St. Martins Marsh and Big Bend Seagrasses Aquatic Preserves (SMMAP & BBSAP)
Annual Seagrass Monitoring Report

Latest Update: 08/29/2018

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2. Background Information:

Seagrass beds are a tremendous natural resource that play a vital role in water quality, substrate stabilization, provide critical habitat, and serve as the primary food sources for many marine species. Florida waters contain over 2 million acres of seagrass habitat and support many commercially and recreationally significant species (FDEP, 2017). Based on the recent mapping data available for Florida, majority of these seagrass beds are located in southern Florida (1,300,000 acres) or in the Big Bend and Springs Coast region (618,000 acres). The western Panhandle has approximately 39,200 acres of seagrass, which is experiencing a decline (Carlson and Yarbro, 2011). Seagrasses are "grass-like" flowering plants that are typically found in shallow coastal marine and estuarine waters. Seagrasses are typically found as small, patchy beds; however, if water quality and sediment conditions remain favorable, and human disturbance is kept to a minimum, these small patches can join to form large, continuous beds known as seagrass meadows (FWC, 2014). There are over 50 species of seagrass worldwide, however seven species of seagrass exist in Florida's coastal waters: turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), shoal grass (*Halodule wrightii*), widgeon grass (*Ruppia maritima*), star grass *(Halophila engelmannii*), paddle grass (*Halophila decipens*), and Johnson's seagrass (*Halophila johnsonii*) (FDEP, 2017).

Survival requirements vary from species to species, but the overall health of the seagrass beds can be correlated to a system's light attenuation, salinity, sediment type and nutrient availability. The amount of light available to seagrass is one of the primary factors associated with the maximum depth at which these plants can grow. Some species of seagrass require higher levels of light, while other species can tolerate lower salinities. Widgeon grass (*Ruppia* maritime) thrives in lower salinity regimes when compared to manatee grass (*Stringodium* filiforme), while shoal grass (*Halodule* wrightii) does better than turtle grass (*Thalassia* testudinum). Each species in Florida has some unique criteria for optimal growth and survival. Where water quality and clarity are poor, seagrasses may only be found in the shallowest waters (FWC, 2014).

Seagrasses are vulnerable to many direct and indirect human impacts, especially eutrophication and other processes that reduce water clarity. Dredge-and-fill projects and declines in water quality pose significant threats to seagrass; propeller scarring is also a major contributor to seagrass loss in Florida's coastal areas (FWC, 2014). Although intensive efforts to improve water quality throughout Florida have resulted in an increase in seagrass coverage, total seagrass coverage in Florida's coastal waters is less than it was in the 1950s and some regions are still experiencing declines (Carlson and Yarbro, 2011).

Macroalgae (seaweeds) are multicellular algae that are typically found in shallow marine waters. It is often categorized into three groups: red, brown and green. Although some macroalgae resemble seagrass, they have significant differences. Macroalgae require sunlight, similar to seagrass, but do not have traditional root systems. Instead, most macroalgae require a hard surface to adhere to by holdfasts. Macroalgae photosynthesize and provide food and shelter for many marine animals (FDEP, 2017). When noted together, seagrass and macroalgae are more commonly referred to as submerged aquatic vegetation (SAV).

3. **<u>Research Objective:</u>**

Seagrass monitoring began in St. Martins Marsh Aquatic Preserve (SMMAP) in 1997 and in the Big Bend Seagrasses Aquatic Preserve (BBSAP) in 2000. Currently, 125 fixed locations are monitored annually to determine species composition, abundance and distribution of seagrasses in St. Martins Marsh (SID), Cedar Key (CK), Steinhatchee (STCH), Dekle Beach / Keaton Beach (DBKB), and St. Marks (SMAR). The monitoring locations were selected to document seagrass coverage throughout SMMAP's and BBSAP's coastal waters. The objective of this effort is to quantify the spatial/temporal variability and analyze trends of seagrass abundance and distribution within the two aquatic preserves (APs). Assessment of seagrass and macroalgae is completed using the Braun-Blanquet scale. Staff examine site-intensive monitoring data annually to determine trends in species composition, abundance, and distribution of seagrasses within these two aquatic preserves. This analysis, in conjunction with the AP's water quality monitoring program, be used to determine the overall health of the highly diverse ecosystems within the aquatic preserves.

4. **<u>Research Methods:</u>**

Seagrass monitoring in St. Martins Marsh Aquatic Preserve began in 1997 with 25 seagrass sites initially being monitored twice per growing season (May to September). As the seagrass monitoring program expanded, monitor was reduced to once per growing season. In Big Bend Seagrasses Aquatic Preserve, seagrass monitoring began in 2000 with the establishment of 25 seagrass sites in Steinhatchee (STCH). In 2006, staff expanded the program in BBSAP by establishing 25 sites in both Cedar Key (CK) and St. Marks (SMAR), thus totaling 75 stations throughout the Big Bend region. In 2013, an additional 25 monitoring stations were added in the Dekle Beach/Keaton Beach (DBKB). It is important to note, in 2017, these sites were reselected to increase distribution of sampling throughout the region. To date, 125 fixed locations are currently monitored annually to determine species composition, abundance and distribution of seagrasses in the SMMAP and BBSAP.

Assessment of seagrass and macroalgae is completed using the Braun-Blanquet method. Initially, seagrass sites were analyzed using the full rating scale of 0 to 5; however, upon examining and manipulating data over time, staff adjusted to only use scale values 1-5 to assign a more tangible value representing percent cover. If no submerged aquatic vegetation is observed, staff record "No Grass in Quad" (NGIQ) on the data sheet. The Braun-Blanquet method is used to measure the community composition, percentage cover, and density of the benthic community (**NOAA, 2014**). This method involves placing a one-meter square quadrat on the substrate and visually inspecting the content inside the boundary. The presence of each species of seagrass and macro-algae are identified and assigned a cover-abundance scale value. The possible scale values for each species are displayed in **Table 1**.

