

3-1-1998

# Seagrass and Caulerpa monitoring in Hillsborough Bay Ninth Annual Report

City of Tampa Department of Sanitary Sewers

Follow this and additional works at: [http://scholarcommons.usf.edu/basgp\\_report](http://scholarcommons.usf.edu/basgp_report)



Part of the [Environmental Indicators and Impact Assessment Commons](#)

---

## Scholar Commons Citation

City of Tampa Department of Sanitary Sewers, "Seagrass and Caulerpa monitoring in Hillsborough Bay Ninth Annual Report" (1998).  
*Reports*. Paper 99.

[http://scholarcommons.usf.edu/basgp\\_report/99](http://scholarcommons.usf.edu/basgp_report/99)

This Statistical Report is brought to you for free and open access by the Tampa Bay Area Study Group Project at Scholar Commons. It has been accepted for inclusion in Reports by an authorized administrator of Scholar Commons. For more information, please contact [scholarcommons@usf.edu](mailto:scholarcommons@usf.edu).

SEAGRASS AND *CAULERPA* MONITORING IN HILLSBOROUGH BAY  
NINTH ANNUAL REPORT

SUBMITTED TO

THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

TAMPA OFFICE

MARCH 1, 1998

CITY OF TAMPA

DEPARTMENT OF SANITARY SEWERS

BAY STUDY GROUP

## EXECUTIVE SUMMARY

The City of Tampa, Bay Study Group has been monitoring water quality in Hillsborough Bay since 1976 and has documented improvements in several water quality parameters since the early 1980's. The improvements in water quality were followed by the emergence of shoalgrass, *Halodule wrightii*, in several areas of Hillsborough Bay.

The Bay Study Group began a monitoring program in 1986 of the seagrasses *H. wrightii* and *Ruppia maritima*, and the alga, *Caulerpa prolifera*. The purpose of the study was to monitor changes in seagrass coverage, because seagrass may serve as an indicator of water quality. However, the study is not intended to link the discharge from the Howard F. Curren Advanced Wastewater Treatment Plant with changes in the seagrass community. *H. wrightii* baywide areal coverage was about 2000m<sup>2</sup> in the initial survey in 1986 and has now increased to about 55.6ha. Coverage for *R. maritima* had fluctuated between 2000m<sup>2</sup> and 40ha between 1986 and 1996. However, following the maxima reported in 1996, *R. maritima* coverage decreased to about 6ha in 1997. *C. prolifera* coverage has varied greatly over the study period. After reaching maximum coverage of 280ha in 1988, *C. prolifera* meadows were reduced nearly an order of magnitude following a "25 year" rainfall event in the fall of 1988. In 1997, no attached *C. prolifera* coverage was noted in Hillsborough Bay.

Seagrass recolonization is occurring in the intertidal and shallow subtidal areas of Hillsborough Bay in response to improved water quality. Sizeable *H. wrightii* meadows are now established in southeastern Hillsborough Bay and along the Interbay Peninsula in western Hillsborough Bay.

## INTRODUCTION

The City of Tampa, Bay Study Group (BSG), created in 1976, has monitored the effects of pollution abatement that occurred in Hillsborough Bay when the Howard F. Curren Advanced Wastewater Treatment Plant (formerly Hookers Point Wastewater Treatment Plant) was upgraded to secondary treatment in 1978 and advanced treatment in 1979. During the mid 1980's, water quality improvements and evidence of minor seagrass revegetation in Hillsborough Bay prompted the BSG to initiate a seagrass study to compliment other programs assessing the environmental status of Hillsborough Bay.

Documentation of submerged aquatic vegetation (SAV) in Hillsborough Bay (including McKay Bay) began in April 1986 with a thorough groundtruthing effort which documented the location and areal coverage of *Halodule wrightii* (shoalgrass), *Ruppia maritima* (widgeongrass) and the attached benthic alga, *Caulerpa prolifera*. Eight additional intensive groundtruthing efforts to document *H. wrightii* were completed in 1989 and 1991-1997, all during the month of October. Study sites were established for *H. wrightii*, *R. maritima* and *C. prolifera*, however, monitoring of *R. maritima* and *C. prolifera* at specific study sites has been discontinued. Generally, study sites are monitored three times a year.

In 1996, the BSG established thirteen seagrass transects in anticipation of a proposed Tampa Bay seagrass monitoring program coordinated by the Tampa Bay National Estuary Program (TBNEP) and the Southwest Florida Water Management District's Surface Water Improvement Program (SWIM). The monitoring program would be a part of the Comprehensive Conservation and Management Plan produced by TBNEP. This plan aims to restore and protect Tampa Bay seagrass meadows principally through the management of nitrogen discharges to the bay. The BSG will be one of several agencies involved in the seagrass monitoring program presented in this plan. Participation in this program may result in future changes to the BSG seagrass monitoring.

The BSG transplanted *H. wrightii* into Hillsborough Bay in 1987 and 1989. Monitoring of *H. wrightii* transplants in Hillsborough Bay has been discontinued due to coalition with naturally occurring coverage. Data for transplants were included in the reports submitted through 1994. Transplant coverage is now included as part of the baywide *H. wrightii* areal coverage estimate.

The purpose of the BSG seagrass program is to monitor changes of SAV, excluding drift macroalgae, in Hillsborough Bay. Seagrass is an important Tampa Bay habitat and may serve as an indicator of water quality. However, the seagrass program is not intended to link the discharge from the Howard F. Curren Advanced Wastewater Treatment Plant with changes in the seagrass community.

This is the ninth annual report submitted to the Florida Department of Environmental Protection (FDEP) to satisfy the requirements set forth in specific condition #14 of FDEP operation permit D029-184532B.

## METHODS

The BSG seagrass program has been modified several times since 1986. The report, "An Ongoing Survey of *Halodule wrightii*, *Ruppia maritima*, and the Alga, *Caulerpa prolifera* in Hillsborough Bay, Florida: Initial Assessment and Design" describes study site locations and experimental design for the naturally occurring seagrass and *C. prolifera* projects through the 1991 spring survey. It does not, however, contain seagrass transplant information and project modifications made after the 1991 spring survey. Transplant information and methods used to evaluate SAV during 1991, 1992, and 1993 were discussed in the annual report submitted to DEP in March, 1994.

Seagrass coverage in an embayment east of the north end of Apollo Beach (Figure 1), had been included in reports after 1989. It is unclear if this area should be included within the boundary of Hillsborough Bay, however, the BSG decided to omit this area as part of the study. Therefore, Hillsborough Bay seagrass estimates reported after 1989 were revised in the sixth annual report to FDEP submitted on March 1, 1995.

## STUDY SITES

### *Halodule wrightii*

The intertidal and shallow subtidal flats around the perimeter of Hillsborough Bay were divided into twelve seagrass study areas (Figure 1). An additional seagrass study area was added to include the northern spoil disposal island, 2-D. Within each of the thirteen seagrass study areas, at least one patch of *H. wrightii*, if present, was chosen as a seagrass study site. Three of the original study sites, B-1, K-3, and K-5 (see reports prior to 1995 for study site locations), have been retained for study.

Each study site is evaluated on a seasonal basis. During each visit to a study site, short shoot density, blades per short shoot, and blade length are measured. Short shoot density is determined using a 100cm<sup>2</sup> (10cmx10cm) square. Blade length (emergence from the short shoot basal stalk to tip of the blade) is measured to the nearest centimeter. Subjective evaluations concerning epiphytes and seagrass health are recorded. Epiphytic cover is rated as clean, light, moderate, or heavy. Seagrass appearance is rated as poor, fair, good, or very good. Salinity, temperature, dissolved oxygen, pH, and depth are recorded.

### *Ruppia maritima*

One *R. maritima* transect was established in western Hillsborough Bay in 1987 and discontinued in 1992. Currently, data on *R. maritima* is collected during seasonal visits to the thirteen subdivisions in Hillsborough Bay. *R. maritima* patches are selected at random and measurements of blade length, short shoot density, and inflorescence, if present, are taken. Short shoot density is determined with a 100cm<sup>2</sup> square.

### *Caulerpa prolifera*

Five *C. prolifera* transects (Figure 2) in Hillsborough Bay were visited seasonally through the fall of 1994. However, due to the paucity of *C. prolifera* in Hillsborough Bay in 1995, the BSG discontinued detailed investigation of these five transects pending the return of significant *C. prolifera* coverage. In the interim, data will only be collected where the alga is present. Information from five randomly tossed meter squares (1x1m) will include: percent *C. prolifera* coverage, frond density and length, percent drift macroalgae cover, the number of the polychaete, *Diopatra cupraea*, depth, temperature, and salinity. Results on transect coverage through 1994 may be found in the 1995 report.

### TBNEP Transects

The BSG established thirteen transects in the fall 1996 in order to follow spatial and temporal seagrass trends. Eleven transects are in Hillsborough Bay and two in Middle Tampa Bay (Figure 3). Four of these transects traverse SWIM seagrass study sites. The transects are divided into 100m sections and range between 160-1300m in length.

Each transect is visited annually, during the fall, and the coverage of each seagrass species is estimated using a 1x1 meter square. Along each transect, meter squares are placed at 25m intervals except at the 100m section traversing the seaward edge of the seagrass meadow. Meter square placement is at 10m intervals along this section. Coverage for each seagrass species within each meter square is estimated using the Braun Blanquet rating system. The system incorporates ratings of 0-5 where: a) 0 represents the absence of coverage, b) 0.5 is less than one percent coverage, c) 1 is 1-5 percent coverage, d) 2 is 6-25 percent coverage, e) 3 is 26-50 percent coverage, f) 4 is 51-75 percent coverage, and g) 5 is 76-100 percent coverage.

Information on seagrass characteristics, hydrographic conditions, and photosynthetic active radiation (when sufficient water column depth allows measurements) is collected where each transect traverses the mid and edge portion of the seagrass bed, and the two meter contour. In addition, samples from each data collection site are taken at mid depth for chlorophyll *a* and turbidity analysis.

### AREAL COVERAGE

Photographs taken from high and low altitudes aid in the determination of SAV coverage for each seagrass study area of Hillsborough Bay. High altitude (ca. 6,000ft.) aerial photographs, taken each fall from a fixed wing aircraft, are utilized to estimate areal coverage where SAV is present in a large, continuous meadow. After a scale is determined for each photograph, a grid composed of 1x1mm squares is placed over the photograph. The number of 1mm<sup>2</sup> squares covering a SAV signature in the photograph are counted and the areal extent of the SAV is determined by multiplying the number of squares counted times the scale determined for a square. Low altitude (ca. 500ft.) overflights are generally conducted monthly by helicopter. Photographs taken at this level are useful in locating and enumerating small *H. wrightii* patches not seen in the high altitude photographs. In addition, the monthly reconnaissance flights assist in tracking the development of SAV during the year.

All intertidal and most of the shallow subtidal flats which have the potential for SAV coverage are visited on foot in the fall within four weeks of the high altitude overflight. During each visit, SAV recorded by the high altitude photographs is groundtruthed. In addition, any SAV not seen on the high altitude photographs is documented. Small patches of *H. wrightii* are enumerated and measured and the area of each patch determined using the formula for an ellipse. There may be occasions where SAV, although widespread, is too patchy to determine the areal coverage from photographs. If the SAV coverage cannot be determined from photographs or groundtruth efforts, the areal coverage is estimated by calculating the percent cover of each species in an area of a known acreage.

In the fall of 1997, the BSG began using the global positioning system (GPS) to accurately map large areas of seagrass. The GPS instrument is composed of a Trimble Pro XL differential receiver interfaced with a Trimble TDC1 Asset Surveyor and is capable of recording positions with sub-meter accuracy. The BSG employs the instrument by following the perimeter of a seagrass bed and automatically recording positions every five seconds. Subsequently, the data is downloaded into a PC using the Trimble Pathware Office software. In this software, seagrass coverage is mapped on a Tampa Bay base map (ARC-INFO Mapping Data, Southwest Florida Water Management District, 1996) . Areal coverage calculations can then be performed.

## RESULTS AND DISCUSSION

*H. wrightii* coverage described in Hillsborough Bay for 1991, 1992, and 1993 has been revised, due to the change of bay area definition, to 2.0ha, 5.2ha and 7.3ha respectively, nearly thirty percent below coverage previously reported.

Two species of seagrass, *H. wrightii* and *R. maritima*, were observed during the 1997 seagrass survey of Hillsborough Bay. *H. wrightii* coverage in Hillsborough Bay increased nearly 40 percent from 40.4ha reported in 1996 to about 55.6ha in 1997 (Figure 4). *R. maritima* coverage, however, decreased from 40ha in 1996 to about 6ha in 1997. *H. wrightii* coverage was present in each seagrass study area (Figure 1), except area 6 in McKay Bay, while most of the *R. maritima* coverage was found between the Alafia River and Pendola Point (areas 4 and 5). *H. wrightii* areal coverage is summarized in Table 1.

The survey of the thirteen seagrass transects was completed in the fall of 1997. Results for seagrass distribution and abundance for each transect are reviewed concurrent with a discussion of seagrass areal coverage for each of the thirteen seagrass study areas of Hillsborough Bay (including McKay Bay). There are no transects currently established in areas 1, 7, and 13. In addition, transects 14 and 15 are outside the boundaries of Hillsborough Bay and the results for the transects will be presented without discussion of areal coverage.

*H. wrightii* coverage for the northeastern, southeastern, northwestern, and southwestern portions of Hillsborough Bay is illustrated in figures 5, 6, 7, and 8, respectively. These figures are intended to present the general areal extent for *H. wrightii* and are not used for areal coverage calculations.

