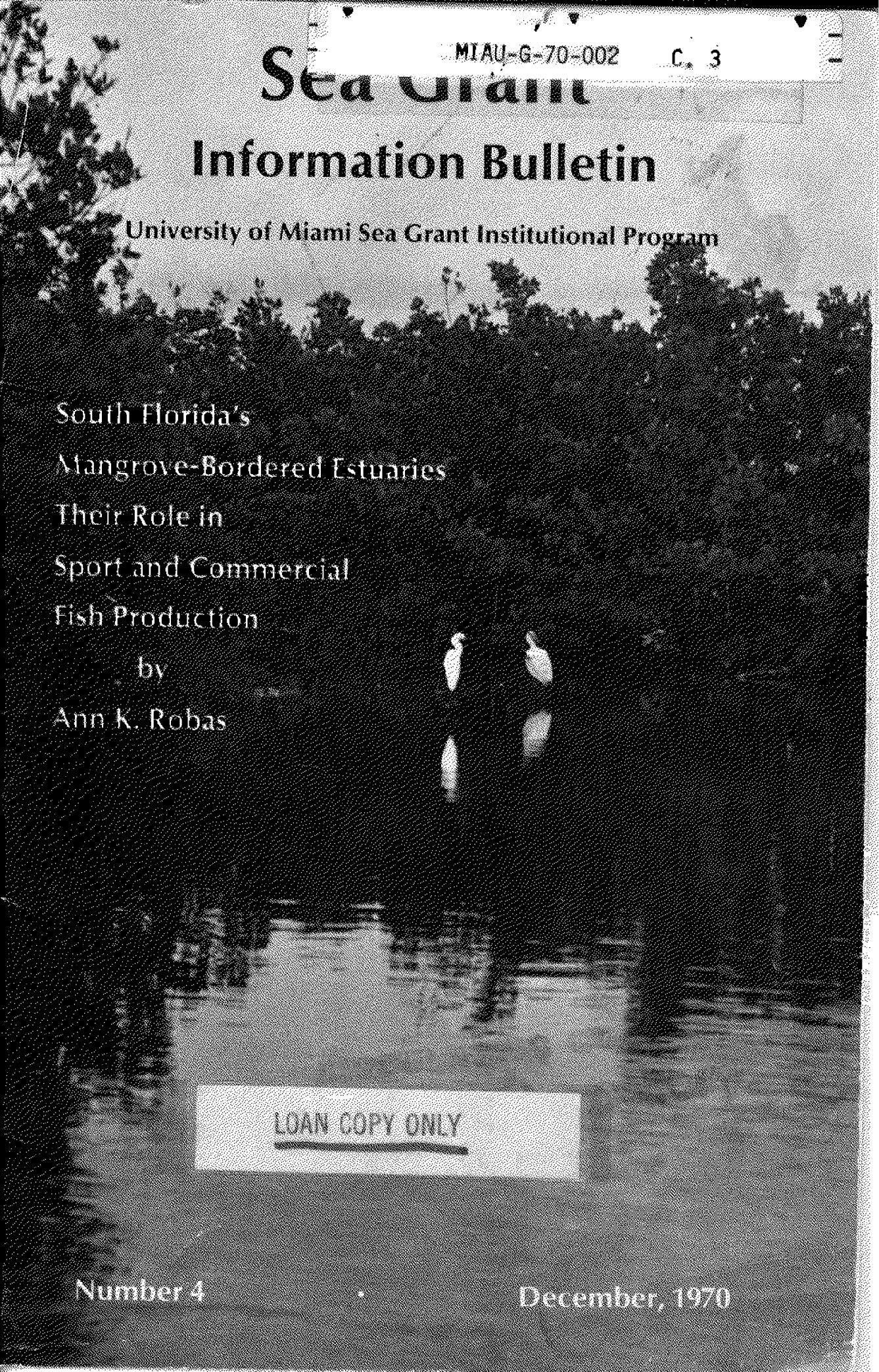
Sea Grant

Information Bulletin

University of Miami Sea Grant Institutional Program



South Florida's Mangrove-Bordered Estuaries Their Role in Sport and Commercial Fish Production

by

Ann K. Robas

Number 4 • December, 1970

South Florida's Mangrove-Bordered Estuaries

Their Role in Sport and Commercial Fish Production

by

Ann K. Robas

Sea Grant

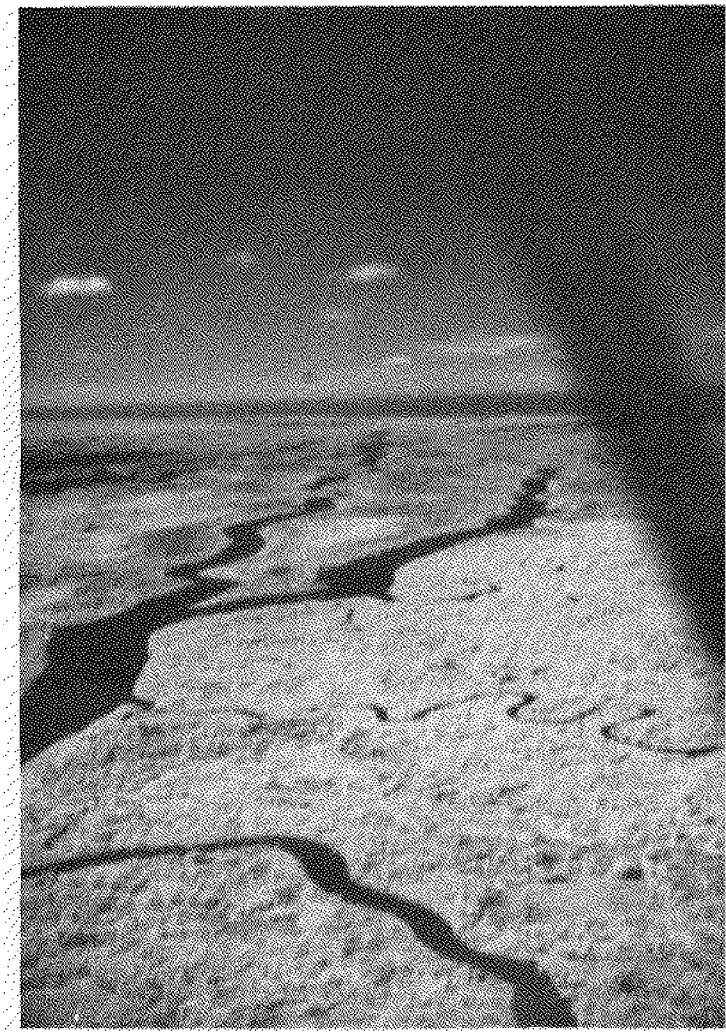
Information Bulletin

Number 4 · December, 1970

University of Miami Sea Grant Institutional Program

Cover Photo: A roseate spoonbill and immature little blue heron are reflected in the waters of a mangrove estuary.
Courtesy Dr. C. P. Idyll

Mangrove estuary as seen from the air.



GENERAL STATEMENT

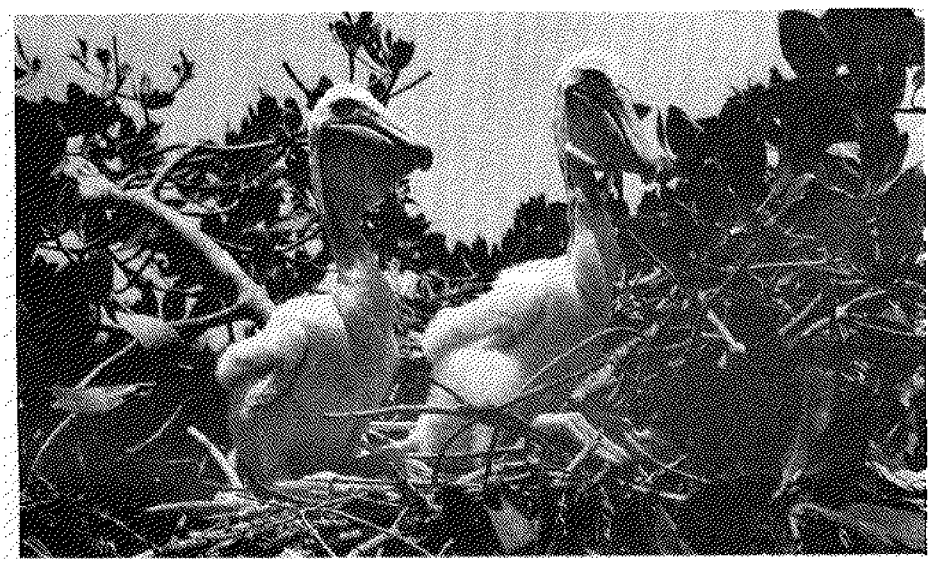
Recently there has been a tremendous demand for reliable information which will serve as the basis for important decisions on the effective management and control of estuaries. There are a large number of conflicting demands on shallow water areas. This makes it difficult to serve all interests to the degree demanded by concerned groups.

