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NOAA Technical Memorandum NMFS SER-2

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Report of the National Marine Fisheries Service Biological Laboratory, St. Petersburg Beach, Fiscal Years 1970 and 1971

JAMES E. SYKES

SEATTLE, WA.
July 1972

NOAA TECHNICAL MEMORANDA

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U.S. DEPARTMENT OF COMMERCE
Peter G. Peterson, Secretary
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Robert M. White, Administrator
NATIONAL MARINE FISHERIES SERVICE
Philip M. Roedel, Director

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REPORT OF THE NATIONAL MARINE FISHERIES SERVICE BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FISCAL YEARS 1970 AND 1971

by

JAMES E. SYKES

Abstract

Most of the major coastal and offshore fisheries of the United States depend upon species related to rearing and nursery areas in estuaries and the nearshore zone. To maintain and increase coastal shelf fisheries, it is necessary to provide continuing biological production near shore. Such provision requires a thorough ecological knowledge of the nursery and rearing area. Currently over 6,000 engineering proposals for estuarine areas are reviewed by Federal agencies each year. In view of relentless pressures affecting estuaries, this Laboratory works with other Federal agencies and the Gulf States to provide data directly applicable to the preservation, maintenance, and enhancement of nursery areas that generate valuable commercial and recreational species.

Report of the Laboratory Director

JAMES E. SYKES

ESTUARINE ENGINEERING: BIOLOGICAL EFFECTS

After nine years of investigating the coastal environment, interpreting data on estuarine value to the marine resource, and presenting conclusions before public hearings, legislative and conservation groups, it is refreshing to observe that the nation is beginning to develop an appreciation of coastal resources.

In 1970 opposition to environmental and resource mismanagement climaxed on a special occasion called "Earth Day." Activities included demands to reduce air and water pollution, to cleanse cities and roadways of litter, and to engineer systems for controlling a staggering accumulation of waste products. Also included were discussions that will probably have some bearing on future private-interest development and degradation of sovereign coastal sea floors and the protein-rich organisims dwelling therein. Attention was turned to the necessity of having marshlands continue as natural features rather than becoming shopping centers and concrete parkways; a barrage of questions including "how have hotel owners gained permission to build across public beaches almost to the water's edge?" were heard time and again.

The first years of the 1970's forecast a great decade for the conservation of remaining aquatic resources. The Florida legislature showed its enthusiasm for conserving and wisely managing those resources by passing 40 conservation-oriented bills. The following are examples of those that relate to objectives of coastal research at the St. Petersburg Beach Biological Laboratory:

1. A constitutional amendment prohibiting future sale of submerged lands except when clearly in the public interest.
2. No longer will there be illegal dredging in navigable waters.
3. The period in which local governments can act on applications for new bulkhead lines is extended from 60 to 90 days.
4. Authority of the State Cabinet to waive adverse biological reports in issuance of dredge-fill permits is removed.
5. The Cabinet now has powers of eminent domain to repurchase privately-owned submerged lands.

APPLICATION OF RESEARCH RESULTS

The philosophy of the National Marine Fisheries Service is reflected by the Laboratory in that research, even though basic in some instances, must be applicable to problems having direct bearing on commercial and sport fisheries. Research must result in usable information within a reasonable length of time. Our scientists are indoctrinated early in their careers with the fact that their mission involves problem solving — reaching solutions to problems confronting fisheries — not those of purely academic or scientific interest.

Problems in the coastal environment have direct bearing on fisheries, for without a satisfactory ecological habitat along the edge of the sea, the Nation's fisheries would be in serious trouble. Sixty-five to 90 percent of the species comprising commercial catches have a biological, developmental link to the shallow, sea-connected bodies of water called estuaries. Our knowledge of the essential quality standards of estuaries is growing rapidly, although it is difficult to keep pace with industrial and commercial demands placed on those systems because new forms of commerce continue to expand — especially on the coast. New oil drilling sites continue to be located, thermonuclear power plants are increasing, port facilities are on the upswing, and coastal population figures continue upward.

Ecological studies at this Laboratory have resulted in direct application of environmental information to fishery problems. (See Annual Reports for fiscal years 1962 through 1969.) The now famous Zabel-Russel proposal to dredge and fill in Boca Ciega Bay, Florida, was contested by the Bureau of Commercial Fisheries in 1967. The U.S. Army Corps of Engineers denied the permit, but a Federal Judge reversed that decision, declaring that the Corps did not have the authority to deny on the basis of fish and wildlife values. A ruling by a Federal Court of Appeals stated that the Corps indeed has the authority and a recent Supreme Court refusal to hear the case brought final settlement. Action of the Federal courts has, therefore, set a precedent, which will be a benchmark for future protection and management of estuaries throughout the Nation.

In this biennium we were again able to provide useful data and conclusions in cases requiring environmental control. Particularly overwhelming was the call for data from our portion of the Gulf of Mexico Estuarine Inventory. This is a unified study of Gulf estuarine systems, which began in 1967 and is cooperative between the states of Lousiana, Mississippi, and Alabama and the National Marine Fisheries Service. Information accumulated by this Laboratory through the Inventory program was provided the Washington Office in connection with a jetport study in the Everglades; the Florida Development Commission for its study of land ownership and use along the Florida west coast; and portions of our own staff as we carried out a special assignment under Public Law 89-454 to appraise fisheries and fishery economics of the Apalachicola Bay system in Florida. An additional value of the Inventory became obvious as we conducted the Lousiana Coastal Studies program in cooperation with the Louisiana Wildlife and Fisheries Commission, the Bureau of Sport Fisheries and Wildlife, the U.S. Army Corps of Engineers, and the Coastal Studies Institute of Louisiana State University. Louisiana provided its Inventory data on abundance of juvenile commercial species per estuarine area of the Louisiana coast. Without this background information, our portion of the study would have been more difficult and less effective.

