SAUERS

SHORELINE ANALYSIS
OF
SARASOTA COUNTY BAY SYSTEMS
WITH REGARD TO
REVEGETATION ACTIVITIES

By

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EXECUTIVE SUMMARY

The goals of this study were: 1) to inventory and evaluate the estuarine resources of Sarasota County, 2) to develop techniques for managing and protecting those resources, and, 3) to make this information available to the residents of Sarasota County. In order to achieve these goals, the activities in this study were divided into three sections (Figure 1).

The first section, Resource Mapping, is an inventory of estuarine resources in Sarasota County, and is divided into three subsections describing these resources. They are Shoreline Mapping, Grassbed Mapping, and Geographical Areas of Particular Concern (GAPC). The subsections are complemented by detailed maps of Sarasota County shorelines, grassbeds, and the GAPC in Appendices II, III, and IV, respectively.

The second section describes two pilot projects: 1) an experiment with mangrove horticulture, and 2) a demonstration of experimental stabilization techniques on Little Edward's Island, a small, county-owned spoil island located in Robert's Bay, Sarasota County, Florida. The third section presents the results from a shoreline preference survey designed to determine the knowledge and preferences of residents regarding shorelines.

In the shoreline inventory, all the bay shorelines, including the passes and tidal creeks to the first bridge, were mapped and classified according to shore type. Aerial photographs taken in 1974 were used for preliminary mapping and updated by field checking all the shorelines in the county. The following categories, or combinations of categories,

were recorded on the maps for all of the shorelines: 1) beach, 2) seawall, 3) rip-rap, 4) mangrove, 5) Australian pine/ Brazilian pepper, and, 6) other vegetation. These maps provide an inventory of the shore types and approximate mileage of each type in the county. Additionally, 1948 aerial photographs were mapped in the same way to provide a historical perspective of the changes in shoreline types.

The figures for 1948 and 1974 are included as Table I. There has been a tremendous increase in seawalls, rip-rap, and Australian pine/ Brazilian pepper shorelines with associated decreases in mangrove, beach and other vegetation. There has also been a 16% increase in total shoreline length due to the creation of extensive canal systems and filled land. The 1948 shoreline inventory can be used as a model for future management programs due to the relatively unaltered states of those shorelines.

The information summarized on the maps aided in pinpointing and describing the Geographical Areas of Particular Concern (GAPC) as defined in the Florida Regional Coastal Zone Management Atlas (a copy is available for use at the Sarasota County Department of Long Range Planning). The GAPC include marine grassbeds, tidal inlets, spoil islands, and areas requiring restoration and stabilization. These areas are valuable resources which help maintain water quality, provide recreational opportunities, wildlife habitats and may serve as plant sources for natural colonization of shorelines or shoreline stabilization projects.

As part of the inventory, the seagrass beds were mapped for 1948 and 1974 in an attempt to evaluate the current status of grassbeds and

to assess the feasibility of revegetation. Seagrasses are of particular importance because they support a large diversity of marine organisms, such as shrimp, crabs, and fishes, as well as their primary role in sediment stabilization.

The mapping showed an approximate 20% loss of seagrass coverage in the county (Table II), but in Little Sarasota Bay there has been a 9% increase. The losses can be attributed mainly to dredge and fill activities and the decline in water quality. The increase of coverage in Little Sarasota Bay is probably due to changes in salinity and current patterns caused by the construction of the Intracoastal Waterway. Results indicate that revegetation would probably not be effective until causes of seagrass decline are rectified, for example, improvement of water quality. The 9% increase of seagrass beds in Little Sarasota Bay indicates that seagrasses are capable of recolonization in areas where there is suitable habitat. This implies that once water quality is improved, natural recolonization will follow.

Two pilot projects were undertaken to observe the effectiveness of different methods of shoreline stabilization, and to obtain information on nursery cultivation of shoreline vegetation. These projects have provided specific information and materials concerning methods for growing and transplanting shoreline vegetation.

In the first pilot project, an experiment with mangrove horticulture was undertaken to develop efficient methods for growing red and black mangroves. The nursery plants were systematically subjected to different treatments, such as fertilizer vs. no fertilizer. Table IV describes in detail the treatments used. Growth and survival rates

were measured after 25 weeks (Figures 2 and 3); the results showed that the red mangrove seedlings had a lower mortality rate than the black mangrove seedlings.

The addition of mulch to the pots resulted in increased growth for both species of mangroves. Furthermore, the watering techniques apparently had an effect on the survival rate of the black mangrove seedlings; those plants which were in standing water showed a lower mortality than those watered daily in drained pots. The other treatments did not appearently affect growth rates. However, a significant difference may occur once the plants have been transplanted.

After the cost of supplies and labor for each treatment had been calculated and campared to the success of growth, it was concluded that none of the described treatments were as cost effective as natural conditions. Consequently, we feel that county owned GAPC areas could most beneficially serve as ' natural' nurseries with minimum input, such as planting, harvesting, etc.

In the second pilot project, Little Edward's Island was used as an experimental area for several shoreline stabilization techniques. The plant species and techniques used for stabilization were determined by environmental variables such as soil, slope, tidal inundation, and existing vegetation. The removal of some of the Australian pine enhanced the chances for growth of the native vegetation already present on the island, and provided more areas for revegetation. A trail was built on the island to permit people to see the different types and uses of the vegetation. Additionally, Little Edward's Island can be used as one of the county-owned 'natural' nurseries.

In addition to the pilot projects, a shoreline preference survey was undertaken to determine public preferences for different shoreline types. In the survey, fifteen slides were chosen as representative of the six shoreline categories. The representative shoreline pictures were shown to eight local associations whose members included homeowners, boaters, and conservationists. A total of 151 responses were analyzed and the results, summarized in Table VIII, showed that respondents consistently preferred natural or vegetated shorelines to seawalls and revetments. According to this survey, public shorelines should also be maintained in a natural state. Additionally, it was apparent that the process of estuarine erosion is poorly understood, particularly the threat of erosion caused by Australian pine.

The work embodied in this study is a starting point for a program designed to preserve and manage Sarasota County's valuable shoreline resources. By using Little Edward's Island as a showcase for alternative restoration and stabilization techniques, and by incorporating the information in this report into a comprehensive management program, Sarasota County can begin to preserve and restore its estuarine resources. The following recommendations are directed towards this goal.

RECOMMENDATIONS

1) To promote and encourage shoreline revegetation, Sarasota County should use native vegetation for stabilizing their public shorelines. These shorelines should be managed in a manner consistent with the recommendations in the "Homeowners' Guide to Shoreline Management". A stock of shoreline vegetation should be developed and made available for use by local homeowners as well as the County. Specific plants are listed and described in the homeowners guide. Many of these plants could be grown on several of the county owned GAPC, listed in Table III of this report.

2) Management plans for the Geographical Areas of Particular Concern should be developed. Possible directions for these plans are suggested in Table III of this report. The Parks and Recreation Department could take responsibility for managing these areas, using the expertise of other governmental agencies and local individuals who are knowledgable in shoreline ecology. An individual or board should be appointed to direct the completion and maintenance of the work begun on Little Edward's Island.

3) Currently, there are no enforcable or appropriate County regulations protecting mangroves or other shoreline vegetation. (The tree ordinance is not valid below Mean High Water or on single family lots. The Marine Park zoning ordinance would need only slight modification to provide this protection by prohibiting the removal or destruction of shoreline vegetation.

4) There is a need for comprehensive plans concerning the three passes in Sarasota County: Midnight Pass, Big Sarasota Pass, and New Pass. Long term policies should be generated for these dynamic areas that deal with navigational dredging, future development and catastrophic alterations. Zoning restriction should be placed on these areas to protect property and lives.

5) Drainage into the bays, bayous, and creeks should be investigated with regard to water quality and quantity. This would involve extensive mapping and water analysis, directed towards the control and management of these small drainage networks. Such an approach to pollution control could be beneficially addressed by the federal 208 water quality program.

6) The marine grassbeds of Sarasota County are dwindling at the rate of approximately 1% per year. The preservation of these areas should be more fully investigated, in particular destruction of grassbeds by boaters. Boaters should be made aware of the marine resources of Sarasota County

and their responsibility to preserve those resources. The boating public can be instrumental in either protection of destruction of our grassbeds, mangroves, wildlife and other marine resources. A "Boater's Guide to Sarasota County" could be developed, describing our resources and ways of preserving and protecting them.

7) The County would benefit from a full time staff dealing with coastal zone management to coordinate public and private activities and implement the previous recommendations.

FOREWORD

The estuarine resources of Sarasota County are the basis of economic well-being in this area. Tourism, commercial and sport fishing, and boating, as well as land values, all depend on the continued health of our bays, creeks, and coastal wetlands. The value of these resources is further emphasized by recent legislation and planning policies that seek to protect the remaining natural areas:

> "Coastal marshes, dunes, and islands are extremely vulnerable to intrusions by man, because these areas are constantly in a state of change. Beaches erode and accrete, dunes shift, and tidal actions inundate and drain self-perpetuating systems. Estuaries are virtual nutrient traps, and as a result, are biologically productive... Because of our expanse of shoreline, and the number of bays, Sarasota County must take steps to preserve the adjacent wetlands."
>
> Sarasota County Planning Department
> Environmental Element, Phase II
> 1975

An estuary is defined by Pritchard (1967) as "A semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage." The estuaries of Sarasota County are the tidally inundated creeks and bays, and the vegetation in and around these water bodies. Our estuarine shorelines, particularly those in a relatively undisturbed state, are valuable resources perfomming functions that help to maintain the quality of life in the county.

Estuaries are extremely productive areas for plants and animals; nutrient-rich sediments and water drain into the estuaries while tides replenish the soil with nutrients from the sea. H. Odum (1964) found that the mixing of salt and fresh water produces a medium which is very efficient for oxidizing organic material and cycling nutrients.

These nutrients enhance the growth of phytoplankton and rooted plants, which provide food and protection for animals. Many animals enter the estuary at the larval stage and use the area as a nursery, while others enter to feed or spawn. The enormous production of organic matter and the ability to cycle it rapidly makes estuarine systems valuable wildlife habitat. The estuaries and associated wildlife have a large economic value because of the recreational and aesthetic benefits they provide to residents and visitors. Also, since many fish use these areas, the commercial and sports fisheries are dependent on them.

Coastal wetlands also play an important role in shoreline stabilization and flood control. The mangroves and marsh vegetation at the mouths of rivers, tidal creeks, and along bay shores absorb seasonal flooding and dissipate wave energy; they provide a dynamic buffer zone for protecting the uplands.

Within the bays and estuaries, the gently sloping, vegetated bottoms help lower the velocity of water being flushed into the estuaries, allowing sediments to settle, while the plants trap and stabilize the sediments. This directly affects the turbidity in the bays because the fewer sediments that are suspended in the water column, the clearer the water will be. Clearer water permits marine grassbeds to colonize deeper water, which provides more habitat for marine animals. This provides additional benefits because the plants maintain water quality by assimilating nutrients and minerals.

Yet, despite the benefits imparted by a healthy, functioning estuary, our wetlands have been consistently drained and developed. It has been common practice to dredge canals and use the spoil material to fill the low-lying wetlands for waterfront homesites. Concrete seawalls separate the land from the water, eliminating important inter-

tidal areas. Such a pattern of construction eliminates the chance for natural recolonization of coastal vegetation.

Destruction of coastal wetlands is not confined to developed areas. Siltation and turbidity, caused by sediments suspended by dredging, can destroy adjacent grassflats and tidal marshes, while alterations in upland drainage change the physical and chemical makeup of the water draining into the estuaries. Not only are fewer grassbeds and wetlands present, but they are required to assimilate greater amounts of nutrients resulting in increased stress on the system. Disrupting the natural systems by filling or digging up marine grassbeds and tidal marshes eliminates the capacity of these areas to filter water, trap sediments, and provide wildlife habitat. The ecological functions of estuarine vegetation have not been assumed by the seawalled finger canals and waterfront homesites that displaced the natural shorelines.

