

# **An Evaluation of Seagrass Communities in the Southernmost Reach of the Indian River Lagoon**

**Mary S. Ridler, Richard C. Dent and Lorene R. Bachman  
WildPine Ecological Laboratory  
Loxahatchee River District**

**December 2000**

## **Introduction**

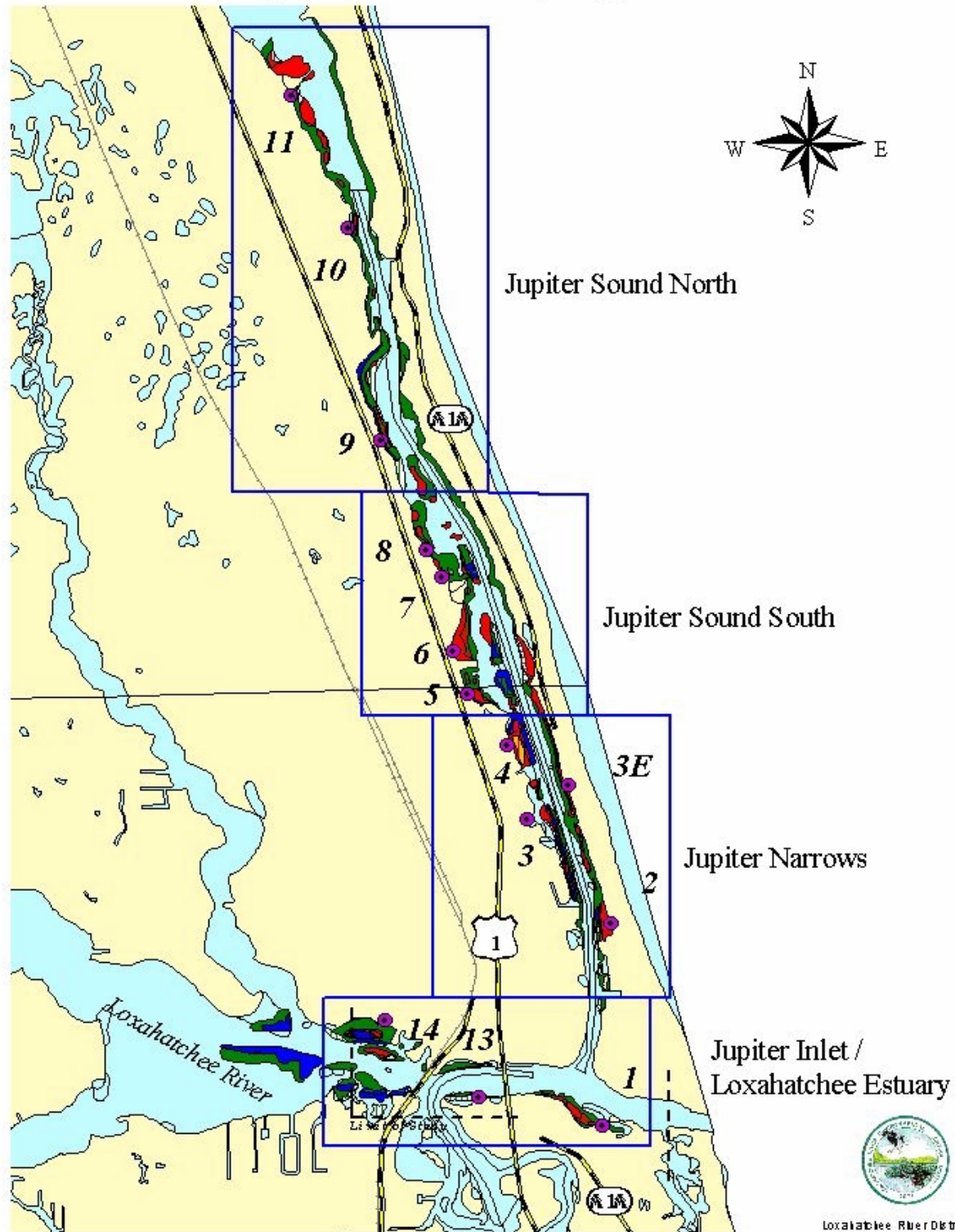
The southernmost portion of the Indian River Lagoon consists of the Loxahatchee River estuary, the Jupiter Inlet and an approximate five-mile reach of the Intracoastal Waterway running from the Jupiter Inlet northerly toward Hobe Sound. Figure #1 presents a map of the study area.

Submerged Aquatic Vegetation (SAV) is recognized as one of the most important habitats within the Lagoon, yet its' health and vitality are issues of continuing concern. For the purpose of this report SAV will be referred to as seagrass. Seagrass habitats continue to play a critical role in providing sediment stabilization, nutrient cycling, detrital food sources and nursery grounds for many recreational and commercially important fisheries. However, over the last twenty years, significant amounts of seagrass have been depleted or completely lost in certain areas of the Lagoon. (Indian River Lagoon National Estuary Program, 1992. Indian River Lagoon, a Fragile Balance of Man and Nature.)

In 1998 the Loxahatchee River District conducted an in-depth evaluation of the seagrass communities in the southernmost portion of the Indian River Lagoon and the Loxahatchee River. The final report of this evaluation detailed summer season distribution, density and composition of seagrasses (Ridler M.S., Dent R. C., Bachman L., 1999. Distribution, Density and Composition of Seagrasses in the Southernmost Reach of the Indian River Lagoon. Loxahatchee River District). In the summer of 2000, the area was re-visited to replicate the earlier evaluation and to assess for any observed changes.

The overall goal of the current research effort is to add to the current information available on seagrass communities and to make relative comparisons to prior studies in the southernmost portion of the Indian River Lagoon. Four distinct, objectives were identified and used to define the scope of study. The first objective was to characterize the density of seagrass from the Jupiter Inlet to the eastern extent of the Loxahatchee estuary and northerly along the Indian River Lagoon for approximately five miles. The second objective was to record information on species identification and composition. The third objective was to document this information and create

**Figure 1. Study Area, Research Segments and Sampling Stations**



a digital map series. And, the final objective was to compare the 2000 data with information gathered in 1998, with primary emphasis on overall seagrass distribution, seagrass densities and composition at each of several stations.

## **Methodology**

The study started in May of 2000 and data collection continued through September of 2000. There were four steps involved in the study: in-situ ground truthing, photo-interpretation, digital mapping and comparison of data between 1998 and 2000.

### *In-Situ Ground-Truthing*

The fourteen stations that were evaluated in 1998 were re-visited in this study. Figure #1 shows the study area and the fourteen monitoring stations. The stations were grouped into four segments, each of which characterizes a portion of the study area based predominantly on distance from the Jupiter Inlet. The point transect method employed in the 1998 work was replicated for this study. This technique involves the placement of a linear transect line perpendicular from the shore out to the deepest edge of the grass bed. Transects at the sampling stations varied in length due to water depth and interference with the main channel. At all stations, the transect lengths tracked those done in 1998. Once the transect line was laid on the bottom, researchers swam the length of the line recording observations, every half meter, on what the line was hitting, either sand or vegetation. Where vegetation was encountered, the species was identified and recorded. Once the fieldwork was completed, all the information was entered into a computer database and analyzed to calculate densities, as percent coverage, and species composition. Global Positioning System (GPS) coordinates for each of the original transect lines were established to allow for consistent semi-annual evaluations of grassbeds.

At each station the same number of transects lines were evaluated as those done in the 1998 study. Transects were sampled once during the summer of 2000. Sampling was conducted primarily at low tide, using a mask, fin and snorkel.

### *Advanced Photo-interpretation*

Following the techniques used in 1998, the information generated was analyzed and then cross-referenced using aerial photographs. Photo-interpretation involves looking at photographs and interpreting vegetation density for known areas and extending those densities into areas that appear similar in the photographs. Specifically, 2000 aerial photographs provided by the Jupiter Inlet District were studied and variations in the shading and colors of the seagrass beds were observed. The differences in shading and color correlate to different seagrass densities. Distinct patterns were observed for the fourteen sampling stations where densities were known. Similar densities were then extrapolated and assigned to other portions of the study area displaying similar patterns.

### *Digital Mapping*

In 1998, base GIS maps of the study area were developed. Using the field information obtained during the summer of 2000, a new series of digital maps was created. The most recent maps report information gathered during 2000 and show both seagrass spatial distribution and relative densities. The method of quantification used in 1998 was also used in 2000. Densities were delineated into four categories: sparse, patchy, dense and dense continuous coverage. A second series of maps was made showing the study area and the extent of the distribution, and density changes for the 1998 –2000 time frame.

### *Comparison of Data*

The information generated in 1998 was compared with data gathered in 2000. The four individual segments were analyzed for relative differences in distribution, density and composition. The remaining parts of this report outline the changes that have occurred within the study area. The report is organized into the respective individual segments.

In addition to comparing seagrass coverage's, environmental conditions have been evaluated for the 1998 and 2000 years. Water quality data was compiled for the year preceding the sampling events of 1998 and 2000. The parameters included in water quality monitoring include: dissolved oxygen, salinity, clarity, turbidity, pH, fecal coliform, chlorophyll a and others. Water quality is an issue that plays a major role in the overall health of seagrass. While rainfall proceeding the 1998 analysis was normal to slightly above average, the period proceeding the 2000 evaluation was significantly below normal. Therefore some differences in water quality were anticipated.

### **Conditions of the Study Area and Types of Measurements**

The environmental character of the study area between 1998 and 2000 did not significantly change nor were any man-induced changes observed. Figure #1 presents a map of the study area showing the Jupiter Inlet, the eastern portion of the Loxahatchee River estuary and an approximate five mile reach of the Intracoastal Waterway extending northerly from the inlet channel. Figure #1 also shows the four segments into which the study area has been divided and the fourteen sampling stations selected for evaluation. At each station, multiple shore to channel transects were established for monitoring. Data is recorded for each transect and data from each suite of transects are composited and reported for the individual sampling station. Appendix 'A' presents this data in tabular form.

The hydrology of the southernmost portion of the Lagoon is strongly influenced by tidal exchanges through the Jupiter Inlet. Prior research has shown that the incoming tide is diverted rather evenly with approximately 45 percent of the marine water flowing northerly into the Lagoon and a similar percentage moving inland into the Loxahatchee estuary (Chiu, T.Y., 1975. Evaluation of Salt Intrusion in the Loxahatchee River, Florida. University of Florida). The remaining ten percent is channeled south to the Lake Worth Lagoon. This tidal influence assures that the waters of the entire study area are well flushed and the substrate is bathed with saline waters on a routine basis. The 250 square mile watershed of the Loxahatchee River estuary, west of the Alt. A1A Bridge, is substantially larger than

the drainage basin for the lower Lagoon. Therefore, a greater freshwater influence is exerted on the water of the estuary. This influence varies seasonally and in other respects, but typically results in modified physical and qualitative characteristics of the water leaving the estuary on an outgoing tide. In contrast, the effect of tidal flushing along the Lagoon is much more constant.