The St. Petersburg Beach Laboratory assembled data on value of biological production in some new bay-fill cases destined for examination at the Federal level under the Fish and Wildlife Coordination Act. One proposal involving 1,200 ha was viewed adversely by the Florida Cabinet but was also committed to a public hearing by the U.S. Army, Corps of Engineers. Many data, including those from the Laboratory, were used in the hearing. Action on this permit is pending.

In January 1971, the laboratory began work with the National Park Service to determine the biological value of south Florida's nearshore and estuarine areas. Our investigations include collection of environmental information and sampling of eggs, larvae, juveniles, and adult sport and commercial fish occurring within a study area lying on the Gulf coast side of the Everglades National Park between Cape Romano and Cape Sable.

The ability to solve fishery-connected problems is enhanced by a given amount of long-term monitoring of environmental quality as well as the in-depth, short-term projects that we emphasize. For instance a 30-station, Tampa Bay monitoring project, described later in the section on Biology and Ecology of Estuaries identifies broad environmental changes of a subtle nature. Small dredge-fill operations, continuing over a decade or so, gradually add to

the volume of suspended matter in a water system, and an increase in that volume cannot be identified over a brief span of time. Similarly, if dredging cases are reduced in number, increased transparency of the water is not readily apparent. Also, subtle changes in levels of nitrates and phosphates from domestic sewage can only be measured through long-term data collection and interpretation. Results of the monitoring study were applied this year in connection with a proposal to fill 850 ha in Old Tampa Bay. Proponents claimed that the water system was already degraded beyond repair; our data, covering a span of nine years, showed that turbidity was actually lowering very gradually, principally because fewer dredge-fill proposals were approved. Our records also disclaimed the high pollution levels cited by landbuilding proponents; nitrate and phosphate had increased very slightly over the period of our observation and were not yet critical. Our faith in the value of long-term monitoring — when done for specific purposes — was increased.

The accumulation of knowledge stemming from scientific examination of specific problems is also used to advantage when data are nonexistent and when there is no experience in a given geographical area about to experience environmental disturbances. In other words, a research staff such as ours can apply experience gained in previous investigations to new, unfamiliar situations. One of the Laboratory scientists worked with a team of biologists and engineers in developing a Departmental view of a proposal to locate a jetport in the Virgin Islands. Since indicators of environmental quality and potential biological production were readily known to the investigators, no great problem was encountered in the ensuing hydrological and biological surveys. A report of findings and recommendations was submitted and was used to evaluate potential effects of the jetport on marine ecology in the area.

MARICULTURE

The number of fish and shellfish culture groups, largely supported by industry, is steadily increasing in Florida. The development of satisfactory culture techniques for most species is painfully slow and mariculture is not the simple, fast-profit enterprise that many non-biologists envisioned a short time ago. Success on a commercial scale will be costly and time consuming and will come gradually with a few species. Companies and governmental agencies that have the will, the talent, the funds, and the patience stand to be rewarded with success, perhaps after several years of frustrating experiences.

In Governmental programs such as those at this Laboratory, priorities and risk balances must be considered carefully. Upon weighing such factors we did not consider our pioneering efforts with pompano culture to be among our high priority research items, and we committed only enough funds and manpower to expect a yield of moderate results. We did consider, however, that even this small project was necessary since we are located in a major maricultural development area. The project has produced two principal achievements: (1) pompano eggs have been spawned and fertilized for the first time (they have not yet been brought to hatching), and (2) the Laboratory has been able to establish thorough communication with the mariculture industry. We consider communication important in the early development of this science for two reasons. First, we can inform interested members of industry of our successful techniques and our failures; second, we can provide an informational service to our own agency concerning progress and predictions of growth within an industry directly related to commercial fisheries. Communication of such information is especially important since the National Marine Fisheries Service is not heavily involved in mariculture in the eastern Gulf area and should remain aware of events and progress in that field.

Biology and Ecology of Estuaries

John L. Taylor and Carl H. Saloman

This program consists of three projects in which research is directed toward (1) identifying the qualitative and quantitative distribution of bottom plants and animals that support commercial and sport fisheries and (2) understanding various features of the water and sediments that are essential for maintenance of rich and productive bottom communities.