### Seagrass Study Area 1

*H. wrightii* coverage in area 1, near the Tampa Electric Company Big Bend power generating plant, increased to 5600m<sup>2</sup> in 1997 (Figure 9), nearly twice the amount reported in 1996. About a dozen new patches developed in the TECO turning basin and the existing coverage on the east and west sides of Fishhook Spoil (Figure 6) increased in size. There was no *R. maritima* reported in this area.

### Seagrass Study Area 2

Area 2, including the Kitchen in southeastern Hillsborough Bay (Figure 6), registered the greatest increase for *H. wrightii* coverage of all areas, gaining over 10ha between 1996 and 1997 (Figure 10). Generally, coverage did not expand seaward, however, the bulk of the increase was a result of continued coalition of patches along the western periphery of the meadow as well as revegetation of previously barren pockets within the meadow. Coverage in area 2 was estimated at 40ha in 1997.

*R. maritima* has been found predominantly along the shoreline in the eastern portion of the Kitchen. Coverage was reduced two orders of magnitude from about 10ha in 1996 to approximately 1000m<sup>2</sup> in 1997.

Transect 2 (Figure 11), which traverses east to west through the Kitchen, illustrates the distribution and Braun Blanquet coverage rating of seagrass in the area. Sparse *H. wrightii* coverage begins about 70m from shore and generally becomes more dense in the next 300m. A solid band of very dense coverage is evident from about 380m to over 500m from shore. The coverage becomes patchy in the 550-620m range and coverage was not present beyond 620m. Although *R. maritima* was reported in the Kitchen, no coverage was evident on the transect.

### Seagrass Study Area 3

In area 3, between the Kitchen and the Alafia River, patches of *H. wrightii* have been developing in a band from just north of the Kitchen to Bullfrog Creek (Figure 6). This trend continued through 1997 and some of the coverage began to coalesce. Areal coverage increased from 4500m<sup>2</sup> in 1996 to nearly 1.1ha in 1997 (Figure 12). *H. wrightii* was the only seagrass species noted in this area during 1997.

Braun Blanquet data from transect 3 (Figure 13), which runs west from the mouth of Bullfrog Creek, illustrates the patchiness of *H. wrightii* in this area. Although there were a considerable number of shoalgrass patches present out to the 300m portion of the transect, only the meter square placed at the 20m mark contained any seagrass.

### Seagrass Study Area 4

*H. wrightii* coverage between the Alafia River and Archie Creek expanded from 1000m<sup>2</sup> in 1996 to 9000m<sup>2</sup> in 1997 (Figure 14). Generally, the seagrass remains patchy with the bulk of the coverage seen near Archie creek (Figure 5).



About 2ha of *R. maritima* was observed in area 4 during 1997. The majority of the coverage was found near the mouth of Archie Creek.

Seagrass was not present along transect 4, however, this transect is located to the south of most *H. wrightii* coverage in this area.

#### Seagrass Study Area 5

*H. wrightii* coverage between Archie Creek and Pendola Point increased from 1500m<sup>2</sup> in 1996 to nearly 8000m<sup>2</sup> in 1997 (Figure 15). The majority of this seagrass was documented about 1km north of Archie Creek. Patchy coverage was noted just north of Archie Creek and along the western end of Pendola Point (Figure 5).

Half of the total 1997 Hillsborough Bay *R. maritima* coverage was found in area 5. About 3ha of coverage extends in a narrow band along the shoreline from the mouth of Archie Creek north to the east end of the Pendola Point peninsula.

There was a mixture of *H. wrightii* and *R. maritima* in the coverage along the first 100m of transect 5 (Figure 16). Braun Blanquet data from the transect survey also illustrates the coalition of *H. wrightii* patches in the 80-120m range and patchy coverage ending 180m from shore.

#### Seagrass Study Area 6

*H. wrightii* coverage has never been observed in McKay Bay (Figure 1) during the BSG seagrass study. However, there were scattered patches of *R. maritima* in northwest and southeast McKay Bay. *R. maritima* coverage in area 6 was estimated at approximately 1000m<sup>2</sup> in 1997.

Seagrass was not reported on transect 6. However, there is scattered *R. maritima* coverage near a tidal creek to the south of the transect line.

#### Seagrass Study Area 7

This area encompasses the Davis Island shoreline. About 300m<sup>2</sup> of *H. wrightii* (Figure 17) was discovered in the northeast section of the seaplane basin (Figure 7) in 1997 and was the only seagrass species noted in area 7.

#### Seagrass Study Area 8

Patchy *H. wrightii* and *R. maritima* coverage has recently began to develop on the shallow flats near of the intersection of Bayshore Boulevard and Bay to Bay Boulevard (Figure 7). About a dozen *H. wrightii* patches with a total area of 80m<sup>2</sup> were documented in 1997 (Figure 18). A few small patches of *R. maritima* were also noted in this area during 1997.

There was no seagrass coverage documented along transect 8. However, several small patches of *H. wrightii* are located just to the north and south of the transect line.

### Seagrass Study Area 9

*H. wrightii* was the only seagrass species reported in area 9 during 1997. Coverage in area 9 did not change between 1996 and 1997 and remained at an estimated 1.1ha (Figure 19). Most of the coverage was found just north of Ballast Point along Bayshore Boulevard (Figure 7).

Braun Blanquet data from transect 9 (Figure 20) indicates a band of dense to patchy *H. wrightii* coverage beginning approximately 30m from the seawall and ending at the 70m mark. The coverage pattern found along this transect is typical of the *H. wrightii* distribution found in this area.

### Seagrass Study Area 10

*H. wrightii* coverage in area 10 did not change appreciably between 1996 and 1997 (Figure 21). In 1997, there was a narrow, nearly continuous band of shoalgrass between Ballast Point and the navigation channel on the east side of Macdill Air Force Base (Figure 8). The areal coverage was estimated at 5.9ha.

Most of the *R. maritima* in area 10 was found just north of the air base. Coverage for this area was estimated at 2000m<sup>2</sup> in 1997.

*H. wrightii* coverage along transect 10 (Figure 22) started about 20m from the beginning of the transect. Dense coverage was found in the 20-60m range and no seagrass was found beyond 80m.

### Seagrass Study Area 11

*H. wrightii* coverage in area 11 rebounded after a nearly 50% loss reported in 1996. In 1997, coverage increased 170% to an estimated 4ha (Figure 23). This seagrass meadow was located within 100m from the shore, just north of Catfish Point (Figure 8). In addition, greater than 1ha of *H. wrightii* has developed north of Catfish Point, approximately 300-500m offshore.

Most of the *R. maritima* noted in area 11 during 1997 consisted of a narrow band located shoreward of the *H. wrightii* meadow found just north of Catfish Point. The areal estimate was determined to be 4000m<sup>2</sup>.

There are two transects in area 11. Coverage along transect 11.1 (Figure 24) was comprised of *H. wrightii* and *R. maritima* in the initial 30m. A relatively dense stand of *H. wrightii* was found between the 50-100m portion of the transect. *H. wrightii* found at 325m is a portion of the seagrass developing in the area 300-500m offshore. Seagrass was not found on transect 11.2.

### Seagrass Study Area 12

There was a slight increase in *H. wrightii* coverage for area 12 during 1997 (Figure 25). Most of the coverage was located just east of the marina on Macdill AFB (Figure 8). In addition, scattered patches were found east to Gadsden Point. Areal coverage was estimated to be about 1.2ha.

Patchy *R. maritima* was found from the marina on Macdill AFB east to Gadsden Point. Areal coverage for this species was determined to be about 3000m<sup>2</sup> during 1997.

Seagrass coverage along transect 12 (Figure 26) consisted of patchy *H. wrightii* coverage in the initial 100m and a small area of shoalgrass located about 725m from the shoreline.

#### Seagrass Study Area 13

*H. wrightii* was the only seagrass species reported in this area during 1997. Generally, coverage consists of narrow, patchy bands located on the eastern and northern shoreline of the spoil disposal island 2-D (Figure 5). In addition, there were several patches along the small spoil island just to the east of island 2-D. Coverage was estimated at 600m<sup>2</sup> in 1997 (Figure 27).

#### Seagrass Study Transect 14

Transect 14 is located at the mouth of Broad Creek on the south end of Interbay Peninsula. Information from Transect 14 (Figure 28) indicates a broad band of *H. wrightii* beginning at 50m and extending out to the 400m mark. The densest portion of the meadow was located along the 250-400m portion of the transect. In addition, patchy shoalgrass was found in the 600-700m section.

#### Seagrass Study Transect 15

Transect 15 is located at the mouth of Wolf Branch Creek south of Apollo Beach. Data from transect 15 (Figure 29) indicates scattered *H. wrightii* coverage in the first 150m of the transect. More dense coverage was found between 150-375m. Also, it should be noted that scattered *H. wrightii* was developing along the 700-1000m section of the transect, however, no seagrass was detected using the Braun Blanquet rating system on 25m intervals.

#### *Caulerpa prolifera*

*C. prolifera* has been observed in four general areas of Hillsborough Bay: 1) along southeastern Interbay Peninsula; 2) near Ballast Point; 3) between Pendola Point and the Alafia River; and 4) along Davis Island.

*C. prolifera* in Hillsborough Bay has exhibited both rapid increase and rapid loss in coverage since monitoring began in 1986. For example, in 1986, between April and December, a 40 fold increase in coverage to 200ha was documented in western Hillsborough Bay. A 90 percent reduction in coverage occurred in the fall of 1988 immediately following a "25 year" rainfall event which lowered salinities to 2ppt in some parts of Hillsborough Bay. The decline of *C. prolifera* in that area is probably a result of extended exposure to unusually hyposaline conditions. Similarly, in an area south of Pendola Point, the alga expanded from 8000m<sup>2</sup> in 1987 to 190ha in 1990. Following this maximum, coverage has steadily declined. However, the decline of the alga in this area does not appear to be related to major rain events.

Three major areas of *C. prolifera* coverage were reported in 1994: 1) between Gadsden Point and the marina on the south end of Macdill AFB (25ha), 2) Ballast Point (1ha), and 3) south of Pendola Point (3ha). Coverage in Hillsborough Bay for 1995 rapidly declined to less than 2000m<sup>2</sup> with scattered coverage observed in each of the three areas. However, in 1996, no coverage was observed around Ballast Point or Pendola Point. Sparse coverage was observed just east of Gadsden Point. In 1997, attached *C. prolifera* coverage was not observed in Hillsborough Bay.

The development and decline of *C. prolifera* coverage has been documented in other areas of Hillsborough Bay. Sparse *C. prolifera* was found along southeastern Davis Island between 1986-1989 and on the west end of Bird Island (Figure 1) from 1993-1994.

In summary, *C. prolifera* has rapidly colonized large intertidal and subtidal areas of Hillsborough Bay since 1986. Furthermore, this alga appears to be sensitive to low salinity for extended periods. Although, some drift *C. prolifera* was occasionally noted during surveys, attached coverage was not documented in 1997.

## CONCLUSION

Improving water quality in Hillsborough Bay has allowed recolonization of *H. wrightii* into most intertidal and shallow subtidal areas of Hillsborough Bay. A majority of the *H. wrightii* renewal has occurred in the Kitchen, although development and coalition of *H. wrightii* patches have created sizable meadows in the western and northwestern sections of the bay. In 1997, patchy *H. wrightii* coverage continued to develop and coalesce on the flats north of the Kitchen. Also, patchy coverage has continued to develop slowly between Pendola Point and the Alafia River. Finally, *H. wrightii* has begun to develop nearly three miles north of Ballast Point, potentially the first seagrass present in this area in four decades.

Several areas of Hillsborough Bay have *R. maritima* meadows which vary in size from year to year. In recent years, this species has become a minor component of the total seagrass coverage in Hillsborough Bay, although in 1996, it increased to about 40ha, equaling the amount reported for *H. wrightii*. In 1997, however, *R. maritima* coverage was estimated to be about 6ha, only ten percent of the total seagrass coverage in Hillsborough Bay.

*C. prolifera* has been a major contributor to SAV coverage in the past decade. This alga has been observed growing in deeper waters than *H. wrightii*, suggesting that the alga may be a pioneer SAV species in areas with relatively low light penetration. *C. prolifera* can vegetate large areas in a short period and, conversely, undergo sudden, large scale die-offs. For example, the loss of the *C. prolifera* meadows in western Hillsborough Bay occurred immediately following exposure to unusually low salinities for an extended period in 1988. In other areas, reductions in areal coverage do not appear to be salinity related and appear to occur more gradually.

