A BIBLIOGRAPHY

on Sarasota Bay, Florida

--Its Resources and Surrounding Areas--

REPORT
to the
U.S. ENVIRONMENTAL PROTECTION AGENCY
Region IV, Atlanta, Georgia

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by the
MOTE MARINE LABORATORY
Coastal Resources Program
Sarasota, Florida

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INTRODUCTION

This bibliography contains 348 citations of direct relevance to Sarasota Bay, Florida, its resources, and surrounding areas. In addition, 40 of the most important references --shown in bold type-- have been annotated, either by quoting their respective abstracts or summaries, or by original synopses (prepared by Greg Blanchard).

This document accompanies a report, "Sarasota Bay, Florida: Identification of Resource Management Problems and Issues", prepared by Mote Marine Laboratory for the U.S. Environmental Protection Agency, Region IV, in fulfillment of a cooperative agreement to evaluate Sarasota Bay in the context of estuary research and management needs. Individual references have been sequentially numbered to facilitate their citation in the Issues Report, but the bibliography has been produced under separated cover to facilitate its distribution and use.

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Annotated References

by

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Armentano, T.V., R.A. Park and C.L. Cloonan. 1988. Impacts on coastal wetlands throughout the United States, Ch. 4, In: U.S. EPA, Impact of sea level rise on coastal wetlands in the U.S. (in press).

Increasing atmospheric concentrations of carbon dioxide and other gases released by human activities are generally expected to cause a warming of the earth and elevation of sea level by expanding ocean water, melting glaciers, and affecting the polar ice sheets. Coastal marshes and swamps are generally within a few feet of sea level and would be lost if sea level rises significantly. Although new wetlands could form where new areas are flooded, this could not happen where the land adjacent to today's wetlands is developed and protected from the rising sea. The impact of sea level rise on coastal wetlands will depend in large measure whether developed areas immediately inland of the marsh are protected from rising sea level by levees and bulkheads. The projected rise in sea level can be expected to result in a net loss of wetlands in most areas. Factors not considered in this report could increase or decrease the vulnerability of wetlands to a rise in sea level. However, the coastal wetlands of Louisiana appear to be the most vulnerable to a rise in sea level.

Bird, P.M. 1980. Ecological study and environmental evaluation of the fishes of Sarasota Bay, Florida. In: W.J. Tiffany (ed.). Environmental status of Sarasota Bay: selected studies. Selby Foundation & Mote Marine Laboratory, Sarasota, various pages,

Sarasota Bay's fish population composition is comparatively homogeneous and shows considerable overlap of fish species between habitats. Habitats within the Bay, particularly the grass beds, were found to still function as viable ecological niches, affording food and protection to fish species of differing lifestyles. The Sarasota Bay fish population was dominated by the pinfish, Lagodon rhomboides, throughout the year. But peaks in the numbers of individuals and numbers of species occurred in June and October over all individuals and species.

Diversity indices indicated that Sarasota Bay is moderately stressed on an annual basis. The dramatic dominance of a single species, the pinfish Lagodon rhomboides, is also a sign of stress in the ecosystem. Gill anomalies that have been associated with polluted environments were very prevalent in Bay fishes. The high incidence of seriously parasitized fishes at the Phillippi Creek station may also be significant. Estuaries are historically subject to extremes of environmental conditions which vary from year to year as well as other natural and accumulative stresses so a single year of investigation is not sufficient to discern significant biological cycles.

Camp, Dresser & McKee, Inc. 1987. Sarasota County Stormwater Master Plan, Final Rept., Sarasota Co. Transportation Dept., Sarasota Co., Fla.

Inadequacies of the existing stormwater management system motivated preparation of a Stormwater Master Plan with the purpose of

assessing the need for improvement of major drainage systems in developed areas of Sarasota County. Analysis was limited to portions of 2 major basins, Alligator and Phillippi Creeks, and extrapolated to the 14 remaining non-coastal basins. Objectives of the detailed hydraulic and hydrologic analyses were for developed or developing areas to: 1) assess the adequacy of primary stormwater conveyance systems; 2) estimate improvement costs; 3) prioritize the management needs of individual basins; 4) develop a plan or identify options available for financing operation and improvement.

The analysis focused on improvements to the primary conveyance and outfall system. Local systems were treated only in enough detail to establish their impact on the primary system. Major tasks of the analysis were: 1) data collection; 2) drainage facility mapping; 3) land use mapping; 4) design storm development; 5) level of service determination; 6) Alligator and Phillippi Creek study; 7) assessment of the remaining basins; 8) ranking system development and application; 9) finance plan development. Consideration was given to the effects of flood control such as degradation of downstream water quality, floodway inundation, and outfall environmental impacts. 'Soft' drainage features including natural drainageways, artificial lakes, canals, and grass-lined open channels were focused on during development of the Master Plan due to the benefits they may give. Expected benefits included stormwater treatment, surficial aquifer recharging, and saltwater intrusion barriers.

CH_2M-Hill and Larsen Engineering, Inc. 1982. Manatee County wastewater master plan. Bradenton, FL. 1 Vol. (looseleaf).

Manatee County's Wastewater Master Plan is the result of a program to provide coordinated planning of wastewater management methods and facilities for the period 1985 to 2005. The planning area excludes the cities of Bradenton and Palmetto and subdivides the southern county to accommodate the expected rapid growth. Planning efforts are consistent with the results of an environmental inventory made for the original Section 201 facilities planning program. Additional design considerations include influent characteristics, regulatory requirements, effluent limitations, and evaluation criteria for wastewater disposal and treatment options. Most criteria are subjective, including such criteria as environmental impact, resource recovery, and implementability.

