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An ongoing survey of Halodule wrightii, Ruppia maritima and the alga, Caulerpa prolifera, in Hillsborough Bay, Florida

City of Tampa Department of Sanitary Sewers

An Ongoing Survey of *Halodule wrightii, Ruppia maritima* and the Alga, *Caulerpa prolifera,* in Hillsborough Bay, Florida

April 1986 - April 1988

Initial Assessment and Design

City of Tampa
Department of Sanitary Sewers
Bay Study Group

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EXECUTIVE SUMMARY

In 1976, the City of Tampa created the Bay Study Group by initiating a comprehensive study of phytoplankton productivity and standing crop to monitor the effects of sewage pollution abatement in Hillsborough Bay. During the late 1960's and early 1970's, the City of Tampa was implicated as a major point source polluter of Hillsborough Bay based on its release, since 1951, of primary treated sewage into Hillsborough Bay. To alleviate nutrient loads into Hillsborough Bay, the City of Tampa constructed an Advanced Wastewater Treatment facility with a 60 MGD capacity. Secondary treatment was achieved in January 1978 followed by advanced wastewater treatment in January 1979.

Bay Study Group measurements in Hillsborough Bay have shown that concentrations of planktonic blue-green algae have diminished since 1983 and that water clarity has improved since 1979. Within the last decade, water quality improvements in Hillsborough Bay have also been observed by FDER district personnel and the Environmental Protection Commission of Hillsborough County.

The decline of seagrass coverage in Tampa Bay has been repeatedly attributed to dredge and fill operations and the degradation of water quality. Conversely, improving water quality conditions may lead to an increase in seagrass coverage. Seagrass meadows are vitally important to an estuarine ecosystem by stabilizing sediments and providing habitat for fish, shellfish, and many crustacean species. Seagrasses also represent a significant component of detrital food chains.

An increase in the areal coverage of the seagrass *Halodule wrightii* (shoal grass) has been documented along the eastern shore of mid-Tampa Bay between Apollo Beach and Simmons Park by a cooperative effort of the Bay Study Group and Mangrove Systems, Inc. After examining aerial photographs taken between 1983 and 1986, and after groundtruthing seagrass in June 1986, *H. wrightii* presence in a defined 3 km^2 area was found to have increased from zero coverage in January 1983 to 13.04 hectares in April 1986.

Bay Study Group personnel found indications of recent seagrass revegetation within Hillsborough Bay after reviewing aerial photographs taken from 1938 through 1986. Aerial surveys and field observations also revealed that, since April 1986, dramatic increases occurred in the coverage of *Caulerpa prolifera*, an attached benthic alga resembling seagrass to the untrained observer. In April 1986, the Bay Study Group began monitoring seagrass coverage, seagrass species composition, and *C. prolifera* coverage within Hillsborough Bay and adjacent waters. This monitoring program has been established to document existing vegetation and to find out if changing macrophyte coverage relates to changes in water quality conditions.

All Hillsborough Bay sandflats with potential for seagrass and *C. prolifera* growth have been carefully surveyed by monthly helicopter overflights (courtesy of the City of Tampa Police Department Aviation Unit), annual overflights by fixed wing aircraft, and numerous groundtruthing efforts. The location and areal coverage of each occurrence of seagrass and *C. prolifera* have been recorded. Several experimental sites were selected and marked off with PVC pipes to enable detailed measurements of vegetative coverage at least three times each year. Experimental sites include eight *H. wrightii* patches, one transect traversing an area of the seagrass *Ruppia maritima* (widgeon grass), and three transects each traversing an area of *C. prolifera* growth.

To date, 137 *H. wrightii* patches have been located with a cumulative area of about 1,960 m^2 (0.2 hectares). *H. wrightii* patches were most frequent in The Kitchen, an area in southeastern Hillsborough Bay. Considerable seasonal variability in *H. wrightii* blade coverage indicate that year to year assessments should be made during the same month each year, and preferably during a month of maximum blade cover (late summer).

From April 1986 to December 1986, *C. prolifera* exhibited a dramatic expansion in areal coverage from 2.5 hectares to 200 hectares along the southeastern portion of the Interbay Peninsula. Just south of Pendola Point, aerial coverage of *C. prolifera* increased from 0.9 hectares in March 1986 to approximately 65 hectares in January 1988. Total Hillsborough Bay *C. prolifera* coverage to date is about 275 hectares.

The cumulative areal coverage of several occurrences of *R. maritima* in Hillsborough Bay totaled 2.0 hectares. During the spring and summer, areas of *R. maritima* were often characterized by the conspicuous presence of flowering stalks.

The Bay Study Group will continue to monitor water quality conditions in Hillsborough Bay through monthly measurements of the phytoplankton community as well as dissolved oxygen and water clarity. Furthermore, periodic seagrass and *C. prolifera* coverage estimates should document whether or not submergent vegetation is returning to Hillsborough Bay, and if it is returning, whether or not its return is related to concurrent water quality trends. Large scale seagrass transplanting projects should not be undertaken until the progress of natural revegetation is adequately assessed and understood. Likewise, transplanting of *C. prolifera* into Hillsborough Bay would presently appear unnecessary due to the dramatic growth already underway in Hillsborough Bay.

ACKNOWLEDGEMENTS

The Bay Study Group thanks the Tampa Police Department's Aviation Unit for providing helicopters and pilots to aid in our seagrass program. Their generous assistance greatly enhanced our capabilities to locate areas of submergent vegetation and to monitor changes occurring in Hillsborough Bay. Also, we would like to thank Clint Lochridge and Alan Brasier of the City of Tampa Publications Department for their assistance in graphic art reproduction.

INTRODUCTION

Seagrasses are important both environmentally and commercially. Established seagrass beds can improve water quality by enhancing the settling rates of particulate matter (Ginsburg and Lowenstam 1958). The horizontal rhizome system of seagrass tends to stabilize sediments (Ginsburg and Lowenstam 1958) thereby repressing erosion and the resuspension of fine grained sediments (Kemp, *et al.* 1984). Submerged vascular plants, such as seagrass, can significantly contribute to the organic carbon budget (Kemp, *et al.* 1984) and are utilized indirectly in detrital food chains (Thayer, *et al.* 1975). Seagrass also serves as a habitat for fish and invertebrates and as a nursery for many of their species (Phillips 1960). In turn, commercial and sport fish frequent seagrass beds to forage for food.

Environmental degradation related to rapid urban development and dredge and fill in the Tampa Bay area (Simon 1974) has resulted in significant reductions in seagrass coverage (Lewis, *et al.* 1985). Lewis and Phillips (1980) reported a 79.6% loss of seagrass in Hillsborough County from 1876 to 1980 coinciding with an apparent decrease in the commercial catch of spotted sea trout in Tampa Bay.

Seagrass mapping in Florida has been accomplished by aerial photography, groundtruthing surveys, and the review of old maps, charts, and written records. Phillips (1962), in the most comprehensive seagrass study of Tampa Bay to date, mapped seagrass using 96 transects along the entire shoreline from Pinellas Point (Pinellas County) to Piney Point (Hillsborough County). Sipe, *et al.* (1979) reported "marine meadows" in Tampa Bay on vegetation maps for the years 1920, 1948 and 1978. These maps were generated using historical maps and aerial photography. Lewis and Phillips (1980) created seagrass coverage maps for 1876, 1948 and 1980 by integrating information from recent and historical photographs, groundtruthing surveys, and old maps. Virnstein and Carbonara (1985) mapped a portion of the Indian River on Florida's east coast using color aerial photography and groundtruth surveys to determine areal distribution and species composition of seagrass. They encountered difficulty differentiating between *Halodule wrightii* (shoal grass), *Syringodium filiforme* (manatee grass), and drift algae in aerial photographs and concluded that on-site determinations were needed to accurately assess species composition.

After reviewing oblique and vertical aerial photographs from 1938 through 1986, the City of Tampa Bay Study Group believes a reestablishment of seagrass is occurring in areas of Hillsborough Bay. Hillsborough Bay contains approximately 1,800 hectares (1 hectare = 10,000m^2) of intertidal flats that were apparently devoid of seagrass in 1983. Presently, 0.01% of these intertidal flats have *H. wrightii* coverage. Aerial photographs also illustrate an escalation in the growth of the attached benthic alga, *Caulerpa prolifera,* primarily on the subtidal flats around Interbay Peninsula and Pendola Point. Adjacent to Hillsborough Bay, the Bay Study Group and Mangrove Systems, Inc. (MSI) have documented a reestablishment of *H. wrightii* between 1983 and 1986 utilizing aerial photographs.

The unique opportunity exists in Hillsborough Bay and adjacent waters to assess potential seagrass restoration in areas that have been, in recent years, virtually free of seagrass coverage. Growth of *C. prolifera,* its possible competitive interactions with seagrass, and its value as a benthic habitat can also be ascertained.

The Bay Study Group intends to periodically monitor seagrass coverage, seagrass species composition, and *C. prolifera* coverage within Hillsborough Bay and adjacent waters. Potential relationships between various environmental parameters and seagrass coverage will be investigated. Results should provide valuable information concerning natural seagrass renewal and rates of seagrass growth. Such information is much needed in order to make sound decisions concerning seagrass restoration and viable mitigation options.

MATERIALS AND METHODS

Hillsborough Bay (Figure 1), a subdivision of Tampa Bay, is defined, for purposes of this study, as the area north of a line demarcated by: 1) the west end of the sheet pile at Tampa Electric Company's Big Bend discharge canal; 2) red marker #2; and 3) the MacDill AFB marina near Gadsden Point. McKay Bay, East Bay, as well as creeks and rivers extending east to U.S. 41 and north to Platt Street and State Road 60, are considered part of Hillsborough Bay. Figure 1 also shows locations of Figures 2-5, 7-11, and 13-15.

In April 1986, the Bay Study Group began surveying Hillsborough Bay and adjacent areas for seagrass and macroalgae using on-site groundtruthing and aerial photography. Monthly low altitude surveys by helicopter and annual high altitude surveys by fixed wing aircraft were scheduled in order to acquire oblique and vertical photographs respectively. When feasible, surveys were conducted at low tide.

