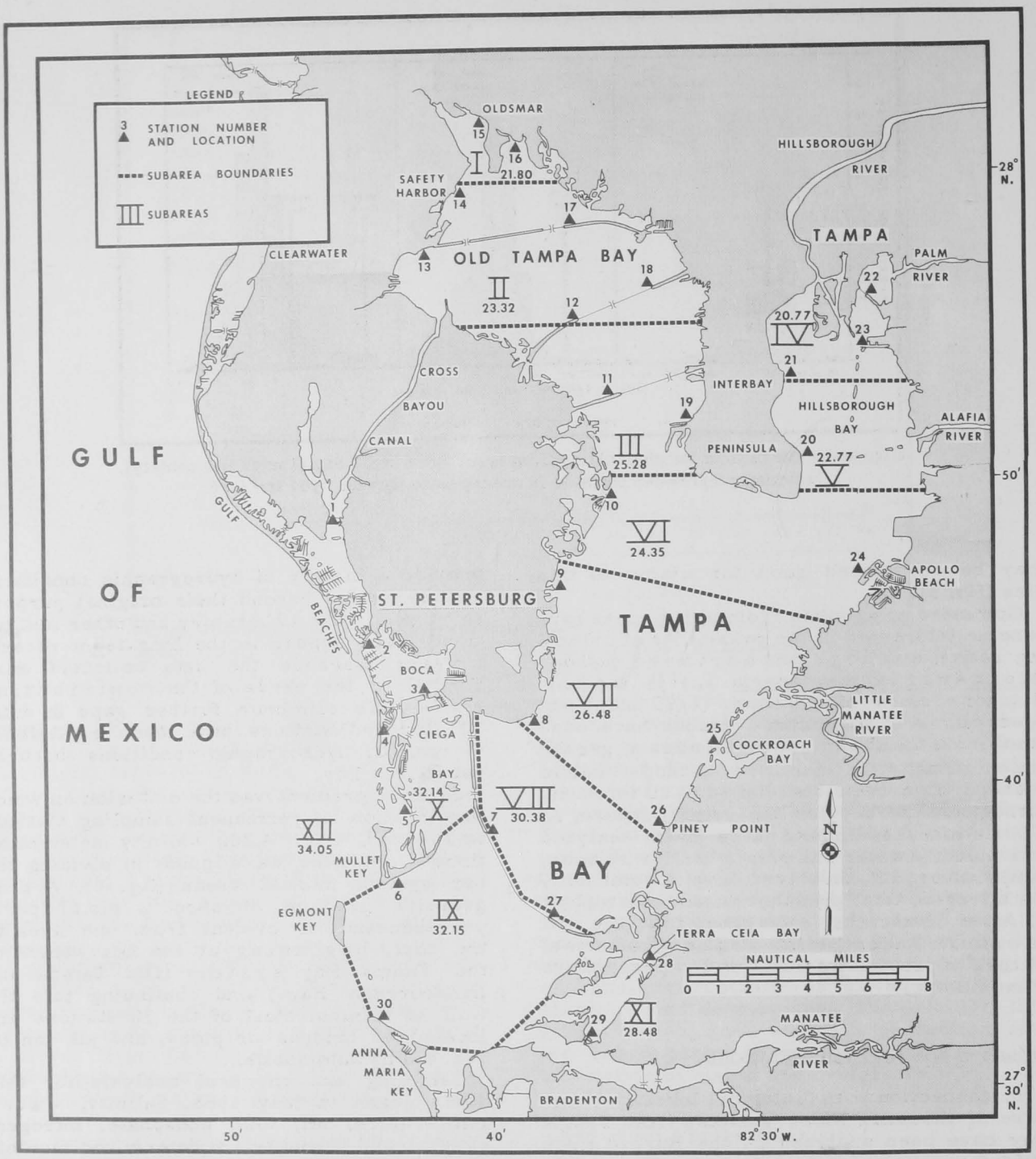


Figure 6.--Subareas, salinity, and standard hydrological stations in Tampa Bay. Subareas are indicated by roman numerals; mean annual salinities (p.p.t.) are shown in arabic numerals. Standard stations (1-30) are shown as black triangles.

Research and Museum Space

Further development of the Benthic Project has recently been facilitated through acquisition of 1,900 square feet of floor space. This area will be used primarily to house the collection of plants and animals from the eastern Gulf of Mexico and adjacent areas. Space has also been provided for a chart and drafting room and a photomicrography laboratory.

BIOGEOCHEMICAL ALTERATION AND EFFECT

Charles M. Fuss, Jr.

Studies continued on the feasibility of re-establishing sea grasses on bay bottoms modified by dredging. Initial aims were to determine the transplanting qualities of two locally abundant species, turtle grass (Thalassia testudinum) and shoal grass (Diplanthera wrightii), under semicontrolled conditions in trays within an open sea-water system and in closed aquaria. Experiments indicate that turtle grass is more resistant to handling than shoal grass and may be maintained for at least 8 months under artificial conditions. Experiments to determine survival and growth of these grasses in aquaria began in July 1965. Plants were obtained from lower Boca Ciega Bay and transplanted to aquaria with a bottom area of 2.7 square feet and equipped with subsand filters. After the plants were collected with a shovel and washed free of sediment, the fresh wet weight of each was recorded before it was planted in a substrate of washed gravel covered with clean sand. Nutrients were supplied periodically throughout the experiment, and the water temperature and salinity were controlled within limits of the natural environment.