Table 1. *Halodule wrightii* coverage (m<sup>2</sup>) by area in Hillsborough Bay for the years 1986, 1989, and 1991-1997.

|       | 1986 | 1989 | 1991  | 1992  | 1993  | 1994   | 1995   | 1996   | 1997   |
|-------|------|------|-------|-------|-------|--------|--------|--------|--------|
| AREA  |      |      |       |       |       |        |        |        |        |
| 1     | 690  | 700  | 400   | 500   | 2000  | 2630   | 2500   | 3000   | 5600   |
| 2     | 1125 | 3300 | 16300 | 40801 | 34000 | 135000 | 167000 | 296000 | 400000 |
| 3     | 0    | 0    | 40    | 350   | 250   | 1200   | 2500   | 4500   | 10800  |
| 4     | 0    | 0    | 200   | 475   | 500   | 600    | 500    | 1000   | 9000   |
| 5     | 0    | 0    | 15    | 150   | 600   | 1200   | 750    | 1500   | 7900   |
| 6     | 0    | 0    | 0     | 0     | 0     | 0      | 0      | 0      | 0      |
| 7     | 0    | 0    | 0     | 0     | 0     | 0      | 0      | 0      | 300    |
| 8     | 0    | 0    | 0     | 0     | 0     | 0      | 0      | 10     | 80     |
| 9     | 85   | 140  | 800   | 1900  | 7000  | 10400  | 8700   | 11000  | 11000  |
| 10    | 40   | 750  | 1600  | 6750  | 22400 | 32400  | 54000  | 60000  | 59000  |
| 11    | 0    | 65   | 200   | 650   | 5000  | 10500  | 28500  | 15000  | 40000  |
| 12    | 20   | 20   | 20    | 250   | 1300  | 2800   | 17000  | 11000  | 11700  |
| 13    | 0    | 0    | 0     | 0     | 30    | 100    | 400    | 500    | 600    |
| TOTAL | 1960 | 4975 | 19575 | 51825 | 73080 | 196830 | 281850 | 403510 | 555980 |

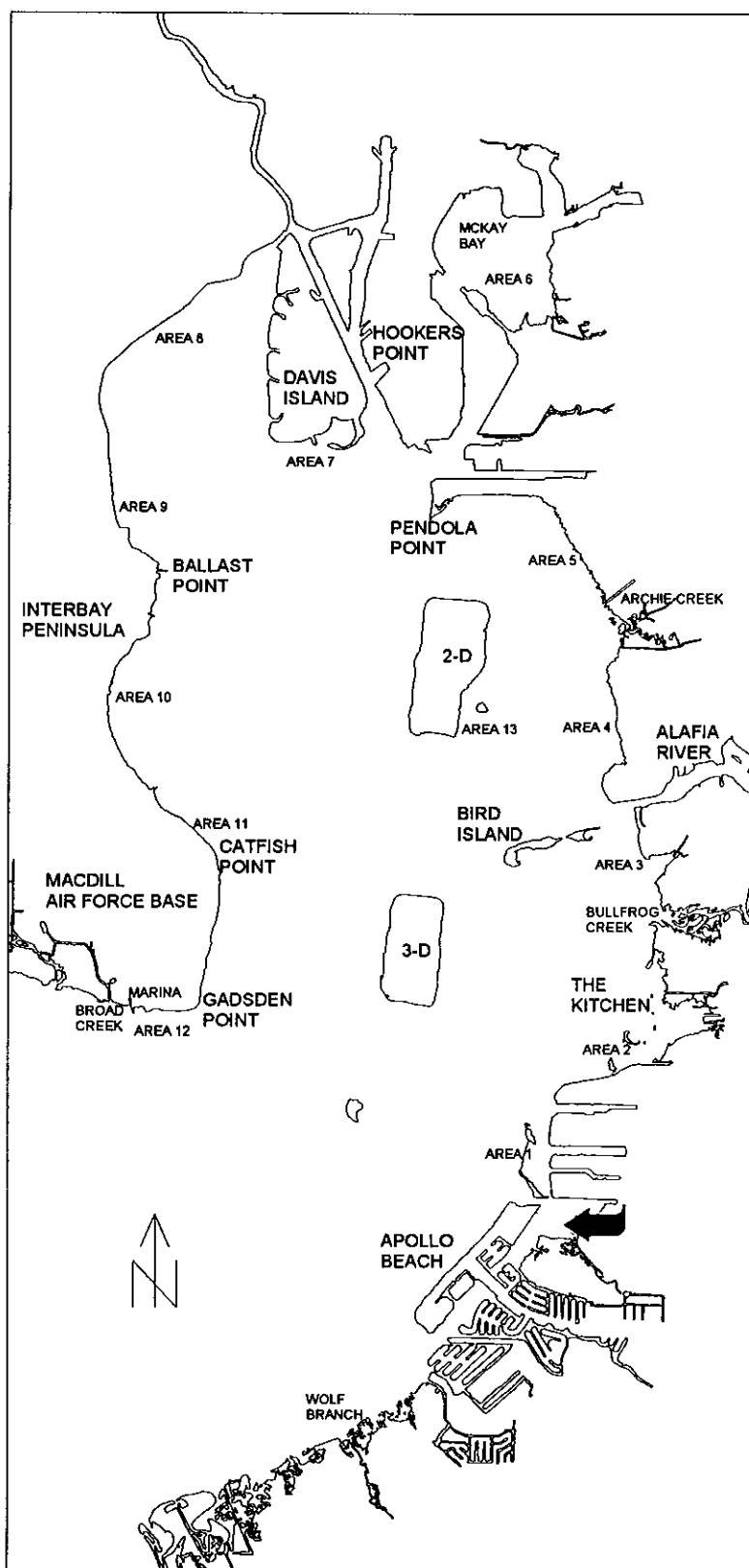


Figure 1. Location of the thirteen seagrass study areas in Hillsborough Bay. Arrow indicates embayment previously included as part of Hillsborough Bay.

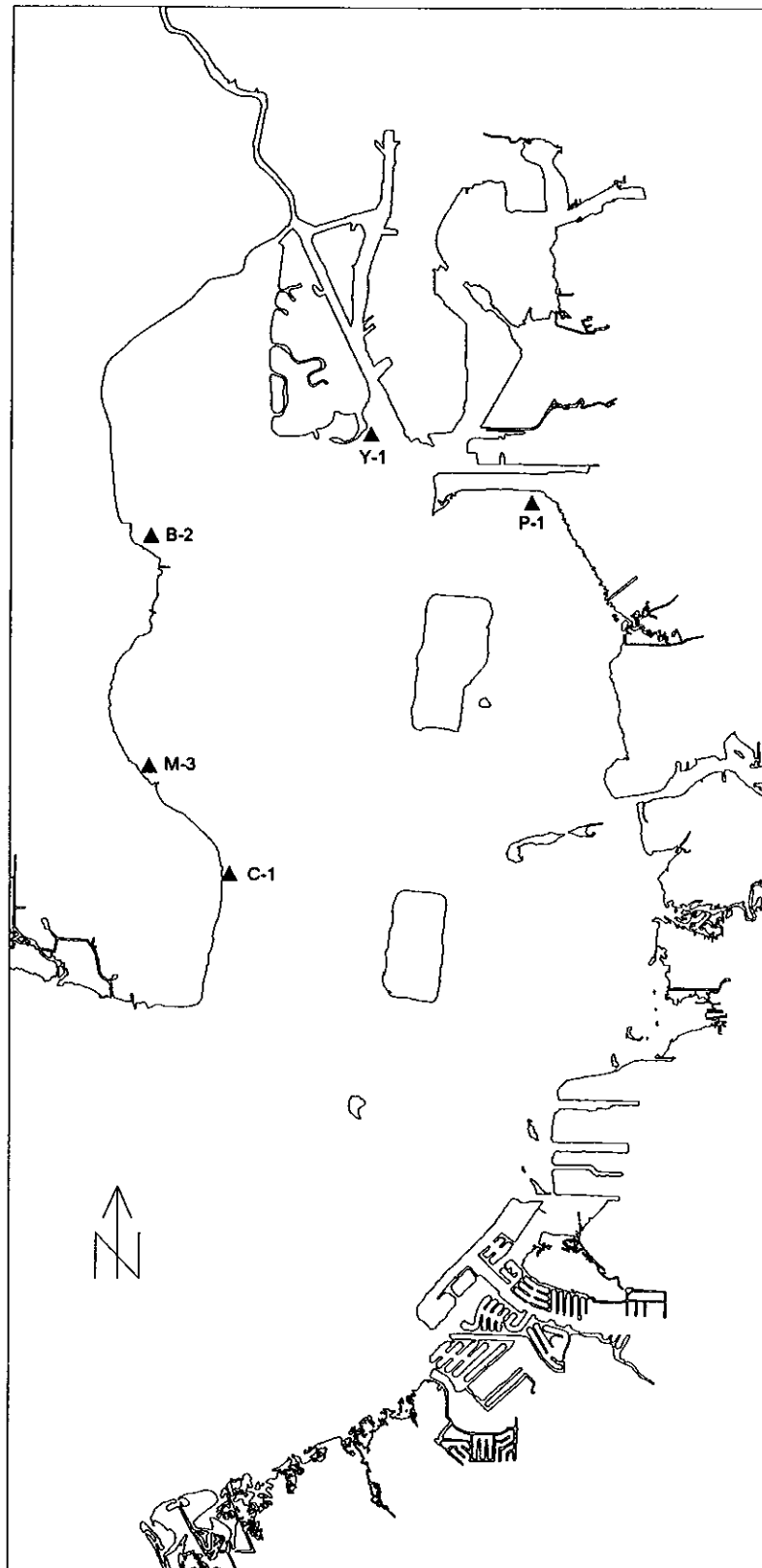


Figure 2. Location of the five *Caulerpa prolifera* transects in Hillsborough Bay.

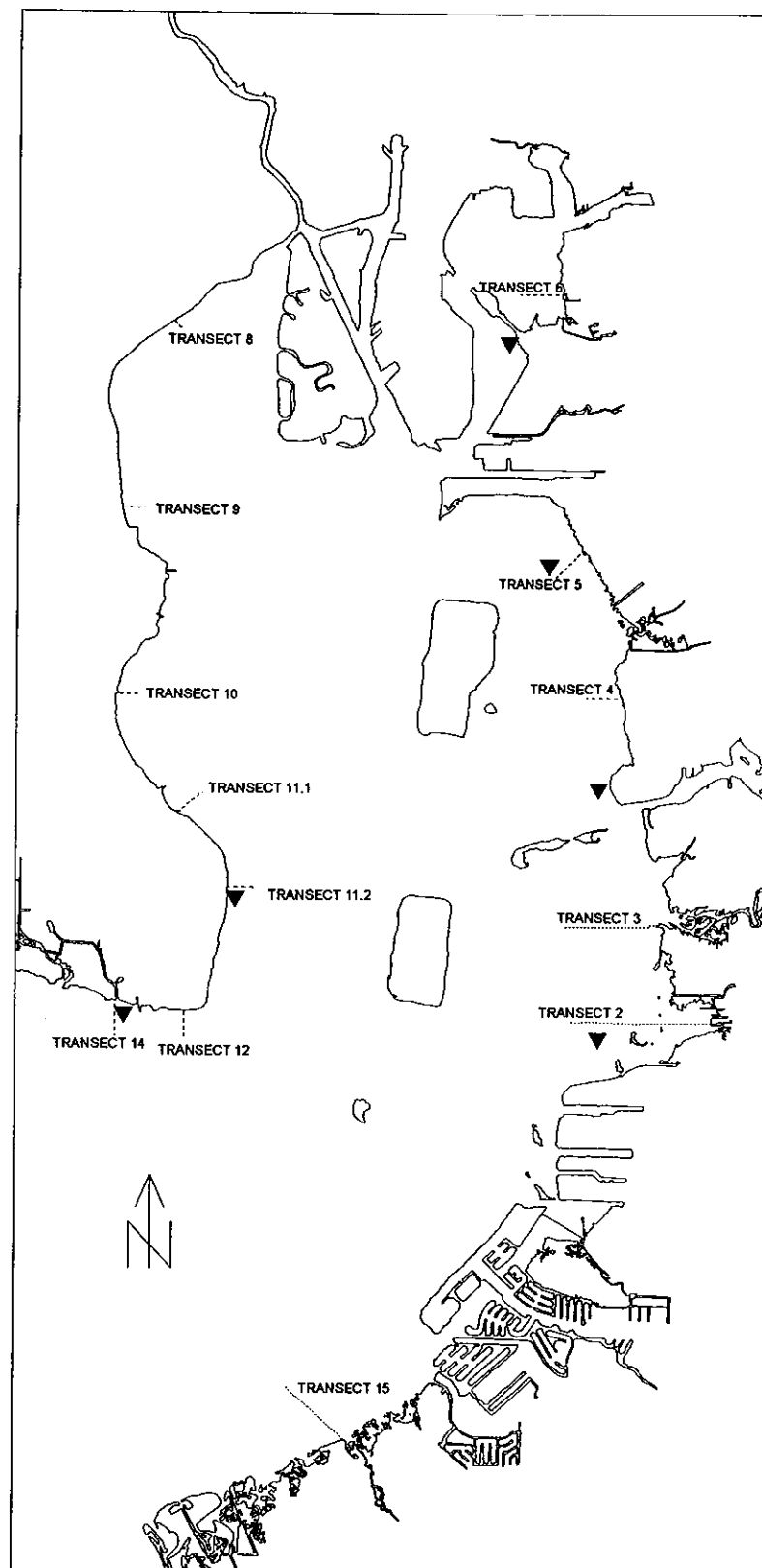


Figure 3. Location of the thirteen COT seagrass transects and the SWIM study sites (▼) in Hillsborough Bay.