Table 1. Braun-Blanquet Density Values

0	Not Present
0.1	Solitary Specimen
0.5	Few, with Small Cover
1	Numerous, but Less than 5% Cover
2	5-25% Cover
3	25-50% Cover
4	50-75% Cover
5	75-100% Cover

At each fixed monitoring location, the quadrat is randomly distributed four times, and the Braun-Blanquet visual cover assessment is conducted. Data recorded includes values for each seagrass and macro-algae species observed within the quadrat, in addition to values for total SAV cover, total seagrass cover, and total macro-algae cover. See **Table 2** and **Table 3** for SAV species lists and codes used for seagrass monitoring within SMMAP and BBSAP. Additional observations that are documented include: epiphyte density, sediment type, sediment depth, presence of urchins (*Lytechinus variegatus*) or bay scallops (*Argopecten irradians*), and presence of prop scars or "blowouts." Abiotic water quality parameters (temperature, salinity, and dissolved oxygen) are recorded at each sample site using a YSI 650 MDS datalogger. The datalogger is calibrated prior to sampling each day per instructions set forth in the YSI User Manual. Cores were historically taken at randomly selected sites to measure above and below ground biomass; however, AP staff discontinued biomass sampling in 2009. From these monitoring surveys, staff are able to detect seasonal and annual trends, as well as short and long-term changes, within seagrass communities using statistical analyses.

Table 2: Seagrass Species Encountered During Seagrass Monitoring

Common Name	Scientific Name	Monitoring Code
Star Grass	*Halophila engelmanni*	HENG
Shoal Grass	*Halodule wrightii*	HWRI
Widgeon Grass	*Ruppia maritime*	RMAR
Manatee Grass	*Syringodium filaforme*	SFIL
Turtle Grass	*Thalassia testudium*	TTES

Table 3: Macroalgae Species Encountered During Seagrass Monitoring

Species Name	Monitoring Code
Acetabularia crenulata	ACRE

Avrainvillea levis	ALEV
Anadyomene stellata	ASTE
Bataphora oerstedi	BOER
Caulerpa ashmeadii	CASH
Caulerpa cupressoides	CCUP
Caulerpa langinosa	CLAN
Caulerpa mexicana	CMEX
Caulerpa paspaloides	CPAS
Caulerpa prolifera	CPRO
Caulerpa racemosa	CRAC
Codium isthmocladum	CIST
Digenia simplex	DSIM
Halimeda incrassata	HINC
Penicillus capitatus	PCAP
Penicillus dumetosus	PDUM
Padina vickersiae	PVIC
Rhipocephalus phoenix	RPHO
Sargassum spp	SXXX
Udotea flabellum	UFLA
Ulva spp	ULVA
Drift Algae	Drift

5. <u>Site Location and Character</u>

Big Bend Seagrasses Aquatic Preserve

Big Bend Seagrasses Aquatic Preserve is comprised of mostly rural and undeveloped coastal habitats. "The low wave energy and shallow depths, combined with low sediment loads and generally high contributions of clear groundwater from the Floridan aquifer system in the rivers draining to the region, create a physical environment highly conductive to the survival and growth of seagrasses in the Big Bend," (Mattson, 2000). These pristine and relatively undisturbed waters make ideal habitat for seagrasses. Within BBSAP, is the second largest contiguous seagrass meadow in the eastern Gulf of Mexico. Six different species of seagrasses are found in BBSAP boundary: shoal grass (*Halodule wrightii*), paddle-grass (*Halophila decipens*), star grass (*Halophila engelmanni*), widgeon grass (*Ruppia maritima*), manatee grass (*Syringodium filiforme*) and turtle grass (*Thalassia testudinum*). Paddle grass is found in deeper waters of the AP, outside the BBSAP seagrass monitoring program zone. Distribution of these grasses is largely dependent upon water clarity, water depth, and salinity. Seagrass beds are highly productive ecosystems that support an abundance of both vertebrate and invertebrate species. Seagrass meadows make an ideal nursery for many organisms by acting as a food source and providing cover from larger predators.

The Big Bend region of Florida is especially important for commercial and recreational fisheries. The seagrass beds in this region provide vital habitat to many sport fish such as redfish, speckled sea trout, and grouper. Commercially targeted species include stone crab, blue crab, oysters, shrimp and mullet. "The Big Bend region accounts for between 25% and 33% of the total commercial blue crab landings in Florida and supports the largest recreational scallop fishery in the state," (Mattson, et al., 2007). "Approximately 2.2 million acres of seagrass have been mapped in estuarine and nearshore Florida waters, and they provide ecological services worth over $20 billion each year," (Carlson and Yarbro, 2011).

As BBSAP's shallow estuarine waters have become impacted by human development, it is important to collect and establish baseline conditions within the BBSAP for post-impact comparisons and to identify any habitat restoration or watershed management opportunities. BBSAP's seagrass and water quality data provides helpful information which can be used to address management issues of the resource.

St. Martins Marsh Aquatic Preserve

The St. Martins Marsh Aquatic Preserve (SMMAP) includes 23,000 acres of submerged lands from the Crystal River to the Homosassa River in coastal Citrus County, Florida. It is composed of open water, mangrove islands, several inlet bays, tidal rivers and creeks, saltmarsh, and adjoins upland hammock islands. Nutrient exchange between the marshes and the Gulf of Mexico makes the saltmarsh a significant area of primary production and a nursery ground for commercial and recreational fish species. Five different species of seagrasses are found in SMMAP: shoal grass (*Halodule wrightii*), star grass (*Halophila engelmanni*), widgeon grass (*Ruppia maritima*), manatee grass (*Syringodium filiforme*) and turtle grass (*Thalassia testudinum*). Distribution of these grasses is largely dependent upon water clarity, water depth, and salinity.

The SMMAP is especially important for commercial and recreational fisheries. The seagrass beds in this region provide vital habitat to many recreational fish species such as redfish, speckled sea trout, and grouper. The seagrass beds also provide vital habitat to the Florida Bay Scallop; in company with the Steinhatchee area in the Big Bend, these coastal waters are considered the state's leading scallop harvesting grounds.

It is important to collect and establish baseline conditions within the St. Martins Marsh Aquatic Preserve for post-impact comparisons and to identify any habitat restoration or watershed management opportunities. SMMAP's seagrass and water quality data provides helpful information which can be used to help address management issues of the resource.