The filling of the estuaries for urban development and their use by industry, causing various states of pollution, has already reduced the potential of the country to produce more food from the sea, and this process is going on at an accelerated rate.

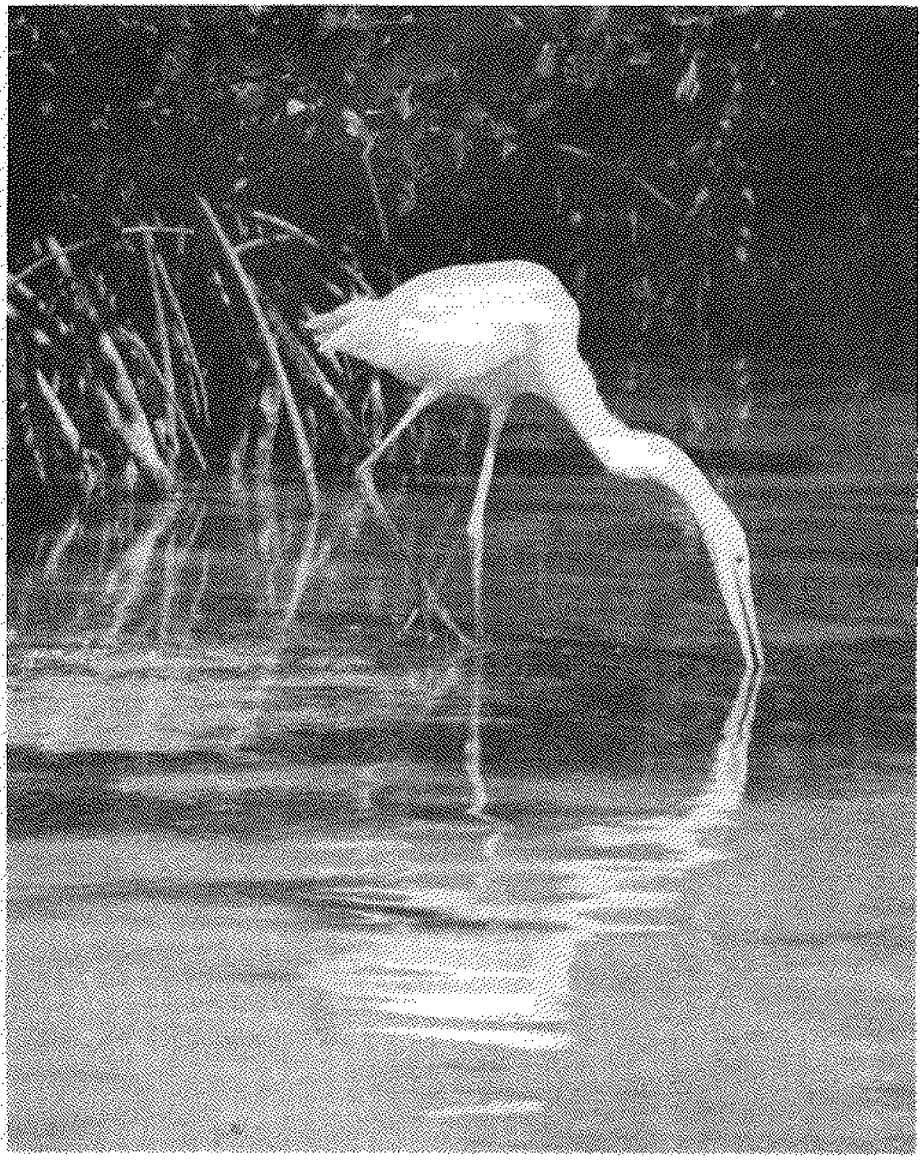
To some extent the changing and destruction of the edge of the sea areas is inevitable; in other cases it can be prevented if the public and government officials are aware of the principles involved.

The Sea Grant Program of the University of Miami, established by a grant from the National Science Foundation and supplemented by funds from the University of Miami and industrial sponsors, was set up for the purpose of carrying out practical research in the ocean environment and to collect and disseminate information already available.

Probably no more useful research could be accomplished under the Sea Grant concept than to develop principles for multiple-use management of the estuaries and shallow areas of the U.S. coastline.



The top of a red mangrove tree serves as a nesting place for young brown pelicans. Courtesy: Florida News Bureau, Florida Development Commission



Great White Heron "fishing" in the shallows of a red mangrove estuary.
Courtesy: Florida News Bureau, Florida Development Commission

TABLE OF CONTENTS

INTRODUCTION

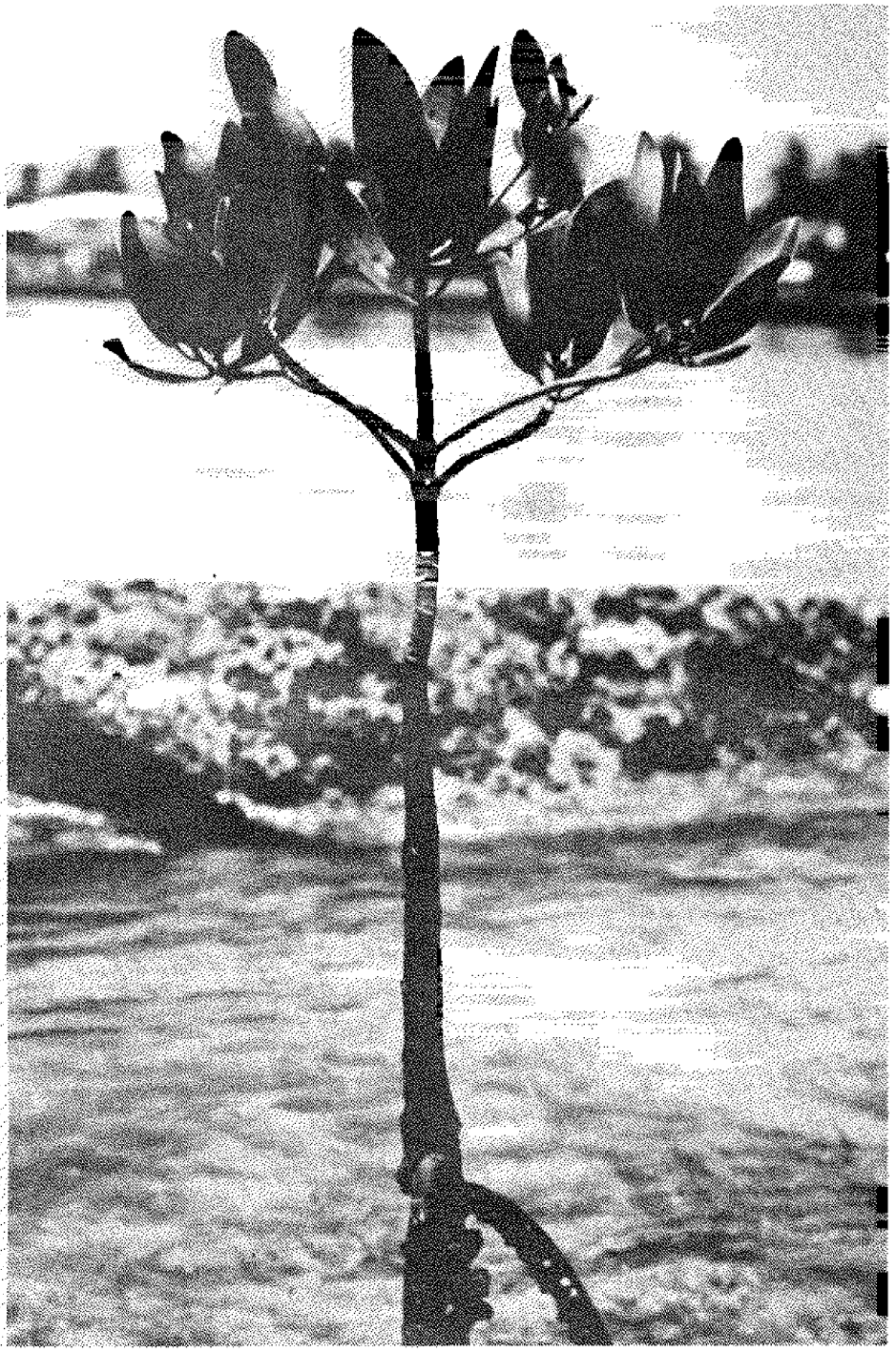
"There is no other case in nature, save in the coral reefs, where the adjustment of organic relations to physical conditions is seen in such a beautiful way as the balance between the growing marshes and the tidal streams by which they are at once nourished and worn away."