Two seagrasses (*H. wrightii* and *Ruppia maritima* or widgeon grass) and one alga (*C. prolifera*) were mapped as part of the survey objectives. *H. wrightii* often grows in discrete patches that, when blade cover is retained, are distinguishable from surrounding areas of sand. The north-south and east-west axes of every *H. wrightii* patch encountered were measured during field surveys. Patch areas were determined using the formula for an ellipse, $A = \pi ab$, where a and b are the lengths of the semi-major and semi-minor axes, respectively. Subsequently, the location, shape, and approximate areal coverage of all *H. wrightii* patches found were recorded. *R. maritima* and *C. prolifera* do not grow in discrete patterns, thus estimates of their areal coverage were not as accurate. Areal estimates for *R. maritima* and *C. prolifera* were obtained using a planimeter on vertical aerial photographs. On-site estimates of areal coverage provided data for areas too small to use a planimeter effectively.

Eight patches of *H. wrightii* were selected for detailed study to encompass a variety of geographical locations and substrate characteristics. Five sites are located in the area known as The Kitchen (Figure 2) and are designated K-1 through K-5. In addition, single patches were selected in the Big Bend turning basin (T-1 in Figure 3), near the MacDill AFB Bayshore Boulevard entrance (M-1 in Figure 4), and along Bayshore Boulevard (B-1 in Figure 5). A square grid (Figure 6) was set up to encompass each *H. wrightii* patch by driving PVC pipes (¾-inch diameter) into the sediment at 1m intervals. All grids measure 7x7m except at site K-5 where the grid size is 8x8m.

The boundaries of each patch were measured in relation to the grid at 0.5m intervals. Short shoots densities were estimated using a 12.5 cm square in five arbitrarily selected locations within each patch. Each patch was plotted on paper and the area of seagrass cover was calculated using a planimeter.

Transects were set up in three areas to estimate *C. prolifera* abundance. An area of *C. prolifera* exists from the MacDill AFB runway extension, east to Gadsden Point and north to just north of the navigation channel serving MacDill AFB. Transect M-3 (Figure 4), which runs parallel to the shoreline, is located on the northern border of this *C. prolifera* zone. Transect Y-1, which runs perpendicular to the shoreline, was set up at Davis Island on the west side of "Cut D" channel (Figure 7). Transect B-2 (Figure 5) was marked off perpendicular to the shoreline near Ballast Point. All transects were 5m wide with lengths ranging from 80m to 200m depending on location. Each transect was partitioned into 5x20m quadrates. Transects were delineated by PVC pipes (¾-inch diameter) and terminated where *C. prolifera* became very sparse or absent. Ten randomly selected 1m squares within each 5x20m quadrate were visually inspected to estimate the percent coverage of *C. prolifera*. In addition, five of the ten 1m squares were randomly selected for blade counts. The abundance of the polychaete, *Diopatra cupraea*, and attached or drift macroalgae, other than *C. prolifera*, was also estimated in all randomly picked 1m squares.

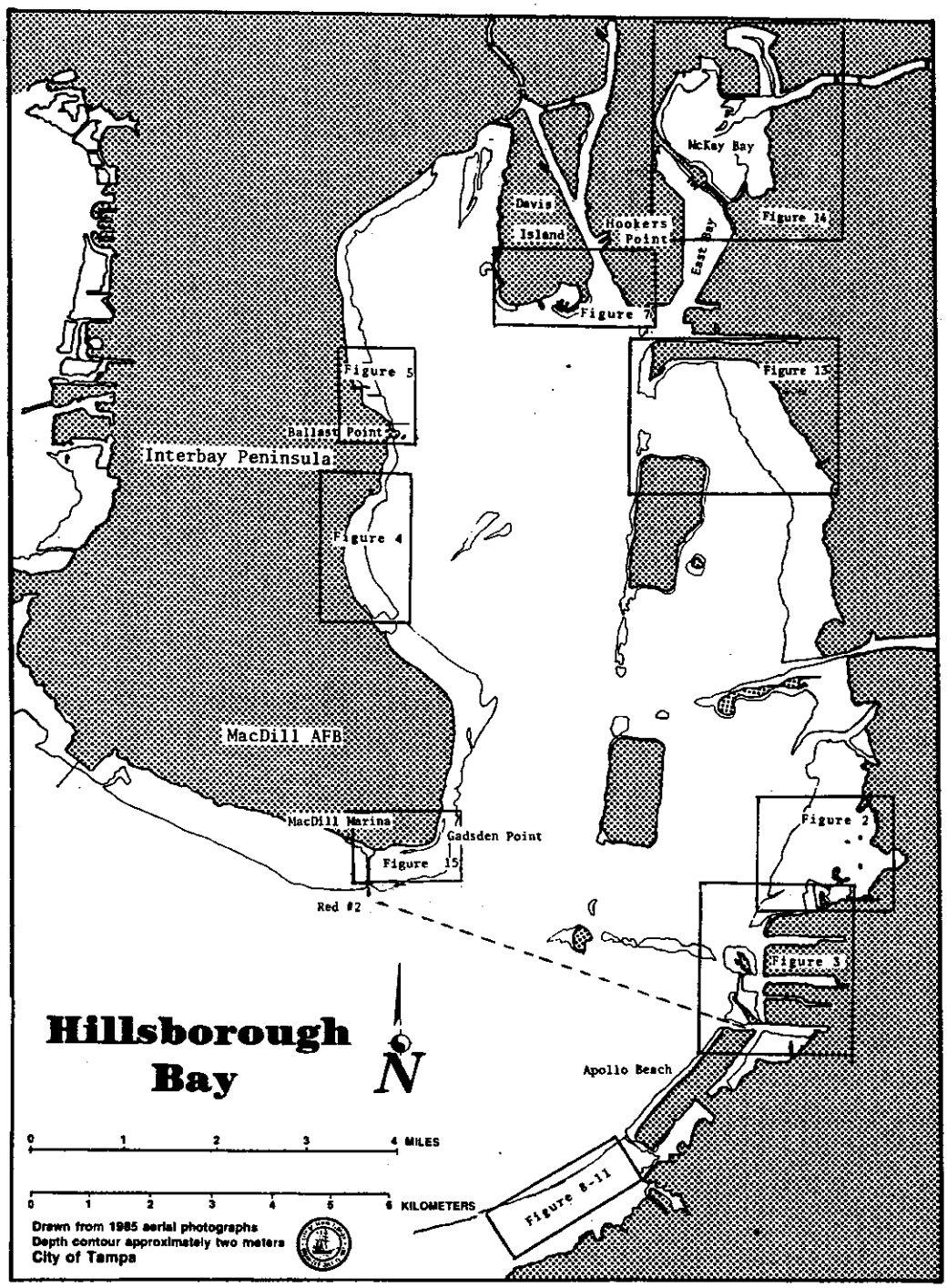

Figure 1.
Locations of detailed maps shown in Figures 2-5, 7-11 and 13-15. Southern limit of Hillsborough Bay is indicated by the hyphenated line.

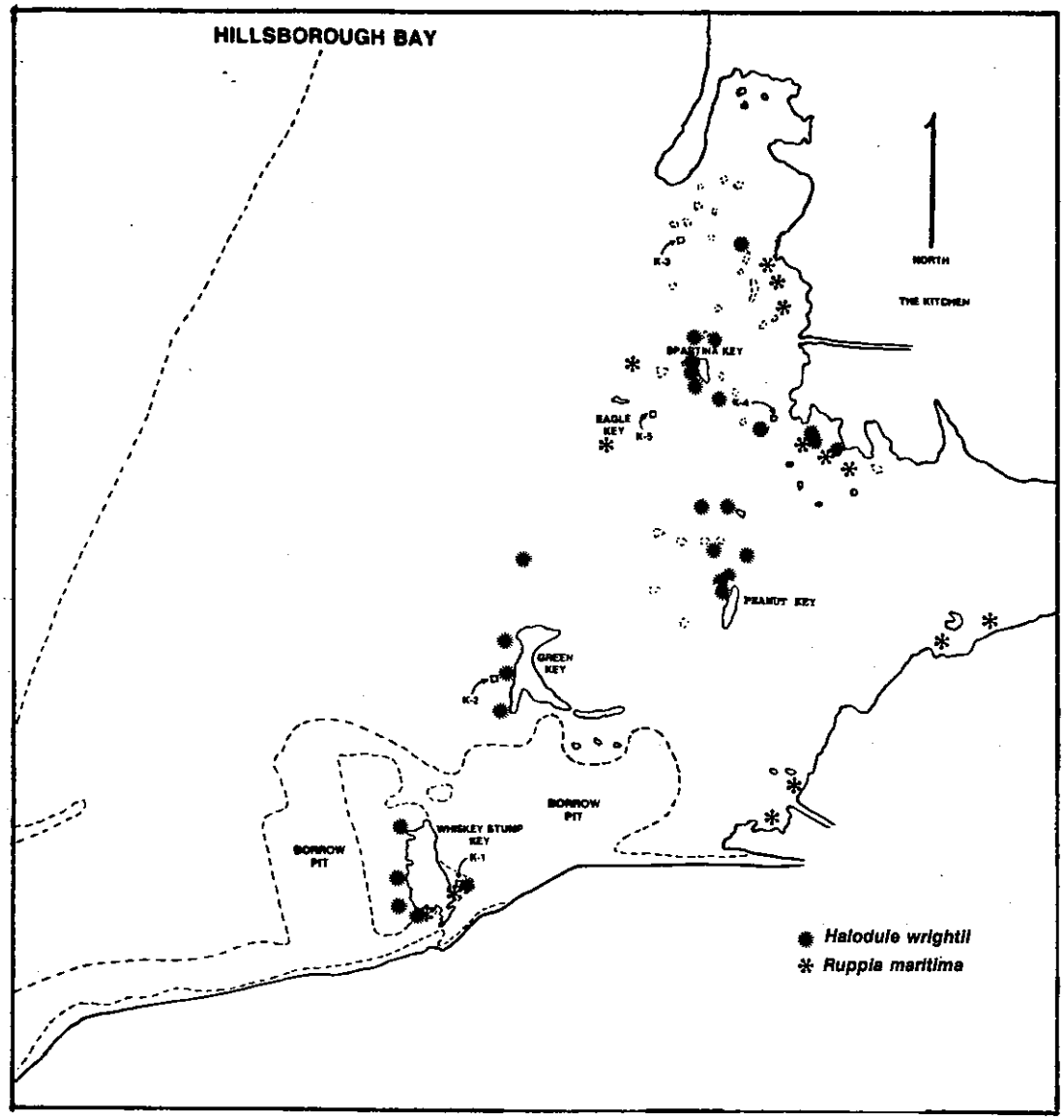

Figure 2.
Areas of *Halodule wrightii* and *Ruppia maritima* coverage and locations of *H. wrightii* study sites (K-1 through K-5) in The Kitchen.