6. Station Locations

St. Martins Marsh (SID) monitoring stations are located within the St. Martins Marsh Aquatic Preserve, between the Crystal and Homosassa Rivers in Citrus County, Florida. Cedar Key, Steinhatchee, Dekle Beach / Keaton Beach and St. Marks monitoring stations are located within the Big Bend Seagrasses Aquatic Preserve. More specific geographic locations for these sites are as follows: Cedar Key (CK) monitoring stations are located in the coastal waters of Cedar Key in Levy County; Steinhatchee (STCH) monitoring stations are located west and south of the town of Steinhatchee in both Dixie and Taylor Counties; Dekle Beach / Keaton Beach (DBKB) monitoring stations are in the coastal waters of Taylor County extending from the communities of Keaton Beach to the north to Hagen's Cove to the south; and St. Marks (SMAR) monitoring stations are located in Apalachee Bay, south of the town of St. Marks in Wakulla and Jefferson Counties.

Table 4: St. Martins Marsh (SID) Monitoring Stations

Station ID	Latitude	Longitude
SID01	N 28.83096	W -82.77872
SID02	N 28.83096	W -82.75973
SID03	N 28.83096	W -82.74073

SID04	N 28.83096	W -82.72173
SID05	N 28.83096	W -82.70273
SID06	N 28.81429	W -82.77873
SID07	N 28.81429	W -82.75973
SID08	N 28.81429	W -82.74073
SID09	N 28.81429	W -82.72173
SID10	N 28.81429	W -82.70273
SID11	N 28.79762	W -82.77873
SID12	N 28.79762	W -82.75973
SID13	N 28.79762	W -82.74073
SID14	N 28.79762	W -82.72173
SID15	N 28.79762	W -82.70273
SID16	N 28.78096	W -82.77873
SID17	N 28.78096	W -82.75973
SID18	N 28.78096	W -82.74073
SID19	N 28.78096	W -82.72173
SID20	N 28.78096	W -82.70273
SID21	N 28.76429	W -82.77873
SID22	N 28.76429	W -82.75973
SID23	N 28.76429	W -82.74073
SID24	N 28.76429	W -82.72173
SID25	N 28.76429	W -82.70273

Table 5: Cedar Key (CK) Monitoring Stations

Station ID	Latitude	Longitude
CK01	N 29.10353	W -83.07146
CK02	N 29.10169	W -83.06670
CK03	N 29.09684	W -83.06095
CK04	N 29.09580	W -83.06958
CK05	N 29.10060	W -83.07297
CK06	N 29.09957	W -83.08224
CK07	N 29.10458	W -83.08136
CK08	N 29.11029	W -83.08109
CK09	N 29.11466	W -83.07697
CK10	N 29.09577	W -83.02865
CK11	N 29.09841	W -83.03444
CK12	N 29.09840	W -83.02859
CK13	N 29.10166	W -83.03252
CK14	N 29.08084	W -83.05309
CK15	N 29.08583	W -83.06857
CK16	N 29.10689	W -83.09766
CK17	N 29.12688	W -83.10284
CK18	N 29.13523	W -83.10408
CK19	N 29.13709	W -83.09472

CK20	N 29.13389	W -83.08359
CK21	N 29.11887	W -83.08010
CK22	N 29.11855	W -83.02962
CK23	N 29.12137	W -83.03386
CK24	N 29.12410	W -83.03476
CK25	N 29.12799	W -83.03003

Table 6: Steinhatchee (STCH) Monitoring Stations

Station ID	Latitude	Longitude
STCH01	N 29.67500	W -83.44167
STCH02	N 29.67500	W -83.47500
STCH03	N 29.66750	W -83.46690
STCH04	N 29.65833	W -83.42500
STCH05	N 29.64167	W -83.40833
STCH06	N 29.64140	W -83.41460
STCH07	N 29.64440	W -83.42570
STCH08	N 29.64167	W -83.44167
STCH09	N 29.63453	W -83.42518
STCH10	N 29.62500	W -83.42500
STCH11	N 29.61290	W -83.42370
STCH12	N 29.60833	W -83.40833
STCH13	N 29.60046	W -83.41712
STCH14	N 29.59167	W -83.42500
STCH15	N 29.59160	W -83.43860
STCH16	N 29.58240	W -83.42520
STCH17	N 29.57611	W -83.42495
STCH18	N 29.57499	W -83.44167
STCH19	N 29.56520	W -83.42070
STCH20	N 29.55833	W -83.42500
STCH21	N 29.54620	W -83.41520
STCH22	N 29.54770	W -83.43420
STCH23	N 29.54166	W -83.44167
STCH24	N 29.53340	W -83.42030
STCH25	N 29.52449	W -83.42500

Table 7: Dekle Beach/Keaton Beach (DBKB) Monitoring Stations

Station ID	Latitude	Longitude
DBKB01	N 29.87838	W -83.65393
DBKB02	N 29.87557	W -83.64135
DBKB03	N 29.87239	W -83.65296

DBKB04	N 29.86916	W -83.63774
DBKB05	N 29.86133	W -83.62980
DBKB06	N 29.85209	W -83.66123
DBKB07	N 29.84761	W -83.62319
DBKB08	N 29.84132	W -83.62485
DBKB09	N 29.83685	W -83.47698
DBKB10	N 29.83293	W -83.62881
DBKB11	N 29.82599	W -83.62142
DBKB12	N 29.81831	W -83.62869
DBKB13	N 29.82188	W -83.60457
DBKB14	N 29.80674	W -83.63106
DBKB15	N 29.80146	W -83.61715
DBKB16	N 29.80883	W -83.60097
DBKB17	N 29.79853	W -83.59284
DBKB18	N 29.79231	W -83.58658
DBKB19	N 29.78787	W -83.60000
DBKB20	N 29.77870	W -83.60526
DBKB21	N 29.77323	W -83.59346
DBKB22	N 29.76472	W -83.59856
DBKB23	N 29.75266	W -83.58934
DBKB24	N 29.75188	W -83.57326
DBKB25	N 29.73651	W -83.58193

NOTE: Dekle Beach / Keaton Beach site locations were updated in 2017 to maximize sampling efforts in this region. Historic site coordinates are available upon request.