**Figure # 2: General Water Quality Characteristics of the Study Area**

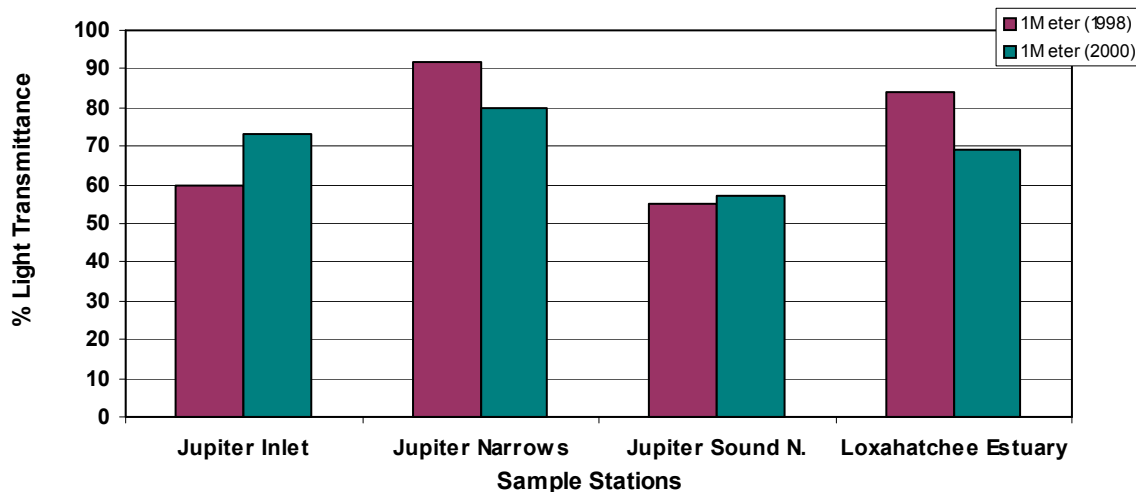
Station	Inlet Station (1)		Narrows Station (2)		Sound N. Station (11)		Loxahatchee Estuary (14)	
	1998	2000	1998	2000	1998	2000	1998	2000
Temperature (C)	24.5	25.6	24.2	25.6	24.3	25.4	24.7	25.7
pH (standard units)	7.9	7.8	8.0	7.8	8.0	7.7	8.0	7.8
Alkalinity (mg/L)	127.0	116.0	127.0	116.0	121.0	119.0	124.0	119.0
Turbidity (NTU)	1.98	1.23	1.55	1.02	2.5	3.58	1.95	1.76
Transparency (m)	3.1	3.5	2.6	3.8	2.0	1.9	2.1	2.2
Color (Pt/Co units)	<20	6.0	<20	6.0	<20	9.0	<20	8.0
TSS (mg/L)	4.9	5.6	5.6	6.1	6.5	7.3	5.8	6.8
Salinity (ppt)	33.0	33.6	33.5	34.0	32.6	33.4	32.2	33.1
Conductivity (umho/cm)	50100	51100	50800	51500	49800	50700	49100	50500
Dis. Oxygen (mg/L)	7.05	6.87	7.05	7.12	6.72	7.08	7.22	6.95
Dis. Oxygen (% Sat)	99	99	99	99	97	99	99	99
B.O.D. (mg/L)	1.0	0.8	1.0	1.0	1.7	0.9	1.1	1.1
Total Nitrogen (mg-N/L)	.87	0.72	.99	0.58	.95	0.63	0.83	0.63
Total Phos (mg-P/L)	0.025	0.007	0.028	0.007	0.025	0.014	0.030	0.013
CHL A (mg/L)	2.1	0.7	1.7	0.6	3.5	2.6	2.0	1.8
F-Coli (cfu/100ml)	5.0	2.0	4.0	2.0	3.0	2.0	3.0	3.0
Florida Water (FWQI)								
Quality Index	20	18	22	18	31	20	22	21
Trophic State Index (TSI)	32	16	33	15	39	35	38	31

Figure #2 summarizes the general water quality characteristics for four representative stations in the study area. Values shown represent the 12-month period during and immediately proceeding the sampling events of 1998 and 2000 and are believed to be representative of existing conditions. The WildPine Ecological Laboratory, as a part of its long-range monitoring program, conducted the water quality sampling. A comprehensive expression of water quality is the Florida Water Quality Index (FWQI), which is a blended measure of water clarity, dissolved oxygen, organic demand, nutrients, bacteria and biological integrity. Index values range from 0 to 90 with lower values reflecting superior water quality conditions. The FWQI scale sets a value of less than 45 as reflecting 'good' water quality, values from 45 to 59 as indicators of 'fair' water quality and values above 60 as a 'poor' water quality measure. A second measure important to seagrass productivity is

the Trophic State Index (TSI). This index combines secchi disc measurements, chlorophyll a concentrations, and nutrient values. A TSI number from 0-49 indicates 'good' trophic water quality. The Loxahatchee River District develops and publishes the FWQI and TSI values, along with more detailed information on over 20 individual perimeters, for the area twice annually. With infrequent exception, during and after large rainfall events, the quality of water in the study area is consistently good. It should also be noted that the macroinvertebrate communities within the study area have been studied and report high species diversity (Dent R.C., Ridler M.S., Bachman L., 1998. Profile of Benthic Macroinvertebrates in the Loxahatchee River Estuary, Loxahatchee River District).

Another measure commonly used in seagrass studies is light transmittance, or specifically the amount of photosynthetic active radiation available to the vegetation. An evaluation of the quantity of light reaching various depths was conducted at four of the seagrass monitoring stations for both 1998 and 2000. On days without significant cloud cover, readings well above 1,000 umols were observed at the water surface. Figure #3 provides a review of the percentage of reduction in light reaching various depths in the water column for both 1998 and 2000. Two out of the four stations sampled for light were shown as having a decrease in light transmittance. This decrease may be due to a number of variants including cloud cover. The light meters work very well on clear sunny days, however, cloud cover has a dramatic effect on the readings. Some of the days that sampling occurred on, had partly cloudy skies. Future evaluations of light transmittance must eliminate, the cloud cover variable so that this measure can provide greater insight.

Figure # 3: Light Transmittance at Four Representative Stations



Other water quality comments include: below normal rainfall accumulations during the dry season of 1999 and continuing through the 2000 sampling period. In the eight months prior to the 1998 study, rainfall was 44 inches. Conversely, in the eight months during and prior to the 2000 evaluation rainfall was significantly lower with only 19 inches recorded. This may play a significant role in seagrass density and composition. As shown in Figure

#2, most stations in 2000 had higher salinity readings than 1998, lower total nitrogen, lower phosphorus and lower turbidity. All four components play an integral part of seagrass growth. The next sections of this report will describe seagrass measurements used including density, distribution and composition of seagrass recorded during the 2000 study. The comparison of 2000 data with 1998 data will be presented in subsequent portions of this report.

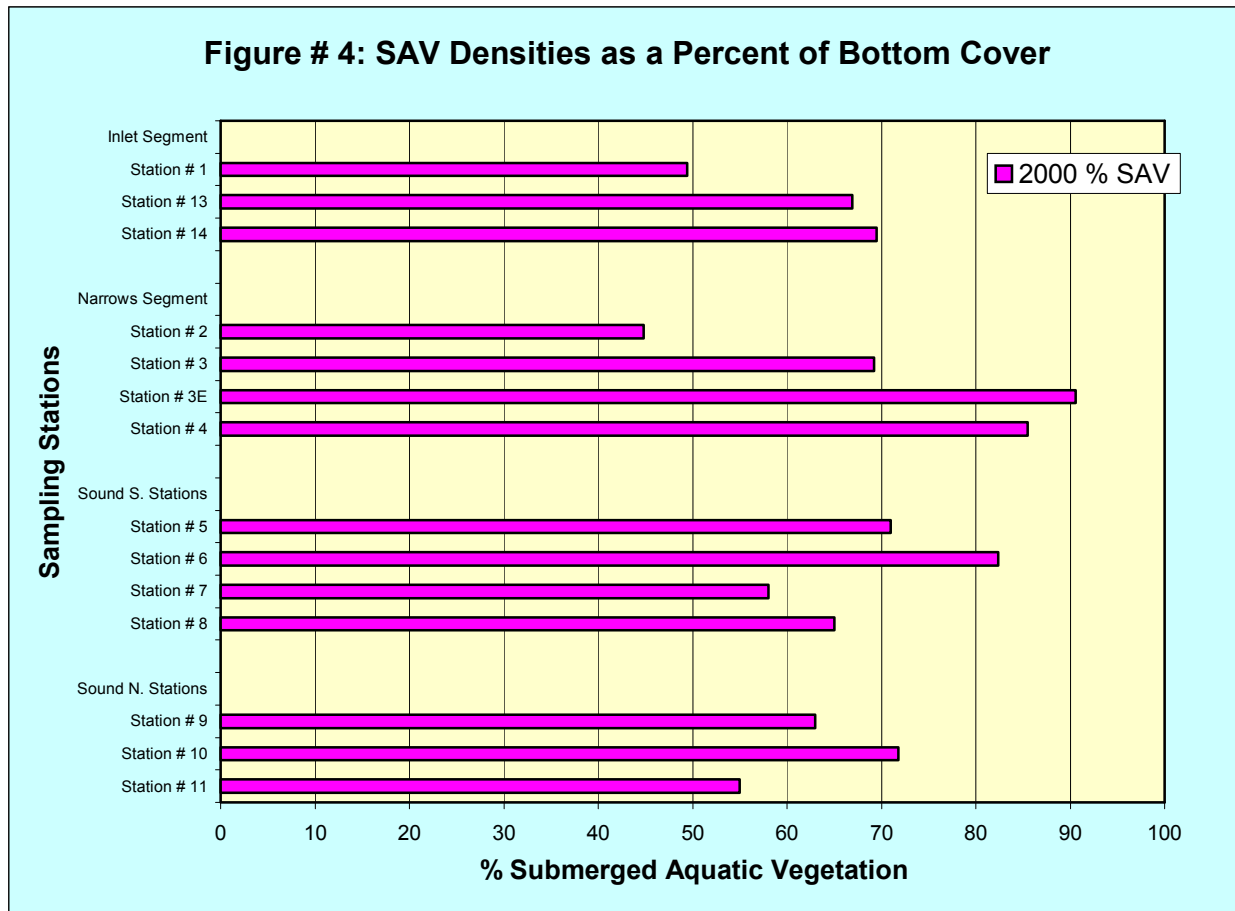
## *Density*

For the purpose of this study, the density of seagrass is defined as the percent of seagrass or macroalgae observed along a defined linear transect. Researchers recorded either sand or seagrass presence in one-half meter increments along each transect. Thus, a seagrass density of 40 percent would indicate that vegetation was encountered at four out of ten sampling points along the transect and sand was recorded for the remaining points.

This study described seagrass density using the same scale that was employed in 1998. This scale is divided into four categories. This scale is comparable to the measurements used by St. John's River Water Management District (SJRWMD) in their studies of other sections of the Indian River Lagoon. The scale is described below.

Sparse	= less than 25 percent seagrass
Patchy	= 26 to 50 percent seagrass
Dense	= 51 to 75 percent seagrass
Dense Continuous	= greater than 76 percent seagrass

Figure #4 shows the presence of seagrass as a percent of bottom cover at each of the fourteen sampling stations for 2000. In general, seagrass is observed in densities from 45 to 90 percent, thus falling into either the patchy or dense category. In 2000, three stations (#3E, #4 and #6) had dense continuous seagrass coverage. No stations within the study area displayed sparse coverage. There are sparse areas within the study area, but most can best be described as sand bars or shoals.



## *Distribution*

Distribution is considered the spatial extent of seagrass communities, regardless of density, and is described in a map series developed with the advance photo-interpretation method and GPS coordinates. Figures #6, #7, #8 and #9 are digitized maps that document the seagrass distribution of the study area. These maps show the overall distribution of seagrass in each of the four study segments and show the relative density of seagrass. These maps also demonstrate which areas have changed in seagrass densities from the 1998 study and will be referenced in later sections.