North Manatee County, currently served by numerous on-site and local systems, is proposed for development of a centralized wastewater service. Disposal options for the central treatment facility in this area include surface discharge into the Manatee River, deep well injection, limited access irrigation, urban refuse, and evaporation/percolation ponds. Surface discharge into the Manatee River after secondary treatment was recommended after analysis of alternatives. Increases in facility capacity serving southwest Manatee County will be required as the area develops. Expansion of the existing facility and reevaluation of discharge alternatives was recommended. Analysis of alternatives showed that surface discharge into the Manatee River of secondarily treated effluent was the preferred disposal alternative.

Southeast Manatee County is currently served by on-site and local systems in areas not concentrated enough to be served by the existing Southwest sewage treatment facility. A separate centralized sewage treatment service for the Southeast county is proposed. The discharge of secondarily treated effluent into the Manatee River is recommended as the best disposal alternative.

Collins, K.M. (1988). Growth and land use around Sarasota Bay: 1860-1987. In: E.D. Estevez (ed.). Proceedings, Sarasota Bay Scientific Information Symposium (in preparation).

The health of the Bay's natural resources was important to Sarasota Bay area residents, mostly fishermen and farmers, until recognition of the area's potential as a tourist destination in the 1920's subjugated concern for the protection of the natural environment to the profit motive. Development was particularly intense during the 1960's, and many of the Bay's natural features were altered or destroyed. Public and legislative knowledge of the experiences of Florida East coast communities motivated growth management efforts to protect the Bay's natural resources but intense development pressures rendered early attempts at comprehensive plans and zoning of coastal communities inadequate. The Local Government Comprehensive Planning and Land Development Act significantly improves growth management of coastal Florida communities. Comprehensive plans that will be adopted are now tied to the availability of natural resources as well as the ability of local governments to provide essential services.

Daltry, W.E. 1988. Economy of Sarasota Bay. In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in preparation).

Sarasota Bay's conventional economic impact of $20 million dollars annually is small, less than 1% of the total economic activity of Sarasota and Manatee counties bordering it. But, its contribution to the overall value of the community is much larger. Usage of the Bay as a sewage disposal and stormwater runoff pond are significant non-expenses to local governments. This environmental neglect increases the dollar value of the Bay by about 40%. The scenic value of Sarasota Bay is estimated using the conventional economic impact of waterfront residential properties. The annual dollar value of waterfront residential properties worth approximately $1.9 billion are four times the Bay's conventional economic value, or $87.5 million. About $115 million dollars of annual economic activity is provided by Sarasota Bay when the factors above are summed.

Edwards, R.E. 1988. Fishes and fisheries of Sarasota Bay. In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in preparation).

Based on limited ichthyological surveys of Sarasota Bay and extensive surveys of adjacent Tampa Bay and Charlotte Harbor, probably over 200 species of marine and estuarine fishes regularly occur in Sarasota Bay. Many important species are known to move between Bay waters and coastal Gulf waters due to seasonal changes in water temperature, food abundance, and/or life history patterns. Freshwater inflow to Sarasota Bay is low, and it does not have extensive areas with estuarine conditions, intertidal mangroves, or salt marshes. Movements of species requiring estuarine areas as nursery habitat to and from Tampa Bay may also be significant.

Sarasota Bay's recreational fishery is undoubtedly large and economically important, but it has not been quantified. Striped Mullet (Mugil cephalus), Spotted Seatrout (Cynoscion nebulosus), and Red Drum (Sciaenops ocellatus) are the most important species in the commercial fishery. Landings during 1985 from Sarasota and Manatee counties were 2,440,000, 70,000, and 45,000 pounds respectively. Spotted Seatrout landings have been in an almost continuous decline since 1951. The Bay is similar to other Florida systems in that the greatest previous impacts and the most serious future threats to fish and fisheries are probably those arising from changes that accompany regional population increase and urbanization. An inventory and characterization of important fisheries habitats is recommended in order to understand past and future changes of Bay fisheries.

Environmental Science and Engineering, Inc. 1977a. Final water quality report for the Phillippi Creek study area. Submitted to: SW Fla. Reg. Plann. Council. October.

Results of the Southwest Florida Section 208 Program study of the Phillippi creek area of coastal Sarasota County are presented. The water resources of the Phillippi Creek area are described and historical water quality data are examined. A sampling program was designed to obtain storm-event samples oriented toward quantifying nonpoint pollution loads and productivity samples incorporating chemical, physical, and biological data. Analysis of an energy flow model of an estuary was used to design the productivity sampling study.

A limited number of suitable storms restricted the storm-event sampling but enough data were obtained to show marked differences in the quality of the runoff water between stations. Pollutant loads from point sources, nonpoint sources, and background pollution levels were calculated for present conditions and estimated for future conditions. Regression models relating the concentration of a pollutant in runoff water to the percent imperviousness of the watershed were developed. Total wet season pollutant loads are approximately 1.5 times the dry season pollutant loads. Predictions of future total pollutant loads assuming no nonpoint controls were made.

The productivity sampling results showed that total community metabolism exceeded total respiration at all stations which is concluded to be indicative of a productive estuary. Diversity of planktonic and benthic invertebrate communities was not found to be indicative of a stressed environment, either. Total community metabolism is proposed as

a good indicator of water quality. Recommended and maximum allowable pollutant loads are presented. In order to meet recommended pollutant loads, nitrogen should be reduced 71% and phosphorous 91%. Lead loads are currently acceptable.

Estevez, E.D. and D.A. Bruzek. 1986. Survey of mollusks in southern Sarasota Bay, Florida, emphasizing edible species. Mote Marine Laboratory Tech. Rept. 102.

