SEAGRASS MEADOWS OF SARASOTA BAY:
A REVIEW

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ABSTRACT

Sarasota Bay contains four of the seven species of seagrasses occurring in Florida. These are *Thalassia testudinum* Banks *ex* Koenig (turtle grass), *Syringodium filiforme* Kutzing (manatee grass), *Halodule wrightii* (Ascherson (shoal grass), and *Ruppia martima* L. (widgeon grass). The distribution of seagrasses is limited to the shallow shelf areas and shoals within the bay; our best "guesstimate" of the current (1987) seagrass cover within the bay is 3,062 ha (7,565 acres). Our estimate of the post-World War II seagrass cover in the bay is 4,047 ha (10,000 acres), indicating about a 25% decrease in seagrass areal coverage during the last four decades. There are no definitive research data to define the exact causes of this decline. Various theorized causes include light limitation from turbidity increases due to dredging, competition from microalgae and macroalgae due to eutrophication, and physical damage and removal due to boat propeller damage. Due to the probable importance of seagrass meadows as sources of reduced carbon and fisheries habitat for the bay, the exact causes of the decline need more precise delineation. Better protection and active restoration efforts receive high priority in bay management programs.

INTRODUCTION

Seagrass meadows have long been recognized as important food sources and habitat for benthic invertebrates and fish (Phillips 1960; Randall 1965; Wood, Odum and Zieman 1969). Wood *et al*. (1969) list these six important ecological characteristics of seagrasses:

1. High growth and production rates;
2. Leaves that support large numbers of epiphytic organisms with a biomass often approaching that of the seagrasses themselves;
3. Although used directly as food by few organisms, they produce large quantities of detritus which serve as a major food source for many species;

4. Ability to bind sediments and prevent erosion, and in turn provide a quiescent environment in which a variety of organisms can grow;
5. Provide organic matter which encourages sulfate reduction and an active sulfur cycle;
6. Act as nutrient sinks and sources.

More recently, the value of the epiphytic algae as a source of carbon in estuarine food webs has been validated (Fry, Macko and Zieman 1987), and the role of seagrass blades as a substrate for epiphytic algae is increasingly emphasized as a critical ecological role in eutrophic systems.

Several authors have noted that as the areal cover of seagrass meadows declines, typical fisheries associated with them also decline (Zieman 1982; Lewis, Durako, Moffler and Phillips 1985). Declines in seagrass cover have been reported for several estuaries in Florida, including Tampa Bay (Lewis et al. 1985), Charlotte Harbor (Harris, Haddad, Steidinger, Huff and Hedgepeth 1983), and Biscayne Bay (Harlem 1979).

THE EXISTING INFORMATION BASE

Sauers (1980) reports that four of the seven seagrass species that occur in Florida are currently found in Sarasota Bay. These are *Thalassia testudinum* Banks *ex* Koenig (turtle grass), *Halodule wrightii* Ascherson (shoal grass), *Syringodium filiforme* Kutzing (manatee grass), and *Ruppia maritima* L. (widgeon grass). A fifth species, *Halophila engelmannii* Ascherson, is reported as doubtful as an extant species in Sarasota Bay yet its occurrence has been documented in adjacent bays (Sauers 1980).

As has been reported for Tampa Bay (Phillips 1962, Lewis et al. 1985), seagrass meadows are limited to the shallow waters shoreward of the two met.er (one fathom) contour with more typical maximum depths for seagrass occurrence being 1.0 to 1.3 m (3 to 4 feet). Reduced light penetration due to high summer turbidities appears to be the limiting factor, although definitive data are lacking (Sauers 1980).

Definitive data on the current areal coverage by seagrass meadows in the bay, as well as the historical cover, also do not exist. Although four sets of areal cover data have been obtained and three trend analyses have been done on portions of the study area (as defined for this symposium), each study has resulted in different acreage figures. This has been due to many factors, including differences in boundaries of the study area and different base years. For this presentation, one additional attempt was made to determine areal cover and trends. This cursory mapping effort was done with the assistance of Ken Haddad at the Florida Department of Natural Resources Marine Lab in St. Petersburg. The base years used, based on available aerial photography, were 1957 and 1986 (see Figures 1 and 2). The data from our study and the four previous estimates are summarized in Table 1.

Table 1. Seagrass areal cover data reported for Sarasota Bay.