Clearly, action must begin towards restoring our coastal wetlands and shoreline vegetation. Only with active restoration will the altered shorelines provide the services rendered naturally. These services are extremely valuable to an area that depends on beaches, fishing, and clean water. The current exclusion of estuarine vegetation by shoreline development does not protect the ecological processes which ensure the continued quality of life in Sarasota County. This study directly addresses the changes to our estuarine shorelines.

Shorelines were chosen as the focus for this study because: 1) shoreline changes are indicators of the alterations to estuarine resources due to development in coastal areas, and 2) there is tremendous potential for restoration of these areas.

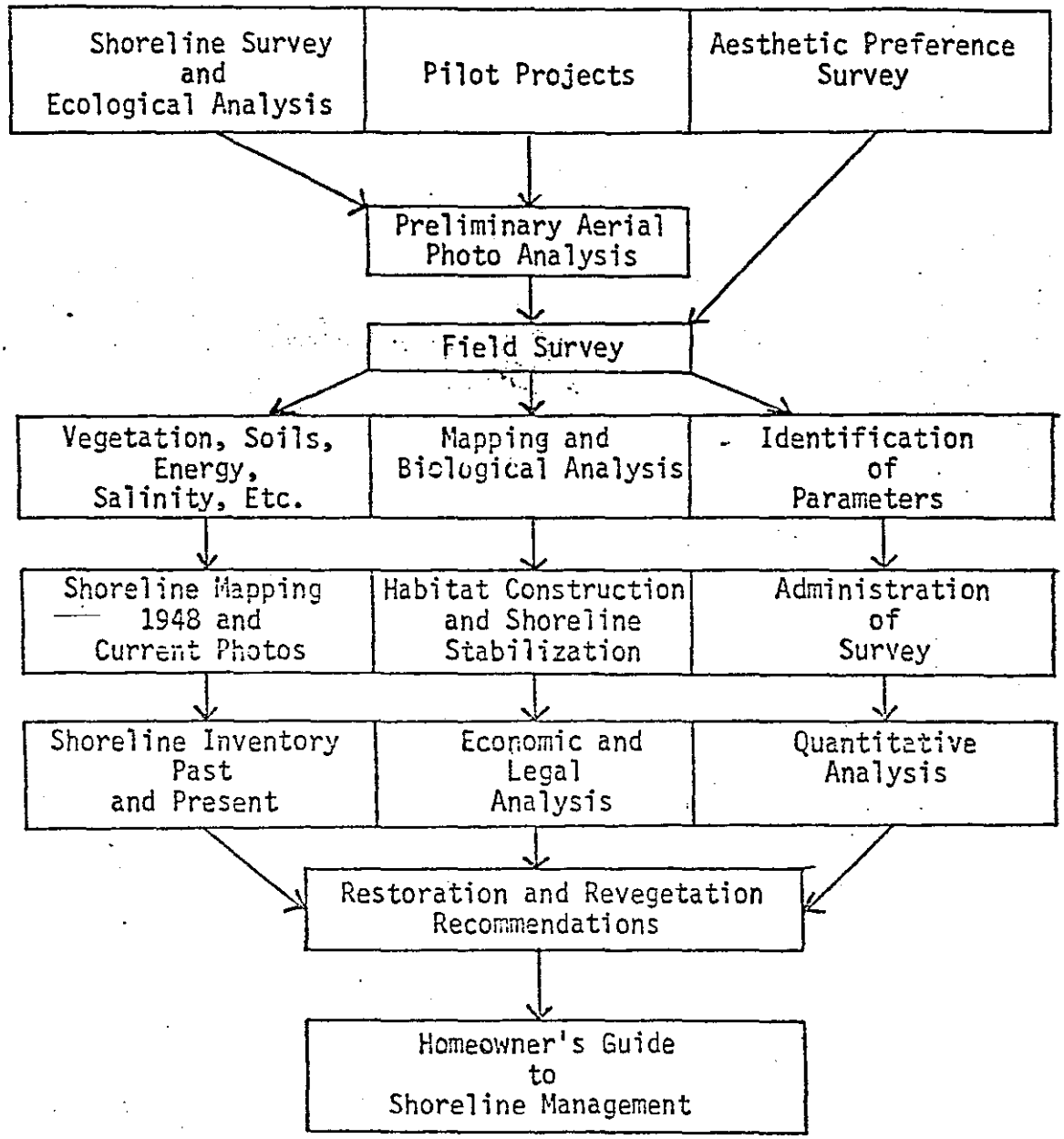
This project provides the initial steps towards a management program by presenting materials, information, and techniques for restoration.

This report presents our results in three sections (Figure 1). The first, Resource Mapping, is an inventory of estuarine resources in Sarasota County, and is divided into three subsections describing these resources. They are Shoreline Mapping, Grassbed Mapping, and Geographical Areas of Particular Concern (GAPC). The subsections are complemented by detailed maps of Sarasota County shorelines, grassbeds, and the GAPC in Appendices II, III, and IV, respectively.

The second section describes two pilot projects: 1) an experiment with mangrove horticulture, and 2) a demonstration of experimental stabilization techniques on Little Edward's Island, a small, county-owned spoil island located in Robert's Bay. The third section presents the results from a shoreline preference survey designed to determine the knowledge and preferences of residents regarding shorelines.

These sections have described both the human and natural aspects of Sarasota County's bay shorelines and have detailed ways to make these aspects more compatible. This study has undertaken the preliminary steps towards shoreline management. The recommendations in the "Executive Summary" discuss ways to implement shoreline restoration and management in the future. The "Homeowner's Guide to Shoreline Management" (included as Appendix I) condenses much of the information in this report into laymen's terms and is available to the public. Because the human and natural aspects of estuaries are very complicated, interrelated, and often in conflict, comprehensive shoreline management is necessary in urban areas. We hope that this project has provided the initial step towards a management program for Sarasota County.

Figure 1. Project Summary.



SECTION I

RESOURCE INVENTORY

SHORELINE MAPPING

Methods:

The mapping required a series of steps to insure that accurate information was recorded. The shorelines were mapped from the 1974 Soil Conservation Service aerial photographs. These maps were field checked by boat and information on vegetation and structures was noted. In this way an up-to-date record of all shores in Sarasota County was compiled.

After analyzing the maps, the shorelines were divided into the following six types:

1) Beach - These include only bay and estuarine beaches and are characterized by a low, gentle slope. They are composed of shell, fine sand, or silty sand, and often there is mixed salt marsh vegetation or lawns behind them. The shell and sand beaches are generally found in areas of medium to high wave energy and help dissipate this energy. The silty beaches are found in low energy areas and are probably the result of deposition of sediments.

2) Seawall - Included in this category are manmade structures which form a solid wall. They prevent water and nutrient exchange through the soil and create a vertical barrier between land and water. Often, there is a dredged canal or channel in front of them. Some common examples are: a) typical concrete seawall, b) seawalls made of wood or other materials, or c) rock-rubble held together by cement.

3) Rip-rap - This type of shore is composed of rock-rubble or large stones stacked together, but not cemented together. Some shores

are made of compactly arranged stones while others are merely piled rubble. Sometimes the rock material is underlain by a permeable filter cloth which does not present a barrier to the movement of water, In most places, there is lawn behind the rip-rap, but in some cases, there is mixed vegetation of mangroves growing on or behind the rip-rap. Rip-rap is most commonly found along protected, or low energy areas, such as canals.

4) Mangroves - These are areas where the predominant plants are mangroves. They vary from a single row of trees to thick stands fringing the shore; including forests atathe mouths of creeks, and islands in the bays. The areas may be comprised of one species, or a combination of several species. They may be stands growing naturally, or ones planted and pruned by man. Mangroves are found along the open bay, as well as in protected areas.

5) Australian pine/Brazilian pepper - The most abundant plants in these areas are either Australian pines or Brazilian pepper, two exotic species of plants. They are often found growing on disturbed sites, or on eroding banks. They were categorized separately from the other plants because of their susceptibility to erosion and washout.

6) Other Vegetation - This category includes all the shore plants not included in the above two categories. The majority of these plants are salt marsh species, although some are weedy species that have colonized steep banks or are growing on rip-rap. In areas where the shore slope is very low, cabbage palms may be growing on, or adjacent to, the shoreline.

After the maps were field checked, another set of maps was made, amended from the working maps. These were then blueprinted and the

shore categories were color coded for ease of interpretation.

A similar technique was used for the 1948 maps, except for field checking. The 1948 Soil Conservation Service aerial photographs were traced and interpreted with with the aid of the 1948 U.S. Geological Survey topographic maps and a magnifying glass. On the 1948 maps, the categories of seawall and rip-rap were combined because it was impossible to distinguish between them on the aerials. For many shorelines, several types were mapped because shorelines often consist of more than one shore type. Then, the mileage for each shore type was measured. To approximate the total number of miles of shoreline for Sarasota County in 1948 and 1978, the overlap of shoreline types was eliminated. An Alvin Inch Counter was used to measure mileage.

Results and Discussion:

The results from the maps are summarized in Table I. It can be seen that there are some considerable differences between 1948 and 1978.

TABLE I. SHORELINE MILEAGES FOR 1948 AND 1978

Shore Type	1948	1978
Beach	43.5 miles	37.1 miles
Seawall	14.4 miles	84.5 miles
Rip-rap	.....	26.1 miles
Mangrove	105.7 miles	83.6 miles
Australian pine/ Brazilian pepper	5.0 miles	17.7 miles
Other Vegetation	56.6 miles	51.9 miles
TOTAL*	182.7 miles	213.3 miles

* Corrected for overlap.

14.3% change 1948-1978

There is an increase in the total number of shoreline miles due to extensive dredging of canals, filling of land, and the associated building of seawalls and rip-rap, the two categories which show the greatest percentage of increase. Of these two categories, rip-rap is more easily colonized by plants. In many canals, vines and woody herbs were growing down from the uplands, while in protected bayous and tidal creeks, mangroves were colonizing the rip-rap from the water. Seawalls, especially newly built or well-tended ones, present difficulties for colonizing plants because there are no horizontal surfaces on which they can establish themselves. However, low or old, broken seawalls present an excellent opportunity and these shores were often colonized by native vegetation. Additionally, plants grew in low energy areas where there was a beach in front of the seawall.

The only other category which showed an increase in mileage was the Australian pine/Brazilian pepper (AP/BP), probably beacause these introduced species have been planted by more people and have had more time to spread. AP/BP spread most easily into areas that have been disturbed in some way; they have difficulty becoming established in undisturbed areas. Typical places where AP/BP grow are spoil islands, spoil piles along mosquitoe ditches, and in yards along canals and bayous. They are a potential erosion hazard because their roots are easily undercut by waves, and the AP are susceptible to being blown over due to the combination of their height and shallow root system.

The Mangrove category showed the greatest decrease, mainly due to extensive filling for homesites. The mangrove forests are often not as extensive as they once were; where there once was a fringe forest, there may now be only a narrow strip of mangroves. Many of the mangrove shorelines mapped were an example of this. Some of the man-

grove shorelines were manicured hedges. The particularly attractive ones were low hedges with large red or black mangroves growing over them. Even though these hedges are not mangrove forests, they are important because they are more stable than seawalls and provide a seed source for colonization of other areas and habitat for marine organisms. Still, many mangroves have been destroyed and much restoration work must be done if the ill effects of seawalls are to be mitigated.

The remaining categories, Beach and Other Vegetation, show relatively small decreases in mileage, probably due to seawalls, rip-rap, and exotic vegetation. In many places, the native vegetation behind the beach has been replaced by lawn.

These alterations have increased the need for sensible, informed management of the shorelines. The 1948 maps can be used to help outline a management program because in 1948, many of the shorelines were in a relatively unaltered state. Some recommendations are outlined in the "Homeowner's Management Guide".