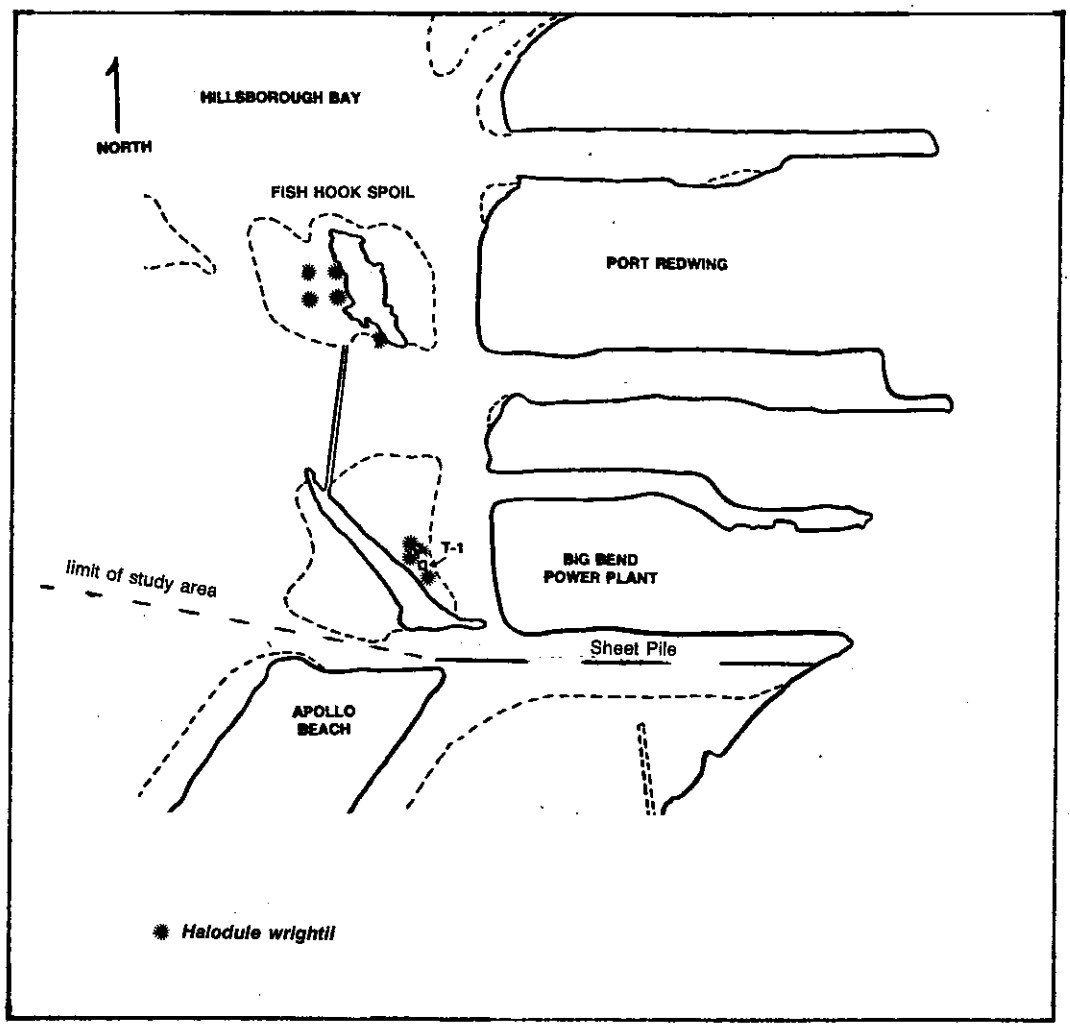

Figure 3.
Areas of *Halodule wrightii* coverage and location of the *H. wrightii* study site (T-1) at the Big Bend turning basin and Fish Hook Spoil.

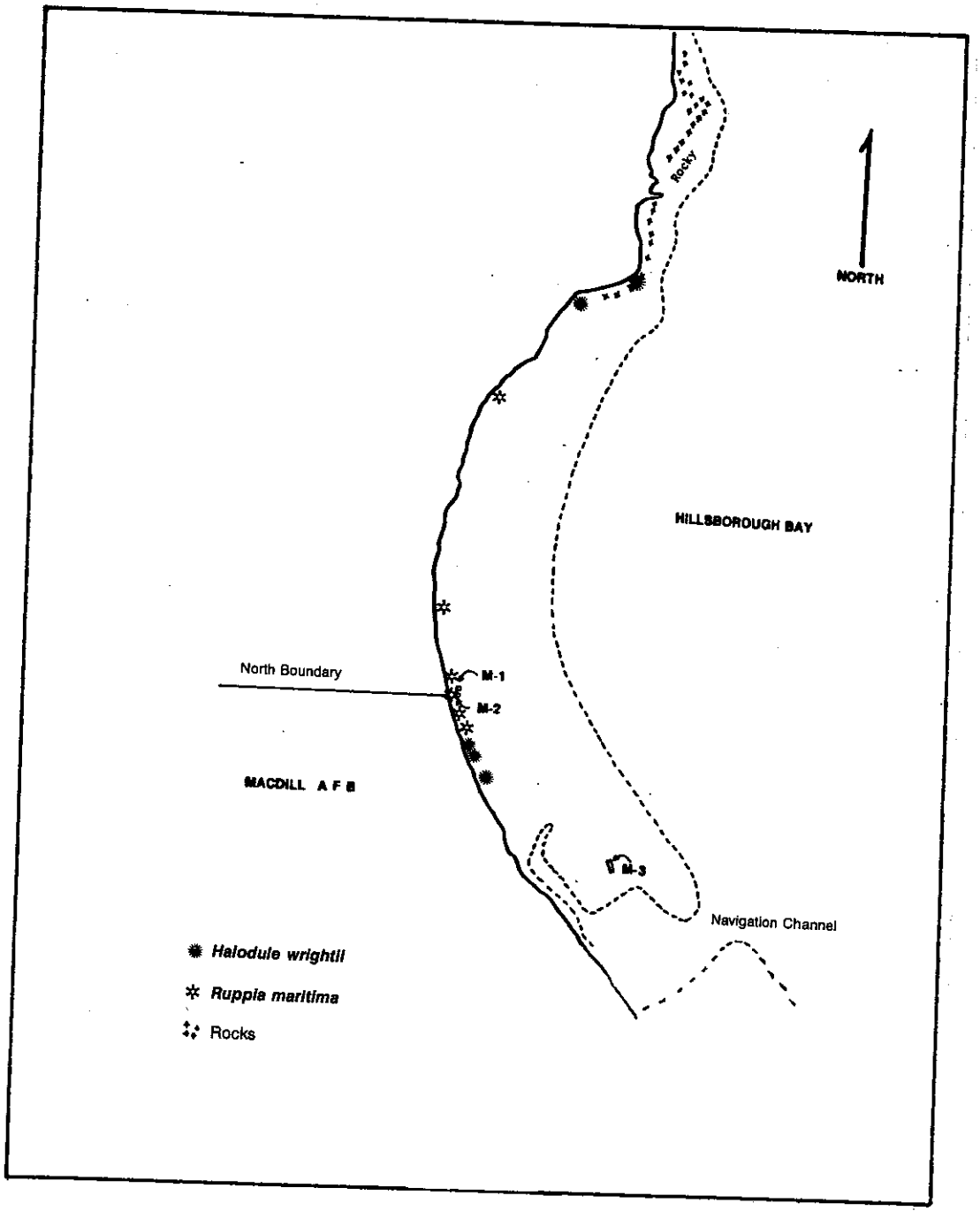

Figure 4.
Locations of *Halodule wrightii* (M-1), *Ruppia maritima* (M-2), and *Caulerpa prolifera* (M-3) study sites between Ballast Point and the MacDill AFB navigation channel.