In the indoor aquaria shoal grass showed progressive decline and defoliation, and died after about 3-1/2 months. Turtle grass also showed signs of failure during the first month, but for 3 months thereafter new leaves were produced. Following the apparent rejuvenation, however, plants started to wane and by the end of 7 months all were dead. Accumulation of hydrogen sulfide about the rhizomes as well as other less obvious agents, may have caused death.

Plants transplanted in September 1965 to trays (10.8 square feet) suspended in the open sea-water system outside fared somewhat better. Turtle grass was planted in half of each tray and shoal grass in the other half. Water for the system is drawn through sand and gravel intake filters to remove fouling organisms and sediment, but the plants receive essentially the same nutritive elements as those growing under natural conditions. A drain valve in the bottom of each experimental tank allows part of the outflowing water to percolate down through the substrate and remove excessive concentrations of hydrogen sulfide from the root system. No attempts have been made to control temperature or salinity.

Some trays were removed 6 and 8 months after introduction to determine the condition and net weight of the plants; others will be removed after 10 and 12 months. Turtle grass specimens were in good condition after 6 and 8 months, but shoal grass specimens were in poor condition and only a few survived (table 1).

Despite the reduction in weight of plant material recovered after 8 months as compared with that recovered after 6 months the growth of leaves and roots of turtle grass was substantial (table 2).

The decrease in weight of recovered living plant material and increase in root and leaf length between plants harvested at 6 months and at 8 months is believed to indicate both the effects of transplanting (the dying back of original roots and leaves) and the initial phase of recovery (rapid growth of new leaves and roots) at the beginning of the new growing season.

As an index of relative vigor, measurements of leaves and roots of transplanted turtle grass were compared with those of plants from natural grass beds. The mean length of leaves was 2 inches for experimental plants and 1.8 inches for those growing under natural conditions. On the other hand, mean root length was 1.7 inches for transplants and 3.2 inches for plants in the field. Root growth in trays was obviously abnormal. Rather than generally arising from rhizome nodes, new roots of experimental plants were confined to the basal region of leaves. Apparently the coarse substrate or transplantation, or both, disrupts normal root formation. It seems that existing rhizome systems generally do not survive transplanting, and new root systems must originate from the leaf-bearing branches.

From the outset of work on sea-grass culture, algal growth on leaves and containers was a nuisance and bias factor. Fortunately biological controls were soon found. The sea slug (Phyllaplysia engeli) kept aquaria free of filamentous algae, and the fan-tail mullet (Mugil trichodon) and the sail-finned molly

Table 1.--Weight and percentage of living sea grasses recovered 6 and 8 months after planting in trays suspended in an open sea-water system

Genus and period	Wet weight planted (9/1-3/65)	Plant material recovered	
		Wet weight	Percentage
Thalassia:	Ounces	Ounces	Percent
6 months....	28.0	22.4	80
8 months....	28.1	16.8	60
Diplanthera:			
6 months....	5.3	0.9	17
8 months....	5.3	0.1	2

Table 2.--Measurements of new leaves and roots of Thalassia at 6 and 8 months after planting in trays suspended in an open sea-water system

Item	Period		Increase in 2 months
	6 months	8 months	
			Percent
New leaves with original green tips:			
Number of leaves measured	126	136	--
Length range	0.1-5.3 inches	0.1-6.0 inches	--
Mean length	2.0 inches	3.2 inches	60
New roots with original tips:			
Number of roots measured	86	69	--
Length range	0.3-3.5 inches	0.7-4.1 inches	--
Mean length	1.7 inches	2.1 inches	24

(Mollinesia latipinna) partially cleared algae from walls and leaves in outside tanks.

On the basis of information now available, turtle grass appears to be acceptable for transplanting to areas in lower Tampa Bay that have been denuded by dredging and pollution. As a further test, plants have been set out in shallows of dredged canals bordering bayfills (fig. 7). New leaves have been produced by the introduced plants. If transplantation is

Figure 7.--Transplanting turtle grass in shallow test areas.

successful, turtle grass may help bring shallow bottoms back to former levels of biological production.

AERIAL SURVEY OF SEA SURFACE TEMPERATURE AND FISH SCHOOLS

Charles M. Fuss, Jr.

The aerial survey of temperature (IRT--Infrared Thermometer) and fish schools in the southeastern Gulf of Mexico was suspended for the first half of this fiscal year because U.S. Coast Guard aircraft and project personnel were not available. Monthly flights were resumed in January 1966 and continued through April. Instrument failure in the IRT system necessitated the cancellation of the May flight, and Hurricane "Alma" caused the postponement of a flight scheduled for early June. It is expected that flight schedules will be improved in the coming year.

The original flight plan (which included flights offshore to water depths of 100 fathoms) was modified by reducing the length of offshore legs (to extend only to water depths of 20 fathoms); this change increased the nearshore coverage and reduced flying time from 8 to 5 hours. Instead of three triangular patterns out to 100 fathoms, we now fly five patterns out to 20 fathoms. The north-south coverage remains the same, i.e., Cape Sable to Anclote Keys.

Generally satisfactory results have been obtained with the IRT with the exception of the recent breakdown. The instrument was checked during operation by comparing readings taken with the airborne unit with simultaneous stem-thermometer readings obtained from the R/V Kingfish on station 5 miles offshore. Additional checks were made in the surf line at the bar adjacent to the Laboratory. Offshore IRT readings were accurate to 0.9° F. and surf readings to 1.4° F. An improved foam-rubber-lined mount for the instrument sensing head was fabricated at the U.S. Coast Guard Air Station. The mount attaches to the "JATO" rack (a rack at the forward edge of the after station hatch of the HU-16 Albatross aircraft) and places the sensing unit in a dead air space within the aircraft hull.