HISTORICAL ac	HISTORICAL ha	HISTORICAL year	CURRENT ac	CURRENT ha	CURRENT year	PERCENT CHANGE	REFERENCE
7,610	3,080	(1970)	--	--	--	--	McNulty, Lindall and Sykes 1972
1,925	783	(1948)	1,460	591	(1974)	-25	Evans and Brungardt 1978
262	106	(1948)	114	46	(1979)	-57	Sauers 1981
5,902	2,389	(1957)	4,493	1,818	(1982)	-24	NUS Corp. 1986
10,000	4,047	(1957)	7,565	3,062	(1986)	-25	This paper

The major differences in the numbers are primarily the result of each study concentrating on seagrass cover in different parts of the bay. For example, Evans and Brunghardt (1978) included only South Sarasota Bay and Robert's Bay, while the NUS Corporation study (1986) included only North Sarasota Bay. Sauers (1980) studied only a highly stressed portion of South Sarasota Bay; McNulty, Lindall and Sykes (1972) included both Sarasota Bay and Little Sarasota Bay, but did not include any historical data. A more detailed effort to determine seagrass meadow coverage in the study area is now underway by Mangrove Systems, Inc., under contract to Sarasota County. Complete areal coverage for the years 1948-49 and 1985 is being used, and the Florida Department of Natural Resources is continuing its assistance. The resulting maps and data should be available during 1988.

The most important conclusion to be drawn from the data in Table 1 is that all studies of trends in seagrass cover indicate that it is declining; our best estimate is that Sarasota Bay has lost about 25% of its historical seagrass cover. While some locations or specific grassbeds within the bay have exhibited increases in seagrass cover from year to year, this may be more indicative of seasonal variations than of a positive trend. As has been pointed out by several authors (Sauers 1980, Zieman 1982, Lewis _et al_. 1985), as seagrass cover declines, the available habitat for commercially and recreationally important fish and shellfish species also declines. Decline in seagrass cover has been implicated as one of the primary contributing factors to the collapse of the scallop fishery in Tampa Bay, and to declines in commercial harvests of spotted seatrout and bait shrimp.

Detailed studies of the fauna associated with seagrass meadows in Sarasota Bay have not been conducted, as has been reported for Tampa Bay

(Lewis et al. 1985). However, the few studies that have been done indicate that seagrass meadows in the bay support a diverse and abundant fauna and are a particularly important habitat. Clarke (1980) collected 17 species of shrimp from two seagrass meadows in the bay; the commercially important pink shrimp, Penaeus duorarum, was numerically dominant. Bird (1980, p. 12) collected 109 species of fish from the bay and concluded that:

> "Habitats within the Bay, particularly the grass beds, still function as viable ecological niches, affording food and protection to many fish species of differing lifestyles. Every effort should be made to protect and avoid further degredation (sic) of these vital areas".

Although much more study of seagrass meadow functions within the bay is needed, it is valid to conclude that, based on similar studies elsewhere in Florida (Zieman 1982), the seagrass meadows of Sarasota Bay are a critical component of the bay's ecological systems. Their continued existence is essential if the bay is to provide wildlife habitat and to support commercial and recreational fisheries. It is also safe to assume, based on the available data, that the total area occupied by seagrass meadows has been declining by about 1% per year over the last three decades. It is obvious that this decline must be stopped, and if possible, active restoration of seagrass meadows in the bay be initiated.

Of crucial importance in initiating a course of action toward these goals is an understanding of what factors have historically, and are currently, causing declines in seagrass areal cover. The problem is not unique to Sarasota Bay. Similar problems with defining causative factors in seagrass declines have been reported for Tampa Bay (Lewis et al. 1958), Chesapeake Bay (Orth and Moore 1983), the coast of France (Peres and Picard 1975), and Australia (Cambridge and McComb 1984). It is a worldwide problem, and it is critical to the concept of seagrass meadow restoration. Without understanding the causes of declines and the assurance that those causes are no longer present, the planting of seagrasses on barren substrate may be futile (Phillips and Lewis 1983, Fonseca 1987, Lewis 1987). In reference to Sarasota Bay, Sauers (1981, p. 136) noted that:

> "...historical changes add an important dimension to the determination of where and when to proceed with a [seagrass] revegetation effort. By noting the trend of seagrass decline in several areas of Sarasota Bay, one might conclude that ambient conditions are not suitable for successful restoration".

What are the ambient conditions that might prevent successful seagrass restoration and what are their causes? We do not know for sure, but there are some possible answers worth investigating.