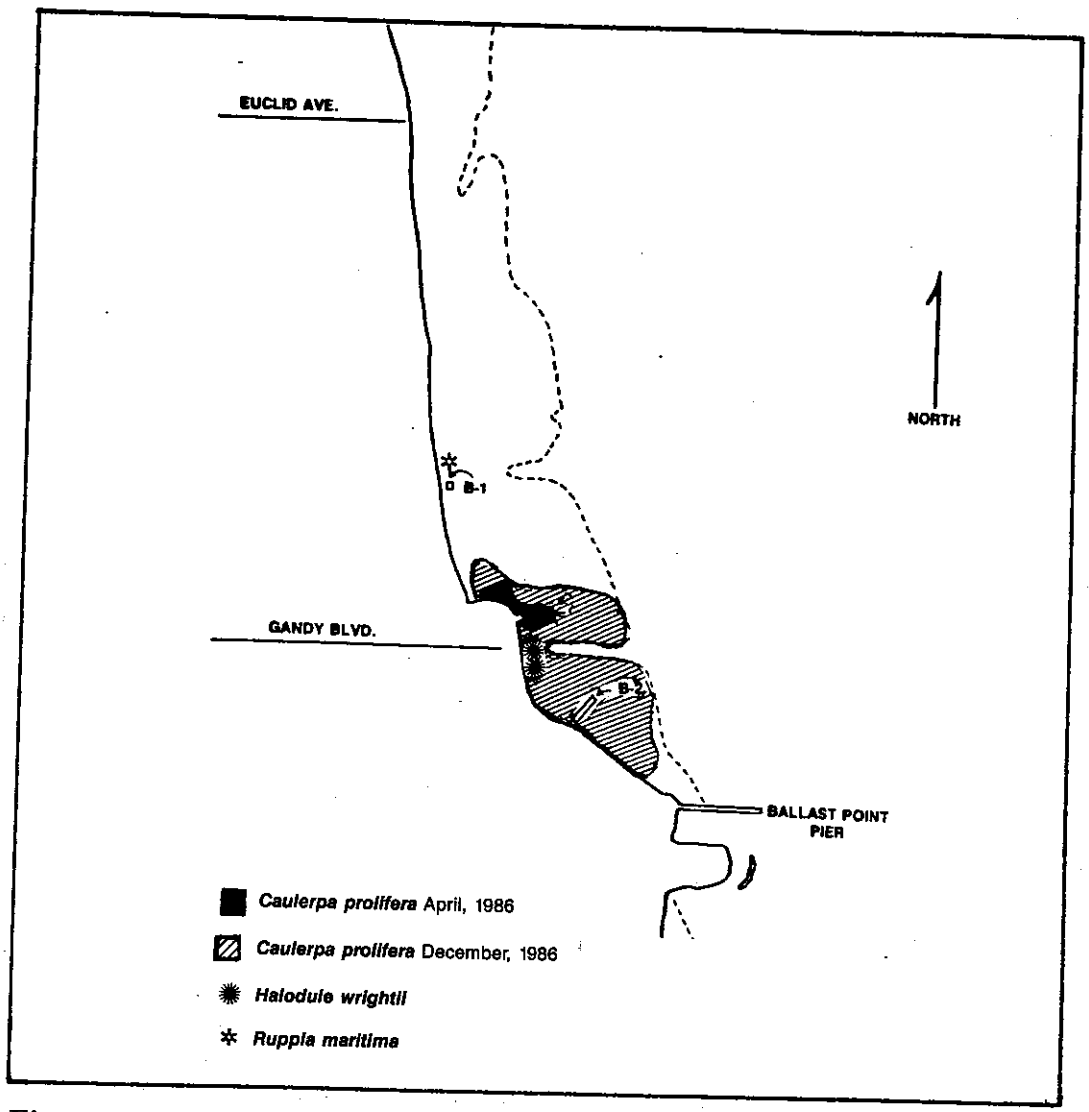

Figure 5.
Locations of *Halodule wrightii* (B-1) and *Caulerpa prolifera* (B-2) study sites. Area of *C. prolifera* coverage in April 1986 and December 1986 at Ballast Point.

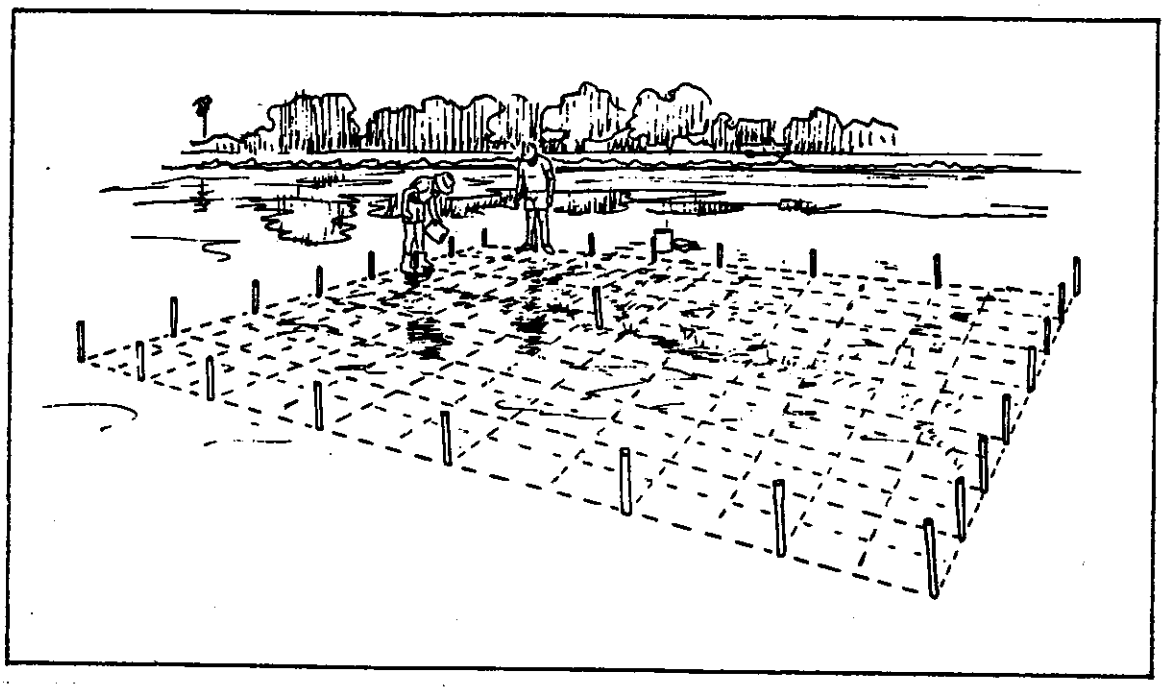

Figure 6.
Grid system of a *Halodule wrightii* study site (M-1) with PVC pipes at 1m intervals. Hyphenated lines represent the positions where a measuring tape is placed during measurements of patch dimensions.

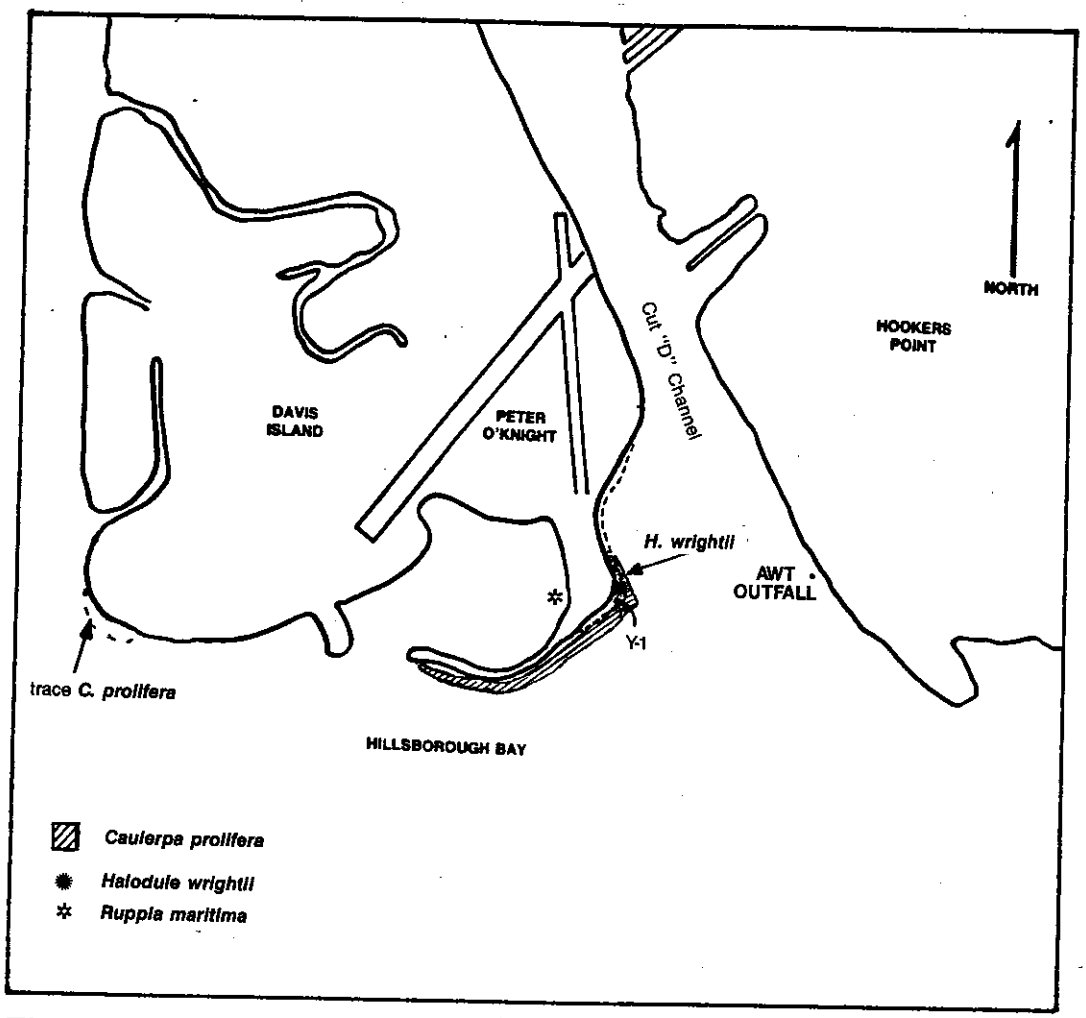

Figure 7.
Areas of *Halodule wrightii, Ruppia maritima* and *Caulerpa prolifera.* The *C. prolifera* study site is designated by Y-1.

One site of *R. maritima* (M-2, Figure 4) has been established for detailed study. The transect design and counting techniques are the same as those used for the *C. prolifera* sites. Two other *R. maritima* sites, located in The Kitchen and McKay Bay, are under consideration for study.

Elevation measurements have been made to determine the height of each study site relative to mean sea level, thereby enabling the placement of each study site on the intertidal-subtidal profile. Intertidal-subtidal elevations have been determined using City of Tampa bench marks that referenced National Ocean Service datum. Subsequent elevation monitoring will determine any occurrence of erosion and/or deposition.

All twelve study sites were established by December 1986 and every site will be revisited three times each year. Each site will be described as to areal coverage and short shoot density for comparison to 1986 baseline data. In addition, the water column depth, water temperature and salinity will be measured at each study site. Sediment samples from each site have been analyzed for grain size, total and organic carbon, and total nitrogen by MSI at the University of South Florida, Bayboro Campus. Total phosphate and selected metals will be determined by the City of Tampa, Department of Sanitary Sewer Chemistry Laboratory.

The Gadsden Point/MacDill AFB runway extension area is monitored by monthly overflights. Oblique aerial photographs are taken to document changes in seagrass and algal distribution. Qualitative observations of seagrass and algal distribution have been made with several on-site excursions in 1986. A more extensive study to determine seagrass and algal distribution will be initiated in 1988.

In June 1986, the Bay Study Group and MSI sampled six transects, that were oriented perpendicular to the shoreline, from the Simmons Park to Apollo Beach intertidal-subtidal zone. Surface and bottom measurements of salinity, temperature, and dissolved oxygen were recorded at stations positioned at 80m intervals along each transect. Furthermore, at each station, a 1m square was arbitrarily tossed ten times around an anchored boat. The species composition and percent cover of seagrass and drift algae were estimated *in situ* in each 1m square. At two transects, the same transects previously examined by Lewis and Phillips (1980) in 1980, blade densities were estimated by counting blades in a 0.25m square arbitrarily tossed six times. Subsequently, the City of Tampa contracted MSI to map an area delineated by a 3x1km rectangle located approximately 350m from shore (Figures 8-11). This area, with little macroalgae cover and only one seagrass species, *H. wrightii*, was selected to minimize interpretive errors. Although seagrass existed closer to shore than the study area, the grasses were not monospecific and mats of macroalgae prevented accurate interpretation of aerial photographs.