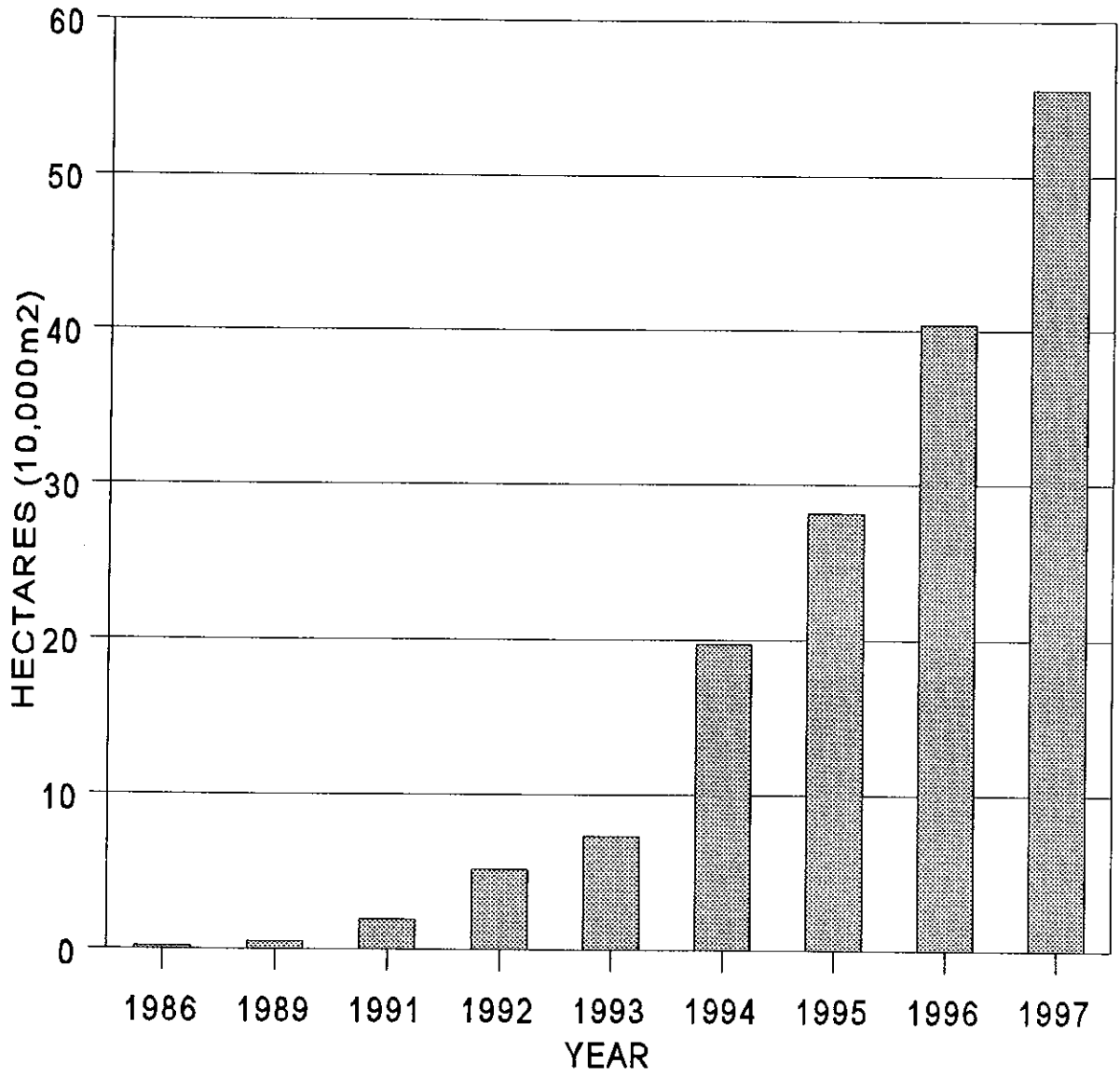


Figure 4. *Halodule wrightii* coverage in Hillsborough Bay.

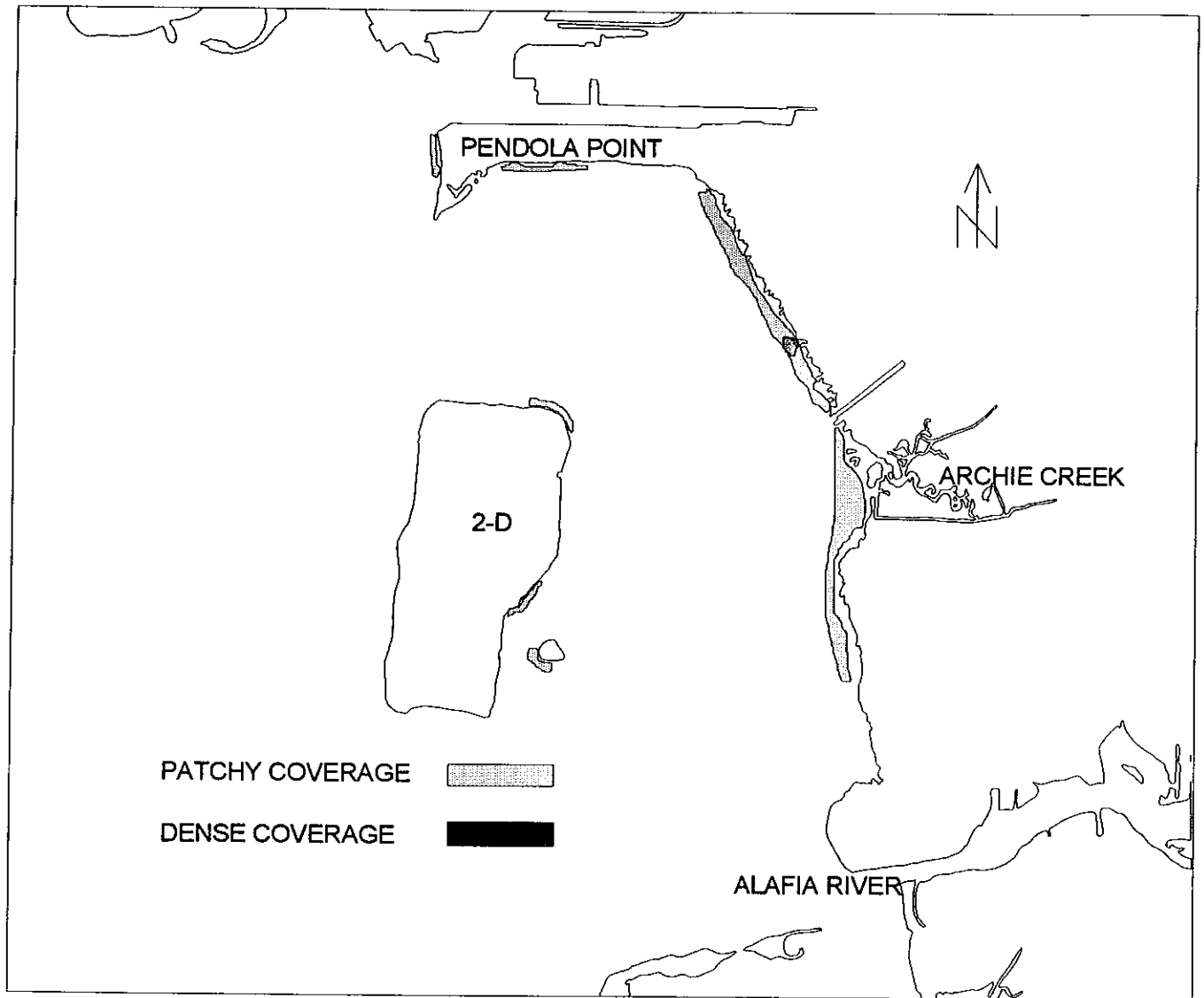


Figure 5. Distribution of *Halodule wrightii* in northeastern Hillsborough Bay (areas 4, 5, and 13).

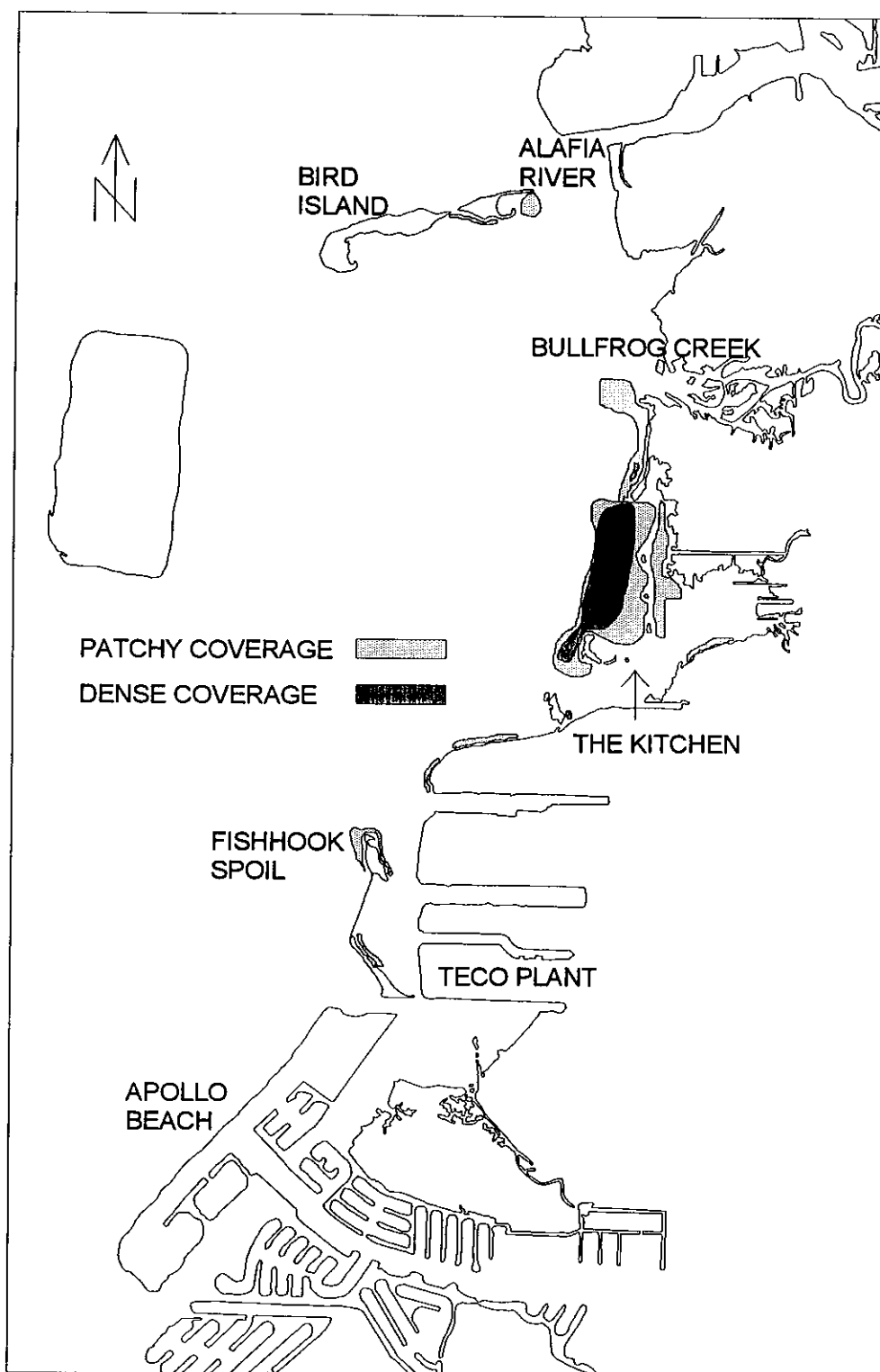


Figure 6. Distribution of *Halodule wrightii* in southeastern Hillsborough Bay (areas 1, 2, and 3).

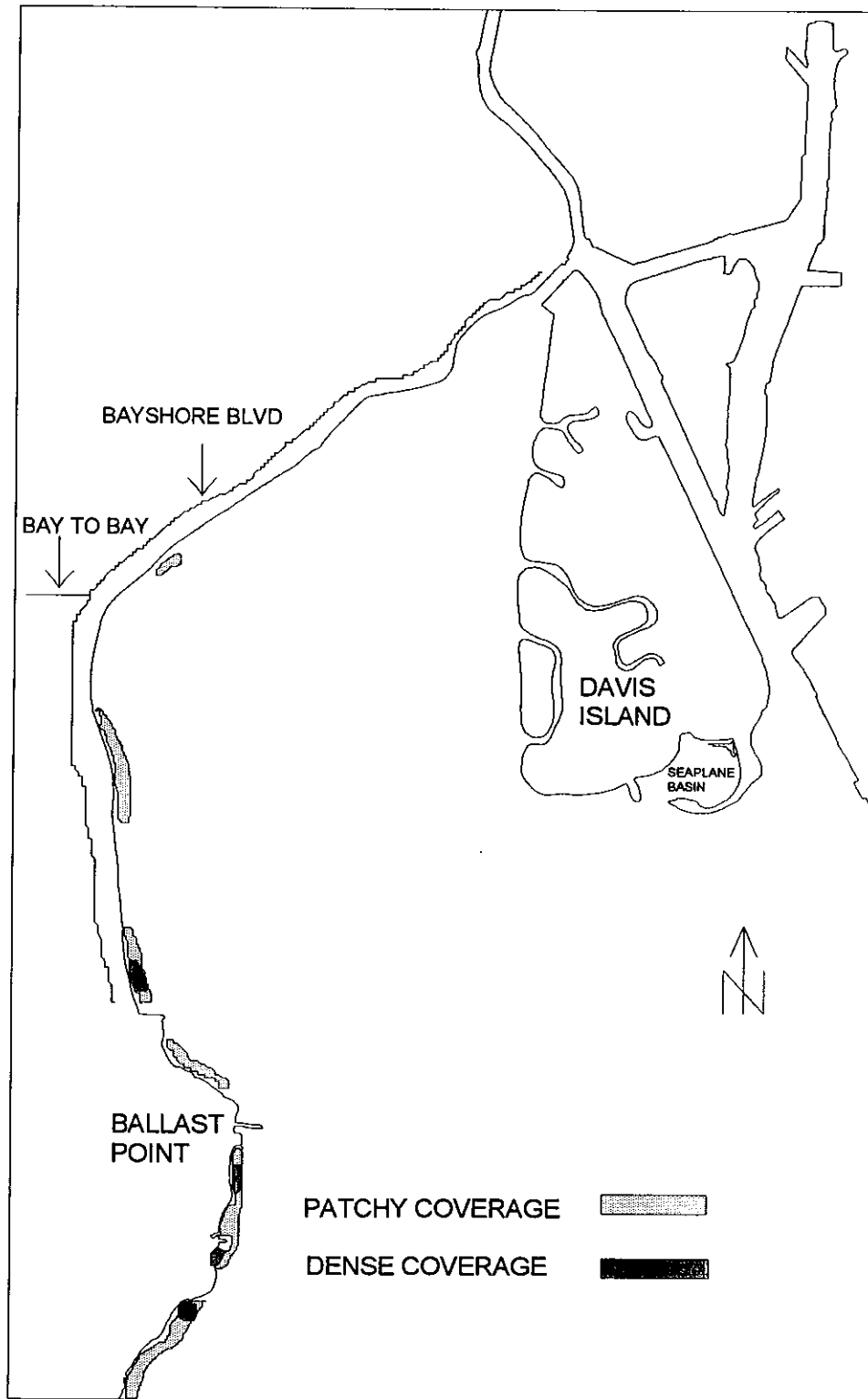


Figure 7. Distribution of *Halodule wrightii* in northwestern Hillsborough Bay (areas 7, 8, and 9).