A literature review and field collections were made to assess the historical and present distribution of mollusks in Sarasota Bay south of Manatee County. Most traditional, commercial mollusk species occur or have occurred in the bay. Scallops have not been landed since 1964 and oysters have not been landed until 1967. Landings of hard clams, the largest shellfish resource of the bay, ended in 1971. Hard clams were present at many stations during the field collections, including waters which are closed by testing or because the waters are unclassified. Scallops and oysters are too rare to support a commercial fishery but hard clams may be capable of managed harvest. Quantitative distribution data and life history information on hard clams should be a research priority in the bay, especially if new areas can be opened to shellfishing.

Evans, M.W., T. Brungardt and R.K. Evans. 1978. Shoreline analysis of Sarasota County Bay systems with regard to revegetation activities. New College of USF, Fla. Envir. Stud. Prog., Sarasota Co., C.E.T.A. Prog. 2nd Sarasota Bd. Co. Comm. 71 p.

Study goals were: 1) to inventory and evaluate the estuarine resources of Sarasota County, 2) to develop techniques for managing and protecting those resources, and, 3) to make this information available to the residents of Sarasota County. Resource mapping showed an increase in seawalls, rip-rap, and Australian Pine/Brazilian pepper shorelines with associated decreases in mangrove, beach, and other vegetation. Total shoreline length was found to have increased 16% due to the creation of extensive canal systems. There was a 20% loss of seagrass coverage county-wide which was attributed to poor water quality and dredge and fill activities.

Two pilot projects undertaken to observe the effectiveness of different methods of shoreline stabilization and to obtain information on nursery cultivation of shoreline vegetation. A shoreline preference survey of the general public showed that public shorelines should be maintained in the natural state and that the process of estuarine erosion is poorly understood by local residents. Recommendations were made concerning shoreline revegetation, management plans for Geographical Areas of Particular Concern, County regulations, comprehensive plans for the 3 County passes, drainage, marine grassbeds, and coastal zone management staffing.

Evans, M.W. 1988. Geological evolution of Sarasota Bay. In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in preparation).

Studies near Sarasota Bay and knowledge of the Florida carbonate platform suggest that the location and morphology of the Bay are controlled by dissolution and collapse of the underlying limestones. In-filling of Sarasota Bay and similar West Florida lagoons is controlled by the interaction of tidal inlets, waves, wind, and biologic production of sediments. These processes in Sarasota Bay create 5 depositional environments: 1) protected bay; 2) open bay; 3) tidal delta; 4) mangrove forest; 5) tidal channel. The geologic response of the Bay to alterations in Bay processes and environments is unknown due to the lack of investigation. Research recommended to generate data for effective management is in the areas of: 1) basic geologic history and stratigraphy; 2) the composition, source and fate of fine grained suspended load; 3) sediment transport and accumulation in intertidal areas with respect to the rate of sea level rise.

Evans, R.K. 1988. Shoreline vegetation of Sarasota Bay: a review. In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in preparation).

Natural vegetation associated with Sarasota Bay shorelines includes three species of mangroves (Rhizophora mangle, Avicennia germinans, and Laguncularia racemosa), tidal marsh species (predominantly Spartina alterniflora), and other associated species such as leather fern (Acrostichum spp.) and buttonwood (Conocarpus erecta). In high energy areas of the bay, beaches along the intertidal areas with upland vegetation near the shoreline are common natural features. Approximately 22% of Sarasota Bay shorelines remain in a relatively natural state.

Of the altered shorelines, 45% are bulkheaded, 10% have been rip-rapped, and 23% have been artificially filled. In most of these instances, the intertidal areas have been eliminated or significantly reduced and space for native vegetation eliminated. Intertidal species have been replaced with upland plant species, usually ornamental lawns. Exotic plant species, primarily Brazilian pepper (Schinus terebinthifolius) and Australian pine (Casuarina equisetifolia) also invade in these instances and often shade any remaining shoreline fringe vegetation. Management considerations addressed in the paper include preservation, restoration options, mitigation, mechanisms for recovering the function of a natural intertidal community, and an analysis of existing regulatory programs.

Flannery, M.S. 1988. Watershed and Tributaries. In: Estevez, E.D. (ed.), Proceedings of an Estuarine Seminar on Tampa and Sarasota Bays: Issues, Resources, Status and Management. U.S. Dept. of Commerce, NOAA, Estuarine Programs Office, Washington (in preparation).

A low-lying coastal area drained by small streams, canals, conduits, and tidal creeks comprises the entire drainage basin of Sarasota Bay. The freshwater tributaries and their associated brackish zones are important elements of the Bay's biological structure and productivity. Six tributaries have been identified to supply runoff into Sarasota Bay. The low salinity habitat they create is utilized as nursery areas by a wide variety of marine fishes and invertebrates.

The distribution of rainfall is the most important meteorologic variable in the delivery of fresh water to Sarasota Bay. Streamflow is highest in the late summer with a smaller peak in February and March. All tributaries to Sarasota Bay have been channelized or otherwise modified to facilitate stormwater drainage. Water quality data are available for three of them. Nutrient concentrations in Whitiker Bayou are high due to the discharges from the City of Sarasota's Sewage Treatment Plant. Phillippi Creek receives both stormwater runoff and domestic wastewater discharges. The main conclusion reached was that tributaries should be managed for their own values, the low salinity habitats upstream of their mouths.

Florida Department of Natural Resources. 1985. Manatee County marine habitat restoration plan. Bur. Mar. Res. Mar. Lab., St. Petersburg. 112 p.

An assessment of potential techniques and sites for creation and restoration of marine fisheries habitats in Manatee County was made to direct the usage of a fund created by legislation for marine habitat research and restoration. The marine fisheries habitat is defined to be the coastal resource area of the Manatee County Comprehensive Plan for the purpose of this plan. It includes areas such as tidal marshes, mangrove forests, mud flats, oyster reefs, seagrass beds, and the water column.