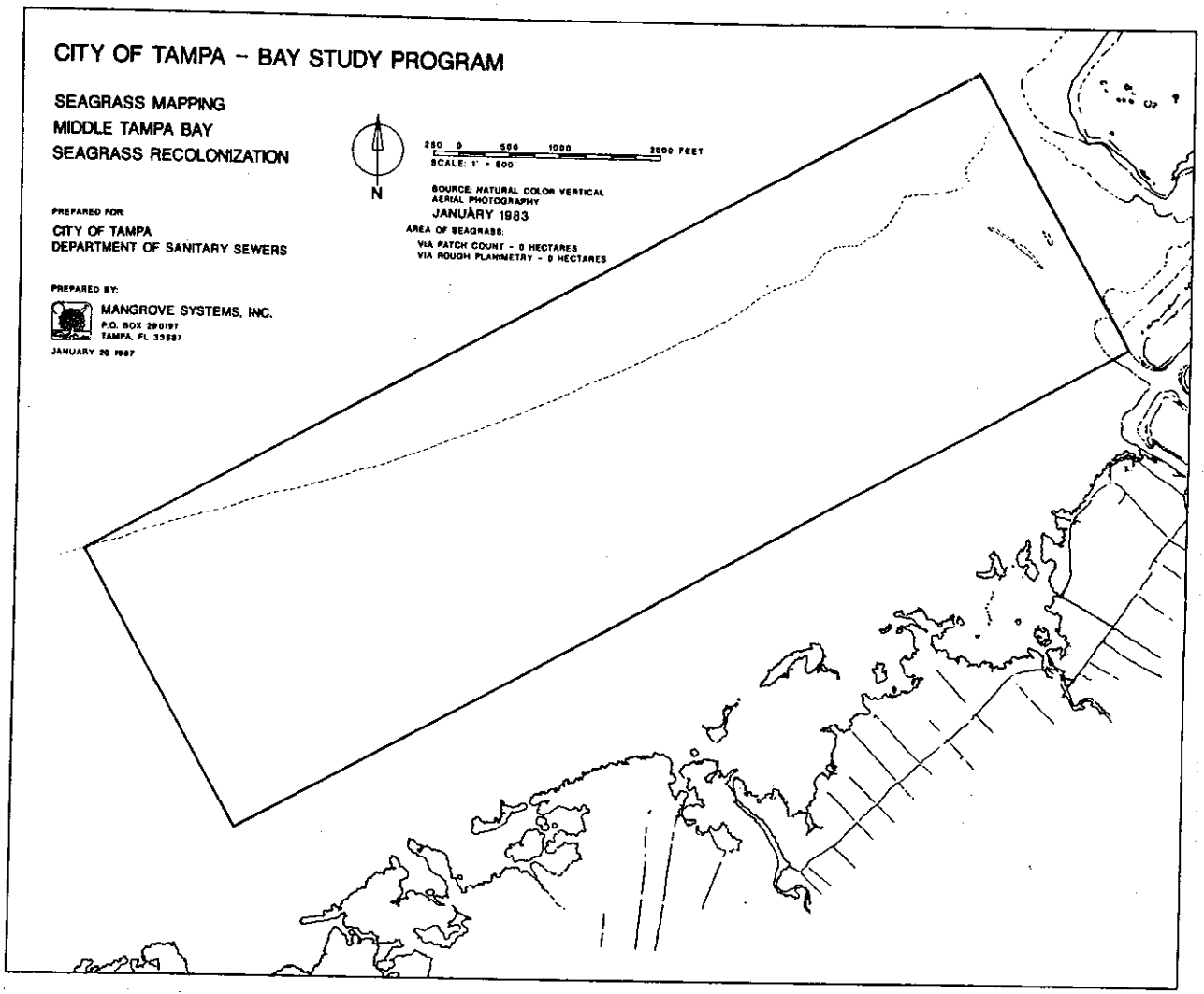

Figure 8.
Halodule wrightii coverage in a 3x1km area between Apollo Beach and Simmons Park in January, 1983.

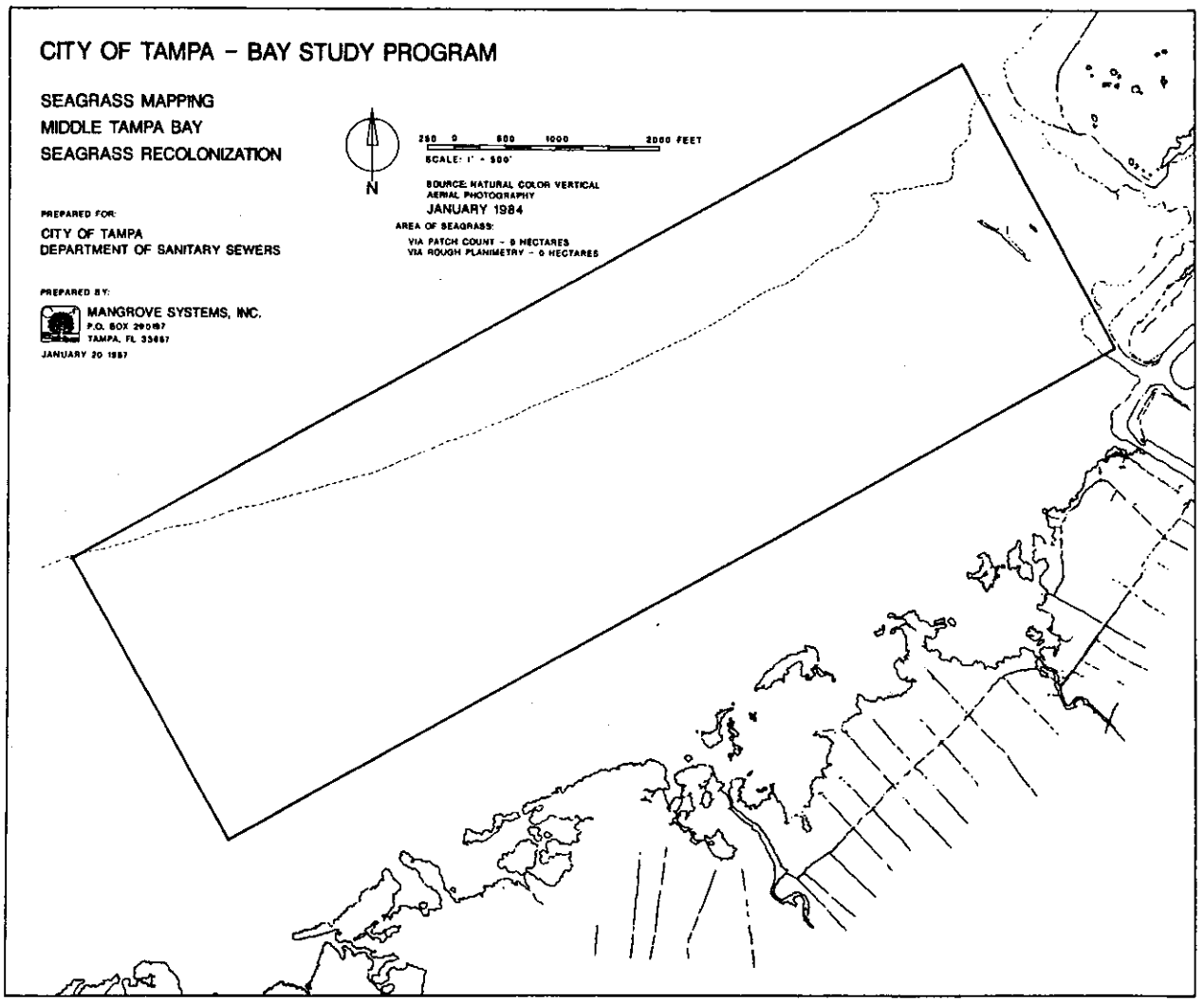

Figure 9.
Halodule wrightii coverage in a 3x1km area between Apollo Beach and Simmons Park in January, 1984.

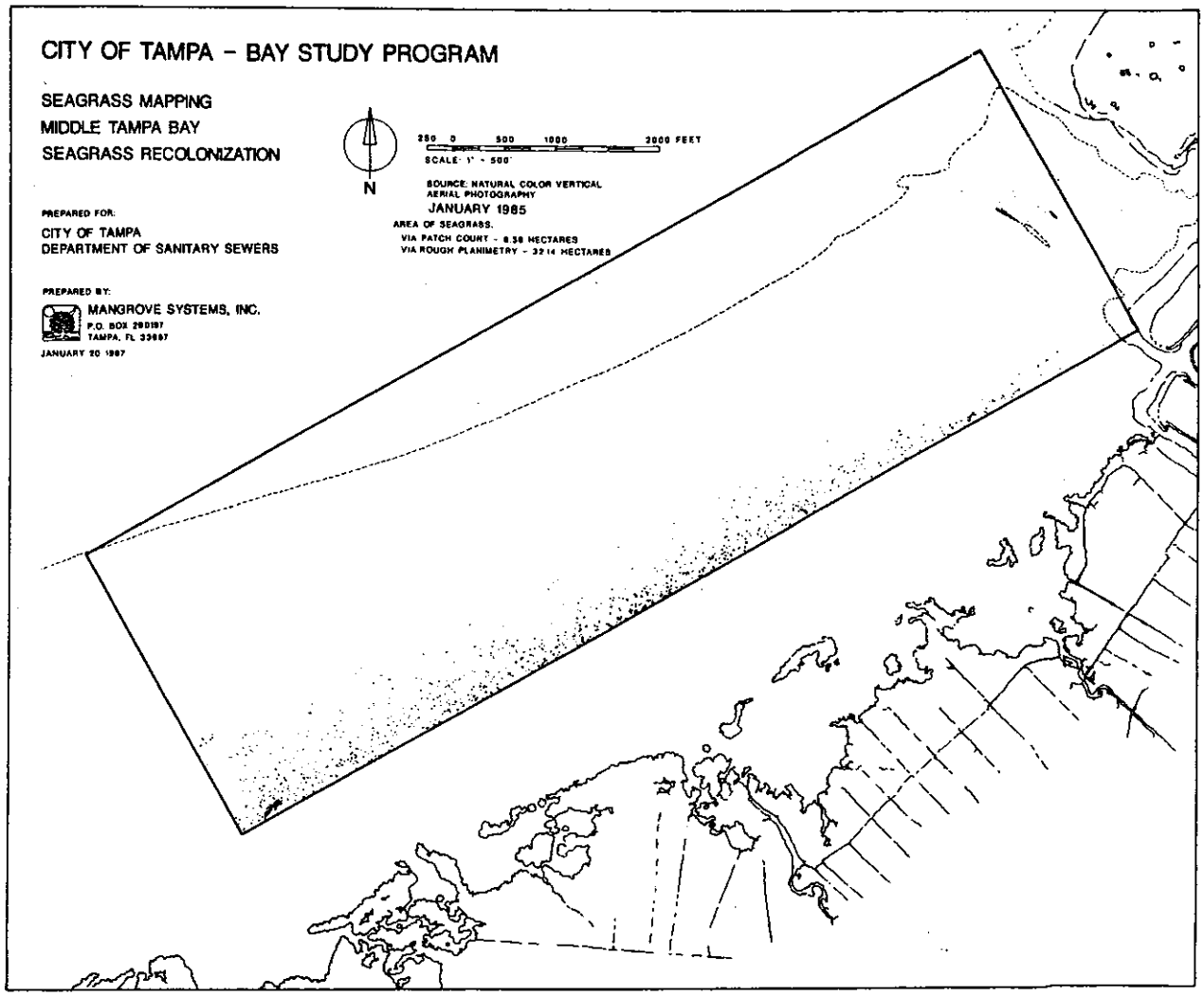

Figure 10.
Halodule wrightii coverage in a 3x1km area between Apollo Beach and Simmons Park in January, 1985.