The first project, Tampa Bay Estuarine Studies, was started in 1963 when bottom samples were collected at more than 400 stations throughout the Bay. Data were published on hydrology, sediments, and plants collected at these stations. Identification and analysis of invertebrates has taken longer, but

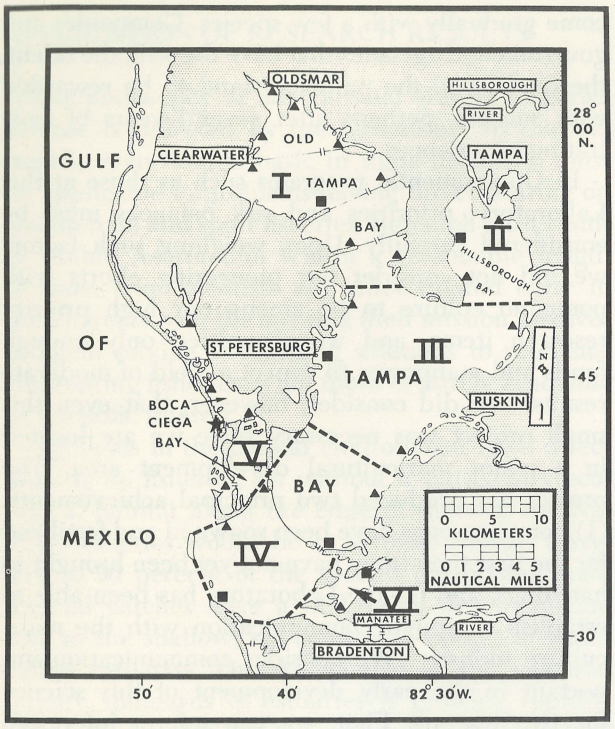

Figure 1. — NMFS hydrological stations in Tampa Bay, Florida. Squares designate stations at which chlorophyll, carotenoids, and primary production were determined in addition to standard determinations made at all other (triangle) stations. Dock station measurements (star) included all parameters plus Secchi disk disappearance depth.

reports are available and others are being completed. Results from the project show that Tampa Bay supports an abundant and diverse assemblage of bottom organisms in all areas except Hillsborough Bay and parts of Boca Ciega Bay (Fig. 1). The first of these areas receives a large volume of domestic sewage, which is responsible for extensive sludge deposits. The other area contains many dredged access canals that have soft sediments and few bottom organisms. The canals are deep and semi-enclosed and collect large quantities of silt and clay. The fine, organically rich sediments in both areas of Tampa Bay have a high biochemical oxygen demand (BOD), and there is too little dissolved oxygen to permit the survival of most invertebrates.

In addition to showing which estuarine areas are either grossly polluted or nearly natural, bottom animals can also be used as indicators of more subtle changes in environmental conditions. Polychaete worms are especially useful for this purpose because of their great diversity, abundance, and sensitivity to change. For example, existence of abnormally large numbers of two polychaete species in undredged sections of Boca Ciega Bay (Fig. 1) indicates that further pollution would very likely have rapid and undesirable consequences on water quality, fishery resources, and recreational activities.

The second project is designed to monitor hydrological conditions throughout Tampa Bay on a regular basis. Daily water samples are collected at the laboratory dock, and monthly samples are collected at 30 stations in various other parts of the estuary (Fig. 1). Hydrological factors recorded include: water temperature, salinity, pH, total phosphorus, total Kjeldahl nitrogen, dissolved oxygen, turbidity, chlorophylls, carotenoids, and primary production. Secchi disk disappearance depth is also recorded at the dock station. To detect daily variation of the factors measured, water samples are collected at the dock station in the morning at 0730 and again at 1230. These data indicate that broad diel fluctations often occur in dissolved oxygen, primary production, nutrients, and turbidity.

Over a period of time, our data have documented changes in water quality due to the activities of both man and nature. For example, turbidity was high in Boca Ciega Bay for many years because of widespread dredging activity. Most of the dredging has been curtailed, and our data show a clearing of the water. Tidal flushing and activities of the bottom organisms are also largely responsible for the progressive increase in water clarity within the past few years.

The third project is financed by the U.S. Army Corps of Engineers, through a research contract. It is called the Sand Key Project, and the objective is to describe biological and physical conditions existing along 24 km of nearshore coastal waters between Clearwater Beach and St. Petersburg Beach, Florida (Fig. 2). The Corps is interested in this area because the shoreline in the vicinity of Sand Key is eroding and beach restoration is being considered. Consequently, the Corps is anxious to learn where sand can be obtained and where dredging will do the least damage to biological resources. The study area encompasses the coastline shown (Fig. 2), and sampling is taking place within the zone to an offshore distance of approximately 1,000 m. Research efforts are concentrated along a 15-km portion of coast off Sand Key and a 2.7-km section off Treasure Island. The latter area has already had sand pumped in to restore the

beach while initial beach restoration is being considered along the Sand Key area.

Data gathering is accomplished according to the following nine methods:

Physical Description. The bottom contour has been mapped with a recording fathometer on transect lines at 100-m intervals extending out 1,000 m into the Gulf of Mexico.

Currents. A current meter is being used to determine current velocity and direction at surface and bottom under various conditions of tidal phase and weather.

Sedimentology. Bottom sediments have been collected at each benthic station and will be analyzed for weight percent of various size particles, calcium carbonate, organic composition, and statistical characteristics.

Hydrology. Water samples from the surface and bottom are collected monthly along transects and in three passes (Fig. 2). Determinations are made of temperature, salinity, pH, total phosphorus, total Kjeldahl nitrogen, dissolved oxygen, turbidity, transparency, and chlorophyll.

Meterology. At each station meterological data include wind speed and direction, air temperature, and cloud cover. At the laboratory continuous recordings are also made of air temperature, rainfall, wind direction and velocity, solar radiation, and barometric pressure.