MARINE GRASSBED MAPPING

There is much controversy concerning the loss of our submerged grassbeds. This estuarine resource inventory addressed the problem through mapping the grassbeds in Sarasota County.using current and historical aerial photographs. There were two objectives to the mapping: first, to evaluate the current status of the grassbeds, and second, to investigate the feasibility of seagrass restoration. This inventory represents only a preliminary assessment of the marine grassbeds; as such, it should be used as a beginning for more intensive analysis of preservation and management techniques.

Methods

The grassbeds were mapped from 1948 and 1974 aerial photographs taken in February and March, respectively. The corresponding time of the year that the photographs were taken should effectively negate any seasonal differences in the standing crop of the grassbeds. The grass areas were traced from the aerial photographs onto shoreline maps using a light table. The scale of the maps was 1 inch = 660 feet. The areas were then measured with a Lasico Compensating Polar Planimeter.

No effort was made to correct or update the 1974 photos; field checking merely verified the existence and approximate location of vegetated areas. Additionally, the field observations allowed a close view of the zonation and status of individual grassbeds.

It should be noted that the measurements of these grassbeds are

only an estimate of real coverage. Aerial photographs of the east side of Sarasota Bay were not available for 1948; however there have been no significant dredge operations in that area between 1948 and 1974, so the grassbeds should be somewhat the same. It is also probable that there have been changes in seagrass abundance and distribution since the latest available aerials in 1974. The changes could be significant due to two extremely cold winters in 1976-77, and 1977-78, with the resulting die-back of seagrasses. Additionally, our estimates of seagrass coverage should be regarded as minimum because they represent winter standing crop, which is the time of year the grassbeds are smallest. However, with due respect to these sources of error, we feel that our measurements are reliable estimates of the status and changes of the grassbeds.

Results and Discussion:

Table II presents the results of the grassbed mapping.

TABLE II. RESULTS OF MARINE GRASSBED MAPPING

	1948	1974	Δin acres	Δ%
South Sarasota and Robert's Bays	1934.8*	1459.7	-475.1	-24.6
Little Sarasota Bay	385.7	420.4	+ 34.7	+ 9.0
Dryman, Blackburn, Dona and Robert Bays	267.6	189.0	- 78.6	-29.4
Lemon Bay	639.6	503.6	-136.0	-21.3
TOTAL	3227.7	2572.7	-655.0	-20.3

* Complete aerial photographs were not available; this figure is an estimate based on 1974 data and historical information.

Appendix III contains the maps with the 1948 and 1974 areas outlined. From Table II it can be seen that there has been an overall loss of about 20% in grassbed acreage, but there has been a 9% increase in Little Sarasota Bay in the same time period. This increase might be attributed to the construction of the Intracoastal Waterway and the resulting changes in water circulation and salinity.

One conclusion to be drawn from the maps is that the major grassbeds are still viable, although they have been considerably diminished. Figures from McNulty, et.al, 1972, show that approximately one half of this loss can be attributed to loss of bay bottom by filling. Other factors contributing to the loss of grassbeds are dredging projects that deepen bay bottoms below the depth of adequate light penetration, and the loss of marginal habitat due to increased turbidity and other stresses.

The increase in grass coverage in Little Sarasota Bay suggests that the seagrass communities have not lost their ability to colonize new areas if improvements in habitat quality occur. It seems apparent that areas suitable for seagrass colonization are either presently inhabited or are capable of natural colonization. Also, revegetation would entail the removal of transplanting stock from existing beds, possibly increasing the stresses on those beds. Therefore, attempts at seagrass revegetation might not be successful because uncolonized or denuded areas are not suitable habitat. For these reasons, grassbed revegetation is not recommended.

With respect to the current status of grassbeds in Sarasota County, it is possible that simple acreage is not an indicator of the health and integrity of these communities. Leaf density or productivity could change drastically without substantially altering the

size of the grassbed. In this context, the degradation or improvement of these communities would not be readily visible.

One important aspect of seagrass conservation that was apparent from field observations was the destruction of grassbeds by boaters. In some areas, up to 40% of viable grassbeds have been destroyed by propellor furrows. These furrows do not readily grow back and persist as scars for three to five years (Phillips, R.C., 1960).

It is our opinion that seagrass revegetation is not currently feasible. However, there is much that could be done to protect the dwindling marine grassbeds. Shoreline restoration may prove to be a technique for seagrass preservation. Additionally, the public should be made aware of seagrass communities and their value as natural resources. Boaters in particular should recognize the impact they have on these areas.

McNulty, J.K.; W.M. Lindall, Jr. and J.E. Sykes. 1972. Cooperative Gulf of Mexico Estuarine Inventory and Study, Florida: Phase I, Area Descriptions. 126p. U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. NOAA Technical Report NMFS CIRC - 368.

GEOGRAPHIC AREAS OF PARTICULAR CONCERN

The criteria set forth in the Florida Regional Coastal Zone Management Atlas (CZMA) were used to determine the Geographic Areas of Particular Concern (GAPC) for Sarasota County. A copy of the CZMA is available for use in the county planning office. The GAPC are defined as areas that deserve a special status and associated plan because they are unique or valuable resources. In general, designated vital or conservation areas in the CZMA include marine grassbeds, coastal marshes, mangrove swamps, gulf and estuarine beaches, spoil islands, parks and recreational areas, and tidal inlets. Field experience aided in selecting the appropriate areas in Sarasota County. These areas were outlined on a set of U.S. Geological Survey topographic maps (Appendix IV) using two classifications derived from the CZMA: vital, or preservation areas, and conservation areas.

Vital areas include relatively undisturbed areas that provide substantial ecological, economic, or aesthetic benefits to the public, which would be greatly decreased if these areas were altered or developed. Vital areas, designated by red on the topographic maps, should be preserved or restored. On the other hand, conservation areas can tolerate limited and careful development and still supply benefits to the public. Conservation areas, designated by yellow on the topographic map, are better suited for recreation and require management to maintain their ecological integrity. The type of management must be tailored to the individual site.

Table III lists the recommended GAPC for Sarasota County. Each listing is accompanied by a classification, approximate location, brief

description and recommendations for the future. Refer to the maps for exact locations. The GAPC are ideal places for scientific study, experiments in shoreline stabilization, restoration, and control of exotics. Because they can provide substantial ecological, economic, or aesthetic benefits to the public, each GAPC deserves a management plan for future use, restoration, or preservation. Although limited, the recommendations listed in Table III suggest possible directions for management.

TABLE III

Geographic Areas of Particular Concern

Area	Location	Classification	Ownership	Description	Recommendations
Bay Isles	Longboat Key near Sarasota/ Manatee county line	Conservation	Arvida	This area is a canal dredged through the landward edge of what was once a thick mangrove fringe. Now all that remains is a narrow strip of mangrove fringe on the bay side of the canal, intended as a buffer for the upland shore. Currently, these small islands are suffering from erosion problems. The mangroves are falling into the water and the islands are disappearing.	Much of the erosion is caused by wakes made by boats using the canal. A "no wake" policy should be strictly enforced. Also, planting of mangroves should be attempted to help restore the remaining fringe. In the future, wider fringes should be left.
Quick Point	South end of Longboat Key on Sarasota Bay	Conservation	Arvida	This is a mangrove swamp with a tidal lagoon. The interior has been spoiled and has Australian pine (AP) and Brazilian pepper (BP) growing on it. Also, the area has been mosquito ditched and these ditches have AP growing on the resulting spoil piles.	This area could be developed if done in a way that protects the lagoon and mangrove fringe. The areas that have exotic plants should be managed to prevent the exotics from taking over the mangroves.

Area	Location	Classification	Ownership	Description	Recommendations
North shore of New Pass	South end of Longboat Key	Conservation	Arvida	This is mostly unstable filled shoreline. It was filled in the 1930's for building purposes and now, subject to the dynamic forces of waves and tidal action along the pass, is eroding. There are Australian pines and other vegetation growing on the shore.	This area is ideal for limited recreation. The cove is a protected spot for boats. We recommend elimination of exotics from eroding shores and planting dune vegetation to help trap and stabilize the area. Signs should be posted to explain the value of dune vegetation and why they should avoid walking on it.
City Island	North end of Lido Key on bay side	Conservation	City of Sarasota	This is filled land, partially seawalled, some shelly beach, exotics, mangroves, and other vegetation. It is intensively used for recreational purposes, particularly by boaters.	The City Island area should be maintained as an area for recreation, particularly for boaters. The AP and BP should be gradually removed from eroding shores and replaced with native vegetation.
Pansy Bayou	North end of Lido Key	Preservation	Sarasota County	This is a mangrove swamp and a protected bayous with fine sand and mud bottom. It is a productive area for benthic organisms.	This area should be protected as is, although the exotics should be controled.

Area	Location	Classification	Ownership	Description	Recommendations
Brushy Bayou and Otter Key	South end of Lido Key	Preservation	Sarasota County	This is a mangrove swamp surrounding a tidal lagoon and a mangrove island, the center of which has been spoiled and has AP growing on it. The mangrove swamp has been mosquito ditched and the resulting spoil piles have AP and BP growing on them. It is a diverse area used intensively for recreation. It provides habitat for benthic organisms, other marine life, and birds.	The mangrove swamp, tidal inlet, and island should remain a preserve and can be used for nature study or similar low intensity uses. The AP and BP could be gradually replaced with native species to improve the upland habitat.
South Lido Park	South end of Lido Key on Big Sarasota Pass	Conservation	Sarasota County	This is a county park and includes a beach on Big Sarasota Pass on which there are parking and picnic areas, and which is vegetated with Australian pine.	The beach should continue to be maintained as an intensive recreational area. Steps should be taken to prevent people from walking on the dune vegetation. for instance, signs could be posted explaining the importance of the plants and their low resistance to trampling. Additionally, the recently accreted land should be stabilized through dune establishment. Vehicular traffic should be prohibited, including country vehicles.

Area	Location	Classification	Ownership	Description	Recommendations
Sanddollar Key	Island in Big Sarasota PPass	Preservation	Sarasota County	This is a low island, essentially a sand bar, which has been colonized by pioneer stabilizing vegetation, which is slowly building up the island. Extreme high tides overwash the island. It is used by boaters, and during the spring, Least terns and other shorebirds attempt to nest there.	This island should not be developed in any way. People should be able to use the perimeters of the island, but signs should be posted to discourage them from walking on the vegetation. In addition, people and their pets should be warned not to disturb the birds during the spring nesting season.
Edward's Island	Robert's Bay near Siesta Key	Conservation	Sarasota County	These islands are discussed in depth in the Pilot Projects section of this report. Please refer to that section for information.	
Skier's Island	Robert's Bay near Siesta Key	Conservation	West Coast Inland Navigation District	This is a spoil island used by boaters for recreational purposes. The low areas on the island have mangroves and other salt marsh vegetation growing on them, while the high areas have AP and some native shrubs.	Since the island is owned by WCIND, it is reserved for future spoiling in case the need arises. Therefore, this island should remain as it is because prior commitments preempt a county management plan. However, a spoiling schedule for all future spoil islands should be developed in order to maximize potential habitat for birds and to minmize water quality problems.

Area	Location	Classification	Ownership	Description	Recommendations
Edward C. Wright Nature Preserve	Siesta Key on Robert's Bay	Preservation	Bayside Club Property Owners Assoc.	This is a mangrove swamp comprised of a network of tidal lagoons and mangrove islands. It has been set aside as a nature preserve, and it is valuable as wildlife habitat.	Currently, this area is unused by the public and should be left undeveloped to perform its valuable functions naturally. There have been several illegal land fills on the landward edge and some misdirected attempts at mangrove pruning. These activities should be regulated or prevented.
Midnight Pass	The tidal inlet between the south end of Siesta Key and the north end of Casey Key.	Preservation	The land around the pass is part of the Palmer estate.	This is a very dynamic area; an area that is constantly in flux. Due to the physical forces acting upon it, the pass is always changing its location, causing the ends of Casey and Siesta Key to erode and accrete, depending on the movement of the pass. Also, the sandbars in the pass shift their positions. It is a valuable area for wildlife; birds particularly use the sandbars as roosting or loafing areas. The area is also intensively used for recreation. Many people fish in the pass and boaters often anchor their boats and use the beaches on Casey Key and Siesta Key.	Because this area is unstable, it is not suitable for development. If it becomes necessary to mark the channel, moveable buoys should be used. This way,the buoys could be moved to mark the natural channel, eliminating the need to dredge a channel to fit the buoys. Additionally, the AP should be prevented from encroaching further on the beach on Casey Key. This will allow the native beach plants to establish themselves and help stabilize the beach.

