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PROCEEDINGS OF THE INDIAN RIVER RESOURCES SYMPOSIUM

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THE INDIAN RIVER LAGOON

MARINE RESOURCE COUNCIL
OF EAST CENTRAL FLORIDA

THE INDIAN RIVER LAGOON

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THE INDIAN RIVER LAGOON INITIATIVE

Foreword

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The Great Lagoon of the Ais sheltered, fed, and sustained generations of Indians of the Ais tribe of East Central Florida. It harbored shipwreck victims from Spanish galleons and the pirates who sought New World gold. The one hundred and forty mile long avenue of protected waterway provided a travel route for Indian dugout canoes, settlers rafts, and steamboats carrying building materials, services, and tourists south and winter produce and world famous oranges north. Today's space age industry, a tourist related economy and a tide of new Florida residents are attracted to the shores of the lagoon for recreation, climate, and fisheries (Barile, 1985).

Early Indians dependent on the resources of the lagoon knew its bountiful nature, its seasonal moods and biological migrations (Rouse, 1951). Today we know little of this estuary of 211 square miles or how it is reacting to or will in the future react to human activities. Even the name of the body of water, has evolved from the Great Lagoon of the Ais to the Ais Lagoon to the Ais River during the English period in Florida. The name today, the Indian River, almost implies that the estuarine quality of the lagoon disappeared with the ancient Ais tribe.

Today the Indian River is still an estuary spanned by bridges and causeways connecting the mainland to the barrier island, artifically opened to the sea by four inlets maintained by navigation projects, and acted upon as a depository for the waste of human activites. Freshwater runoff from streets, parking lots, and homes discharge directly into the lagoon or into drainage ditches then creeks and then into the lagoon. Sewage discharges add to the pollution load as does discharge from industrial and commercial areas.

Formal concern for the future of the lagoon system by the scientific community culminated in 1981 with the FIRST Symposium (Montgomery, 1983). Interdisciplinary participants interested in the maintenance and wise use of the Indian River system met for the first time to exchange their knowledge in presentations and poster

sessions describing recent or ongoing research in the Indian River, Banana River, and Mosquito Lagoon. The results of the meeting were published as a special edition of the Florida Scientist.

The Marine Resources Council of East Central Florida was formed in 1983 expanding the membership of the FIRST group to involve the general public, elected officials, recreation and commercial fishermen, managers, engineers, and attorneys. Upon organization, the group proposed that a meeting be held to assess the condition of the lagoon's resources and seek direction for management of the estuary in the future. The concept for the meeting was supported by grants and donations from the Florida Legislature, Florida Sea Grant, F.I.T., cities and towns, industry, and citizens.

The Indian River Resources Symposium was held at the Melbourne campus of the Florida Institute of Technology on January 18 and 19, 1985. Organized in two parts, the meeting first presented summary papers dealing with descriptions of the physical and biological functions of the Indian River System, the history of man's impact on the lagoon and the economic value of the lagoon; and an analysis of the existing legal land and water management framework related to the lagoon. The State of the Lagoon session was attended by nearly four hundred people from the six counties bordering the lagoon. This proceedings includes a compilation of the papers presented during that day long meeting.

The second part of the symposium, the American Assembly Sessions, brought together nearly ninety leaders selected to geographically represent more than thirty special interests related to the lagoon; elected officials, marina oeprators, fishermen, homeowners, representatives of local, regional, and state agencies, scientists, boaters, and developers. Divided into five heterogeneous groups, each was asked to come to a consensus on twenty-four questions related to eight issues significant the the future of the lagoon's vitality. Results of the one and one-half days work by the American Assembly groups was summarized in a concluding address. Both an analysis of the group response to each question and the final address are a part of this publication. Also included are the results of a region wide survey of issues and probledms concerning the lagoon undertaken as part of the project.

Results of the Indian River Symposium could be summarized by pages published and/or by action taken as a result of the meeting. Three issues seemed to emerge

related to the lagoon; for each a course of action has been initiated.

1. There is a lack of coordination in the management of the lagoons resources.
2. There is incomplete understanding of the physical system, the impact of freshwater inflow, water movement, and circulation.
3. There is limited understanding of the relationship of the physical processes to the biological system, particularly the submerged aquatic vegetation, the basis of all life in the lagoon.

Since the symposium, a course of action has been taken relating to each issue. The Governor of Florida has directed the committee coordinating the State Coastal Management program to work with the MRC in recommending means to coordinate management of the lagoon as a system rather than a part of six counties, nearly forty towns and cities, two region planning councils and drainage and inlet districts. Representatives of each state agency, water management districts, and citizens have been organized as the Indian River Field Committee to report to the Governor before 1986.

Through funds made available from the Federal Coastal Mangement Program, $160,000 has been granted to the Water Management Districts and local governments to undertake studies related to grassbeds and the hydrology of the lagoon. The studies should produce the first bibliography of the lagoon, the first complete map of the lagoon defining its watersheds, an analysis of existing information, and a direction for future study. Grassbed investigations will map the areas of submerged vegetation and assess their relative condition.

Two technical committees have been formed to serve as advisors on the various studies. The action of these groups could serve to encourage, inform, and coordinate the direction of research activities to meet the needs of decision makers and managers for sound information related to resource use. The Florida Legislature, led by the local delegation and based upon the outcomes of the symposium, as appropriated funds to allow MRC to coordinate the activities resulting from the symposium, encourage public awareness and fund key research.

As awareness of the unique nature, economic value, and aesthetic appeal of the lagoon has increased it has become obvious that indeed the Indian River is not a river and should not be treated as such. As an estuary, it lives in gentle balance, resilient to the daily

patterns of changes, but fragile faced with unpredictable surges of human induced modifications. Perhaps we have been deluded to think if called a river the lagoon would lose its estuarine qualities and perform as a river flushing away our discharges and effluents. It is interesting that since the symposium, the term Indian River Lagoon has appeared more and more often in print and conversation.

In totality, the response to the symposium has been called the Indian River Lagoon Initiative. It represents an awakening to the value of an estuary which has drawn so many to its shores. It represents the awareness that we little understand a resource whose attributes we have used with little regard. The initiatives represents a commitment to do something, to work together, to address the problems facing the lagoons survival and to enjoy and benefit by its resources long into the future.

Palm Bay, Florida
June, 1985

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TABLE OF CONTENTS

THE RIVER THAT'S NOT A RIVER

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THE RIVER THAT'S NOT A RIVER

by

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Abstract

The Indian River lagoon is a bar-built estuary that extends some 120 miles along the east coast of Florida, from St. Lucie Inlet, at its southern end, to a broad, shallow lake at its northern end. The Intercoastal Waterway runs through the Indian River, connecting to Mosquito Lagoon by way of Haulover Canal, about eight miles south of the River's northern extremity, and continuing south below St. Lucie Inlet via another man-made canal. The waterway has a control depth of nine feet. The rest of the lagoon averages little more than three feet in depth. It's area of 211 square miles (548 km^2) contains a mean volume of about 220 billion gallons (829 x $10^6 m^3$), the upper linear half of the River widening out to include about two-thirds of its area and volume.

In addition to St. Lucie Inlet, the Indian River connects to the sea by way of the larger Ft. Pierce Inlet, 23 miles north of St. Lucie Inlet. A third, much smaller opening, Sebastian Inlet, also man-made, lies 25 miles north of Ft. Pierce Inlet. The three inlets, the only communication between the Indian River and the Sea, thus all occur in the lower part of the River and the two with any significant capacity for exchanging water (Ft. Pierce and St. Lucie Inlets) lie within the southern 20% of the River's length.

On a normal tide, the three inlets exchange on the order of 10 billion gallons of water between the River and the Ocean, less than 5% of the River's volume. Actually, tidal flushing is restricted to an area a mile or two either side of the inlets, beyond which the tide serves only to move the same water back and forth. Tidal amplitude is not, in any event, very large.

Freshwater inputs to the Indian River occur through several rivers or creeks that are natural

tributaries but that are now fed primarily through an intricate system of managed canals. These divert water across the coastal ridge and into or away from Lake Okeechobee or the St. John's River drainage basins. The major drainage canals feed into the Indian River by way of the St. Lucie River, Taylor Creek, Sebastian River and Turkey Creek.

The various canal systems are managed for the benefit of agricultural and residential interests in the interior, not for the benefit of the Indian River. Any adverse effects of their drainage upon the River tend to be exacerbated by the fact that water is released to the River when it is least needed, during periods of heavy rainfall, and diverted away from the River when most needed, during drought conditions. Impact of the freshwater drainage is minimized, on the other hand, by the fact that three of the four major sources, (St. Lucie River, Taylor Creek, and Sebastian River) are almost directly opposite the three inlets (St. Lucie, Ft. Pierce, and Sebastian Inlets, respectively). Much of their outflow accordingly goes directly out to sea, though the fraction remaining in the Indian River under differing conditions has not been determined.

Only one major canal/creek system enters the River in an area remote from an inlet. That is Turkey Creek, just south of Melbourne, the influence of which may be seen during periods of peak discharge some distance south of the Melbourne region.

Freshwater also enters the Indian River through numerous small, unmonitored canals and creeks, from stormwater drainage directly into the River, and from groundwater seepage. None of these sources is thought to be large relative to the above mentioned major contributors, which together amount to 300-1000 billion gallons per year, depending upon rainfall and diversion practices. Wastewater adds another 15 billion gallons per year, most (2/3) to the northern half of the River.

A rough estimate of a mean water balance for the Indian River as a whole shows that inputs from all sources, including direct rainfall to the River may be exceeded by evaporation in dry years or may be several times greater than evaporation in wet years (Table 1). Such a range would imply mean residence times for the entire River anywhere from a few months to infinity. Such calculations,

however, are simplistic and misleading for several reasons. First, lagoon-type estuaries are much more influenced and controlled by extremes rather than mean conditions. Rainfall not only varies dramatically both seasonally and from year to year, but characteristically occurs over short periods of a few days interspersed by long, dry spells. A foot or more or rain falling over a few days may exert significant short-term localized flushing of the River in contrast to the effects of the same precipitation spread over several months.

A case at point is the effect of the release of water from Lake Okeechobee during March, 1983, following heavy rains the previous winter. The addition of some 160 billion gallons to the St. Lucie River, according to R.P. Reichard and S.M. Lewit (F.I.T.), resulted in a diversion of incoming tidal flow from St. Lucie Inlet northward up the Indian River to Fort Pierce, completely flushing the lower river with seawater over a ten-day period. Such complex hydrodynamic flows resulting from the combined effects of freshwater drainage and tidal exchange may be a common feature of certain parts of the Indian River that can be understood and predicted only through further intensive studies of the whole system.

A second complication to the use of a simple water balance in predicting residence time is that other factors, such as wind, may be of equal or greater importance in mixing and moving water from one part of the River to another and out the inlets. Probably a major mechanism in flushing the Indian River is that created by major storms that produce sudden large freshwater inputs together with strong prevailing winds that provide direction of flow to the dynamic head of freshwater.

But intensive storms of short duration are also interspersed with periods of little or no wind or rain, often of prolonged duration. During such times, there may be virtually no net movement of water in the Indian River.

There are also major differences in the dynamic forces influencing water exchange in the different sections of the River. The lower half of the system includes not only the three openings to the sea, but also the three largest sources of freshwater. North of Sebastian Inlet, the only significant freshwater input is Turkey Creek. North of Melbourne, wastewater becomes a major source of freshwater. Calculation of a water balance of that

section of the Indian River (Table 2) reveals that it is, in the long term, a "negative estuary" by the classical definition of D. W. Pritchard, in that water must normally flow into the system to compensate for evaporation. Again, strong northerly winds and heavy rains may produce a periodic cleansing effect, but the region would appear to be particulary prone to stagnation in fine weather and susceptible to the cumulative effects of anything added to the water. Far from the situation in a 100-mile section of a real river (i.e. one with a current speed of several knots), where something added at the source may end up at its mouth two days later, the Indian River at its upper end may retain its additives for long periods of time, perhaps indefinitely, and should not be thought of, in that connection, as a river at all.

TABLE 1.

ESTIMATED ANNUAL HYDROLOGICAL BALANCE

INDIAN RIVER

(BILLIONS OF GALLONS)

RIVER VOLUME	220
INPUTS:	
RAIN	130-250
TRIBUTARIES	
ST. LUCIE RIVER	60-400
TAYLOR CREEK	25-100
VERO BEACH CANALS	20-80
TURKEY CREEK	10-75
ALL OTHERS	25-100
LOCAL STORMWATER DRAINAGE	0-5
GROUNDWATER SEEPAGE	0-5
WASTEWATER	15
TOTAL INPUTS	285-1030
LOSSES	
EVAPORATION	160-320
NET OUTFLOW	0-870
RESIDENCE TIME	3 MONTHS - ∞

TABLE 2.

ESTIMATED ANNUAL HYDROLOGICAL BALANCE
INDIAN RIVER NORTH OF MELBOURNE*
(BILLIONS OF GALLONS)

RIVER VOLUME		110
INPUTS		
RAIN	66-124	
UNMONITORED CREEKS & CANALS	3	
STORMWATER DRAINAGE	3	
GROUNDWATER SEEPAGE	3	
WASTEWATER	10	85-143
EVAPORATION		86-160
NET FLOW OUT		0-57
RESIDENCE TIME		2 YEARS-∝

* ASSUMED TO BE HALF TOTAL AREA AND VOLUME OF ENTIRE INDIAN RIVER.

THE IMPORTANCE OF INLETS AND SEA LEVEL IN THE DEVELOPMENT OF HUTCHINSON ISLAND AND THE INDIAN RIVER LAGOON, FLORIDA

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The width of the Indian River Lagoon and barrier island from St. Lucie Inlet north to Melbourne is variable. Three artificial cuts (inlets) variable in size and depth occur in this area. The width of the barrier island increases at the inlets by a factor of two because of the growth of tidal deltas into the lagoon. Elsewhere are a series of triangular (delta-shaped) structures which extend from the barrier island into the lagoon causing the lagoon to become narrower and the barrier island wider (Fig. 1). In some portions of the lagoon the number of delta-shaped structures increases and they coalesce, making the original morphology of individual delta-shaped structures difficult to differentiate. This situation exists between Vero Beach and Wabasso where the lagoon is relatively narrow and the barrier island relatively wide.

Information on the evolution of the triangular-shaped structures extending from the barrier island into the lagoon is provided from aerial photographs, including the 1945 series by the U. S. Department of Commerce (NOAA), scale 1:20,000; the 1976 series, scale 1:24,000; and the 70 mm low-angle color slides taken in 1981 by the Harbor Branch Foundation; and also from short cores taken in the lagoon.

Historical records of change in lagoon morphology also provide useful data. For example in 1886 Captain David Gibson attempted to dig a ditch for a distance of a quarter mile from the Indian River to the ocean at what is now known as Sebastian Inlet, and where aerial photographs suggest that there were former inlets. The attempt failed, in part because high winds and tides several times erased in one night the work of weeks. Efforts to open a waterway from lagoon to ocean continued. Dredging began in 1919 and in 1921 a channel was completed. The cut, however, rapidly filled with sand. Then in 1924, without the work of man, a storm opened the channel and it has been maintained open by man since that time. This shows that hurricanes or storms are capable of altering lagoonal sediment by closing or opening inlets and forming tidal deltas.

Aerial photographs and historical data indicate that if maintenance dredging of the inlets were to cease, the inlets would close, migrate, and reform at a new location.

Physiographic features such as a narrow, partially marsh-filled lagoon, complex meandering tidal channels and

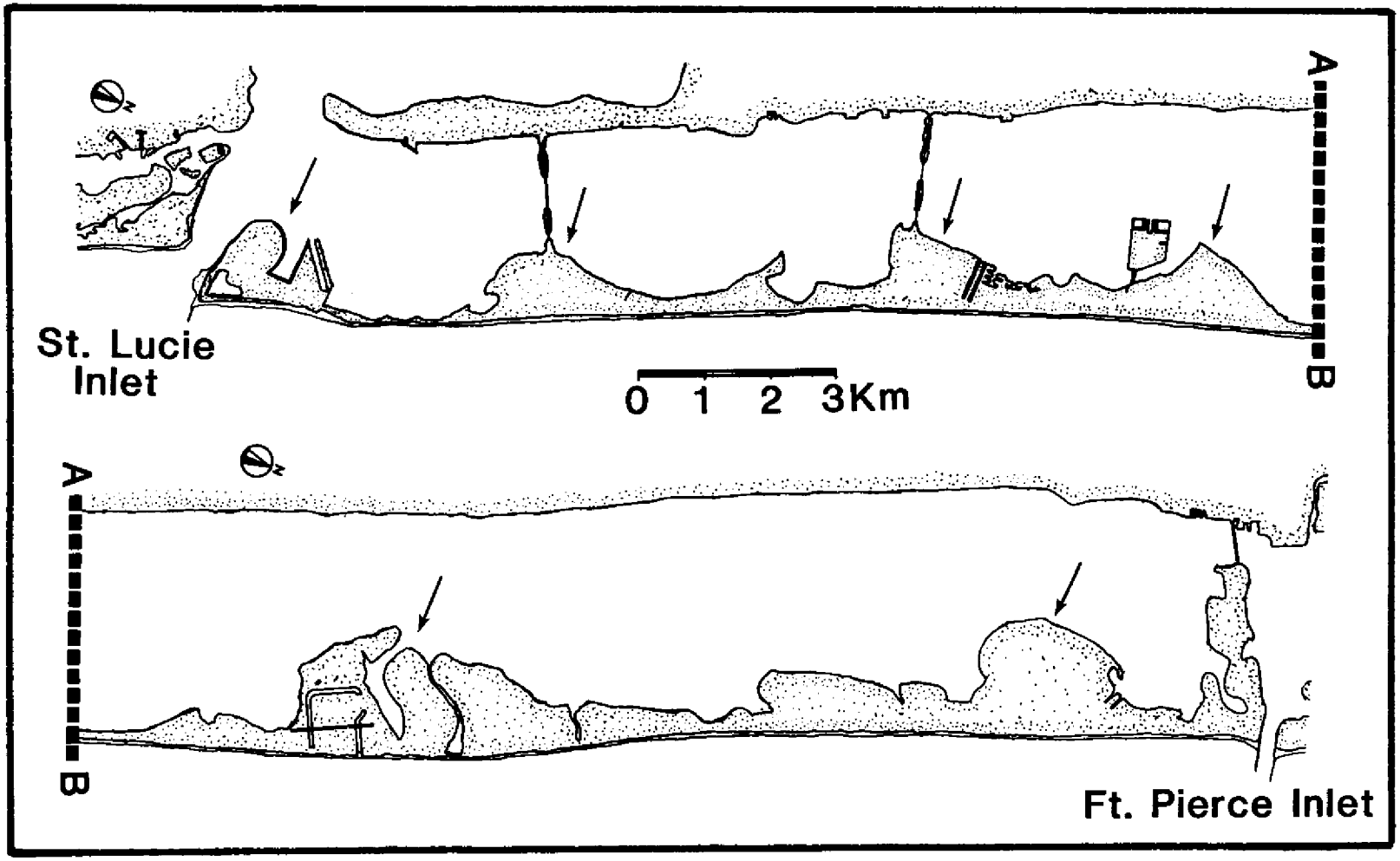


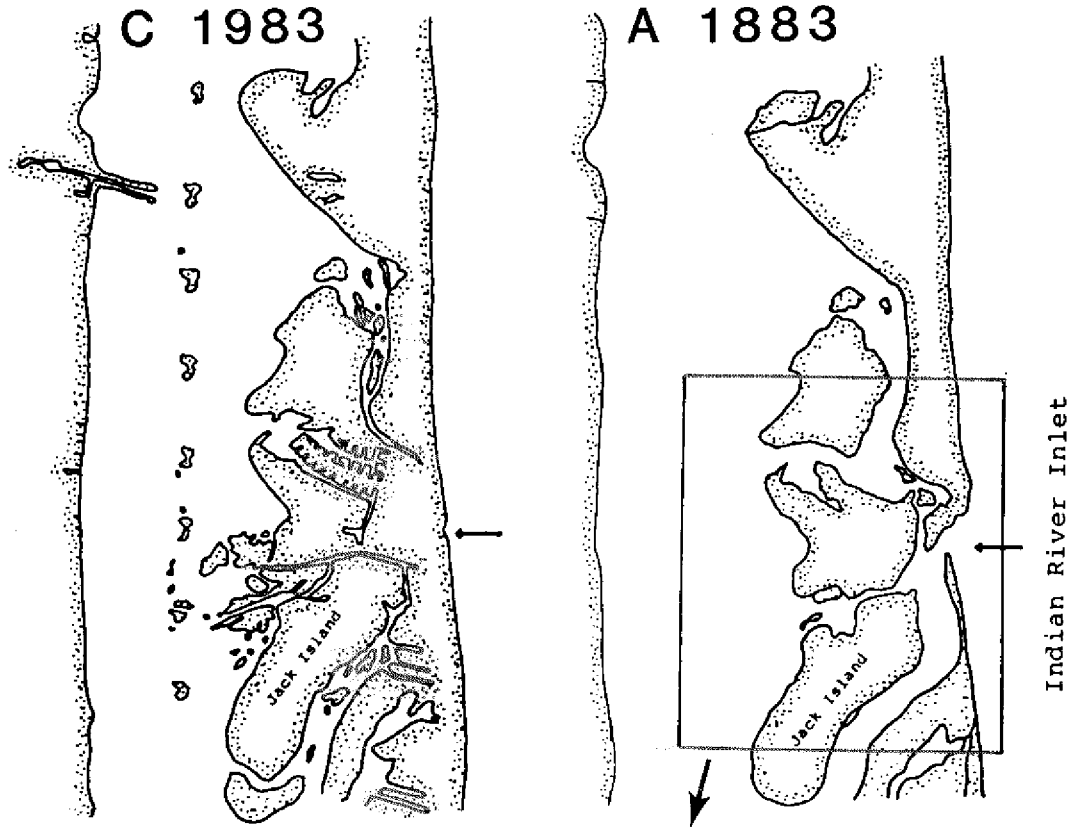
Figure 1. Portion of the Indian River Lagoon between St. Lucie Inlet and Fort Pierce Inlet. Arrows show the triangular (delta-shaped) structures which extend from the barrier island into the lagoon.

elongate, angular islands are indicative of former inlet locations (Fig. 2 A,B,C). These elongate islands, which commonly parallel the main relict tidal channel and lie perpendicular to the barrier island shoreline, are usually vegetated and in some instances are surrounded by tidal marsh. These features form at a point where sand is transported by tidal currents from the ocean into the lagoon and is deposited. The major island accretion process is related to the combination of tidal currents and wave action over the adjacent tidal deposits in the vicinity of the main channel. Storms may be one of the major factors in their formation and alteration. Continued migration of the inlet leads to development of additional islands and subsequent preservation of earlier formed features. As sand supply and wave energy are reduced, the islands gradually assume the triangular shape such as now seen in the relict inlet near Fort Pierce, (Figs. 1 and 2), or between Vero Beach and Wabasso.