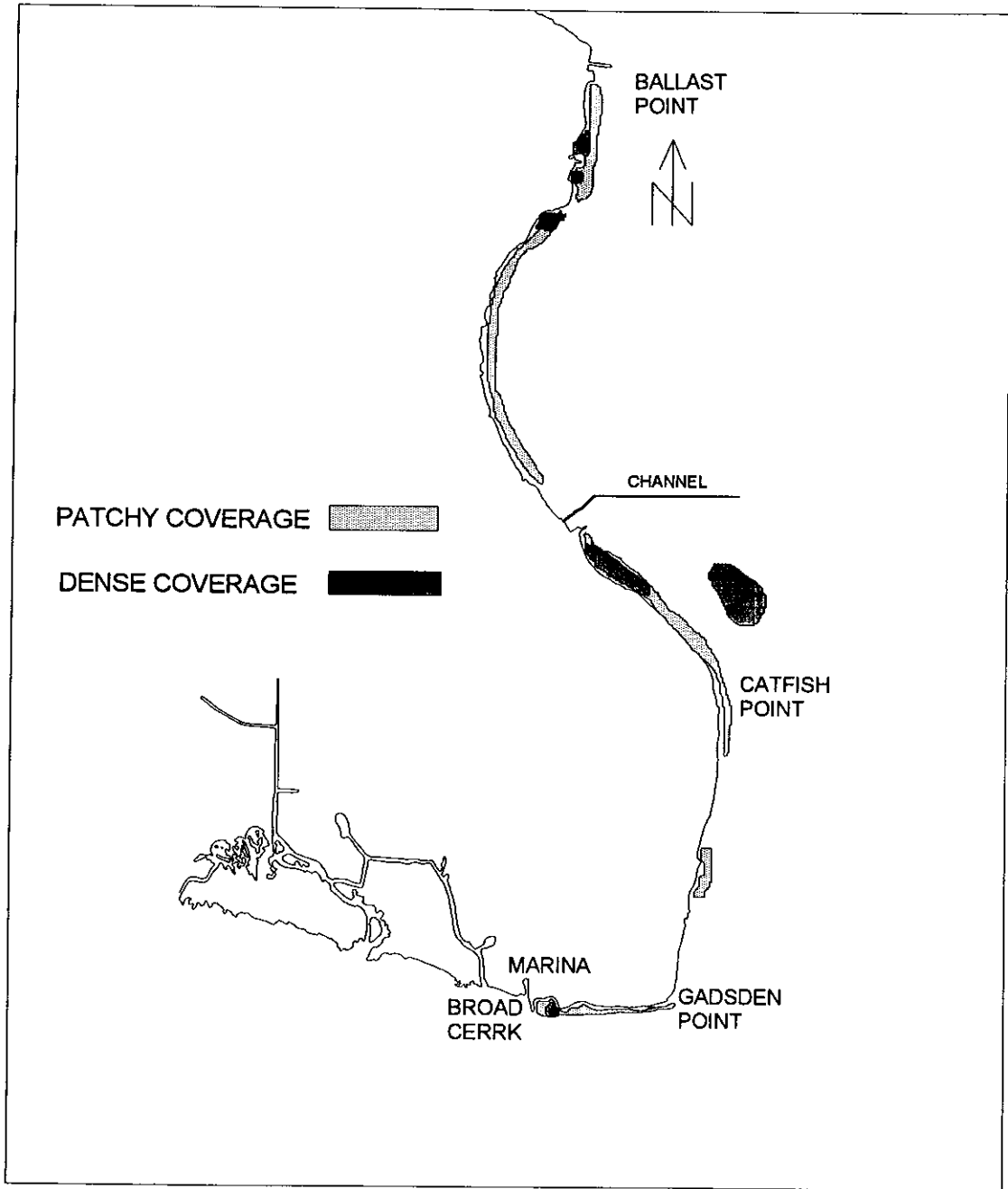


Figure 8. Distribution of *Halodule wrightii* in southwestern Hillsborough Bay (areas 10, 11, and 12).

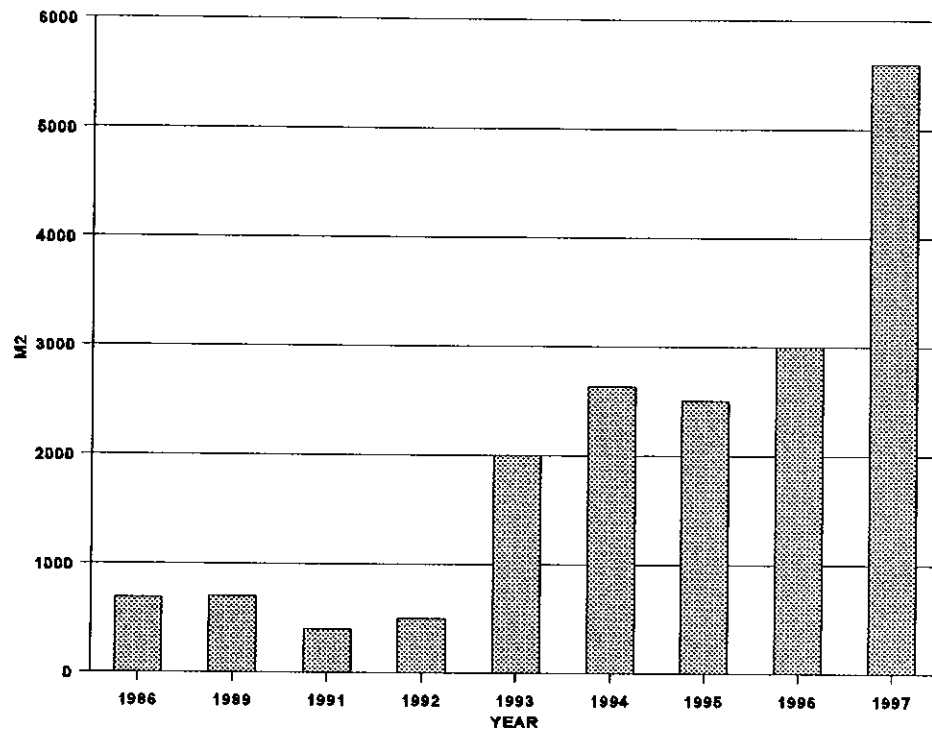


Figure 9. *Halodule wrightii* coverage in area 1.

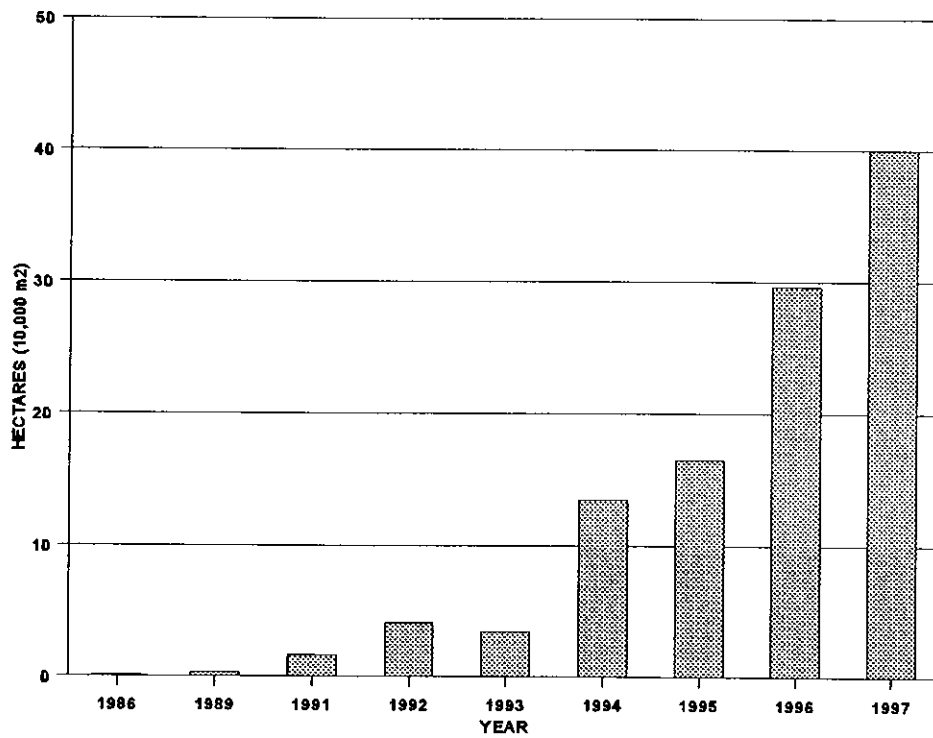


Figure 10. *Halodule wrightii* coverage in area 2.

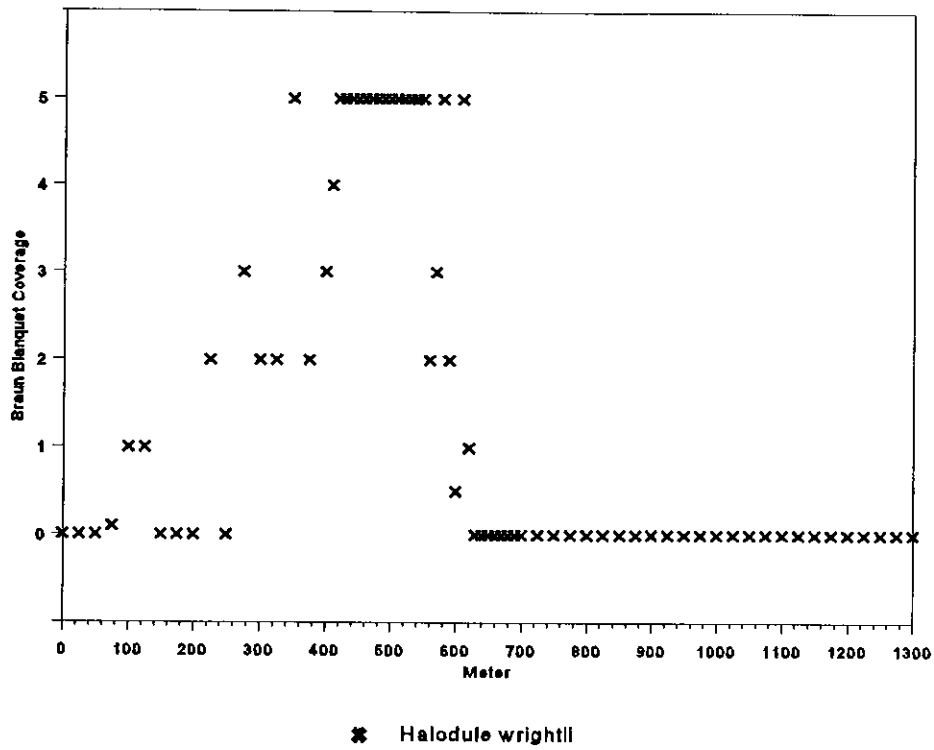


Figure 11. Distribution and coverage patterns of seagrass along transect 2 in 1997.

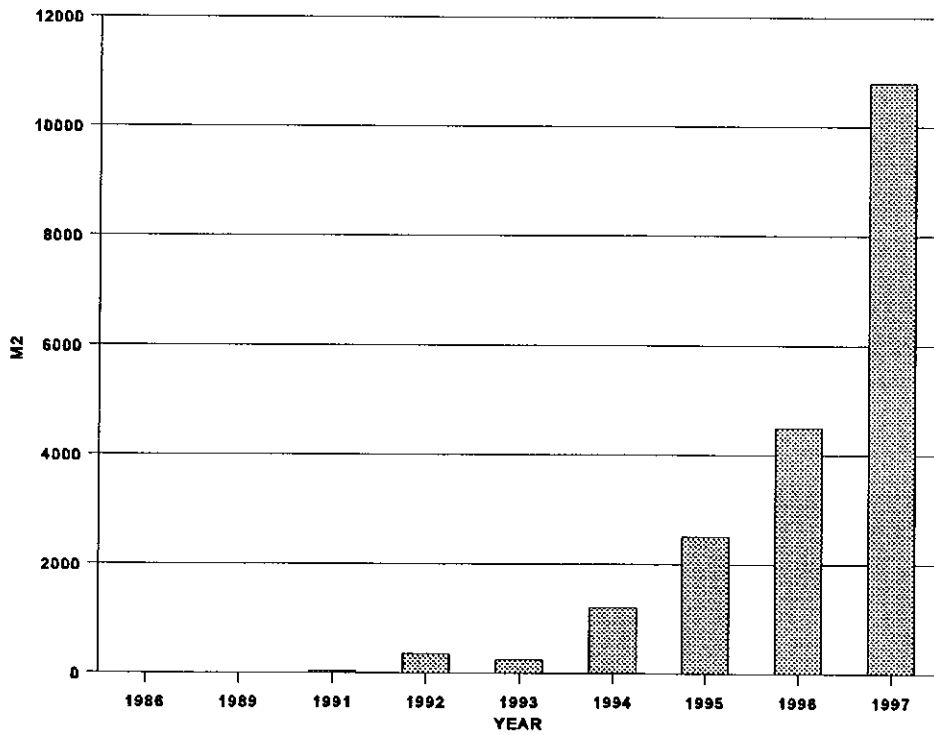


Figure 12. *Halodule wrightii* coverage in area 3.