Table 8: St. Marks (SMAR) Monitoring Stations

Station ID	Latitude	Longitude
SMAR01	N 30.06016	W -84.17051
SMAR02	N 30.06131	W -84.15289
SMAR03	N 30.06414	W -84.13629
SMAR04	N 30.06500	W -84.11961
SMAR05	N 30.06376	W -84.10274
SMAR06	N 30.06156	W -84.08627
SMAR07	N 30.06176	W -84.06987
SMAR08	N 30.06325	W -84.05243
SMAR09	N 30.07262	W -84.03893
SMAR10	N 30.07518	W -84.02169
SMAR11	N 30.08974	W -84.04982
SMAR12	N 30.07838	W -84.06923
SMAR13	N 30.07470	W -84.08907
SMAR14	N 30.07464	W -84.10557
SMAR15	N 30.08141	W -84.11957
SMAR16	N 30.05055	W -84.15928

SMAR17	N 30.05278	W -84.14236
SMAR18	N 30.05541	W -84.12576
SMAR19	N 30.05745	W -84.10857
SMAR20	N 30.05676	W -84.09095
SMAR21	N 30.05761	W -84.07223
SMAR22	N 30.05926	W -84.05395
SMAR23	N 30.07869	W -84.05362
SMAR24	N 30.07083	W -84.05075
SMAR25	N 30.07035	W -84.07165

7. Data Analysis and Discussion

St. Martins Marsh (SID)

Submerged aquatic vegetation (SAV) monitoring began in 1997 in the St. Martins Marsh region. Originally, only species occurrence and coverage were reported for each site; total grass and total SAV (seagrass and macroalgae combined) Braun-Blanquet (B&B) scores were not recorded until 2002. The St. Martins Marsh monitoring region is a very unique area in that five species of seagrasses, and approximately 20 species of macroalgae (See Table 2 & 3), have been documented by Aquatic Preserve (AP) staff. Since 2002, average total coverage B&B score of seagrass in the St. Martins region ranges from 3 – 4.5 (See Figure 1). With the exception of 2002, 2003, and 2009, average total coverage B&B score of seagrass has sustained a score above 3.5; moreover, the average total coverage B&B score of seagrass for 2018 was 3.98. Turtle grass (*Thalassia testudinum*) is the most commonly encountered species of seagrass, followed by manatee grass (*Syringodium filiforme*) then shoal grass *(Halodule wrightii*) (See Figure 2). Star grass (*Halophila engelmanni*) has been observed every year, but not to the extent of the other seagrass species. Widgeon grass (*Ruppia maritime*) has been documented intermittently at the eastern monitoring sites that experience more freshwater input.

Figure 1: Average Total Seagrass B&B Score for all sites within St. Martins Marsh
***Total coverage was not reported for St. Martins Marsh prior to 2002**