N. S. Shaler, 1886

Man's changing attitude about his environment and his responsibility to it requires that decisions be made in the future which had not seemed necessary in the past. Many of these will be conflicting, but the right decision will be easier to make if man realizes there is no other purpose for the preservation of natural resources than for his own use and enjoyment. Man's "use" can take many forms—dollar profit, recreation, aesthetics—but these are still of value to him and not to environment for its own sake.

This bulletin is designed to promote a greater awareness of the importance of the estuarine areas as well as associated marsh and mangrove shallows—to fishermen, both commercial and sport, and to those who enjoy the sea as a place of recreation and relaxation. Many of these coastal regions are in great danger of obliteration by various means. It is to be hoped that enlightened self-interest will lead to the preservation of most of the remaining acres of these sometimes unprepossessing areas.

Channel makes its way through cattails at high tide in Everglades National Park. Courtesy: Florida News Bureau, Department of Commerce



The mangrove is unique even in its seeding pattern. The seeds germinate and put out their first root while still on the parent tree. Falling into the soft mud below, they quickly adapt and can reach a height of forty feet. Seedlings that fall during high tide continue to grow and form roots as they are carried along with the tide, sometimes for thousands of miles. When they lodge in mud in compatible brackish water they thrive and the mangrove forest spreads.

Courtesy: William M. Stephens.

SOUTH FLORIDA'S MANGROVE-BORDERED ESTUARIES
Their Role in Sport and Commercial Fish Production

"Marshes are unnecessary swampland. They breed mosquitoes, sandflies, rats and snakes, and they take up valuable waterfront acreage that could be better utilized if filled in for housing developments."

This false concept of shallows on the edge of the sea as useless acreage is an old one, and old attitudes are hard to change, but change they must if we are not to lose some of our greatest environmental assets.

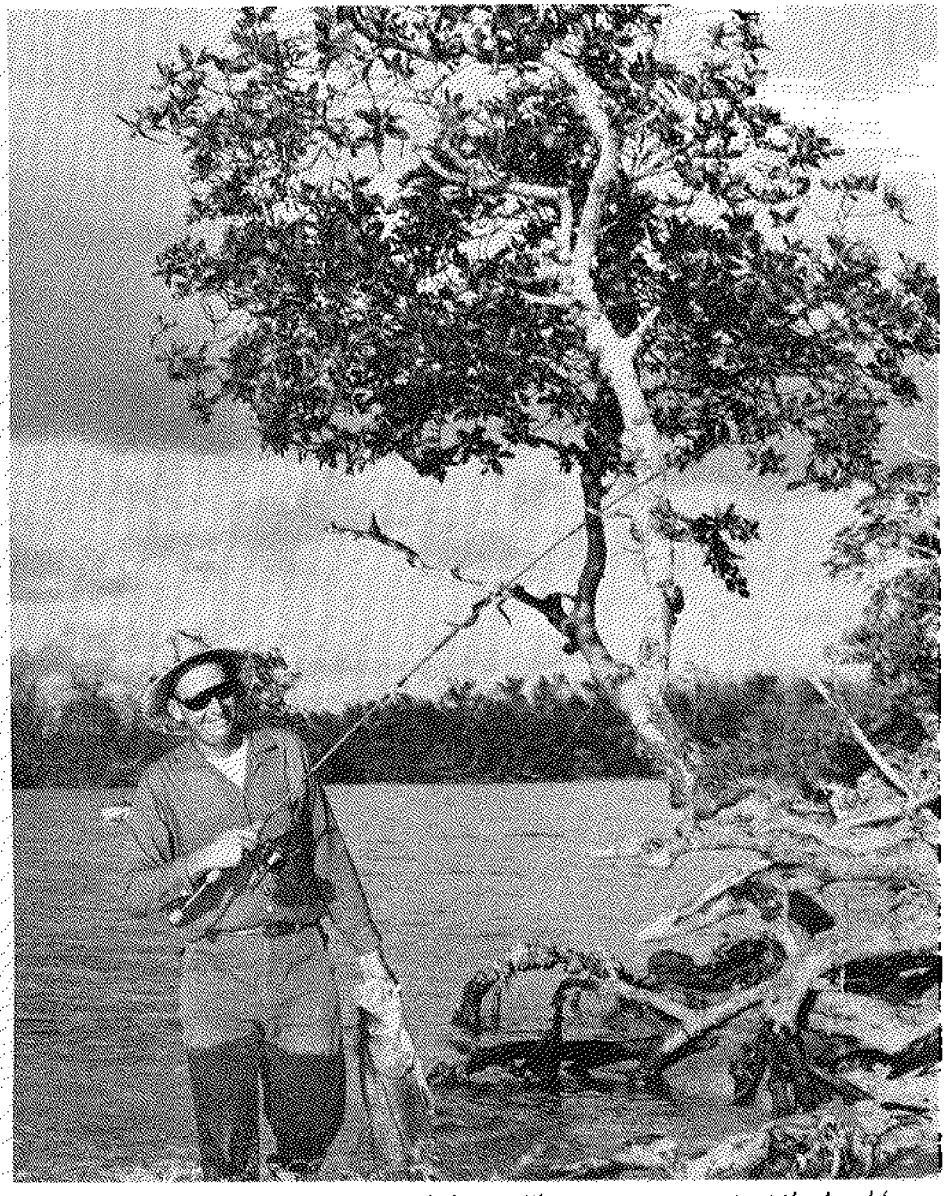
The word "ecology" is becoming a common household word to people who only months ago had never heard it. As man becomes more conscious of the fact that his way of life is controlled by natural laws, he becomes more interested in the science that occupies itself with the relationship between living things and their environment. A close connection exists between living creatures and men's activities, and this science of ecology is concerned with these events and relationships.

"Togetherness" is much over-worked, but it is a one-word definition of the science of ecology—all living things are tied in some way to each other and to their environment. What affects one lowly microscopic organism can ultimately affect the highest organism, man. Every plant and animal has its place in the scheme of things. Although it might not appear to be very important whether a certain species lives on the shady side or the sunny side of a rock, its presence or absence will affect other plants or animals associated with it, and in turn they will have an effect on still others.

The ecologists, scientists who study these inter-relationships, are attempting to open the eyes of mankind to nature's delicate balance and to find ways of reversing the damage already done by man. Whether in greed, short-sightedness or mere ignorance, men determine each other's fate by their actions against nature.

Nowhere is nature's balance more delicate than in the estuaries and coastal marshes—those areas where the salt water from the ocean mingles with the fresh water from the land. From the air some estuaries can be seen to form a maze of channels, becoming increasingly narrow as they wind their way toward the interior; from offshore they may appear as impenetrable masses of marsh grass or mangrove thickets, depending on the section

of coast they occupy. The estuaries' importance as havens and nurseries for over half the United States' harvest of fish and shellfish more than compensates for their unprepossessing appearance. The overriding problem as ecologists see it is not that the estuary is unfriendly to people but that people are hostile to the estuary.



The valuable mangrove tree: its tough finger-like prop roots protect the land from wave damage, act as depositories for soil that precipitates from the estuarine waters and are thus called "land builders", act as supports on which oysters attach themselves and grow, and as havens for small marine animals in the estuary. The leaves provide the greater portion of nutrition to consuming sea animals in mangrove estuaries. Snook, like the one just caught by this fisherman, live in the estuaries most of their lives. Courtesy: Florida News Bureau, Florida Development Commission

AMERICAN ESTUARIES

The story of American estuaries begins about 3,000 years ago, the time when the sea stabilized at its present level after the last Ice Age. It was then that the present continental shelf, which had been a coastal plain complete with forests and coves and tidal marshes, became the shallow sea-submerged plain that now forms a border to this continent. While some land submergence is still occurring, the coastal area, if unaltered by man, would just about be holding its own against the sea.