Distribution throughout the five-mile northern stretch of the Lagoon is nearly complete along both shorelines. Similar to 1998, the western shoreline showed more extensive spatial distribution possibly due to the shallower water depths. The western shoreline gradually slopes toward the main channel whereas the east shoreline has a steeper slope. Conversely, within the Loxahatchee estuary, seagrass distribution is not complete with only limited areas of vegetative growth when compared to the Intracoastal Waterway segments. Even less spatial area is covered by seagrass within the Jupiter Inlet area where velocity and depth extremes may be limiting.

For purposes of verification, a few additional transects were evaluated. Information regarding these transects was employed to enhance the accuracy of the distribution



measures only. Generally, in areas that were adjacent to sampling stations, the seagrasses found mirrored the densities and species compositions of the closest station.

### *Species Identification and Community Composition*

Five species of seagrasses are identified within the study area:

<i>Syringodium filiforme</i>	manatee grass
<i>Halodule wrightii</i>	shoal grass
<i>Thalassia testudinum</i>	turtle grass
<i>Halophila johnsonii</i>	Johnson's seagrass
<i>Halophila decipiens</i>	paddle grass

Also noted are species of macroalgae, which, for this report, are all grouped and referred to as algae.

All seagrass beds are made up of several species of seagrass or algae. The relative presence of one species to another can be used to describe the composition of the community. The mixture of seagrass species depends upon many environmental factors, predominantly wave action, water clarity and water depth. At many sites *H. wrightii* or *H. johnsonii* were observed living closest to shore, where tidal fluctuations and wave action occur. These species tend to be more tolerant of harsher conditions. As the shoreline slopes into deeper water, *S. filiforme*, and *T. testudinum* tend to be more dominant. Further out toward deeper water, *S. filiforme* and *T. testudinum* disappear and *H. wrightii*, *H. johnsonii* or *H. decipiens* reappear. This profile is evident at many stations in the study area.

In general terms, *S. filiforme* is the species found most often in the study area. This trend was also observed in 1998. At approximately half of the stations, *S. filiforme* became more abundant than in 1998. The trend of *S. filiforme* being the most dominant species is encouraging because this species is associated with water of good quality and high light attenuation. The second most abundant species of seagrass was *H. wrightii*. *H. wrightii* was denser in 2000 than in 1998. *S. filiforme* and *H. wrightii*, constituted over half of the total seagrass found in 2000.

Similar to 1998, there were substantial areas found within the study area that had populations of *H. johnsonii*. At many of these stations *H. johnsonii* was found growing intermixed with *H. wrightii*. *H. johnsonii* is a species of special concern because it is currently considered threatened within the Indian River Lagoon.

One species that have limited representation in the study area was *T. testudinum*. In 2000, *T. testudinum* was found at only 3 stations. *T. testudinum* was seen in the study area, at stations #2, #3 and #4. It was also observed to be living among *S. filiforme*. While both *T. testudinum* and *S. filiforme* tend to occupy similar depths, *T. testudinum*, is generally less pollution tolerant and/or more light dependent. Another species that had limited

representation was *H. decipiens*. This species was found in small concentrations at three sampling stations, all of which are in the northern segment of the study area.

## **Findings and Results**

### **2000 Study**

The following evaluation of the individual segments in the study area provides information on seagrass communities. Please refer back to Figures #6 through #9 for map showing the distribution and density of seagrasses in the four segments. Figures #10, #11, #12 and #13 display the relative abundance, in percent, of the individual species that characterize the seagrass communities observed in each of the four study segments. These figures show the relative percentages of seagrass species only and do not include sand bottom coverage's.

#### ***Jupiter Inlet / Loxahatchee Estuary Segment ..... stations #1, #13 and #14***

There are three seagrass monitoring stations located in this segment. Station #1 is located on the south side of the Jupiter Inlet near DuBois Park. At this station there were five transects evaluated in 2000 compared to three in 1998. The reason for the difference in the number of transects was due to environmental conditions such as water velocity. Station #1 experiences extreme water velocity changes due to the close proximity to the Jupiter Inlet. The linear transects used for monitoring extend out from the shoreline an average distance of 65 meters and terminate in 2 meters of water. Station #13 is one mile west of the inlet, located on the south shore between the U.S. Highway One Bridge and the Alt. A1A Bridge. Station #13 has a mangrove-fringed shoreline and the two transects were extended from shore and average of 50 meters and terminated in 2.4 meters of water. Station #14 is located one and a half miles west of the inlet on the west side of the Alt. A1A bridge and the FEC railroad bridge. Five transects were evaluated at this station. All transects ran from the north shore out into the Loxahatchee Estuary. Transects at this station were an average of 170 meters and ended in 1.6 meters of water. Station #14 has a sand bar that runs east to west and is evident in Figure #6 as the area seen in blue (sparse).

Stations #1 and #14 are two long-term water-quality monitoring stations. The water quality characteristics recorded at these stations are believed to be representative of this entire segment. Water quality for 2000 is displayed in Figure #2. Salinity averages about 33 ppt. Turbidity averages 1.5 mg/l, pH is at a value of 7.8 and dissolved oxygen levels average 6.9 mg/l. One major difference between the inlet and the estuary is color with significantly higher levels observed in the estuary. The composite index for water quality, FWQI, is within the good range between 18 and 21. The TSI index is also in the good range of 16 to 31.

Station #1 was the only station in this segment that had a patchy seagrass density. This station is the closest to the Inlet and therefore experiences the most significant fluctuations in water velocity. Stations #13 and #14 had dense seagrass recorded. Densities in this segment ranged from 49% to 69.5%. Seagrass distribution in this segment is not complete and is dependent on environmental conditions. The seagrass communities found within

this segment are associated with shallow, clear water. Figure #9 shows the composition of the seagrass communities for these stations. The predominant species of seagrass found at station #1 and #14 was *H. wrightii*. Station #14 the predominant species of SAV was macroalgae, followed by a combination of species. All three of the stations had populations of *H. johnsonii*.

#### *Jupiter Narrows Segment ..... stations #2, #3, #3E and #4*

The Narrows segment is directly north of the Jupiter Inlet in the Lagoon portion of the Intracoastal Waterway and contains four seagrass monitoring stations. Station #2 is located on the east shore just north of the SR 707 Bridge approximately one mile north of the inlet. The four transects established for monitoring are each 70 meters in length with an ending water depth of less than 2.0 meters. This station is subject to extensive recreational use. On the western shore of the Lagoon, station #3 is approximately one-half mile north of station #2. The two transects at station #3 start from a residential shoreline and extend out 100 meters to an ending depth of 2.5 meters. Station #3E is on the east shore diagonally across from station #3. This station is protected from the shore by a fringe of mangrove and two transects extend from the mangroves nearly 70 meters and end in 2.0 meters of water. Station #4 is a half-mile north of station #3 and located on the west side of the Lagoon. Each of the two transects at this station run 100 meters and concludes in 2.6 meters of water depth.

In this segment, station #2 is monitored for water quality and macroinvertebrates and the data are considered representative for the entire segment. The physical and chemical characteristics of this segment show average salinities of 34 ppt, and very low turbidity, color and nutrients are observed. Dissolved oxygen levels are high, averaging above 7.1 mg/l and levels of organics are relatively low. The composite FWQI at station #2 is very good at 18, the lowest in the full area of study. Likewise. The TSI index is quite good displaying a value of 15. Light transmittance through the waters at station #2 is very good, however has seen a slight decline since 1998.

Three out of the four stations in this segment have significant areas of dense seagrass, ranging between 51.6% and 90.6% coverage. The fourth station, station #2, had an average of 45% coverage that is described as patchy. Spatial distribution within this segment is complete along both the east and west shorelines with the exception of small areas immediately north of the SR 707 bridge. Along the western shore, the seagrass grows a relatively greater distance from the shore primarily due to the greater extent of shallow water. Also, a sand bar running parallel to the western side of the channel serves as a protective barrier and deflects wave action from watercraft.

Seagrass composition at the sites within this segment is shown on Figure #10. *S. filiforme* and *H. wrightii* are in equal composition at stations #2 and #3. At stations #3E and #4 *S. filiforme* was the predominant species. Overall, *H. wrightii* and *S. filiforme* make-up more than 50% of all seagrass found at all stations in this segment. Other species that were found include: *T. testudinum* at stations #2, #3 and #4 and *H. johnsonii* at stations #3 and #4.

### *Jupiter Sound South Segment ..... stations #5, #6, #7 and #8*

The stations of the southern half of Jupiter Sound are all located north of the Narrows segment and are all located on the western side of the Lagoon. Stations #5 and #6 are on opposite sides of a land jetty approximately two miles north of the Jupiter Inlet. Each station had two transects that extended out 100 meters and ended in a water depth of 2.0 meters. Station #7 is located one-half mile north of station #6 and is situated behind a small sand bar, creating a protected cove. Recreational boaters have used station #7 because a sand bar forms at low tide. The two linear transects at this station run an average of 150 meters from a residential shoreline into 2.0 meters of water. Station #8 is located a quarter of a mile further to the north and is adjacent to a small marina. At this station, only one transect exists and extends out approximately 100 meters and terminates in 3.0 meters of water.

No long-term water quality, biological or light monitoring has been undertaken in this segment. However, water quality and macroinvertebrate information from the two neighboring segments (Station #2 and Station #11) indicates probable good water quality and healthy biological communities in this segment of the study area.

Stations #5, #6 and # 7 have dense coverage of seagrass, ranging from 58.2 % to 70.5 %. Station #6 has a dense continuous coverage of 82.4%. At all four stations in this segment *S. filiforme* was the most prevalent species found. Stations #5, #6 and #7 all had large populations of *S. filiforme* in combination with *H. wrightii*. This combination means that *S. filiforme* and *H. wrightii* were found living among each other. Station #8 was the only station in this segment to have *H. decipiens*. At station #8, *H. decipiens* was found to comprise 36% of the seagrass found. Similar to the Narrows segment, the seagrass distribution in this segment is complete along both shorelines with larger distributions associated with the western shallows. Two land jetties in this segment effectively harbor portions of the substrate and allow expanded growth of seagrass further east into the Lagoon. Figure #12 shows each of the four stations in this segment and provides a breakout of the composition of species at each station.

### *Jupiter Sound North Segment ..... stations #9, #10 and #11*

The three stations in this segment are the northernmost stations sampled in this study. All three stations have transects extending from the west side of the Lagoon. Station #9 is 3.7 miles north of the inlet near an upland that consists of low density commercial and residential land uses. The station is located in front of a jet ski rental business and the three transects extend an average of 80 meters and end in over 2.5 meters of water. Station #10 is located 4.5 miles north of the inlet and possesses two transects that are 50 meters in length and terminate in over 3.0 meters of water depth. The station is protected by a mangrove shoreline. Station #11 is the northernmost seagrass sampling location and is approximately five miles north of the Jupiter Inlet, just south of the Hobe Sound Wildlife Refuge. This station is adjacent to one of the long-term seagrass stations sponsored by the SJRWMD. The two transects at station #11 extend out 75 meters and end in 2.5

meters of water. Each of the transects run parallel to a sand bar with fairly steep slopes. Additional transects were run perpendicular to the original transects. Data from these additional transects are not included in the composition figures found later in this report, but the information was used to draw the distribution map in Figure #9.

Station #11 is monitored for water quality and macroinvertebrates and is believed to accurately portray the physical, chemical and biological characteristics of the northern half of the Jupiter Sound. Water quality is 'good' with an average FWQI number of 20 and an average of TSI 35. Salinity values average above 33 ppt with only occasional drops below 20 ppt., turbidity is near 3.5 mg/l and pH levels and the mean concentration of dissolved oxygen is similar to other water quality observations in the study area. Station #11 does not receive as much of the clear saline water on in-coming tides as do stations closer to the inlet. Therefore, the light transmittance at station #11 drops 45 percent from one meter to two meters of depth, total suspended solids average of 7.3mg/l and transparency, as measured by secchi disc depth, averages less than 2 meters.