Area	Location	Classification	Ownership	Description	Recommendations
Phillipi Creek	Mangrove system at the mouth of Phillipi Creek	Preservation		This area is a mangrove swamp interlaced with lagoons and oyster bars. The Intracoastal Waterway cuts through it. There is a spoil ridge that runs across it and has AP growing on it; otherwise it is relatively undisturbed. This system provides wildlife habitat and serves as a much needed filter for water entering the bay from Phillipi Creek. Also, it provides an aesthetically pleasing view along the Intracoastal Waterway.	This area should not be developed for intensive recreation, but the dikes may present an opportunity for a nature trail.
Bird Keys	In bay behind Midnight Pass	Preservation	Part of Palmer estate	These are a group of mangrove islands which have had dredged materials dumped on the centers. AP is growing on these spoil piles and in some places, on the perimeter. The island and the bars around them are an invaluable area for birds and marine life. The area is used intensively by boaters and fishermen.	Because this area is such a valuable wildlife and recreational resource, it should be left as it is. However, gradual replacement of AP with native species would improve the upland habitat of the islands.

Area	Location	Classification	Ownership	Description	Recommendations
North Creek	Across Little Sarasota Bay from midnight Pass	Preservation	Part of Palmer estate	North Creek, the tidal marshes, oyster bars, and mangroves around it form a relatively undisturbed system. It is one of the most natural sites left in this part of Florida. The different types of habitat in close proximity provide an excellent refuge for wildlife, both aquatic and terrestrial. The estuarine system also acts as a filter for the water coming down the creek.	Because the North Creek estuarine system and the uplands behind it are relatively undisturbed, we recommend that the area be preserved as it is, to be used in the future as a research educational area.
Nokomis Beach Park	In Blackburn Bay near the Venice inlet	Conservation	Sarasota County	This is a spoil island which is very close to Manasota Key and has a small bridge to it. There is a boat ramp on the island which is used extensively by boaters. People often fish from the riprap which surrounds the island. The island is flat with steep sides and a road going down its length. The top of the island is vegetated mainly with grass, and the sides have some mangroves and other shrubby salt marsh plants growing on them.	In some areas around the island, the sides are eroding. These areas should be planted with native groundcover plants to help stabilize the bank.

Area	Location	Classification	Ownership	Description	Recommendations
Turner Key, Bird Island, and near-by islands	Turner Key is at the mouth of Lyons Bay, Bird Island is at the mouth of Dona Bay, another island is north of Turner Key, and one island is at the Venice Inlet.	Conservation	Sarasota County	These islands have mangrove fringes and spoil material on the centers, in particular Turner Key and the island at the Venice Inlet. AP and BP grow on this material and in some places, on the shore, resulting in steep and eroding banks. The other two islands are predominantly mangrove and are used by birds for roosting.	Because Turner Key and the island at the mouth of the Venice Inlet are readily accessible, they present great potential as a recreational resource. The area is intensively used by boaters, and these islands would be ideal as boating parks. The AP and BP should be gradually eliminated and other shoreline vegetation should be planted to help stabilize the eroding banks. Bird Island and the mangrove islands just to the north of Turner Key should be left undisturbed as habitat for birds.
Red Lake area	Behind Casperson Beach just south of the Venice Municipal Airport	Conservation	City of Venice, Sarasota County	This area is comprised of a lake with a mangrove fringe and a large spoil island that also has a mangrove fringe, but the higher ground has AP growing on it. There is a small mangrove island in Red Lake that is intensively used by Pelicans and other shore birds as a roost and rookery.	Since this area is directly behind Casperson Beach, it is subjected to a high degree of recreational use. The lake and mangrove island should remain undeveloped, as it is a valuable habitat for wildlife. However, the spoil island presents the opportunity for the addition of a park to Casperson Beach. The

Area	Location	Classification	Ownership	Description	Recommendations
Red Lake (continued)					island is currently open sand and exotics and could be improved upon with proper landscaping using native vegetation. In this way, the public could see the benefits, beauty, and versatility of native vegetation. It would be an ideal showcase.
Alligator Creek	The mouth of Alligator Creek along the Intracoastal Waterway at the north end of Lemon Bay	Preservation		This is the mangrove island and fringe at the lower end of Alligator Creek where it empties into Lemon Bay. The area has been mosquito ditched, but is otherwise relatively undisturbed. In addition to providing wildlife habitat, this area performs the valuable function of filtering the water that enters Lemon Bay from the upland homesites.	This area should be left undisturbed to continue performing its valuable functions.
Mangrove and salt marshes along the Myakka River	All tidal marshes and mangrove swamps along the the brackish and salt water water areas of the Myakka River	Preservation	Numerous Owners	This is one of the only areas in Sarasota County where there are still extensive mangrove forests and salt marshes in a relatively undisturbed state.	These mangrove forests and tidal marshes should be left intact and protected so they can continue to perform the vital functions described in the foreword.

SECTION II

PILOT PROJECTS

MANGROVE HORTICULTURE

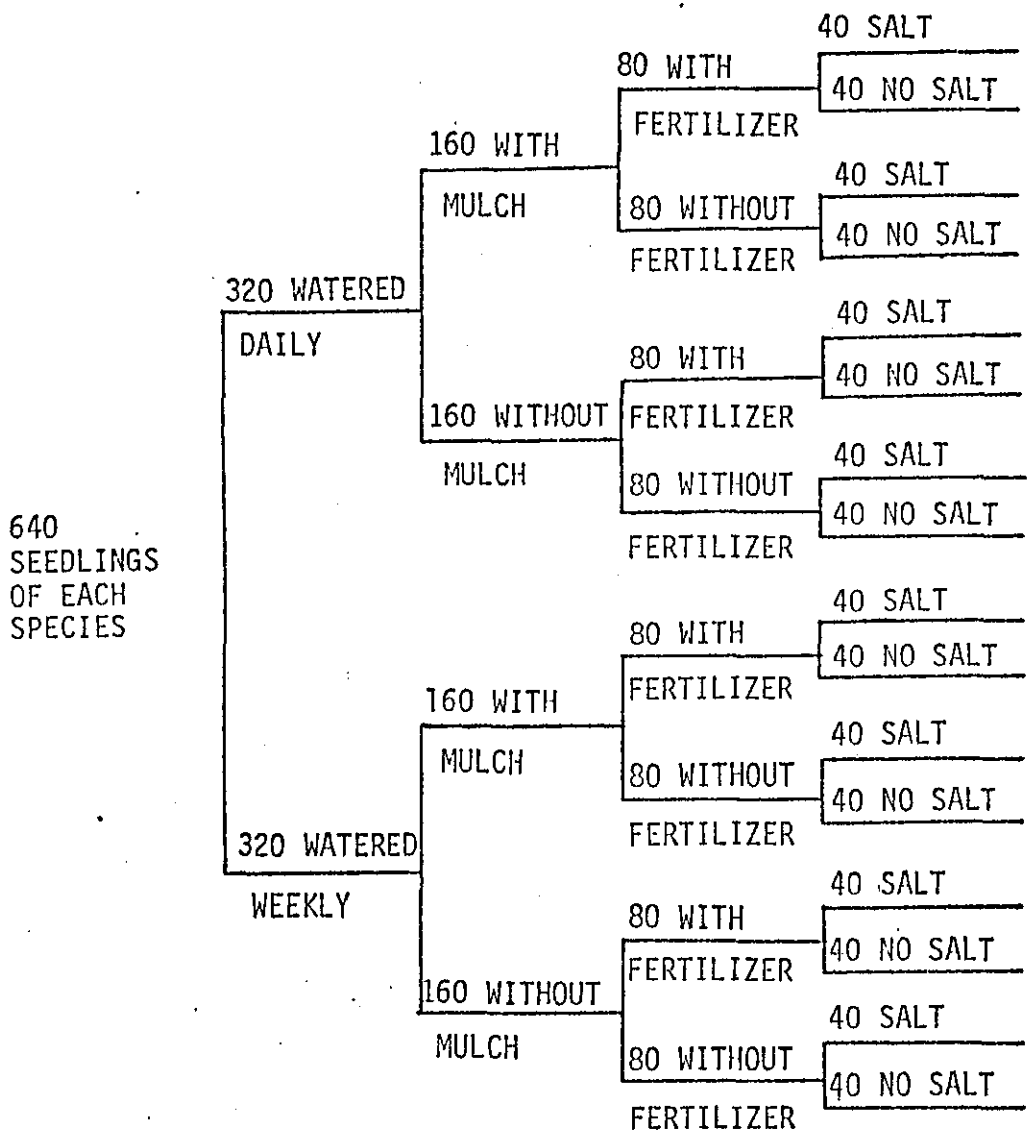
Methods:

In September 1977, 640 red and 640 black mangrove seedlings were collected. The seedlings were collected either floating in the water, or from trees from which they were about to drop. The seedlings were then planted in 640 one-gallon cans, two of the same species in each can. The cans were divided into two groups, 320 which had entire bottoms and did not drain, and 320 which had holes in the bottom. The cans which drained were watered daily and the others were watered once a week. Those watered once a week usually had standing water in them.

Mulch, in the form of grass clippings, was mixed 50/50 with the soil of 160 cans in each watering schedule. The other cans remained plain soil. These four groups were then divided into 16, receiving the following additional treatments: 1)Salt, 2) Fertilizer, 3) Salt and Fertilizer, and 4) the Control group which had no salt or fertilizer. Thus, there were sixteen different treatments with eighty plants in each group, forty red and forty black mangrove seedlings. Table IV presents a graphic description of the treatments, including the results of those treatments after 25 weeks.

The red mangrove seedlings were planted one third of their length into the soil, and the black mangrove seedlings were placed partially into the soil, still in their seed coats. The seedlings were watered according to the described schedule, and after two weeks, when the seedlings were beginning to root, the salt and fertilizer treatments were begun. The treatments were applied on 14 October 1977, and 18 weeks later on 17 February 1978, when visible signs of the previous treat-

TABLE IV: TREATMENT AND SURVIVAL OF RED AND BLACK MANGROVE SEEDLINGS



	Results after 25 weeks: Red Mangrove Seedlings		Black Mangrove Seedlings	
	% Survivorship	Average # of leaves	% Survivorship	Average # of leaves
40 SALT	90	3.7	18	9.4
80 WITH FERTILIZER / 40 NO SALT	70	3.3	8	7.9
160 WITH MULCH / 80 WITHOUT FERTILIZER / 40 SALT	78	3.1	15	6.2
160 WITH MULCH / 80 WITHOUT FERTILIZER / 40 NO SALT	75	3.5	8	8.3
320 WATERED DAILY / 40 SALT	68	2.2	35	5.3
320 WATERED DAILY / 80 WITH FERTILIZER / 40 NO SALT	75	1.7	15	4.8
320 WATERED DAILY / 160 WITHOUT MULCH / 80 WITH FERTILIZER / 40 SALT	90	2.3	18	3.3
320 WATERED DAILY / 160 WITHOUT MULCH / 80 WITHOUT FERTILIZER / 40 NO SALT	95	1.8	20	3.5
320 WATERED WEEKLY / 40 SALT	85	3.3	8	5.7
320 WATERED WEEKLY / 80 WITH FERTILIZER / 40 NO SALT	80	3.4	23	3.9
320 WATERED WEEKLY / 160 WITH MULCH / 80 WITHOUT FERTILIZER / 40 SALT	78	3.1	70	2.9
320 WATERED WEEKLY / 160 WITH MULCH / 80 WITHOUT FERTILIZER / 40 NO SALT	90	3.2	8	2.4
320 WATERED WEEKLY / 160 WITHOUT MULCH / 80 WITH FERTILIZER / 40 SALT	83	2.5	5	4
320 WATERED WEEKLY / 160 WITHOUT MULCH / 80 WITH FERTILIZER / 40 NO SALT	93	2.2	13	5.8
320 WATERED WEEKLY / 160 WITHOUT MULCH / 80 WITHOUT FERTILIZER / 40 SALT	78	2.5	50	1.4
320 WATERED WEEKLY / 160 WITHOUT MULCH / 80 WITHOUT FERTILIZER / 40 NO SALT	93	2.8	55	1.4

trimental and beneficial effects on growth. It enhanced growth at first because the constant moisture helped loosen the seed coats which allowed the cotyledons to open, whereas the seedlings watered every d day spent most of the time dry and consequently were much slower losing their coats. But the standing water inhibited growth later because the seeds floated, causing difficulty in rooting firmly in the soil. The standing water also enhanced the growth of fungus on the cotyledons. The blacks watered every day showed a 17% survivorship, while those watered once a week showed a 39% survivorship. The watering schedule did not appear to have a significant effect on the red mangroves which showed 80% and 84% survivorship for plants watered every day, and once a week, respectively.