Extensive concentrations of fish schools were located in the Cape Sable-Cape Romano area during the winter flights, and after the waters warmed in the spring the schools extended as far north as Sarasota. Although seasonal observations are not complete, sightings during random flights made over the past 1-1/2 years have indicated that northward movement extends to Tampa Bay by late spring. During the summer, near-shore schools are sparse. The apparent northward movement may actually be offshore movement from the estuaries (Florida Bay, Charlotte Harbor-Pine Island Sound, and Tampa Bay) as the water warms. Most fish sighted inside 10 fathoms were believed to be Atlantic thread herring (Opisthonema oglinum). A recent commercial exploratory effort in the St. Petersburg area produced purse-seine catches of thread herring in excess of 50 tons. The fish were taken within 1 mile of shore.

CHEMICAL ENVIRONMENT PROJECT

(Primary Production)

John A. Kelly, Jr. and Lucius Johnson, Jr.

Measurements of primary productivity show the amount of carbon fixed through photosynthesis, which in turn is a quantitative way of determining the amount of food available to organisms that are directly and indirectly dependent on the productive capacity of plants. Primary production is determined by the light-dark bottle method, and results are used to evaluate annual fixation of carbon in Tampa Bay estuary and as an index of comparative food synthesis in this and other bodies of water.

In fiscal year 1966, primary production was recorded once each week at four locations in the estuary--Old Tampa Bay, Hillsborough Bay, Tampa Bay, and Egmont Key. A submarine photometer was used to show transmission of sunlight through the water to values of 100 (surface), 65, 35, 20, and 10 percent. From each depth a water sample was collected and transferred to clear (light) and opaque (dark) glass bottles. These were then arranged in a compartmented box designed to simulate light intensity at depths from which water samples were obtained. After 24 hours in the simulator, each bottle was analyzed for dissolved oxygen. The difference in O_2 concentrations between light and dark bottles was then equated with carbon production to yield gross primary production per unit area of sea surface.

A comparison of productivity data from the four sampling stations in the Tampa Bay system ranked Hillsborough Bay first (average--15.6 pounds of carbon per acre per day), Old Tampa Bay and Tampa Bay intermediate and nearly equal (average--10.4 and 10.1), and Egmont Key lowest (average--5.5). Highest values were in late spring, late summer, and early fall, and lowest values during the late fall, winter, and early spring (fig. 8).

Although high primary productivity values indicate a fertile body of water, they do not necessarily signify a healthy ecosystem. Often they are the result of sewage and industrial pollutants that overfertilize the water and support excessively high concentrations of

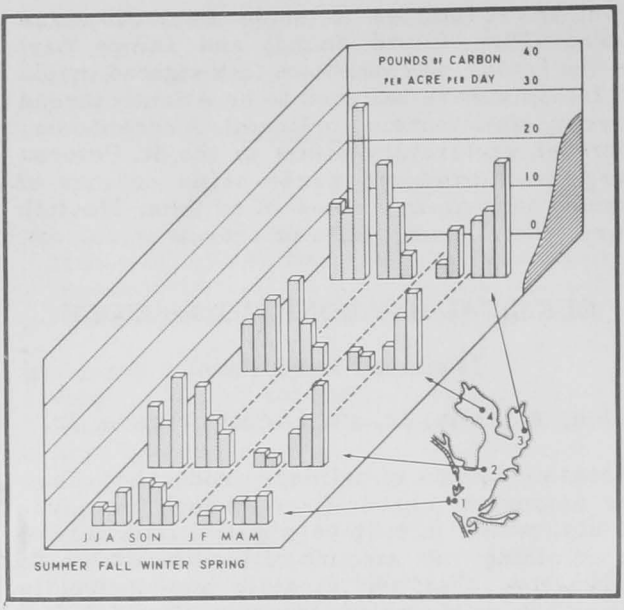


Figure 8.--Estimated production of organic carbon in Tampa Bay, June-November 1965 and January-May 1966. (Station 1, Egmont Key; Station 2, Central Tampa Bay; Station 3, Hillsborough Bay; Station 4, Old Tampa Bay.)

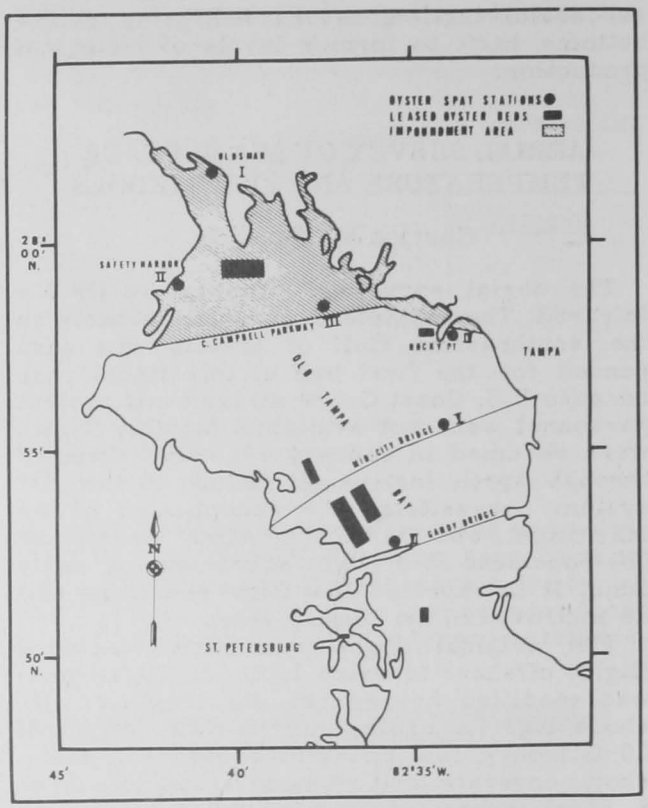


Figure 9.--Sampling stations, major commercial oyster producing areas, and proposed fresh-water lake impoundment in Old Tampa Bay, Fla.

phytoplankton. When this happens, all available oxygen in the water may be consumed, causing the death of zooplankton and the suffocation or starvation of other animals. The effect of such overfertilization may range from the replacement of economically important finfish and shellfish with species of little or no value as human food to the complete destruction of fish and all aesthetic aspects of the environment. Such is the case in Hillsborough Bay where death of marine life is often attributable to oxygen depletion and the number of economically important finfish is reduced.