All three stations in this segment have dense seagrass coverage's ranging from 55% to 72.4%. Stations #9 and #10 both are primarily populated by *S. filiforme*. Station #11 is also populated by *S. filiforme* but is followed closely by *H. decipiens*. Station #11 had a presence of *H. wrightii* but the species was mixed in combination with *S. filiforme*. While seagrass distribution is also complete in this segment, the band of vegetation is narrower and concentrated more so along the shorelines. This segment is the furthest north and the water is more highly colored and more turbid, limiting light penetration to relatively shallow depths. The presence of a sand bar at station #11 is associated with the greater spatial distribution in this limited area.

## **Comparisons with 1998 Study and Future Research**

The final objective of this study was to compare the results of this investigation with the work done in 1998. All of the fourteen stations were originally surveyed in 1998 and the next sections will compare the stations from 1998 to 2000. The graphical method used in Figures #6, #7, #8 and #9 to describe changes in seagrass distribution and densities are listed below.

- \* **Solid Colors** = seagrass densities that remained the same from 1998 –2000
- \* **Vertical Lines** = seagrass densities that increased from 1998 – 2000
  - background color represents the density in 2000
  - lines represent the seagrass density in 1998
- \* **Horizontal Lines** = seagrass densities that decreased from 1998 – 2000
  - background color represents the density in 2000
  - lines represent the seagrass density in 1998

### *Distribution:*

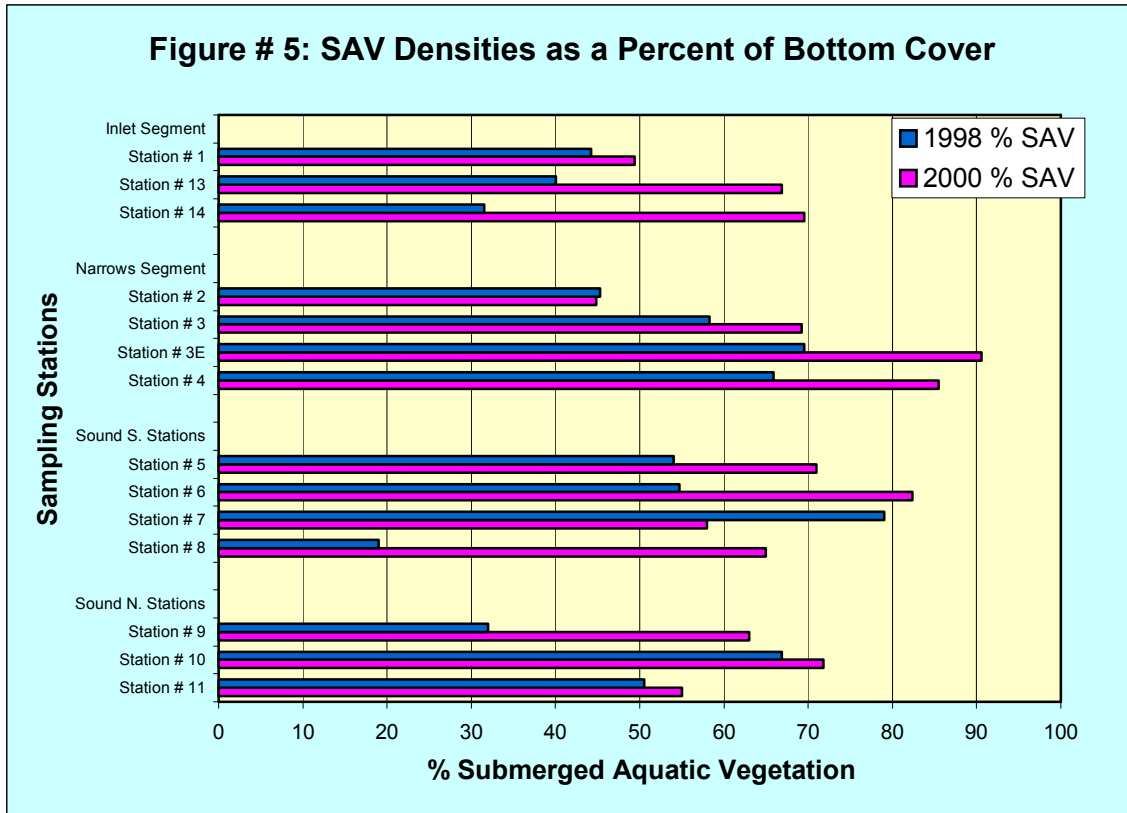
Overall seagrass distribution did not change drastically from 1998 to 2000. There were small areas where there was no seagrass reported in 1998 that exhibited seagrass presence in 2000. Those areas are seen in Figures #6, #7, #8 and #9 as having a white background with vertical bars. The color of the vertical bars represent the density observed in 2000. Station #13 saw the biggest change in seagrass distribution, which dramatically increased the overall size of the grassbed. Other areas within the study showed slight decreases in distribution and those areas are seen in Figures #6, #7, #8 and #9 as areas with a white background and horizontal lines. The line colors designate what the seagrass density was in 1998.

### *Density:*

All but two stations demonstrated increases in seagrass coverage from 1998 to 2000. Stations #2 and #7 were the only two stations that saw a decrease in density. Decreases are represented on the maps by areas that have horizontal lines. The horizontal lines represent the color (density) that the area was in 1998. Station #2 decreased slightly from 45.3% to 44.8%, while station #7 decreased from 78.4% to 58.2%. Station #7 was the only station in 1998 that had a dense continuous seagrass coverage. Even with the decrease, station #7 still has a dense seagrass coverage. A possible explanation for this decrease is that recreational boaters utilize the area around station #7 as a sand bar at low tide; therefore boats are constantly anchoring in the area. Figures #5 shows the presence of seagrass as a percent of bottom cover at each of the fourteen representative stations for 1998 and 2000.

Seven stations increased in density enough to change their scale rating. These areas are seen on the maps by having the new density color with vertical bands that reflect the density (color) that existed in 1998. For example, areas that were patchy in 1998 that in 2000 were dense are colored red with green vertical lines. Stations #13, #14, #3E, #4, #6, #8 and #9 all increased in the scale to the next category either from patchy to dense or dense to dense continuous. The Narrows segment and the Jupiter Sound South segment experienced the biggest overall density increases with stations #3E and #4 having areas of dense continuous coverage (yellow with red vertical bands). Station #8 was the station that saw the most dramatic change between 1998 and 2000 going from sparse to dense seagrass coverage. This change may be attributed to the lack of rainfall and subsequent increases in salinity in the Intracoastal waterway. Many of the areas in the study area that have a blue or sparse seagrass coverage are areas of shoaling or sand bars.

**Figure # 5: SAV Densities as a Percent of Bottom Cover**



### Composition:

While density generally increased within the study area, species composition decreased. The two species that saw the largest reductions were *H. johnsonii* and *T. testudinum*. In 1998 four stations had *T. testudinum* present and in 2000 only three stations recorded this species. Out of those three stations, two also experienced a reduction in the percentage of *T. testudinum* observed. Both stations that exhibited *T. testudinum* found it in combination with *S. filiforme*. The only station where *T. testudinum* increased, was station #2 which, overall, had a decreased in seagrass density. Station #2 in 1998 has *T. testudinum* present but only in combination with *S. filiforme*. In 2000, station #2 had *T. testudinum* present by itself and in combination with *S. filiforme*. Also at station #2, the percentage of *T. testudinum* and *S. filiforme* combination increased from 1998.

The other species of seagrass that showed a decline in presence the original transects was, *H. johnsonii*. In 1998, five stations exhibited *H. johnsonii* and in 2000 it was recorded at only four stations. Out of those three stations, two of them had a decrease in the percentage of *H. johnsonii* present. At stations #1 and #13, *H. johnsonii* was found in patchy densities in the surrounding areas. Station #14 had decreases in *H. johnsonii*, and *S. filiforme*, but increased in *H. wrightii*. This transition of species was also seen at other stations. This trend is concerning, because *H. wrightii* is the most versatile species of seagrass, meaning it is the species most likely to be found when other species can not live due to water quality limitations.

An interesting trend that occurred between 1998 and 2000 is that while overall seagrass density increased, species composition decreased. For example, station #14, in 1998 had a good representation of *H. wrightii*, *S. filiforme* and *H. johnsonii* that in 2000 changed to domination by *H. wrightii*, reduction in *S. filiforme*, and a reduction in *H. johnsonii*. At the same time this shift in species was occurring, overall seagrass density was increasing, attributed largely to an increase in *H. wrightii*. Conversely, at station #2 species composition increased and seagrass density decreased slightly. In 1998, station #2 was dominated by *H. wrightii* and *S. filiforme*. That domination changed in 2000 to reduced coverage's of *H. wrightii* and *S. filiforme* and increased percentages of *T. testudinum* and *T. testudinum* in combination with other species. At the same time species composition was increasing, overall seagrass density decreased at station #2.

### *Other Studies:*

In 1998, seagrass surveys conducted by the Jupiter Inlet District (JID) were evaluated. JID conducts bathymetric and seagrass surveys every two years within the Jupiter Inlet/Loxahatchee Estuary segment. The study evaluates the distribution of SAV in this area. A comparison of the distribution maps generated from the current study with the graphics presented in earlier works shows a general agreement with the coverage and location of seagrasses and indicates that there has been a small decrease in the spatial extent of SAV. No comparisons of the presence of species or the composition of the SAV communities can be drawn with the earlier studies. As relates to density, however, the prior JID reports concluded that the grassbeds in this part of the estuary were healthy with a density of greater than 10 percent. SAV density evaluations undertaken for the current study agree with the findings of greater than ten percent and were able to quantify the SAV coverage at this location (station #14) as ranging between 50 and 65 percent, an increase compared to 1998.

The second point of interface with previous research work is in the northernmost area sampled under this study. The long term SJRWMD program for SAV monitoring includes a transect immediately adjacent to station #11. Since 1992, the SJRWMD has been working within the Lagoon to monitor and record distribution, density and species composition information. Since the method of sampling for the long-term program differs from and is more complex than the methods used in the current study, no specific comparisons are drawn; however, general information seems to match relatively well.

### *Future Research:*

In the future there are five distinct areas in which this information will prove a valuable tool. These projects are ones that the Loxahatchee River District plans on coordinating in the future.

The first project includes returning to the fourteen sampling stations every two years to conduct surveys and compare information. The next is evaluation of the study area is scheduled for the summer of 2002 and is intended to provide temporal comparisons and other observations. The second project will be to evaluate for *T. testudinum*. Throughout



the study area *T. testudinum* is one of the species least represented. This study will establish GPS coordinates for all *T. testudinum* beds so future year comparisons can be drawn regarding the extent of this important species. The third project is an evaluation of seasonal variations within the study area. The Loxahatchee River District has and will continue to record information at three stations for the South Florida Water Management District. The fourth project will be to compare the current seagrass information to results of analytical work compiled from sites further north in the Indian River Lagoon. The fifth project will be to compare the seagrass community information with available data on other biological communities such as benthic macroinvertebrates and juvenile fish.