Information obtained from the 1945 aerial photographs of the Sebastian Inlet area and from the recorded history of the inlet indicate that relatively large tidal deltas are formed in a relatively short time. The filled-in part of the lagoon between Vero Beach and Wabasso is the result of former inlets in that area. Inlets and their associated tidal delta sediments appear to be a major cause of lagoon infilling and barrier island expansion. A similar situation exists from Cape Lookout to Bird Island in North Carolina: where there are many inlets, there is a marsh-filled narrow lagoon behind the barrier island (similar to the area north of Vero Beach); where there are a few inlets, there is a relatively wide shallow lagoon behind the barrier island (similar to the transact A-B in Figure 1).

Other processes that produce features in the lagoon are washover lobes which are not easily visible in aerial photographs. Another type is cuspate spits extending from the barrier island into the lagoon (e.g., those featured near Palm Bay area; Fig. 3). These cuspate spits are formed by wind driven waves resulting in circulation cells and shoreline drift, and are common features in shallow restricted lagoons.

The morphology of the Indian River Lagoon has changed through recent time mainly by migration of inlets. Historical records, aerial photographs and sedimentary deposits indicate that storms and hurricanes are one of the prime causes of the formation of inlets and consequently of morphology changes of the barrier island and the lagoon. Severe erosion and deposition may result from hurricanes because of high winds, increased water levels, storm tides and high waves. The frequency of hurricanes in South Florida is one hurricane in five years, with a direct hit once in fifty years. The frequency of hurricanes is slightly less in the Indian River lagoon area. Since the barrier island in this area is unusually narrow and low in elevation the lagoon has little protection from storms or hurricanes.



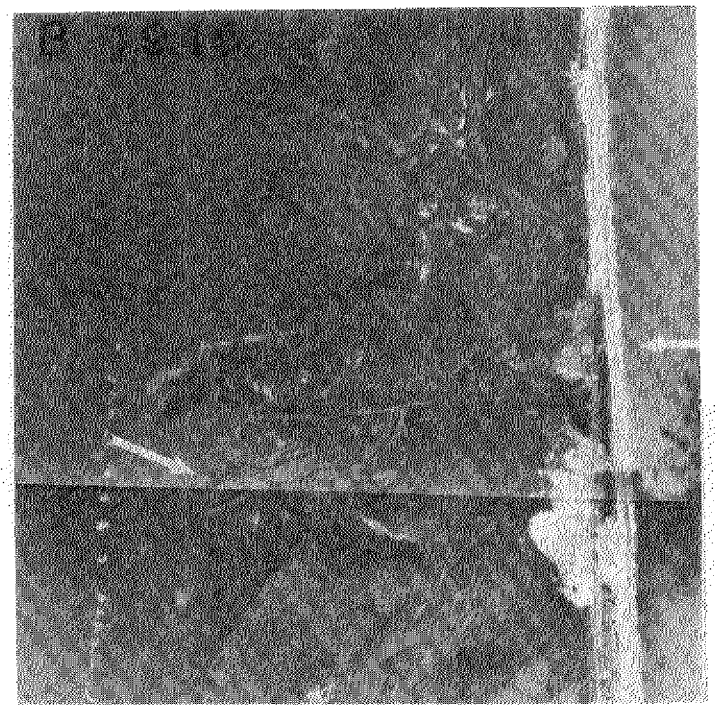


Figure 2. Relict inlet (former Indian River Inlet) about 4 Km north of Fort Pierce. (A) Indian River Inlet (National Ocean Survey U.S.C. and G.S. Chart H 1513 b) in 1883. (B) Aerial photograph (NOAA, 1945), showing the meandering channels and elongate, angular islands which represent former tidal deltas. (C) Location of relict inlet 100 years later (1983).

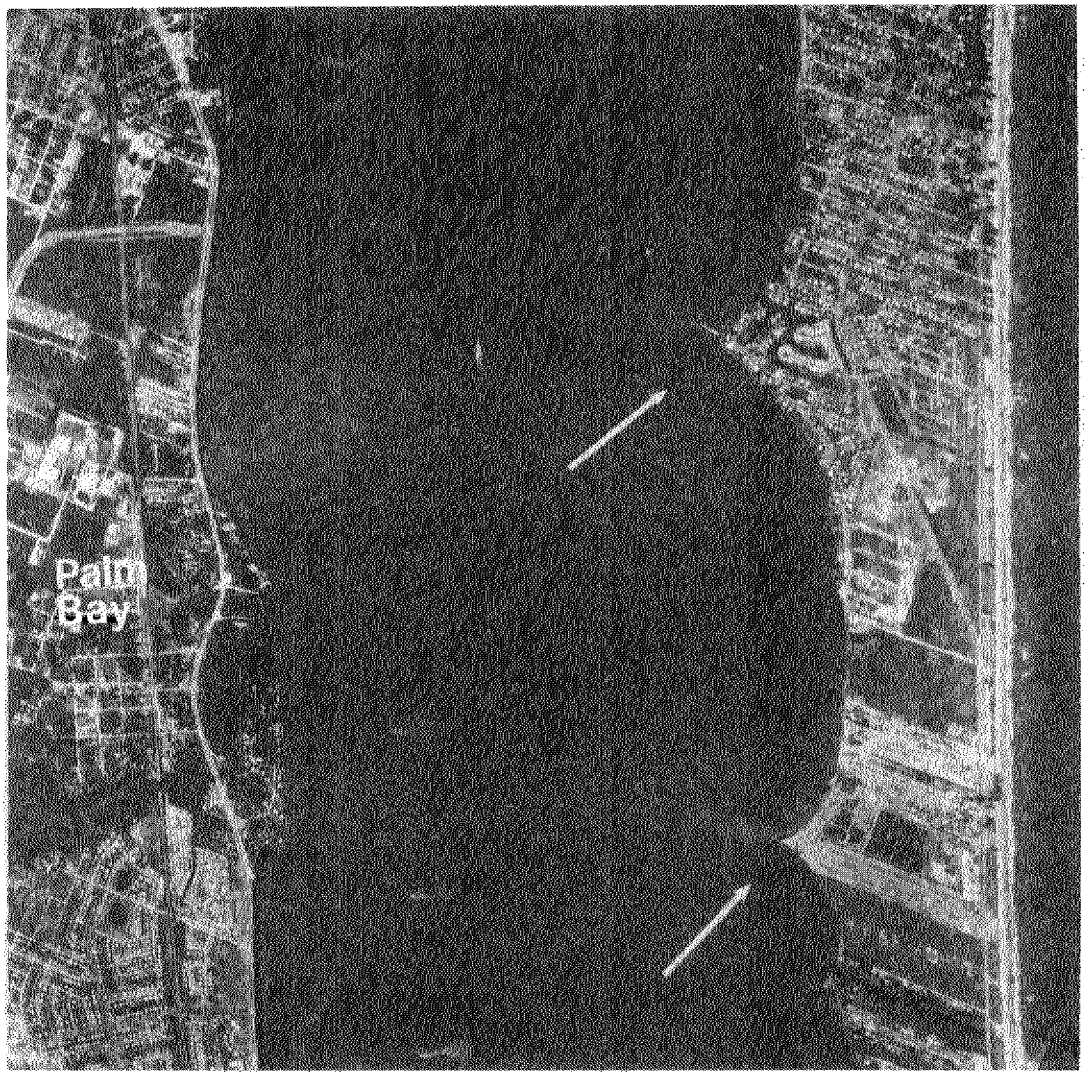


Figure 3. Aerial photograph of Palm Bay area indicating cuspate spits which project from the barrier island into the lagoon.

Storms may cause severe erosion or deposition within the lagoon.

Other factors also play an important role in the formation of inlets,and subsequently the alteration of existing geomorphology, hydrology and sedimentation. Some of these factors are topography and width of the barrier island and position of sea level. For example, a storm is most likely to breach the barrier island at a site having the lowest elevation and form an inlet and associated tidal delta. With time, the development of tidal deltas results in the formation of a relatively wide barrier island with a narrow marsh-filled lagoon, similar to that seen in the vicinity north of Vero Beach. When the barrier island is relatively wide, the possibility of a storm breaching the barrier island and forming an inlet diminishes.

The position of sea level is important since when sea level is high, the possibility of the sea breaking through the barrier island and opening an inlet increases and the lagoon would have better exchange with sea water. When sea level is low the number of inlets and the possibility of inlet migration would decrease, and the lagoon would become more restricted.

Ultimately, the position of sea level controls lagoon morphology and sedimentation, and determines the existence of the lagoon. The presence of three distinguishable sedimentary deposits (marine, brackish and lagoon) in cores taken from the lagoon are a result of the changing position of sea level in relation to the barrier island and lagoon:

A) Marine environment - In the late Pleistocene ($\sim$125,000 years B.P.) when sea level was higher than today, the entire coast was inundated, and possibly the present barrier island was an offshore sandbar (Fig. 4A). The depression (Eastern Valley) behind the mainland ridge (Atlantic Coastal Ridge) may have been a lagoon at that time with the mainland ridge acting as a barrier island, a situation analogous to the present day Hutchinson island and Indian River Lagoon.

B) Subaerial environment - As sea level dropped during onset of the glacial age (from 125,000 to 35,000 years B.P.) the site of the present lagoon and barrier island became land. Eventually sediments became partially lithified, forming the Anastasia Formation now exposed on Hutchinson Island, and the lithified crust within the lagoon (Fig. 4B).

C) Brackish water environment - Between 35,000 to 30,000 years B.P., sea level rose to a height of a few meters lower than present sea level. At that time the lagoon became partially (less than today) inundated by sea water and had a brackish water environment (Fig. 4C).

D) Subaerial environment - During 30,000 to 6,000 years B.P., the present day barrier island and lagoon were exposed. Wind or fresh water deposits which have characteristics similar to the mainland sand dunes and an age of 6,570±65 years B.P. formed at that time. The exact manner in which these sediments were deposited is not clear.

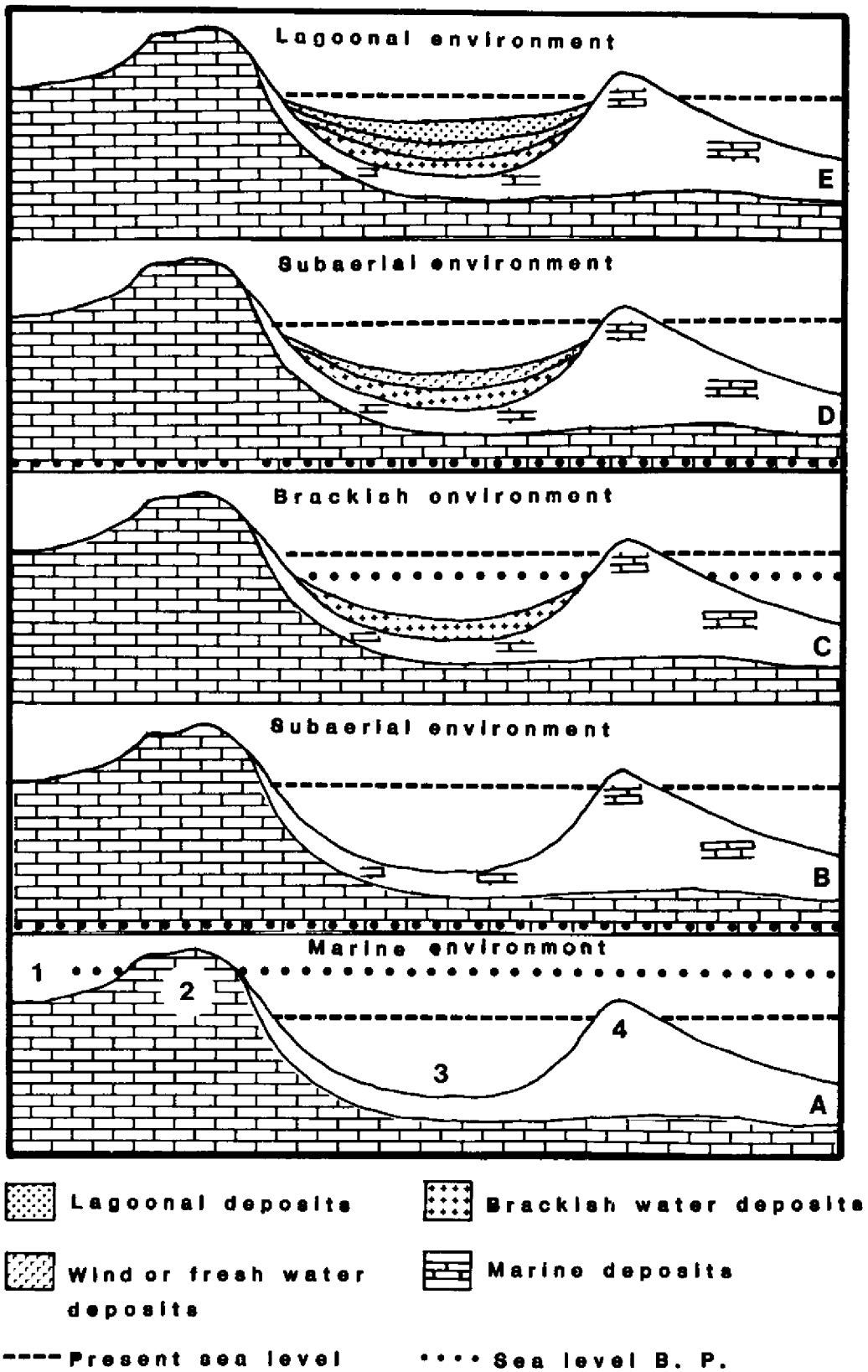


Figure 4.

Schematic developmental history of the Indian River Lagoon (1 = depression behind the mainland ridge; 2 = mainland ridge; 3 = site of the present lagoon; 4 = site of the present barrier island). A - Late Pleistocene (∿125,000 years B.P.), sea level was higher than today. B - During the glacial and interglacial age (125,000 to 35,000 years B.P., sea level was much lower than today. C - At 35,000 to 30,000 years B.P., sea level may have been a few meters lower than today. D - From 30,000 to 6,000 years B.P., sea level was lower than present and the Indian River area was exposed. E - The Indian River depression became inundated by sea water about 5,000-6,000 years ago during the last sea level rise.

Deposition may have occurred when the present day lagoon was a non-marine depression and wind and/or fresh water transported sand to the depression (Fig. 4D). Exposure, oxidation and leaching of shells has obliterated much of the evidence which might have led to a more exact determination of the environment of deposition.

E) Lagoonal environment - About 5,000-6,000 years ago the lagoon became inundated by sea water (Fig. 4D). Since that time many sedimentary facies analogous to the present surface sediments have been deposited in the lagoon. The most recent events important to the evolutionary history of the lagoon has been man's interference with the natural processes.

Today man has become partially responsible for the morphology, hydrology and sedimentation of the lagoon through the following controlling measures:

1 - Dredging inlets to maintain them open and stationary;

2 - Controlling the amount of sea water and sediment movement through the inlets by regulating the depth and width of the inlets;

3 - Dredging to prevent the formation of natural tidal deltas;

4 - Limiting the amount of fresh water discharged into the lagoon by major rivers such as the St. Lucie River by way of dams and locks;

5 - Dredging of the Intracoastal Waterway resulting in the deformation of bottom topography and subsequently, the alteration of water movement, as a result and

6 - The formation of artificial islands from dredged material, laying cables, construction of causeways, boat traffic, all of which have changed the natural morphology of the lagoon.

Man's interference has resulted in an artificially stable lagoon environment, by preventing natural evolution of lagoon morphology. Under natural conditions, the lagoon and barrier island would undergo rapid changes in morphology resulting in abundant subenvironments and the complex facies which are preserved in the sedimentary sequence within the lagoon.

By all means we should educate the public in order to preserve the hydrology, geomorphology and the habitats of the Indian River Lagoon for future generations.

ACKNOWLEDGMENTS

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This is contribution No. 000 from Harbor Branch Institution, Inc.

WATER QUALITY IN THE INDIAN RIVER

by
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Water quality will be defined in terms of the bacteriological condition (namely fecal coliform), and the chemical condition (pesticides, metals, nutrients) of the Indian River. The Indian River will be divided into seven segments of relatively equal water quality. The qualitative aspects of that water quality will be defined in terms of the assimilative capacity of that segment of the Indian River.

It is impossible to provide an all encompassing statement as to the water quality in the Indian River. The river is some 125 miles long and six major cities are built along its shores. The three inlets from the Atlantic Ocean provide flushing and tidal exchange only to a small area near the inlets themselves. One major freshwater river and many smaller streams, creeks, and manmade stormwater ditches also affect water quality. For clarity, the Indian River is divided into seven segments. Each segment has fairly uniform water quality. Areas of problem water quality are described within each segment. The segments are as follows:

1. Turnbull Creek to Titusville
2. Titusville to Cocoa
3. Cocoa to Melbourne
4. Melbourne to Sebastian Inlet
5. Sebastian Inlet to Vero Beach
6. Vero Beach to Fort Pierce
7. Fort Pierce to St. Lucie Inlet

Segment 1 - Turnbull Creek to Titusville

Water quality here is very good. There is essentially no urban development and little agricultural runoff. The one waste water treatment plant discharge could have a slight effect in the immediate vicinity of the discharge. Fecal coliform densities rarely exceed a value of 2 Most Probable Number (MPN) of fecal coliform per 100 mo of water. Also total phosphorus and total Kjeldahl nitrogen are well within normal limits.

Segment 2 - Titusville to Cocoa

Water quality here varies from good to fair. There is more runoff potential in this area. Increased

urbanization and point sources of pollution also degrade water quality. There are two major municipal waste water treatment plant discharges and several small domestic package waste water treatment plant discharges affecting water quality in this area.

Segment 3 - Cocoa to Melbourne

Water quality varies from fair to poor. There is one major waste water treatment plant in this area which discharges directly into the river, and several smaller plants discharge into creeks which drain into the river. Increased urbanization occurs along both sides of the river. Runoff potential also increases.

Segment 4 - Melbourne to Sebastian Inlet

Water quality is generally poor. There are several major creeks draining into the River in this area. These creeks are major receptors for large storm water drainage areas. At least seven waste water treatment plants discharge either directly into the river or into creeks draining into the river.

Segment 5 - Sebastian Inlet to Vero Beach

Water quality here is also generally poor. The North Relief Canal discharges into this area, while the Main Relief Canal discharges in the vicinity of Vero Beach. The river is very narrow in this section, possibly resulting in a low flushing potential.

Segment 6 - Vero Beach to Fort Pierce

Water quality is good. Water quality near the two cities is fair to poor, however, between it improves to good. The South Relief Canal discharges into this area, but appears not to have the adverse effect on the river that the North and Main Canals have.

Segment 7 - Fort Pierce to St. Lucie Inlet

If the city proper of Fort Pierce and the portion of the river south of Jensen Beach is excluded, the remaining area of the Indian River has very good water quality. There is one major waste water treatment plant discharge in Fort Pierce and two smaller plant discharges near Jensen Beach. The large drainage area of the St. Lucie Estuary discharges into the Indian River.

As noted, water quality in the Indian River ranges from very good to poor. Upon closer inspection, one can see that those areas of lesser water quality are the areas the most impacted by human intervention. Urbanization, residential development, high runoff potential,

agricultural influences, and drainage systems all cause degradation of water quality to a certain degree. The degree of degradation depends on the assimilative capacity of the Indian River.

THE LAGOON - NURSERY, PANTRY, HOME

HABITATS OF THE INDIAN RIVER

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Estuaries, such as Indian River, are coastal embayments or lagoons where saltwater and freshwater interact. They are among the most productive ecosystems on Earth and provide food and shelter for a large group of living resources. This includes over 70% of Florida's marine commercial and recreational finfish and shellfish which depend upon the estuary during some part of their life cycle. Some popular species, such as spotted seatrout, spend their entire life within the estuary. Numerous studies have shown that estuaries are most important for juvenile fishes. Based upon this information, estuaries must be maintained for suitable habitation by these species and the species that provide for a naturally balanced ecosystem.

Assessing the relationship between a fishery and an estuary requires detailed knowledge of every single life stage of an involved species and its interaction with the environment for food and cover. Marshes, mangroves and seagrasses play an important role in the estuarine and nearshore environment and are important components of fisheries habitat. These components provide not only food and cover, but detrital matter which ultimately fuels several food webs. The loss of these vegetation components of a fisheries habitat has a compounding and long-term effect on the estuary by not only removing food and cover, but also eliminating their role in absorbing flood waters, assimilating waste and excess nutrients, recycling nutrients, controlling shoreline erosion, and trapping particulates which result from erosion. Loss of wetland habitat components can result in reduced water quality and altered circulation patterns that will, in turn, affect the health of the estuary and ultimately the fisheries.

Florida's fishery is popularly considered to be declining and fisheries landing statistics suggest this trend is true for some species (i.e. spotted seatrout, shrimp). Many factors can lead to a decline in a fish population (e.g., overfishing, water quality degredation, loss of specific habitat components, natural

events) and it is very difficult to single out the individual processes causing the decline. In many cases, it is certainly man-induced; as Florida's human population increases, pressure on the fishery and every other resource also increases. Under natural conditions, the percentage of eggs hatching and surviving to maturity is much less than one percent. Man continually reduces that percentage.

One step in understanding a fishery is to map and quantify the estuarine habitat that is so crucial to the survival of many species. This information can then be used to monitor the habitat over future years and to identify areas of degradation. The Florida Department of Natural Resources is currently mapping several components of habitat which are identifiable by remote sensing techniques. These components are seagrass, mangrove, saltmarsh and, in some cases, tidal flats and oyster bars. In addition, we are mapping changes of habitat in selected areas, from ca. 1940/1950's to the present and assessing fisheries trends during the same time periods. Preliminary results were recently developed for the area from St. Lucie Inlet to just north of Satellite Beach Bridge (RT.404). The remainder of Brevard County will be completed at a later date.

Two areas were analyzed for loss of mangroves, marshes and seagrasses: (1) a seven mile stretch north of Ft. Pierce Inlet and (2) a seven mile stretch encompassing Sebastion Inlet. The Sebastian area experienced a 38% (1270 acres) decline in seagrass since 1951 with 16% of that decline occurring after 1970. The loss was typified by a general reduction in the size of the beds. A 25% (536 acres) loss of seagrass occurred in the Ft. Pierce area since 1958 with 11% of that decline occurring after 1970. The western edge of the shoreline experienced the majority of loss. We can only speculate as to the reasons for this loss (i.e. natural or man-induced).