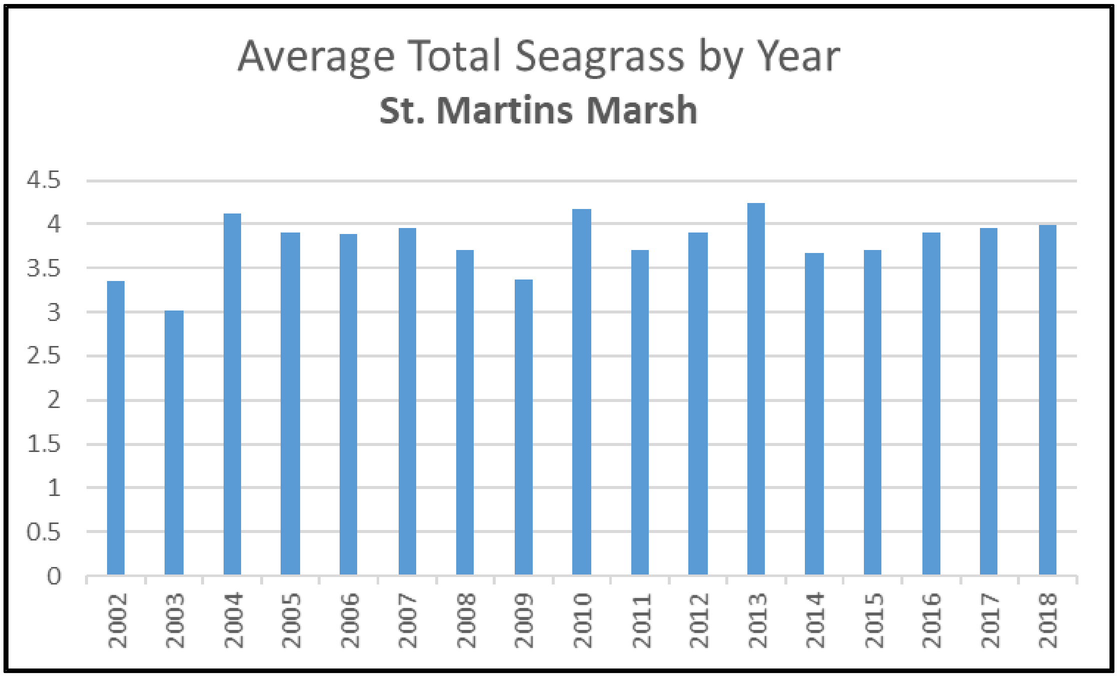


Figure 2. Percent Occurrence of Individual Seagrass Species in St. Martins Marsh

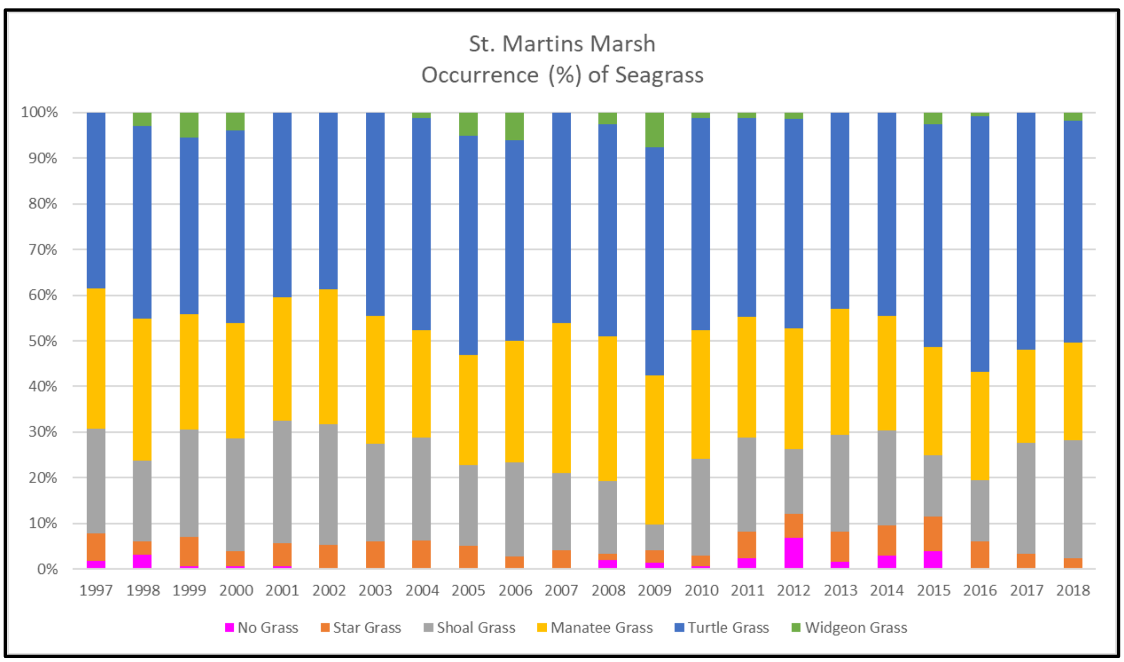
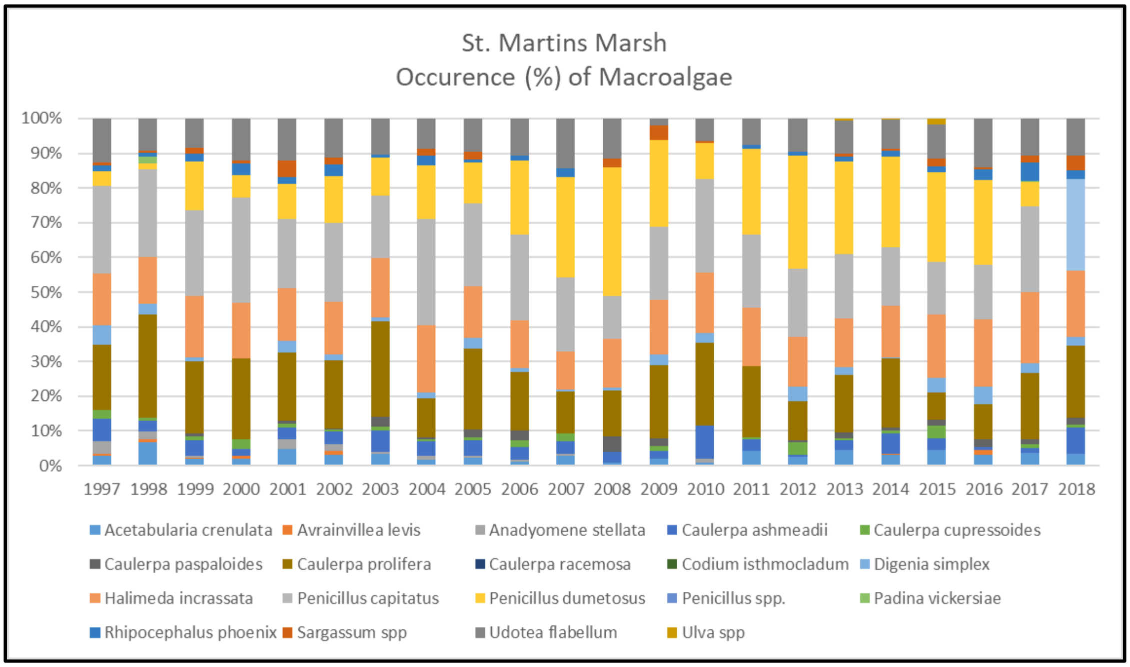


Figure 3: Percent Occurrence of Individual Macroalgae Species in St. Martins Marsh

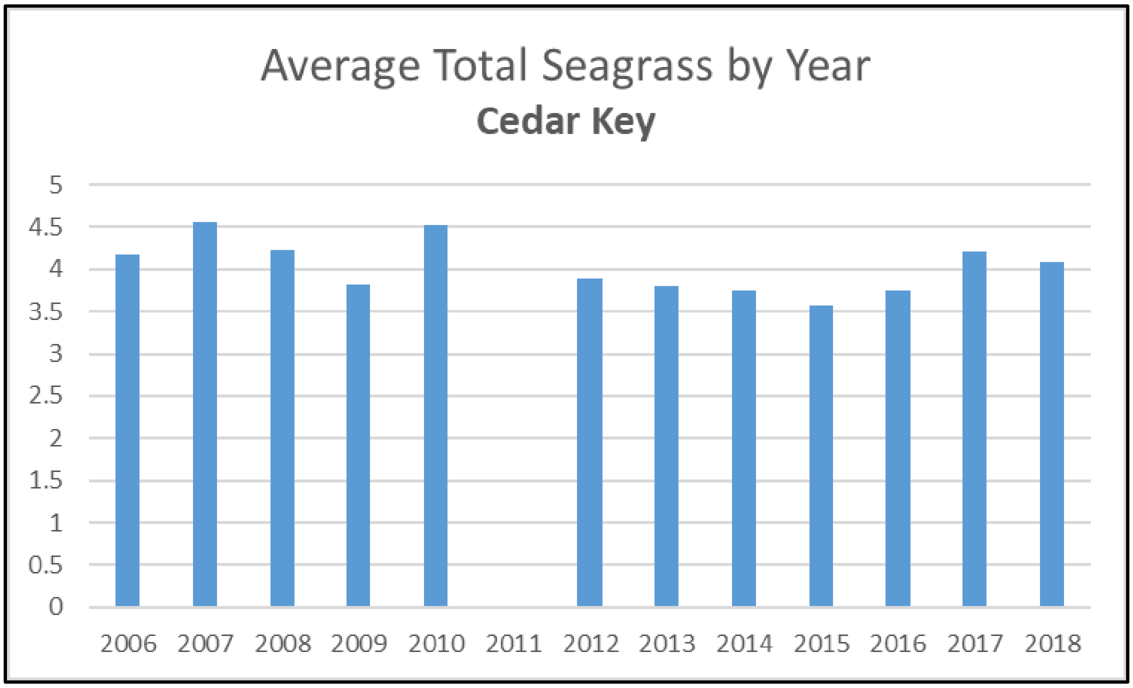


Although almost 20 species of macroalgae have been observed in the St. Martins region; c*aulerpa prolifera*, *penicillus capitatus*, *penicillus dumetosus*, *udotea flabellum*, and *halimeda incrassata* have been the most prominent species (See Figure 3). Interestingly, since 2007, *penicillus capitatus* and *penicillus dumetosus* combined have been observed more than any other macro algae; *penicillus spp.* typically occur at approximately 40% of St. Martins Marsh sampling sites. Prior to 2007, *penicillus spp*. were encountered at approximately 25-30% of all monitoring sites. In 2018, *Penicillus capitatus* and *Penicillus dumetosa* were combined into one code: *Penicillus spp.* To streamline sampling. Other macro algae species commonly encountered, although not to the extent of the afore mentioned, include: *acetabularia crenulata*, *caulerpa ashmeadii*, *digenia simplex*, and *rhipocephalus phoenix* (See Figure 3). Drift algae is observed annually at most sites; however, since it is not attached to the sea floor, it is not included in the total SAV or total coverage B&B scores.