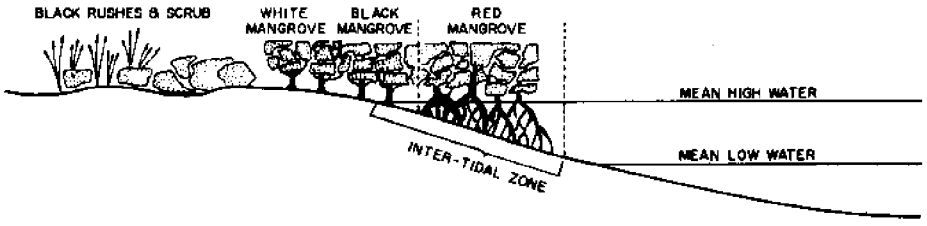
The one million days—give or take a couple of hundred thousand—since our coastlines became stabilized have been days of evolution and adaptation—of "survival of the fittest." These one million days of selectivity by nature have produced on the Atlantic and Gulf Coasts a band of salt-tolerant grasses and trees that protect approximately 3,700 miles of coast that would otherwise be buffeted by the relentless action of the ocean's waves. This buffer zone, called "high marsh" from the Middle Atlantic States north, "low marsh" from the Middle Atlantic States south, and "mangrove shallows" in tropical Florida, damps the pressing tides which flood the low-lying banks. Tides distribute nutrients and sediments upstream as well as downstream throughout the bays, rivers and creeks of the marsh complex, and these provide food for plants, shrimp, fish and oysters. As the tides recede they also pick up organic materials produced by marsh plants and drop these into the mouths of the bays, rivers and creeks—the estuarine waters—giving a rich food supply to the even more abundant plants and animals living there.

This interaction of land, sea, air and sun provides some of the richest food producing areas in the world—twenty times as productive per unit as the open sea, seven times as productive as an alfalfa field, and twice as productive as a corn field, according to the distinguished ecologist, Dr. E. P. Odum of the University of Georgia. Unlike a farm, however, marshes and estuarine areas plant, fertilize and harvest themselves without human assistance, and the "crop" provides the initial link in a food web which leads ultimately to consumption by humans.

In Sapelo Island, Georgia, at the University of Georgia Marine Laboratory, Dr. Claire P. Schelske and Dr. Eugene P. Odum were pioneers in demonstrating that the high productivity of the Georgia salt marshes is based mainly upon decomposed cordgrass, *Spartina alterniflora*. In decaying, huge amounts of bacteria and

micro-algae are produced which are utilized as the principal food of fishes and other animals in the salt marsh and adjacent estuaries. The fragments of the cord grass break down into smaller particles and provide food material for even the tiniest sea creatures.

Mudflats, salt prairies, deltas, swamps, grasslands and mangroves are all names that identify the land part of an American estuary and coastal zone. They all look unimposing. Their strong odor of sea and decomposing vegetation is often offensive, and they are usually so mucky and wild that they are almost impossible to walk through. One wonders how they can be anything but useless, desolate and worthless.



Drawing: R. R. MARRA

The ecologically valuable part of the mangrove estuary is the intertidal zone where the red mangroves grow. Mosquitoes do not breed here but lay their eggs in the marsh above the mean high water line where hatching depends on seasonal tidal flooding.

MOSQUITOES DO NOT BREED WHERE RED MANGROVES GROW

Mangrove areas and salt marshes are much maligned as mosquito breeding areas but this is only partially true. Mosquitoes do not breed in the most productive part of the intertidal zone where the red mangroves grow. In the marsh where black and white mangroves, black rushes and scrub occur, mosquitoes do lay their eggs on damp soil; hatching is dependent on seasonal tidal flooding. Generally the ecological value of the marsh above the intertidal zone where the mosquitoes breed is small compared to that of the red mangrove region.

LINK BETWEEN MANGROVE AREAS AND FISHES

It has taken scientists a long time to relate the fish and bird populations to the nutrient riches found in the "worthless" miles along the edge of the sea. But research is now yielding important

information about the productivity of these areas, and it is essential that the layman be convinced that we must reverse our misuse of them soon enough to save them from extinction.

Florida's waters are famous for excellent salt water fishing. The state's tidal shoreline (including the outer coast, off-shore islands, sounds, bays, rivers, and creeks to the head of tidewater or to a point where tidal waters narrow to a width of 100 feet) is 8,426 miles long. Florida's tideland acreage is second only to Alaska's in extent. The 700 square-mile mangrove area (including part of Everglades National Park) that forms a coastal band around the southern coast of Florida is a nursery for at least thirty species of the most popular commercial and sport fish and shellfish.

The estuary is a dangerous place for organisms which are not able to adjust to rapid environmental changes such as temperature, salinity, silt and numerous other fluctuations characteristic of the water. But for those organisms that can adapt to normal fluctuations, the estuary provides food and a comparative haven from less tolerant ocean fishes. Here they are preyed on by fewer enemies. Some game fish such as spotted seatrout spend most of their lives in estuarine waters and usually have only a bigger fish or the sportsman's hook to elude.

"The flats of the mangrove estuaries are quiet . . ." This raccoon makes its way through the shallows to feast on the oysters that grow on the red mangrove prop roots. Courtesy: Dr. C. P. Idyll

THE MANGROVE ESTUARY

The flats of the mangrove estuaries are quiet—except for the clicking claws of the fiddler crabs, the snap-closing of the oyster shells, the fluttering of bird wings disturbed by an encroaching snake, the crack of a limb, the rush of water as a fish jumps for a low-skiming insect, the swish of water when the fastidious raccoon washes his morsel of food, and other sounds one has to really listen for.

The waters of these estuaries are still too, but beneath the surface, larvae of many species of fish and shellfish are progressing toward maturity, and countless numbers of mature fishes dart about. The water is teeming with life-giving organisms that can only be seen through high powered microscopes—their value apparent only to the organism that eats them or to scientists who study such things.

Two such scientists, Dr. Eric J. Heald and Dr. William E. Odum, supported by a grant from the National Institute of Health, earned their doctorates at the University of Miami's Rosenstiel School of Marine and Atmospheric Science for their research on the importance of the mangrove to Florida's fisheries. Since fishes form some of the most compelling magnets for Florida tourists who spent $5.5 billion on the sport in 1969 (almost a quarter of the state's total personal income), the project seemed worth pursuing.

THE IMPORTANCE OF MANGROVE DETRITUS TO FLORIDA FISHES

Working in the North River estuarine system of Everglades National Park, Heald and Odum found that while small amounts of phytoplankton and algae were eaten by some bottom feeding organisms, it is the fragmented leaves of the mangrove, *Rhizophora mangle*, like the *Spartina* leaf material of Georgia marshes, which substitute for phytoplankton as the base of the nutrient pyramid.

Dr. Heald discovered that mangrove tree leaf fall resulted in the large annual production of leaf debris exceeding three tons (dry weight) per acre. Their importance to the ecosystem of the estuary starts after they fall from the tree and begin to decompose. The speed of decomposition depends on whether they fall on the land or in the water—the water being the more efficient en-

vironment for decomposition. The physical breakdown of the leaf is speeded by crabs and amphipods—the latter are relatives of the shrimp about the size of a grain of rice—whose agile claws shred the decomposing leaf into smaller fragments. Within six months more than 30% of the leaf material has been grazed by scavenging aquatic organisms. Three more months are sufficient for the leaf to be reduced to fragments no larger than 1 mm. in width.