FAUNAL PRODUCTION PROJECT

John H. Finucane

Investigations in fiscal year 1966 emphasized research on ecology and culture of oysters (Crossostrea virginica) and identification of fish eggs and larvae collected in Tampa Bay and the Charlotte Harbor estuary from 1963 to 1965. Ichthyofaunal research is a continuation of long-term studies on the biology of fishes in the eastern Gulf of Mexico. The oyster research, however, was stimulated by a recent proposal to transform an oyster-producing area of Old Tampa Bay into a fresh-water lake (fig. 9). Despite objections by State and Federal conservation agencies, pending construction plans call for impoundment of Old Tampa Bay north of Courtney Campbell Causeway. When completed, a dam would eliminate 17 square miles (11,000 acres) of prime estuarine habitat in which a number of commercially important species of fish, shellfish, and crustaceans spend all or part of their life cycle. More brackish than the main part of Tampa Bay, Old Tampa Bay has great potential value to commercial oyster growers.

Oyster Spatfall Study

Objectives of the oyster investigation were to appraise oyster resources in Old Tampa Bay and estimate the potential for a managed fishery that would use convential cultch cultivation as well as rafting techniques. Evidence from fishery statistics and a recent rise in the sale of oyster leases indicate that the fishery is expanding. More than 1,000 acres of bay bottom are now leased to oyster growers; in 1964 about 150,000 pounds of meats were marketed for $41,000. The area of potential oyster grounds in Old Tampa Bay has been estimated by the Bureau's Shellfish Advisory Service at more than 15,000 acres. In beginning research to document various aspects of oyster biology, cement board and scallop-shell spat collectors were used to obtain

information on setting, survival, and growth at representative stations in and outside of the proposed impoundment area.

Experimental oyster rafts, patterned after those of the Japanese, are being used to determine the oyster-culture potential of various areas in Tampa Bay (fig. 10). Particular emphasis is on dredge-and-fill areas of Boca Ciega Bay that are no longer suitable for conventional oyster culture.

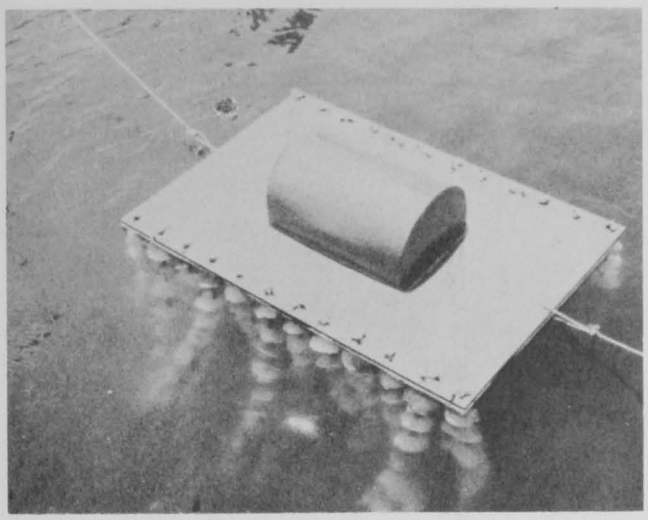


Figure 10.--Experimental oyster culture raft.

Dense attachment and rapid development on spat collectors show that the average salinity (23 p.p.t.), water temperature (79° F.), and pH (7.8) are well suited for oyster growth. The accumulation of spat on the collectors indicated that the spawning season in Old Tampa Bay lasts from 21 to 30 weeks (fig. 11). After the oysters attached, the average growth was nearly 1/2 inch in the first month and four-fifths of an inch in the second month. Thereafter, the monthly growth increment of oysters was largely obscured by barnacles, and attention was directed to the growth of populations attached to cultch in deeper water, where barnacles were fewer. On the beds, clumps of 4 to 6 oysters per cultch shell are common, and oysters often reach a length of 3 to 5 inches in 10 to 12 months (fig. 12).

Although 62 percent of the spatfall collected came from these stations in the area planned for impoundment, even the lighter spatfall at the three stations below the proposed impoundment was 10 to 15 times greater than that reported for Chesapeake Bay.

Even though oyster larvae appear to be broadcast throughout the estuary, some types of bottom are not suitable for attachment. For this reason rafted cultch was placed in potentially productive waters where bottoms are either too hard or too soft to support their development. We are particularly interested in measuring oyster growth on rafts that have been placed in deeply dredged canals between bayfills. These areas now have deep deposits of fine sediments and an impoverished benthic community, although the water supports abundant planktonic oyster food. If successful, this type of habitat may be useful in commercial production.

Zooplankton Study

Research on fishes of the eastern Gulf included an analysis of the distribution and seasonal occurrence of fish eggs and larvae sampled at selected stations from 1963 to 1965 in the Tampa Bay system and adjacent offshore waters. Sampling areas within the embayments were selected on the basis of salinity gradients, bottom types, and water depth. Although much taxonomic work remains to be done, quantitative data from surface plankton collections at each station have provided information on spawning in the nearshore and semienclosed waters as well as some estimates of the abundance of fish eggs and larvae in relation to salinity and other environmental conditions.