Restoration techniques suggested for trial application in Manatee County are: 1) seagrass planting; 2) mangrove planting; 3) marsh planting; 4) littoral habitat creation along seawalled shorelines. Widespread implementation of a particular technique is not recommended until cost and efficacy is evaluated. Restoration sites were evaluated using the following criteria: 1) potential for creating functional marine fisheries habitat; 2) potential for eliminating or reducing a source of pollution; 3) availability of authorized access to the site; 4) suitable environmental conditions for an applicable restoration technique. Initial restoration projects, a site plus a suite of restoration techniques, were recommended at the Hendry fill and Port Manatee area (dredging, seagrass planting), any bulkheaded waterfront (littoral habitat), Bayshore Gardens/Trailer Estates Marina (aeration), and the Tidy Island area (spreader ditches).

Florida Department of Environmental Regulation. 1986. Proposed designation of Sarasota Bay and Lemon Bay as Outstanding Florida Waters. Rept. to Envir. Reg. Comm.

The Sarasota and Lemon Bay estuarine systems are recommended for designation as Outstanding Florida Waters (OFWs) with the exception of most tributaries, the areas near the mouths of Phillippi Creek and Whitaker Bayou, and artificial bodies of water. Alternatives designating no portion of Sarasota and Lemon Bays as OFWs or all of Sarasota and Lemon Bays as OFWs were rejected. Analysis showed that most of the waters in these two estuarine systems met the criteria of exceptional ecological and recreational significance for a "Special Water" designation. Water quality is generally good and there are considerable acreages of mangroves and marine grassbeds. The recreational significance of Sarasota and Lemon Bays probably exceeds the ecological significance already, and recreational use of the Bays is rapidly increasing.

The OFW designation enables the Department of Environmental Regulation and the regional water management district to apply more stringent criteria for permitting activities in the designated waters. Existing ambient water quality on the date of the designation may not be further degraded. Water quality behind Midnight Pass poses a problem since it has decreased after the pass closed. If Midnight Pass is reopened as expected, an amendment to the OFW rule may be required to increase the water quality standard to a level appropriate for a open Pass situation.

Giovannelli, R.F. 1988. Stormwater. In: Estevez, E.D. (ed.), Proceedings of an Estuarine Seminar on Tampa and Sarasota Bays: Issues, Resources, Status and Management. U.S. Dept. of Commerce, NOAA, Estuarine Programs Office, Washington (in preparation).

The water surface area of the Sarasota Bay system is approximately 40 square miles. There are another 30 square miles in the watersheds of minor tributaries and 50 square miles in the Phillippi Creek watershed. A sub-tropical pattern of rainfall produces unique seasonal characteristics affecting the quality and quantity of urban runoff. The summer rainy season produces the most significant portion of the runoff volume into the Bay system. Only about 10% of the Sarasota Bay watershed is undeveloped. The degree of development is directly related to the volume of runoff and is inversely related to the runoff water quality.

Separate stormwater and sanitary sewer systems serve the Sarasota Bay area so sanitary sewerage is collected and treated on a continuous basis by dedicated facilities while stormwater is untreated. The volume of runoff from the Tampa and Sarasota Bay areas is the highest among any large metropolitan area tributary to the Gulf. In the current regulatory environment, most local government attention is focused on flooding and runoff quantity problems. Results of a wasteload allocation showed that Sarasota Bay is sensitive to urban runoff due to the relative area of the Bay to the area of tributary watersheds.

Goodwin, C. 1988. Circulation. In: Estevez, E.D. (ed.), Proceedings of an Estuarine Seminar on Tampa and Sarasota Bays: Issues, Resources,

Status and Management. U.S. Dept. of Commerce, NOAA, Estuarine Programs Office, Washington (in preparation).

Physical characteristics giving the most insight into a system's circulation pattern are the tidal prism and the average annual freshwater inflow volume. An index of the degree of vertical density stratification in bays and estuaries, the estuary number, is computed using those characteristics. Values greater than 100 indicate a well-mixed system. Sarasota Bay has an estuary number of 1000. In such well-mixed systems, tidally-averaged horizontal circulation patterns caused by the interaction of tidal water motion and the bottom configuration predominate. Relatively little is known about the overall circulation pattern in Sarasota Bay while numerous circulation studies have been conducted in Tampa Bay. Questions which remain unanswered for both Tampa and Sarasota Bays are: 1) does wind dominate tide-induced circulation or is it a short-term perturbation, 2) what percentage of the water exiting the bays on an ebb tide returns during the next flood tide.

Haddad, K. 1988. Fisheries and Habitat. In: Estevez, E.D. (ed.), Proceedings of an Estuarine Seminar on Tampa and Sarasota Bays: Issues, Resources, Status and Management. U.S. Dept. of Commerce, NOAA, Estuarine Programs Office, Washington (in preparation).

Components of local estuaries important to juveniles of commercial and recreational fish species: mangroves, saltmarshes, seagrass meadows, mudflats, unvegetated bottom, and the water column are reviewed. Mangroves cover approximately 7% of the area of Sarasota and Tampa Bays. The aerial root systems provide a substrate for algae and invertebrates and provide protective structure to juvenile fishes. Saltmarshes, about 1% of the total estuarine area, serve mainly as transitional areas between the mangroves and freshwater marshes. About 10% of Tampa and Sarasota Bays are covered by seagrass meadows which are critically important to the productivity of the Bay systems. Seagrass meadows are the dominant subtidal vegetation in these systems. The complex food web of the seagrass meadows, which has high organism diversity and abundance, is a major food source for all stages of fish in the local Bays.