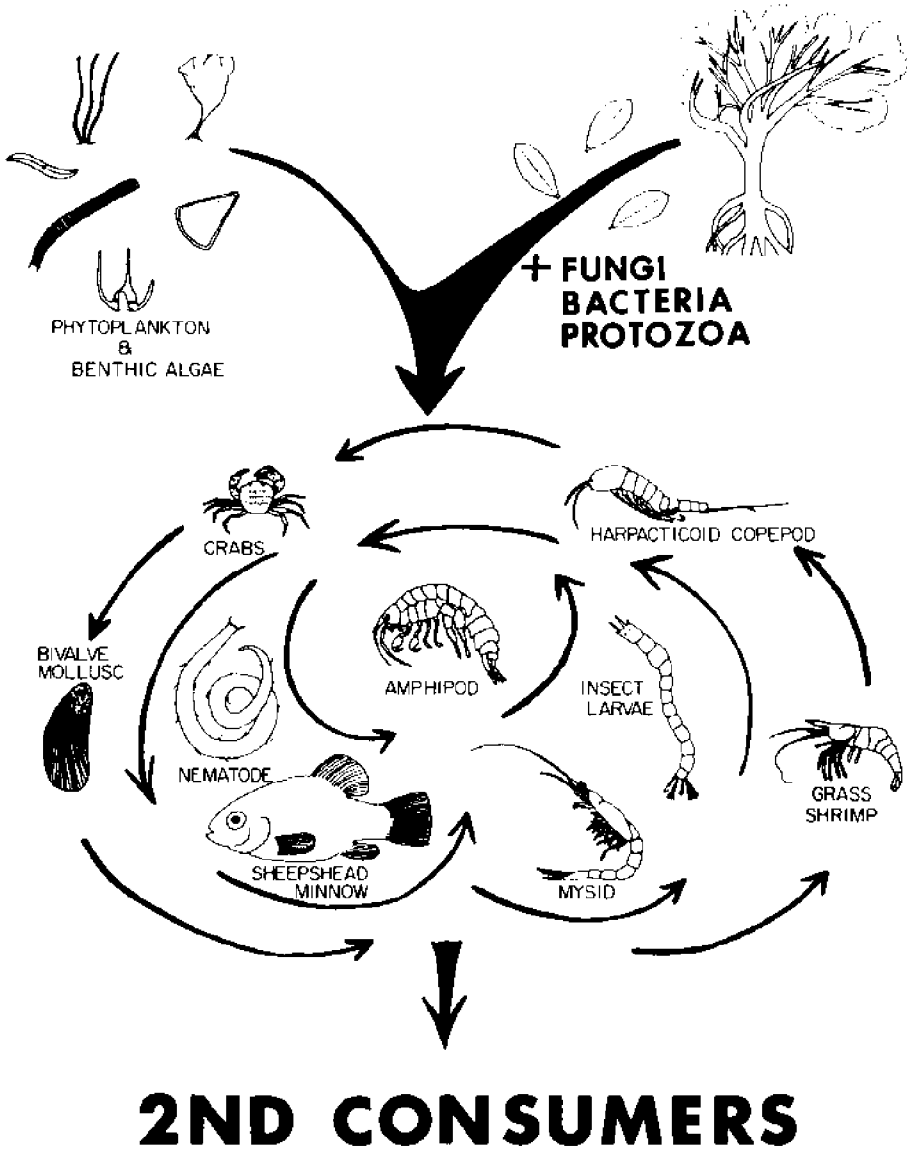
During this breakdown process the particles of mangrove litter become covered with bacteria and fungi, which use the leaf material as food. These organisms, which are themselves rich sources of vitamins and protein increase the caloric content and the relative percentage of protein of the leaf particle. Thus, the particle becomes an increasingly valuable food source for larger animals as it decreases in size and becomes more heavily coated with micro-organisms. At the end of 12 months Heald found that the mangrove particles were about 22% protein compared to about 6% when they left the tree in the intact leaf. These particles of leaf, now called detritus, get smaller and smaller as diminutive animals ingest them, devouring the bacteria and fungi and excreting the indigestible cellulose bit, which then gets another collection of micro-organisms which go down the gullet of yet another sea creature. The process is repeated again and again. The detritus—the vehicle upon which the bacterial and fungal protein rides—can hardly get too small, for when it reaches less than 5 or 10 thousandths of a millimeter it may combine with other small particles in conglomerates, and the cycle is continued.

William Odum examined the stomach content of over 6,000 organisms representing approximately 90 species of fish, shellfish, oysters, clams and insect larvae to discover what served as their food in the estuarine environment. From such observations, Odum and Heald were able to reconstruct the biological pathways of the food energy flowing through estuarine community and to assess the relative value of mangrove material to the fishes and other members of the animal community in the estuary.

ENERGY FLOW

The energy flow—the food chain, food cycle or food web—of the estuary or the open sea is so complex that it is not possible to illustrate in any form other than a three-dimensional model. Even this would be further complicated by the need to show

seasonal variations. It should be understood that the feeding habits of the animals vary according to season and also individual species vary their diets in different parts of the estuary or ocean.



This diagram shows that the mangrove leaf provides a greater portion of nutrition to the consuming sea animals in the North River estuary than does phytoplankton and bottom-growing algae. These animals eat small amounts of living algae along with large quantities of mangrove detritus. Detritus particles in the form of fecal material is utilized and re-utilized, as shown by the cyclical nature of the diagram.

Estuarine Food Web

In the North River estuary of the Everglades, detritus accounts for 80-90% of the nutrition of a number of species of crabs, worms, insect larvae, shrimp, and small forage fishes. These detritus eaters are the prey of over sixty species of juvenile fishes (some of which are important game and commercial species) which live in the mangrove-bordered estuary for varying periods of their lives. Among these are the tarpon, snook and ladyfish, which utilize the mangrove belt from the time they reach the estuary as post-larvae. Gray snapper, sheepshead and red drum spend the first few weeks of their lives in the grass beds of Florida and Whitewater Bays, and then move into the mangrove habitat for the next several years. Of this group, the gray snapper is the most dependent upon the mangrove environment. Other game fishes which are found in and near the mangrove zone are the spotted seatrout, crevalle jack, the gafftopsail catfish and the jewfish. The young of these fishes eat amphipods and insect larvae, then, as they grow larger, they consume shrimp, crabs and fishes—all detritus eaters. They also consume forage fishes such as the tidewater silver sides, the silver jenny, and the rainwater killifish, which in turn feed on detritus feeders.

The value of the grass and mangrove nursery areas for commercial species is thus very great. Shrimp also eat large amounts of detritus, and other commercially valuable species such as menhaden, spotted seatrout, red drum, striped mullet and blue crab are also dependent on the estuarine detritus food web system.

Open Sea Food-Web

The more familiar marine food begins with microscopic plant plankton instead of with detritus. The food pyramid here is built on the base of water, carbon dioxide, oxygen, calcium, nitrogen and phosphorus salts, amino acids and other materials, which support the growth of the phytoplankton—the microscopic plant life composed chiefly of diatoms. The zooplankton—the microscopic animal life of the sea made up of protozoa, copepods and other crustaceans, minute worms, tiny jelly fish and other organisms—feed on the plants.

The consumers include organisms found on the ocean's bottom, those living in the intertidal zones and those that occupy the open water at various depths. Primary consumers either

Coastal birds concentrate in regions rich in plankton because fish life is generally prolific there. These Man-O-War birds and Brown Pelicans nest in the red mangrove trees that border the estuaries in tropical Florida. Courtesy: Florida State News Bureau, Tallahassee

filter particles from the water or consume sediment deposits.

The secondary, or larger, consumers, including bottom fishes such as flounders, rays, killifish and silversides are found moving back and forth with the tides, feeding on primary consumers. Nearer the surface, members of such commercially important families of fishes as menhaden, sardines and anchovies ingest both phytoplankton and zooplankton. Other valuable fishes, including large numbers of game fishes and some mammals, inhabit the shallow waters along the seacoast. The larger predatory fishes occupy the deeper waters, eating the smaller fishes.

Marine birds and sea turtles are a third consumer group, and link the land to the sea in that they breathe air and breed on land but depend on the sea for their food. Coastal birds concentrate in regions rich in plankton because fish life is generally prolific there. Shore birds like the sandpiper feed from the high tide and intertidal zones; pelicans, cormorants and sea ducks seek food at low tide.

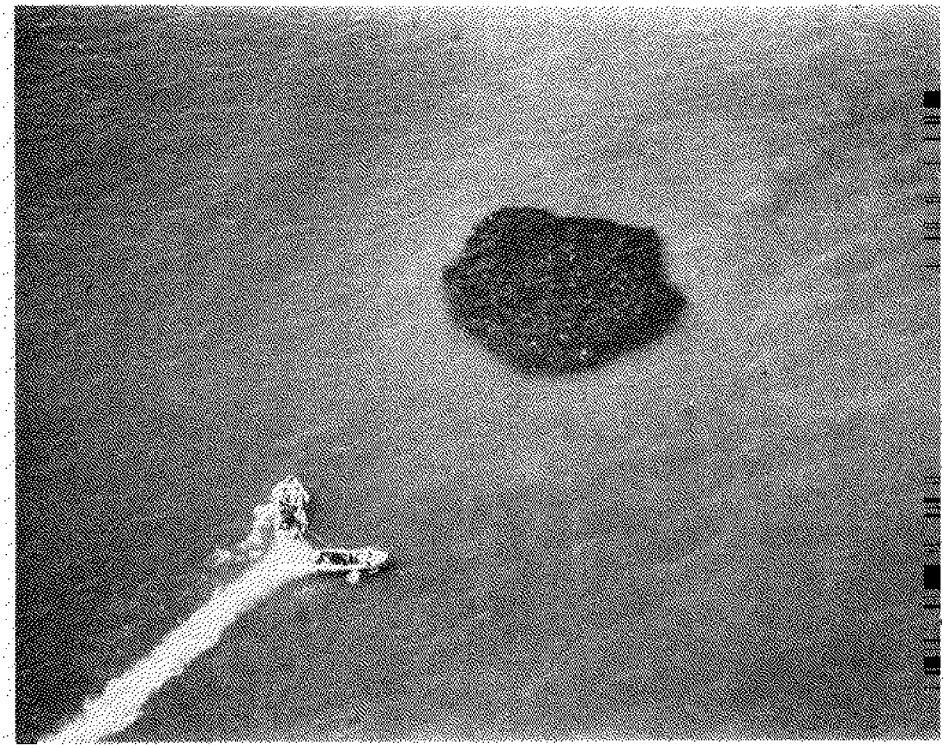
It is important to note again that in some estuaries, including those surrounded by mangroves, the animal communities are supported differently from those of the open sea in being far less dependent on plankton plants, relying instead on mangrove detritus with its load of bacteria and fungi.