The 1984 seagrass inventory (St. Lucie Inlet to Satellite Beach) documented 7,054 acres of seagrass comprising 8.5% of the total submerged bottom (82,560 acres). This is most likely an underestimate since small seagrass patches were not measured. But, when considering the loss of seagrasses we have observed and extrapolating those losses to the entire study area, we should estimate at least a 3,000 acre decline for the entire area.

Assessing loss of mangroves was difficult because of the large number of mosquito impoundments. The Ft. Pierce study area has lost 27% of its mangroves since 1958 with seven percent of that loss occurring since 1970. These losses were primarily due to development and do not include impoundments.

We chose to assess mangrove loss separately as a function of impoundments, assuming that all impoundments were closed to the commercial fisheries. However, realizing that all impoundments are not alike, these figures will be refined and each impoundment will be assessed on an individual basis. For example, in some cases impoundments actually encouraged the growth of mangroves. Many of the pre-impoundment areas consisted of high marsh succulents, Batis and Salicornia, with interspersed mangroves and are now predominantly mangroves. However, it is our contention that most impounded areas remove important habitat and constitute a loss of habitat unless properly managed for the fishery. Biddingmeyer and McCoy (1978) calculated 8,113 acres of impoundments in the study area. We have determined that a total of 7,900 acres of mangrove occur in the study area and 6,064 acres or 76% of the total mangrove acreage are impounded. This leaves only 1,836 acres of mangrove area available to the fishery.

This data indicates that fisheries habitat is being lost in the Indian River. This is not uncommon in Florida, as evidenced by other areas. From 1944 to 1982, the Charlotte Harbor estuary experienced a 29% (30,000 acres) decline in seagrass coverage while an 11% increase in mangroves was observed. The Tampa Bay estuary lost approximately 80% (≃61,000 acres) of its seagrasses and 44% of mangroves and saltmarshes. In fact, an estimated one third of the total United States coastal wetlands loss due to urbanization, occurred in Florida. Florida is losing approximately 75,000 acres a year of fresh and saltwater vegetated wetlands.

Comparisons of commercial fisheries landings show mixed trends from 1951 to 1983, for spotted seatrout and red drum in Indian River (Volusia, Brevard, Indian River, and St. Lucie Counties) to Tampa Bay (Pinellas, Hillsborough, and Manatee Counties) and Charlotte Harbor (Lee and Charlotte Counties). Statistically, Indian River has had no change in commercial red drum landings Tampa Bay has had reductions in landings, and Charlotte Harbor has had a significant increase in catch. Spotted seatrout landings, however, are very revealing. Indian River and Tampa Bay have had a significant declines in spotted seatrout commercial landings while Charlotte Harbor shows an increase.

These trends suggest a declining fishery in Indian River for some species which depend almost entirely on the estuary such as seatrout. In contrast, Charlotte Harbor had an increased catch but this may reflect an increase in fishing pressure resulting from and increase in the human population. Charlotte Harbor still contains over 50,000 acres of seagrass despite substantial loss.

The maintenance of Indian River and other estuaries in Florida is not just an aesthetic or environmental concern; a sound economic concern also exists. Florida's commercial fishermen harvested fish and shellfish with an estimated wholesale value of $175 million and, at retail prices, of $1.25 billion in 1980. Florida ranks third in the nation in resident anglers also (2,127,000) and approximately 1,278,000 tourist anglers fished in Florida waters in 1980. Sport fishermen alone generate a $1.4 billion industry which, when combined with commercial fishing, constitutes a minimum $1.6 billion industry. In comparison, phosphate mining industry generates a $3 billion wholesale industry; the citrus industry totals $1.2 billion, and cattle production, $311 million. Obviously, the fishing industry is important to Florida and we must realize the long term importance of fisheries habitats to that industry.

We also must educate the public as to the importance of maintaining healthy and diverse habitats in our estuaries and the importance of those habitats to the Florida quality of life. A statewide survey found that less than 7% of Florida's population could actually name any saltwater areas serving as major nurseries for young and growing saltwater fish. When given a yes/no choice as to whether bays and lagoons serve as major nursery areas for many young saltwater fish, only 44% said yes.

The Indian River has not yet experienced the same level of human population growth as some other Florida estuaries, but growth has begun and already fisheries habitat degradation has occurred. If we can learn from past mistakes and implement sound management for the Indian River system, the lagoon can continue to provide the natural resources of aesthetic, recreational, and commercial value for years to come.

The Productive Web of Life in the Estuary

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In this presentation I would not only like to demonstrate the great biological diversity of the Indian River lagoon, but I would also like to reveal the interdependence of the wide variety of organisms that reside in this estaury.

To often we consider the creatures of primary interest to ourselves, without the realization that they are dependent on a wide variety of abiotic and biotic factors that vary through time and space with or without the influence of man.

The ultimate certainty is that the oppurtunity for natural ecosystem description has virtually vanished from the Indian River lagoon and its associated semi-aquatic and terrestrial ecosystems. However, we must now try to understand the interrelationships of the plant and animal communities that have been impacted by man in order to preserve or even restore the natural ecosystems and resources associated with them.

Habitat Diversity and Interrelationships.

Along the east coast of Florida there are at least 14 broadly classified regional aquatic habitats extending from freshwater tributaries out into the Indian River lagoon through ocean inlets and into the Atlantic Ocean to the continental slope. All are interrelated. Molecules and organisms passively and actively flow or migrate from one system to another. Nutrient cycles in an inland freshwater lake have the potential of effecting anchovy survival and mackeral migrations on the adjacent continental shelf. Abiotic elements such as rainfall, atmospheric temperature and tides greatly influence the movement of elements and organisms between these habitats. Understanding the nature of these complex physical and biotic interactions requires major interdisciplinary study which has not proceeded much beyond the descriptive phase in the Indian River lagoon and its associated aquatic systems.

Those regional habitats that are receiving the most detailed study are seagrass beds and mangrove - saltwort high marshes. Further study is needed for freshwater tributary and marsh habitats, various lagoon open bottom and canal habitats, inlet faunas and all continental shelf and slope habitats.

Diversity of Life and Ecosystems.

When I first began my ichthyological research within the Indian River lagoon 14 years ago, there was no comprehensive information on the constituents of the aquatic invertebrate, fish, reptilian and marine

mammalian faunas of this region of Florida. Historical research had always placed emphasis on fishery species with little concern for organisms of no direct economic value to man. Since my initiation to the region, there has been a major increase in the qualitative assessment of the indigenous aquatic fauna by many investators representing a variety of institutions, followed by quantitative studies within certain habitats. Seagrass beds and salt marshes received the most comprehensive and detailed treatment. Though rudimentary at first, there has been a gradual realization among the public and certain fishery managers, that the health of a fishery species is dependent on the health of its environment, a variety of non-exploited species and the complex system on which it depends for food and shelter.

The results of the initial qualitative studies have demonstrated that not only does the Indian River lagoon contain the most speciose estuarine fish fauna in North America (400+ species), it contains many organisms whose North American range is limited to this region. Many of these organisms are abundant, some even supporting fisheries limited to the Indian River lagoon.

If we look at a phyletic sequence starting with some of the aquatic plant species we may better appreciate this unique regional diversity of life.

-- There are numerous semiaquatic plants, three mangrove species and six seagrass species found within the Indian River. One seagrass is a recently described species, presently only known from the lagoon. Over 200 species of macrophytic algae (better known collectively as sea weeds) are also known from the lagoon.

-- A veritable constellation of planktonic and benthic invertebrates also occur in the region. An undescribed cirratulid polycheate from Sebastian and Fort Pierce inlets may exemplify the undiscovered diversity in this component of the marine fauna.

-- Over 260 species of molluscs occur within the lagoon, both of tropical and temperate origin. Of these, scallops, clams and oysters support notable fisheries.

-- Everyone is familiar with the blue crab, but we have three other very similar species within the lagoon, including a red form. At least 479 species of macrocrustaceans (decapods = shrimp and crabs and stomatopods = mantis shrimp) occur within the lagoon and adjacent coastal waters. A variety of euryhaline freshwater shrimp and fish occur within tributaries to the lagoon, some of which are rare and/or represent new continental records.

-- Over 700 fish species occur within a 15 to 30 mile radius of the lagoon, from freshwater tributaries to the continental shelf.

-- Of the reptiles, the regional nesting loggerhead sea turtle population represents the largest nesting population in the United States. An endemic salt marsh snake is unique to the regional barrier island.

-- The nearly extinct dusky seaside sparrow represents another such endemic. Christmas bird counts on Merritt Island often represent the most speciose count in the United States.

-- The Indian River lagoon system contains one of the largest remaining manatee populations within the state and a major concentration of estuarine bottlenose dolphin. Otters are also frequently seen in barrier island marshes.

A great number of other unique estuarine organisms of all phyla are necessarily being left out of this account in order to be concise in this presentation. However, it has now been proven by a wide variety of researchers and institutions that the Indian River lagoon and associated aquatic systems contains one of the richest and productive aquatic faunas within the continental United States. No other estuary has revealed such a large variety of plants and animals and greater concentration of rare and endangered organisms.

The Interdependence of Ecosystems and Their Fragility

The great biotic diversity of the Indian River lagoon makes the interrelationships between organisms more complex and difficult to understand. The mixture of organisms with tropical and temperate affinities and narrow to wide physiological tolerance of various environmental parameters makes biotic and abiotic interactive mechanisms more difficult to observe and describe. However, we can give a basic description of some of the most obvious relationships between phyla and abiotic variables.

The most prominent abiotic variables are seasonal changes in rainfall, sea level and water temperature with all of the subsequent factors related to these (such as water salinity and nutrient loads).

Seasonal temperature regimes are quite different between northern, central and southern portions of the lagoon. The lower minimum and mean water temperatures in the northern lagoon means a more temperate flora and fauna will survive there, while tropical organisms may flourish throughout the year in the southern portion of the lagoon. Unseasonably cold conditions may cause some hypothermal stress and mortality, particularly in the southern portion of the lagoon. Many stenothermic organisms have adapted to thermal adversity by migrating to sea, toward the Florida Current or into deeper thermally stratified depressions within the lagoon. Spring fed freshwater sources also offer thermal refugia to euryhaline forms.

Rainfall comes mostly during the period between June and November, typically peaking during September and October, the remainder of the year being relatively dry. This means that freshwater tributary and canal runoff and nutrient loads needed by estuarine plants, macrophytes and plankton will peak during the fall. Estuarine and nearshore Atlantic salinities will reach their seasonal low during this period.

Sea level rises with the warming of the Atlantic Ocean and reaches its peak during October. This is coincident with the peak rainfall period. Estuarine water heights are significantly higher during the fall and for much of the lagoon this seasonal sea level rise surpasses daily lunar tidal amplitudes. This means more shallow estuarine nursery habitat, and salt marshes, are available for fishes and crustaceans during the fall inundation. Subsequently, many organisms reach their reproductive peak during the late summer and fall.

Despite seasonal spatial variation in these primary abiotic variables much of the lagoon is similar in that its primary productive base is formed by a basic combination of submergent and emergent macrophytes, detrital material derived from aquatic and terrestrial plants and phytoplankton (i.e.

microscopic plants). All are impacted by freshwater flows carrying dissolved nutrients, tannins and a wide variety of other molecules.

Detritus, microscopic and macroscopic plants are then consumed by a wide variety of invertebrate and vertebrate primary consumers, such as, larval invertebrates, copepods, shrimp, clams and oysters, polycheate worms, sheepshead minnows, sailfin mollies, mullet, sea turtles and manatees.

These consumers are in turn preyed upon by a wide variety of secondary consumers, most notably, anchovies (on copepods and invertebrate larvae), channel bass, spotted seatrout, mojarras, snook, blue crabs, squid (mostly on worms, shrimp and anchovies), semi-aquatic snakes, wading and diving birds (on various fish and shrimp).

Top level consumers are also diverse with larger snook, seatrout, sharks, tarpon, ospreys, eagles, otters, and bottlenose dolphin, all consuming a wide variety of the other estuarine organisms - though mostly fish.

There are actually thousands of species in this food web, each with its own preferred microhabitat, water chemistry and reproductive season. All of these factors, including the organism's place in the food web, change with the growth of the species. Many consumers in this web are opportunists feeding on the most available organisms when and where they are available and their capture would use the least amount of energy. A loss of some species would reduce prey options and indirectly or directly effect other organisms within the predator - prey matrix.

For better understanding, the food web can be subdivided into to three major areas based on the nature of the primary producer and its consumption: (1) detrital-microbial consumption, (2) macro/microphytic grazing and (3) planktonic grazing (see Figure 1). Mangroves, cordgrass and some aquatic plant production may be consumed as detritus with its associated microbial component. This component forms the basic diet of the most numerous marsh resident fishes, sheepshead minnows and the transient striped mullet. Mullet form the largest estuarine piscine biomass. Algae, particularly epiphytic algae, and seagrass may be consumed directly by manatees, sea turtles, amphipods and small gastropod molluscs. These, in turn, are consumed by a wide variety of decapod crustaceans, and fish. Planktonic plants are consumed by zooplankton, i.e. copepods, and a variety of filter feeders, i.e. clams, oysters, polycheate worms, barnacles. The filter feeders are then consumed by a few decapods and fishes, e.g. sheepshead with crushing jaws. Anchovies prey upon copepods and other zooplankters, and represent the largest fish population numerically. Many of the decapod predators and abundant fish such as sheepshead minnows, mullet and anchovies are consumed by tertiary consumers such as the spotted seatrout and snook and a variety of wading birds. The fish fauna is most speciose in this consumer category. These are then consumed by the top predators which represent a low biomass and number i.e. sharks, bottlenose dolphin and ospreys.

All three of these basic trophic chains are not exclusive with various species alternating between the various food sources with growth and migration from one habitat to another.

Figure 1. Diagramatic representation of the three basic food webs of the Indian River lagoon and the interrelatinships of all the species within the ecosystem.

The Systems Approach.

We should now recognize that it is not effective to concentrate protective measures on a single species of interest within a system. Single species legislation is commonplace in legal measures protecting certain aquatic organisms today. However, the species is a dependent member of a complex and barely comprehendible ecosystem. If portions of this ecosystem are eradicated or damaged the species may become extinct. Then it will not matter what size, bag limits, or protection status are legislated. If the productive web of life in this estuary is to be diverse and preserved it must be through a systems approach not a species approach. Then, and only then, will we be able to confidently state that our indigenous aquatic resources are being protected for future generations.

MAN AND THE LAGOON

THE INFLUENCE OF HUMANITY ON THE COASTAL LANDSCAPE OF FLORIDA: The Indian River as a Case Study

By

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INTRODUCTION

The coastal landscape has attracted ever increasing numbers of people since the very early days of Florida's history. In no other area of Florida is the presence of humanity more visible. It is estimated that well over 70% of Florida's total population lives within the coastal zone. The ecological impacts of accomodating ever increasing numbers of individuals within the coastal zone are not well understood and as a consequence in most cases are not considered as decisions are made concerning growth of the region. Only after symptoms of a declining environmental quality are noticed is there sufficient public attention drawn to the issues of growth management and environmental planning to achieve some measure of protection of the landscape components and processes that are threatened. For example, experience has shown that only after marked declines in commercial and sports fisheries is there enough public awareness of the problem to foster enough support to achieve some reversal of the trend. However, in many cases not enough is known about the causes of the declines much less what management strategies are necessary, so little if anything is done of lasting impact.

Again and again attention is focused because of some symptom....loss of sport fisheries, eutrophication of water bodies, near extinction of species, or salt water intrusion....and resources are directed at solving the symptom, not the problem. The problem, in most cases is the development of the landscape with little attention given to the "system" of the landscape. Little awareness is shown of the structural and functional "wholeness" that is the landscape system of wetlands and uplands, dry lands and water bodies, and developed lands and natural lands. Development patterns recognize individual property rights, and the infrastructure of urbanization, but pay little heed to the "infrastructure of nature"... the storage, movement, and discharge of surface and ground waters, the movements and budgets of nutrients, or the currents, eddies, and tides of marine waters.

Any plans to manage growth, or solve the myriad problems associated with the existing web of the urbanized coastal zone must have as a basis an understanding of Florida's landscape as an integrated whole system. Development regulations, plans for infrastructure expansion, and public policy need to reflect a new awareness of the landscape as a whole system, where wetlands are recognized for their values of water storage and

purification, where watersheds are left intact, where waters are recycled and conserved, where the interconnections between uplands and estuaries are recognized, and where humanity lives in a balanced economy of nature and society.

Whole Systems Approach

Understanding the whole landscape as one system may be a method of beginning to solve some of the complex problems that face decision makers, managers, and regulators. A whole systems approach sees the landscape of uplands and estuaries as one interconnected system, and the development of inland areas as directly affecting the health and well-being of the coastal estuary.

To understand any component of a landscape, such as the estuary, one must first look to the larger system in which it is embedded, and the driving forces that shape and sustain it. For like all of nature, the landscape is organized as systems within systems. The estuary is a marine system embedded within a much larger marine environment, interfacing with the terrestrial environment and driven by forces generated at the global scale. From the seaward side come the forces of waves, winds, and tides that shape barrier islands, carve inlets and flush the estuary. From the landward side come runoff waters from abundant rainfall, carrying nutrients and organic matter that sustain long pyramidal food chains. From above, sunlight penetrates the clear waters providing the energy for photosynthesis of the abundant plant life.

In all, the estuary can be thought of as the interface of land and water, where the energies and materials of the landscape are concentrated and where the energies of the sea are dissipated. It is at this interface that marine productivity is highest and the attraction for humanity to congregate is greatest, and where the delicate balance of inputs from the land and inputs from the sea is easily disrupted....where changes in the quantities of water, nutrients, or organic matter, or changes in flushing by tidal action can cause major changes in the structure of the estuary.

THE INDIAN RIVER BASIN

Physical Features

Shown in figure 1 is a map of the watershed of the Indian river system as detailed by Conover and Leach (1975). The total area of the drainage basin is given by Hughes (1978) as 3605 km^2. Average elevation and highest elevation are about 8 and 27 meters above MSL respectively. The basin stretches approximately 134 kilometers from the Ponce de Leon Inlet on the north to the St. Lucie Inlet at its southern extreme. At its widest point near the Brevard/ Indian River County line, the basin is about 27 kilometers (measured from the Indian River inland). For much of its length the basin averages less than 3 kilometer in width.

Historically, the watershed for the Indian River was probably much narrower in the area of central Indian River and southern Brevard counties,

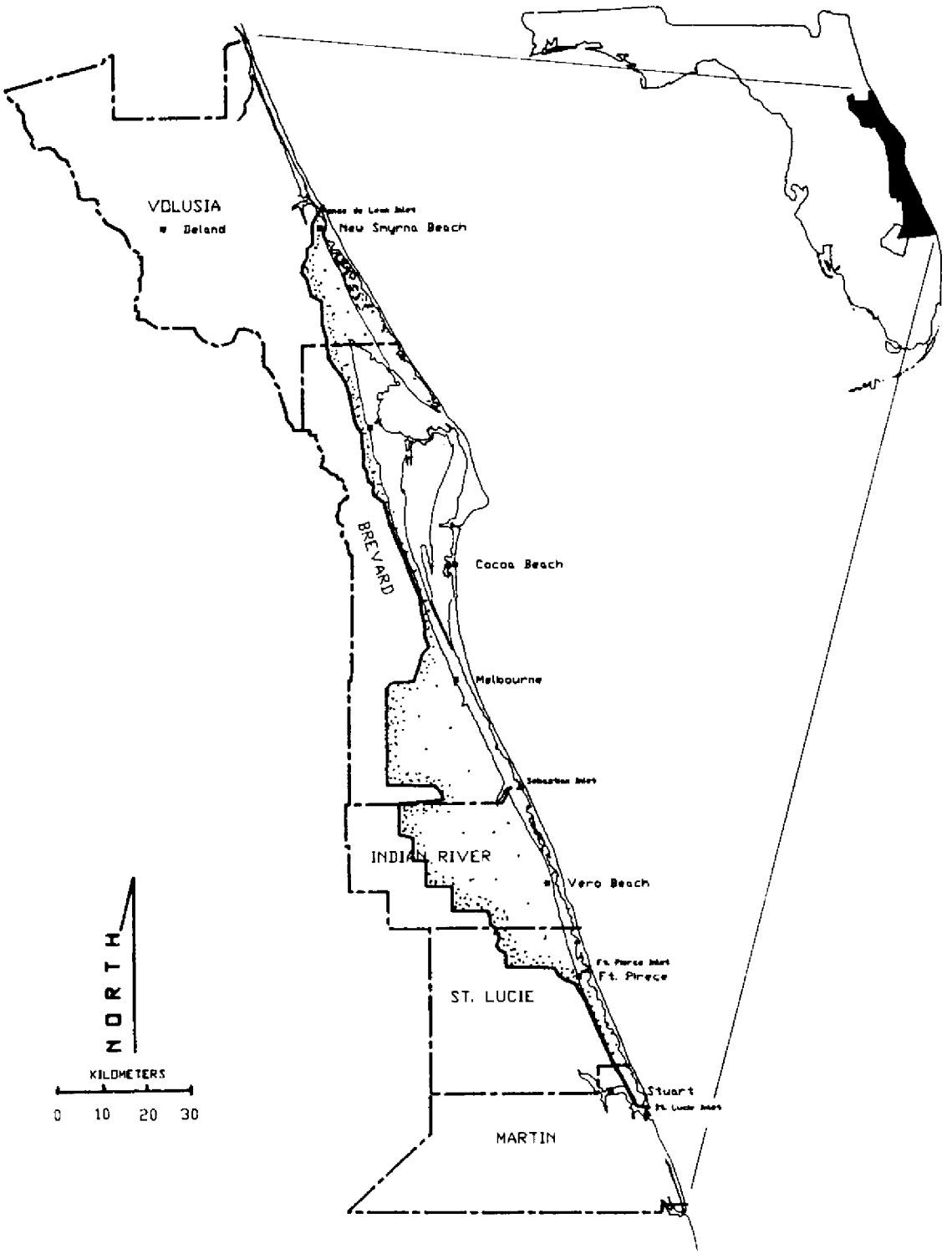

Figure 1. The Indian River watershed. In recent years the watershed boundries have been altered through development activities, especially in southern Brevard and Indian River counties.

where extensive ditching and drainage canals have routed waters eastward into the estuary. These waters probably were part of the St. Johns marsh and flowed northward and westward, forming part of the headwaters of the St. Johns River.

Brooks (1981) describes the physiography of the basin as part of the eastern flatwoods district, consisting of five distinct sub-districts that originated during the late Pleistocene. Generally, the basin is a series of well drained ridges interspersed with relic inlets and terraces. The extreme coast is dominated by offshore barrier islands perched on top of middle and late Pleistocene coquina and sand shell ridges. Where the basin is widest, drainage canals have increased the basin's western limits to include areas of poorly drained flatwoods and organic soils of the St. Johns Marsh.