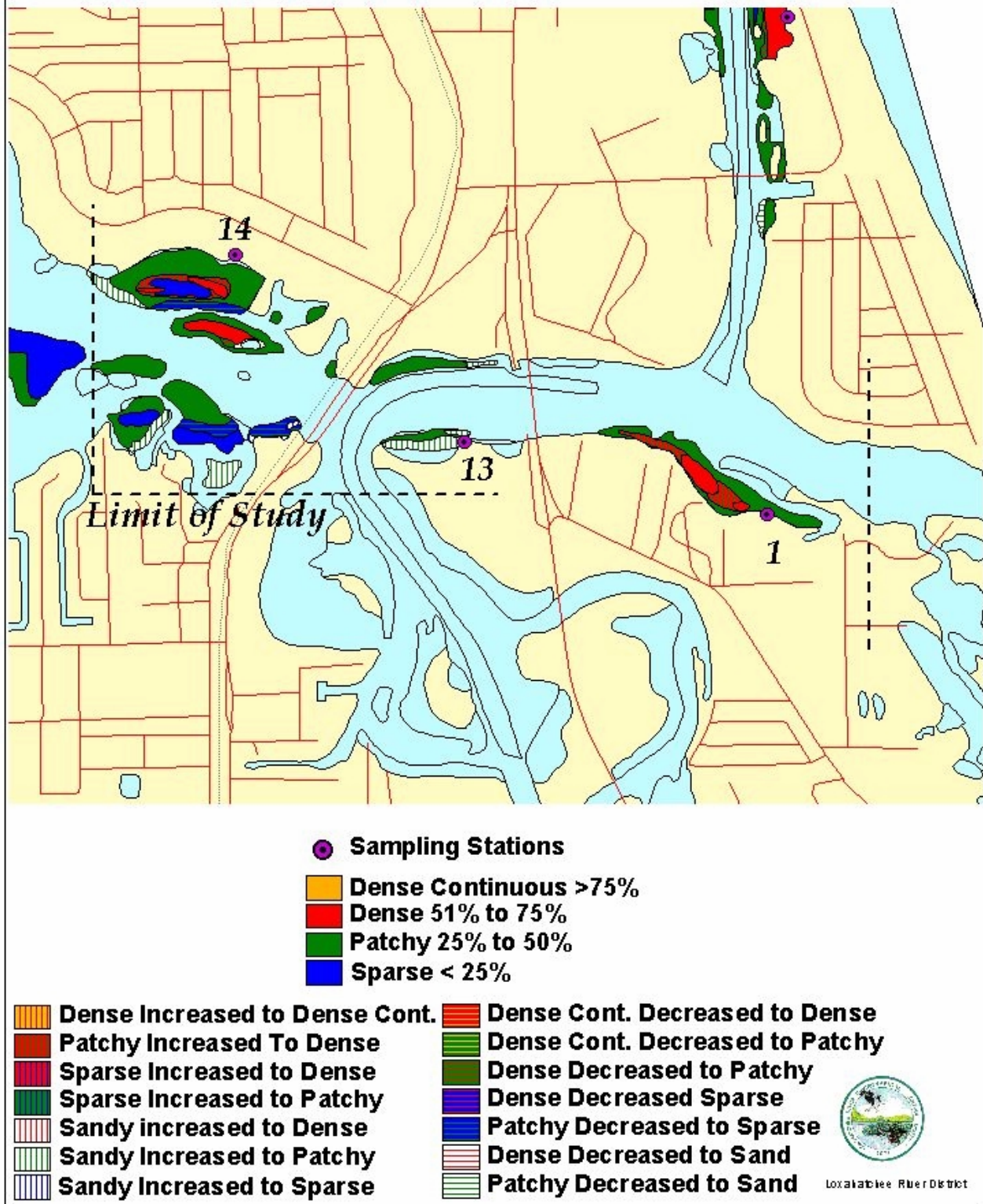
## **Summary**

The two-year comparison and this report on the evaluation have fulfilled the initial objective of the research effort. The comments listed below are provided to summarize the major findings of the study and to encourage further evaluations and research efforts.

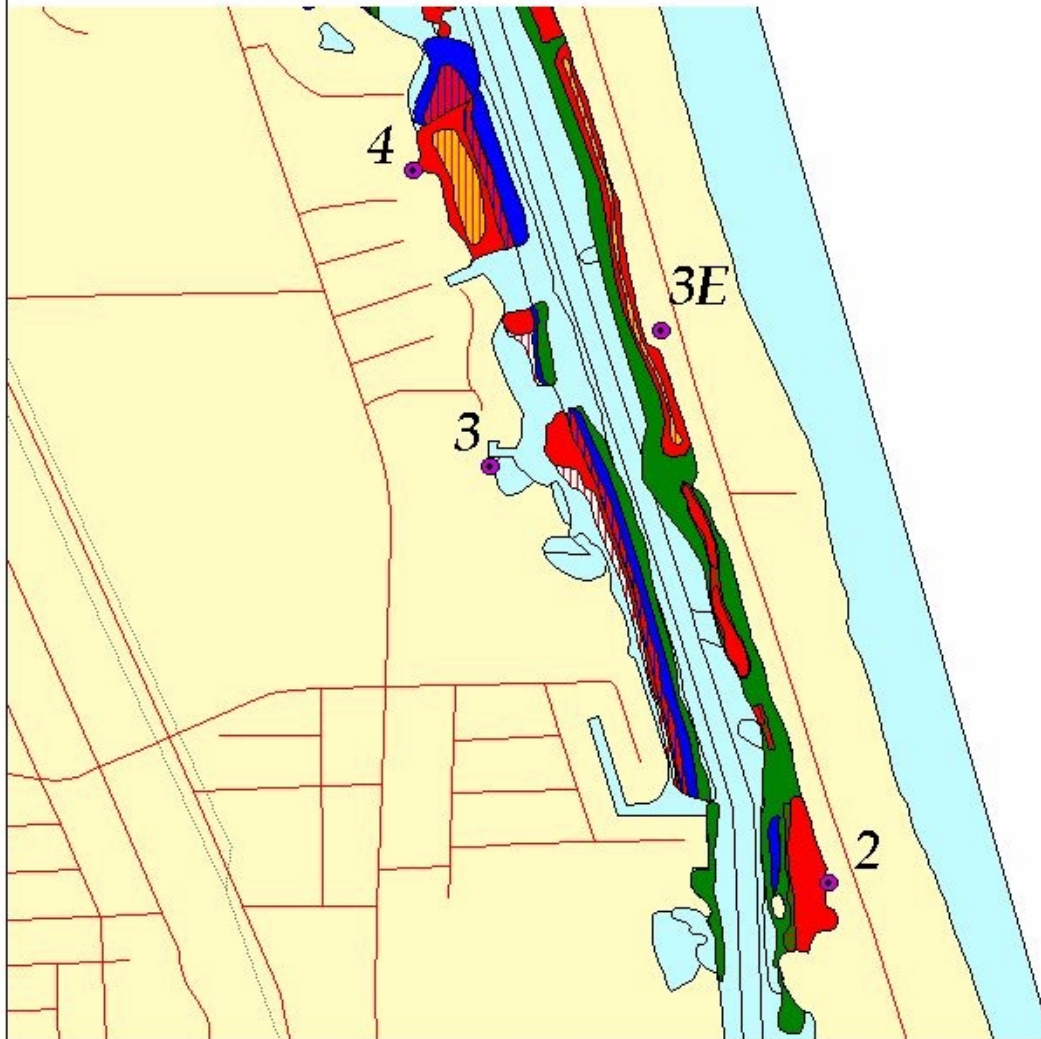
- The primary objective was to add to current information available on seagrass communities in the southernmost reach of the Indian River Lagoon and the Loxahatchee River estuary. This objective was achieved and the information is presented in this report.
- The second objective was to compare the 2000 data with information gathered in 1998. This was accomplished and the results are displayed in this report.
- The overall distribution of seagrass communities did not significantly change from 1998 to 2000. Small areas within the study area did experience distribution increases and decreases from 1998.
- Seagrass densities increased at twelve of the fourteen stations. Densities were observed from 45% –90%.
- Seven of the representative stations increased in seagrass density and changed their density scale rating, changing from patchy to dense or dense to dense continuous.
- There were some stations within the study area that experienced an increase in the overall area (size of bed).
- The two species that increased the most throughout the study area were, *S. filiforme* and *H. wrightii*.
- While density increased, composition generally decreased throughout the study area.
- The two species that decreased the most were *T. testudinum* and *H. johnsonii*.
- The species that seemed to replace *T. testudinum* and *H. johnsonii* were *S. filiforme* or *H. wrightii*.

**KEEP SCROLLING TO VIEW MAPS, FIGURES AND TABLES**

**Figure 6. Inlet Stations: #1, #13, #14  
Spatial Distribution and Relative Density of Seagrass 2000**



**Figure 7. Jupiter Narrows: #2, #3, #3E, #4  
Spatial Distribution and Relative Density of Seagrass 2000**



● Sampling Stations

■ Dense Continuous >75%

■ Dense 51% to 75%

■ Patchy 25% to 50%

■ Sparse < 25%

■ Dense Increased to Dense Cont.