FISH AND SHELLFISH LANDINGS IN POUNDS AND DOLLARS

Statewide commercial landings of many of the species found in the North River estuaries show that impressive poundages are supported by the detritus-based food web. In 1968 Florida waters yielded over 1,334,000 pounds of striped mullet worth $100,000; 3,703,000 pounds ($1,062,000) of spotted seatrout; 874,000 pounds ($132,000) of red drum; 15,608,000 pounds ($1,241,000) of blue crabs; 32,077,000 pounds ($15,719,000) of shrimp. And these figures do not include landings of the sport fishermen whose catches of some species such as spotted seatrout exceed the commercial production.

RECIPROCAL FUNCTION OF FISH AND ESTUARIES

A record high of 1.2 billion pounds of menhaden were landed in the Gulf of Mexico in 1969, while the entire Atlantic Coast—



Menhaden migrate in immense schools with their heads close to the surface, packed side-by-side, often tier above tier. Seen as dark red blotches from the air, this school is being surrounded by the fishermen's huge net soon to be processed for use as food for poultry and swine, fertilizer, oils for margarine, paints, linoleum, as well as for many other uses. Courtesy: Hall Watters, Standard Products Co., Southport, North Carolina

traditionally the bountiful area for the menhaden fishery—landed less than 400 million pounds. Florida's dwindling menhaden landings (43 million in 1967; 24 million in 1968) have forced two of the three fish processing plants to close. The one remaining plant in 1969 landed 20 million pounds.

It may well be that the loss of estuaries on the Atlantic side is responsible in significant measure for this costly decline. The menhaden spawn in the ocean and its larvae are carried by currents into the lower estuary where they stay for three to five weeks; then they move up tributaries to near the boundary of fresh and salt water. After several months the estuary is swarming with menhaden juveniles and the fish begin to venture in and out of the passes. By the time the first "norther" of fall or early winter appears the majority are out in the shallows of the open sea over the continental shelf.

The menhaden's dependence on the estuary is greatest in the juvenile stage when they first become filter feeders. If they are deprived of an abundance of food at that stage they perish. At this time of their lives they are primary consumers of the estuarine food supply. When they have converted estuarine food material they then become food for larger fishes.

The shrimp-estuary interrelationship is similar to that of the menhaden. As detritus eaters, they grow rapidly and in turn become food for larger fish.

PERILS TO THE ESTUARY

Perils to the estuarine areas have increased enormously over the last twenty years. The recent sale of Bald Head Island, off the coast of North Carolina, for a residential development is an example of an estuary lost through man's short-sightedness. This island has an area of about 12,000 acres, with only 3,000 acres above the water line at high tide. It teems with sea birds, sea turtles, otter, mink, alligators and fish in the marshland and surrounding shallows. Objections to its sale came from ecologists and state officials, including the governor, who had earlier formed a drive to raise funds to buy the island for the state. The governor's statements that "the public interest would be best served if the state could control its use," and that "this property can best be used for research in the marine sciences" were to no avail. The effects of this loss of fish and wildlife, recreation, scenic beauty and scientific investigations will be permanent.

VALUE AND BEST USE FOR FLORIDA'S SUBMERGED LAND

Bald Head Island is only one example of infringements on the rights of the public, accounts of which can be found in the newspaper nearly every day: For example, on 22 July 1970 the *Miami Herald* reported that "When it began, the alleged illegal overfill was estimated at only 3 million cubic yards . . . field studies now indicate in excess of 5 million cubic yards. . . ."

The State of Florida's sales of submerged land to real estate developers keep the courts busy ruling on whether a sale is in the "best interest" of the public, and for how much the land should be sold. In connection with the proposed sale of 27 acres of turtle grass-covered bottom near Miami, there was such a disparity in the appraised value of the tract of land compared with the estimate made four years previously that the Attorney General in 1967 called for a moratorium on all sales of submerged lands until the legislature could set some kind of rational policy. "The implication," said he, "that submerged lands just offshore from enormously valuable Key Biscayne have *declined* in value over the past four years strains the credulity of anyone who knows anything at all about waterfront property in Florida."

How Much is an Acre of Estuarine Land Worth?

An appreciation of the real value of coastal marshes and of estuaries will help in planning for use in the public interest and will keep unwise sales to a minimum.

In dollars and cents, how much is an acre of estuarine land worth? If one is talking about how many fish are lost to the public as food and as recreation by the sale of an acre of this rich nursery ground, no universally acceptable yardstick is available. However, estimates made in the northeastern United States and in the Gulf of Mexico suggest that fish production alone on an acre of submerged lands would have an annual value of $380. If this figure is capitalized at a modest 5% over a 20-year period, one acre yields $7,980 in fish production alone. It is estimated that for every acre filled or dredged, two others are ruined for fish production by siltation, pollution and other disruptive forces. If the capitalized value of that one acre and the loss of two are added, the total value comes to a whopping $23,940, based only on its seafood production potential.

In a recent report Charles H. Wharton of Georgia State University estimates the value of the 2,300 acre Alcovy River Swamp

in northern Georgia to exceed $7 million per year, or $430 million over the next 100 years.

LEGISLATION TO PROTECT ESTUARIES

The modern facts of life are that man's expansion over the earth and his need for a healthful environment must coexist. The conservationists maintain firmly that the land bordering on coastal waters between the mean high tide line and the open sea must be the domain of the public, and in state after state they are fighting for legislation to this effect.

Legislation to protect estuaries for the good of the public does not come easy. Groups interested in preserving estuaries inform the public that the destruction of these nurseries for fish and wild life is a multiple and permanent loss. These groups have confidence that once the public knows what the problem is they will act in a positive and intelligent way to remedy the situation through legislative channels.

So it was in San Francisco. With 67% of the estuarine habitat of California already destroyed, an aroused citizenry formed the "Save San Francisco Bay Association." Their purpose was to call to the attention of the public the fact that its rights to recreational and commercial fishing were being denied. The shellfish lost were 15 million pounds of oysters, 300,000 pounds of clams and 6.5 million pounds of shrimp. The Bay no longer supports an oyster or a clam industry and produces only 10,000 pounds of shrimp annually. Oil slicks and acid wastes destroy bass and salmon. Deformed fish are a frequent sight as chemical pollution has taken its toll on the eggs or larvae, and habitats have been buried in silt. In 1965 the San Francisco Bay Conservation and Development Commission was created. Among its first acts was the immediate prohibition of dredge and fill projects, thus protecting the remaining marshes.