Mulching the soil did not affect the survival rate of the red mangroves, but did have an effect on the growth rate. The red mangroves growing in mulch averaged more than three leaves, while those growing in pots without mulch averaged less than three leaves. For the black mangroves, there was such a high mortality rate that it was difficult to determine what effect soil treatment had upon the survival rate, but mulching the soil did increase the growth rate for the survivors. The blacks growing in mulch averaged more than five leaves per plant, while those without mulch averaged less than four.

The other treatments had varied effects on the two species of mangroves. The black mangroves were drastically affected, while the reds showed no significant reactions. In the black mangroves, fertilizer hadaa detrimental effect, indicated by a 30% survival rate for non-fertilized plants, and a 15% survival rate for those with fertilizer. However, the fertilized plants that survived showed an in-

ment of fertilizer had disappeared. In each pot, one tablespoon of fertilizer was applied and approximately eight crystals of rock salt. Since the seedlings were growing out-of-doors, the watering schedule was modified according to the amount of rain. At times, when frost was a threat, the seedlings were covered with cloth.

On 7 April 1978 the surviving plants were counted to determine the mortality rate. These were then measured for growth by counting the leaves.

Results and Discussion:

There were sixteen treatments and two species of plants which totaled thirty-two groups of forty plants (Table IV). The growth success of each treatment is measured in percent survivorship and average leaf development. Figures 2 and 3 show percent survival plotted against leaf development.

It can be seen that, overall, the red mangroves had a considerably higher percentage of survivors than the black mangroves; 82% of the 640 reds survived, while only 28% of the blacks survived. This is partially due to the planting techniques used for the black seeds, which were planted while still in their seed coats. The survival rate might have been increased if the seeds had been soaked until the seeds coats feel off and roots started growing before planting because, during watering, the seeds floated around the cans which inhibited the root growth into the soil. This is also a reason for the increased survival of the black mangroves in the cans watered once a week; they had a chance to put down roots in between waterings. However, these cans often had standing water in them which seemed to have both de-

Figure 2: GROWTH AND SURVIVAL OF RED MANGROVE SEEDLINGS

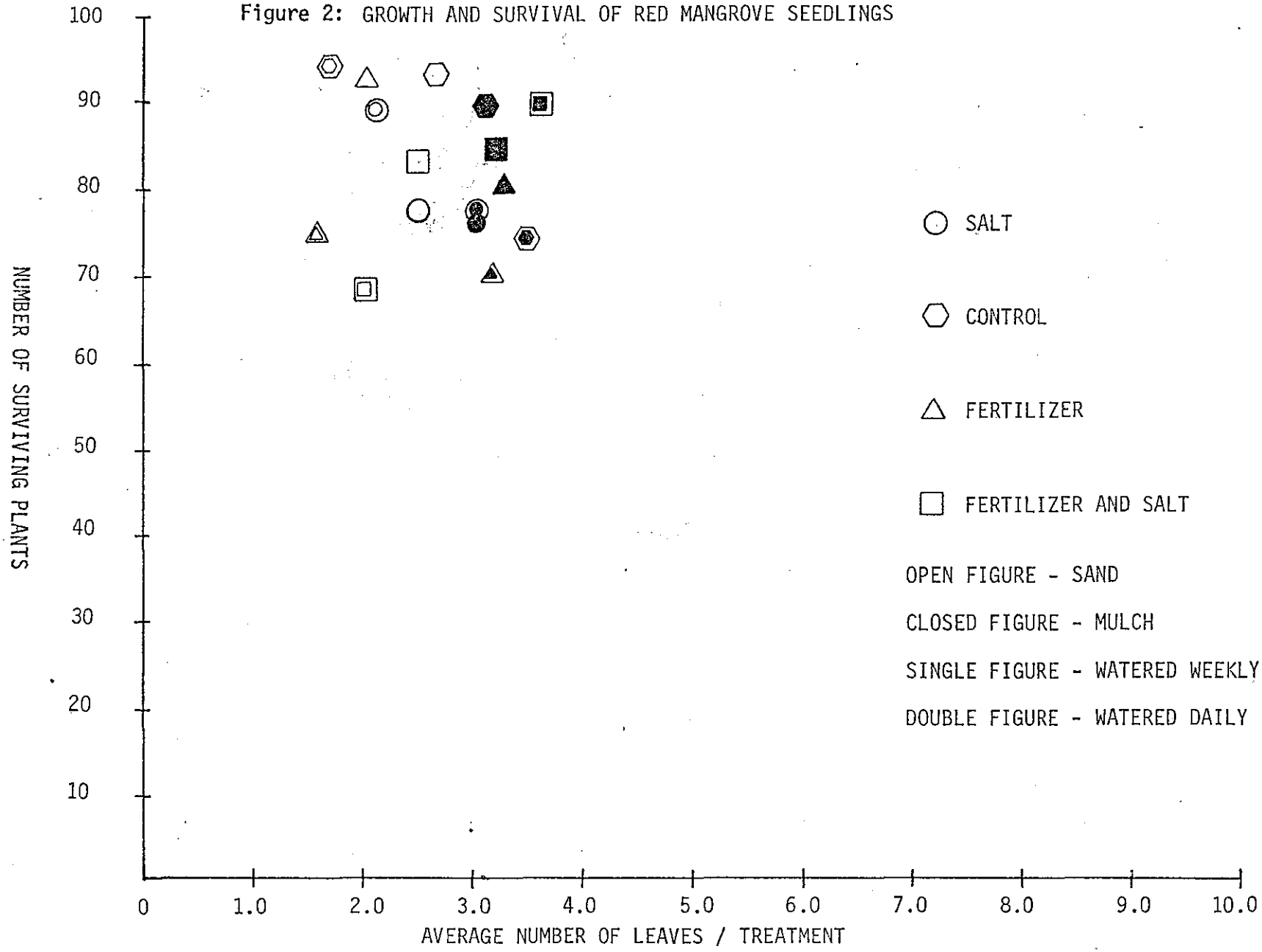
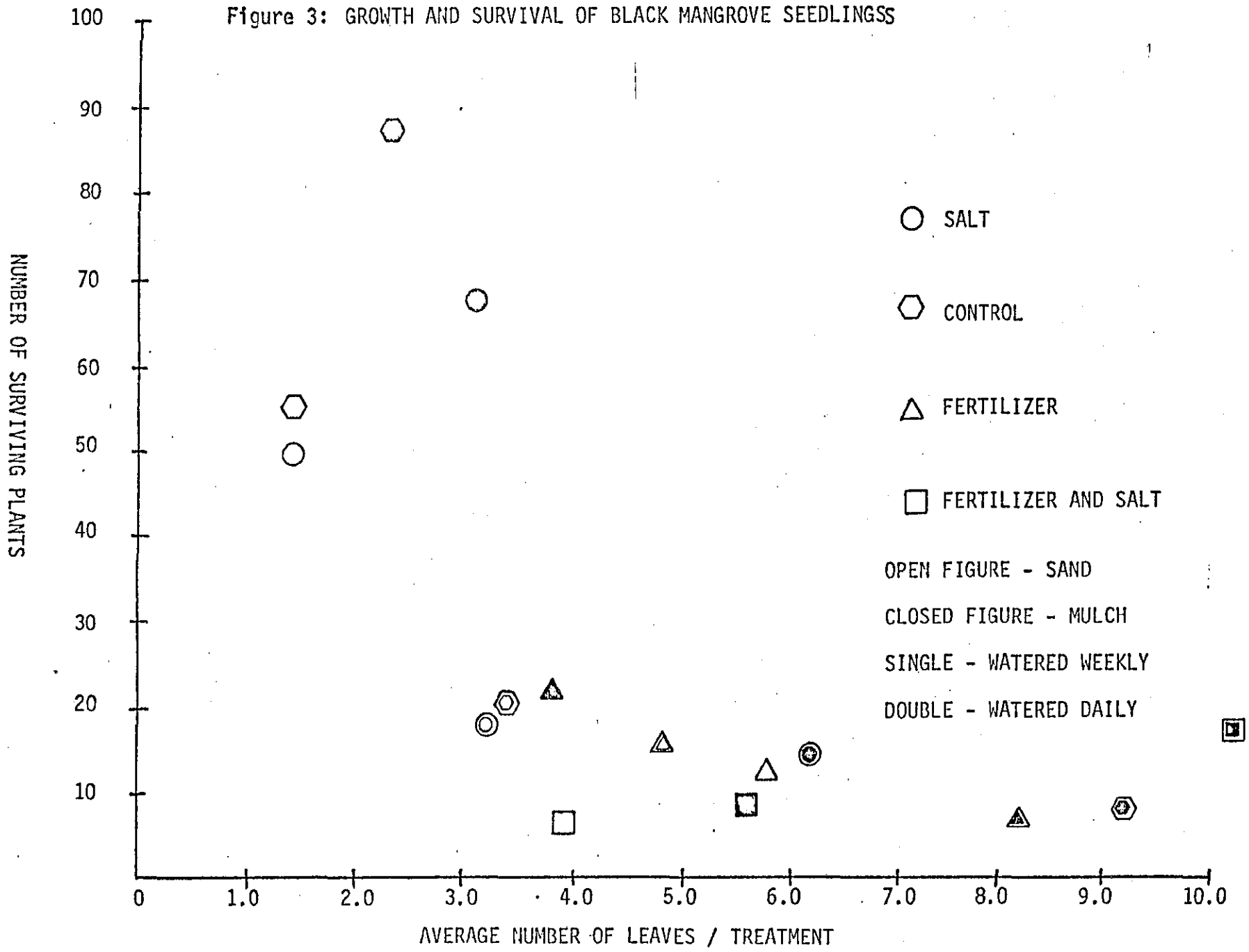


Figure 3: GROWTH AND SURVIVAL OF BLACK MANGROVE SEEDLINGSS



creased level of leaf development, with an average of greater than five leaves per plant as compared to less than four per plant for plants without fertilizer. Salt treatment, on the other hand, increased the survival rate over those plants without salts. 27% of the plants treated with salt survived as opposed to 19% of those without salt. Salt treatment had no apparent effect on the leaf development. The red mangrove survival rate and leaf development were not affected by the fertilizer or the salt treatments, possibly because they may be more tolerant of these environmental changes.

Grasshopper predation was apparent, but did not seem to have a significant effect on survival, with 9.4% of the reds and 12.5% of the blacks showing predation. Also, a leaf fungus was observed, but had no apparent effect on survival.

The data were not analyzed for cumulative effects of the treatments because that would require a more detailed statistical analysis than we were prepared to do. This would, however, be a worthwhile endeavor. A further useful experiment that could be done is a series of strength of treatment gradients which would help to pinpoint the optimal conditions for growing mangroves successfully in a nursery situation. Related to this, the effects of the treatments on nursery stock transplanted into a natural situation needs to be measured. Also, data is needed on survival success of transplanted nursery seedlings as compared to seedlings transplanted from a natural habitat.