Plankton. Plankton hauls with a 1/2 m, number "O" mesh net are made monthly from shore seaward on 10 transects and in three passes. Other hauls are made parallel to the shore at 100 m, 300 m, and 600 m distances. Plankton volume is calculated, and numbers of individuals in major animal groups are enumerated and expressed as percentages.

Benthic animals. SCUBA is being used to collect benthic samples. A stainless steel plug sampler, 1/64 m^2, 23 cm in depth, and with a screen mesh cover of 0.701 mm opening, is used to take four samples at each station on a transect line. The samples are immediately strained through a sieve (0.701 mm mesh), and the animals collected are later enumerated by number of species and individuals.

Fish. Fish samples are taken monthly at nine sites. Inshore samples are taken with a 30 by 2 m beach seine with a 0.6 cm mesh. Offshore samples are taken with two 100 by 3-m monofilament gill nets. Stretch mesh size in one net is 10 cm and in the other, 6.7 cm. Fish are identified, measured, and enumerated.

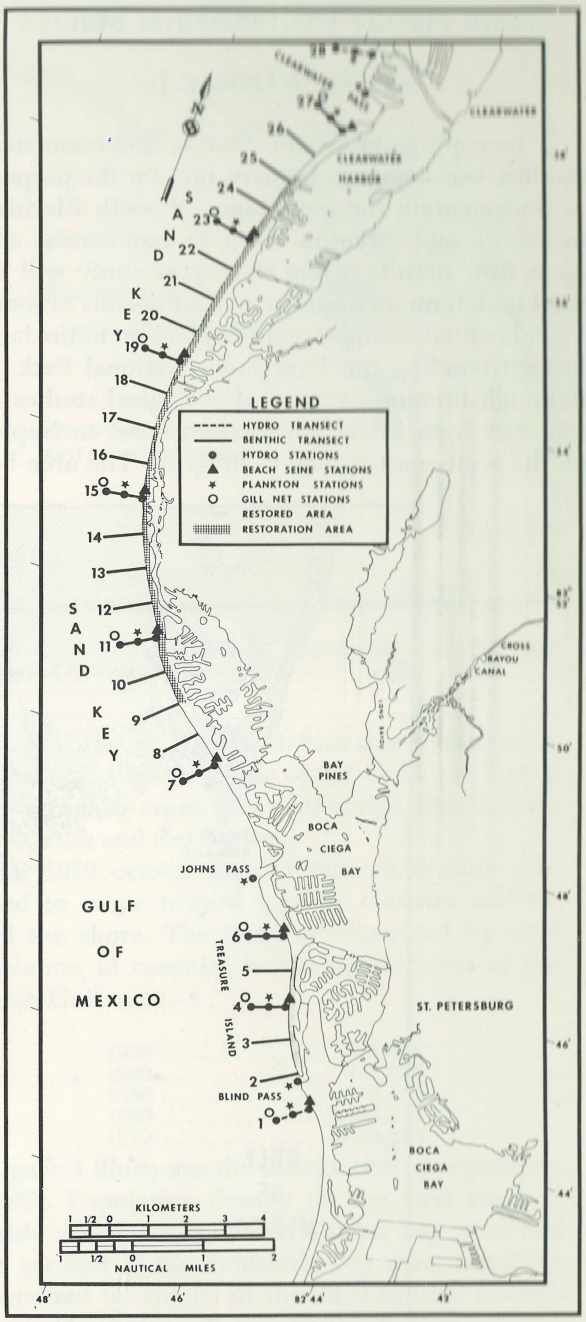

Figure 2. — Coastal Florida from Blind Pass to Clearwater Pass showing transects, stations, areas of restored beach (Treasure Island), and the site for potential restoration (Sand Key).

Creel census. Interviews of fishermen on three commercial sport fishing piers are conducted to determine the extent of sport fishing, its value, species caught, amount of fishing effort, and other relevant biological data.

South Florida Environmental Studies

William N. Lindall, Jr.

A new program, South Florida Environmental Studies, was begun in January 1971 for the purpose of documenting the importance of south Florida's nearshore and estuarine areas to commercial and sport fish. Results of the three-year study will be used to determine freshwater requirements of south Florida estuaries and to assist in plans for future land use surrounding the Everglades National Park. A thorough literature review of ecological studies in estuaries from Miami on the east coast to Naples on the west coast is now in progress. The area between Cape Romano and Cape Sable was selected for intensive field sampling because it receives most of the freshwater discharge from the park (Fig. 3). Quarterly sampling for eggs, larvae, and juveniles of major commercial and sport fishes is conducted at 68 stations from inland bays and rivers to 20 miles offshore. Hydrological sampling at each station includes salinity, temperature, dissolved oxygen, and light transmission.

The first quarterly sampling was conducted May 15 through May 22. Analyses of biological samples have not been completed, but because of the record drought in south Florida, hypersaline conditions (up to 41.5 ppt) were measured over much of the inshore sampling area.