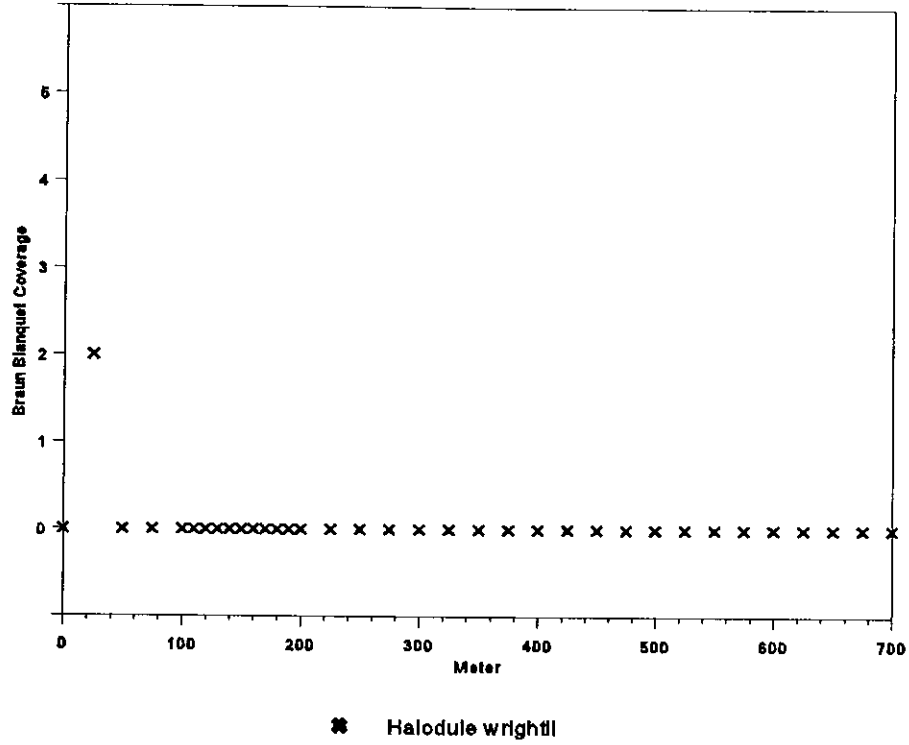


Figure 13. The distribution and coverage patterns of seagrass along transect 3 in 1997.

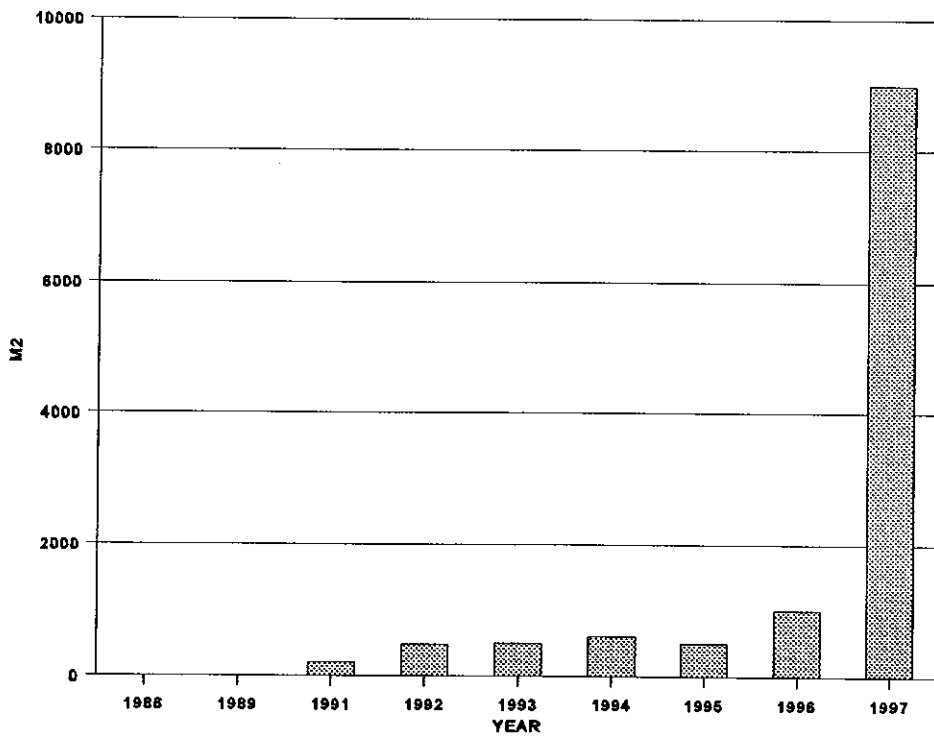


Figure 14. *Halodule wrightii* coverage in area 4.



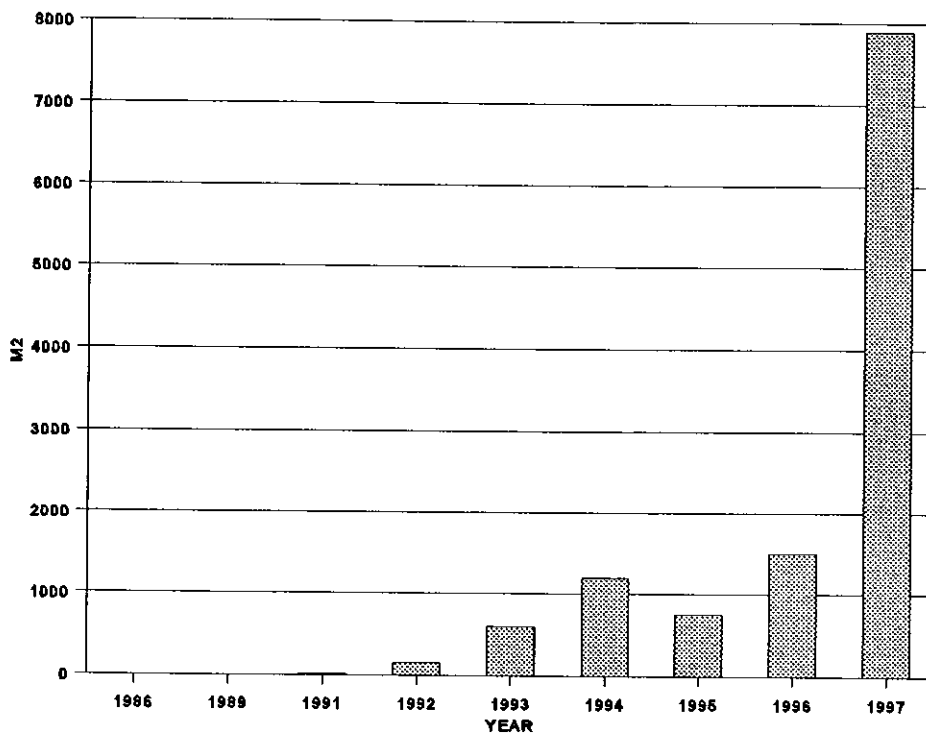


Figure 15. *Halodule wrightii* coverage in area 5.

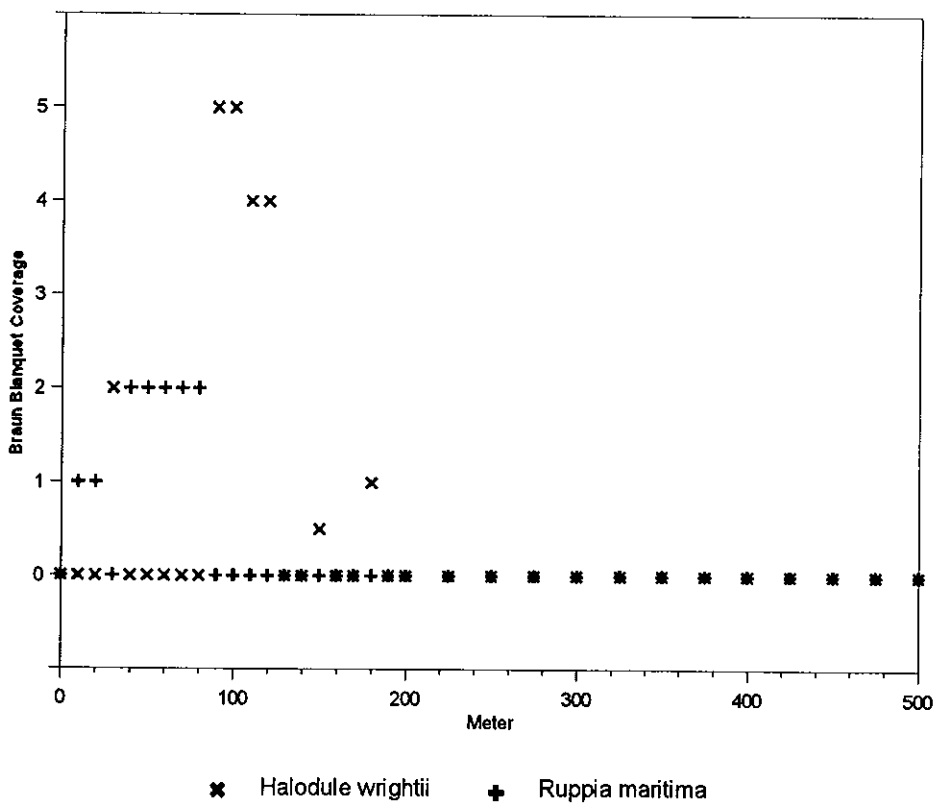


Figure 16. The distribution and cover patterns of seagrass along transect 5 in 1997.

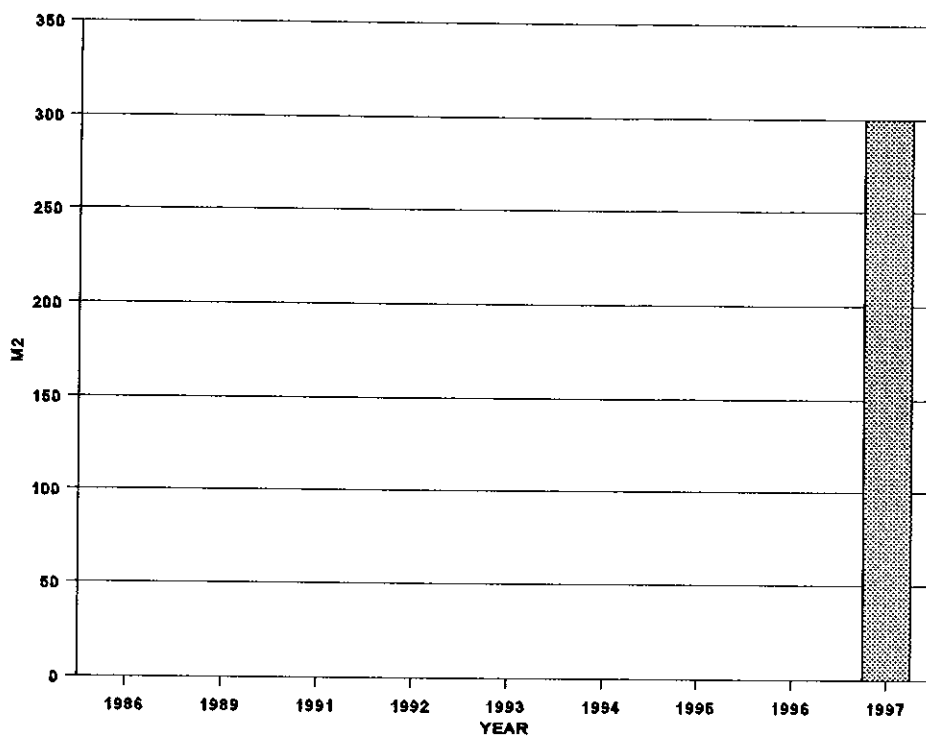


Figure 17 . *Halodule wrightii* coverage in area 7.