The cost of growing these mangroves was approximately $450.00 for labor and materials, $150.00 for those watered once a week and $300.00 for those watered every day. The cost for those watered daily is higher because of increased labor ane water. With 754 surviving plants

total, each plant cost $0.64 to produce. If all the plants had been watered only once per week, the price could be reduced to $0.36. Also, if the black mangrove seeds had been soaked until their seed coats fell off before planting, the survival rate probably would have been higher; consequently, the cost per plant would have been lower.

A less expensive way to grow mangroves would probably be to use disturbed mangrove areas a 'natural nurseries'. Mangrove seedlings could be planted in these areas and left to grow, checked occasionally for success, then transplanted as necessary. This would require less labor and would take advantage of the resources available in the local habitat, for example, tides, nutrients in the water, and rain. This would probably be a more efficient and economical way to grow mangroves.

LITTLE EDWARD'S ISLAND

One goal of this study was to determine the possibility of using native vegetation for shoreline stabilization and habitat restoration on Sarasota County shorelines. This pilot project addressed that goal by using Little Edward's Island, a county owned spoil island near Siesta Key in Robert's Bay, as a demonstration site for experiments in revegetation. It also served as an example management program of a Geographical Area of Particular Concern in Sarasota County.

On Little Edward's Island an inventory of resources and possibilities for the island, control of exotic plants, revegetation using native plants, and construction of a nature trail were begun as the management program. These tasks will hopefully provide an educational opportunity for local residents.

Little Edward's Island was first used as a deposition site for dredged material in 1905, and has been subsequently spoiled several times. A deep channel runs along the eastern edge of the island, separating it from its sister island, Big Edward's Island. These islands are composed of a combination of coarse limestone rock, shell, and finer sediments. The larger materials are fairly stable but the finer sediments are subject to erosion in the absence of vegetation. Surrounding Little Edward's Island is a thin mangrove fringe with intermittent Australian pines and Brazilian peppers. On the east and west ends of the island, there are low, sloping areas that are occasionally inundated and are vegetated mainly by Australian pine and Buttonwood. Rising abruptly from sea level is a spoil dike, which is approximately twenty feet above mean sea level at the highest point. The dike en-

closes the center of athe island, a rocky plateau which is vegetated by Australian pine, Brazilian pepper, and a few other plant species. On the north and west side of the island, there are extensive grass-flats and oyster bars. Descriptions of the plant associations on the island are listed below. The location of these associations are delineated in Figure 4.

Beach - This is a sparsely vegetated shore that surrounds the island. The beach, as drawn on the map, is at approximately mid-tide. Because the island has extensive shallow flats around it, the beach merges with the flats in some areas. The east side of the island is subject to considerable wave action due to boat wakes and southwest winds.

Mangrove - This designates areas which are predominantly mangrove. It is generally a combination of the four mangrove species; red, black, white, and buttonwood, with a few Australian pines present.

Australian pine - This area is dominated by Australian pine and Brazilian pepper. It starts on, or near, the shore and continues up the sides of the dike to the top edge. Near the water there is a sparse understory of buttonwoods.

Diked area - This area was diked when the dredging occurred and is now the highest point on the island. It is a rocky area with somewhat barren ground, vegetated by an open stand of Australian pine and Brazilian pepper with an understory consisting of a few native plant species.

Sparse Mangrove - This is a sparsely vegetated shore area characterized by scattered mangroves, mainly buttonwood, and glasswort. The glasswort appears to be colonizing more of the area.

Oyster Bar - This designates the large oyster bar off the south-

west end of the island. In Figure IV, only part of the oyster is visible because the map was drawn at mid-tide.

Table V presents a preliminary plant list for the island. The island is used occasionally as a roost for shore birds, and recently Little Blue herons have established a rookery there. Also, several common species of passerines use the island. Mammalian residents include marsh rabbits and norway rats.

After the inventory was completed, a plan was developed for using the island as an educational and recreational facility. In this management plan, native vegetation was used to demonstrate various shoreline stabilization techniques. In addition, a nature trail was built to use the island as a "showcase" for this work.

On the island seven study areas were chosen for demonstrating management techniques (Figure V). Areas were chosen because of their need for soil stabilization or because they were highly visible. Six of the areas are on the shoreline, and one is on the spoil dike. The management for each area was determined by a combination of what was necessary and what materials were available.

Management

Listed below are the descriptions of each area and the experimental mangement techniques employed. Each letter is correlated with a zone on Figure V.

A) This site is 99 linear feet along a gently sloping, shallow beach composed of sand and muck, with the spoil dike rising steeply behind it. It is colonized by the four species of mangrove.

Management of this site consisted of selective pruning of the existing mangroves and removal of all Australian pine and Brazilian

FIGURE 4.

VEGETATION MAP OF LITTLE EDWARDS ISLAND

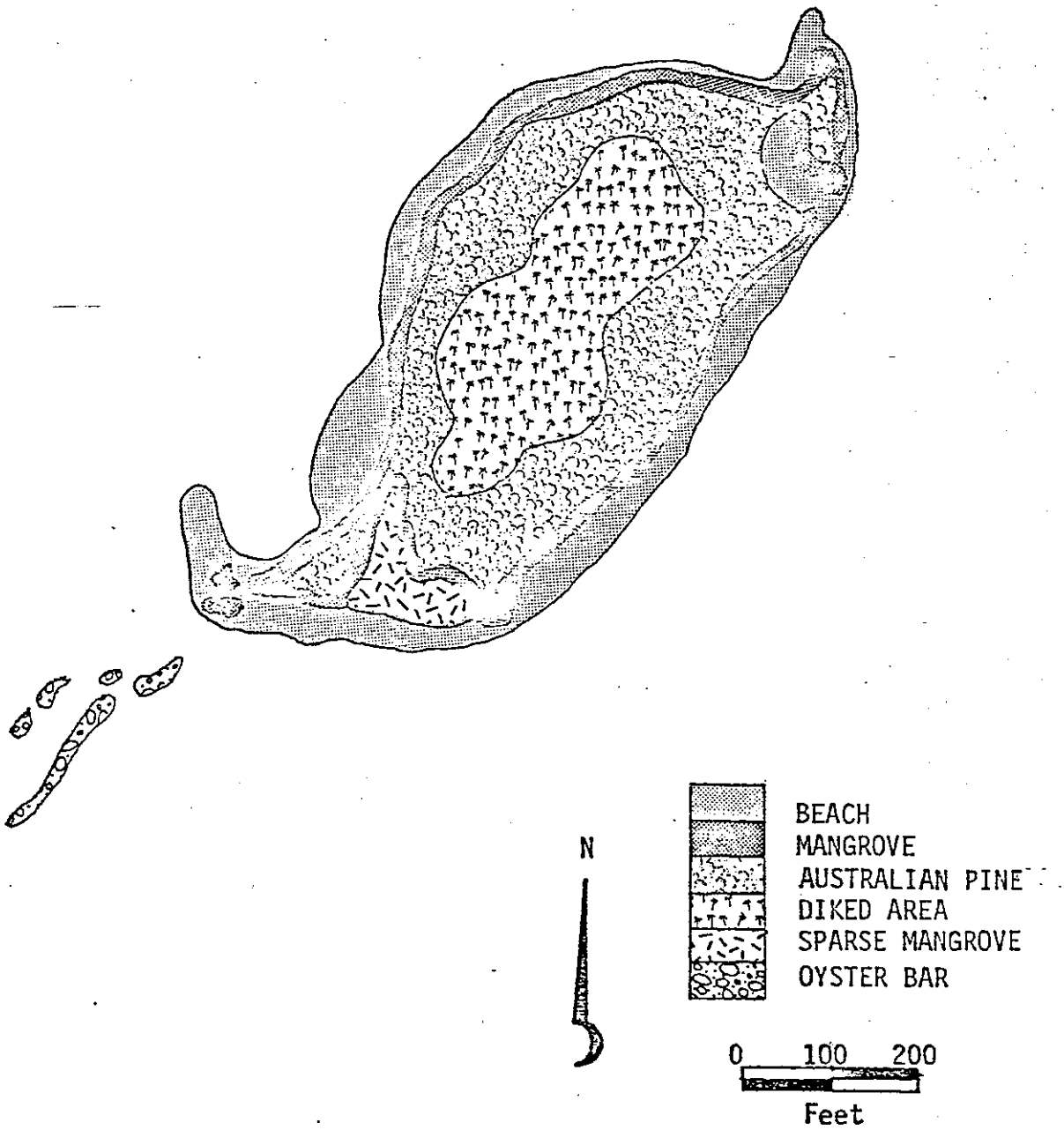


TABLE V

PRELIMINARY PLANT LIST FOR THE EDWARD'S ISLANDS

OCTOBER 1977

* Plants found on uplands
# Plants found on shore

TREES AND SHRUBS

Anacardiaceae Cashew Family
*# Schinus terebinthifolius Brazilian pepper

Arecaceae Palm Family
* Washingtonia robusta Washington palm

Asteraceae Aster Family
* Baccharis glomeruliflora Groundsel

Avicenniaceae Black Mangrove Family
Avicennia germinans Black mangrove

Casuarinaceae Beefwood Family
*# Casuarina sp. Australian pine

Combretaceae Combretum Family
Conocarpus erecta Buttonwood mangrove
Laguncularia racemosa White mangrove

Cupressaceae Cypress Family
* Juniperus siliciola Southern red cedar

Moraceae Mulberry Family
* Ficus sp.

Oleaceae Olive Family
* Ligustrum sp.

Rhizophoraceae Mangrove Family
Rhizophora mangle Red mangrove

VINES

Anacardiceae Cashew Family
* Toxicodendron radicans Poison Ivy

Cucurbitaceae Cucumber Family
* Momordica charantia Wild balsalm-apple

Fabaceae Pea Family
* Vigna luteola Wild pea

HERBS

Aizoaceae Carpetweed Family
* Sesuvium portulacastrum Sea purslane

Apocynaceae Oleander Family
* Vinca rosea Periwinkle

Asteraceae Aster Family
Borrichia frutescens
* Pluchea camphorata Camphor weed

Bataceae Saltwort Family
Batis maritima Saltwort

Boraginaceae Borage Family
* Heliotropium indicum Heliotrope

Chenopodiaceae Goosefoot Family
Salicornia bigelovii Annual Glasswort
Suaeda linearis Sea blite