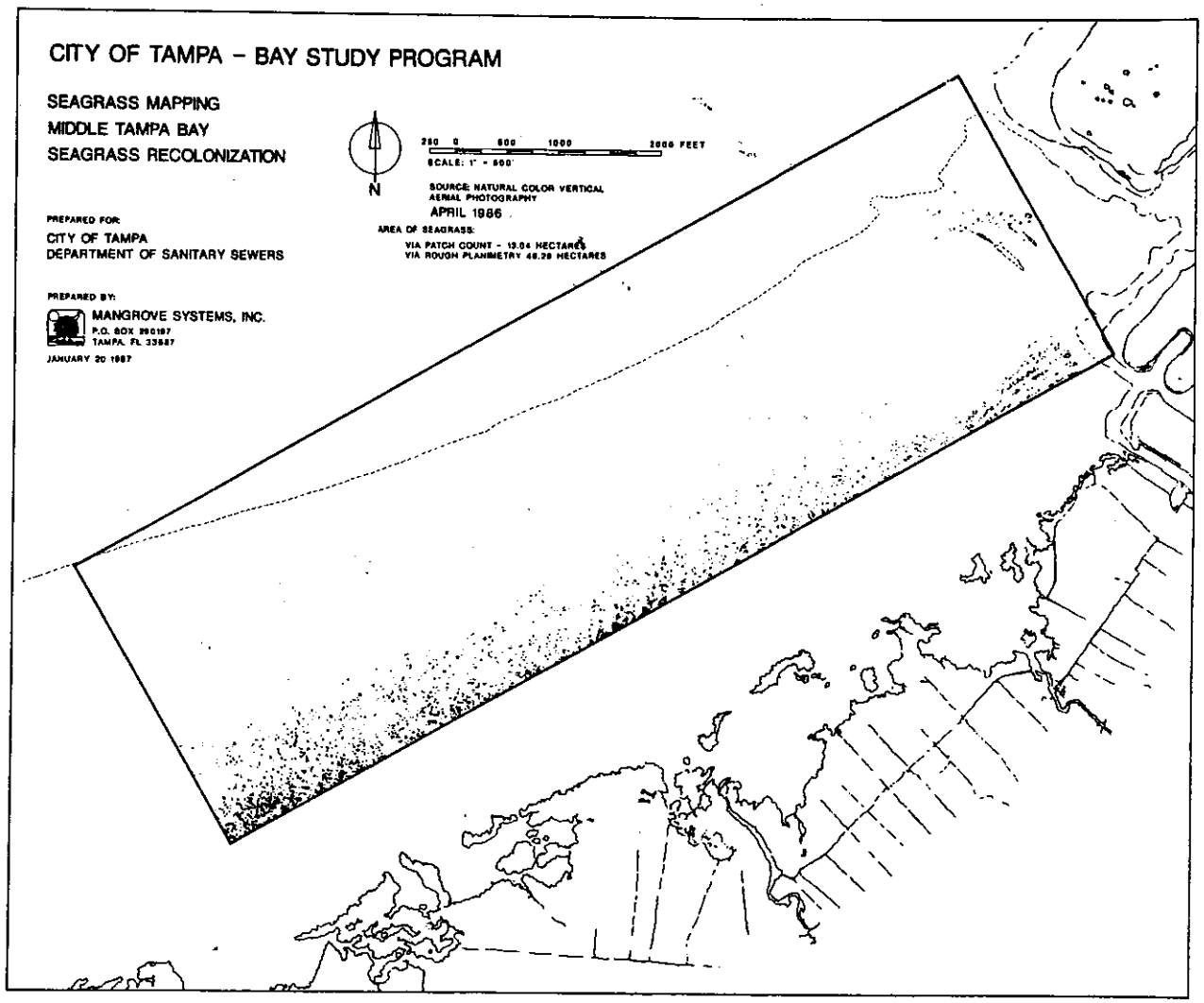

Figure 11.
Halodule wrightii coverage in a 3x1km area between Apollo Beach and Simmons Park in April, 1986.

RESULTS AND DISCUSSION

Halodule wrightii

One hundred thirty-seven patches of *H. wrightii* totaling about 1,960m², have been located and visited in Hillsborough Bay (Table 1). The predominant area of *H. wrightii* is located in The Kitchen where 83 patches, totaling about 1,125m², have been identified. Other areas of seagrass include Big Bend's turning basin (Figure 3), Fish Hook Spoil (Figure 3), western Hillsborough Bay along Bayshore Boulevard (Figures 4 and 5), and Davis Island (Figure 7).

Differences in *H. wrightii* blade persistence were observed both seasonally and geographically. *H. wrightii* exhibited dramatic decreases in blade coverage in late fall after reaching maximum densities in the summer. In The Kitchen, patches that were frequently exposed during low tide were virtually denuded in late fall. Patches which usually retained water coverage generally had a less dramatic blade loss during the fall. T-1, located at the Big Bend turning basin, was an exception to this observation. Although not exposed as often as most seagrass in The Kitchen, blade loss may be augmented by turbulence from tugboat propeller wash. In general, most *H. wrightii* sites in Hillsborough Bay had little, if any, blade coverage during the winter. Although not quantified, patches along Interbay peninsula generally retained more blade coverage than patches on the east side of the bay. Consequently, groundtruthing during the winter is difficult and subject to underestimates of areal coverage. Annual winter loss of *H. wrightii* blade coverage must be taken into account when making conclusions regarding seagrass coverage utilizing aerial documentation and on-site observations.

Data accumulated from *H. wrightii* study sites over the next two to three years should provide insight into whether revegetation is suffucient to restore Hillsborough Bay's seagrass beds. Meanwhile, test plantings of *H. wrightii* in a variety of locations would determine if artificially introduced vegetative material would initiate a viable seagrass community. Introduced vegetative material may be necessary due to an apparent lack of seed production in Tampa Bay's natural *H. wrightii* beds. Should test plantings persist and show significant expansion, a more extensive replanting project should be considered in areas of limited natural revegetation.

Caulerpa prolifera

Between April 1986 and December 1986, dramatic increases in *C. prolifera* coverage occurred on the sandflats of the southeastern portion of Interbay Peninsula and just north of Ballast Point pier. In April 1986, an area of *C. prolifera* measuring 2.5 hectares was present at about a 1.5m depth east of Gadsden Point. By December 1986, *C. prolifera* covered an area stretching 4km north and 1km west of Gadsden Point (Figure 12). This area of growth was calculated to be 200 hectares and generally did not exceed the three meter depth contour. Transect M-3, on the northern edge of this *C. prolifera* zone, contained clumps of *C. prolifera* in three of four 5x20m quadrates. No quadrate had more than ten percent coverage. North of Ballast Point pier, *C. prolifera* coverage spread from 2.8 hectares in April 1986 to 10 hectares in December 1986 (Figure 5). The greatest percent cover at transect B-2 ranged from 7% to 10% of a 100m² area located between 1.2m and 1.5m below mean sealevel.

C. prolifera was discovered at Davis Island (Figure 7) in October 1986. The areal coverage, estimated in December 1986, was found to be about 1.5 hectares. The greatest percent cover at this transect ranged from 10% to 15% of a 100m² area which occurred between 0.75m and 1.1m below mean sealevel. Generally, *C. prolifera* found in intertidal areas had stunted blades compared to blades in subtidal areas.

Table 1. Approximate areal coverage (m^2) of *Halodule wrightii, Ruppia maritima,* and *Caulerpa prolifera* in Hillsborough Bay, February 1988. Number of patches of *H. wrightii* in parentheses.