Cedar Key (CK)

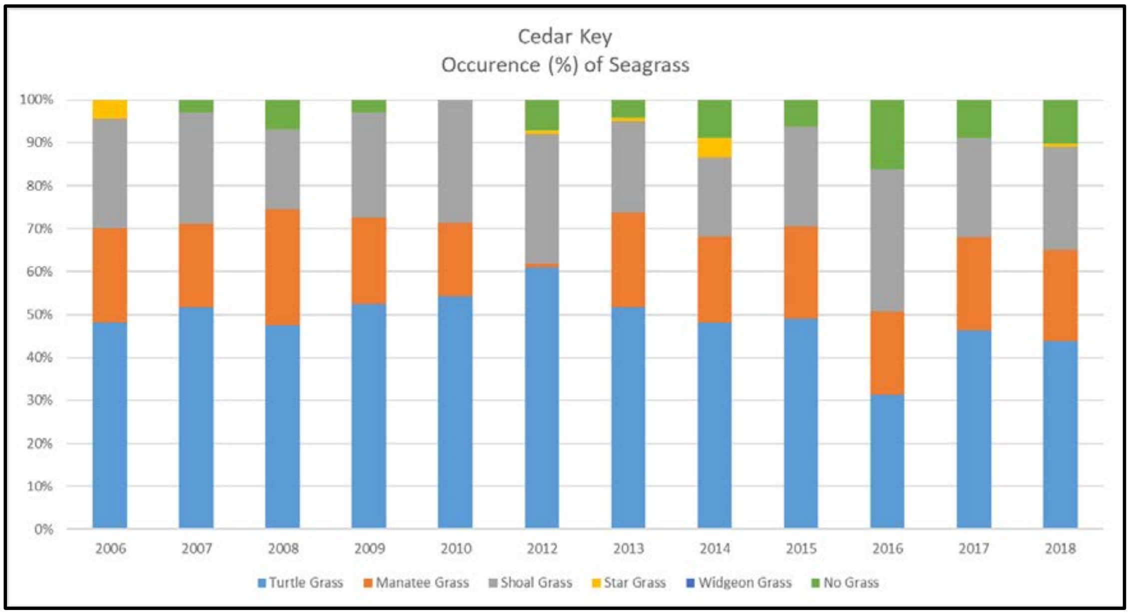
Submerged aquatic vegetation (SAV) monitoring began in 2006 in the Cedar Key region. Staffing shortage and unfavorable weather patterns prevented monitoring in 2011. To date, four species of seagrass and five species of macroalgae have been recorded in the Cedar Key region. Since 2006, the average total coverage Braun-Blanquet (B&B) score of seagrass in the Cedar Key region ranges from 3.6 – 4.5 (See Figure 4); the 2017 average total coverage B&B score for seagrass in Cedar Key was 4.08.

Figure 4: Average Total Seagrass B&B Score for all sites in Cedar Key



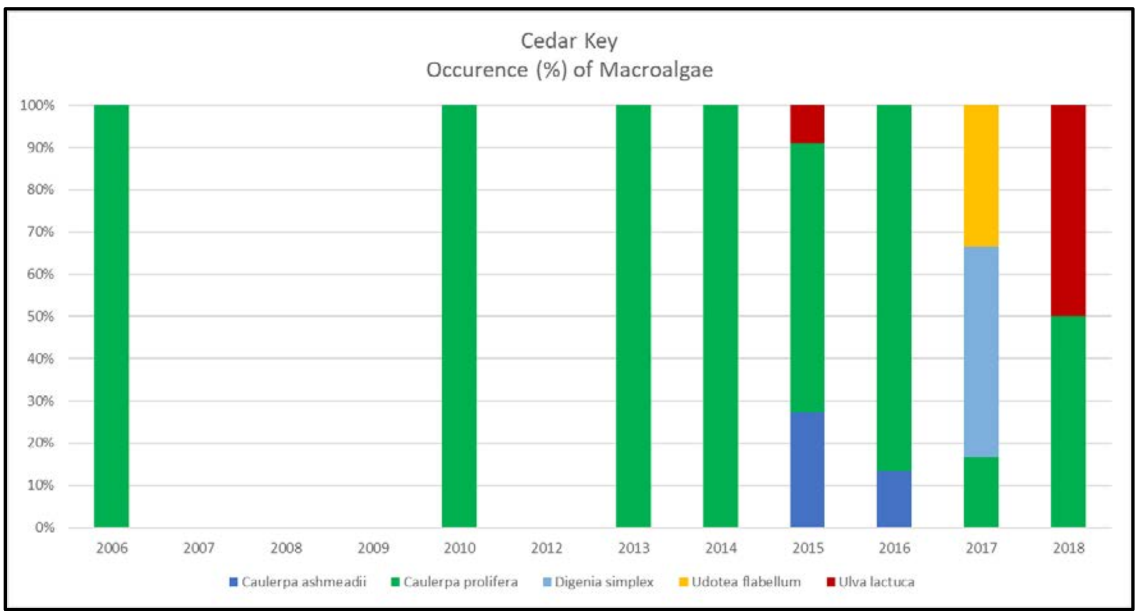
Turtle grass (*Thalassia testudinum*), shoal grass (*Halodule wrightii*), and manatee grass (*Syringodium filiforme*) are the most commonly encountered species of seagrass; star grass (*Halophila engelmanni*) has only been observed 15 times to date. Turtle grass is the most dominant seagrass species in Cedar Key (See Figure 5). Historically, Cedar Key differed from the other monitoring regions in that only one macro algae species had been documented; *Caulerpa. prolifera* had only been observed 20 times since 2006 (See Figure 6). In 2015, however, *Caulerpa ashmeadii* and *Ulva lactuca* were encountered eight times. *Digenia simplex* and *Udotea flabellum* appeared in 2017. Drift algae is encountered and documented every year; however, since it is not attached to the sea floor, it is not included in the total SAV or total coverage B&B scores.