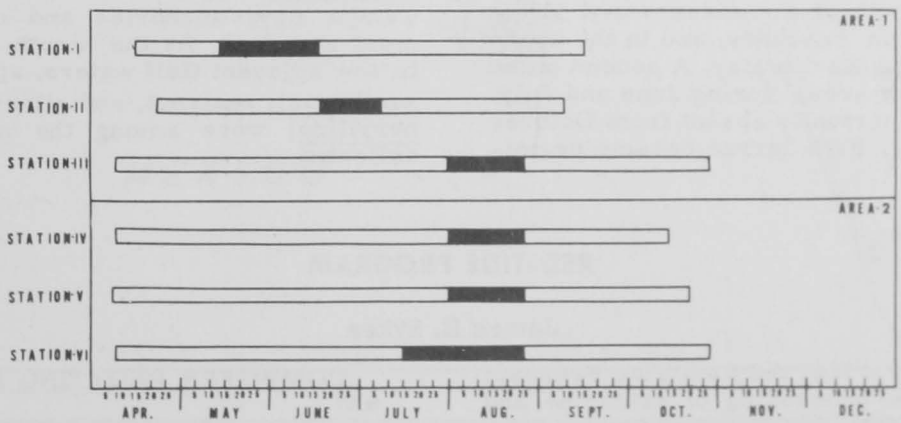


Figure 11.--Dates of oyster spatfall (horizontal bars) and periods of peak spatfall (shaded portions of bars) at six stations in Tampa Bay.

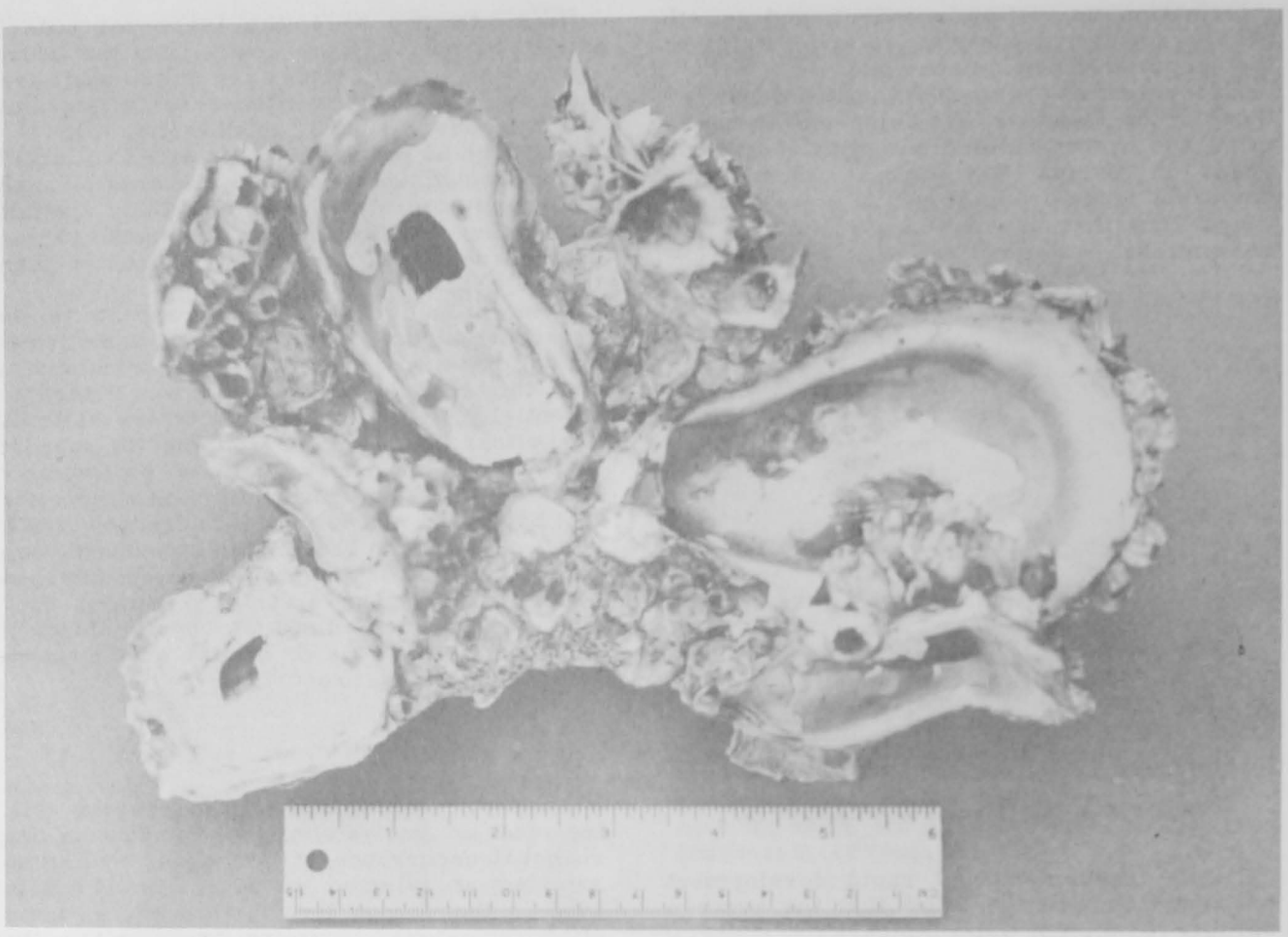


Figure 12.--Ten-month-old oysters from cultivated bed in Old Tampa Bay.