An overview of the current fish industry and some new programs which will influence fisheries management in Sarasota Bay is also presented. The bay has historically been a productive source of fish and shellfish. New approaches to fisheries management, habitat restoration, and fish stock enhancement will help in understanding Bay fisheries and increase the quality of fishery production.

Hand, J., V. Tauxe and J. Watts. 1986. Sarasota Bay basin technical report. An appendix of the 305(b) water quality inventory for the State of Florida, June 1986. Water Quality Monitoring Technical Rept. #79. Fla. Dept. Envir. Reg., June.

STORET water quality data from over 5000 Florida STORET stations during the 1970-1985 time period were assigned to 926 respective EPA

Status and Management. U.S. Dept. of Commerce, NOAA, Estuarine Programs Office, Washington (in preparation).

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reaches. About 70% of these reaches are stream reaches, 20% are estuarine or ocean reaches and 10% are lake reaches. The water quality of these reaches was classified according to an EPA stream water quality index and a DER lake and estuary trophic state index. The majority (60-70%) of Florida reach miles which were assessed exhibited good water quality and met there designated use, 25-30% partially met there designated use and 7-8% of Florida reach miles exhibited poor water quality and did not meet their designated use.

The distribution of water quality problem areas closely followed the distribution of Florida's population. Most water quality problems (55%) in the state were caused by point sources of pollution, including both domestic (33%) and industrial (22%) sources. Nonpoint sources of pollution accounted for about 44% of the water quality problems. Trend analyses performed on problem reaches where there was sufficient data indicated there were no significant trends in most cases.

Heyl, M.G. and L.K. Dixon. 1988. Water quality status and trends (1966-1986) in Sarasota Bay. In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in preparation).

A review of the water quality status and trends of Sarasota Bay was conducted to establish the state of knowledge regarding the water quality of the Bay. Specific goals were: 1) establish the current water quality; 2) review previously reported trends for Sarasota Bay and compare those trends with surrounding areas; 3) document the existence of unreported trends; 4) identify areas requiring additional research. The 1986 Florida Water Quality Assessment 305(b) Technical Report listed Sarasota Bay's water quality as 'good' using the WQI index and as 'poor' using the TSI index. The TSI index, designed for Florida estuaries, is probably the most appropriate measure. Analysis of previously published data showed that water quality in Sarasota Bay is improving and that the Bay is becoming less saline. But, the Sarasota Bay system was found to be relatively understudied compared to the adjacent Tampa Bay. A 6-point plan of recommended research is proposed which includes: 1) describe the Bay's productivity at all trophic levels; 2) establish the trend and status of seagrass communities and the relationship of water quality parameters to the heath of the seagrass communities; 3) establish the role of chemical precipitation in the Bay; 4) establish the cause of decreasing salinity in the Bay; 5) define the role of sediments in Bay nutrient fluxes; 6) establish and maintain a central database of Bay water quality data.

Lewis, R.R. III. 1988a. Seagrass meadows of Sarasota Bay: a review. In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in preparation).

Four of the seven species of seagrasses occurring in Florida (Thalassia testudinum, Syringodium filiforme, Halodule wrightii, and Ruppia Maritima) are represented on the shallow shelf areas and shoals of Sarasota Bay. The Bay's seagrass coverage as of 1987 is estimated to

be 3,062 hectares, a 25% decline from the post-World War II value of 4,047 hectares. Definitive data on the causes of the decline do not exist. Theorized causes include: 1) reduced light penetration due increased turbidity from dredging; 2) competition from algae due to eutrophication; 3) physical removal or damage due to boat propellers. Seagrass meadows are important as fisheries habitat and as sources of reduced carbon. Bay management programs should include better seagrass protection and active restoration efforts.

Lincer, J.L. 1975. The ecological status of Dona and Robert's Bays and its relationship to Cow Pen Slough and other possible perturbations. Final Rept. to Bd. Co. Commissioners, Sarasota Co., by Mote Marine Lab.

A study of the ecological status of Dona and Robert's Bays was initiated due to observed decreases in water quality which accompanied channelization of Cow Pen Slough. Hydrographic tidal models for the study region were produced and showed a dramatic difference in the hydrology of the wet season versus the dry season. The Cow Pen Slough/Shakett Creek basin outfall dominates the Dons/Roberts Bay salinity profile during the wet season. Rainy season activity generates low dissolved oxygen levels and significantly lower pH levels. Limited sedimentological analyses found fine-grained sands, organic matter and clay accumulated in Dona Bay after maximum runoff had occurred.

Cow Pen Slough contained generally lower amounts of nutrients than other creeks entering the study area. The effect of high rainfall on suspended solids levels in Cow Pen Slough/Shakett Creek is much greater than other creeks which was attributed to the lack of naturally vegetated banks and meanders. Chemical oxygen demand in Cow Pen Slough/Shakett Creek becomes very high after the first rainfall of the season due probably to the resuspension of bottom sediment. Chlorophyll, plankton, bacterial, benthic invertebrates, marine algae, and fishes were also sampled. A direct correlation was observed between salinity and benthic community species diversity. Widely fluctuating salinity causes the absence of bottom-stabilizing seagrasses and is considered to be partially responsible for increased turbidity in the bay.

Conclusions of the study may be summarized as: 1) the freshwater influx from Cow Pen Slough disrupts the normal dynamics of the estuary and results in freshwater weed and sediment accumulation in the estuary; 2) channelization has removed the buffering effect of a meandering creek bed while urbanization has disrupted the buffering effect of slow sheet-flow and rivulets ; 3) the effects of urbanization are reflected in the water quality program; 4) during the dry season Dona Bay functions as well as any Florida estuary; 5) bay water quality rapidly deteriorates at the beginning of the wet season due to runoff from Cow Pen Slough; 6) tidal flushing somewhat improves water quality later in the wet season; 7) Robert's bay is less affected than Dona bay to runoff due to better tidal flushing. Suggested management objectives and remedies are presented and discussed.