Declines in water quality, especially reduction of light penetration associated with increasing turbidity, and the phytoplankton and epiphytic algae blooms associated with increases in dissolved nutrients (eutrophication), have been implicated in declines of seagrass acreage in estuaries worldwide (Peres and Picard 1975; Kemp, Boynton, Twilley, Stevenson and Means 1983; Cambridge and McComb 1984). Priede-Sedgwick, Inc. (1982, under contract to the Florida Department of Environmental Regulation [FDER]) conducted a wasteload allocation study in Sarasota Bay with specific reference to the impacts of the 34 million liters/day (9 million gallons/day) of secondarily treated sewage effluent discharged at Whitaker Bayou. Based on the results of the study, the FDER concluded that additional treatment of the effluent to tertiary levels (to remove nutrients) was not warranted. An expert panel convened by the City of Sarasota to review the issue concluded that the study had been critically flawed in its analyses and it "... could not be used to accurately depict the response of Sarasota Bay to point and non-point source loads..." (Wang, de Rooij, Ryther and Huggins 1985, p. 1-5). The panel's major conclusion was that relocation of the secondary discharge to a point 591 m (1800 ft) from the eastern shore of the bay was unacceptable because:

1. Violations of FDER's transparency standard would increase;
2. Poor natural mixing in the bay would result in accumulation of solids and nutrients;
3. Additional growth of phytoplankton would be expected to occur;
4. Distribution of seagrass would be likely to decline; and
5. Risk of stratification of dissolved oxygen would be increased.

These conclusions support the conclusion of Sauers (1981, p. 137), made some four years earlier, that:

> "Efforts should be made to reduce the input of nutrient-rich wastes to Sarasota Bay, since such inputs support blooms of phytoplankton and algae which contribute to high turbidity levels. These impacts result in declining seagrass stock and loss of benefits associated with the healthy functioning seagrass community."

Another, less well-documented problem is the direct physical removal of seagrasses resulting from damage by boat propellers. In healthy seagrass meadows, minor damage is probably not a problem. But in stressed systems, repeated damage on a large scale (Figure 3) could result in the loss of significant seagrass acreage. The remaining seagrass meadows in Sarasota Bay are being subjected to increasing pressure from both commercial and recreational boaters. Improved channel marking and educational programs will help, but active enforcement by FDER and Florida Marine Patrol are essential. Propeller dredging is now considered an illegal form of dredging and filling by state and federal resource agencies, but making a case is difficult.

RECOMMENDATIONS

Phillips and Lewis (1987) list nine priority research topics (Table 2), the results of which are considered essential to the proper management of seagrass meadows. All nine apply to Sarasota Bay; only one --historical mapping-- is now underway. The nine topics are arranged in approximate order of priority (highest first); however, the status of the existing data base for a particular area and local input on priorities are important. The outcome of some earlier studies can also dictate rearranging priorities. For example, if close interval aerial mapping (Topic 2) reveals that certain areas are showing natural recovery, this may raise the priority of Topic 6 in order to determine the possibilities of seagrass restoration.

If restoration testing is undertaken in Sarasota Bay, the prime candidate sites would be the submerged spoil areas adjacent to dredged channels in the bay where natural colonization by seagrasses has occurred. The primary problem with large scale restoration is the lack of available planting material. Lewis (1987) lists five potential non-destructive donor material sources (Table 3). Source E, impact site salvage, was successfully used during the replacement of the New Pass Bridge during 1983-1985 when 600 square meters (6,500 sq. ft.) of seagrass was impacted by fill (Mangrove Systems, Inc. 1985). The other sources remain to be tested in Sarasota Bay.

Table 2. Research priorities for seagrass meadows of Sarasota Bay (modified from Phillips and Lewis 1987).

TOPIC	DESCRIPTION
1. Historical Analysis	Aerial mapping and measurement of aerial cover of seagrasses over the period 1948-1986.
2. Current Trends	Close interval (maximum 2 years) areal mapping to monitor current trends in seagrass cover.
3. Light Requirements and Water Quality	Determination of the current light climate in various water bodies, the amount of light necessary to support healthy meadows, and factors that may be reducing downwelling irradiance.
4. Geology and Hydrology of Meadow Physiognomy	Determination of the effects of existing surface and subsurface geology and current patterns on meadow shape and size.
5. Fishery Habitat Importance	A comprehensive biological sampling program aimed particularly at species of importance in commercial and recreational fisheries.
6. Restoration Techniques	Multi-method plantings at selected locations representing the wide spectrum of potential restoration sites to determine the best species/methods combinations.
7. Propeller and Trawl Damage and Recovery Rate Monitoring	Quantification of increasing physical damage and needed recovery rates.
8. Boat Usage Management Study	Increased use of shallow-boat-channel markers, boat ramp signage, and boat-use-closure areas to protect seagrasses.
9. Target Water Quality Criteria	In conjunction with Topic 3, development of water quality criteria that are designed to ensure seagrass meadow protection.