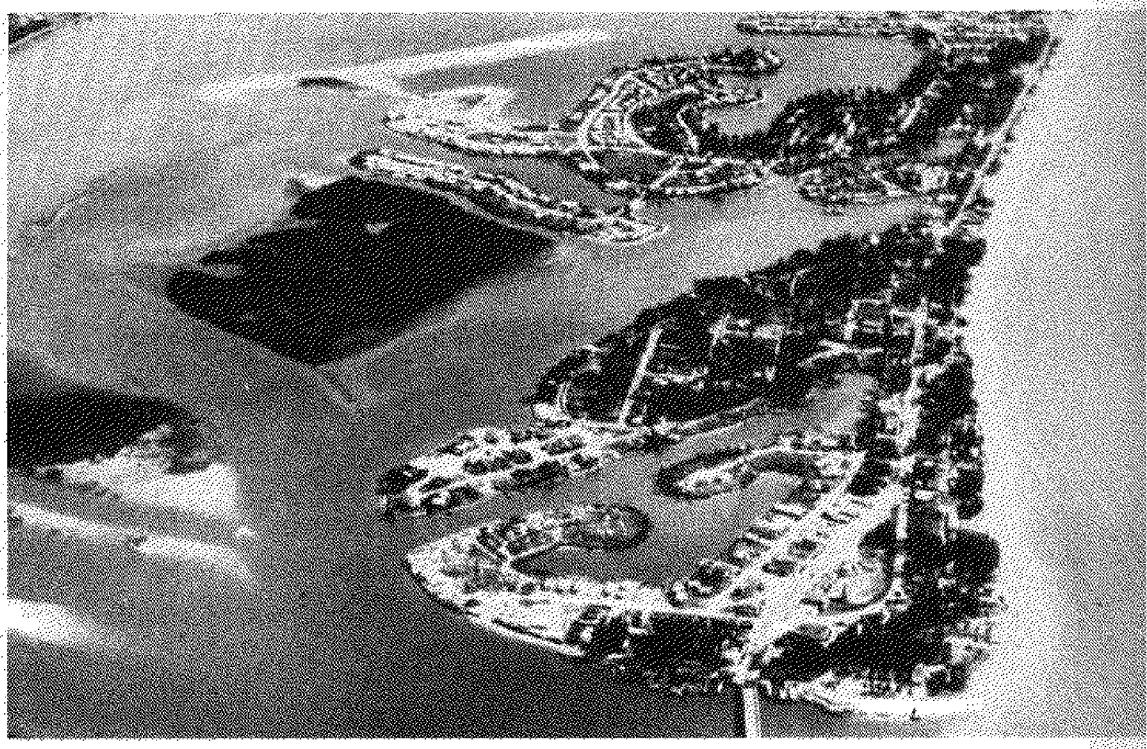
The Massachusetts Wetlands Protective Act of 1965 was passed after five years of persistent work by conservation groups. These groups publicized the fact that one-fifth of the marshes had already been destroyed and that swift action must be taken to preserve the rights of the public to the remaining valuable lands. The Act provides that no one may "remove, fill, dredge any bank, flat, marsh, meadow, or swamp bordering on the coastal waters" without a hearing and a state license and a biological investigation. Many other states are pressing for similar laws.

THE PEOPLE OF FLORIDA OWN ALL SUBMERGED LANDS

While Florida has no law as sweeping as the Massachusetts Wetlands Protective Act, this state is making progress. At the time of statehood in 1845, a committee of cabinet members, the trustees of the Internal Improvement Fund, was given the responsibility of stewardship over all submerged lands, bay bottoms, estuarine lands seaward of the line of mean low tide, and inland marshes and swamps. These lands are vested in the "inalienable ownership of the general public, to be guarded for the public good by the state." In one transaction during the early days of statehood "public good" was interpreted so curiously that the Trustees sold 4 million acres of these lands for 25 cents an acre! Until 1957 the Trustees still considered submerged land practically worthless except for filling, but in that year the Bulkhead Act was passed to preserve the tidelands from encroaching development. Still submerged lands continued to be sold by the Trustees at an alarming rate.

Public pressure that had been gradually building up was responsible for the success of Representative Ted Randell's (Lee County) amendment to the Bulkhead Act in 1967. This tightened the restrictions on the Trustees of the Internal Improvement Fund, and in 1969 only 55 acres of submerged acres were sold. The Trustees still have the authority to continue to sell, fill and set unfavorable bulkhead lines, leaving the public no real assurance of protected estuaries.

Of Florida's 1,900,000 acres of estuarine area, 390,400 acres—or 19.6%—have declined in biological productivity or have been completely taken out of production. In the St. Petersburg area, the Boca Ciega Bay has been reduced by 20% through filling for real estate development. Since 1964 there has been a decrease in such destruction of the Boca Ciega Bay estuary. During that year the energetic opposition of representatives of the Audubon Society, the Wilderness Society, the Isaac Walton League, the League of Women Voters, the St. Petersburg Garden Club, owners of property in the vicinity of the proposed land fill, Florida Board of Conservation, Federal agencies and university scientists and students halted a developer's plan to dredge and fill 500 acres for waterfront homes. However, their success has meant a fight. Opposition to the filling of 11 acres of the Bay for a trailer park was taken all the way to the U.S. Court of Appeals for the Fifth Circuit at New Orleans. The ruling that was handed



Boca Ciega Bay, St. Petersburg, Florida before fills—1952, Courtesy: U.S. Bureau of Sport Fisheries and Wildlife, Sand Hook Marine Laboratory

Boca Ciega Bay, St. Petersburg, Florida after fills—1962, Courtesy: U.S. Bureau of Sport Fisheries and Wildlife, Sandy Hook Marine Laboratory

down in July, 1970, states that environment should be considered along with other factors in the filling and dredging of coastal wetlands. This is a giant step in the history of Florida wetlands conservation.

Concerned citizens, uniting under the name "Conservation 70's" will try to persuade the 1971 Legislature to pass a law setting the bulkheading boundaries at the mean high water line. This line is critical in four ways: because otherwise estuaries will be destroyed; because the Federal authority ends there; because the line divides public and private ownership; and because this line separates the "worthless" land and the expensive land above it.

WHO HAS A STAKE IN THE PRESERVATION OF THE ESTUARIES?

Commercial fishermen, a scattered body not known for being very effective in protecting their interests, have a large stake in preserving the estuaries.

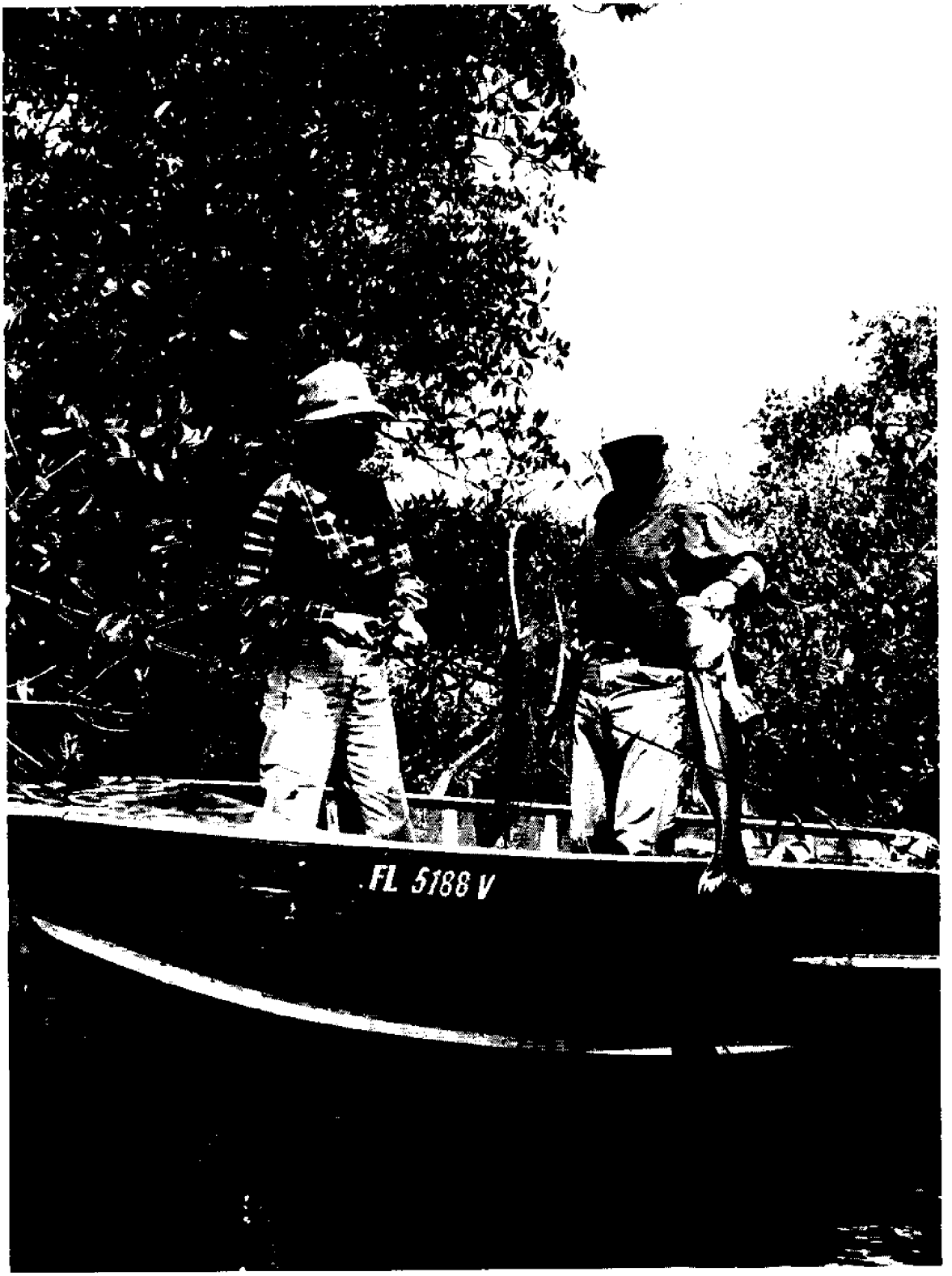
The 4 million sport fishermen in Florida, who are growing by a half million each year, depend on the estuaries for their fun.