In Tampa Bay and adjacent Gulf waters, 10 stations were established in 5 major areas in waters ranging from brackish in Old Tampa and Hillsborough Bays to nearly oceanic at the mouth of the estuary.

From the standpoint of seasonal distribution, fish eggs were collected in greatest numbers at the mouth of the estuary and in the Gulf of Mexico in February, and in the upper reaches of Tampa Bay in May. A second pulse occurred in both areas during June and July. Fish eggs were virtually absent from October through January. Fish larvae became prominent members of the plankton in June, and certain forms dominated the catch in various areas of the estuary. In Hillsborough Bay anchovies (Anchoa spp.) were the most abundant larvae, and in Old Tampa Bay commercially important species such as seatrout (Cynoscion spp.) and menhaden (Brevoortia spp.) were common. In central Tampa Bay, anchovies and menhaden were most abundant. At the mouth of the Bay and in the adjacent Gulf waters, spot (Leiostomus xanthurus), seatrout, and silversides (Menidia beryllina) were among the major species collected.

RED-TIDE PROGRAM

James E. Sykes

In fiscal year 1966, the Red-Tide Program emphasized the processing of estuarine and oceanographic data for a series of years from Tampa Bay and the Gulf of Mexico, analysis of plankton populations associated with the Florida red-tide organism, Gymnodinium breve, and beginning of studies of red-tide

COMPUTER PLOTTING PROJECT

James E. Sykes

In studying etiology of red tide over a period of several years, the Laboratory staff has compiled a considerable volume of raw ocean-

visually presenting some of these data, we consulted NODC (National Oceanographic Data Center). In cooperation with the staff of NODC, we developed the idea that the data could be processed, programmed, and plotted in a vertical presentation of contours along transects extending from Tampa Bay into the Gulf of Mexico (fig. 13). Monthly and seasonal changes in selected physical and chemical factors could be detected by visual inspection of an atlas presenting the contoured vertical sections. The sections were drawn automatically by the NODC CALCOMP[2] plotter and include values of temperature, salinity, sea-water density (sigma-t), phosphorus, nitrogen, copper, silicon, and concentration of Gymnodinium breve in samples. The atlas when completed will, to our knowledge, be the first of its type and should be useful in red-tide studies and also should be a model for presenting similar oceanographic data.

[2]Trade names referred to in this publication do not imply endorsement of the commercial products.

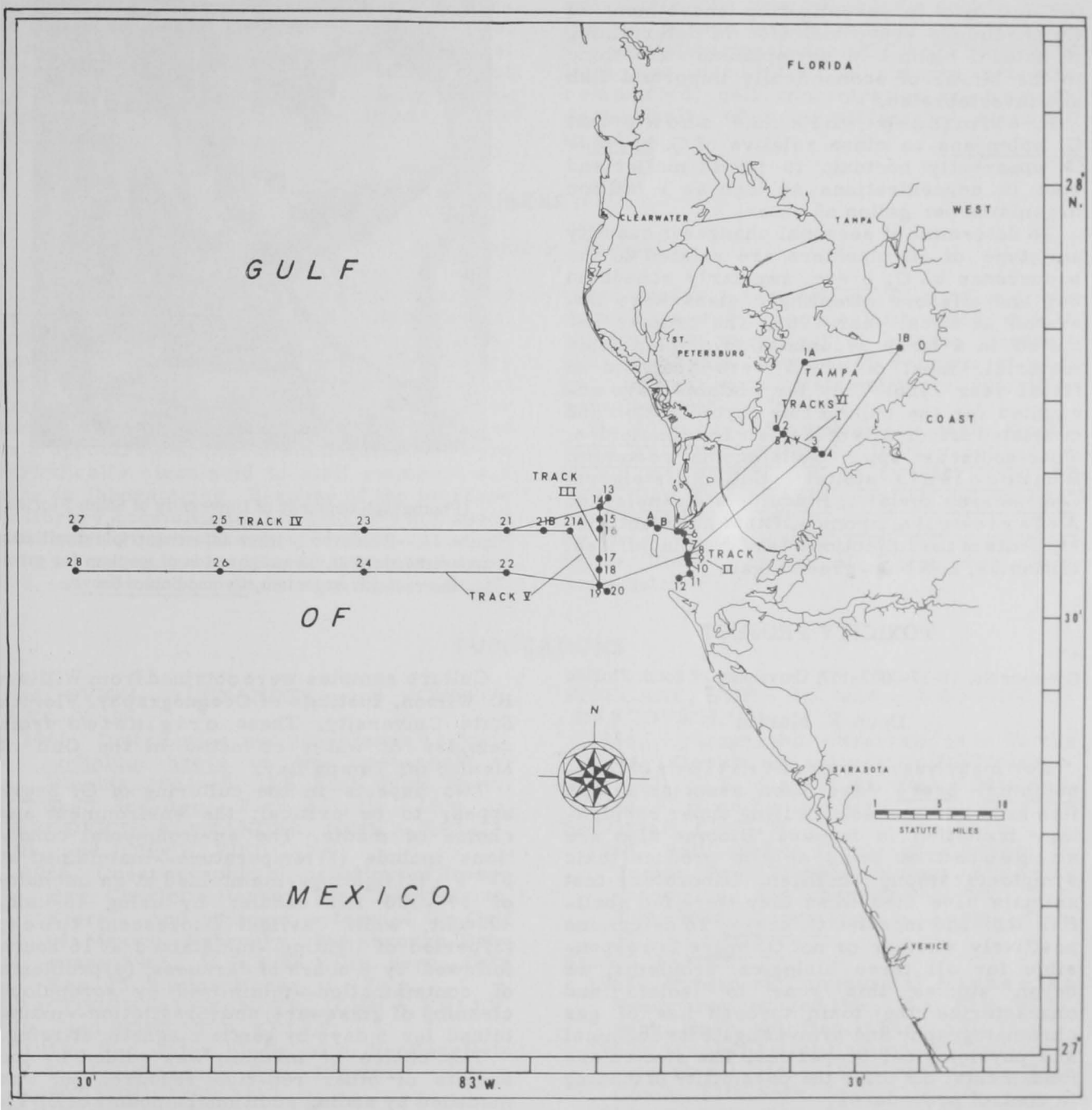


Figure 13.--Tracks from which vertical sections of oceanographic data were plotted.