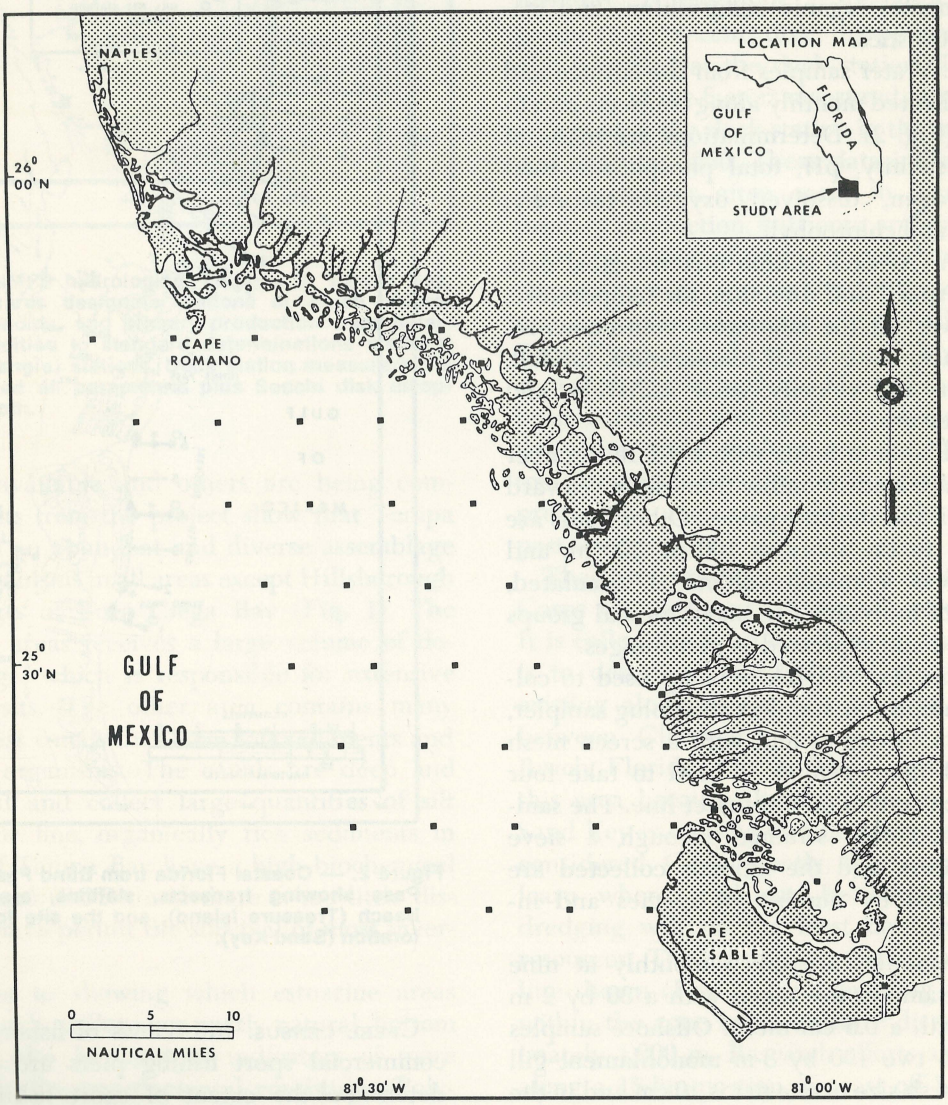

Figure 3. — South Florida between Cape Romano and Cape Sable showing inshore and offshore stations of south Florida Environmental Studies program.

Environmental Description, Monitoring, and Management

The program consists of two projects: The Cooperative Gulf of Mexico Estuarine Inventory and Case Histories.

ESTUARINE INVENTORY

J. Kneeland McNulty, William N. Lindall, Jr., and Ernest A. Anthony

In the fall of 1965, several members of the Estuarine Technical Coordinating Committee (ETCC) of the Gulf States Marine Fisheries Commission agreed that an inventory of estuaries of the Gulf of Mexico was urgently needed. The group recognized the accelerated competition the states were experiencing between fisheries and industrial and municipal growth. Agreement was reached that the best way to offset such influences was to develop realistic, comparable appraisals of estuarine resources along the entire coast. An inventory was conceived that would include physical descriptions of the estuarine basins and the waters within them plus comprehensive biological studies of plant and animal life. Funding was provided through the Commercial Fisheries Research and Development act (Public Law 88-309, as amended) with which studies in Alabama, Mississippi, and Louisiana were financed in part. This Laboratory and the National Marine Fisheries Service Laboratory, Galveston, Texas, undertook the Florida and Texas portions of the study largely because other uses were made of P.L. 88-309 funds in those states. Members of the ETCC developed work outlines that all participants followed so that methods of study were the same and results were comparable. The study was divided into four phases: Area Description, Hydrology, Sedimentology, and Biology.

The Florida Area Description phase was completed by this Laboratory and submitted for publication. It combines original observations with a review of the literature on dimensions, vegetation, geology, stream discharge, oyster and clam beds, artificial fishing reefs, human population, economic development, pollution, and dredging. The manuscript contains 21 double-page maps portraying over 0.86 million ha of open water, tidal marsh, mangrove swamp, filled and drained areas, areas closed