Driving Energies of the Estuary

The estuary is a complex system whose main driving energies come from both the sea and land (see Figure 2). From seaward come the driving forces of wind, waves, and tides that continually shape and reshape the coastal beach and dunes systems; the most energy intensive of Florida's ecological systems. The never ending surf and tidal cycles and the ever changing winds buffet the seaward edge of the dune causing less than ideal conditions for life. The vegetation that colonizes and lives on the dune has adapted to life in a very harsh environment. Sometimes considered fragile, the plants that have adapted to these conditions are actually quite hardy. However, stabilization of the high energy coastline is a demanding role that leaves little excess energy to cope with additional stress. As a consequence, a small amount of additional stress is usually all it takes to begin the processes of decline, ending in their erosion from winds, waves or tides.

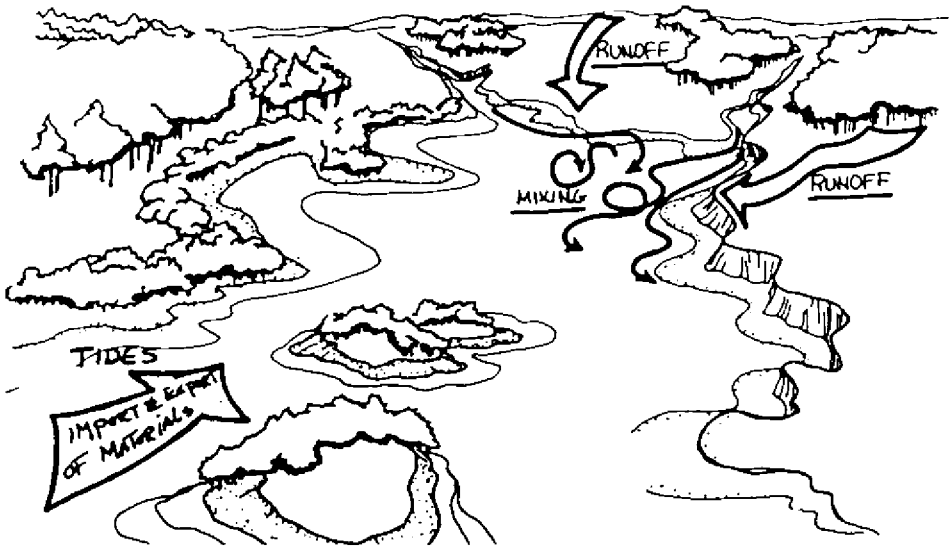

Figure 2. The estuary is a complex ecological system whose most important sources of energy are the flushing by tidal cycles, and the inflow of nutrient laiden runoff from the landscape.

Landward from the frontline defensive ecological systems of the coastal beach and dune are less fragile communities, that benefit greatly from the continual cycles of tides and storms. Salt marshes and mangrove forests line most of the coastal areas where wave energies are not too strong and where tidal influence is sufficient to keep the environment saline. The organic matter produced by these communities represents the single greatest food source for estuarine food chains.

The most important sources of energy to the estuarine environment are the tides that flush nutrients, organic matter, and larvae in and out again, and the inflow of waters laden with nutrients and organic matter from the terrestrial environment. Their physical energies shape the contours of bay bottoms, scouring tidal channels, and depositing sand bars, develop tidal creeks shaped to insure flushing even at their farthest reaches, and open and close ocean inlets as the yearly cycles of wet seasons and spring tides trade influence. Carried by these two intertwining waters are the chemical energies of nutrients that are required by vegetation for growth, and the seeds, larvae, and juvenile fish that insure the estuary remains a diverse, resilient, and productive soup.

Driving Energies of the Upland Landscape

Of the main renewable driving energies of the upland landscape rain is the dominant force. Given in figure 3 is a diagram of the hydrologic cycle showing the relative percentages of rainfall that are evaporated, transpired by vegetation, recharged, and that portion that is runoff. The amount of rainfall, its cycle through the landscape, and the periodicity of the wet and dry seasons control many of the processes of Florida's landscape mosaic and coastal estuarine resources. Nearly 70% of total rainfall returns to the atmosphere either as evaporation or as transpiration from vegetation. Of the remaining rainfall, about 10% recharges ground waters, and 20% runs off the landscape.

Because of their importance, the contributions of fresh water from rainfall, runoff and sewage are compared in table 1. Rainfall and runoff contribute a total of 592 billion gallons (2.2 billion cubic meters) of fresh water per year to the Indian River. Historically, runoff was probably less than 1/2 of its current value, since the water basin boundries have changed through construction of drainage canals. By comparison, if it is assumed that the sewage from all the populations of Brevard, Indian River and St. Lucie counties were discharged to the Indian River, the total additional fresh water would amount to only 26 billion gallons (98 million cubic meters) per year, or about 4.4% of the total freshwater input to the estuary.

The final columns in table 1 show nutrient contribution to the Indian River based on average concentrations of total phosphorus in rain, surface water runoff, and treated sewage effluent. A different picture emerges when relative contributions of nutrient sources are compared. The contribution of sewage is greater than rainfall and runoff combined (bear in mind that sewage estimates are based on estimated population serviced by sewage plants that discharge to the estuary; the actual sewage flows may be somewhat different).

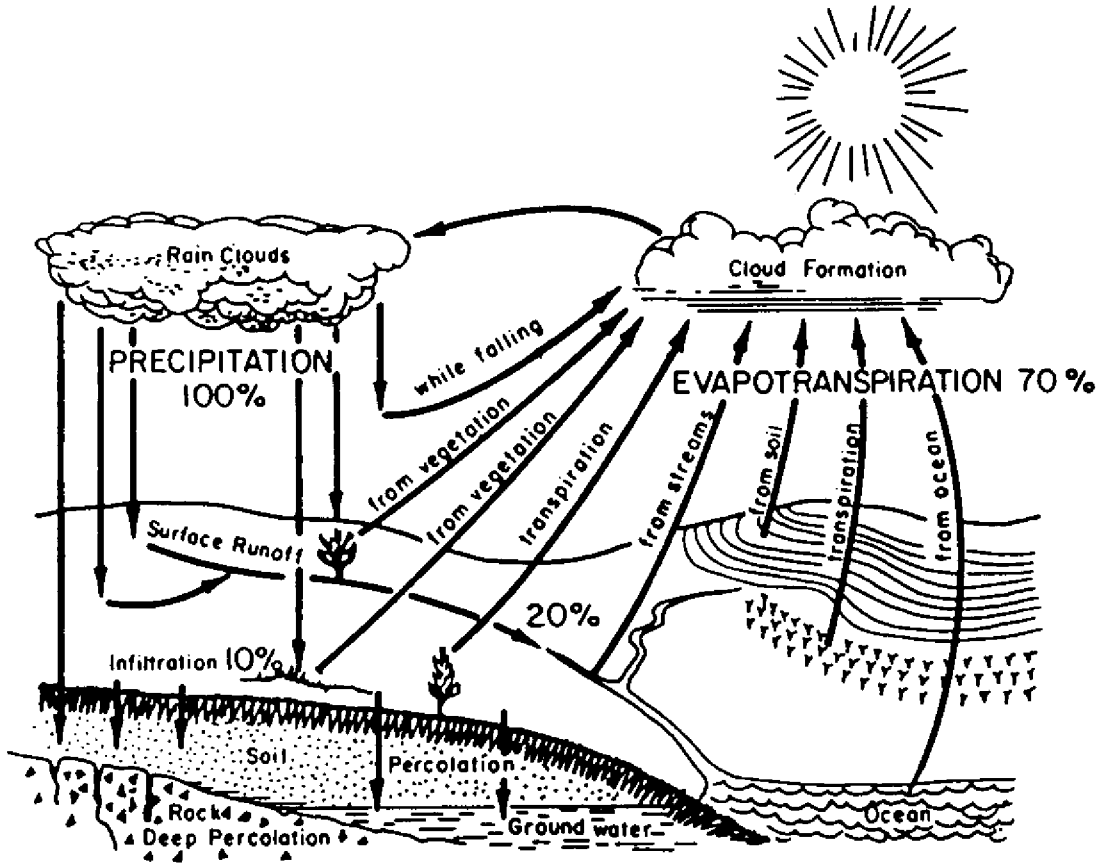

Figure 3. Diagram of the hydrologic cycle showing the relative portions of rainfall that are evapotranspiration, runoff, and infiltration.

Landscape Organization

Figure 4 is a conceptual drawing of the landscape showing the inland areas of flatlands with scattered wetlands, intermingled with sloughs, and rivers and streams that flow slowly to the estuary. The dry season ends with the onslaught of wet season rains that first fill the scattered isolated wetlands to overflowing, in turn filling the sloughs, and eventually sending excess runoff slowly to the estuary. Through sloughs, streams, and finally rivers the water gently meanders, always moving slowly through the vegetated channels whose friction acts to minimize runoff velocities and hold the water on the landscape.

Water is held back on the landscape and released only very slowly to obtain maximum benefit from its life-giving moisture and the nutrients it carries. Ground waters are maintained at high levels whenever rainfall is retained on the landscape. When runoff and infiltration are great, local ground water levels are deep. In these instances, during dry seasons, vegetation show signs of drought stress, wilt, drop their leaves, and if the drought continues for long enough, even die.

Table 1. Estimates of Yearly Inflows of Fresh Water and Nutrients to the Indian River Estuary

Source	Fresh Water		Nutrients (Tot. P)	
	Gallons	Cubic Meters	Pounds	Kilograms
	($\times 10^9$)	($\times 10^9$)	($\times 10^3$)	($\times 10^3$)
Rain[1]	349.4	1.3	171.6	78.0
Runoff[2]	243.6	0.9	404.8	184.0
Sewage[3]	26.4	0.1	615.3	279.7

1. Area of Indian River taken as 995 km^2, rainfall taken as 1.33 m/yr, and average concentration of Tot. P in rainfall as .06mg/l.
2. Average runoff per year taken as 0.256m/yr, area of basin as 3605 km^2, and average Tot.P concentration of 0.2mg/l.
3. Sewage estimate based on total population of 482,000 people, average daily sewage generation of 568 liters/person, and Tot.P concentration of 4mg/l.

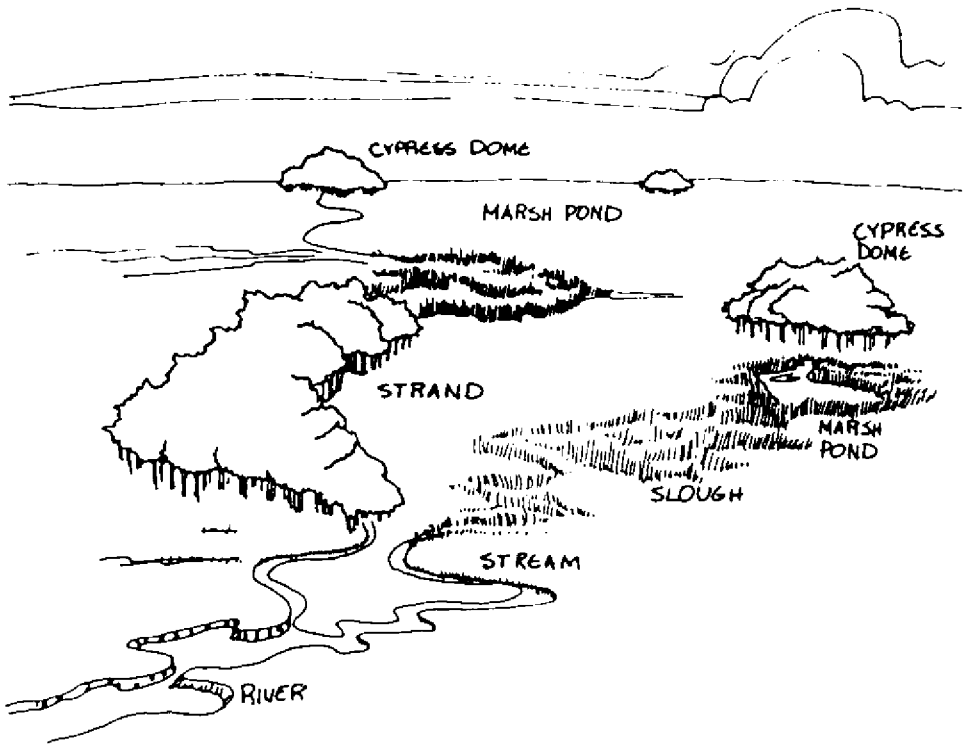

Figure 4. Conceptual diagram of the organization of the Florida landscape, showing inland wetlands that contribute wet season runoff slowly to rivers and estuaries.

The "primitive" Florida Landscape resembled that shown in Figure 4, and was organized around the dominant energy associated with rainfall. In the primative landscape there were no quick ways to the ocean. Every water course was a gentle one, meandering and winding ever so slowly to the sea, providing ample opportunity for waters and nutrients to do the work of the landscape and for the maintenance of high water tables. Nutrients were removed from surface waters as they flowed gently to the sea through complex channels of wetlands, sloughs, and floodplain swamps. This insured that over-enrichment of the downstream estuaries did not occur. The nutrients that did arrive were organic nutrients, that acted much like time release fertilizers, releasing their energy to the estuary slowly over time to minimize the potential of over-enrichment.

A balanced system, the estuary ebbed and flowed over the centuries, receiving wet season runoff and the organic nutrients it carried, processing them and developing long complex food chains based on them. With the influences of humanity in the landscape, many of these relationships have been changed; most inadvertently, for the relationships of inland development on the quality and productivity of the estuary were not well understood, or considered.

Effects of Landscape Reorganization

Rainfall, the main renewable driving energy of the landscape, is also the main force that humanity must "control" when developing the Florida landscape. Excess wet season rains must be dealt with to minimize flooding of developed lands, and in many areas ground waters must be lowered to insure adequate "drainage and control" of storm waters. Unfortunately, these alterations of the existing conditions extend far beyond the property boundries of the development. Neighboring lands and downstream water bodies are forever altered as well. Canals and drainage ditches lower ground water levels in adjacent lands for distances as great as 1 mile on either side of the ditch, and carry increased amounts of runoff of poorer quality to down stream water bodies.

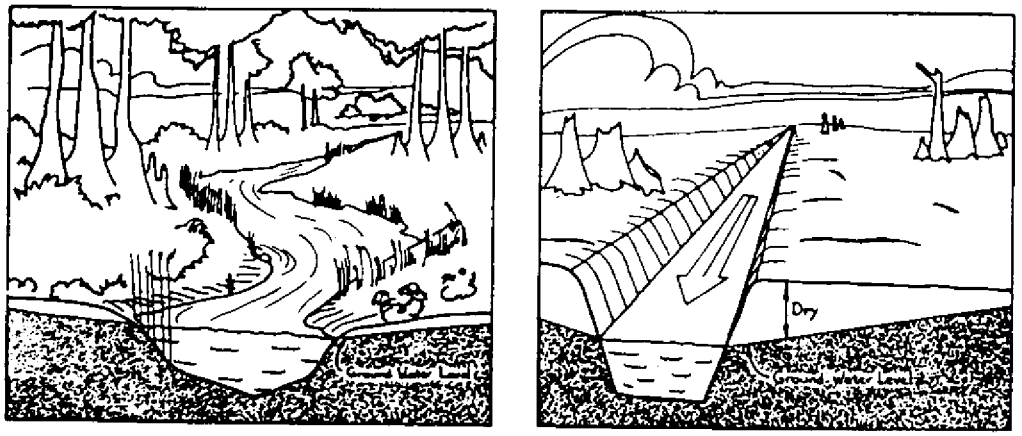

Figure 5. Diagram showing the natural landscape and effectsof channelization. When channelized as in the drawing on left, landscape values are disrupted. Water tables are lowered, vegetation suffers drought, and pollutants are carried to estuaries without the benefit of treatment by floodplain wetlands.

When sloughs and streams are channelized as in figure 5, the friction that was caused by meanders and vegetated channels is lost. Waters then flow with greater velocity, causing greater erosion of banks and decreasing the ability of vegetation to filter nutrients, metals and other pollutants. The net result is increased loads of sediments and nutrients as well as other pollutants in the receiving estuaries. Increased sediment and nutrient loads decrease available light within the estuarine water column, having the overall effect of reducing photosynthetic activity, which in turn has a direct negative impact on fisheries. Increased pollutant loads have direct impacts on the viability of the marine environment.

Not only does the estuarine environment suffer, but the terrestrial environment suffers as well, for the loss of nutrients as they are leached and flushed from the landscape decreases productivity of vegetation. Lowered water tables as a result of the straightening and deepening of

streams decreases water availability and increases the likelihood of drought stress during the dry season. In all, the straightening and deepening of streams has little positive benefit to the environment, although it does help to alleviate flooding of urbanized areas by increasing the rate and velocity of runoff.

Strongly related to the problems associated with the channelization of streams are the problems associated with increased impervious surface within watersheds. Shown in figure 6 are typical runoff hydrographs for a natural watershed and one that has a large amount of impervious surface. As the amount of impervious surface increases, the amount and speed of waters running off the land increases. The end result of such changes is increased velocity of runoff waters, and greatly diminished purity. Couple increased impervious surface with channelization of streams, and the overall result is a fast decline in the quality and resiliency of the receiving estuaries.

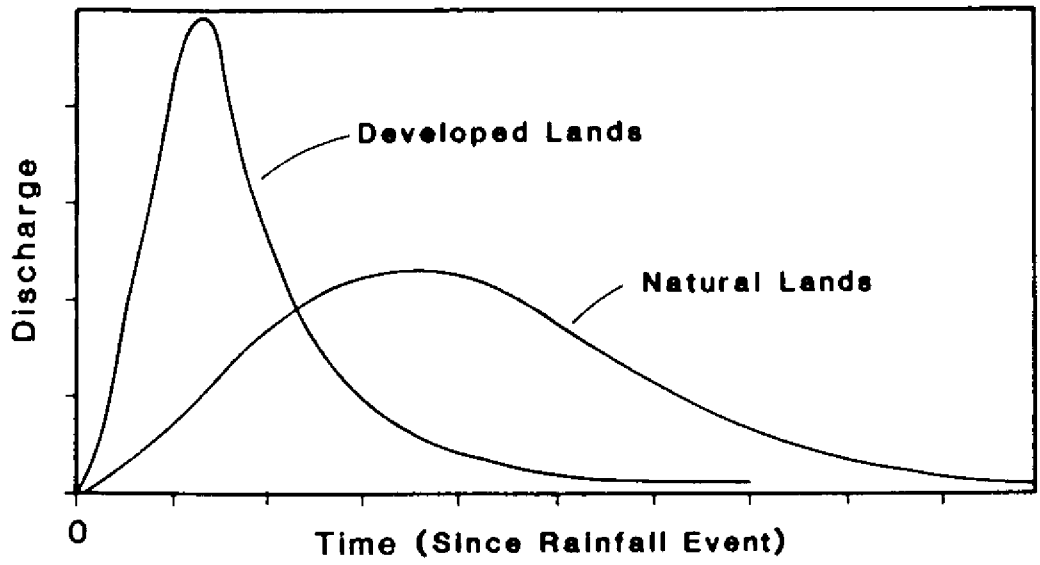

Figure 6. Typical runoff hydrograph for developed and natural lands, showing the increase in volume and rate of discharge after a rainfallbecauseof the increased area of impervious surface.

Both the physical reorganization of the landscape during development and the reorganization that results from the release of by-products as development is complete, have a profound effect on structural and functional characteristics of the landscape and its components. When lands are paved, sodded, and built upon, and when canals are dug for "storm water control", the amount and timing of runoff are changed. When septic tanks, sewage treatment plant outfalls, and fertilizer are allowed to enter surface waters without further treatment, the quality of runoff waters and receiving water bodies are greatly affected. The lowering of ground water tables to accommodate development lowers productivity of ecological systems, decreases storage of waters, and increases the need for irrigation of crops and lawns.

In all, as the landscape is reorganized to better "fit" the needs and desires of humanity, the overall effects on the wider environment are not considered. Humanity now controls the destiny of the landscape through the release and control of energies that shape, move, and dig the earth, and energies that build and maintain clusters of buildings and their inhabitants. The high energy concentrated by-products of the urbanized landscape released to the environment develop new ecological systems at outfall points and reorganize other existing systems through which they pass. Without an overall landscape perspective, one that integrates into "wholes" rather than dissects into pieces, the task of managing the environment is rendered almost hopeless. Resource management strategies must include the wider setting within which the resource is embedded. Management must start with the watershed, and the use, reuse, and reorganization of the landscape at that level must be dealt with first, before any realistic management strategy can be outlined for the parts.

Protecting Wetland Values

Wetlands, andthe vital functions they perform, are worthy of special mention in any management strategy. Unconstrained development in the past has lead to the loss of untold acreage of wetlands, but more importantly, it has lead to the loss of vital services and wildlife habitat.

The consequences of insensitive and unconstrained development on Florida's wetlands are well documented. Since the turn of the century, approximately 40% of the wetlands within the state have been drained, converted to agricultural uses, or developed as urban lands. Little understood in the public forum however, are the secondary impacts on the public health and well being.

When wetlands are eliminated from the landscape, or when wetland functions are severely impaired through insensitive development techniques, much more is lost than just a "few worthless swamps". Wildlife habitat is lost that directly affects species that depend on those areas for survival. The near extinction and endangerment of wildlife species is due for the most part from loss of habitat, rather than over-hunting or poaching.

The loss of wetland functions, like water storage and water quality enhancement, directly affect the health, safety and well-being of humanity. As storage is lost and urbanization increases, downstream floodingresults, requiring ever increasing expenditures of money and energy to mitigate. Valuable water is shunted to the estuaries, increasing nutrient loads and contaminants. Without the filtering that wetlands perform, ground waters and runoff waters become increasingly contaminated with an array of nutrients, metals, and toxins, threatening public water supplies, and the quality of receiving water bodies.

Present state and federal laws affect only a portion of Florida's wetlands and leave to ultimate destruction the majority of Florida's most valuable natural assets. The role of comprehensive planning in protecting Florida's wetlands is very important, for only through the stated objectives and goals of community comprehensive plans can the value of wetlands to the community at large and their value in enhancing the public's health and

well-being be asserted. Without comprehensive planning that recognizes the values of wetlands and that protects these values, individual values in almost all cases overpower the values associated with wetlands and the public good.

SUMMARY

Sound landscape management is a prerequisite to managing down stream systems of lakes, rivers, streams, and estuaries. To accomplish this the following concepts and principles are suggested as a means of guiding development within the Indian River watershed.

1. Prohibit the lowering of ground water tables, and instead, encourage development to raise elevations of roads and housing to minimize flooding.

2. Discourage any increases in impervious surfaces, and encourage the use of surfaces of parking lots, low intensity roads, and walkways that allow water to percolate into the soil.

3. Prohibit the channelization of streams or creeks, and encourage vegetated swales for the management of storm waters.

4. Require that all storm water management systems be designed to accommodate vegetation in all channels, swales, and retention basins.