Euphorbiaceae Spurge Family
* Chamaesyce hirta
* Chamaesyce maculata

Melastomataceae Melastome Family
* Gaura angustifolia

Poaceae Grass Family
Spartina alterniflora Slender cord grass

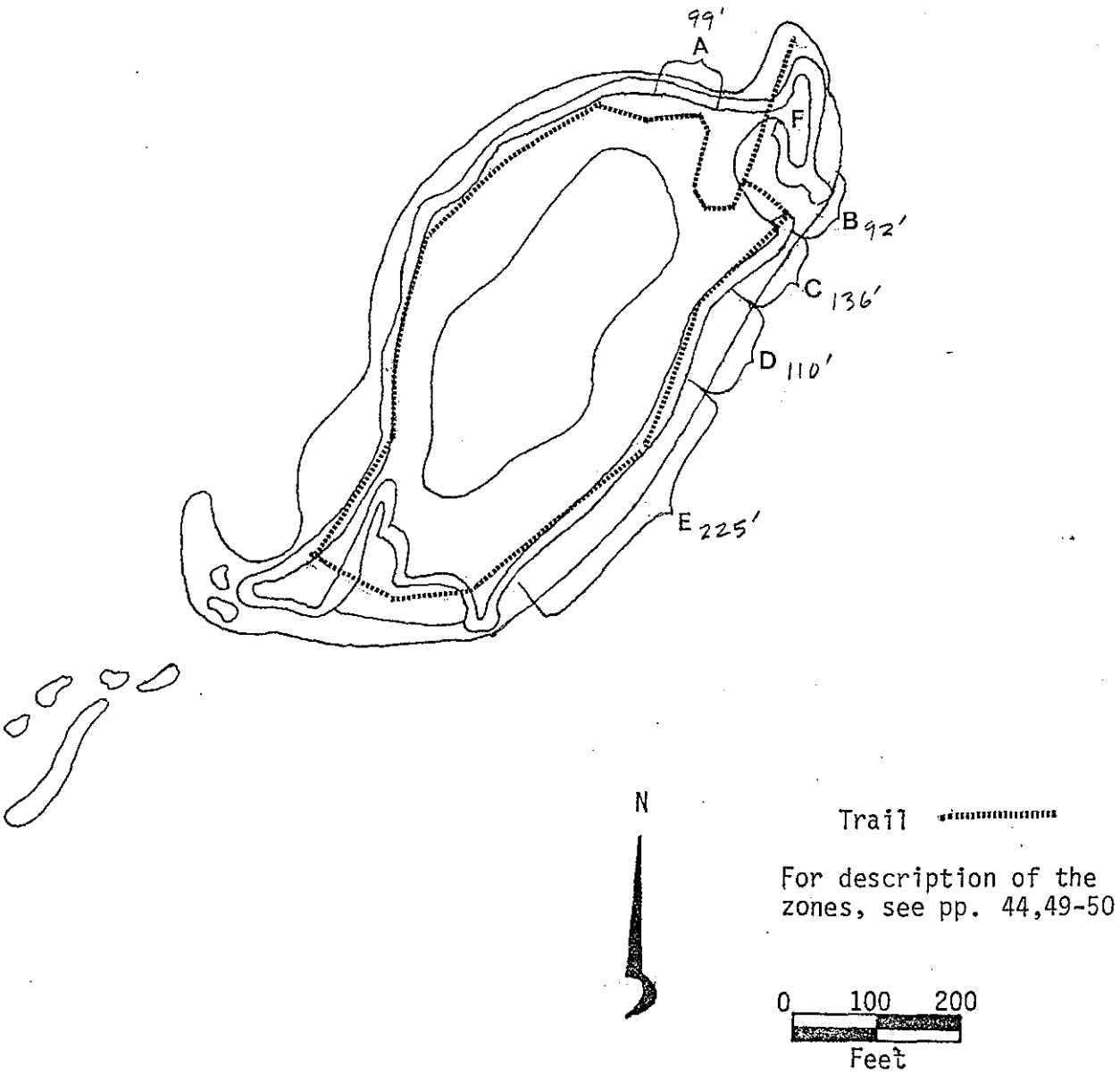
Portulacaceae Purslane Family
Portulaca oleracea Purslane
*# Portulaca pilosa Pink purslane

Plumbaginaceae Leadwort Family
Limonium carolinianum Sea lavender

Verbenaceae Verbena Family
* Lantana camara Shrub verbena

FIGURE 5.

MANAGEMENT AREAS ON LITTLE EDWARD'S ISLAND



pepper on, and seaward of , the dike. Spartina patens was planted behind the mangroves at the foot of the dike, and Uniola paniculata, Panicum amarulum, and Paspalum vaginatum were planted on dike to stabilize the finer sediments.

B) This is a fairly steep berm composed of coarse rock and shell, barren of vegetation save for Australian pines. This site is 92 linear feet and receives high energy waves from boat wakes originating in the Intracoastal Waterway.

Management here included cultivation of Spartina patens on the top of the berm and Paspalum vaginatum and Panicum amarulum on the shoulders of the berm. The exotics were cut down behind the berm to enhance the growth of the native vegetation there, particularly buttonwood.

C) This is 136 feet of shore along a fairly steep rock and coarse shell beach, similar to that in zone B except that a scattered mixture of the four mangrove species grows on the beach and berm. There is a swale and small berm behind the front beach.

Red and black mangroves were planted on the beach to aid their seaward colonization.

D) This site is 110 linear feet of shore adjacent to site C. It is a coarse shell beach with a slope similar to that of the previous site. There are sporadic black and buttonwood mangroves on the beach and berm, and a swale behind.

Management of this site included cutting down the Australian pine and Brazilian pepper on the shore. Red and black mangroves were planted on the shore, but this area was left fairly open to provide a view from the trail.

E) This site is 225 linear feet of sand and shell beach. There

are black, white and buttonwood mangroves on the beach with a dense mat of pneumatophores underneath.

Management here was simply removal of Australian pine and Brazilian pepper and selective trimming of the mangroves.

F) This is a large swale on the northeast end of the island. The substrate is sandy and there was a forest of Australian pine on much of it, edged by buttonwoods. There also is a fairly open, sandy area that is occasionally inundated.

The site is considerably different now as the Australian pine and Brazilian pepper have been removed. Coccoloba uvifera, Ipomea pes-caprae, and Panicum amarulum were planted in plots here. Cutting the exotics may enhance the growth of the existing native plants, such as buttonwood and sea lavender.

G) This site is comprised of the spoil dike, in particualr those areas on the north and east sides of the island which have been cleared. The substrate is rock rubble, overlaid by a small amount of finer soils.

In this site, the Australian pine and Brazilian pepper were removed from the dike, leaving a sparse covering of small Southern red cedar. On the dike, Coccoloba uvifera, Uniola paniculata, Ipomoea pes-caprae, and Ernodia littoralis were planted.

The planting was completed in June 1978. The success or failure of the techniques will not become evident for several months, to a year. This concludes the site specific revegetation experiments.

In order for the island to be an educational tool, it needs to be accessible and attractive to the public. Towards this objective, plans were developed for the creation and management of a park. Because the site is near the Intracoastal Waterway, it is readily accessible by boat, so a park would be aimed primarily towards boaters. The initial

it would be beneficial if the county planned for long-range management of the island.

SECTION III

SHORELINE PREFERENCE SURVEY

SHORELINE PREFERENCE SURVEY

Introduction:

Approximately 90% of Sarasota County shorelines are privately owned. This land is used predominantly for residences, either single family homes of condominium and apartment buildings. Because such a high percentage of shorelinesnare privately owned, the attitudes and preferences of the residents must be incorporated into shoreline management.

For shoreline management to be relevant to homeowners, it must be concerned with economic costs, environmental quality, and aesthetic appeal. It is important tnat shorelines be pleasing to the eye as well as functional. Additionally, management of public shorelines, such as parks, should be consistent with their use. Because these areas are designed for the public benefit, aesthetic quality should be a prime objective of public resource management. Thus, the preference survey can be used as a means of evaluating shorelines.

The shoreline preference survey was designed to determine the attitudes of shoreline residents and non-residents towards shoreline types typically found in Sarasota County. The results of the survey can then be used to pinpoint areas where public education is needed, as a guideline for long range planning of Sarasota County shorelines, and as an aid to the private homeowner.

Proceedures:

While mapping the shorelines, photographs were taken of many types of typical and unusual shorelines. These slides were then used for the

surveys; only those slides which were obviously of poor photographic quality were not used. Two types of surveys were developed and administered to different groups.

The preliminary survey (Figure 6) was designed to reduce the number of slides for the final survey and to remove sampling and investigator bias. For this survey, the shorelines were categorized as 1) mangrove dominated, 2) beach, 3) mixed salt marsh vegetation, 4) Australian pine and Brazilian pepper, 5) seawall, and 6) rip-rap.

The preliminary survey was then used to ask two groups of experts to define and rate each picture. The experts, people who had a professional knowledge of shorelines and vegetation, consisted of volunteers from the Florida Field Biologists meeting and the staff of the Environmental Studies Program at New College.

A survey of professionals is often used as a means of quantifying the accuracy of the variables to be used in a general survey. This survey of expert opinion helped quantify the photographic quality of each slide and determine how well the slides represented the six shoreline categories.

In order to determine the most representative slides of the original 58, the responses were analyzed in the following ways: the percentage of agreement among experts of each category type was determined and means and standard deviations were computed for both the typical to unusual scale and the photographic quality scale (Figure 6).

Fifteen slides were chosen for the final survey. They were based on the analysis of best agreement among the experts and included the "most unusual" and "most typical" slide from each category, plus three additional slides depicting natural or beneficial shoreline development.

The final survey used the fifteen slides to determine the atti-

tudes of shoreline residents and non-residents in Sarasota County (Figure 7). The survey was divided into three components: 1) background information, 2) responses to the slides, and 3) individual comments. The background information provided general information on the lifestyle of each respondent and was used as a basis for categorizing the responses. It was a preliminary hypothesis thatperception of the shorelines would change according to the respondent's background, i.e. whether they were shoreline residents, how long they have lived in Florida, and how often they use the water resources of Sarasota County.

Four questions were asked about each of the fifteen slides: 1) How much do you like this shoreline? 2) How much would you like your shoreline to look like this? 3) Do you think erosion will occur at this site? 4) Would you like public shorelines to be maintained in this manner? The respondents rated each question on a seven point numerical scale from "not at all" to "very much".

The comments section provided respondents an opportunity to give their opinions on the marine resourves of Sarasota County. These comments were analyzed as percentages of comments with no comments, percentage which were optimistic and percentage of comments which were pessimistic. Additional comments were noted which indicated the overall understanding of marine systems by the respondents.

The survey was presented to 151 people in eight organization. The organizations, listed in Table VI, included conservation, homeowner and boating associations. All of these groups have an important interest in shorelines and although this selection presents a distinct bias in terms of total population in Sarasota County, it was

Figure 6. Preliminary Survey To Determine and Evaluate Representative Shorelines.

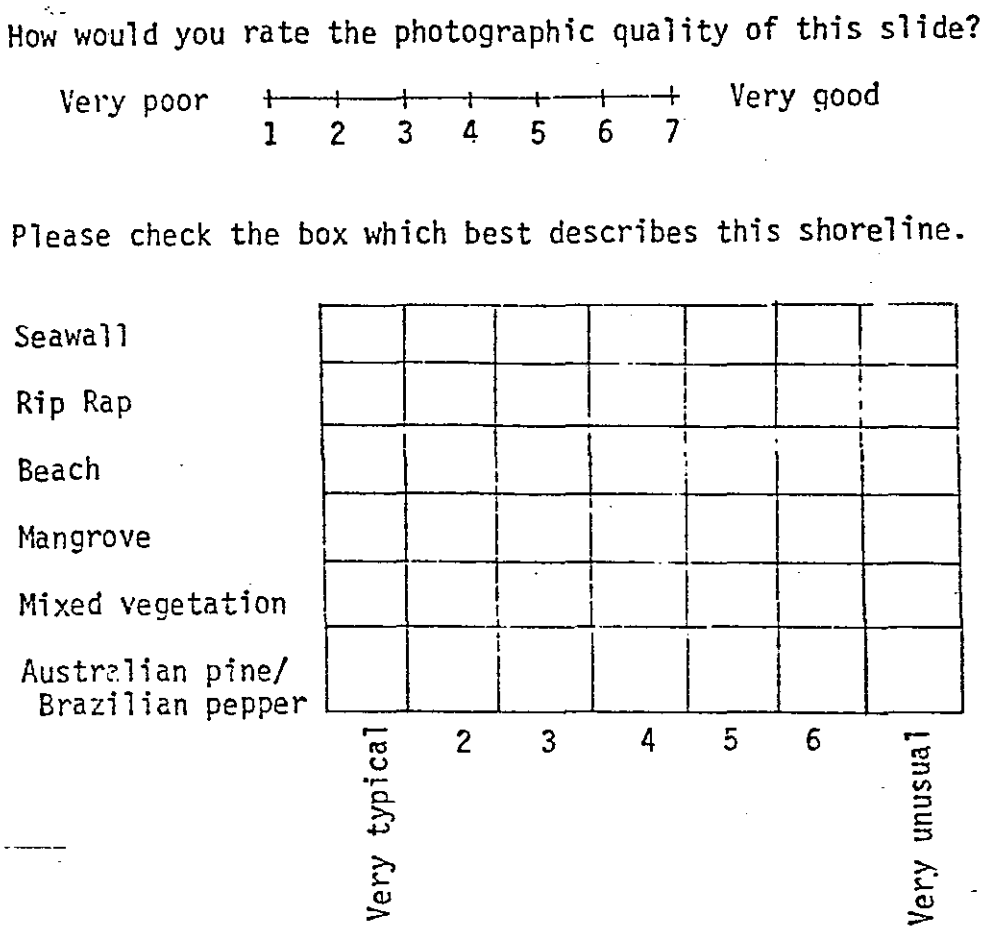


Table VI. Survey Presentations by Organization and Number of Responses.