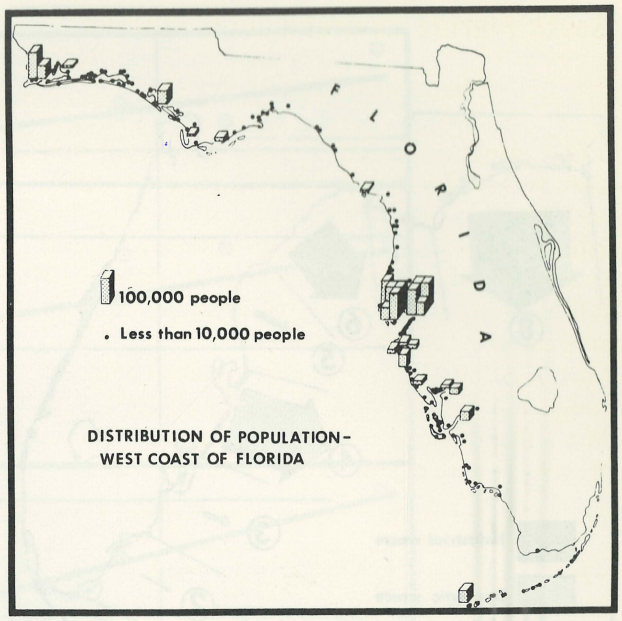

Figure 4. — The distribution of population on the west coast of Florida, 1960.

to shellfishing or other activities due to pollution, sources of pollution, public oyster beds, and leased oyster-growing areas. The manuscript also includes many tables and text-figures.

The 1970 census showed that Americans continued to move toward warmer climates and toward the shore. The trend is illustrated by total population of counties bordering estuaries of the Florida Gulf coast.

1930	614,616
1940	847,896
1950	1,338,359
1960	2,448,210
1970	3,320,226

Figure 4 illustrates the distribution of population in 1960. Population density on the west coast of Florida was greatest in the Tampa Bay area and next greatest in the Pensacola Bay area, a pattern maintained by results of the 1970 census. Growth was most rapid from Tampa Bay southward.

Pollution coincides generally with sizable communities and large industries. The quantity of domestic waste is greatest in Tampa Bay and vicinity whereas that of industrial waste is greatest in northern estuaries (Fig. 5). We constructed the figure by totaling the flow of pollutants in each of eight segments of the coast from data provided by State, County, and Federal agencies.

As might be expected, a direct relation exists between human population in communities border-

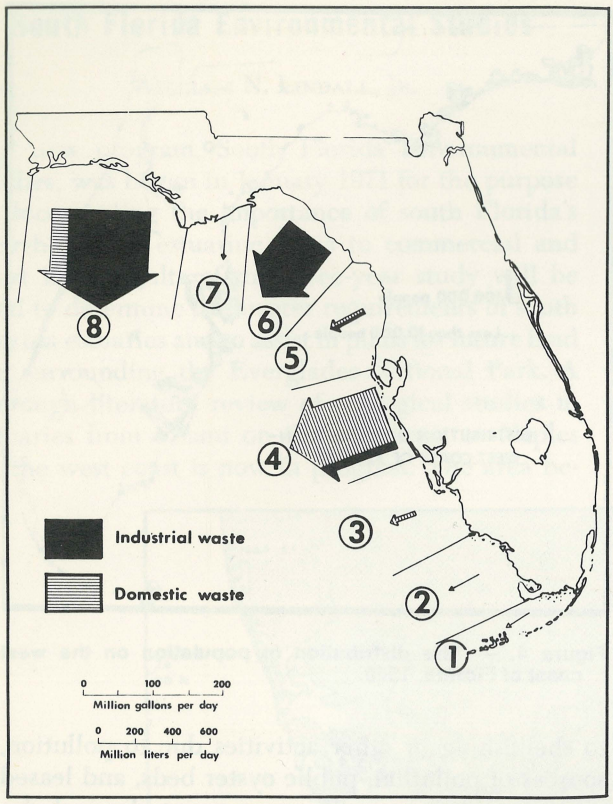

Figure 5. — The flow of pollutants into estuarine areas by coastal segment. Circled numbers are coastal segment numbers.

ing estuaries and areas closed to shellfishing, the number of sources of pollution, and areas of filled land (Fig. 6). Trend lines in the figure were computed by the method of least squares. The obvious implication is that, as the human population increases, the damages to estuarine habitats increase proportionately unless controls are initiated to reverse the trend.

CASE HISTORIES

WILLIAM N. LINDALL, JR., AND JOHN R. HALL

In June 1970 water was introduced into a network of seawalled canals that were cut from upland adjoining Tampa Bay. The 4.5-m deep canals provide about 6 ha of new estuarine habitat. We conducted monthly biological sampling in the canals for one year to obtain information on colonization by benthic and nektonic animals and to correlate the biological data with physical and chemical measurements. Benthic organisms were sampled by divers using a 1/64-m² plug sampler. A 4.8-m trawl was used to collect swimming and epibenthic organisms. Salinity, temperature, turbidity, dissolved oxygen, pH, total phosphorus, and total Kjeldahl nitrogen were determined monthly; particle-size analyses of sediments were conducted semiannually.

Preliminary findings show that the bottom sediments and water column are rapidly colonized by pioneer species. Possibly because of oxygen depletion brought on by accumulation of high-organic bottom sediments, the number of fish species declined in the April-June 1971 period.

Louisiana Coastal Studies

WILLIAM N. LINDALL, JR., AND JOHN R. HALL

One area of the United States where the availability of fresh water has become critical is the High Plains of west Texas and eastern New Mexico. Here the underground water supply is expected to be exhausted by 1990. To help solve the problem, a plan was developed to divert some 16.053 km³ of Mississippi River water to the area annually.