PLANKTON ECOLOGY PROJECT

John A. Kelly, Jr.

A constant-temperature room was installed in the plankton laboratory during the year. The room contains 15,000 square feet of illuminated shelf space and is capable of maintaining a constant temperature of 50° to 90° F. within ±4°; is currently operational and serving as a backup system for red-tide toxin work being done under contract by the University of South Florida; and is scheduled for full use in investigating encystment of Gymnodinium breve and also in determining if natural blooms of phytoplankton are toxic to the larvae of economically important fish and invertebrates.

Preliminary work has shown that G. splendens--a close relative of G. breve--is apparently nontoxic to larval mullet and spot in concentrations as high as 1 million organisms per gallon of water.

To determine if seasonal changes in quantity and type of all plankters are related to the occurrence of G. breve, regularly scheduled bay and offshore sampling cruises were operated in fiscal year 1965. The cruises resulted in a large accumulation of planktonic material, most of which were analyzed in fiscal year 1966. Thus far diatoms have accounted for the bulk of this phytoplankton and consisted principally of Melosira nummuloides, Coscinodiscus spp., Skeletonema costatum, Rhizosolenia stolterforthii, R. steigera, Chaetoceros socialis, Biddulphia sinensis, and Asterionella japonica. Other abundant constituents of the collections were dinoflagellates, tintinnids, and blue-green algae.

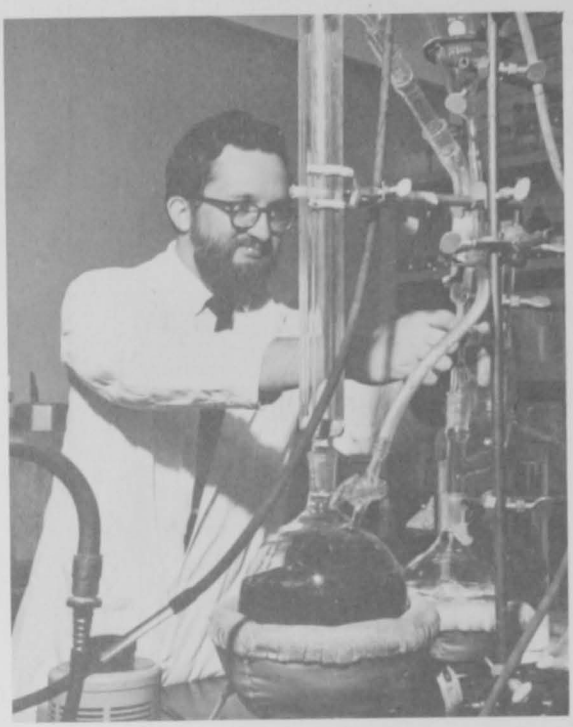
TOXICITY PROJECT

Contract No. 14-17-0002-167, University of South Florida

Dean F. Martin

For many years concentrations of Gymnodinium breve have been associated with fish kills and aerosols causing upper respiratory irritation in humans. Blooms also are suspected of being able to produce toxic symptoms among shellfish. Laboratory test animals have died when they were fed shellfish that had ingested G. breve. To determine positively whether or not G. breve is responsible for all three biological problems, we began studies this year to isolate and characterize the toxin through use of gas chromatography and to investigate its chemical and physiological properties. The studies are fundamental but offer the possibility of leading to control procedures.

In late 1965 the University of South Florida was awarded a contract to study the toxin. Cultures of G. breve were acquired, personnel trained to assist in culturing and counting the organism, and techniques developed for maintaining a stable supply of G. breve (fig. 14).



(Photograph courtesy of University of South Florida.)

Figure 14.--Research worker adjusting triple distillation apparatus used in the preparation of medium for growing the red-tide organism, Gymnodinium breve.

Culture samples were obtained from William B. Wilson, Institute of Oceanography, Florida State University. These originated from samples of water collected in the Gulf of Mexico off Tampa Bay.

Two aspects in the culturing of G. breve appear to be critical; the environment and choice of media. The environmental conditions include (1) temperature--maintained at 37° F.; (2) lighting--maintained at an intensity of 175-300 foot-candles by using 48-inch, 40-watt, white daylight fluorescent tubes; (3) period of lighting--maintained at 16 hours followed by 8 hours of darkness; (4) problems of contamination--minimized by scrupulous cleaning of glassware; and (5) agitation--maintained for 5 days by gentle magnetic stirring.

The choice of medium was guided by the results of other red-tide research but was modified by adding additional amounts of EDTA (Ethylenedinitrilotetraacetate--a water-softening agent) and iron.

The results in the culturing of G. breve differ from those in previous reports in four respects:

1. Earlier workers have said nothing about the pH of cultures of G. breve as a function of time. In current observations pH rises steadily as the concentration of cells increases. This rise is accompanied by a previously reported change in color from colorless to yellow, and by increases in turbidity and viscosity.