Manatee County, Florida. 1979. The Manatee Plan, a management system for Manatee County. 4 Vol., Bradenton.

The Manatee County Comprehensive Plan includes fifteen elements establishing the standards and criteria for future development in unincorporated Manatee County. Each element specifies the goals, objectives, and policies relevant to it as well as implementation statements identifying agencies, regulations, procedures, and resources required to execute the plan element. The Manatee Plan enacting ordinance addresses Plan adoption, applicability and effect, descriptive provisions, prescriptive provisions, and applicability to projects in the permitting process.

Conservation and coastal zone protection elements are separate elements of the Manatee Plan. The conservation element presents a detailed analysis of existing and potential problems and existing natural resources. Various alternative management strategies are examined. Principal matters addressed by this element's policy document are land use considerations, protection of agricultural lands, wetlands and drainage, woodlands, public safety, extraction (mining) processes, wildlife, and scenic areas and community design. The coastal zone element of the Manatee Plan analyzes existing conditions in the marine, estuarine and general coastal environment. The Policy document for this element addresses management boundaries, water resource protection, vegetative resources, natural landforms, activities impacting natural resources, and structures and activities. Other elements of the Plan which are significant from the perspective of coastal zone protection are the port and drainage elements.

Morrill, J.B. 1974. Hydrography of the Grand Canal and Heron Lagoon Waterways, Siesta Key, FL.

Water quality and marine life in two dead end canal systems on Siesta Key, Florida was compared to determine the effects of canal aging, whether or not such canals represent a public health risk, whether or not there is a 'good' canal system design and why it is good, and whether an old canal system be improved. Data were collected on hydrography, benthos, sedimentation, and phytoplankton in a seawalled and a 'naturally' banked canal system.

Study results did not directly answer the original questions but indicate the complex nature of the dead end canal system. The overall water quality and diversity of marine life was greater in the naturally banked canal system than the seawalled canal system, but poor circulation and a sewage outfall in the studied seawalled canal system appeared to be the primary cause of its poor water quality. General recommendations for water quality management and improvement in a dead end canal system include: 1) increasing the rate of tidal flushing; 2) pruning the shoreline vegetation to reduce the amount of leaf fall entering the canals; 3) restricting application of biocides and fertilizers to the uplands bordering the canals to periods of low rainfall to reduce the amount of runoff of; 4) employment of artificial methods to increase

dissolved oxygen above 2.0 ppm; 5) periodic monitoring of water quality and marine life; 6) reduction in storm sewer runoff.

Morris. J.K. 1988. SARABASIS discussion, group summary and evaluation. In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in preparation).

A participatory exercise asking symposium attendees to identify issues, problems, and benefits of Sarasota Bay was conducted using the Nominal Group Technique. The Nominal Group Technique emphasizes individual thinking and ranking of ideas in response to a specific question and includes a technique for compiling these individual rankings into group ranking. The group ranking of an idea is a measure of how strongly the members of a group felt about a particular idea. The ideas on the benefits of Sarasota Bay fell into several broad categories: 1) Habitat; 2) Recreation; 3) Aesthetics; 4) Economics; 5) Education and Research; 6) Interaction with Nature; 7) Water Conditioning; 8) Miscellaneous. Ideas collected on the issues and problems of Sarasota Bay also fell into several groups: 1) Education and Research Lacking; 2) No Management Plan; 3) Water Issues; 4) Habitat Destruction; 5) Lack of Coordinated Government; 6) No Forum for the Bay. The parts of a management plan can be formed by equating the benefits as the things to protect and the issues and problems as the things the plan should try to resolve.

Patton, G.W. 1987a. Studies of the West Indian manatee: Anna Maria to Venice, Florida. Mote Marine Laboratory Tech. Rept. 105.

Almost no Manatees were believed to exist in the Bradenton to Venice portion of Florida's west coast during the first half of this century. Three aerial survey programs conducted in the study area during the 1970's reported non-winter sightings of only twenty animals. A study was undertaken to provide data for determination of the regional status of manatees and important sites of concentration and ran from January to December 1985. Twenty-five flights (a total of 81 hours) resulted in 138 sightings totaling 314 manatees in herds of 1-12 animals; 8% were calves. A distinct southward migration trend was evident for December. Five areas of regular or recurring non-winter aggregation were identified: the southeast corner of Anna Maria sound; a large area "inside" Longboat Pass; the area between Coon Key and City Island; "inside" Midnight Pass; and the portion of Roberts Bay situated east of Siesta Key.

Pierce, R.H. and R.C. Brown. 1984. Coprostanol distribution from sewage discharge into Sarasota Bay, FL. Bull. Environ. Contam. Toxicol. 32:75-79.

Distribution of the fecal sterol, coprostanol, was determined in sediment from forty-one sites throughout Sarasota Bay, Florida to

estimate the impact of sewage effluent discharged from the City of Sarasota's wastewater treatment plant into Sarasota Bay. Coprostanol is one of the principle sterols found in the feces of man and other mammals, and has been shown to be a reliable marker of fecal pollution.

The results show very high coprostanol levels (2,500 ng/g sediment) in Whitaker Bayou (site of a sewage treatment plant outfall), indicating short range deposition of sewage-derived particulate matter. Concentrations decreased with distance into the Bay. Concentrations within Sarasota Bay exhibited a skewed distribution with the contours extending much farther from Whitaker Bayou in a north-south direction along the eastern shoreline than in a westward direction out into the Bay. The area containing coprostanol that may be considered to originate from the City of Sarasota wastewater discharge into Whitaker Bayou was approximately 7 km (N-S) by 2.2 km (E-W) or about 15.4 km2. Since Sarasota Bay encompasses about 80 km2, this study shows that approximately 20% of the Bay sediments has been impacted by sewage-derived particulates emanating from the Sarasota wastewater effluent.