In addition to engineering, legal, and political problems, planners are concerned about the effects a diversion of this magnitude would have on the abundant wildlife and fishery resources of coastal Louisiana. Several agencies were called upon, therefore, to determine freshwater needs of fish and wildlife inhabiting Lousiana's estuaries. The Laboratory was assigned the tasks of (1) documenting the role of Louisiana's estuaries as nurseries and contributors to the Gulf of Mexico commercial fishery and (2) determining fresh water requirements to optimize the commercial fishery resource. Our contract to make the study is with the U.S. Army, Corps of Engineers.

For the study, coastal Louisiana was divided into nine hydrologic units, each enclosing a natural catchment basin (Fig. 7). Because of time limitations, field sampling was not possible; therefore, we relied on existing published and unpublished data such as commercial catch statistics, results of Louisiana's portion of the Cooperative Gulf of Mexico Estuarine Inventory, and hydrologic reports of the Coastal Studies Institute of Louisiana State University, and meetings with biologists of the Louisiana Wildlife and Fisheries Commission.

Results show that additional fresh water is required to optimize the commercial fishery resource over much of the Louisiana coast, especially in

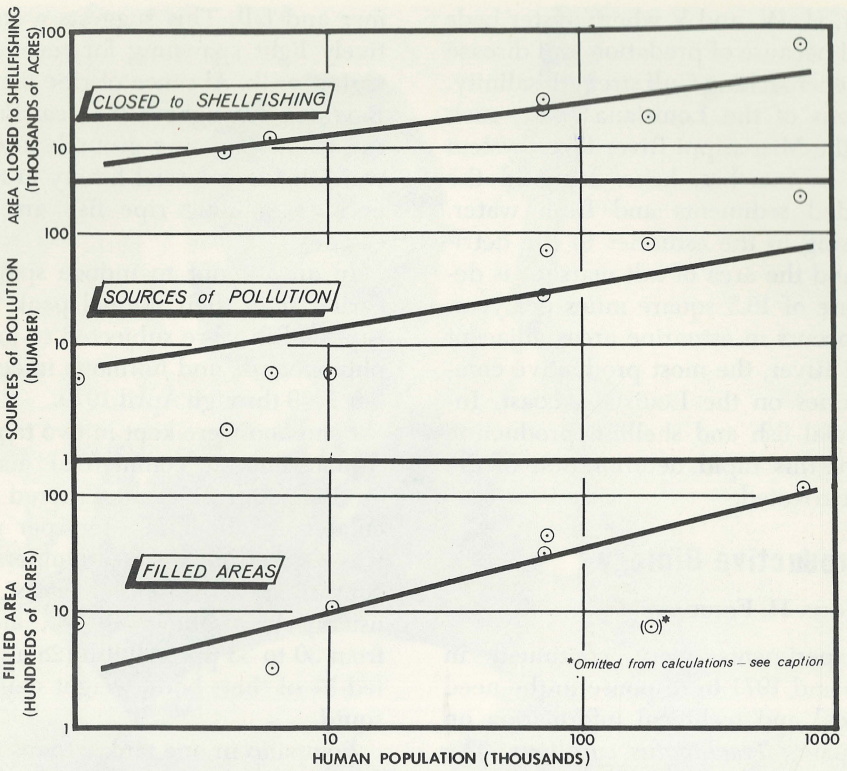

Figure 6 — The relation between the human population in communities bordering estuaries and the filled area, the number of pollution sources, and the area closed to shellfishing in the eight segments of coast in Figure 5. Two segments were omitted from calculation of the trend line because they differed widely from the other six. One appears in parentheses; the other fell slightly below the base.line, so is not shown.

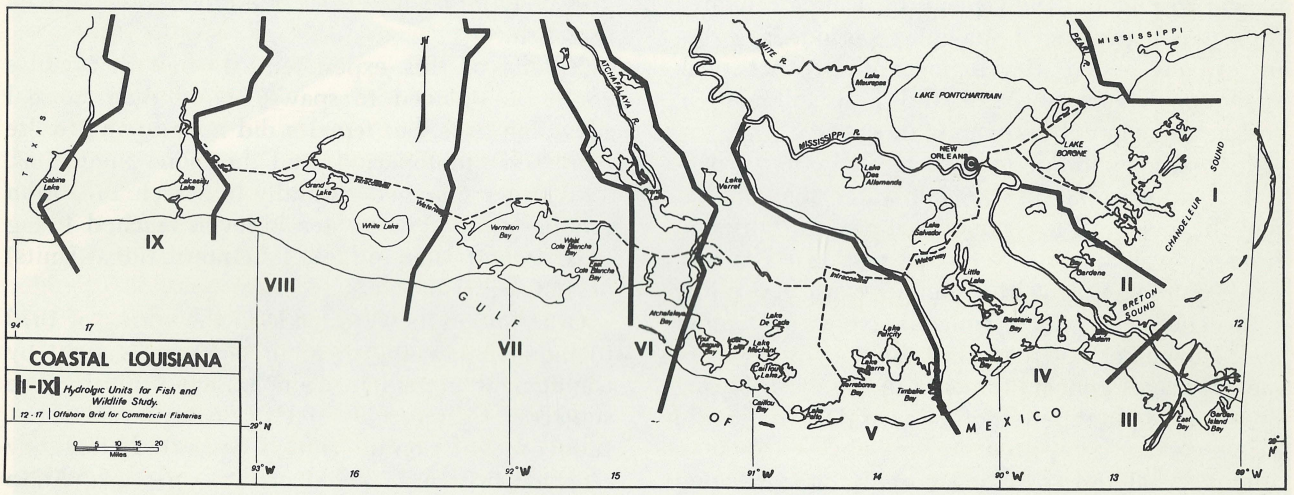

Figure 7 — Coastal Louisiana showing natural catchment basins (Hydrologic Units I-IX), offshore commercial fishing grids (12-17), and major bays, lakes, and rivers. One mile equals 1.61 km.