Figure 5: Percent Occurrence of Individual Seagrass Species in Cedar Key



****Note: Sampling did not occur in 2011**

Figure 6: Percent Occurrence of Individual Macroalgae Species in Cedar Key



****Note: Sampling did not occur in 2011**

Steinhatchee (STCH)

Submerged aquatic vegetation (SAV) monitoring began in 2000 in the Steinhatchee region. Originally, only species occurrence and coverage were reported for each site; total grass and total SAV (seagrass and macro algae combined) Braun-Blanquet (B&B) scores were not recorded until 2003. No data was collected in 2005 due to lack of staff. Severe weather events prevented data collection in 2012 and 2015 due to significant tannic output from the Steinhatchee River which resulted in a dark plume in the Gulf of Mexico.

Five species of seagrass and approximately 18 different species of macroalgae in the Steinhatchee region have been recorded in this region. Since 2003, average total coverage B&B score of seagrass in the Steinhatchee region ranges from 2.5 – 4.64 (See Figure 7). The 2017 average total coverage B&B score of seagrass for Steinhatchee is 4.17. Turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*) are the most commonly encountered species of seagrass; however, since 2010, turtle grass has become the most dominant seagrass species (See Figure 8). Shoal grass *(Halodule wrightii*), star grass (*Halophila engelmanni*), and widgeon grass (*Ruppia maritime*) are observed occasionally, but not to the extent of the other seagrass species.

Figure 7: Average Total Seagrass B&B Score for all sites in Steinhatchee

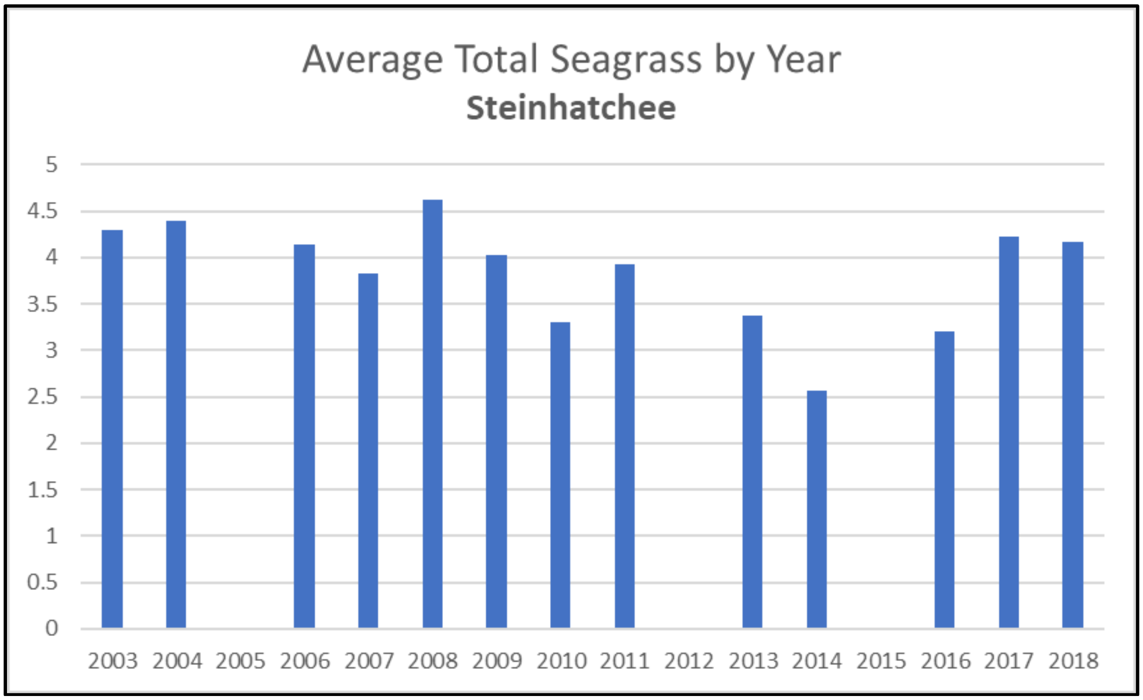
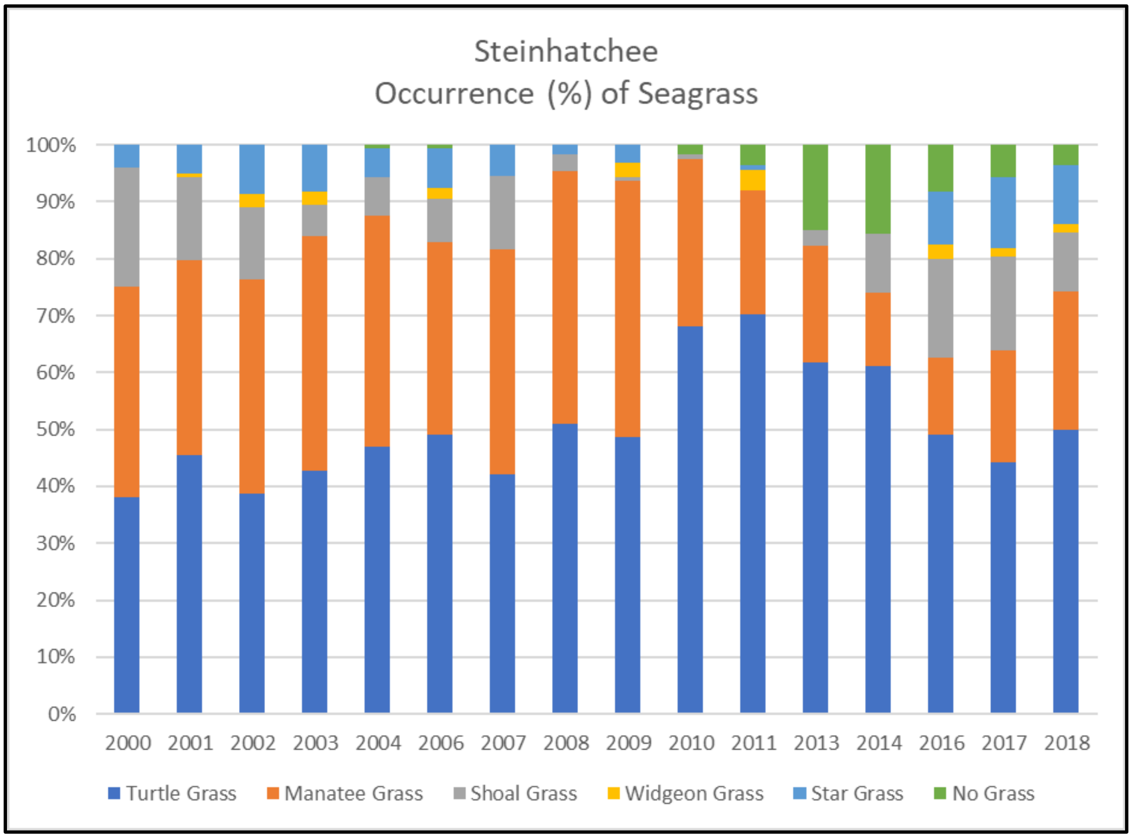