Table 3. Summary of existing and proposed seagrass restoration plant material sources (from Lewis 1987).

SOURCE	ADVANTAGES	DISADVANTAGES
A. Harvested, unattached rhizomes	-available year-round -culture not required	-presently available only for *Halodule wrightii* and *Syringodium filiforme*, in the Florida Keys
B. Harvested fruits	-no sediment disturbance	-seasonal availability -locating fruiting plants -high cost of collection -presently available only for *Thalassia*
C. Collected seedlings	-no sediment disturbance -salvage of plant material that would normally die -low collection cost	-seasonal availability -presently available only for *Thalassia* -culture may be required
D. Beach drift-line salvage	-available year-round -salvage of plant material that would normally die -no sediment disturbance -low collection cost	-culture may be required
E. Impact site salvage	-intact plug removal helps ensure success	-replanting site needs to be prepared prior to salvage

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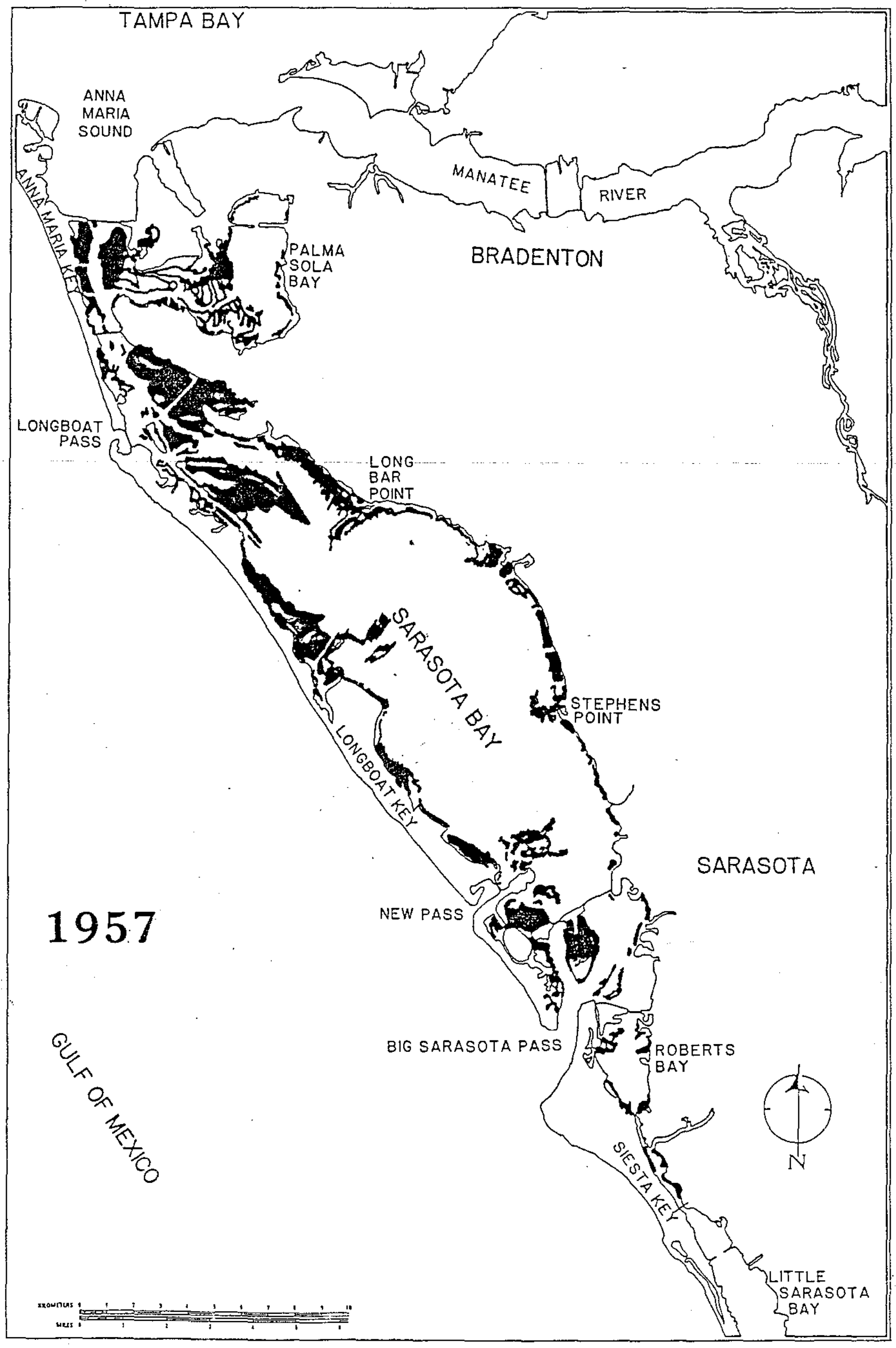
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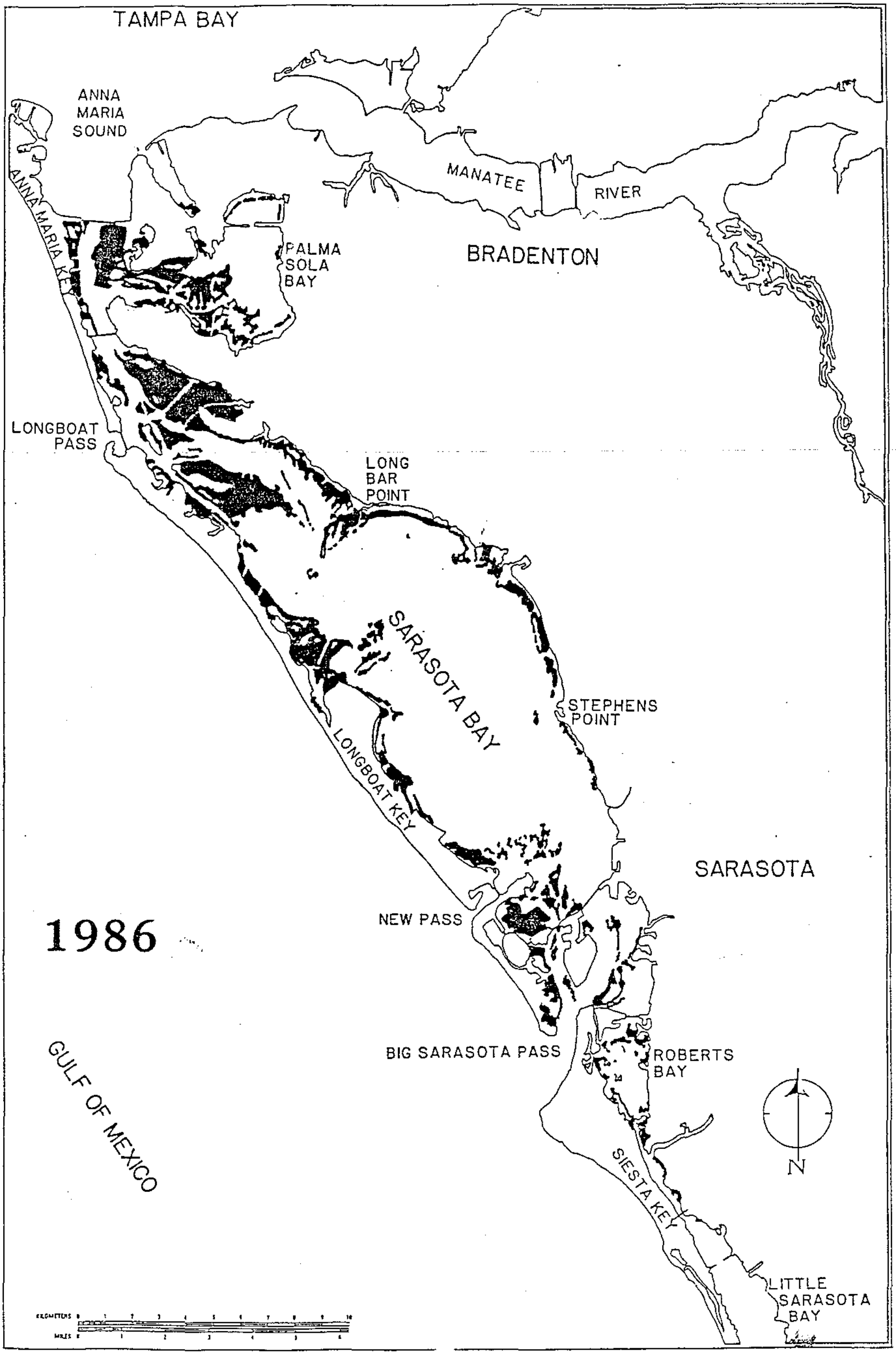
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