2. Oil droplets have been observed scattered on the surface of the cultures. The droplets, observed under 40X magnification, are first noted when the cell concentrations are about 5,000 per liter and become especially prominent when concentrations are about 250,000 cells per liter.

3. The use of alternating periods of light and darkness, instead of continuous light, was beneficial to the growth of cultures. Essentially natural conditions have been used: 8 hours of darkness per day (8:00 p.m. to 4:00 a.m.). Some workers have used light to concentrate cells at the top of the culture flasks before counting. In our experience the cells tend to concentrate in the bottom of the flasks, which is the region farthest removed from the light.

4. The growth curves for pure unialgal culture do not seem to have been recorded previously. We have recorded a growth curve for our purest unialgal culture and found that the population doubled in size when continuous light was used. The pH changes are also recorded; cell concentration increases dramatically when the pH reaches about 8.0 to 8.1.

LIBRARY

Annemarie P. Rempel

During the year, library holdings increased by 125 volumes of books, 708 journal issues, and about 2,000 reports, reprints, translations, and miscellaneous items. The library subscribed to 58 scientific and technical journals and received 32 journals on a gift or exchange basis. New material was displayed on a special rack, and lists of acquisitions were periodically circulated to staff members and outside laboratories. Because of the increase in library acquisitions, 112 feet of shelf space and two file cabinets were added.

Items requested on interlibrary loan totaled 177, of which 162 were received as duplicated copies for retention. Thirty-five items were borrowed from local libraries, and 28 publications were lent to outside libraries and individuals. Nearly 300 reprints of staff publications were distributed to scientific personnel and institutions.

Shelf list cards for unbound material facilitated an inventory of the library collection, which was completed in October 1965. A simplified method for charging out unbound material was begun. Also, a card system by type of publication was put into effect to facilitate location of items charged to scientists.

PUBLICATIONS

DRAGOVICH, ALEXANDER, and JOHN A. KELLY, JR.
1966. Distribution and occurrence of Gymnodinium breve on the west coast of Florida, 1964-65. U.S. Fish Wildl. Serv., Spec. Sci. Rep.--Fish. 541, iii + 15 p.

DRAGOVICH, ALEXANDER, JOHN A. KELLY, JR., and JOHN H. FINUCANE.
1966. Oceanographic observations of Tampa Bay, Charlotte Harbor, Pine Island Sound, Florida, and adjacent waters of the Gulf of Mexico, February 1964 through February 1965. U.S. Fish Wildl. Serv., Data Rep. 13, 2 microfiches, ii + 73 p.

DRAGOVICH, ALEXANDER, JOHN A. KELLY, JR., and ROBERT D. KELLY.
1965. Red water bloom of a dinoflagellate in Hillsborough Bay, Florida. Nature 207(5002): 1209-1210.

FINUCANE, JOHN H.
1965. Threadfin shad in Tampa Bay, Florida. Quart. J. Fla. Acad. Sci. 28(3): 267-270.

FINUCANE, JOHN H., and ALEXANDER DRAGOVICH.
1966. Hydrographic observations in Tampa Bay, Florida, and adjacent Gulf of Mexico--1963. U.S. Fish Wildl. Serv., Data Rep. 14, 83 p. on 2 microfiche.

SALOMAN, CARL H.
1965. Bait shrimp (Penaeus duorarum) in Tampa Bay, Florida--biology, fishery economics, and changing habitat. U.S. Fish Wildl. Serv., Spec. Sci. Rep.--Fish. 520, iii + 16 p.

SYKES, JAMES E.
1965. Bureau of Commercial Fisheries Symposium on red tide. U.S. Fish Wildl. Serv., Spec. Sci. Rep.--Fish. 521, 11 p.
1965. Multiple utilization of Gulf coast estuaries. Proc. Southeast Game Fish Comm. 17th Annu. Sess.: 323-326.
1966. Report of the Bureau of Commercial Fisheries Biological Station, St. Petersburg Beach, Florida, fiscal years

1962-1964. U.S. Fish Wildl. Serv., Circ. 239, 26 p.

1966. Report of the Bureau of Commercial Fisheries Biological Station, St. Petersburg Beach, Florida, Fiscal Year 1965. U.S. Fish Wildl. Serv., Circ. 242, iv + 30 p.

SYKES, JAMES E., and JOHN H. FINUCANE.
1966. Occurrence in Tampa Bay, Florida, of immature species dominant in Gulf of Mexico commercial fisheries. U.S. Fish Wildl. Serv., Fish. Bull. 65(2): 369-379.

TAYLOR, JOHN L.
1965. Bottom samplers for estuarine research. Chesapeake Sci. 6(4): 233-234.

1966. A Pacific polychaete in southeastern United States. Quart. J. Fla. Acad. Sci. 29(1): 21-26.

MANUSCRIPTS IN PRESS

DRAGOVICH, ALEXANDER.
Morphological variations of Gymnodinium breve Davis. Phycologia.

DRAGOVICH, ALEXANDER, and JAMES E. SYKES.
Oceanographic atlas for Tampa Bay, Florida, and adjacent waters of the Gulf of Mexico, 1958-61. U.S. Fish Wildl. Serv., Circ.

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.

KELLY, JOHN A., JR., and ALEXANDER DRAGOVICH.
Occurrence of macrozooplankton in Tampa Bay, Florida, and adjacent Gulf of Mexico. U.S. Fish Wildl. Serv., Fish. Bull.

ROUNSEFELL, GEORGE A., and ALEXANDER DRAGOVICH.
Correlation between oceanographic factors and abundance of the Florida red tide (Gymnodinium breve Davis), 1954-61. Bull. Mar. Sci.

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.

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