Location	*Halodule wrightii*	*Ruppia maritima*	*Caulerpa prolifera*
Davis Island	0.5 (1)	50	15,000
Kitchen	1125 (83)	9,600	0
Fish Hook Spoil	560 (24)	0	0
Big Bend Turning Basin	130 (14)	0	0
South of Ballast Point	59 (9)	2,800	2,000,000
North of Ballast Point	86 (6)	500	100,000
Northwest McKay Bay	0	200	0
Southeast McKay Bay	0	7,700	0
Pendola Pt. -Archie Creek	0	1,000	650,000
Total (m^2)	1,960.5 (137)	21,850	2,765,000
(hectares)	0.2	2.2	276.5

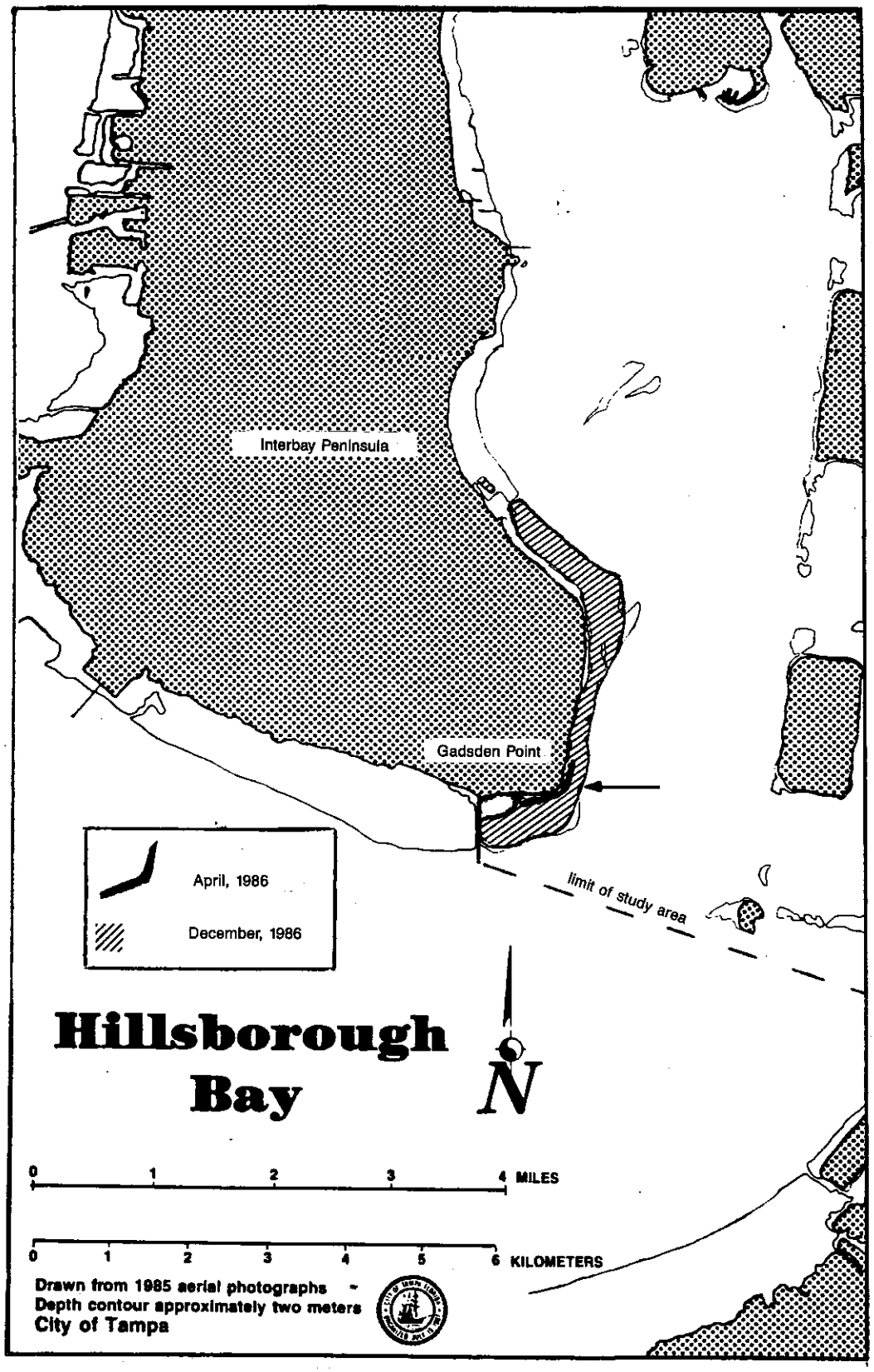

Figure 12.
Area of *Caulerpa prolifera* coverage in April 1986 and December 1986 along southeastern Interbay Peninsula.

In October 1987, the presence of *C. prolifera* was documented during an on-site intertidal survey between Pendola Point and Archie Creek (Figure 13). Further examination in January 1988 revealed an expanse of dense *C. prolifera* (greater than 25% coverage m^{-2}) growth covering about 65 hectares. Sparse areas of *C. prolifera* coverage (less than 25% coverage m^{-2}) were noted between the area of dense coverage and Archie Creek.

Monthly aerial photographs of the Pendola Point to Archie Creek tidal flats were reviewed to estimate the progression of *C. prolifera* growth. Approximately 9,000m^2 of sparse *C. prolifera* coverage, discernible in March 1986 (Figure 13), appeared to coalesce through September 1986. Further growth was not apparent until rapid expansion occurred during the summer of 1987.

Difficulties in using aerial photography for identification of submergent macrophytes are illustrated by our initial assessment of sparse *C. prolifera* beds as drift macroalge. Not until *C. prolifera* coverage exceeded 25%m^{-2} were these misidentifications discovered and corrected.

The ecological value and role of *C. prolifera* is uncertain but the alga appears to be an opportunistic species. *C. prolifera* may be able to tolerate lower light levels than seagrasses which could allow the alga to act as a pioneering species in unvegetated areas or to revegetate areas of declining seagrass (personal communication February 4, 1988 from Clinton J. Dawes, Department of Biology, University of South Florida, Tampa, Florida). The Bay Study Group has often noticed increased water transparency in and around dense areas of *C. prolifera* compared to areas with little or no submergent vegetation. Also, numerous crabs and fish have been observed in *C. prolifera*.

Ruppia maritima

Several areas of *R. maritima* have been identified in Hillsborough Bay. Two areas are in McKay Bay (Figure 14), one area is in the Davis Island Yacht Basin (Figure 7), and two areas are in The Kitchen (Figure 2). Also, scattered beds of *R. maritima* were found along eastern Interbay peninsula (Figures 4, 5 and 15) and between Pendola Point and Archie Creek (Figure 13). Areal coverages for each location are listed in Table 1. Areas of *R. maritima* growth are often transitory. Some locations of *R. maritima* may persist as well established beds for many years while other areas of growth only exist on the order of a few months to a few years. Beds of *R. maritima* seasonally produce flowering stalks with inflorescence growth initiated in early spring. These flowering stalks mature through summer and become senescent in the fall. Inflorescence production is dormant in fall and winter. Floating mats of detached *R. maritima* inflorescence, which appear to act as a method of seed dispersal, have been observed throughout the flowering season in Hillsborough Bay.

COT - MSI Cooperative Study

Results of the COT-MSI cooperative seagrass study, between Apollo Beach and Simmons Park, can be found in the September 1986 MSI report to the City of Tampa (Mangrove Systems, Inc. 1986).

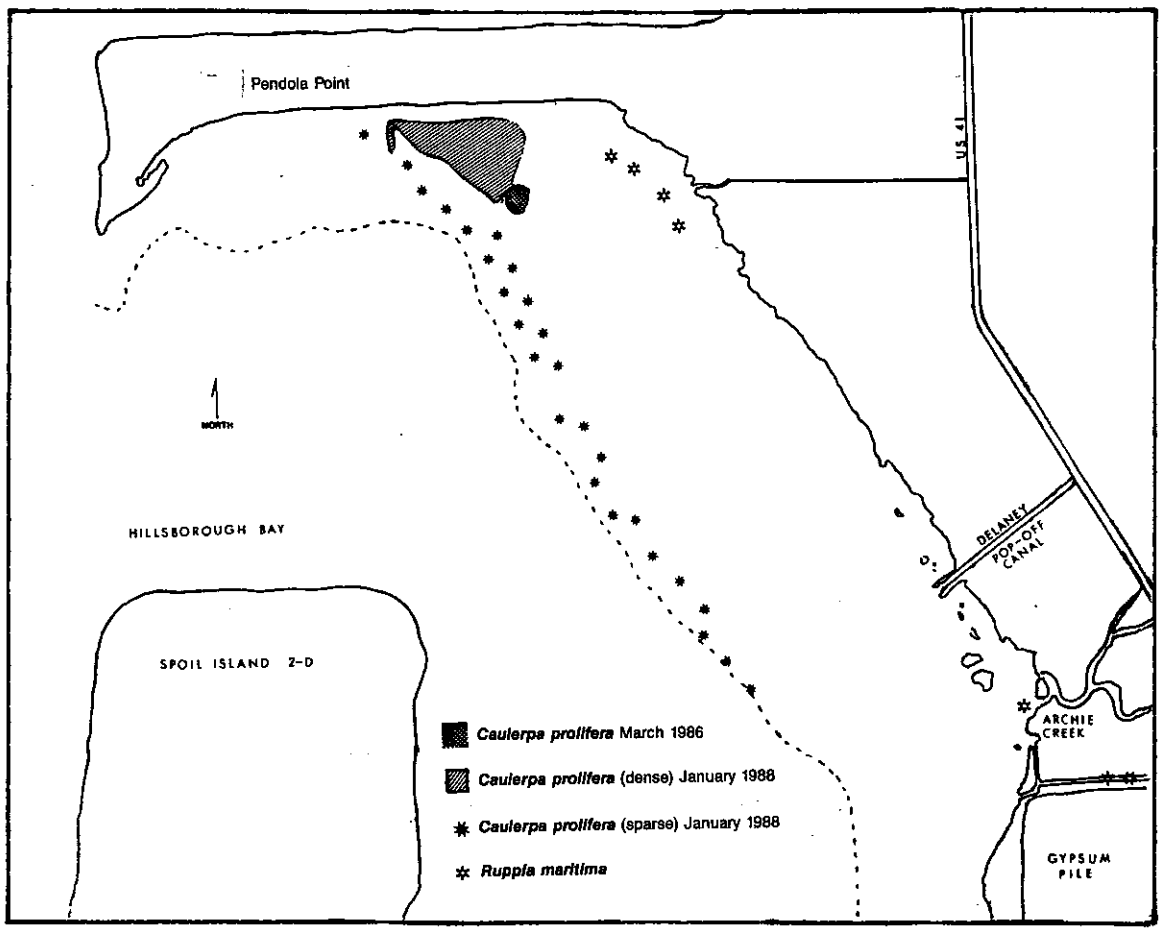

Figure 13.
Areas of *Caulerpa prolifera* and *Ruppia maritima* coverage between Pendola Point and Archie Creek.