■ Patchy Increased To Dense

■ Sparse Increased to Dense

■ Sparse Increased to Patchy

■ Sandy increased to Dense

■ Sandy Increased to Patchy

■ Sandy Increased to Sparse

■ Dense Cont. Decreased to Dense

■ Dense Cont. Decreased to Patchy

■ Dense Decreased to Patchy

■ Dense Decreased Sparse

■ Patchy Decreased to Sparse

■ Dense Decreased to Sand

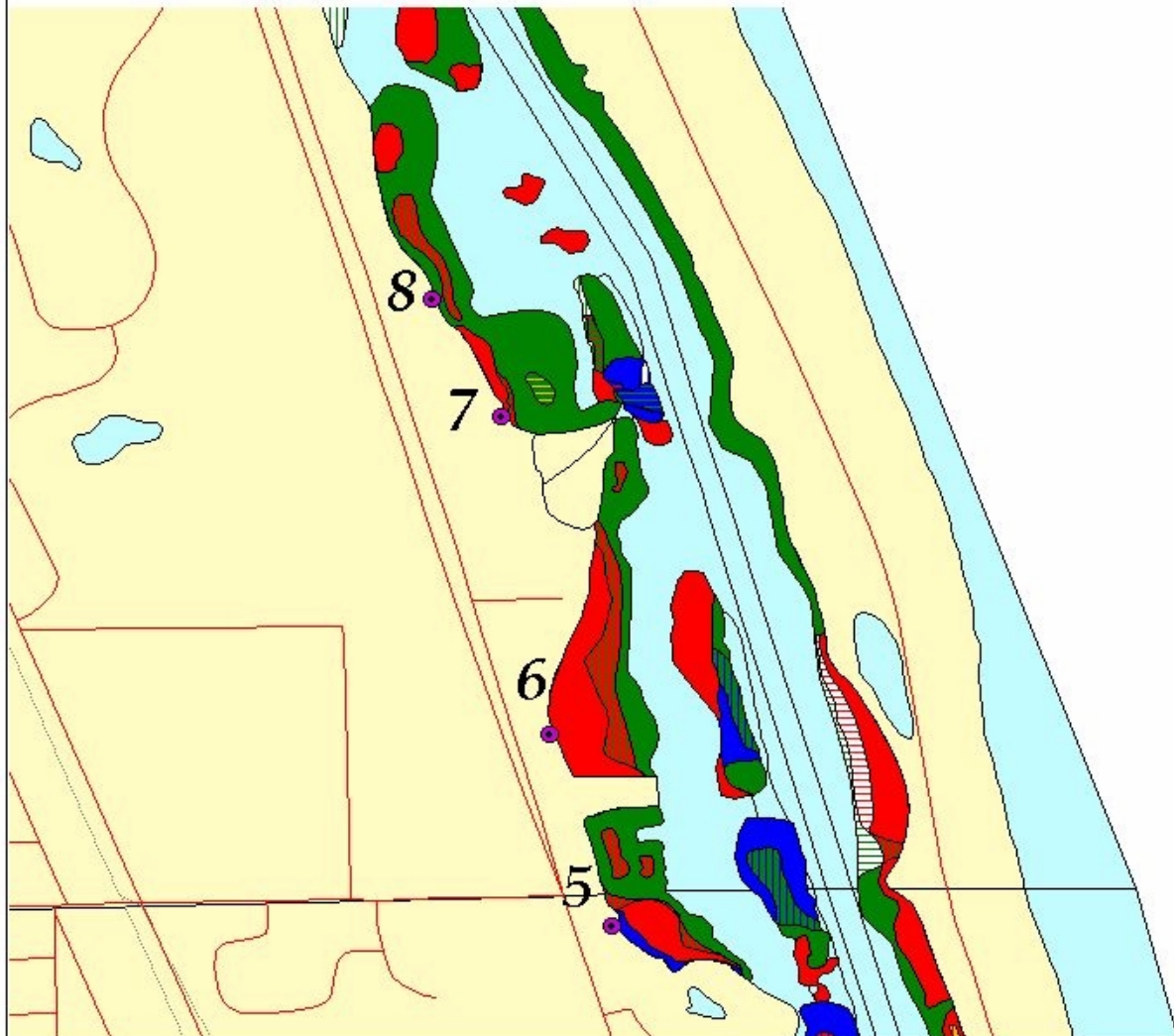
■ Patchy Decreased to Sand



Loxahatchee River District



**Figure 8. Jupiter Sound South: #5, #6, #7, #8  
Spatial Distribution and Relative Density of Seagrass 2000**



● Sampling Stations

■ Dense Continuous >75%

■ Dense 51% to 75%

■ Patchy 25% to 50%

■ Sparse < 25%

■ Dense Increased to Dense Cont.

■ Patchy Increased To Dense

■ Sparse Increased to Dense

■ Sparse Increased to Patchy

■ Sandy increased to Dense

■ Sandy Increased to Patchy

■ Sandy Increased to Sparse

■ Dense Cont. Decreased to Dense

■ Dense Cont. Decreased to Patchy

■ Dense Decreased to Patchy

■ Dense Decreased Sparse

■ Patchy Decreased to Sparse

■ Dense Decreased to Sand

■ Patchy Decreased to Sand



Indian River Lagoon Authority

**Figure 9. Jupiter Sound North: #9, #10, #11  
Spatial Distribution and Relative Density of Seagrass 2000**



● **Sampling Stations**

**Dense Continuous >75%**

**Dense 51% to 75%**

**Patchy 25% to 50%**

**Sparse < 25%**

**Dense Increased to Dense Cont.**

**Patchy Increased To Dense**

**Sparse Increased to Dense**

**Sparse Increased to Patchy**

**Sandy increased to Dense**

**Sandy Increased to Patchy**

**Sandy Increased to Sparse**

**Dense Cont. Decreased to Dense**

**Dense Cont. Decreased to Patchy**

**Dense Decreased to Patchy**

**Dense Decreased Sparse**

**Patchy Decreased to Sparse**

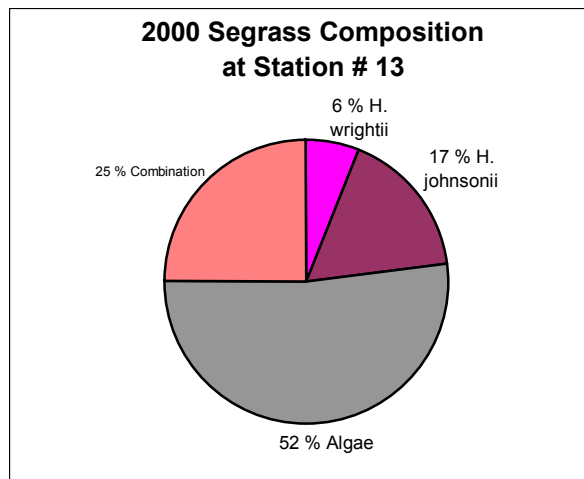
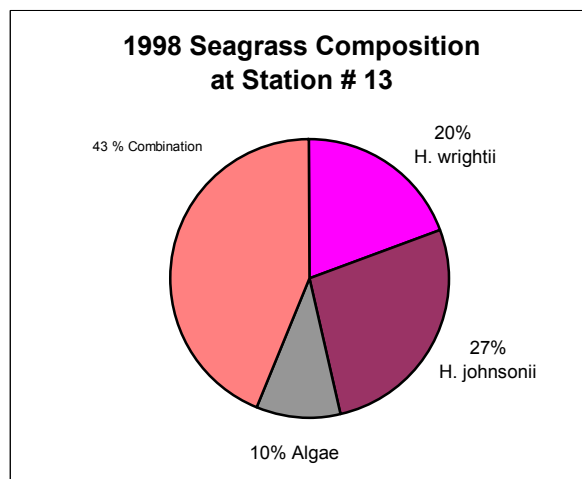
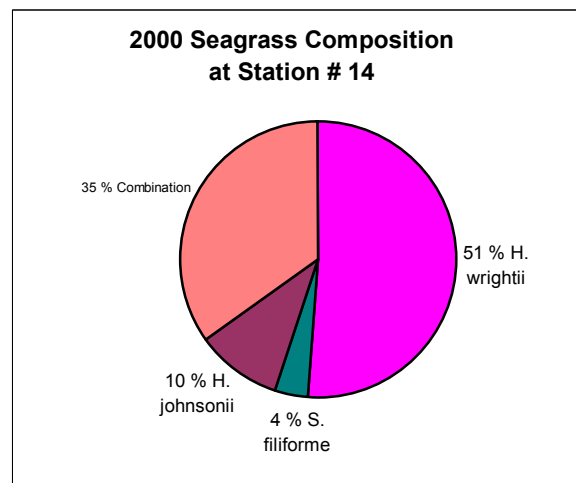
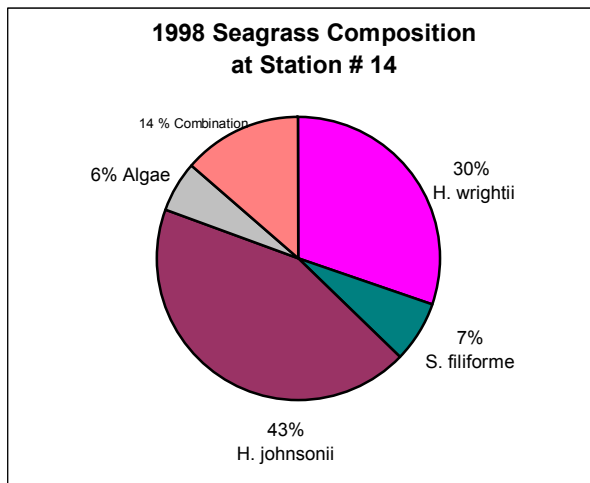
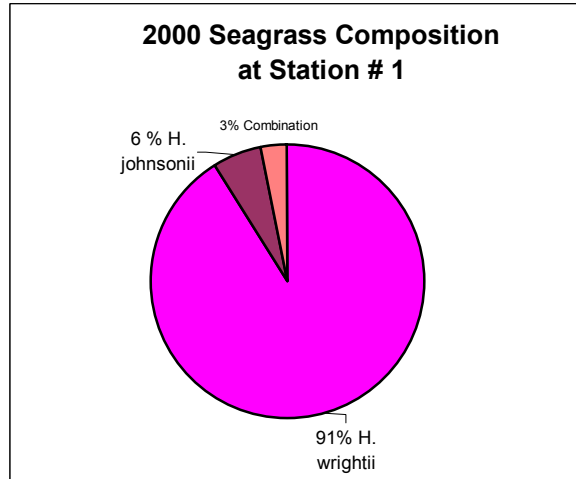
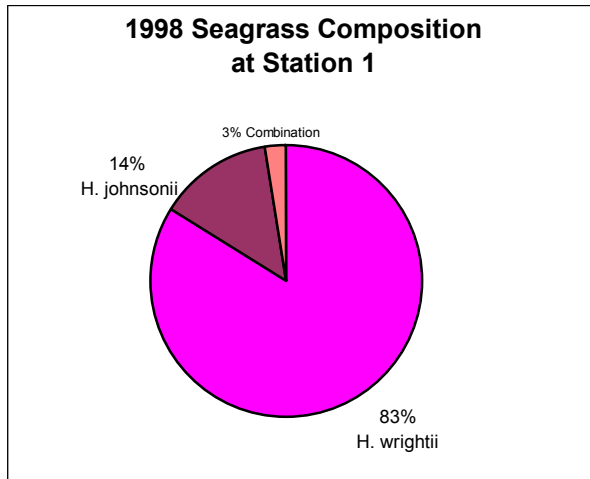
**Dense Decreased to Sand**