5. Encourage "nonstructural" solutions to stormwater management and the use of wetlands (whether natural of artificial) for storm water discharge.

6. Determine acceptable levels of freshwater input to the estuary and develop an overall management plan to insure that these inputs are met. In some areas the increased flushing brought on with increased fresh water loads may be beneficial to off-set other negative consequences of development within the watershed; in other areas, increased inputs may be undesirable.

7. Prohibit any development seaward of the secondary dune, recognizing the shifting character, and high energy nature of the beach and dune system, and encourage management practices that will enhance the integrity of these systems.

8. Let no additional structures be constructed that will interfere with tidal flushing or currents.

9. Discourage the construction of seawalls, especially where there are none at present, or where there is heavy boat traffic or likelihood of wind-generated waves.

10. If additional waterways are dug for boat basins, etc. design channels that taper in width from mouth to farthest landward extent to increase tidal flushing. Design channel sides that do not require seawalls by ensuring that natural vegetation can colonize to stabilize banks.

11. Recognize the exceptional value inherent in wetlands as filters, recharge areas, water conservers, and wildlife sanctuaries and prohibit any further development of all wetlands, whether or not considered jurisdictional by the state.

12. Since terrestrial environments, especially wetlands, are inherently more productive than estuarine systems, and are capable of absorbing high nutrient wastes of urbanized areas, develop plans to reroute nutrient-rich sewage inland to the interior wetlands of the St. Johns River, which has had so much of its base flow diverted.

13. Encourage a BASIN WIDE approach to comprehensive planning, and develop a single, integrated plan that will encourage cooperation between the numerous governmental agencies that now have fragmented jurisdiction over the basin and its resources.

14. And finally, develop a renewed interest in the management of the landscape, and commit the resources necessary to attract professional engineers, ecologists, and planners that will be capable of developing creative solutions and enforcing necessary regulations to ensure a high quality environment for all citizens of the Indian River Basin.

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THE INDIAN RIVER -- WHAT'S IT WORTH?

The Indian River Lagoon System - An Economic Perspective

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The Indian River lagoon system is embraced by four counties -- Brevard, Indian River, St. Lucie, and Martin. The early development of communities in the region was linked primarily to the availability of land, climate, and the potential for producing cattle, citrus, and other agricultural products. In the areas directly adjacent to the Indian River lagoon system, however, cottage commercial fishing and tourist industries began to grow and play an important role in the economic, cultural, and community development of the region. In addition, the later development of commercial ports and shipping facilities began to provide needed resources and jobs. Over time, the industries which are dependent upon the Indian River lagoon system have contributed substantially to the growing economy of the region.

The tangible economic worth of the lagoon system currently manifests itself primarily through industries directly or indirectly associated with

(1) the commercial extraction of the lagoon system's natural resources (i.e. commercial fisheries),

(2) the use of the lagoon system for commercial shipping and port facilities, and

(3) the recreational use of the lagoon system by residents and tourists.

These industries generate important growth revenues for the local economy through the export of product and the direct expenditure of non-local dollars. Intangible economic value is also derived through

enjoyment of the aesthetic qualities of the Indian River lagoon system's natural amenities -- an important original calling card of the region which continues to attract businesses and residents from other areas. The following discussion attempts to focus on the aforementioned industries to provide some feel for the economic importance of the Indian River lagoon system in the four-county region.

Commercial Fisheries Industry

The commercial fisheries industry represents one of the more important of the marine related industries in the area. Commercial landings in 1983 for the four county area (NMFS) are reported to be 30.5 million pounds, with a dockside value of $24.4 million (Figure 1). The dockside value of commercial fisheries production in 1983 represented 14 percent of total Florida value and fully 50 percent of total Florida east coast value. Commercial landings have exhibited an upward trend over the past 20 years, with landings increasing at a faster rate since 1976. Production in 1983 represented a nearly three-fold increase from 1964. Dockside value, however, has demonstrated a much more dramatic increase, with 1983 value representing a increase of almost twenty-fold over the same period. Contributing to this production were 2,262 registered commercial fishing vessels in the four-county area in 1983 (Florida DNR).

The commercial fishing industry in the region is very dependent on species which directly utilize wetland habitat. Species are referred to as wetland dependent if they must spend a portion of their life cycle within the confines of an estuary or lagoon habitat such as the Indian River lagoon system. Other species may be indirectly dependent upon wetland systems through their own dependency on forage species

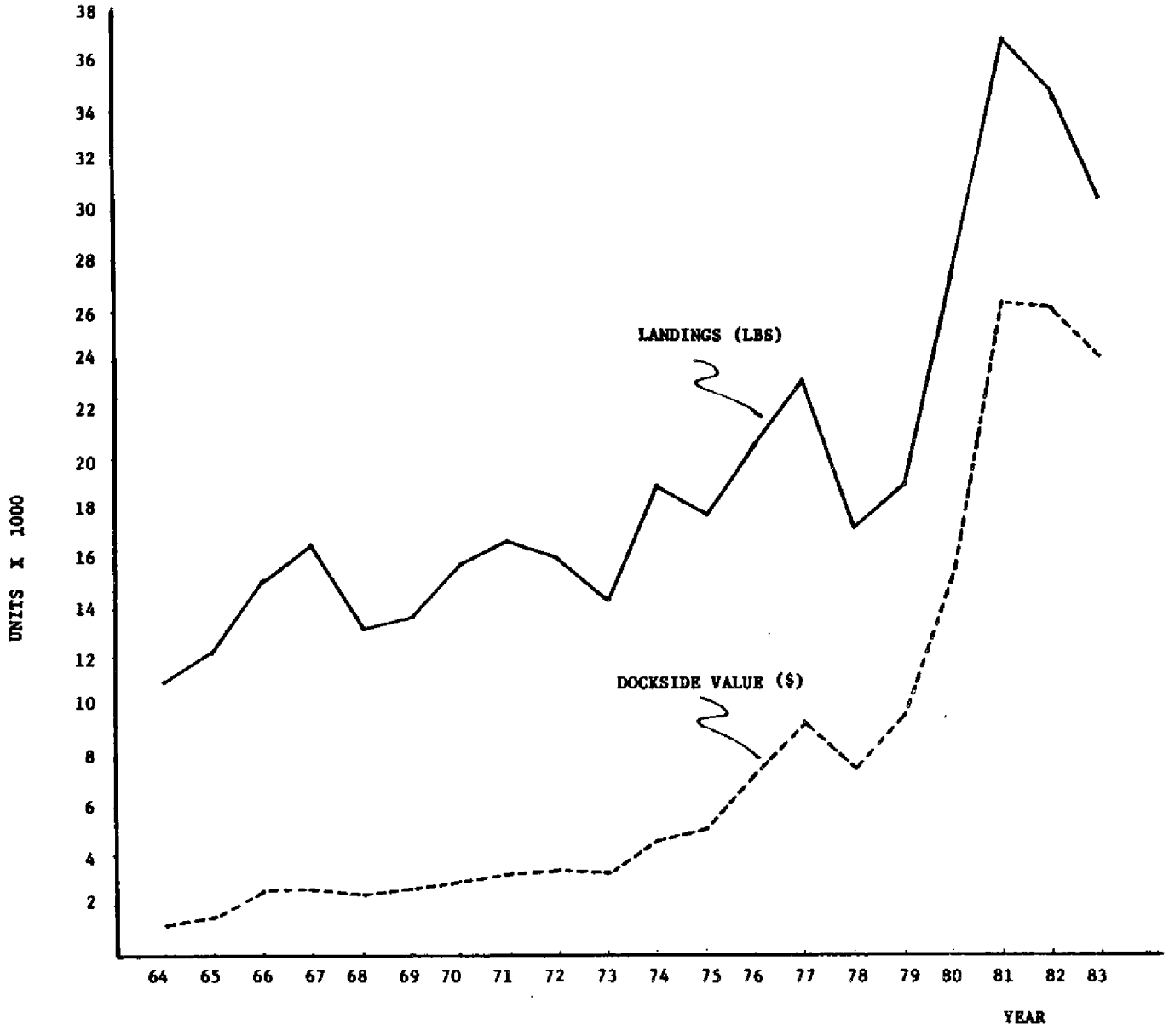

FIGURE 1 : TOTAL COMMERCIAL LANDINGS AND DOCKSIDE VALUE ON AN ANNUAL BASIS FOR THE FOUR-COUNTY REGION, 1964-1983.

which utilize wetland system as nursery or spawning grounds. Of the 57 species which are landed and marketed by the commercial fishing industry in the region, 36 (63 percent) are wetland dependent species. More importantly, $8.1 million (33 percent) of the total dockside value is generated from landings of wetland dependent species. The ten most important species landed in the four-county region in 1983 represent 90 percent of the total 1983 dockside value of commercial landings (Table 1). Of these ten species, five are wetland dependent. The region is the leading producer in the state for four major commercial species.

Shellfish landings have typically been exceeded by finfish landings, particularly prior to 1981 (Table 2). This relationship also held true for dockside value prior to 1981. However, since 1981 the value of shellfish production has skyrocketed, with unpublished 1984 estimates placing this value in excess of $20 million. This increase in shellfish landings and value has occurred primarily in Brevard County, which reported over 99 percent of the shellfish value in the region in 1983. St. Lucie County reported 53 percent of the finfish value in 1983. Brevard County was the second most important county in Florida in terms of shellfish value and St. Lucie was the fourth most important county in Florida in terms of finfish value. Collectively, these two counties represented 11 percent of the total dockside value of commercial seafood production in Florida for 1983.

The dramatic increase in shellfish value in the region is due primarily to recent increases in landings of calico scallops (Argopecten gibbus) in Brevard County, which prior to 1980 had been sporadic and

TABLE 1. Top Ten Commercial Species by Dockside Value in Four-County Area, 1983

Species	$ (X 1000)	Percent of Florida $
Calico Scallops	10,747	92
Swordfish	2,793	30
King Mackerel	2,099	48
Spanish Mackerel	1,627	69
Tilefish	1,359	81
Rock Shrimp	814	21
Pompano	687	32
Spot	677	93
Grouper	607	<1
Blue Crab	545	<1

SOURCE: NMFS unpublished landings data.

TABLE 2. Commercial Finfish (F) and Shellfish (S) Landings and Dockside Value in the Four-County Area, 1979-1983 (X 1000 Units).

	Finfish $		Shellfish $	
	Pounds	$Value	Pounds	$Value
1979	14,010	5,763	5,001	3,863
1980	19,704	8,483	7,826	6,926
1981	18,082	9,492	18,941	17,071
1982	20,042	12,169	15,078	14,325
1983	18,465	11,442	12,044	12,952

	County	Finfish $ Value	Shellfish $ Value	State Rank F	State Rank S	Percent of State Value F	Percent of State Value S
1983	Brevard	2,061	12,920	10	2	3	12
	Indian River	1,136	2	17	25	2	<1
	St. Lucie	6,042	23	4	23	10	1
	Martin	2,203	7	9	24	4	<1

SOURCE: NMFS unpublished landings data.

never exceeded 3 million pounds of meats (Otwell, et al, 1984). Preliminary estimates place 1984 production at 30 million pounds. In addition, landings of hard clams (Mercenaria spp) have increased dramatically, particularly in Brevard County. Preliminary estimates for 1984 place production at approximately .4 million pounds. Also, St. Lucie County has experienced recent increases in swordfish and mackerel landings, thus establishing that county as the leading finfish producer in the region and the leading producer of king mackerel in the state. The major commercial species associated with each county are given in Table 3.

In addition to the harvesting sector, there are approximately 50 seafood dealers, processors, and wholesalers in the region (Johnson, 1983). These businesses generate value-added through processing and handling of locally caught seafood. In addition, a percentage of the raw product is imported from other regions. Of key importance to the local economy, however, is the amount of product which is exported from the four-county area. Conservative estimates of the percentage of the production of locally landed commercial species that is exported from the region are given in Table 4. The exportation of local product brings in outside dollars, which are important growth revenues for the area.

The commercial harvesting, processing, and wholesaling of seafood sets in motion economic activity that involves a network of related businesses and industries in the region. Producers, first handlers, processors, wholesalers, and dealers spend a large percentage of their revenues from seafood sales on fuel, utilities, gear, food, supplies, services, and additional inputs from other firms in the region. These expenditures, therefore, have a supportive primary economic impact on

TABLE 3. Major Commercial Species in Four-County Area 1983.

County	Species	Dockside Value (X 1000)
Brevard	Calico Scallops	$10,747
	Rock Shrimp	814
	Tilefish	634
	Blue Crab	529
	Penaeid Shrimp	408
	Hard Clams	375
Indian River	Tilefish	304
	King Mackerel	301
	Spot	172
St. Lucie	Swordfish	2,559
	King Mackerel	1,356
	Spanish Mackerel	650
	Tilefish	370
	Pompano	246
Martin	Spanish Mackerel	966
	King Mackerel	334
	Pompano	266
	Bluefish	119

SOURCE: NMFS unpublished landings data.

TABLE 4. Estimated Percent of Landings for Top Ten Species That Are Exported From the Four-County Region.

Species	Percent Exported
Calico Scallops	90
Swordfish	> 50
King Mackerel	75
Spanish Mackerel	> 50
Tilefish	> 50
Rock Shrimp	> 50
Pompano	> 50
Spot	> 50
Grouper	15
Blue Crab	75

the individual local businesses. This impact is felt each time the seafood product moves through an additional market stage -- from initial producer to final consumer. An economic impact to the region, however, is registered if the product is eventually exported from the area or purchased in the region by non-local dollars.

Data exist which relate expenditures, incomes, and sales generated from seafood harvesting (Prochaska and Morris, 1978). Therefore, the primary economic impact of seafood harvesting in a region can be approximated given knowledge of regional dockside value. These values, when applied to the four counties along the Indian River lagoon system, provide estimates of the primary economic impact from seafood harvesting by county (Table 5). Note that the primary economic impact associated with Brevard County is larger than the other three counties combined. Dockside value of $14.98 million in Brevard County generated expenditures of $10.3 million and $4.7 million in incomes, which combine to give a primary economic impact of $25.3 million (incomes value is contained in the sales value and is excluded). Further value-added is created by processing and wholesaling. Additional expenditures, sales, and incomes contribute to an additional primary economic impact that is generated at these higher market levels. Using relationships estimated at the state level, a total primary economic impact of $72.9 million is estimated for processing and wholesaling in the four county region. When added to the impact value of harvesting, a ballpark estimate of $114.1 million emerges as the primary economic impact for harvesting, processing, and wholesaling in the region. Carrying the analysis to the retail level is not possible due to lack of data. However, additional value is obviously generated at this final level.

TABLE 5. Primary Economic Impact From the Expenditures, Sales, and Income Associated With Commercial Seafood Harvesting, Processing, and Wholesaling in the Four-County Region, 1983 (X 1000 Units).

County	Expenditures	Dockside Sales	Income	Total County Primary Impact
Brevard	$10,312	$14,981	$4,670	$25,293
Indian River	783	1,138	355	1,921
Martin	1,521	2,210	689	3,730
St. Lucie	4,174	6,065	1,890	10,239
Harvesting Total	$16,790	$24,394	$7,604	$41,184
Processing and Wholesaling Total			$15,855	$72,937
Harvesting, Processing and Wholesaling Total			$23,459	$114,121

Further economic value in the region is generated by the seafood industry beyond the primary impact. The values accounted for above are estimates of direct value -- the revenues initially generated or spent. Additional value is associated with the disposition of sales revenues and incomes generated by seafood harvesting, processing, wholesaling, and retailing. These dollars are spent and respent within the local economy by client businesses and employees, which generate more value via a multiplier effect. The value, however, that is of economic relevance in terms of growth is that associated with product exported from the region. As noted earlier, a large percentage of the seafood produced in the Indian River region eventually leaves the four county area, thereby generating these important growth revenues.

Commercial Port and Shipping Facilities

Industries and businesses associated with the commercial ports and shipping have become established as an integral component of the local economy. Though very little published data exists which describes incomes, employment, and expenditures associated with the port and shipping industry at the state or county level, some indicator values do exist which provide insight into the importance of this industry to the region.

There are two deepwater ports in the region which are of economic significance -- Port Canaveral and Fort Pierce. On a state basis, however, these two ports handled less than two percent of the total reported product value which moved through Florida's ports in 1983 (Table 6). The two ports combined to represent less than one percent of the export value and approximately two percent of the import value reported.

TABLE 6. Ports in Florida That Handled More Than $1 Million in Export and Import Volume, 1983.

Port	$ Value (X million)	Percent of State
Jacksonville	4,474	36
Miami	3,915	31
Tampa	1,752	14
Port Everglades	1,122	9
W. Palm Beach	751	6
Port Canaveral	151	1
Panama City	115	1
Pensacola	107	1
St. Pete	32	3
Ft. Pierce	12	1

SOURCE: U.S. Department of Commerce, 1979-83.

Of the Florida ports that handled over a million dollars of trade in 1983, Port Canaveral and Ft. Pierce ranked sixth and tenth, respectively. Port Canaveral reported handling 136 million pounds of exports and 1,302 million pounds of imports in 1983, valued at $12 million and $144 million, respectively. For the same year, Fort Pierce reported 74 million pounds of exports and 261 million pounds of imports, valued at $14 million and $4 million, respectively. These values reflect dry and tanker cargo poundage, as well as in-transit shipments(U.S. Department of Commerce, 1979-1983). A wide range of products are handled by the ports, including lumber, fresh produce and fruit, gypsum, scrap metal, oil, cement, and others (personal communication with local port authorities).

These facilities obviously generate jobs and demand for services within the surrounding communities. However, the communities in which these two ports are located are not the only ones which derive economic benefit. Other counties and regions within the state depend on the existence of port facilities to move product to destination. For example, a large portion of the fresh citrus produced each year in Florida moves through the two deepwater ports located in the Indian River lagoon system (Florida Dept. of Ag. and Consumer Services, 1983). Ft. Pierce and Port Canaveral rank second and fourth, in terms of quantity handled, among the eight major ports which handle fresh citrus shipments in Florida -- Ft. Pierce being second only to Tampa. The two ports combined to handle 29 percent of the total number of units (4/5 bushel boxes) of fresh citrus moved through Florida ports in 1983.

Complementing the facilities which exist for the loading and off-loading of bulk cargo, the ports attempt to diversify into other activities. For example, Port Canaveral serves as home base to a major

passenger/cruise line, which serves as an added attractant to tourism in the area. In addition, the deepwater ports and the various shallow-water harbors provide facilities for unloading and processing of inshore and offshore commercial finfish and shellfish. Without the geographical characteristics found in the lagoon system which are suitable for ports, the value associated with this product would likely not enter the local economy. The local port authorities are continually seeking ways to expand and diversify facilities and product handled to keep abreast of Florida's growing demand for shipbourne transport systems and the products they handle. Given recent development and plans for future expansion, this industrial sector will become increasingly important as a source of incomes and employment in the future.

Recreational Interests

The recreational use of the Indian River lagoon system by tourists and residents represents a large component of the habitat's usage, particularly in regards to the sheer numbers of people who are involved in these activities. These uses of the lagoon system may be recreational boating, saltwater recreational fishing, sightseeing, hunting, and other activities related with the marine habitat. As was seen with the preceeding subtopics, very little data exists, particularly at the county level, to describe the number and characteristics of the participants and expenditures associated with these activities. However, some insights concerning the amount of use and the economic importance can be gained by examining indicator data that does exist.

Recreational boating represents one of the largest of the recreational uses of the lagoon system by tourists and residents. There were 36,454

recreational boats of all sizes registered in the four-county area in 1983-84 (Florida DNR, 1984). This value was an increase of almost 8,000 boats from the 1978-79 value of 28,859 and represented approximately seven percent of the recreational boats registered in Florida. Fifty-three percent of these boats were registered in Brevard County and 20 percent were registered in Indian River County. St. Lucie and Martin Counties accounted for a combined total of 28 percent of the recreational boats registered in the region in 1983-84. These values provide some indication of use by local residents, however, the number of boats that use the lagoon system but are registered in other counties or states are not accounted for.

The amount of permanent facilities which cater to the recreational boater provides an additional barometer of use. The number of wet slips in the four-county area totaled 2,845 in 1980-81 (Milon, Wilkowske, and Brinkman, 1983). The number of dry storage slots numbered 2,647 during the same period. No doubt these values have increased but no current surveys are available. Brevard County had the largest number of wet slips and dry stacks. With 57 percent of the wet slips and 40 percent of the dry stack volume (Table 7). These values represented 12 and 13 percent of the wet slips and dry stack volume, respectively, in the state. There are 9,000 linear feet of reported dockage offered by the more than 80 marinas, boatyards, and yacht clubs located in the region in 1984 (Boating Almanac, 1984). Access to the river system is further facilitated by the presence of over 30 public boat ramps located along the length of the lagoon system. In addition, there are also approximately 52 charter boats and 8 head (party) boats that operate from docks within the lagoon system.

TABLE 7. Wet Slips and Dry Storage in Private and Public Florida Marinas By County, 1980-1981.

County	Dry Storage	Wet Slips
Brevard	1,057	1,621
Indian River	450	210
Martin	890	759
St. Lucie	250	255
TOTAl	2,647	2,845

SOURCE: Milon, J.W., G. Wilkowske, and G.L. Brinkman, 1983.

Saltwater recreational fishing provides another important source of economic value to the region. This is particularly noteworthy when considering the number of tourists that enjoy this activity in the four-county region. However, data to describe number of fish caught and expenditures does not exist on a county basis. One means by which to measure the amount of saltwater recreational fishing which occurs in the four-county area is by recording "user occurrences". These values indicate the number of times a particular activity occurred in an area over a given period of time. The Florida Department of Natural Resources (DNR) compiles these value for boating and non-boating saltwater recreational fishing by tourists, out-of-county Florida residents, and county residents for all the coastal counties(personal communication with DNR staff). Brevard County, with the larger resident population and tourist draw, had the largest number of saltwater fishing user occurrences among the four counties in 1983 (Table 8). The total number of saltwater recreational fishing occurrences for Brevard County was 1,007,000, which was slightly less than the other three counties combined.

An alternative measure of the amount of saltwater recreational fishing which occurs in a county would be "participation ratios", which are also compiled by the Florida DNR. These values measure the percentage of the population of both county residents and tourists that participate in saltwater recreational fishing, by boat and non-boat means. Though Brevard County possesses the lowest percentage values among the four counties (Table 8), the number of individuals actually participating would be much greater due to the larger resident and tourist populations for Brevard County. Values for participation ratios are not compiled for out-of-county Florida residents, thereby omitting a sizeable component

TABLE 8. County Tourist (T), Resident (R), and Non-Resident (NR) User Occurrences (UO) and Participation Ratios (PR) for Saltwater Recreational Fishing By Non-Boating (NB) and Boating (B) Means By County, 1983.