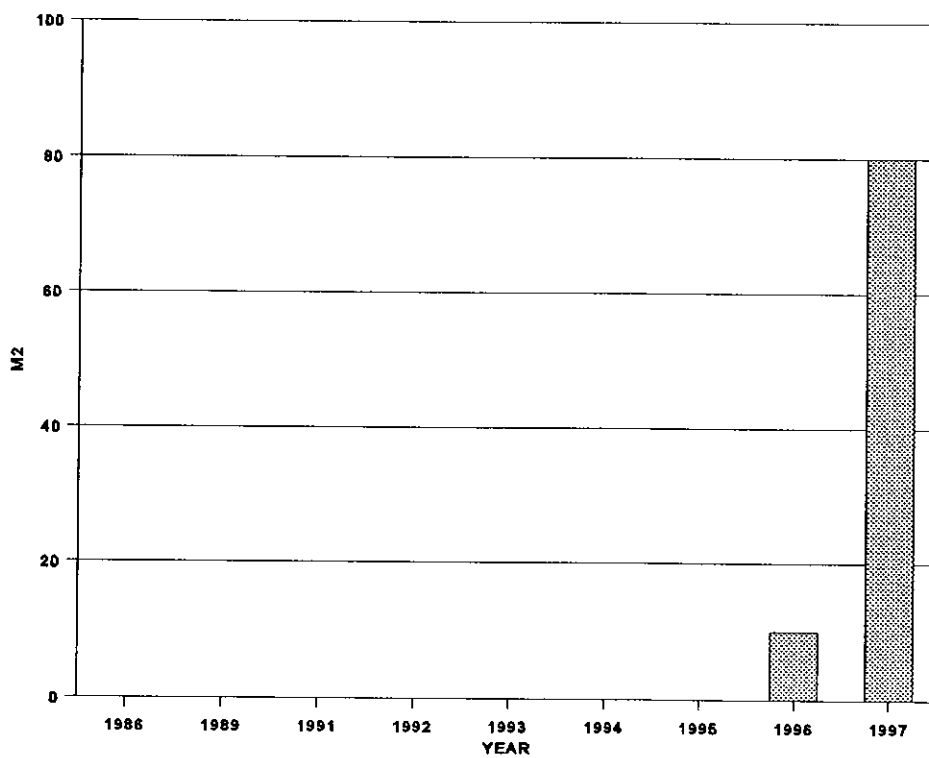


Figure 18. *Halodule wrightii* coverage in area 8.

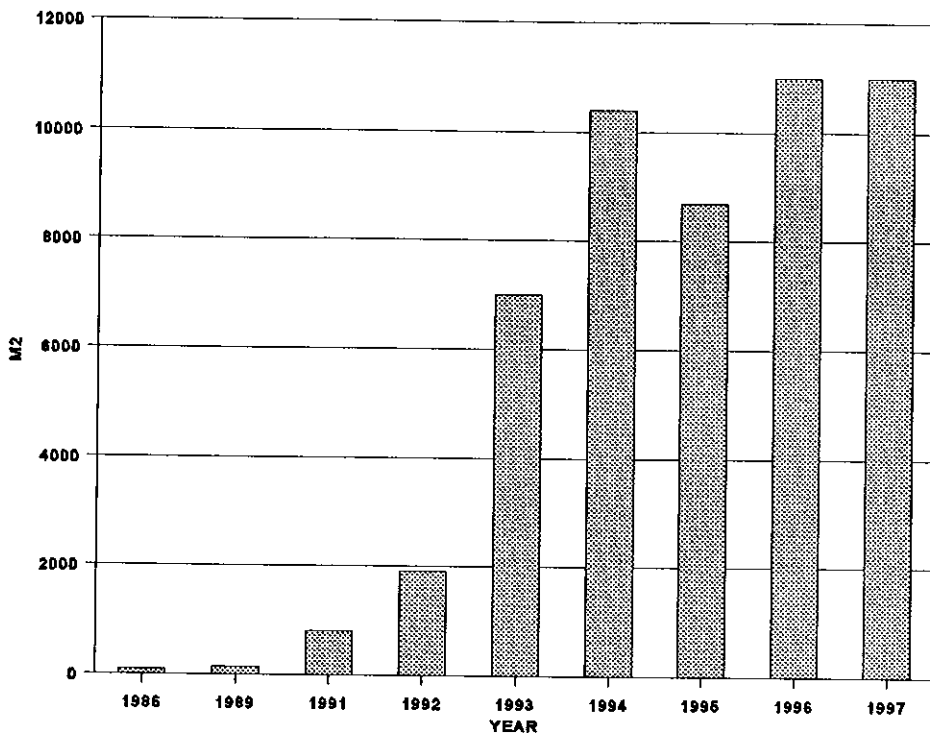


Figure 19. *Halodule wrightii* coverage in area 9.

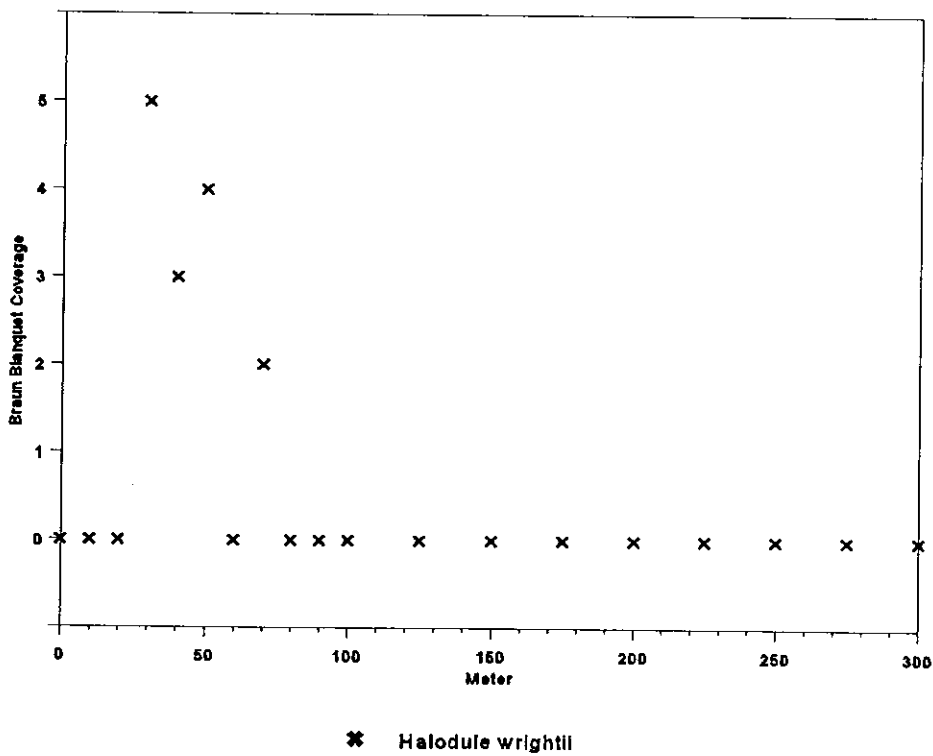


Figure 20. Distribution and coverage patterns of seagrass along transect 9 in 1997.

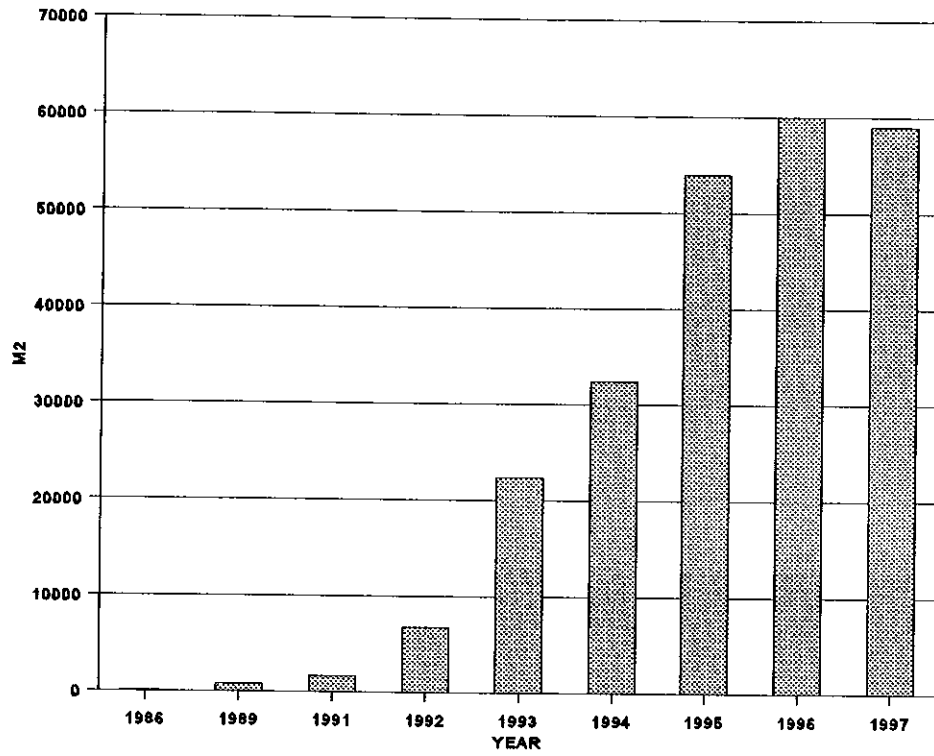


Figure 21. *Halodule wrightii* coverage in area 10.

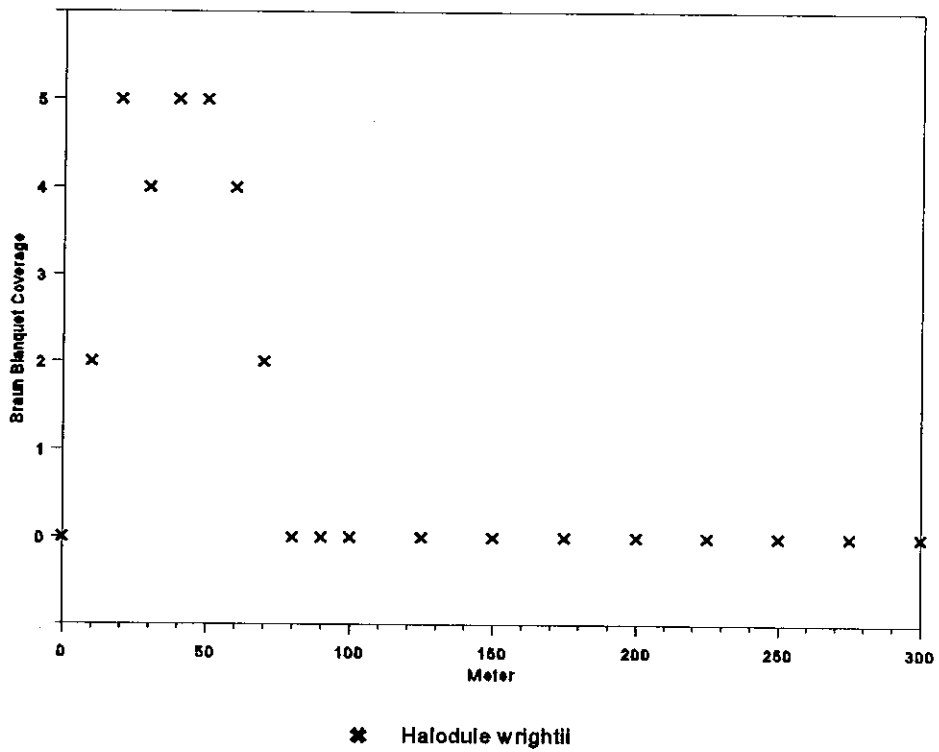


Figure 22. Distribution and coverage patterns of seagrass along transect 10 in 1997.

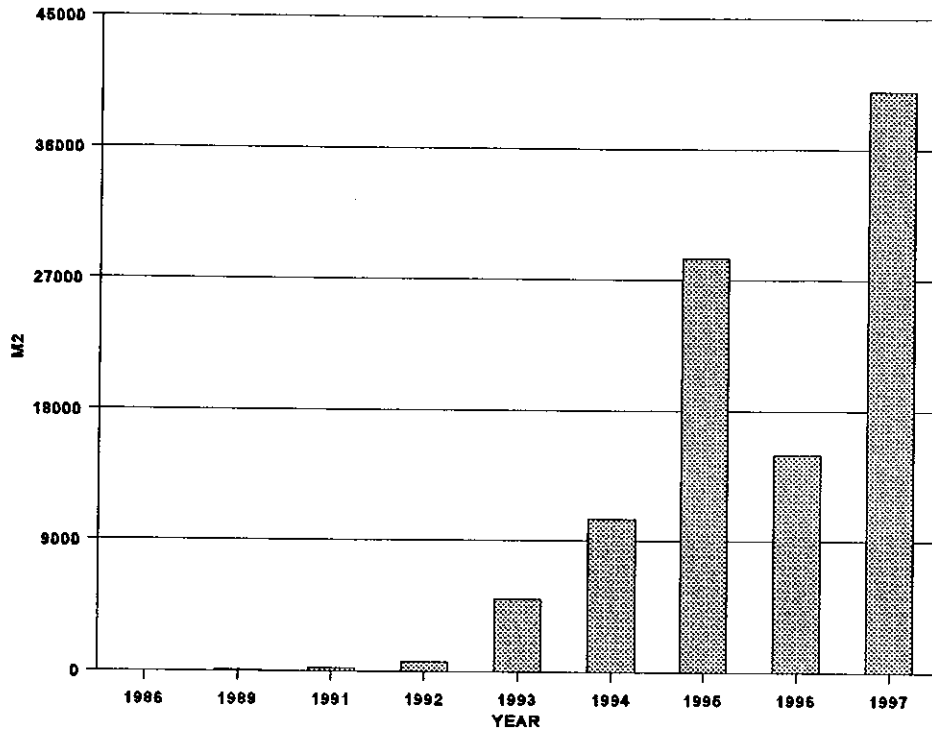


Figure 23. *Halodule wrightii* coverage in area 11.