**Patchy Decreased to Sand**



Loxahatchee River District

**Figure # 10: Submerged Aquatic Vegetation Composition at Jupiter Inlet and Loxahatchee River Stations (#1, #13, #14)**



**Figure # 11: Submerged Aquatic Vegetation Composition at Jupiter Narrows Stations (#2, #3, #3E, #4)**

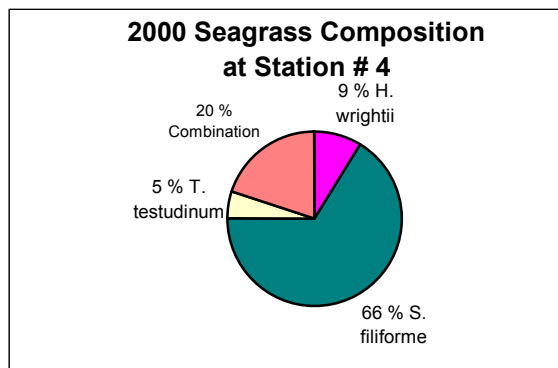
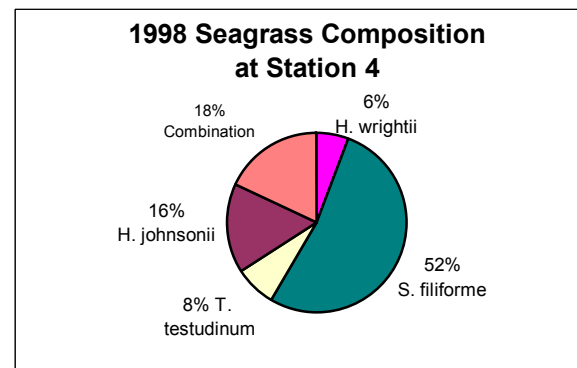
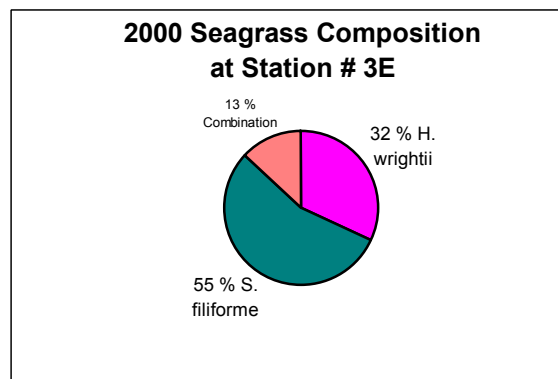
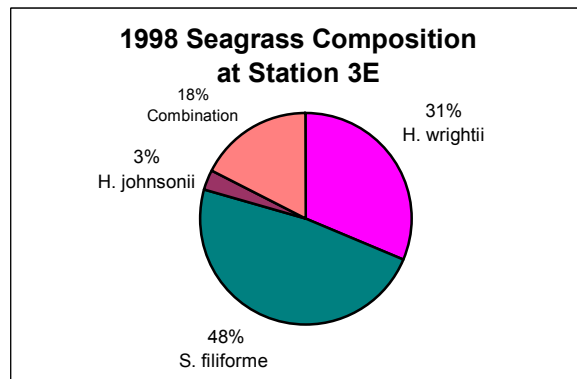
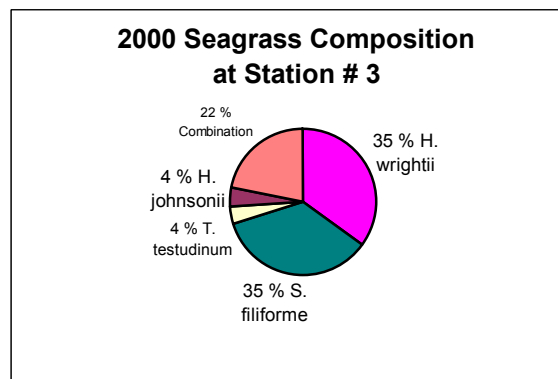
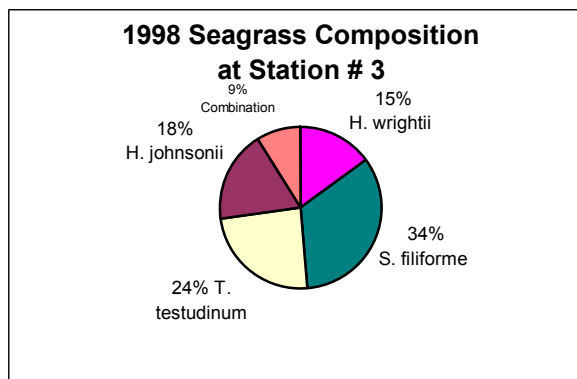
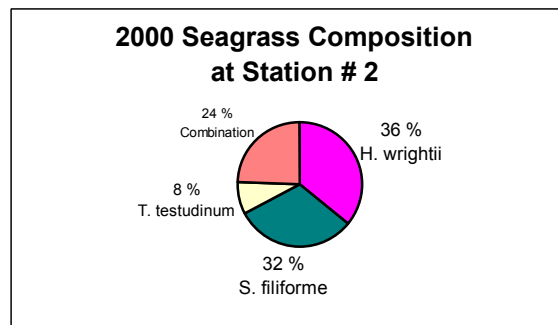
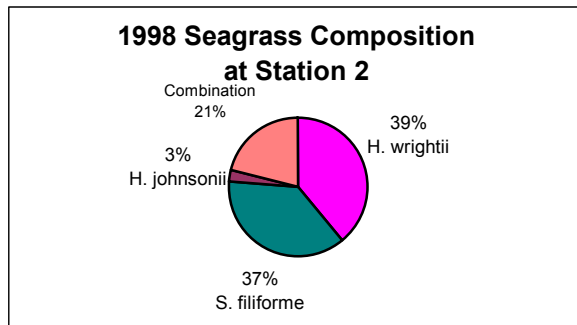
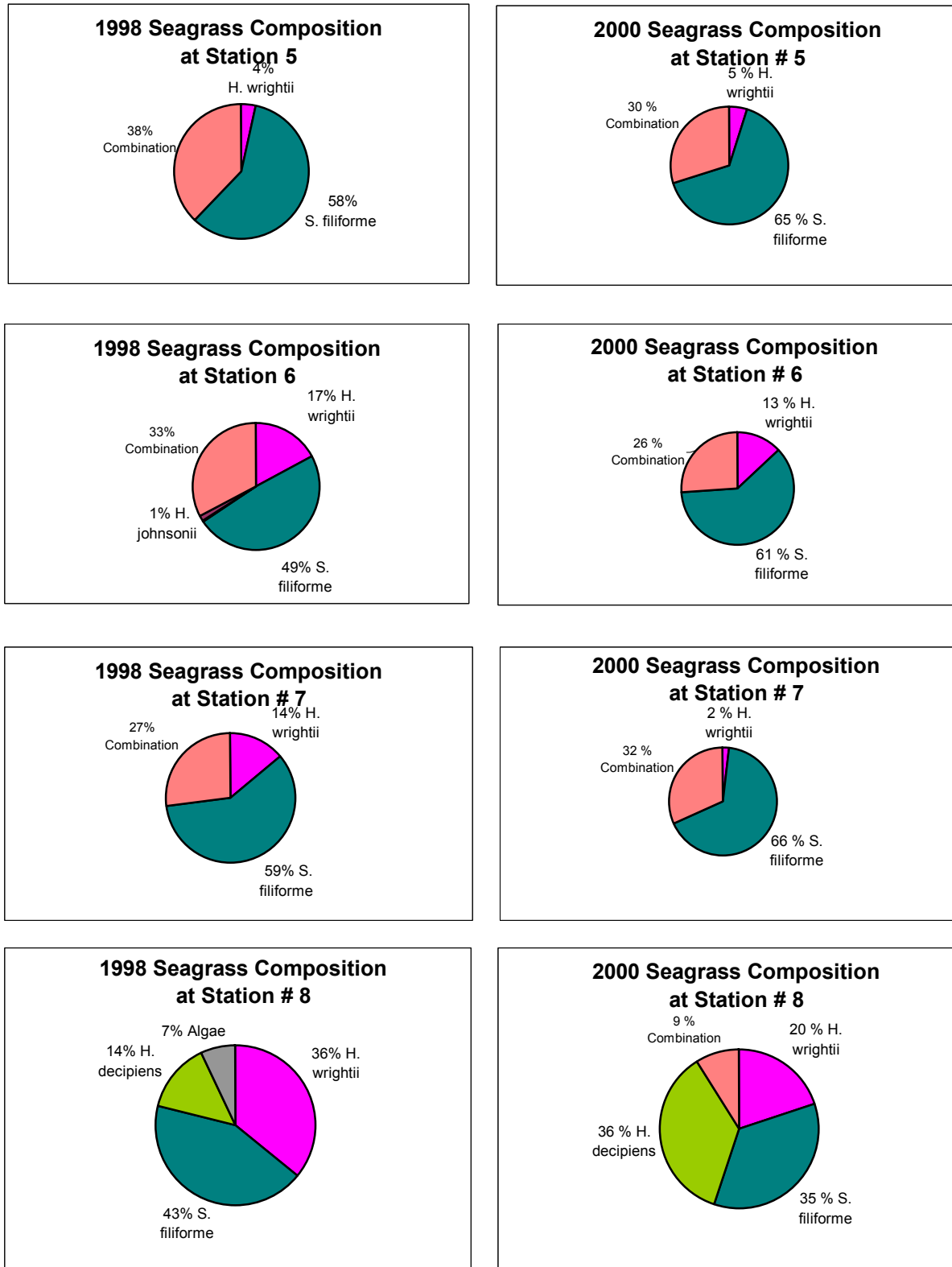
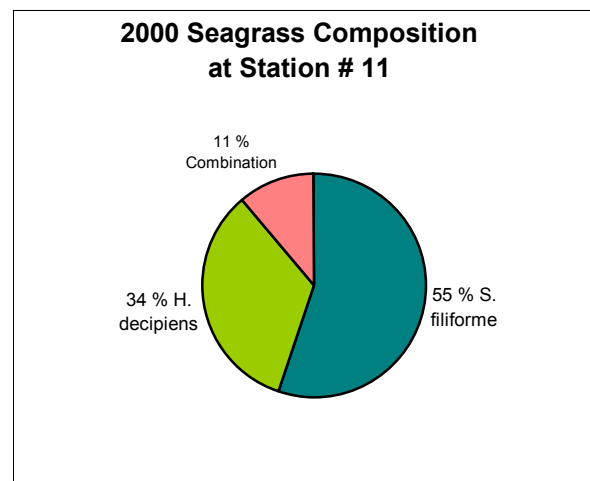
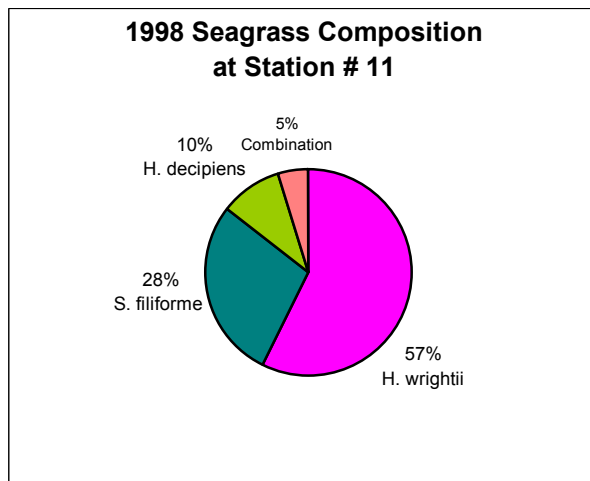
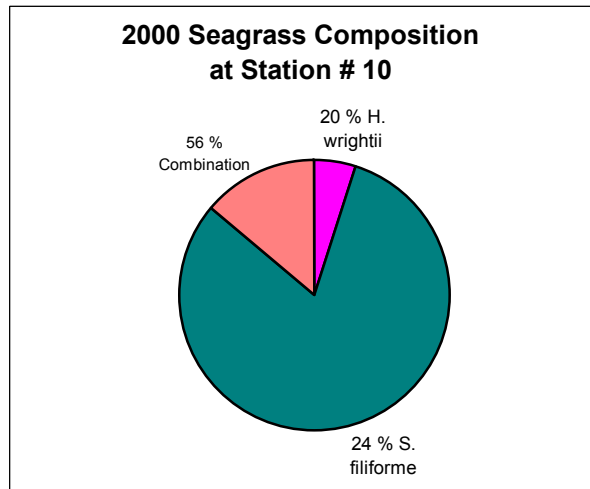
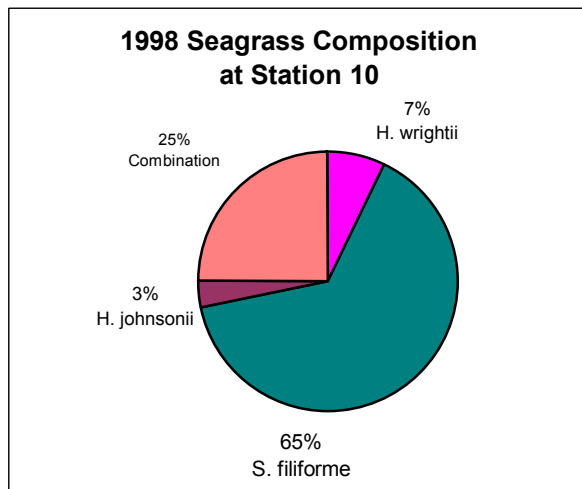
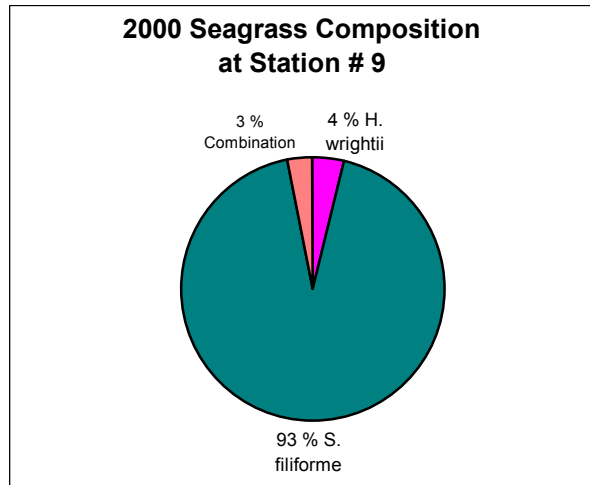
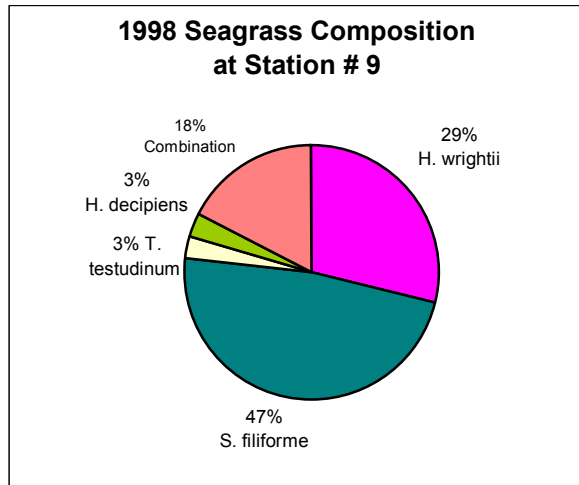