Vacationers and occasional visitors, local business people in resort areas, as well as interested citizens everywhere all have much to lose aesthetically, nutritionally and financially when the marshland is disturbed.

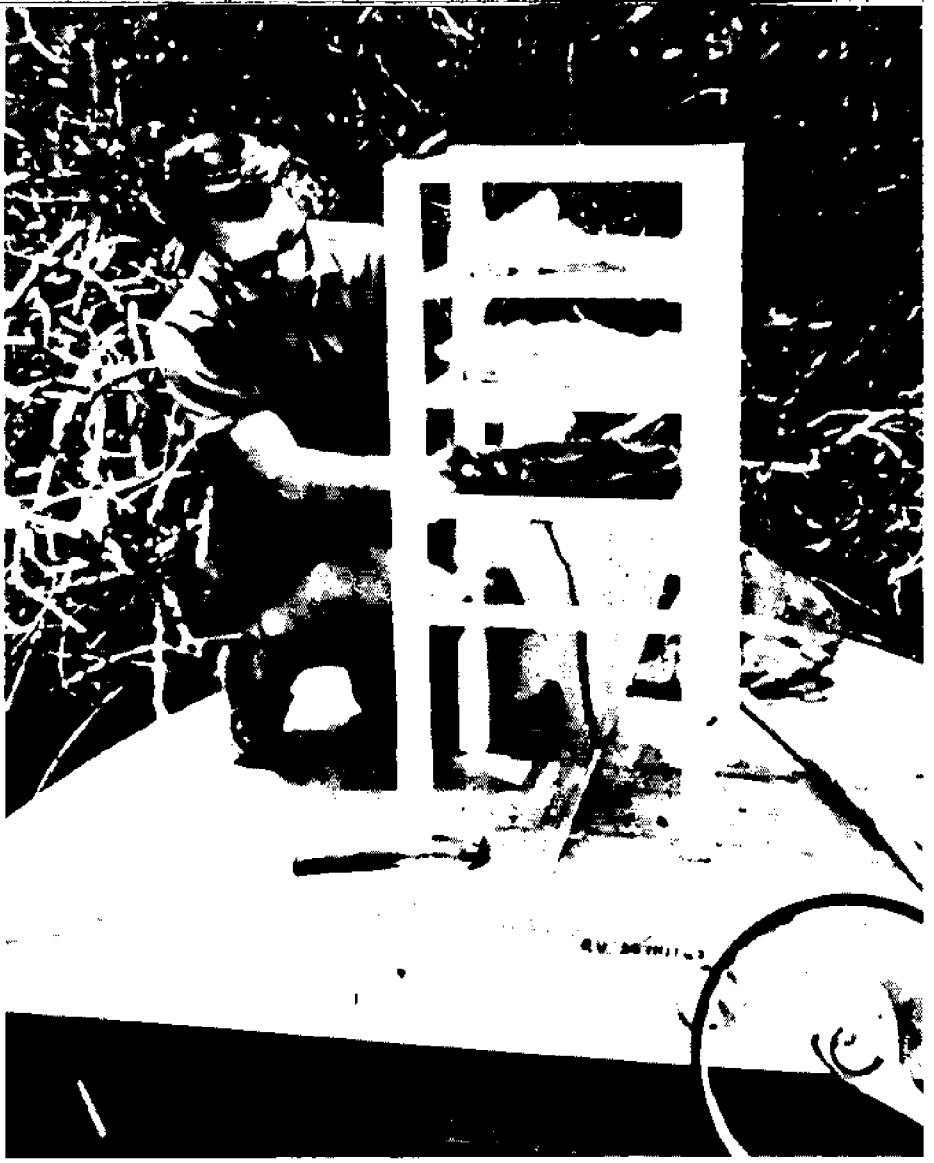
When 90% of the total harvest of seafoods from waters off the United States is taken on the continental shelf and when two-thirds of these seafoods are composed of species whose existence depends on the estuarine zone—or which must pass through the zone en route to the spawning ground—it makes the protection of the estuarine zone the business of all citizens of the United States, even those who may never visit Florida.

An Act similar to the Massachusetts Wetlands Protective Act would seem to put everyone involved in transactions concerning tidelands on the alert and would serve to maintain a proper balance between estuary development and preservation. It is obvious that a re-examination of the entire estuarine ecosystem is long overdue and must be made by a variety of natural scientists, government agencies and business men with objectivity and cool-headedness the keynote.

Because the marshes and mangrove areas are responsible for the production of so many species of game and commercial fish,



The 700 square-mile mangrove area that forms a coastal band around the southern coast of Florida is a nursery for at least thirty species of the most popular commercial and sport fish and shellfish. Courtesy: Florida News Bureau



Research by Dr. Eric J. Heald and Dr. William E. Odum revealed the fragmented leaves of the mangrove to be the base of the nutrient pyramid in the North River estuarine system of Everglades National Park. Here Dr. Heald separates the mangrove leaf debris to measure its nutritive value to the fishes and other members of the animal community in the estuary.

they are worth the effort and money required to protect them. The interdependence and stability of the natural marsh feeding ecosystem has been demonstrated. With little or no assistance from man, these areas continually produce new "crops" of fish and man is required only to reap the harvest. The estuary will continue to perform this necessary function unless it is altered or disturbed. When man tampers irresponsibly with that naturally organized system, he does irreparable damage to the estuary, and indirectly to himself.

As man's eyes are opened to the relationships between living things and their surroundings and to nature's delicate balance, he will find ways of reversing the damage done to his environment as a result of men's good will—or lack of it.

Let us hope his time does not run out.

ADDITIONAL READING

ANONYMOUS. 1970. Summary of Florida commercial marine landings–1968. Ann. summary. Fla. Bd. Conservation.

FARB, P. Life Nature Library, *Ecology*. Time, Inc., New York, 1963.

GREEN, J. 1968. *The biology of estuarine animals*. University of Washington, Seattle and London.

HEALD, E. J. and ODUM, W. E., 1969. The contribution of mangrove swamps to Florida fisheries. *Proc. Gulf Caribb Fish. Inst.* 22 Ann Sess. 130-135.

IDYLL, C. P. et. al. 1965. Conservation in Biscayne Bay. Paper. Institute of Marine Science, University of Miami.

KORMONDY, E. J. 1969. *Concepts of ecology*. Prentice-Hall, Inc., Englewood Cliffs, N.J.

MARX, W. 1968. Suicide in the shallows. *National Wildlife* 6 (4) 4-9.

ODUM, E. P. 1967. *Fundamentals of ecology*. W. B. Saunders Co., Philadelphia.

PROVOST, M. W. 1968. Florida's estuaries and their protection. Paper read at Southwest Fla. Conservation Clearing-house, 16 May 1968, Ft. Myers, Fla.

REDFORD, P. June 1967. Vanishing tidelands. *Atlantic Monthly*. 75-83.

RUSSELL, R. J. 1967. Origins of estuaries. *Estuaries* ed by GH Lauff. Am. Assn. Advancement of Science, No. 83. Washington, D.C.

SCHELSKE, C. P. and ODUM, E. P., 1962. Mechanics maintaining high productivity in Georgia estuaries. *Proc. Gulf Caribb Fish. Inst.* 14 Ann Sess. 75-80.

SHUSTER, C. N., Jr. Aug.-Sept. 1966. The nature of a tidal marsh. *N.Y. State Conservationist*.

STEPHENS, W. M. 1969. The mangrove. *Oceans* 1969, Vol. 2, Nos. 5 and 6; p 51-55; Oceans Publishers, Inc., San Diego, Calif.

SYKES, J. E. 1967. The role of research in the preservation of estuaries. *Contrib No. 33, BCF Bio Lab.* St. Petersburg Beach, Fla.

TAYLOR, J. L. and SALOMAN, C. H. 1968. Some effects of hydraulic dredging and coastal development in Boca Ciega Bay, Florida. *Fishery Bulletin*: Vol. 67, No. 2.

TEAL, J. and M. 1969. *Life and death of the salt marsh*. Little, Brown and Company, Boston.

U.S. Congress, House. Committee on merchant marine and fisheries, estuarine and wetlands legislation. HR 11236, 11245, 11305, 11307, 11309, 11417, 13296, 15676, 15770, 13447. 89th Con. 2d sess. 1966. Serial No. 89-26. 90-91.

WHARTON, C. H. 1970. *The southern river swamp–a multiple-use environment*. Georgia State University.