		U.O.			P.R.	
		R	NR (X 1000)	T	R	T
Brevard	NB	197	228	196	19	6
	B	232	92	62	15	2
Indian River	NB	49	10	100	20	11
	B	25	4	44	16	6
St. Lucie	NB	161	60	133	27	12
	B	72	46	71	19	7
Martin	NB	68	7	92	24	17
	B	120	11	84	30	6

SOURCE: Unpublished Florida DNR data.

of the total number of users. These values for user occurrences and participation ratios, therefore, provide some insights regarding the number of people who are involved in saltwater recreational fishing in the four-county area. However, expenditure values associated with this activity are not available. Thus, a complete picture of economic significance is difficult to assess. Studies are available that provide estimates of the daily and annual expenditures by an average saltwater recreational angler on a state basis (Bell, Sorensen, and Leeworthy, 1982). However, applying these values to the above user values to arrive at an expenditure estimate is confounded in two ways: (1) the user occurrences may include multiple occurrences by the same individual for a given time period and (2) the participation ratios omit the out-of-county Florida resident measure. Thus, expenditure estimates so derived would be biased.

The expenditures by recreational users in the region are primarily at the retail level and impact a variety of businesses that cater to individuals enjoying the recreational activities that the lagoon system has to offer. A wide and varied network of businesses that offer lodging, groceries, fuel, supplies, and many other services generate value-added via sales to tourists and residents alike. Most important, however, expenditures by tourists for this value-added provide a substantial base of growth revenues for the local economy.

Concluding Remarks

The major marine related industries in the Indian River region which can reasonably be delineated and examined are those associated with commercial fisheries, commercial port and shipping activities, and

recreational use of the lagoon system. Other uses also exist that are somewhat less obvious and may not have an observable market value associated with them. Use of the water from the lagoon system for power plant cooling and as a receptacle for residential/industrial waste water discharge are two examples which are noteworthy. One may ask -- what are the values associated with these uses? An appropriate measure may be the opportunity cost (difference in cost of the next best alternative) to local residents, businesses, tourists, and others if these activities were not permitted. And if the consideration of alternatives is appropriate, are aesthetic concerns the primary motivation? If so, then some intangible values may also be associated with the lagoon system. For example, there may be a willingness by user groups to pay, over and above what the market will extract, to preserve certain natural amenities which are found within the lagoon system. Further, will the present patterns of use continued unabated over time erode the economic value of the lagoon system, as pristine marine habitat is reduced and the aesthetic qualities of the system become less attractive? Obviously, economic considerations regarding the lagoon system extend well beyond what the present market generates "over the counter". Given the potential for growth in the region, increased pressure on the habitat by all user groups will place a high premium on effective management which is cognizant of these non-market, as well as market, considerations. Only effective management and wise utilization by all users --- recreational as well as commercial --- will insure that the economic value and unique qualities of the Indian River lagoon system are available for future generations to enjoy.

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DEFINING CURRENT AND EMERGING ISSUES FACING THE INDIAN RIVER

by

Tina Bernd-Cohen

INTRODUCTION

The Indian River is a beautiful and valuable resource, which acts as a magnet -- drawing people to the shoreline. Almost 600,000 people live in the three counties bordering on the Indian River. Yet, the very urbanization of the river creates environmental stresses and land use conflicts, and threatens to destroy those natural assets which attracted people to the river in the first place.

In the most general terms, all issues and conflicts facing the Indian River today are tied to the struggle to balance resource protection with the demands for development and use of the river.

Tilting management in favor of shoreline development can further damage the river's natural resources. On the other hand, excessive restriction of development and resource use can raise private property taking issues and adversely effect the economic interests of those who depend on the river for their livelihood.

Growth management has become the catchword for state and local efforts to resolve these competing interests. The goal is to protect the natural assets of the river,

while allowing shoreline development and use of the river in ways which do not irreparably damage or destroy the river's ecosystem.

The issues facing the Indian River are as diverse and complex as the river itself. I shall attempt to outline some of these issues.

EXISTING MANAGEMENT ISSUE

First is the management question. When you look at the management of the Indian River today, you find that it is complex, fragmented and at times overlapping system involving at least 40 units of government. Each county and city bordering on the river deals with its section independently according to its comprehensive plan and regulations. State and regional agencies operate under separate state statutory authorities. No one agency has the lead role in dealing with the river's many problems.

Adequate management of the Indian River requires coordinated government action at all levels. But, is it possible to have a coordinated management plan for the entire river, given the present fragmented structure? If not, what changes or new mechanisms are needed to bring agencies together under common goals, objectives and management standards? This is an immediate as well as long-term issue. Would the establishment of an Indian

River Management Authority with central regulatory and enforcement powers, and lead agency responsibilities, provide the coordinated management structure needed?

AQUATIC PRESERVES

Turning from the broad management issue to a specific one the Florida Aquatic Preserves Program raises management questions relevant to the Indian River experience. As a result of the presence of abundant seagrass beds, several segments of the Indian and Banana Rivers have been designated for protection under the state aquatic preserves program. Draft plans for some of these areas will be discussed locally at public hearings this February.

The aquatic preserve program sets aside certain state-owned submerged lands and associated coastal waters to protect their exceptional biological, aesthetic and scientific values. Most of Florida's aquatic preserves are in or near areas of increasing ubanization. The program is intended to address pollution problems resulting from shoreline development, by preserving and, where necessary, restoring natural systems. Under state law, aquatic preserves are declared outstanding Florida waters and assigned the highest environmental protection.

Unfortunately, present regulations covering the aquatic preserves only affect the submerged lands and coastal

waters; whereas most water pollution problems originate in upland areas and travel into the river. Such is the case with freshwater runoff, dredge and fill sediments, and point and nonpoint source pollution. Furthermore, mangroves and other shoreline vegetation are not adequately protected under this program. As a result, the designated aquatic preserve areas may be receiving no more protection than non-designated areas.

Expanding the jurisdiction of the aquatic preserve program to cover regulation of shoreline and upland areas to more effectively protect unique aquatic habitat areas, such as the Indian River grass beds, is emerging as an issue for all of Florida's rivers.

SHORELINE DEVELOPMENT

As a result of population growth the Indian River faces many shoreline development challenges. Because of their unique appeal, shoreline properties - both coastal and riverine - are among the nation's most expansive properties. Everyone wants a piece of the waterfront, some for recreation vistas and access; others for commercial fishing, clamming, boating and port operations; and still others for exclusive private residential development.

With increased concentrations of people living along the Indian River and on the coastal barriers, property

values will soar even higher and competition for limited shoreline space will become fierce.

Water dependent industries such as ports, marinas and energy facilities will find it harder to compete with residential developers for shoreline space. Maintaining places for water dependent activites along the Indian River is an emerging and long-term problem.

PUBLIC ACCESS

Another critical issue is public access. One way government tries to establish and maintain public access to the ocean and riverfront is through land acquisitions. Brevard county residents recently approved a $30 million bond issue to purchase such areas. Now local officials must decide which properties for what purposes: riverfronts for scenic values? Boat access? Or habitat protection? Or oceanfronts for beach access and recreation?

Meeting the increasing public need and demand for access to coastal and riverine waters is a long-term concern, as private development gradually locks out public use of the waterfront. Acquisition of shoreline properties will become more costly as development pressures increase. State and local governments must look at ways to provide public access through other means such as dedication,

regulation and transfer of development rights.

MARINA DEVELOPMENT

Marina development is an emerging issue for the Indian River. Marina spaces for private boats will become more valuable as new residents compete with old residents for boat access to the river and ocean. Conflicts between sports fisherman and commercial fisherman will become more intense as increased numbers of fishermen compete for boat ramps, dock and marina space and fishing areas.

Compounding the issue is the growing recognition that docks and marina development destroys valuable grassbeds. The state and Indian River communities may have to restrict the proliferation of small private docks in favor of fewer larger facilities to minimize habitat destruction.

PORT ISSUES

Port issues center around water quality questions. Water quality in the port areas is lower due to waste discharges from shipping and lack of flushing. Should ports be allowed to have slightly lower water quality because they are water dependent industries which provide economic benefits to the region?

RIVER ISLANDS DEVELOPMENT

Development of river islands promises to be a controversial issue. The proposed development of a golf and condominium community on several islands in Brevard County has raised questions about the type and density of development which should be allowed on at present undeveloped saltwater islands in the Indian River.

A temporary construction moratorium on the undeveloped islands has bought the Brevard County Commission time to consider and assess the ecological impacts that could result from developing such areas - particularly impacts on fragile shellfish harvesting and prime habitat areas. Revamping local laws to provide environmental safeguards while addressing development requests offers a real challenge.

BARRIER ISLAND DEVELOPMENT

Barrier island development is another issue affecting the river. Barrier islands are important natural features. They form and define the ocean-side limits of the river system. Their bay-side marshes and mangroves are vital estuarine resources. Their alteration and destruction as a result of island development adversely affects the saltwater lagoon.

Bridges and causeways which link barrier islands to the mainland cross the river and affect boating traffic. They

also act to encourage barrier island development.

FISHERIES MANAGEMENT

Over-exploitation of the fishery resources in the Indian River is a heated issue, pitting recreational fisherman against commercial fisherman. (What is thought to be one of the largest beds of hard clams on the Eastern Seaboard has, for the first time this winter, attracted 800 to 1000 boats with avid clammers aboard.)

Non-resident clammers have been moving into south Brevard County to harvest clams. They have revolutionized clamming by introducing bull rakes to get the bivalves out of the salty Indian River. Local clammers are worried that outsiders will drive the prices down and deplete the breeding populations, ruining future crops.

The state Marine Fisheries Commission is adopting regulations to address clamming concerns such as minimum size limits, clamming hours, and residency requirements. The commission has also prohibited the use of rakes and dredges in the grassbeds. The emerging issue of uncontrolled commercial fishing promises to be a long-term problem.

VITAL AREAS

Protection of the river's vital natural resources is

critical. Vital areas of the Indian River estuarine system include seagrass beds, mangroves, saltmarsh inlets, the shorelines and tributaries, especially where salt and freshwater interface. The conservation of these areas is essential if fish, shellfish, manatees, water birds, and other river wildlife are to survive and thrive.

To protect these vital areas requires coordinated programs between all levels of government, as well as involving citizens and the private interest who rely on the river for their livelihood. Developing the coordination mechanism, as I discussed earlier, is a long-term project.

If government agencies allow continued damage or destruction of vital resources, restoration programs with reliable funding sources will become an important issue. Where mangroves, seagrass beds, have already been destroyed, establishing a lead agency and a source of funding to plant and restore these areas is needed.

ENDANGERED MANATEE

Protection of the endangered species, like the manatee is a concern. Brevard County is a prime Manatee area. Of 1000 manatee living in Florida waters, 300 are believed to be in the Brevard County area. To protect the endangered manatee and their feeding grounds limits on the number of marinas and boat docks along the waterways of the Indian

and Banana Rivers may be required. Motor boats and barge propellers wound and are a leading cause of death for the slow moving creatures. The issue involves balancing the demand for boating in the river with the need to protect the endangered species. Responsible boating practices with minimum water regulations is the key.

Perhaps Brevard County can get a portion of the $250,000 state lawmakers have earmarked for manatee protection. More signs warning boaters to slow down in manatee areas, more patrols, and greater public awareness are ways to address the manatee protection issue. Signs warning boaters to slow down will be placed on Turkey Creek and the Indian River near Turkey Creek this spring.

POLLUTION

Pollution is another serious problem for the river. The Indian River is being polluted by hazardous waste, runoff and sewerage discharges. As a result, water quality and fisheries habitat are deteriorating.

Industrial hazardous wastes dumped into creeks leading to the river increase the chance of fish kills in the river.

Polluted rainfall runoff from roads, parking lots, lawns and other nonpoint sources flow into the river carrying large amounts of suspended materials. These

materials (which don't settle out into retention ponds) eventually move from the freshwater streams into the river. Further polluted by the discharging of treated sewage, excessive algae growth occurs which in turn depletes the river's oxygen level and adversely affects the fish and other living resources.

Planned improvements to county treatment plants are aimed at halting the discharges of sewage into the Indian River. The state has begun to require that local governments stop discharging sewage into surface waters. However, meeting the demands of population growth and staying within strict state guidelines is a major problem. Some area counties plan to continue dumping their treated wastes into the river.

Since many local governments have developed plans for the removal of pollutants from wastewater before discharging it into the river, through the 201 plans, they are reluctant to move to alternative disposal systems.

Funding for treatment plant improvements is also a concern. Federal aid will most likely go to more needed projects elsewhere, leaving the Indian River counties to pay the costs through local sewer rate hikes or alternative funding sources.

Nonpoint source pollution is and will remain perhaps the most serious long-term problem for the Indian River,

because nonpoint source pollution is so difficult to manage. Water management measures, such as retention and detention ponds, offer some mitigation.

It is critical that the amount of pollution allowed to be discharged into the water from point and nonpoint sources be reduced. How we do that and who pays for it is the question.

FRESHWATER FLOW AND WATER COURSES

Increases in freshwater flow into the river is a part of the pollution problem. Upland activities which alter natural streams and water courses affect the river. Clearing the land along the shoreline increases the rate and volume of freshwater flow into the estuary upsetting the delicate ecological balance as well as destroying valuable mangroves and wetlands.

With growing awareness of the need to protect natural water courses and vegetative buffers, and to control runoff, local and state agencies need to take a closer look at ways to protect the complex natural system.

DRAINAGE SYSTEM

Drainage canals raise management problems. Many of the man created drainage canals, which increase the freshwater flow into the estuary, do not meet water quality standards

and are detrimental to the ecology of the Indian River. Sedimentation and increased turbidity are particular problems. Drainage systems are costly to build and maintain. Aquatic weed control introduces poisons to the water and retrofitting these drainage systems to meet current water quality standards would be costly. Should retrofitting be considered and, if so, who should pay?

RESEARCH

Research is an important ingrediant in sound river management. Estuaries are among our most complex natural systems. They present special challenges to scientists and managers, particularly when you add human impact considerations. Management today is based on a minimal understanding of the nature of these complex systems. We lack reliable historic data on estuarine water and sediment conditions; our understanding of the impact of adjacent land use on estuarine systems is imperfect, especially regarding habitat loss and decline in fish stock.

It is critical that we improve the technical data base upon which river management decisions are made, so to minimize or eliminate existing pollution sources and prevent their reoccurence.

INFORMATION AND PUBLIC AWARENESS

There are information and public awareness considerations. Most people don't know much about the Indian River or where to go to find out. Keeping the public informed is a critical and ongoing need. Developing public appreciation of the river's natural assets; public awareness of the need to protect vital habitat and endangered species; and public understanding of the adverse impacts that shoreline development can have on river resources are all essential elements to building a strong local public constituency who will support controversial but necessary measures to protect the river resources for generations to come.

CONCLUDING REMARKS

Eventually, the entire Indian River shoreline will be developed except for pockets dedicated to recreation and open space. What the shoreline will look like and how well the river's natural resources are protected are in the hands of the citizens, developers and government officials.

The ultimate challenge will be to develop a clear picture of what you want the river and its shoreline to look and feel like over the next 20 years - and to create a sound coordinated management system to make your dream a reality.

THERE OUGHT TO BE A LAW ---

MAYBE THERE IS!

FEDERAL AND STATE LEGAL FRAMEWORK FOR MANAGING THE INDIAN RIVER

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Let me start off by giving you some of my general observations regarding aspects of the factual setting involved here which are important from a legal process point of view and some conclusions, based on my experience, about the features of the legal framework within which you might develop a scheme for managing the resources of the Indian River in a better fashion.

With respect to the factual matters, the Indian River is an estuary of great species diversity and wide differences in temperature regimes, which extends approximately 120 miles, and parts of which are in or pass by five counties and 15 municipalities. In addition, it is encompassed within two water management districts (SJRWMD, SFWMD), two regional planning councils (ECFRPC, TCRPC), and two Department of Environmental Regulation districts (SJRD, SEFD). As part of the Intracoastal, much of it has been historically and continues to be heavily traveled by boats. It is a major commercial and recreational fishing, clamming, and boating resource. Portions of it are particularly attractive to populations of manatees, dolphins, and bird life. At the same

time, the River is experiencing the impacts of an expanding population on the uplands adjacent to its shorelines and along those areas which drain into the River, particularly with respect to increased freshwater inflows and pollutant discharges.

With respect to pertinent features of a legal process to better manage the system, I would offer the following thoughts. First, that scheme should be based upon a center of control which is as local in nature as it can be, while yet providing for effective and comprehensive management of the River system. The reason is an old one. Namely, that the more local the control, the more attention that control will give to the expressed wishes of the local public.

Second, to the maximum degree possible, consistent with effective management of the system, the management scheme for the River should not reinvent existing regulatory tools and criteria. It should strive to coordinate and, where necessary, augment those regulations. Existing state, regional, county and municipal regulations which address the River proper as well as the uplands which impact the River should be evaluated to determine how well they can accomplish the management plan goals. Unless there are substantial deficiencies, they should be incorporated as they are into the management program. If significant deficiencies are identified through sound analysis and data, as opposed to unsupported preferences or hunches,

then amendments to those regulations should be proposed to the promulgating units of government. This approach will help avoid creating new feelings on the part of those to be regulated that government has once again enlarged its tangled web. I would note here that any management system ultimately must have the general support of the majority, although not all, of those regulated as well as the support of those not regulated by the system in order to achieve long-term viability and effectiveness. In other words, a law works only as long as the majority of us think it is needed and that it generally operates in a fair manner.

Third, you need a legal scheme which can bridge the many local, regional, and state jurisdictional boundaries which the River encounters. Fourth, management of a resource requires the ability to plan well into the future and, therefore, the need to acquire data upon which a sound regulatory component can be developed and refined. Fifth, no legal scheme, regardless of how intricate and regardless of how many unwanted contingencies it contemplates, can overcome a lack of commitment of resources, lack of informed understanding of the issues and alternative solutions, and lack of strong community support for the program. Conversely, a very minimal legal framework can produce a very effective result given adequate resources, understanding, and support.

Having made these introductory comments, I would like to turn to some federal and state legal mechanisms which might have some application to the Indian River situation, some being more pertinent than others. In doing so, I would note that I shall not attempt to discuss every federal or state law which might conceivably come into play at one time or another with respect to problems and issues associated with the River. Instead, I shall attempt to focus on those laws which have some apparent potential for providing what I believe is the key to better management of the River and that is an umbrella framework for management and regulation. That is not to say that I believe that such an umbrella framework must create a totally new system of planning, management, and regulation separate and distinct from the existing scheme of federal, state, regional and local controls. Rather, it is the comprehensive overview and coordination feature of an umbrella scheme which is important and, which it appears, is needed the most in the case of the Indian River.

The major difference between the basic components of the federal and state systems is that the federal system does not have comprehensive land use regulatory authority, in other words, what we commonly refer to as zoning power. The federal system has, as does the state system, certain planning tools such as the 201 facilities plans and 208 areawide waste management plans and regulatory tools for water quality, wetlands, fishing, boating, and animal protection. Both

systems also have special designation programs and land purchase programs for environmentally sensitive areas. Without general zoning power, the federal legislation is more narrowly focused than state law and, therefore, is not designed to address in a comprehensive manner the type and range of causes and effects confronting the Indian River. Also, the more comprehensive of the federal programs, such as the 208 programs, do not provide any special legal tools outside of what state and local governments already have. They tend to be funding programs which attempt to stimulate and channel the use of state and local laws. Those federal laws can, however, play important roles in the overall management of the River.

For example, designation of the River as a National Estuarine Sanctuary[1] could provide a source of federal funds for study and management of the River. The general purpose of the program is "...to create natural field laboratories in which to gather data and make studies of the natural and human processes occurring within the estuaries of the coastal zone." It is difficult to say at this time whether the Indian River could qualify for Estuarine Sanctuary status, especially since it is anticipated that such sanctuaries will be located in areas relatively undisturbed by human activities. Obviously, portions of the River are relatively undisturbed while other are not. At the same time, the entire River provides a good

laboratory for contrasts between developed and undeveloped areas and it possesses a great diversity of species, some of which are apparently unique to the estuary. Militating against such a designation would be the requirement that the ownership of the lands within the sanctuary be acquired by the State, the cost of which could be prohibitive in spite of what I assume is a large ownership by the State of submerged lands. Also, the orientation of the Estuarine Sanctuary program toward little increase in adjacent development or level of use may conflict with the overall goals and needs of the communities which would be affected even if such goals aimed only at moderate growth. Finally, the program does not provide any inherent regulatory tools. All of those powers must be still be derived from the State law. Currently, Florida has two estuarine sanctuaries, Apalachicola Bay in Franklin County and Rookery Bay in Collier County.

Two other federal programs of possible application are the Wild and Scenic Rivers[2] program and the National Wildlife Refuge[3] program. It is questionable whether the Indian River would even qualify as a river under the Wild and Scenic Rivers Act, since it is really an estuary and not a free-flowing river. But more importantly, both of these programs focus on preservation of relatively untouched areas, and that goal may not be consistent with the present or desired future status of

the Indian River. Also, those programs would not provide the kind of comprehensive management of uplands and water areas which are required in order to properly manage the River system. I would note that there are currently two National Wildlife Refuges in the Indian River at Merritt Island and at Pelican Island.

Now, turning to the State system, there are several legal tools which are relevant to enhanced management of the Indian River. The Outstanding Florida Waters[4] designation system which is part of the regulatory program of the Department of Environmental Regulation can provide limitations on future discharges of pollutants and dredging and filling in the River. However, this designation program is not a management program, but rather augments the existing regulatory criteria of DER. There are already a number of areas within the Indian River which have the Outstanding Florida Waters designation. The designation of future areas as O. F. Waters could be the logical result of additional research, analysis, and planning for the River.

Another useful mechanism is the Aquatic Preserve[5] program. As the name indicates, the focus of the program is preservation. Consequently, the preserve program is more applicable to certain portions of the River than others. One

of the especially valuable features of the program is that it authorizes the Governor and Cabinet, sitting as the Board of Trustees of the Internal Improvement Trust Fund, to adopt and enforce rules and regulations to carry out the use and management criteria of the preserve. Furthermore, the concept of use and management criteria implies that there is to be an ongoing planning function with assigned management responsibilities. On the limitation side, such preserves are limited to lands or water bottoms owned by the State or lands or waters included by agreement with private property owners. In other words, the program is not envisioned to provide the basis for comprehensive land and water management of the scope necessary to manage the Indian River as a whole. Presently, several major portions of the Indian River are under Aquatic Preserve designation; i.e., from Malabar to Sebastian and from Vero Beach to Fort Pierce.