ORGANIZATION	RESPONSES
Manasota 88 Steering Committee	10
Izaak Walton League Manatee County Chapter	15
Cortez Trailer Park	37
Futures Fair Attendents	11
Coast Guard Auxilery Flotila 83	21
Southbay Yacht Club	22
Marine Advisory Board of Sarasota County	17
Longboat League	18
TOTAL	151

essential to survey the people with the most control over the shorelines.

A set program was used to present the survey to insure consistency. This program began with a brief introduction of the speaker and an explanation of the purpose of the survey. Instructions for taking the survey were read and questions answered followed by the presentation of the fifteen slides. After the survey, a slide show was presented which detailed the scope of the entire project, outlined the marine resources of Sarasota County and discussed possible management techniques.

The responses to this survey were analyzed with a SPSS "Crossbreak" program on an IBM computer (Nie, N.H., et al, 1975). This analysis provided a means of categorizing and evaluating responses based on indicated indexing variables. The indexing variables chosen for this study were 1) whether or not the respondent lived on a shoreline and, 2) how much the respondent was in or around the bays and estuaries, based on the respondents estimated utilization in hours per month. For the computer program, this second indexing variable was categorized in three groups: 1) low utilization 0-5 hr/month, 2) medium use 5-15 hr/month, and, 3) high use of the bays and estuaries, over 15 hr/month.

The responses for each question on each slide were analyzed according to means, standard deviations, frequencies, and 'eta' statistics (for a detailed explanation of these basic statistical procedures, see the SPSS manual or any introductory statistics book).

Results and Discussion

The results of the expert ratings are presented in Table VI. Each shoreline category is listed with the ratings of the slides that were chosen for the aesthetic preference survey. In chosing the slides, emphasis was placed on achieving a high percentage of agreement and consistent photographic quality for the most typical and most unusual representative of each category.

In the analysis of the responses to the aesthetic preference survey, the respondents were grouped according to whether or not they lived on waterfront property. Within each group, shoreline residents vs. non-shoreline residents, a further breakdown was based on how much time the respondents were in, or around, our bays and estuaries. This was based upon their estimated answer to the question "How much do you actively utilize the marine resources of Sarasota County, such as swimming, fishing, boating etc.? ____ hours per month". The responses were put in three categories: 0-5 hours per month, 5-15 hours per month, and over 15 hours per month. Figure 8 is an example of the output from the computer program.

A preliminary hypothesis, which was the basis for grouping the responses in such a manner, was that respondents' attitudes and knowledge would differ depending on their familiarity with the systems. Their familiarity was based on their estimated hours of utilization. A second hypothesis was that there would be a significant difference in responses from shoreline and non-shoreline residents.

Based on the 'eta' statistics, or correlation ratios, these hypotheses were not valid. Analysis indicated that there was no

Table VII. Representative Shorelines with Means and Standard Deviations of Rating Variables

Category		Percent Agreement	Quality 1to7 Mean	Quality 1to7 SD	Category Rating 1to7 Mean	Category Rating 1to7 SD
Seawall	Typical	100.0	5.43	1.31	1.59	0.88
	Unusual	89.6	5.40	1.23	5.23	1.55
Mangrove	Typical	70.6	4.82	1.14	2.32	1.09
	Unusual	90.0	5.12	1.06	3.98	2.33
Beach	Typical	83.3	5.25	1.07	3.00	1.61
	Unusual	81.8	4.70	1.32	4.53	1.83
Austrialian pine/Brazilian pepper	Typical	90.0	5.64	---	1.91	1.27
	Unusual	76.0	5.26	1.08	2.37	1.34
Other vegetation Rip-rap	Typical	90.0	5.65	1.05	2.38	1.47
	Unusual	67.4	5.26	1.16	4.24	1.60
	Typical	74.0	5.05	1.16	2.64	1.20
	Unusual	80.9	5.55	0.99	4.50	1.96
Optimum	Low energy	49.0	----	----	----	----
	High energy	45.8	----	----	----	----
	River/creek	44.9	----	----	----	----

MEAN / COUNT / SUM / STD DEV	ACTIVE USE Hrs/Month: 0 to 5	5 to 15	gt 15	ROW TOTAL
	3.08	3.56	3.44	3.37
SHORE	25	25	36	86
RESIDENT	77.00	89.00	124.00	290.00
	1.93	2.16	1.71	1.90
	3.14	3.19	3.09	3.13
NON-	22	16	23	61
RESIDENT	69.00	51.00	71.00	191.00
	2.14	2.17	1.86	2.01
	3.11	3.41	3.31	3.27
COLUMN	47	41	59	147
TOTAL	146.00	140.00	195.00	481.00
	2.01	2.14	1.76	1.95

Raw Chi Square= 0.80303 with 2 degrees of freedom.
Significance= 0.6693
Eta= 0.00547 with Variable 61 dependent
0.00422 with Variable 62 dependent
Number of missing observations = 4

Figure 8. "CROSSBREAK" Analysis of Slide Number 1, Question A- 'Typical Rip-rap', How much do you like this shoreline? 1, not at all to 7, very much.

significant difference between the six group responses. The homogeneity of responses has two implications: First, that the limitations of our sampling procedure were not critical, and, second, the responses adequately represented the views of shoreline residents. Although we found no significant differences between low, medium, and high users of the shoreline residents and non-residents, there is a possibility that other variables, such as age, income, and years as a Florida resident may be highly significant.

The results of the Shoreline Preference Survey are presented in Table 8. This table is based on the average scores of all responses to each of the fifteen shoreline pictures. For each heading, the top five ranked shoreline types are included. For example, the first row presents the shorelines that were "most liked" from typical Australian pine/Brazilian pepper shoreline to a typical mangrove shoreline.

The information in this table has several important implications concerning shoreline management and restoration. From question A, "most liked" shorelines are essentially the most natural and undeveloped areas, while the "least liked" shorelines are primarily developed with seawalls or revetments and one included a visibly eroding beach. This points to the conclusion that, based on the responses received, people would rather see natural shores with "mixed shoreline plants" than concrete and rock structures.

The second question, B, asked respondents to rate "How much would you like your shoreline to look like this?". The answers reflected those of the first question; vegetated shorelines were

MOST LIKED SHORELINES

1	AP/BP*	Typical
2	Other Vegetation	Unusual
3	Other Vegetation	Optimum
4	Other Vegetation	Typical
5	Mangrove	Typical

LEAST LIKED SHORELINES

1	Beach	Unusual
2	Seawall	Typical
3	Rip-rap	Typical
4	Seawall	Unusual
5	River/creek	Optimum

WOULD MOST LIKE TO OWN

1	AP/BP*	Typical
2	Other Vegetation	Unusual
3	Other Vegetation	Optimum
4	Other Vegetation	Typical
5	Beach	Typical

WOULD LEAST LIKE TO OWN

1	Beach	Unusual
2	Seawall	Typical
3	Rip-rap	Typical
4	Mangrove	Optimum
5	Seawall	Unusual

MOST LIKELY TO ERODE

1	Beach	Unusual
2	Beach	Typical
3	Seawall	Unusual
4	Mangrove	Optimum
5	River/creek	Optimum

LEAST LIKELY TO ERODE

1	Seawall	Typical
2	Mangrove	Unusual
3	Mangrove	Typical
4	Other Vegetation	Optimum
5	Rip-rap	Typical

PREFERRED PUBLIC SHORELINES

1	Other Vegetation	Optimum
2	Other Vegetation	Unusual
3	Other Vegetation	Typical
4	AP/BP*	Typical
5	Beach	Typical

* Austrialian pine/Brazilian pepper

Table 8. Summary Results of 'Shoreline Preference Survey'.

preferred and seawalls and revetments were disliked most. The respondents also preferred shorelines with a diverse mixture of vegetation. These attitudes indicate that homeowners would attempt shoreline restoration and management if they are provided with the necessary information and materials.

According to the responses to question D "Would you like public shorelines to be maintained in this manner?", public shorelines should be maintained with mixed vegetation. The county has the opportunity and responsibility of maintaining beneficial and aesthetically pleasing shorelines. Maintaining public shorelines in such a manner would provide individual homeowners with examples.

The answers to question C, "Do you think erosion will occur at this site", indicated that erosion of bay and estuarine shorelines is poorly understood. The shorelines rated as most likely to erode included two visibly eroding shores, two stable shores and one questionable shore. A "typical seawall" was rated as least likely to erode. Although it is not visible in the picture, that seawall is currently losing backfill by subsidence and erosion.

The erosion of bay and estuarine shorelines does not necessarily involve the dramatic loss of land as on gulf beaches. It is usually a slow loss of soil that gradually undermines shorefront structures and vegetation. The Australian pine is especially susceptable to this type of erosion. Australian pine shorelines were consistently rated very high (Question A, B, D) but the potential for erosion was not acknowledged in Question C. It is likely that Australian pine shorelines would not be rated as high if this threat of erosion was perceived.

Generally, the survey showed that people prefer natural, vegetated shorelines over seawalls and revetments. Ironically, over 50% of the shorelines in Sarasota County are either seawalls or revetments. It seems that the major obstacles to shoreline restoration are the lack of information and a ready source of shoreline plants.

Figure 7. Shoreline Preference Survey to determine the attitudes of residents towards Sarasota County shorelines.

Background Information

Sex ___male ___female

Age ___under 25 ___25-35 ___35-45 ___45-60 ___over 60

Are you a full time Florida resident? ___yes ___no

How long have you lived in Florida? ___years

Before coming to Florida where did you live? _____

Do you currently:

___Own your home.

___Own a condominium.

___Rent your home.

___Rent an apartment.

___Other, please specify. _____

Do you currently live on waterfront property? ___yes ___no

If yes, what type? ___bayfront ___canal ___gulf front ___pond/lake

___other, please specify _____

Do you own a boat? ___yes ___no

If yes, what type? (check all that apply)

___power, less than 20' ___power, greater than 20'

___sail ___canoe ___other, please specify _____

How much do you actively utilize the marine resources of Sarasota County, such as swimming, fishing, boating etc.? ___hours per month

How is this time spent? (number in order of importance)

___boating ___swimming ___fishing ___skin-diving ___water skiing

___other, please specify _____

Figure 7. Continued

Shoreline Evaluation

Slide # 1

A How much do you like this shoreline?

not at all _____ very much
1 2 3 4 5 6 7

B How much would you like your shoreline to look like this?

not at all _____ very much
1 2 3 4 5 6 7

C Do you think erosion will occur at this site?

not at all _____ very much
1 2 3 4 5 6 7

D Would you like public shorelines to be maintained in this manner?

not at all _____ very much
1 2 3 4 5 6 7

Slide # 2

How much do you like this shoreline?

not at all _____ very much
1 2 3 4 5 6 7

How much would you like your shoreline to look like this?

not at all _____ very much
1 2 3 4 5 6 7

Do you think erosion will occur at this site?

not at all _____ very much
1 2 3 4 5 6 7

Would you like public shorelines to be maintained in this manner?

not at all _____ very much
1 2 3 4 5 6 7

Figure 7. Continued

Comments

What can be done to improve the shorelines of Sarasota County?

What is the general quality of Sarasota County bays and estuaries, i.e. the fishing, healthiness of eating shellfish, of swimming, cleanliness of water?

Do you think erosion is a serious problem in Sarasota County? Where and Why?

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