Figure # 12: Submerged Aquatic Vegetation Composition at Jupiter Sound South Stations (#5, #6, #7, #8)





**Figure # 13: Submerged Aquatic Vegetation Composition at Jupiter Sound North Stations (#9, #10, #11)**



# Appendix A

## Jupiter Inlet / Loxahatchee Estuary Segment

Station # 1	1998		1998		1998		1998 Ave.
	Transect #1	Transect #2	Transect #3				
% Sand	69.6	52.3	48.9			56.93	
% H. wrightii	22.5	48.8	39.8			37.03	
% H. johnsonii	7.9	0	10.2			6.03	
% H. wrightii + H. johnsonii	1.1	0	2.3			1.13	

Station # 1	2000		2000		2000 Ave.
	Transect #1	Transect #2			
% Sand	65.3	35.7			50.5
% H. wrightii	34.7	55.7			45.2
% H. johnsonii	0	5.7			2.9
% H. wrightii + H. johnsonii	0	2.9			1.4

Station # 13	1998		1998		1998		1998 Ave.
	Transect # 1	Transect # 2	Transect # 3				
% Sand	63.6	43.9	76.3			61.3	
% H. wrightii	20	3.6	0			7.9	
% H. johnsonii	10.9	1.2	19.7			10.6	
% Sand + Algae	0	34.1	0			11.4	
Combination of SAV	7.3	18.3	5.2			9.3	

Station # 13	2000		2000		2000 Ave.
	Transect # 1	Transect # 2			
% Sand	49.5	16.8			33.2
% H. wrightii	2.0	5.9			4.0
% H. johnsonii	2.0	20.8			11.4
% Algae	44.6	24.8			34.7
Combination of SAV	2.0	31.8			16.9

Station # 14	1998		1998		1998		1998 Ave.
	Transect # 1	Transect # 2	Transect # 3				
% Sand	70.0	63.1	72.4			68.50	
% H. wrightii	11.7	5.9	9.8			9.13	
% S. filiforme	2.5	3.8	0.0			2.10	
% H. johnsonii	11.0	16.6	11.8			13.13	
% Combination of SAV	3.7	9.7	5.8			6.4	

Station # 14	2000		2000		2000		2000 Ave.
	Transect # 1	Transect # 2	Transect # 3				
% Sand	58.3	8.3	25.1			30.6	
% H. wrightii	20.7	41.7	44.4			35.6	
% S. filiforme	1.3	4.1	2.1			2.5	
% H. johnsonii	10.0	6.2	4.2			6.8	
% H. wrightii + S. filiforme	6.3	18.6	10.0			11.6	
% Combination of SAV	3.4	21.1	14.3			12.9	

# Appendix A

## Jupiter Narrows Segment

Station # 2	1998				1998 Ave.			
	1998 Tran. # 1	1998 # 2	1998 # 3	1998 # 4	1998 # 1	1998 # 2	1998 # 3	1998 # 4
% Sand	39.7	63.4	59.8	56.54.7	% Sand	47.6	51.6	54.3
% H. wrightii	13.4	3.7	30.7	21.3 17.3	% H. wrightii	1.8	16.8	3.7
% S. filiforme	28.5	20.9	7.9	9.3 16.7	% S. filiforme	16.7	0.6	27.2
% T. testidunum + S. filiforme	11.2	0	0	0 2.8	% T. testidunum	2.3	18.6	4.9
% H. wrightii + S. filiforme	0	9.7	2.4	12 6.0	% T. testidunum + S. filiforme	17.3	5.6	9.9
% Combination of SAV				3.4	% Combination of SAV	14	7	0
								2
								5.8

Station # 3	1998		1998 Ave.	
	1998 Tran. # 1	1998 # 2	1998 # 1	1998 # 2
% Sand	39	44.5	41.75	
% H. wrightii	5	12.5	8.75	
% S. filiforme	8	31.5	19.75	
% T. testidunum	16	12	14	
% H. johnsonii	21.5	0	10.75	
% T. testidunum + S. filiforme	0	0	0	
% Combination of SAV	10.5	0	5.25	

Station # 3	2000		2000 Ave.	
	2000 Tran. # 1	2000 # 2	2000 # 1	2000 # 2
% Sand	26.7	34.8	30.8	
% H. wrightii	23	25.4	24.2	
% S. filiforme	32.7	16.6	24.7	
% T. testidunum	3.2	1.7	2.5	
% H. johnsonii	2.3	3.3	2.8	
% T. testidunum + S. filiforme	8.8	6.7	7.8	
% Combination of SAV	3.3	11.5	7.4	

Station # 3E	1998		1998 Ave.	
	1998 Tran. # 1	1998 # 2	1998 # 1	1998 # 2
% Sand	30.5	23.3	26.9	
% H. wrightii	26.4	19.3	22.9	
% S. filiforme	38.2	31.4	34.8	
% Combination of SAV	3.5	26	14.75	

Station # 3E	2000		2000 Ave.	
	2000 Tran. # 1	2000 # 2	2000 # 1	2000 # 2
% Sand	9.4			
% H. wrightii	28.7			
% S. filiforme	50.3			
% Combination of SAV	11.6			

\*\* Only repeated one transect in 2000

Station # 4	1998		1998 Ave.	
	1998 Tran. # 1	1998 # 2	1998 # 1	1998 # 2
% Sand	42.3	25.8	34.1	
% H. wrightii	1	6.5	3.8	
% S. filiforme	34.1	35	34.6	
% T. testidunum	6.2	3.8	5.0	
% H. johnsonii	15.9	5.4	10.7	
% S. filiforme + H wrightii	0	15.1	7.6	
% Combination of SAV	0.48	9.1	4.79	

Station # 4	2000		2000 Ave.	
	2000 Tran. # 1	2000 # 2	2000 # 1	2000 # 2
% Sand	21.4	7.5	14.5	
% H. wrightii	0	9.0	4.5	
% S. filiforme	52.7	64.8	58.8	
% T. testidunum	2.1	8.0	5.1	
% S. filiforme + T. testidunum	14.4	8.5	11.5	
% Combination of SAV	9.3	2.2	5.8	



# Appendix A

## Jupiter Sound South Segment

Station # 5	1998		1998 Ave.
	Transect # 1	Transect # 2	
% Sand	39.2	52.8	46
% H. wrightii	2.5	1.5	2
% S. filiforme	29.1	33.1	31.1
% S. filiforme + H. wrightii	27.6	0	13.8
% S. filiforme + T. testidunum	0	13.1	6.55
% Combination of SAV	1.5	0	0.75

Station # 5	2000		2000 Ave.
	Transect # 1	Transect # 2	
% Sand	29.6	29.4	29.5
% H. wrightii	4.9	1.5	3.2
% S. filiforme	37.9	54.7	46.3
% S. filiforme + H. wrightii	6.4	0.0	3.2
% Sand + Algae	8.9	0.0	4.4
% Combination of SAV	12.3	15.5	13.9

Station # 6	1998		1998 Ave.
	Transect # 1	Transect # 2	
% Sand	35	55.6	45.3
% H. wrightii	18.1	1	9.6
% S. filiforme	11.5	41.8	26.7
% S. filiforme + H. wrightii	36.2	0	18.1
% Combination of SAV	0	2	1.0

Station # 6	2000		2000 Ave.
	Transect # 1	Transect # 2	
% Sand	15.0	20.3	17.6
% H. wrightii	18.5	3.4	10.9
% S. filiforme	45.5	54.6	50.0
% S. filiforme + H. wrightii	10.5	16.4	13.5
% Combination of SAV	11	5	8

Station # 7	1998		1998 Ave.
	Transect # 1	Transect # 2	
% Sand	19.9	22.9	21.4
% H. wrightii	6.9	15.5	11.2
% S. filiforme	31.4	60.4	45.9
% H. wrightii + S. filiforme	42.1	1.6	21.55

Station # 7	2000	
	Transect # 1	Transect # 2
% Sand	41.8	
% H. wrightii	1.0	
% S. filiforme	38.3	
% Combination of SAV	19.0	

\*\* Only repeated one transect in 2000

Station # 8	1998	
	Transect # 1	Transect # 2
% Sand	81.4	
% H. wrightii	6.6	
% S. filiforme	7.9	
% H. decipiens	2.6	
% Algae	1.3	

Station # 8	2000	
	Transect # 1	Transect # 2
% Sand	35.0	
% H. wrightii	13.0	
% S. filiforme	22.8	
% H. decipiens	23.6	
% Combination of SAV	5.6	

# Appendix A

## Jupiter Sound North Segment

	1998	1998	1998 Ave.
Station # 9	Transect # 1	Transect # 2	
% Sand	64	71.9	68.0
% H. wrightii	4	19.1	11.6
% S. filiforme	25	3.4	14.2
% Combination of SAV	7.5	5.6	6.6

\*\* Only two transects were repeated in 2000

	2000	2000	2000 Ave.
Station # 9	Transect # 1	Transect # 2	
% Sand	48.4	26.7	37.6
% H. wrightii	2.1	3.0	2.5
% S. filiforme	47.4	68.3	57.8
% Combination of SAV	2.2	2.0	2.1

	1998	1998	1998 Ave.
Station # 10	Transect # 1	Transect # 2	
% Sand	38.3	27.9	33.1
% H. wrightii	6.2	3.6	4.9
% S. filiforme	25.9	63.0	44.5
% S. filiforme + H. wrightii	16.0	0.9	8.5
% S. filiforme + Algae	11.1	0.0	5.6
% Combination of SAV	3.6	7.2	5.4

	2000	2000	2000 Ave.
Station # 10	Transect # 1	Transect # 2	
% Sand	29.7	26.7	28.2
% H. wrightii	7.7	0.0	3.8
% S. filiforme	60.4	55.6	58.0
% Combination of SAV	2.2	17.7	9.9

	1998	1998	1998 Ave.
Station # 11	Transect # 1	Transect # 2	
% Sand	49.5	57.9	53.7
% H. wrightii	10.81	42.1	26.5
% S. filiforme	26.1	0	13.1
% H. decipiens	9	0	4.5
% Combination of SAV	5.1	0	2.6

	2000	2000	2000 Ave.
Station # 11	Transect # 1	Transect # 2	
% Sand	66.7	23.4	45
% S. filiforme	13.9	46.8	30.4
% H. decipiens	19.4	18.0	18.7
% Combination of SAV	0.0	11.7	5.9