One legal vehicle with considerable potential, at least theoretically, is that of Interlocal Agreements For County And Municipal Planning Of Future Development[6]. The Florida law authorizes counties and muncipalities to act in concert to plan and regulate land use within their collective jurisdictions. They can create by interlocal agreement a planning commission to acquire information, conduct analyses, and adopt policies and principles for guiding activities in the development of the

area encompassed by a comprehensive plan. Ordinances can then be adopted to implement the policies and principles of the plan. To my knowledge, these planning and zoning powers have not been exercised through interlocal agreements on the comprehensive basis which would be involved in the management of the Indian River. Consequently, this approach would encounter a number of fundamental legal issues regarding the collective exercise of these powers. Nevertheless, it does appear to provide a possible legal vehicle for comprehensive planning and management through local government initiative, rather than through a state-imposed requirement. Without some stimulus for cooperation, it might be difficult to get the number of entities involved in the Indian River to focus on such a cooperative effort at the same time, thereby making it very difficult to develop such an interlocal agreement.

The type of stimulus necessary to focus the attention of the numerous local governments on the coordinated management of the Indian River might be found in the State's Area of Critical State Concern[7] program. Conceptually, the Area program seems well suited for the goals of managing the Indian River in a better fashion while recognizing that the current and probable future level of activity in and along the River requires the management of development and use rather than preservation alone as would be the focus under some of the other federal and

state programs. One of the very valuable features of the Area program is that before the Governor and Cabinet, sitting as the Administration Commission, can designate an Area of Critical State Concern, there must be appointed a Resource Planning and Management Committee[8] for the area under consideration for designation. That committee can be appointed by the Governor acting as the Chief Planning Officer of the State. The purpose is to give the local governments an opportunity to "...organize a voluntary, cooperative resource planning and management program to resolve existing, and prevent future, problems which may endanger..." the resources within the area under study. A major objective of the voluntary program is to effectuate the "...coordination of state, regional, and local planning; program implementation; and regulatory activities for comprehensive resource management." If the program developed by the local entities is deemed acceptable by the Governor and Cabinet, then no Area of Critical State Concern designation can be made. Rather, the Governor and Cabinet can direct state and regional agencies under their control to conduct their programs and regulatory activities in a manner consistent with the approved voluntary program. Those agencies must cooperate to the maximum extent possible to ensure compliance. The State then monitors the implementation of the voluntary program by the local, regional, and state agencies to determine the effectiveness of the program with respect to managing the area

of concern. Interlocal agreements would likely be key mechanisms in a voluntary planning and management program. In addition, if such a program were approved by the Government and Cabinet, it would provide the legal basis to require coordination of state and regional agency activities with the management goals and principles for the River.

Another alternative to the interlocal agreement and voluntary planning and management program approaches would be the enactment of a Special Act of the Legislature in the form of a general bill of local application or a local bill. Under this approach, a specific planning and management entity could be established by the Legislature to mandate, in essence, the type of collective planning and management program contemplated by the voluntary approach described under the Area of Critical State Concern program. If it is politically impossible to achieve support for an umbrella planning and regulatory entity, then a special act might be considered for the purpose of creating a multi-jurisdictional entity to develop a comprehensive strategy for the management of the Indian River. Such an act might formalize the current voluntary entity of the Marine Resources Council of East Central Florida. Any strategy developed by such a planning-only entity would have to involve identifying the various independent agencies in the state, local, regional, and national systems which should be lobbied

for modification of regulations or for stepped-up enforcement of existing regulations. That, of course, becomes a much more cumbersome and time-consuming effort, the results of which are less predictable than would be the case with an umbrella agency with management and regulatory authority.

With respect to conflicts in management policies or regulations of the water management districts, DER district offices, and regional planning councils which have jurisdiction over parts of the Indian River and which may be inhibiting or not advancing sound management of the River, I would offer these thoughts. First, the DER district distinction is merely an internal management distinction within DER which does not remove the fact that both of those districts answer to Secretary Tschinkel. Therefore, if a satisfactory resolution of such conflicts cannot be reached between the appropriate District Managers, they can always be brought to the attention of the Secretary of DER. With respect to conflicts between the regional planning councils and between the water management Districts, one should not lose sight of the fact that a number of the members of each regional planning council are appointed by the Governor, as are all of the members of each of the Water Management Districts. Presently, the Governor and Cabinet are considering a draft state comprehensive plan which the Governor's Office has been required to develop pursuant to the

State And Regional Planning Act of 1984. Once that is adopted, Regional Planning Councils will be required to adopt regional policy plans which are consistent with the State plan. One of the responsibilities of the Governor through his Office of Planning and Budgeting is to adopt criteria, formats, and standards for the preparation of state agency functional plans and comprehensive regional policy plans. One of the requirements which ought to be considered is one which would require state agencies and regional planning councils to identify resources over which they have partial jurisdiction along with another district or planning agency. Such a requirement might require further that those agencies coordinate with each other and establish the means by which they will address those resources in a coordinated fashion.

Finally, any comprehensive program to manage the Indian River system should include, in addition to planning and regulatory functions, a significant land purchase program to acquire areas of prime importance to the River which are relatively undisturbed. Those could include areas immediately along the River or which provide important adjuncts to the River such as upland flood plains which can filter and retard pollutant flows into the River. Purchasing those lands and waters which are truly critical to protection of a resource such as the Indian River is a much more cost-effective method

of accomplishing the goal of protection than attempting to twist or stretch the regulatory law to accomplish that goal often with inequitable results to property owners and with a diminished respect for government.

In conclusion, it is my opinion that there are more than adequate legal tools existing to protect and manage the Indian River in a sound fashion. Also, there are ample laws available to provide for coordination of effort between the various local, regional, and state agencies having jurisdiction over parts of the Estuary. It is the commitment to use those tools in an imaginative and constructive manner that is required.

FOOTNOTES

1. 16 U.S.C. 1451
2. 16 U.S.C. 1274
3. 16 U.S.C. 668
4. 17-3.041 and 17-4.242, F.A.C.
5. F.S. 258.35
6. F.S. 163.160
7. F.S. 380.05
8. F.S. 380.045

THE INDIAN RIVER -- WHAT COULD WE DO?

CONSERVATION OF THE INDIAN RIVER ESTUARY -- WAYS AND MEANS

by

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National Park Service
Washington, D.C.

The idea of developing a regional approach to conserving the resources of the Indian River estuary is appropriate and timely. Environmental protection and land use control activities of state and federal governments have benefitted the Indian River greatly, but they fall short of providing the type of stewardship that is needed for a regional estuary. National and statewide standards can only provide a macro scale framework. Accomplishment of regional goals requires a customized program, one built on regional realities and designed and supported by the communities hereabouts.

Moreover, a regional program must address the interests of all the levels of government -- federal, state, county, municipality, and district -- and all the variety

of private interests. Its most important functions are planning, coordination, and education. To be effective, the program should be directed by a specially created board or commission.

To be effective, a special commission for the Indian River regional estuary certainly would cost money, would face a politically difficult task, and would stir up controversy. But other options are limited. One is to muddle along as we are doing now. A second is to get the state to do it, as it has with the Florida Keys critical area designation.

If muddling along were a popular choice, this meeting would not have been held. A strong case has been presented for action beyond the present state, federal, and local programs aimed at problems that are not being solved under the status quo.

The second mentioned option -- let the state do it -- has not proven successful in Florida or other states. Even states with strong coastal management programs supported by the federal Office of Coastal Resources Management (OCRM) have shown little acumen in setting up

substate programs for regional estuaries. Most of them are too preoccupied with running the state program to volunteer for the complexities of customized regional programs. Some states have been trying to find ways to deal with regional estuary problems for 15 years or longer. No really effective formula has emerged. For example, Oregon has classified its estuaries by three levels of conservation, as appropriate, and tried to vary its approach to each estuary accordingly -- fine on paper but rather ineffective in the field because of local resistance to being "pushed around" by the state and because federal and state agencies want to use their standards of general application, and not customized standards for particular estuaries. California has addressed regional problems by setting up six regional commissions to cover its 1,000 miles of coast and by identifying, in its original master plan, critical conservation problems in individual estuaries. But each California municipality, or county (68 altogether) is required to come up with its own coastal plan; there is no authorization for regional cooperation in planning

or plan execution, nor is there much local enthusiasm for the state program.

There is no real substitute for local initiative, as the U.S. Congress has discovered in its 20 years of effort. A fact often lost in history is that the federal Coastal Zone Management (CZM) Act of 1972 resulted from attempts, dating back to 1965, to establish a program of conservation for regional estuaries. After seven years of effort, Congress gave up and passed a CZM Act to encourage the states to establish land use-oriented coastal programs. The only estuary-specific aspect of the CZM Act is that which authorizes the designation of "estuarine sanctuaries" to facilitate scientific research under "baseline" conditions.

The good news is that the states usually do cooperate enthusiastically with locally organized estuary conservation programs. The examples below show how varied the approaches have been:

Grays Harbor, Washington: Through provisions of the state CZM program, seven counties and municipalities surrounding the Grays Harbor Estuary and the local port

authority organized a joint planning venture to make long term decisions about how the waterfront lands and estuary bottoms would be used and protected. The initial motivation was to improve coordination of coastal development permits with federal agencies. The federal OCRM helped support the program and labeled it a "Special Area Management Program." Commenced in 1975, it has now completed most of its work. Each participating government must ratify the plan and enforce it (with state overview).

White Oak Estuary, North Carolina: After politically blocking a Corps of Engineers inlet improvement project, the local Isaak Walton League chapter persuaded two counties and the village of Swansboro to formally agree to a program to correct problems plaguing the estuary. The state CZM assisted local interests to organize the activity.

Apalachicola Bay, Florida: Convinced that development around the shores of the estuary and upriver was jeopardizing the future of fisheries, the mainstay of the local economy, Franklin County struggled for many years to find mechanisms to protect their bay. They

utilized the state's D.R.I., local planning, critical areas, and other programs. They cultivated federal and private agencies and built a broad conservation program around a state sanctioned federal designation "Apalachicola Bay and River National Marine Sanctuary."

Lower Columbia River Estuary: Washington and Oregon interests persuaded their respective legislatures to set up a bi-state regional planning program (C.R.E.S.T.) to coordinate conservation and development activities for both sides of the estuary among county, municipal, and statewide entities. Federal agencies participated in the process. The Institute for Environmental Mediation facilitated agreement on controversial subjects and the program is now operating.

Tijuana Estuary, California: U.S. and Mexico cooperated to establish the Tijuana National Estuarine Sanctuary in southern San Diego County in 1982. U.S. cooperators included federal, state, county, municipal, agricultural, military, and development interests. The result was that a significant portion of water and land along the lower

estuary was brought into a conservation program and commitments were made by Mexico to ensure appropriate water flow and quality in the Tijuana River as it leaves Mexico.

These approaches are extremely varied but they share a common framework. In some form or fashion each had to accomplish the following:

- Development of a database
- Selection of goals
- Identification of issues
- Analysis of tradeoffs
- Formulation of an estuary plan
- Program design
- Choice of institutional mechanism(s)
- Secure legislative/administrative approval

Technically, each of these approaches is quite straightforward and do-able and a model based on any one or a combination of them should work fine for the Indian River Estuary. The problemsswith these programs are mostly political; I suppose the same applies here. But if public support is strong and if all four counties and

other key participants can forsee benefits exceeding investment and if they act expeditiously, a regional resource conservation program should succeed.

I would strongly suggest a regional commission format with planning and advisory authority and with mandates for coordination and education. There should be strong scientific input and public participation components. The creation of separate policy and technical committees usually works well for the suggested type of entity.

The major initial thrust should be a regional plan incorporating the widest spectrum of subjects and interest groups. If an early start were made, the Indian River conservation plan could be done conjointly with the upcoming revision of Coastal Protection Elements which must be done by each county as part of the mandatory local planning five-year update. This would be an excellent opportunity for four-county cooperation and, as a special initiative, might qualify for special state and/or federal funds. But the Indian River initiative should not be paid for totally by outside funds -- local commitment can only be ensured

if local funds are budgeted for the program.

The Indian River program should, if possible, be formally authorized by the state CZM office and set up so it could qualify for federal SAMP funds. It should be recognized by regulatory agencies and those agencies should provide advisory services. Finally, the program should be controlled so that its role and services are sharply limited to the conservation task at hand and so it doesn't begin to function as a general regional commission. Conserving the aquatic resources of the Indian River for this and future generations is by itself a big and vitally important job.

AMERICAN ASSEMBLY CONSENSUS AND CONCLUSIONS

INDIAN RIVER RESOURCES SYMPOSIUM
FIT, Melbourne, Florida

January 18-19, 1985

Nathaniel Pryor Reed

As your Indian River Resources Symposium concluding speaker, let me state loudly and clearly several facts that may or may not be evident:

1. *The Indian River is a lagoon, not a river. The word "lagoon" needs definition. It means "a shallow sound, channel or pond near or communicating with a larger body of water."*

2. *To correct the unfortunate impression that the meets and bounds of the Indian River Lagoon begin in Brevard County and end at the St. Lucie Inlet in Martin County, let me assure you that the Lagoon begins in Volusia County and ends at the Jupiter Inlet. We who live on Jupiter Island live beside the Indian River Lagoon per Ponce de Leon's classic description, not by the Corps of Army Engineers description.*

Yesterday's morning and afternoon speakers wove a fascinating web about our Lagoon; its physique, its biological make-up, its health and above all, its value. Values are often hard to describe - what is the worth of a red sunset on a cold, clean January evening - or a sun-up from a barrier beach?

We can calculate the worth of that lowly bivalve, the delicious clam or the mullet landings and even the pounds of sea trout.

If it is just dollars, then the Indian River Lagoon is by all accounts extremely valuable to the users.

But what of aesthetics - those intangibles which brought the majority of the 500,000 citizens who live along the Lagoon's 125 miles?

It is obvious way beyond the income from seafood that the future of the Indian River Lagoon is directly related to hundreds of millions of dollars of present day land values and millions more of future values.

The realtors and Chambers of Commerce must recognize that a stagnant, befouled Indian River Lagoon will collapse land values. It's health and well being are directly responsible for the unparalleled growth and prosperity of this region.

What brought this astonishing assemblage of human beings to the Florida Institute of Technology? Was it Diane Barile's driving commitments? She deserves our thanks and sincere compliments. Was it this dynamic campus and its staff and coastal zone management students? Was it the Marine Resources Council and, in particular, that genius Clifton McClelland that brought us together?

Yes, it was all of these, but the single common thread is our love of and genuine concern for the Indian River Lagoon that brought us here.

And, as a very quiet reminder, aren't we lucky that our basic freedom to peacefully assemble in this blessed land allows if not encourages us to meet for our comon good?

What did we learn? We were all genuinely impressed by the quality of the scientific reports. In spite of our imperfect data base, the physical presence of the experts from Harbor Branch and their extraordinary range of science combined with the talents of scientists from FIT, the University of Florida and the Florida Department of Natural Resources gave us the strong confidence that if funded, the research talent is here, available and ready, if not anxious, to escalate their efforts to investigate the resources and make recommendations on how we must learn to work with, if not enhance the Lagoon's functions.

We recognize we live with great physical forces beyond our control - hurricanes, great northeasters and high storm tides. Far too many of our fellow citizens are living in great peril because they are uneducated. They are unaware of the dangers and the risks and the value of this unique Lagoon. They are also totally unaware of Leopold's first law - that the system which sustains them is totally interdependent and that they are part of that system. They impact the system just as the system impacts them.

We, as an educated group, recognize that education is a fundamental necessity if this area is to retain its character and value. Al Burt stated that education was vitally needed. We agree - unless we educate the present and future resident of the Indian River Lagoon as to its hows, whys and wherefores - how will they understand its limits? How will they understand that they are willingly or unwillingly irrevocably tied, ensnarled in the web of the Lagoon? How will they understand it? And, if they can't understand it, the Lagoon will not be appreciated. It will never be loved, cherished and fought for. It is time here at nearby Kennedy Space Center to "ask not what the River can do for you, but what are you willing to do for the River?"

At yesterday's luncheon we heard one of the most superb speeches I have ever had the pleasure of experiencing. Al Burt is a very sensitive, caring, educated observer. He is also a preeminent writer.

His speech should be published and made required reading in the Lagoon's five counties, their county and city elected leadership, and among our state's legislators. We agree that the Indian River Lagoon is evidencing significant signs of disaster.

It is not dead - but it is hurting. We, the citizens of the adjoining five counties are impacting it. We need to coordinate a rescue mission to prevent a terminal disease from destroying our valuable patient.

The sources of impacts are largely known. They are the familiar litany of unnatural fresh water discharges, sewage wastes, nutrients, pesticides, herbicides, mosquitocides, impoundments, turbidity, etc. Both from point and nonpoint discharges our Lagoon is showing an inability to cope with increasing doses of man's wastes - fresh water or nutrients or chemicals.

Water quality is the key indicator. If we are able to defend present water quality and, in time, substantially improve water quality, we and our future citizens will become managers of a dynamic system that is alive and forgiving. How can we break the maze of forty governments and the traditional battles of turf and authority? What do we do if local government not only condones but encourages practices which are destructive to our precious Lagoon?

We have struggled collectively with how to make existing government work - work more attentively and sensitively. I am haunted by Al's first major point: "We can't have it as it once was, but by our concentrated concerned action, we can slow its decline and in time we can enhance, rehabilitate and rejuvinate what we so carelessly have destroyed." We have a much more forgiving system - a more resilient system than Lake Erie and we know what strides have made to resuscitate that once dead lake.

The Indian River's water quality will be the ultimate test of our ability to govern. No other criteria will dictate whether or not our Lagoon survives as a functioning ecosystem.

The upland, shoreline, and the mangrove forest must be managed with the fundamental goal of protecting the water quality of the river. It is a perfect circle and every participant in the room knows it. It is not some incomprehensible babble only understood by learned scientists in lofty places of learning. No, damn it! Gordon Phillips knows it, Richard Thomas knows it, Maggy Hurchalla knows it, John Brooks knows it, Red Arthur knows it, Iver knows it, we all know it!

To effectively come to grips with what to do and how to do it, the five assembly groups strained and struggled. Frankly, we reached no consensus. I would not suggest for a moment that the management of a Lagoon 125 miles long, containing 225 billion gallons of water, four inlets, impacted by a minimum of 500,000 people, five counties, thirty-odd cities, five mosquito control districts, two regional planning councils, two water management districts and innumerable drainage districts will be easy. Every possible combination for a predictable turf fight is all too evident. So we

should not be embarrased by having a difficult time struggling to recommend a management entity that can more properly protect our Lagoon.

I realize that single action is inadequate nor can it satisfy everyone. However, with your permission, I will send this letter to Governor Graham:

Dear Governor:

The Indian River Resources Symposium convened at FIT on January 18-19, 1985 under the leadership of the Marine Resources Council of East Central Florida. A copy of the Symposium report will be forwarded to you before March 30.

The Indian River Lagoon extends some 125 miles in length and traverses five counties, more than thirty towns and cities, two water management districts, two regional planning councils, five mosquito control districts and several water control or drainage districts which combined do not have cohesive or coordinated policies designed to protect the Lagoon's unique habitat. Although there is not a single man-induced catastrophy which threatens the estuary, the Indian River Lagoon is suffering the cumulative impacts from an increasing number of public and private projects and activities which are indicative of the press of urbanization confronting the River.

In spite of the impacts, the Indian River Lagoon is highly productive. In fact, it hosts the highest diversity of species of any estuary in North America. Millions of dollars of shellfish and finfish are landed each year. Without question, the estuary's health and well being is vital to the 500,000 Floridians that live along the shore.

The Symposium focused on the multiple problems and threats to the system. The eighty-five participants utilized the American Assembly format, divided into five working groups and prepared a thoughtful report outlining the problem areas. They focused on specific solutions including the great hope that future losses can be minimized and that thoughtful enhancement will temper the present impacts on the Lagoon.

Among the most important conclusions are that water quality will be the single most important determinant of the Lagoon's future health and productivity. In addressing the critical water quality issue, it was the consensus that solutions to current problems and the avoidance of future ones will require a comprehensive management approach which takes into account local land use policies, resource allocation issues, conflict resolution, monitoring, research funding programs and interagency coordination.

Governor, although we clearly recognize the problems and even many of the solutions, we experience great difficulty recommending a form of multi-county government which could focus the local attention desperately needed to protect the River's many resources.

However, we have concluded that a special Indian River Lagoon Council should be created by Legislative Act which can lead to cohesive and coordinated management which the Lagoon requires.

Furthermore, we recommend the Interagency Management Committee, representatives of the St. Johns River Water Management District and the South Florida Water Management District meet and coordinate with the Marine Resources Council within the next sixty days to determine how the Interagency Management Committee can best assist the Council in achieving a comprehensive management program for the Indian River Lagoon.

As part of that effort, the Interagency Management Council and Water Management Districts should identify in conjunction with the Council significant gaps in their regulatory policies and practices which can be corrected by Executive Order.

Although optimum management of the Indian River cannot be achieved in the near term, your administration can take important steps.

You can provide the leadership for state and regional agencies to work with local governments and a concerned and informed public to achieve a harmonious relationship between them and one of Florida's great natural resources, the Indian River Lagoon.

Sincerely,

Nathaniel P. Reed

Ladies and Gentlemen, it has been a unique pleasure to work with you. I am sincerely impressed by the diversity of this group and the commitment which you share. We Americans are at our best when confronted with peril; we pull together for the common good. This will not be an easy struggle. The path ahead is filled with torturous turns and unforeseen pitfalls. Working together, we have a mission worthy of our collective efforts - the preservation of and the enhancement of the Indian River Lagoon. Let's prove to our children and their children and to the rest of Florida that we are made of stern stuff. We can look back on this important Symposium as a start - a fine first move forward in recognizing what must be accomplished if this great body of water is to be preserved.