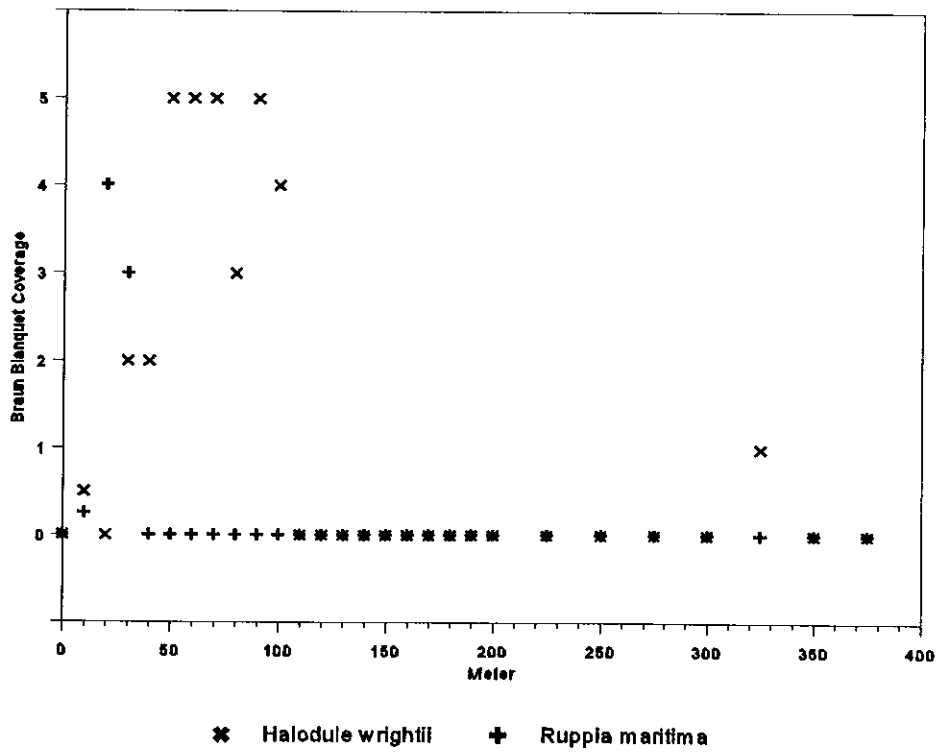


Figure 24. Distribution and coverage patterns of seagrass along transect 11.1 in 1997.

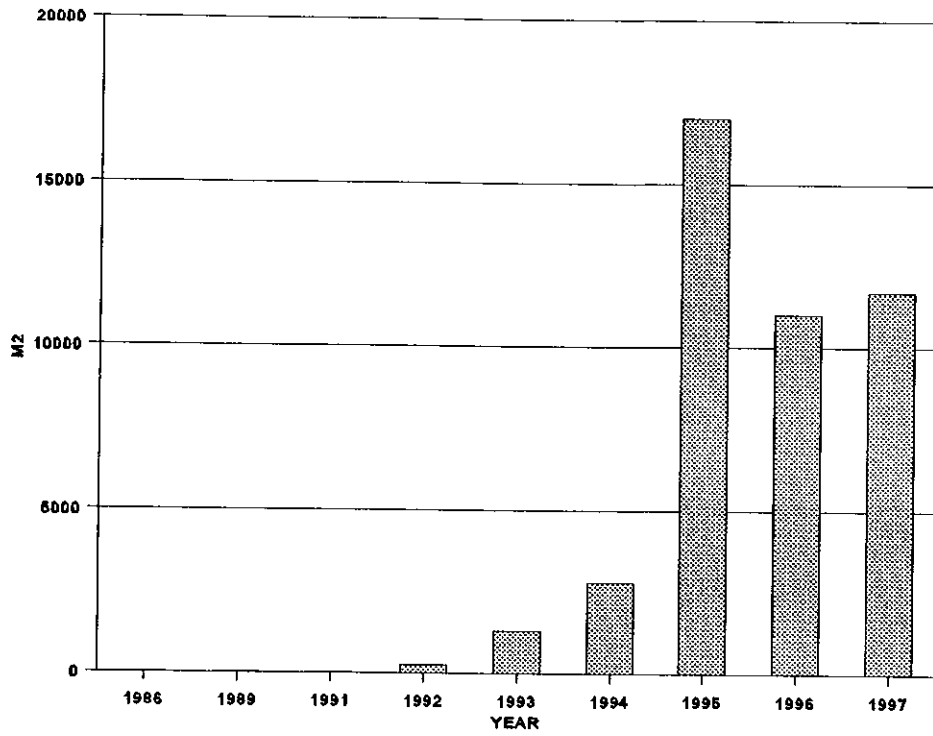
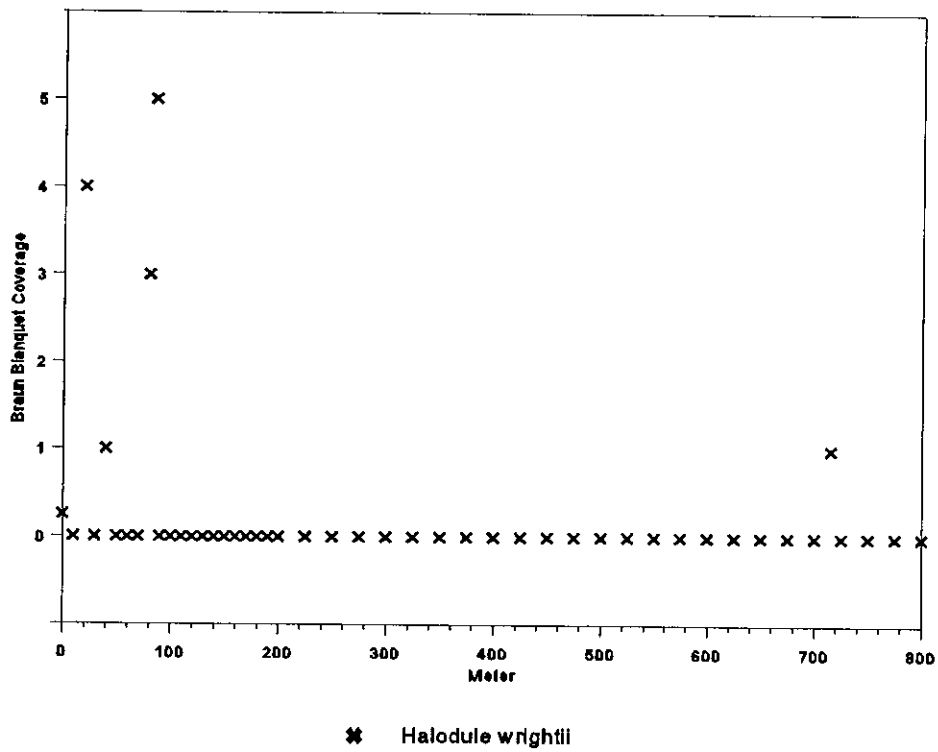


Figure 25. *Halodule wrightii* coverage in area 12.



\* *Halodule wrightii*

Figure 26. Distribution and coverage patterns of seagrass along transect 12 in 1997.

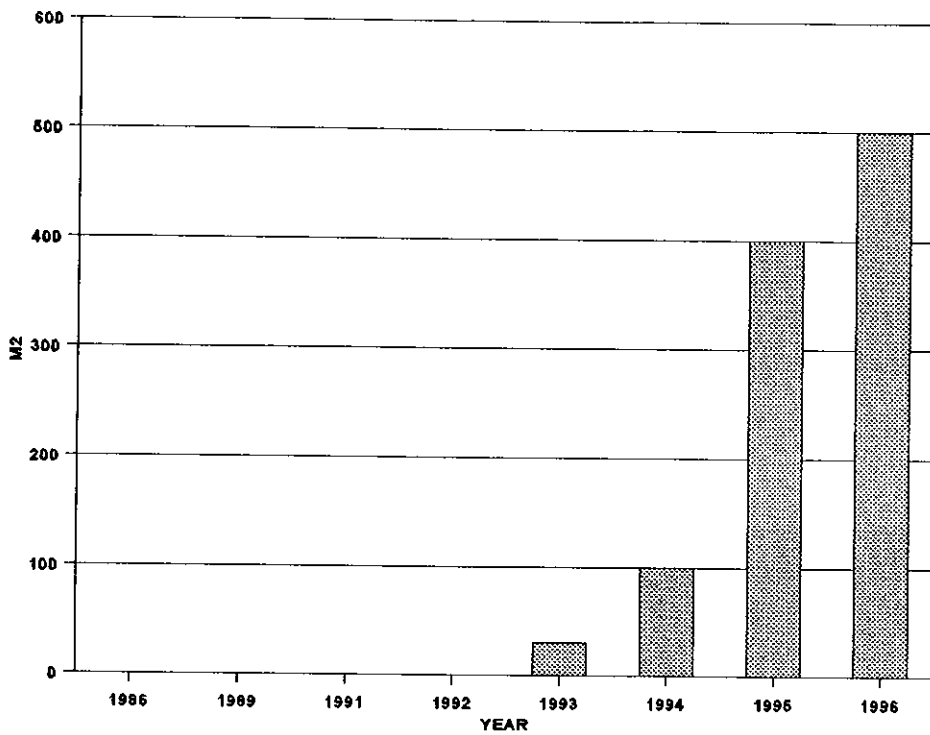


Figure 27. *Halodule wrightii* coverage in area 13.

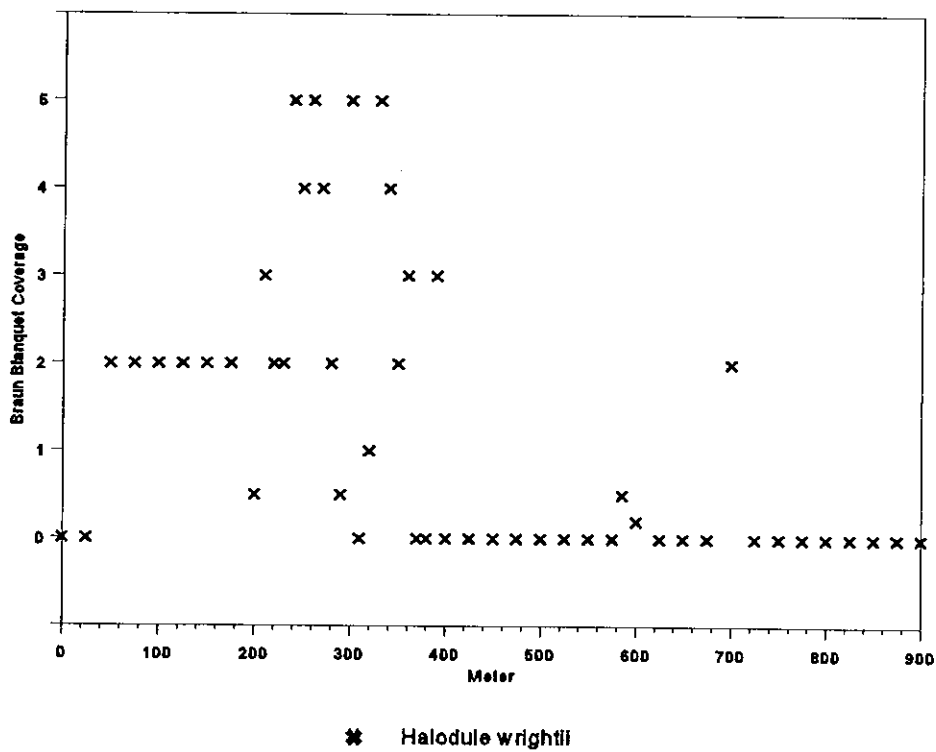


Figure 28. Distribution and coverage patterns of seagrass along transect 14 in 1997.

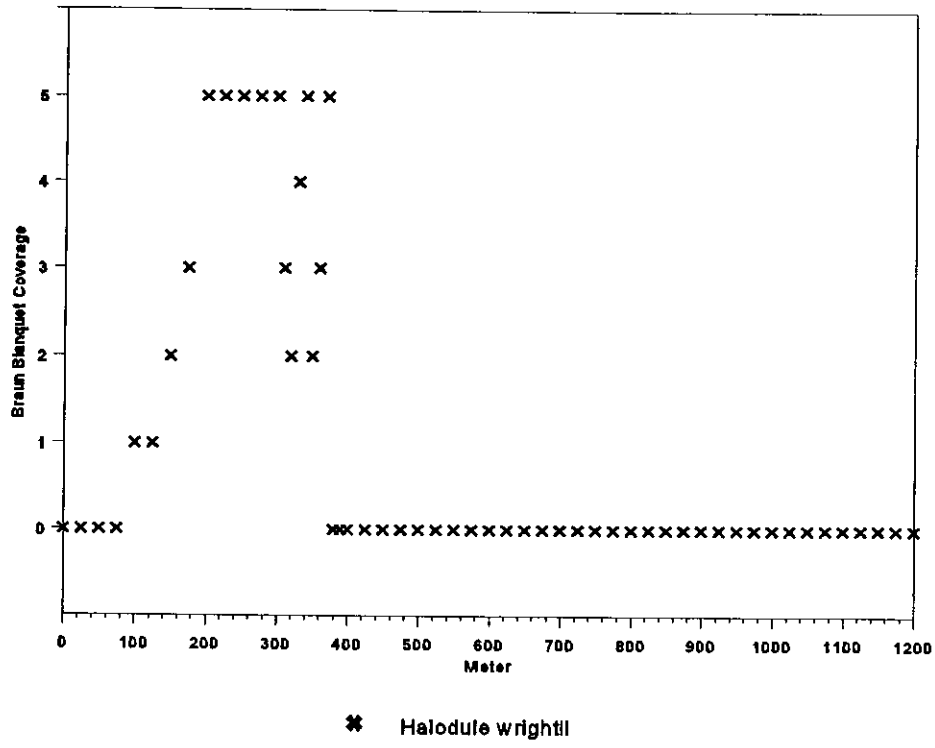


Figure 29. The distribution and coverage patterns of seagrass along transect 15 in 1997.