hydrologic units I, II, IV, and V where oyster beds are being reduced because of predation and disease brought about by encroaching Gulf strength salinity. Man's modifications of the Louisiana coast, such as completion of the Mississippi River levee system and canalization in marshes, have deprived the estuaries of needed sediments and fresh water. Salinity is increasing in the estuaries to the detriment of oysters, and the area of salt marshes is decreasing at the rate of 16.5 square miles per year. Most of the loss occurs in estuarine areas adjacent to the Mississippi River, the most productive commercial fish nurseries on the Louisiana coast. Inevitably, commercial fish and shellfish production will be reduced if this rapid deterioration of the coastal zone is not arrested.

Reproductive Biology

JOHN H. FINUCANE

Mariculture experiments were continued in Fiscal Years 1970 and 1971 in response to the need for basic ecological and technical information on the Florida pompano, *Trachinotus carolinus*. The objectives of these studies were to: (1) determine the rate of gonad development in adult pompano; (2) induce spawning either naturally or artificially through use of various hormones and by changing photoperiods; (3) develop methods of holding, feeding, and rearing; and (4) determine salinity tolerances of juvenile and adult pompano.

Examination of gonads taken from wild stock caught throughout the year in the Tampa Bay area indicated a prolonged spawning period. Egg diameter and oocyte development show that peak spawning occurs in April and May following a resting stage in February and March.

Increasing photoperiod (12 to 14 hours of daylight) and warming of the Gulf water above 20° C may be essential for gonad maturation. Observations show that a recovery and resting stage probably follows during the summer with a possible resurgence of secondary gonadal activity in October and November. A regression of oocyte developmental stages appears to occur in some fish during the shortest photoperiod of the year, December and January.

In general the spawning pattern indicates that most pompano are early spring spawners. The number of near-ripe fish decreases sharply after the spring months even though new groups of juveniles are found along Gulf beaches during summer and fall. This suggests a continuation of relatively light spawning for several months after the spring peak. Absence of ripe females in the Tampa Bay area throughout the year further suggests that the main spawning grounds are well offshore, beyond the commercial fishery in the Gulf of Mexico, because running ripe fish are extremely rare in catches.

In an attempt to induce spawning of pompano earlier than their normal peak in April and May, captive fish were subjected to gradually increasing photoperiods and hormone injections from November 1969 through April 1970.

Pompano were kept in two tanks provided by the Aquatarium, a commercial marine attraction at St. Petersburg Beach. Filtered seawater was circulated at about 27 liters per minute. Each tank was aerated, and water temperature was partially controlled with room heaters. Temperature was usually kept above 18° C, and salinity ranged from 30 to 33 ppt. All fish (28 adult pompano) were fed 5% of their body weight daily on fresh fish and squid.

Pompano in one tank, groups A and B, were subjected to an increasing day-length whereas groups C and D, in another tank, were exposed to normal day-length. Fish in groups A and C were given adrenal corticosteroids (hydrocortisone and desoxycorticosterone) in combination with human chorionic gonodotrophin (HCG). The other groups (B and D) received only HCG. The photoperiod was increased two hours each month, and progressively larger injections of hormones were given each fish.

Results of this experiment showed that males could be induced to spawn before their normal spawning time, but females did not respond to the increased photoperiod and hormone injections. Two males spawned naturally in March 1970 from groups A and C when steroid levels reached 40 mg of hydrocortisone and 400 IU (International Units) of HCG per fish.

Other attempts were made in the spring of 1970 to induce spawning of adult pompano caught by commercial netters in Tampa Bay. All fish were subjected to injections of HCG to ripen the eggs. Induced ovulation of some fish occurred after they received 600 to 1,500 IU of HCG per fish. As in previous experiments most of the eggs did not develop beyond the gastrula stage. The fertilization rate was low, indicting that HCG alone will not produce viable eggs in pompano. Further work is

Figure 8 — Seawater tank units used for pompano spawning and salinity experiments.

needed to determine the best hormone combinations and time intervals between injections and ripeness.

A closed system of circulating seawater in indoor tanks was developed and used for pompano spawning and salinity experiments (Fig. 8). The system consisted of resin-coated plywood tanks holding about 5,700 liters of natural seawater each. A 1/2 hp nontoxic centrifugal pump circulated water through two filter units of nylon floss, activated carbon, and oyster shell. Ultraviolet lights were incorporated into the main discharge lines to reduce bacterial contamination.

To determine the salinity tolerance of pompano, juvenile and adult fish were held during the winter and spring of 1970 and 1971 at salinities ranging from fresh to hypersaline water. Growth and mortality rates were also monitored at various intermediate salinities (5 to 20 ppt). Pompano can tolerate a wide salinity range from 0.5 to about 60 ppt. Below 10 ppt the fish appear more susceptible to fungus infections. The best growth and survival occurred at 20 ppt, and this indicates that intermediate salinity is advisable in commercial rearing of these fish.

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