Thank you

Nathaniel P. Reed
January 19, 1985

CONSENSUS

Indian River Resources Symposium

Definition of the Problem

Question I

A. Problems common to the entire lagoon

1. All groups agreed that the flow of freshwater entering the lagoon presents an overriding problem to the Indian River Lagoon. Their comments related to the question are listed as follows:

   a) alteration of freshwater flow from the land which creates unnatural rates of discharge of freshwater into the estuary

   b) increased runoff of stormwater and unregulated nonpoint source pollution loadings

   c) discharge from agricultural lands with no regard to the impact on the river

   d) loss of floodplain for storage and slow release of stormwater

   e) new wetland regulations may not adequately control stormwater and may still cause an imbalance in the salt/freshwater equilibrium of the estuary

2. The second most important problem was seen as sewage effluent disposal. Recommendations include allowing only water with advanced wastewater treatment to be disposed

3. Unmanaged growth

4. Overfishing

   a) especially over-exploitation of the clam resources

   b) lack of fisheries management

5. Decline in vegetation (grassbeds, marshes, mangroves)

   a) buffers are needed to protect wetlands

   b) protection is needed for the isolated wetlands at the headwaters of creeks

6. Alteration of the bottom of the lagoon

   a) dredging

   b) scouring

   c) sand migration through the inlet

7. Causeways increase poor circulation and impede flushing

8. Water quality - especially turbidity

9. Loss of habitat due to mosquito impoundments

10. Lack of coordinated action by government agencies

11. Lack of public awareness of the uniqueness and vulnerability of the lagoon

B. Problems of Specific Portions of the Lagoon

1. Brevard County - described as the greatest stressed due to population density and distance from the inlet

   a) lagoon from Cocoa to Melbourne (Central Brevard)

   b) clam beds

   c) privately owned spoils islands

   d) Mullet Creek

   e) the Barge canal

   f) Turkey Creek

   g) Sykes Creek

2. Indian River - stressed due to population density and lack of flushing

3. St. Lucie - Martin

   a) discharge from Lake Okeechobee into the St. Lucie estuary

   b) privately owned spoils islands

   c) Jensen Beach Causeway to St. Lucie Inlet

   d) Taylor Creek

C. Problems in Need of Immediate Action

1. State policy of encouraging growth in coastal areas in shorelines

2. Exotic vegetation

3. Bulkheads on shorelines

4. Substitution of marshes with mangroves as a result of mosquito impoundments

5. Diminishment of intertidal zones

6. Lack of public education

7. Inadequate data base on the lagoon

Question II- How can coordinated management of the Indian River Lagoon be administered?

A. A Resource Planning and Management Agency established under Florida Statute, Chapter 380.05 (similar to the Hutchinson Island Committee)

B. An Indian River Lagoon Commission established by a special act of the legislature

C. Interlocal agreements

D. A special basin Board established by both the South Florida and the St. Johns Water Management District

E. Voluntary coordination - a committee from the Marine Resources Council, Harbor Branch, and Florida Oceanographic Society could act as a resource to local governments. The committee could address the results of this conference and borrow from the Hutchinson Island Resource Management Plan. They could provide data base and technical back-up for conclusions and act as a clearinghouse for model ordinances. A minority felt that no voluntary group would have any effect on the actions of local government.

Question III - Can common goals and objectives for the Indian River Lagoon be established?

A. All groups agreed that common goals can be established.

B. Goals

1. The overriding goal for the Indian River should be to have a healthy estuary resilient to short term problems with the diversity of the natural system. A variety of uses can be encouraged if they are consistent with this goal.

2. Encourage the preservation, enhancement, and restoration of existing lagoonal habitat

3. Preserve the efficiency of the river

4. Improve public understanding of the lagoon's ecosystem

5. Enhance the public's ability to use the river without damaging it

C. Objectives should be cost effective and include the following:

1. maintain and improve water quality

2. restore habitat including impoundments, grassbeds, and wetlands

3. reasonable beneficial use

4. discontinue all sewage dischange

5. better understanding and management of non-point source discharge

6. quality, quantity, and timing of run-off should approximate natural conditions

7. manage mosquito impoundments for maximum estuarine productivity

8. enhance the data base for the river

9. increase enforcement of existing regulations

10. institutionalize coordination of planning

11. assess effectiveness of existing laws

12. restore normal river circulation particularly around causeways

13. acquire and maintain public access to the lagoon

Question IV

A. Has the Aquatic Preserve Program been successful in the Indian River Lagoon?

1. All groups agreed that the program has not been successful.

a) Two groups felt the law has not been in effect long enough to determine its effectiveness. In some areas, management plans are just now being adopted.

b) Two groups felt funding had been inadequate and that the Department of Resources staff is too small to effectively manage the preserves.

c) Where the programs have been effective, DNR secured help from local government.

d) The programs may have increased public awareness.

B. Can the intent of the Aquatic Preserve Act be fulfilled when jurisdiction of management extends only to the water's edge?

1. The groups tended to agree that program cannot manage only to the water's edge.

2. The Aquatic Preserve plans must be coordinated with action by local governments and state agencies to control upland impacts. The plans can control point sources but not nonpoint sources.

3. One group suggested that an Indian River Board or a Commission be appointed to review the Aquatic Preserve Program.

Question V. - What measures should be adopted to provide future public view and access to the recreational resources of the Indian River Lagoon?

A. View of the water - all of the groups but one agreed to require public view and access through the following:

1. Government purchase from Ad Valorem taxes

2. Dedication as a condition for large scale development either on the development site or in another appropriate area

3. Work with DOT in taking recreation into account in planning highways and roads. Utilization of road rights-of-way particularly existing causeways

4. Levy of impact fees for development

5. Enact special zoning classification and requirements for waterfronts

6. Government purchase or lease of marinas

7. Construction of centralized boat ramps using funds from the Boating Improvement Trust Fund

8. 1941 Department of Transportation Statute

9. Enact breezeway and public view requirements for shoreline development

B. View of the Shore from the Water

1. Protect the view of the shore through enacting shoreline setbacks and buffers

Question VI - Marinas - Should large public docks be encouraged rather than numerous private, single owner docks and piers?

A. A proper balance between commercial and public dock facilities can be maintained through planning and zoning by proper governmental agencies to assure that public marinas are maintained.

B. While it may be difficult to restrict small docks, larger marinas would be preferred to a proliferation of smaller facilities. Public access could be required at large private facilities.

C. The shoreline of the river should be surveyed to determine optimum areas where dockage will have the least environmental impact. The survey should assess the carrying capacity of the lagoon for boat traffic and set standards for marina siting and design. The design should include upland boat storage.

Question VII Vital Areas

A. Given that mangrove protection and stormwater retention regulations have been adopted in the last year, what matters now need attention to maintain vital habitats?

1. There was general agreement that the new regulations may not be sufficient for protection of the lagoon

2. There is a need for local ordinances to a) protect mangroves, b) regulate runoff from small developments. No runoff should be discharged directly into the lagoon, c) regulate land clearing, shoreline protection, d) control of exotic species . e) retrofitting of existing drainage systems.

3. Areas delineated as in critical need of protection were:
grassbeds
areas of interface in salt and freshwater,, stormwater discharge sites
mangroves
mosquito impoundments
spoil islands
native vegetation
natural contours of shoreline (littorial zones)
marshes
wildlife habitats
causeways areas need more flushing
shellfish areas
fish nursery areas

4. Local government plans should be coordinated to protect areas. Plans should be reviewed for consistency by an Indian River Lagoon Board or Commission. The Marine Resources Council should serve as a clearing house to identify critical areas.

5. An inventory and mapping of current vital areas such as mangroves and seagrass areas was recommended.

6. Mosquito impoundments were considered an area where immediate action and benefits could be achieved in securing maximum productivity of the lagoon.

B. Are restoration programs viable in vital areas of the Indian River Lagoon? Who should be responsible for such programs?

1. In general, the groups agreed that he who damages a vital area should be responsible for correcting the situations.

2. There was general agreement that regional, basin wide or state funding should be made available for preservation and restoration in conjunction with private funding for restoration. Permitting agencies should be responsible for restoration with funding from the project under permit consideration.

3. Fines and restitution for adverse impacts in vital areas were recommended as a preventive measure. Where a project will inevitably damage the resource, compensation should be required in another portion of the river in order to maintain system function. Ties could be exposed to implement mitigation plans.

4. A special mitigation team was suggested which would:
   1. designate areas where mitigation and restoration programs could be successful

   2. assess the success of mitigation and restoration programs

   3. maintain credibility and a working relationship with developers

Question VIII Water Courses

A. Do local governments have effective ordinances to protect natural water courses and vegetative buffers along shorelines? If not, what regulations can be adopted to implement such controls?

1. local government regulations vary from city to city county to county. The degree of enforcement also varies.

2. Regulations between counties and cities should be coordinated as should a public awareness and education programs.

3. Regulations to implement control could be adopted on a unified basis to include:

   a) shoreline protection ordinances with buffer zones required and few hard structures.

   b) stormwater ordinances should include all projects regardless of size

   c) flood plain regulations

   d) comprehensive land use plans should be implemented

e) land clearing ordinances

f) landscape ordinances

g) drainage ordinances should require that past development runoff equal pre-development discharge

h) mangrove protection

i) regulation of docks and piers

j) setback and buffer regulations

B. What measures, if any, should be adopted to address the volume of water development and substances which do not settle out of retention ponds?

1. Natural vegetated wetlands on site should be retained for retention of stormwater and vegetated so as to optimize habitat water storage and percolation to ground water.

2. One group suggested the formation of local taxing districts to develop retention systems for large storm events; one in 25 or one in fifty year storms.

3. The problems of mosquito control in retention ponds was raised by one group.

Question IX Drainage Systems

A. Introduction Much of the drainage basin of the Indian River lies in low coastal lands subject to seasonal high water tables and flooding. In order to allow property owners to use this land, much of it is drained for flood protection. Drainage from the St. John's River Basin is also directed into certain parts of the Indian River. The increase in freshwater flow into an estuary from residential, agricultural, and industrial development can be detrimental to the ecology of the Indian River. Many of the drainag systems which discharge into the Indian River and its tributaries were established before the enactment of current environmental regulations and do not meet the standards for the volume of flow or the maintenance of water quality.

B. Should retrofitting be considered for existing drainage systems which were established before current environmental regulations and do not meet more recently adopted standards for the volume of flow or maintenance of water quality?

1. All groups agreed that retrofitting old systems should be undertaken, that freshwater should be treated as a pollutant. One group emphasized there was a desperate need. Another agreed that the diversion problem from

the C-54 and Fellsmere Canals is being solved by the St. John's River Water Management District. The problem of controlling discharge from the Melbourne-Tillman Water Control District is much more complex. One group cautioned that retrofitting must be done with care because ecosystems have stabilized to the original changes.

C. How can these improvements be financed?

1. There was general agreement that funds should come from public as well as private sources.

2. Two groups suggested, for instance, that the Florida Department of Transportation not discharge directly into the lagoon, but discharge primarily through other structures and ease runoff into the lagoon after movement through swales, wetlands, etc.

3. In the case of the private sector, that they "not be let off the hook", that in retrofitting mitigation may be necessary. If it cannot be accomplished, a fee should be charged in lieu of meeting the new standard.

4. Other means of financing

a) special taxing districts

b) property tax

c) water management district tax

d) user fees based on the volume and rate of discharge

e) impact fees

D. What public agency or agencies would be responsible?

1. The Water Management Districts in some capacity was agreed by two of the five groups

a) the water management districts acting independently and exclusively

b) the water management districts acting independently, but coordinated with local governments for projects below the districts permitting thresholds

2. Two groups suggested a special board selected to manage the Indian River Lagoon

a) a new board

b) sub-basin boards of the St. John's River and South Florida Water Management Districts

X. Fisheries

A. With the increased competition for the use of fisheries resources and docks and launch facilities, can the common public property of these resources be maintained to provide for both recreational and commercial uses.

1. all groups agreed that resources can and should be maintained for public and private use as long as it is managed to provide for all interests

2. Management must be based on the assumption that marine resources while renewable are finite.

B. Should certain areas be restricted to only recreational or commercial fishing?

1. The consensus of the groups was that it would be difficult or impossible to restrict or designate areas for special uses because the fish could move from one area to another and that given the current level of information about the resource it would be difficult to prove that either group was stressing the systems.

2. One group felt that some areas, grassbeds, canals, and navigation channels should be restricted from use by both the recreational and commercial fishermen.

C. Should some boat ramps be designated for only recreational uses?

1. There was general agreement that ramps should not be designated, but that in some areas parking near ramps was a problem, more space is needed to park cars and trailers.

2. The Brevard County clamming areas seem to be the only place experiencing a conflict. Clammers and recreation fishermen compete for the ramp use.

D. What measures can be taken to protect the value of the clam resource and the grassbeds which are vital to the lagoon as a whole?

1. There is a need for more enforcement and monitoring of the clammers by DNR.

2. Grassbeds should be posted or the rules revised to limit clamming to water of more than four feet in depth. A map of the grassbeds should be given to

clammers when they are licensed.

3. A system of intermittent closing of some areas and opening of others may preserve clam population.

4. A local bill on clamming should be taken to the State Legislature.

E. Could user fees be charged in addition to license fees for fishing and/or seafood dealing finfish, shellfish, crabbing, clamming, etc. Fees would be used for resource evaluation, development of management plans, enforcement and restoration.

The groups responded as follows:

1. increase license or user fees for commercial fishermen

2. tax commercial sale of a catch or act harvesting

3. recreational fishermen should be required to purchase a fishing license

4. money collected as an increase to existing license fees should be used in further baseline studies and research necessary for planning and management decisions as well as preservation, restoration, and enforcement.

XI. What research is most critical for future decision making on the river?

A. The following was submitted by a technical subcommittee of the Marine Resources Council:

See attached list

B. One group submitted the following as avenues of research to be pursued.

1. reassessment of the waste load allocations for the lagoon

2. investigate methods to reduce turbidity which can destroy grassbeds

3. investigate methods for using wetlands for stormwater containment

4. analyze the effects of nutrients on biological processes of the lagoon

    1. productivity of plankton
    2. relationship of nitrogen and phosphorus to eutrophication
    3. relate lagoon productivity to master drainage plans

5. document the detrimental effects of runoff from farms, cities, and sewage treatment plants

6. determine the relationship of the loss of isolated wetlands on timing, quantity, and quality of runoff into the lagoon

C. What institution and agencies should be responsible for research?

Universities should undertake the research in cooperation with state agencies.

XII. The protection of the economic, aesthetic, recreational, and environmental values of the river ultimately depends upon informed decision makers and the willing compliance of the public.

A. Is the current public information about the lagoon available and is its distribution coordinated?

No, information is not available and distribution is not coordinated.

B. What suggestions can be made for disseminating research and information to policy makers and the general public about the lagoon?

1. prepare a slide show about the lagoon to be used around the state and region or public broadcasting, civic groups, and schools

2. prepare a list of existing public information resources, booklets, etc.

ACTION

XIII. What mechanism can be established which would implement goals and objectives to protect the lagoon and to coordinate and monitor efforts to maintain the values of the lagoon so important to life in the Indian River region? What agency or unit of government should be responsible for administering programs to enhance the lagoon. What sources of funding would be available?

All of the American Assembly groups agreed that some action must be taken in order to properly plan for and manage the Indian River lagoon. A variety of methods for coordinated and comprehensive programs for the lagoon were proposed. From a review of the recommendations, it is evident that the group felt:

1. That the lagoon should be managed as a unit.

2. That a new agency or combination of existing agencies should be given the responsibility for for protection of the lagoon.

3. That immediate action is required.

The groups seemed to agree that information gathering research and analysis of management strategies should be undertaken on both a technical and management basis.

The following is a summary of the response of four groups who completed this section.

1. Three groups agreed that a special act of the legislature should create a special committee board to manage the lagoon. The establishment purpose and composition of the board varied as described below:

a. An Indian River Lagoon Commission should be established with the lobbying efforts of the Marine Resources Council. The purpose of the commission would be to develop a management program for the river.

b. A committee with a political orientation would be appointed from a locally generated list of nominees. The committee would seek "solutions to Indian River's problem." If local governments did not accept the plan the Governor would be encouraged to initiate a 380 committee to force action on the plan.

c. An Indian River Basin (Lagoon) Task Force would be to submit recommendations for management of the lagoon to the proper legislative delegations by December 31, 1986.

2. Action by the Governor was proposed to:

a. Create basin boards from each of the two water management districts for coordinated research and taking authority necessary to implement protection programs.

3. Three groups suggested that subcommittees or special groups should advise or assist the legislatively appointed board.

a. A technical committee should be established to determine research needs and pass technical solutions.

b. Joint studies of the lagoon should be undertaken cooperatively by the St. John's River Water Management District and the South Florida Water Management District.

c. The Marine Resources Committee should appoint a technical subcommittee to assist the Lagoon Board; act as a Citizens Advisory Group and monitor the progress toward implementing the recommendations of the symposium.

Research Needs/Institutions who could conduct or be responsible for the research

1. Marina siting investigations // County governments, DNR, private sector

2. Fisheries resource management investigations // DNR, universities and private research institutions

3. Inventory and determination of safegaurds for the aquatic preserves along the Indian River system // Regional governments, DNR, DER, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers

4. Investigations on the positive and negative aspects of mosquito impoundments and recharge areas for discharge of wastewater // DNR, U.S. Fish and Wildlife Service

5. Investigations on what can be done to restore or maximize the value of mosquito impoundments for fish and wildlife habitat while still maintaining the mosquito control // DNR, U.S. Fish and Wildlife Service

6. Inventory of pollutants and freshwater entering the Indian River system // County governments, sewage authorities, agricultural sector, water management districts

7. Circulation and flushing characteristics of the Indian River system // water management districts, universities, private research institutions

8. Primary and secondary production processes occurring in the Indian River system // private research institutions, universities, DNR

9. Basic biological and chemical monitoring program to assess state of the Indian River system and to determine extent of short- and long-term variability // private research institutions, universities, DER

10. Investigations of the extent of eutrophication and research to determine sources of natural and anthropogenic nutrients leading to eutrophication; concurrently, research on the ability of the Indian River system to assimilate both natural and human inputs to the system // private research institutions, universities, DER

PRELIMINARY CONCLUSIONS FROM
THE INDIAN RIVER RESOURCES QUESTIONNAIRE

1. Most respondents were familiar with the portions of the river between Cocoa and the St. Lucie River-73%.
   33% were familiar with the Cocoa to Sebastian Inlet area.

2. Few respondents (only 5%) were familiar with the whole river or Mosquito Lagoon.

3. Few new residents of the area responded to the questionnaire.
   Two percent of the respondents had lived in the area one year or less.
   Most (27%) have lived near the river for 1-5 years. Of the respondents 62% have lived on the river from 1-15 years.

4. Interest Groups responding
   - 18% Sports fishermen
   - 16% Scientists
   - 11% Homeowners
   - 9% Commercial fishermen
   - 9% Environmental groups
   - 5% Yacht Clubs
   - 3% Education
   - 3% Bait and Tackle/Marine Equipment Dealer
   - 50% 16 other groups

It could be inferred that sports fishermen, the scientific community and homeowners are the most concerned special interest groups on the river. Those who use the river most often for recreation and livelihood are most concerned

II. A. Condition of the Resources of the Indian River today 1984-1985.

		total river	by county
1.	Shorelines	stressed to average 41%-30%	stressed to average
2.	Wetlands	stressed to average 55%-28%	stressed to average
3.	Seagrass beds	stressed to average 48%-30%	stressed to average
4.	Nursery ares for fish and shellfish	stressed 60% worst possible 12%	St. Lucie County stressed to average
5.	Fish habitat	stressed to average 50%-38%	

6.	Spoil Islands	good to average to stressed 26%-47%-19%
7.	Mosquito Impoundments	average 46%
8.	Sports Fishery	average to stressed 40%-40%
9.	Commercial fishing	stressed to average 43%-34%
10.	Manatees	stressed to worst possible 80%-23%
11.	Endangered species	good to average to stressed 24%-31%-38%
12.	Mangroves	stressed to average 40%-34%
13.	Overall water quality	stressed to average 50%-30%
14.	Water circulation patterns	average to stressed to worst 39%-38%-13%
15.	Regulation Enforcement	average to stressed to worst 33%-32%-23%

Most resources of the river were perceived to be in average or stressed condition. Manatees were believed to be in stressed to the worst possible condition. Nursery areas for fin fish and shell fish were reported in stressed to the worst possible condition. Water circulation and the enforcement of existing regulations were considered stressed tending toward the worst possible condition.

II. B. Evaluation of the economic value of the rivers resources

1.	Ports	beneficial to moderately beneficial 44%-30%	comments
2.	Dredge and fill projects	beneficial 25% detrimental 77%	Brevard had high % of beneficial to moderately beneficial
3.	Barrier Island Development	detrimental 50%	Brevard and Indian River county had higher% for benefit to Barrier Island development

4.	Mosquito Impoundment	mixed response	
5.	Wastewater disposal	detrimental 60%	
6.	Causeways	moderately detrimental	seen as more detrimental in St. Lucie and Martin County
7.	Navigation Channels	beneficial 50% moderately 29%	
8.	Marinas	beneficial	
9.	Commercial fishing	mixed response	
10.	Recreational fishing	beneficial	

The respondents felt that Ports and Marina development as well as recreational fishing were beneficial to the economy around the Indian River. The present methods of Dredge and Fill, Wastewater Disposal and Barrier Island Development were seen as being detrimental to the economy of the region. Mosquito Impoundments and Commercial Fishing received mixed responses with no clear cut delineation between beneficial and detrimental effects on the River's economy.

II. C. Management of the Indian River Resources

1.	Marsh management	average to poor 44%-38%	
2.	Mosquito Impoundment management	average to good 30%-47%	tends to average to poor in St. Lucie and Martin County
3.	Dredge and fill permitting	average to poor 43%-41%	
4.	Fisheries management	average to poor	
5.	Fresh water flow and drainage	average, poor, worst 23%-47%-23%	poor to worst in St. Lucie and Martin County
6.	Local government Estuarine management	poor to worst 44%-25%	

7.	Regional Estuarine Management	poor to average 44%-28%
8.	State Estuarine management	poor 48%
9.	Federal Estuarine Management	poor 50%

Overall response to the management of the Indian River was shown to be from average to poor, and in some cases (Local Government), the respondents felt that management was from poor to the worst possible. Mosquito Impoundment management was the only exception. Respondents felt that the present system of management was above average.

Current Issues

1. Sewage Disposal
2. Waterfront Development
3. Freshwater Input
4. Barrier Island Development
5. Wetlands Alteration
6. Growth Management
7. Uncontrolled Commercial Fisheries
8. Turbidity
9. Sedimentation
10. Endangered Species

The current issues of this list are the ones which the respondents felt were the most important concerning the Indian River System today. The above list pertains to those issues which the respondents rated as less than immediate, but that may become potential problems. These issues were also rated as current problems/concerns. The above are those which respondents felt were long-term problems.

The top 10 issues concerning the Indian River accordint to the respondents were:

EMERGING

1. Marina development
2. Shoreline access for recreation
3. Aquatic weed management
4. Barrier island development
5. Growth management
6. Sewage disposal
7. Sedimentation
8. Uncontrolled commercial fisheries
9. Groundwater reserves management
10. Freshwater input

The above list pertains to those issues which the respondents rated as being of less than immediate but that will become problems in the future. These issues were also rated as current problems

III. A. Status of Scientific research and Information Services

1. Long-term scientific research studies	average to poor 28%-37%
2. Information available to the public	average to poor 33%-41%
3. Elementary School Education in Marine Resources	average to poor 29%-45%
4. Secondary School Information	average to poor 36%-41%
5. Public support of Protection programs	average to poor 32%-41%
6. General Public Awareness of problems	average, poor, worst 23%-46%-20%

For the most part the respondents felt that the Scientific Research and Information Services regarding the Indian River were average to below average. Nearly 40% of the responses were listed as poor for all areas concerned.

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