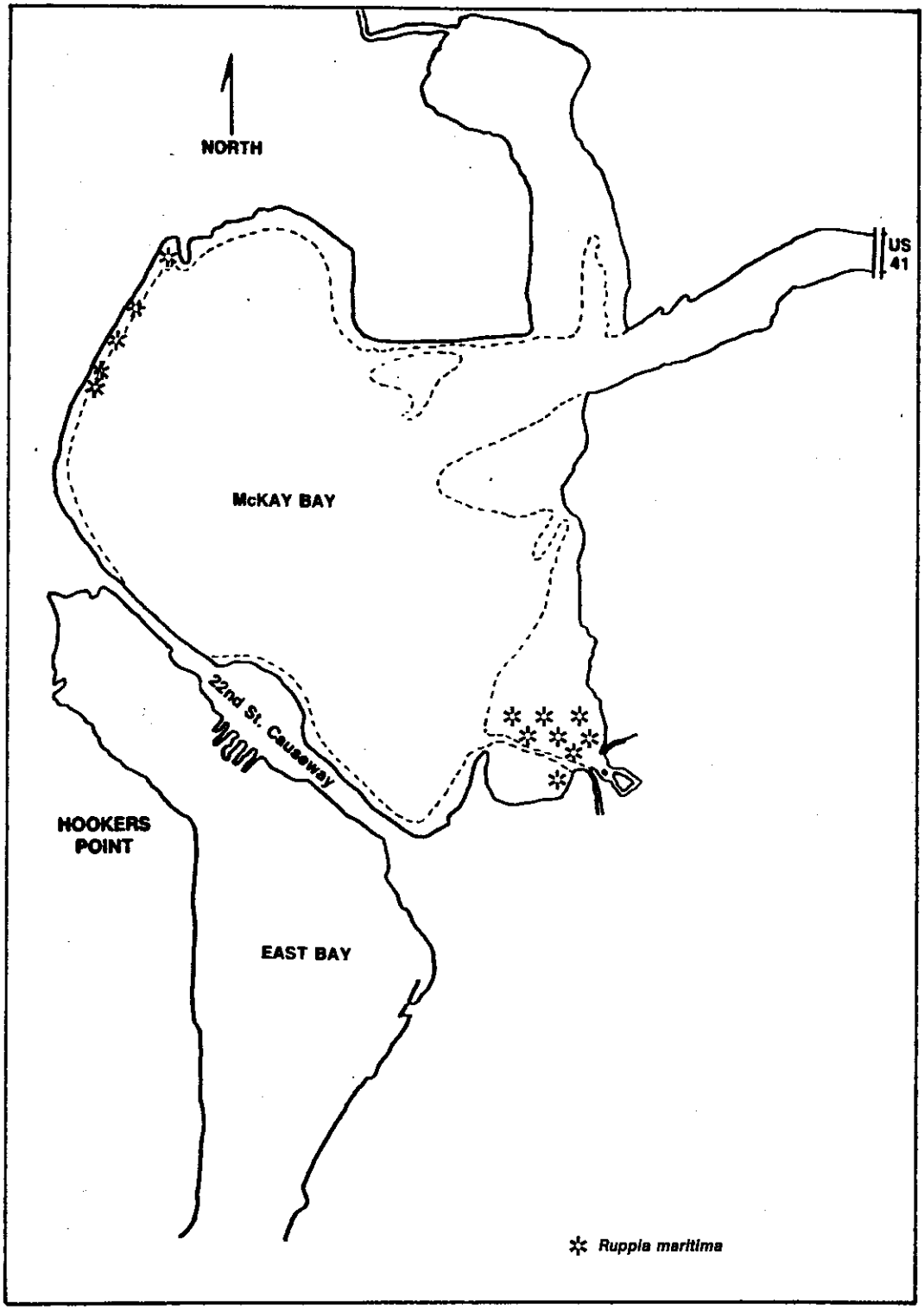

Figure 14.
Areas of *Ruppia maritima* coverage in McKay Bay.

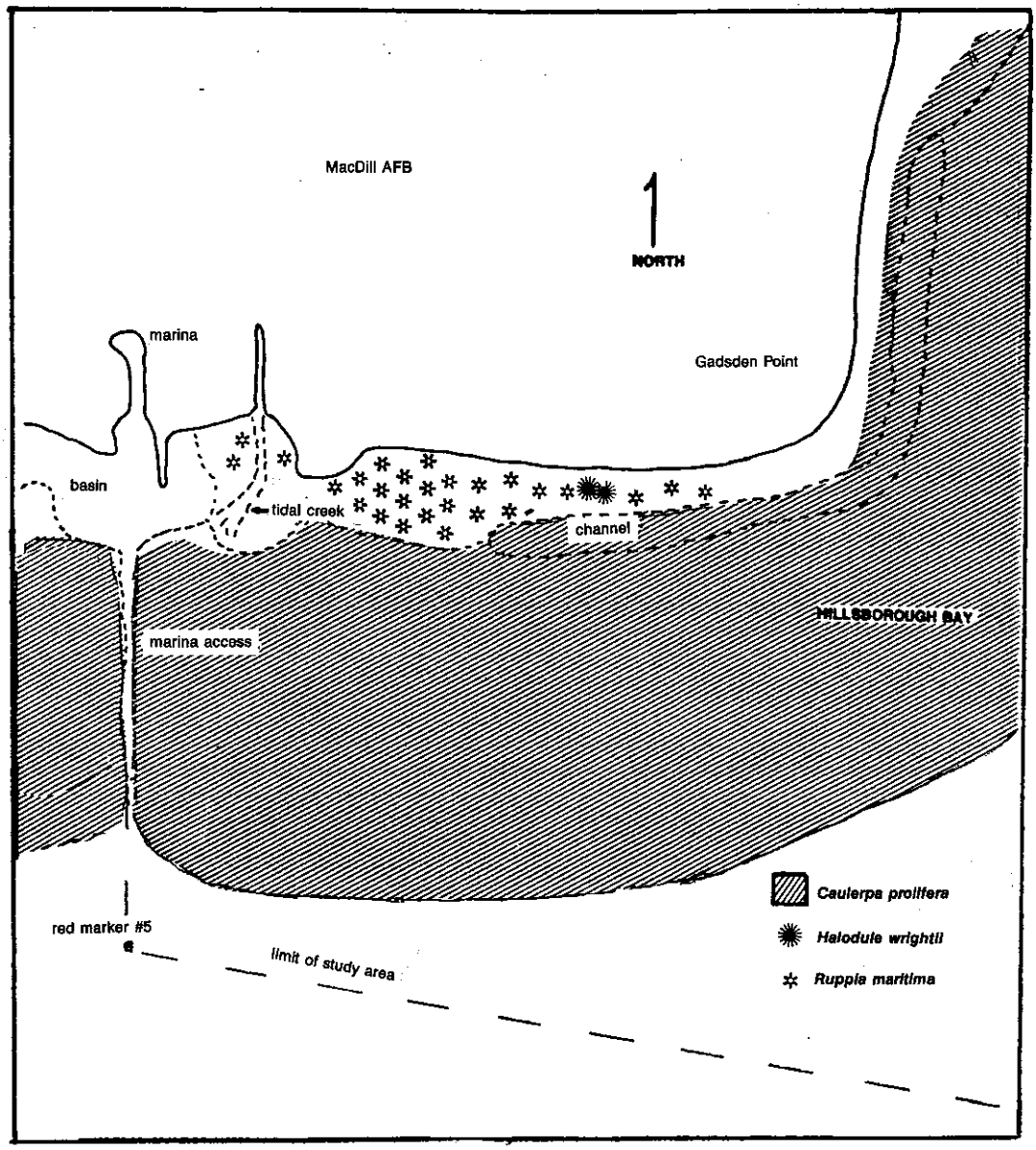

Figure 15.
Areas of *Caulerpa prolifera, Halodule wrightii,* and *Ruppia maritima* coverage between the MacDill AFB marina channel and Gadsden Point.

In the 3km^2 study area mapped by MSI (Figures 8-11), they documented that natural seagrass restoration has occurred since 1983. MSI reported no *H. wrightii* in the study area from the January 1983 and January 1984 aerial photographs. The January 1985 photograph revealed that 6.38 hectares of *H. wrightii* was present, thus marking the beginning of substantial seagrass renewal. A twofold increase in *H. wrightii* coverage was evident from January 1985 to April 1986 (13.04 hectares). The favorable growing season during the spring (April 1986), compared to winter (January 1985), may account for some, but not all, of the areal increase during this period. In the future, mapping efforts should be standardized to minimize interannual variations caused by seasonal cycles in seagrass blade growth. Late summer, during low tides, appears to be the best season to determine seagrass coverage by vertical aerial photography. During late summer, *H. wrightii* has renewed blade coverage defining the area of growth.

SUMMARY

General observations of the seagrasses *Halodule wrightii* and *Ruppia maritima* and the attached alga, *Caulerpa prolifera,* in Hillsborough Bay include:

1. About 57% of nearly 2,000m^2 of *H. wrightii* occurs in The Kitchen. The remainder of *H. wrightii* is located in Big Bend's turning basin and the intertidal areas of Fish Hook Spoil, southern and eastern Interbay Peninsula, and southeastern Davis Island.

2. Seasonal and geographical differences were noted for *H. wrightii* blade persistence. These differences make standardization of seasonal seagrass mapping projects imperative. Vertical and oblique aerial photographs taken during late summer during low tide appear to yield the best information for assessment of seagrass coverage.

3. In an area adjacent to Hillsborough Bay, a mapping effort utilizing vertical aerial photographs documented a substantial increase of *H. wrightii* coverage between Apollo Beach and Simmons Park from 1983 to 1986.

4. Intertidal and subtidal areas of southeastern Interbay Peninsula, Ballast Point, Davis Island and the Pendola Point - Archie Creek tidal flat have *C. prolifera* coverage. From April 1986 to December 1986, *C. prolifera* coverage of southeastern Interbay peninsula increased from 2.5 hectares to about 200 hectares. During the same time period, *C. prolifera* coverage at Ballast Point increased from 2.8 hectares to about 10 hectares. At Davis Island, *C. prolifera* covered 1.5 hectares in December 1986. *C. prolifera* between Pendola Point and Archie Creek increased from 0.9 hectares in March 1986 to 65 hectares in January 1988.

5. By April 1987, approximately 2.2 hectares of *R. maritima* were located and identified in Hillsborough Bay. Approximately half of the *R. maritima* was located in The Kitchen and about a third in McKay Bay. Scattered areas of *R. maritima* were found along Interbay Peninsula, Pendola Point and in the Davis Island yacht basin.

6. *R. maritima* inflorescence was observed in early spring and persisted through summer. Although exhibiting a transient nature in location, *R. maritima* usually retained blade coverage through the fall and winter after inflorescence cessation.

7. The progress of natural revegetation should be assessed and understood before initiating large scale seagrass replanting projects.

8. Areas with monospecific *C. prolifera* coverage appear to serve as a habitat for many types of vertebrates and invertebrates. Also, water transparency is often greater over *C. prolifera* beds than in sparsely vegetated or barren subtidal areas.

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