Sarasota County, Florida. 1980. “Apoxsee”, Sarasota County’s Comprehensive Framework for the Future, Sarasota County, FL.

Conservation and Coastal Zone protection elements of Sarasota County's Comprehensive Plan are combined into one "Environmental" element rationalizing that coastal zone protection is a logical subset of conservation. Analysis reveals 23 primary concerns, real problems, or potential environmental problems. The basis of the Sarasota County's environmental goal is the solution of these problems considering the needs and wants of County residents. Eight objectives are required to be met to satisfy the environmental goal: 1) protect bays and estuaries; 2) protect beaches and dunes; 3) protect wetlands; 4) protect wildlife and wildlife habitats; 5) conserve soil and mineral resources; 6) maintain or improve existing air quality; 7) protect quantity and quality of surface ground waters; 8) protect and restore natural vegetation. Five alternative methods for meeting the objectives are presented and discussed in relation to the individual objectives. These methods are: 1) public acquisition; 2) incentives; 3) regulation; 4) improvement programs and technological innovations; 5) environmental education programs. Twenty-two policies were adopted on the basis of the discussion concerning the application of the methods to the objectives. Each policy is presented with a statement of its importance.

Sarasota, City of. 1979. Sarasota comprehensive city plan. Sarasota Planning Department.

The city Comprehensive Plan provides for an environmental inventory of the City of Sarasota, analysis of factors impacting the environment, and development of a plan for effective environmental protection, enhancement, and restoration. The Conservation and Coastal Zone Protection elements are combined into one common study element in consideration of the study area, coastal setting, similarity, and

administrative efficiency. A four phase Plan was developed consisting of research and analysis, the Conservation and Coastal Zone Management Plan, alternate management techniques, and the implementation program.

Research and analysis establishes the City's environmental base by identifying and inventorying specific resources critical to planning purposes. A composite problems and opportunities statement summarizes the primary research and analysis actions. The Conservation and Coastal Zone Protection Plan specifies the intent, goals, and policy of the Plan and the application of management strategies to particular geographic area and/or environmental issues. Examination of the various natural resource management techniques and their applicability to the City of Sarasota are determined in the alternate management techniques phase and specific recommendations as to the best techniques are made. The implementation program recommends mechanisms to implement the Plan.

Sarasota County, Florida. 1984. Blue Ribbon Panel for Midnight Pass, Summary Rept., April 24. 6 p.

Findings of the 'Blue Ribbon Committee for the study of Midnight Pass' which was appointed by the Sarasota County Board of County Commissioners are presented to the County Commissioners. The Committee divided its findings into 3 sections: 1) findings of fact; 2) the committee's vision of the most desireable conditions in the Midnight Pass Area by 2004; 3) conclusions and recommendations.

The Committee found that natural changes and catastrophic natural events have altered the configuration and biota of the Midnight Pass area. Human efforts have altered the natural dynamics of the pass and bay systems, contributing to the reduced stability of Midnight Pass and altering the extent of natural communities in Sarasota Bay. The Committee concluded that Midnight Pass is a mediating factor in diluting pollutants in Little Sarasota Bay and that pollution impact on Little Sarasota Bay will be exacerbated by the lack of exchange with the Gulf of Mexico. It was also concluded that the Midnight Pass/Little Sarasota Bay area is an altered system in a semi-natural state. Finally, a natural open Pass was agreed to provide more environmental benefits than a closed Pass. Midnight Pass in 2004 was envisioned to be as it was in 1965.

Sauers, S.C. 1988. Present management of Sarasota Bay: is there a method to the madness? In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in Preparation)

Formal allocation of natural resources to human activities is the basis of a conceptual approach to Sarasota Bay management which exploits opportunities for developing a formal management plan: a wealth of local technical expertise; a concerned citizenry; and the advent of the "National Estuary Program". It was concluded following review of current management efforts by federal state, and local agencies that Sarasota Bay is unmanaged rather than mismanaged. Symptoms identified are: lack of comprehension of the bay as an ecosystem; crisis decision making; lack of an institutional advocate for the bay; and lack of practical and

verifiable goals. A consolidation of agency function and responsibility is suggested to address the problem of shortcomings in the existing Sarasota Bay management efforts.

Sauers, SC. 1985. Ecological status of Little Sarasota Bay with reference to Midnight Pass. Submitted to Co. of Sarasota County, Coastal Zone Mgt. Div., Nat. Resour. Mgt.

An ecological monitoring program of the Little Sarasota Bay/Midnight Pass area to follow the response of Little Sarasota Bay to the closure of Midnight Pass was initiated in 1984 to provide local government leadership with detailed information to support future management efforts. The results of this ecological monitoring program support the findings of the Blue Ribbon Panel which commissioned it.

Based on limited historical information, the ecological character of Little Sarasota Bay as a whole and the Gulf of Mexico in the vicinity of the former inlet has not changed significantly over the past decade. Little Sarasota Bay as a whole did not deteriorate significantly during 1984 as a result of the closure of Midnight Pass, but the immediate bay-side vicinity of Midnight Pass has been affected by the inlet closure. It is recommended that Midnight Pass be reopened in view of the fact that ecological, navigational and recreational benefits of Little Sarasota Bay are maximized. Modeling of potential circulation improvements and a variety of environmental safegaurds are also proposed.

Seaman, W., Jr. 1988a. Planning Florida estuaries: bridging the gap between science and management. In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in preparation).

A successful and unique approach to reconcile divergent coastal interests has been implemented in Florida by integrating resource management, applied science, education, and inter-organization coordination. A uniform effort has been made for individual major estuarine systems to: locate scientific coastal data sources; present them to technical and lay audiences; and assist follow-up and continuity. Since 1976, over 50% of Florida's population have been affected by local and regional coastal resource decisions that have been assisted by scientific and policy-oriented conferences, publications, and resultant actions. Cooperative actions among public and private interests have developed for Apalachicola, Biscayne, Choctawhatchee, and Tampa Bays, the lower St. Johns River, and the Indian River Lagoon. The information assembly process helped in each situation to bring the various public and private interests together and increased the understanding of the application of scientific data to management decisions.

Tampa Bay Regional Planning Council. 1987. Future of the region: a comprehensive regional policy plan for the Tampa Bay region. St. Petersburg. 154 p.

The Comprehensive Regional Policy Plan (CRPP) of the Tampa Bay Regional Planning Council is based upon the policy document used by the Council to ensure consistent reviews of Development of Regional Impact, Local Government Comprehensive Plans, applications for federal assistance, and other activities of regional importance. The Tampa Bay Region CRPP contains the following sections: regional description, regional issues, regional goals and policies, and regional performance standards and measures.

The CRPP does not create regulatory authority or authorize the adoption of agency rules, criteria or standards not otherwise authorized by law. The goals and policies of the CRPP provide a framework for directing the human, natural, community and economic resources of the Tampa Bay Region. An implementation strategy consisting of growth management, intergovernmental coordination, and ongoing planning elements is developed. Determination of whether or not a project or activity is contrary to the public interest by the Tampa Bay Regional Planning Council involves consideration and balancing several criteria. If the proposed project or activity is unable to meet these criteria, the Council may consider measures to mitigate adverse effects in granting or denying an application.

Tampa Bay Management Study Commission. 1985. The Future of Tampa Bay. Rept. to Fla. Legislature.

The Tampa Bay Management Study Commission was created by a special legislative act in 1984 to examine opportunities for and the constraints against developing a unified, comprehensive management strategy for Tampa Bay. It was composed of 20 members representing a wide range of Tampa Bay's business, recreational, environmental, industrial, and academic interests.

The Commission reviewed 42 previously identified bay management issues and developed program objectives and recommended solutions for each issue. Recommendations included local government actions; state agency directives; research studies and monitoring programs; and legislative initiatives, amendments and funding allocations. The Commission proposed a total of $5,792,000 worth of needed studies, programs and various allocations.

Establishment of a coordinating, overview agency within the Tampa Bay Regional Planning Council with planning and advisory capacities for other agencies involved in management of the Bay was recommended. In the absence of significant strengthening of state and regional planning legislation the Commission recommended that a Bay Management Authority, with regulatory powers, be created to more comprehensively manage Tampa Bay.

Tiffany, W.J., III. 1980. Environmental status of Sarasota Bay: selected studies, Sarasota, FL: Mote Marine Laboratory.

A collection of marine studies conducted with the intention of providing baseline information to aid long-range planning and resource

management in and adjacent to Sarasota Bay are presented. These are individual, independent studies involving Mote Marine Laboratory and other local institutions of seagrasses, fishes, crabs, shrimp, heavy metals, sediments, plus hydrology and plankton. The study area encompassed Sarasota Bay system between the Bradenton Beach Bridge in the north and Phillippi Creek in the south.

The seagrass study defined the seasonal growth cycles of the two dominant species of seagrasses in Sarasota Bay. Habitats within the Bay were concluded to still be functioning as viable ecological niches in the fisheries study, but the Bay as a whole was found to be moderately stressed on an annual basis. Commercial catches of blue crabs and stone crabs from Sarasota and Manatee Counties are declining, as was the amount of nursery area in the Bay for these species. Copper, iron, and cadmium concentrations found in Bay organisms varied with species and tissue tested. The origin of the heavy metals are unknown, but probably enter the Bay via urban runoff.

U.S. Army Corps of Engineers. 1976. Final environmental impact statement. Maintenance dredging west coast inland waterway, Caloosahatchee River to Anclote River, FL. Jacksonville, FL.

An environmental impact statement prepared as background material for maintenance dredging on the Intracoastal Waterway from the Caloosahatchee River to the Anclote River is presented. The Sarasota Bay subarea encompasses approximately 22 nautical miles of the approximately 150 nautical miles of the entire project. Historical data summarized for the Sarasota Bay subarea cover regional geography, geology, sediments, meteorology, streamflow, tides, water quality, mangroves and seagrasses, plankton and invertebrates, and fishes. The least stable environment within the subarea was identified as the narrows between Little Sarasota and Sarasota Bays and attributed to freshwater input from Phillippi Creek. Studies cited consider the Sarasota Bay subarea as the richest estuarine community on the Florida West Coast.

The adjoining Lemon Bay subarea to the south is approximately 20 miles in extent but is about half the area of the Sarasota Bay subarea. Similar historical data are summarized. Limited chemical data suggests that the Lemon Bay subarea is a sump for fine sediments and toxic materials. There is a relatively limited amount of intertidal habitat available, however, tidal marsh and mangrove communities dominate the shoreline. Two Brown Pelican nesting areas were observed in this subarea.

Walton, R. 1988. Meteorology and hydrology of Sarasota Bay. In: E.D. Estevez (ed.), Proceedings Sarasota Bay Scientific Information Symposium (in preparation).

Sarasota Bay is a shallow embayment with weak tidal currents and other than at the mouths of tributaries, temperature and salinity effects are generally small. But, the Bay is strongly affected by storm events. Collection and analysis of field data enables estimation of transport