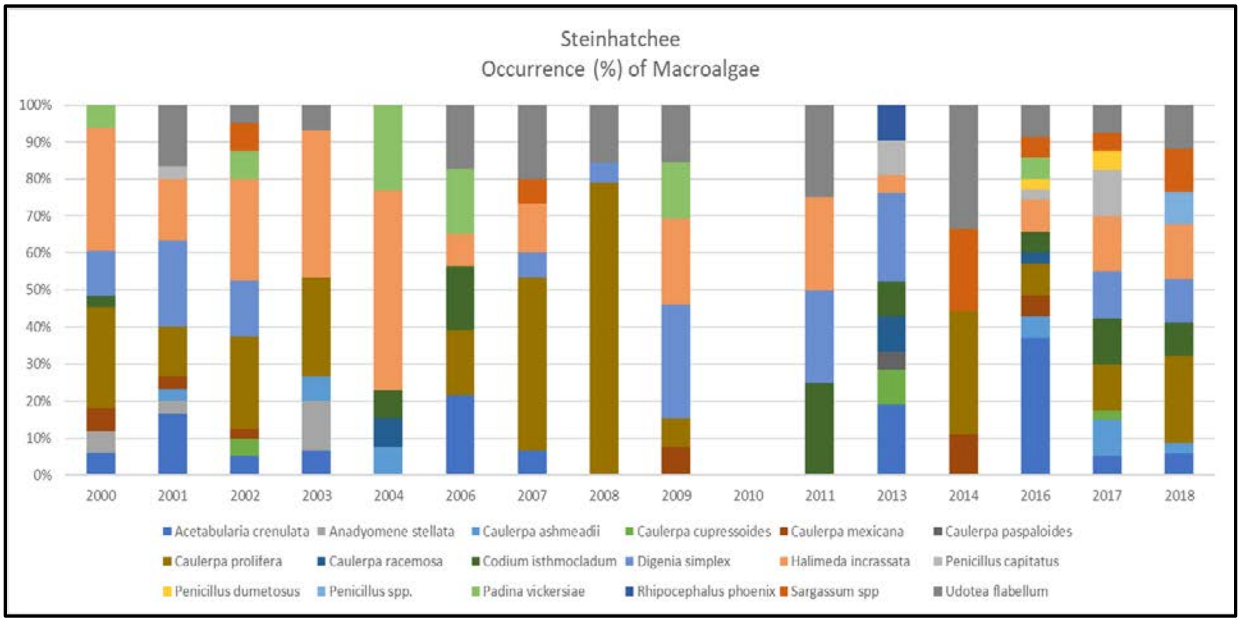
Figure 8: Percent Occurrence of Individual Seagrass Species in Steinhatchee



****Note: Sampling did not occur in 2005, 2012 or 2015**

Major species of macro algae that are encountered include: *Udotea flabellum*, *Halimeda incrassata*, *Caulerpa prolifera*, and *Digenia simplex* (See Figure 9). Occasional observations other *caulerpa* species, as well as *Codium isthmocladum* and *Acetabularia crenulate* have been documented; however, these species are not recorded annually. In 2018, *Penicillus capitatus* and *Penicillus dumetosa* were combined into one code: *Penicillus spp.* Historically, the two species were identified sporadically throughout the region. Drift algae is encountered and documented every year at most sites; however, since it is not attached to the sea floor, it is not included in the total SAV or total coverage B&B scores.

Figure 9: Percent Occurrence of Individual Macroalgae Species in Steinhatchee



****Note: Sampling did not occur in 2005, 2012 or 2015**

Dekle Beach/Keaton Beach (DB/KB)

Submerged aquatic vegetation (SAV) monitoring began in 2013 in the Dekle Beach/Keaton Beach (DB/KB) region. BBSAP expanded monitoring efforts to develop a better understanding of seagrass occurrence and coverage in the Big Bend Seagrasses AP; an additional 25 monitoring sites were established in the Dekle Beach/Keaton Beach region. In 2017, these sites were redistributed to maximize sampling coverage of this region. Historical site coordinates for 2013-2016 are available upon request.

Pre-2017 Assessment

Due to insufficient staffing, monitoring did not occur in this region in 2016. The average total coverage Braun-Blanquet (B&B) score of seagrass in DB/KB was 4.46 for the monitoring time frame: 2013-2016 (See Figure 10). Manatee grass (*Syringodium filiforme*) and turtle grass (*Thalassia testudinum*) were the dominent species of seagrass in DB/KB; star grass (*Halophila engelmanni*) and shoal grass (*Halodule* wrightii) were sparsely observed (See Figure 11). Interestingly, while turtle grass has been the dominant species of seagrass at the other monitoring regions, manatee grass was the dominant species of seagrass for these data points. *Halimeda incrassata* was the most frequently encountered species of macroalgae. Other species of macro algae that were recorded include: *Acetabularia crenulata* and *Caulerpa paspaloides* (See Figure 12). Drift algae was encountered and documented at most sites; however, since it is not attached to the sea floor, it is not included in the total SAV or total coverage B&B scores.

Figure 10: Average Total Seagrass B&B Score for all sites in Dekle Beach / Keaton Beach Pre – 2017 Site Locations

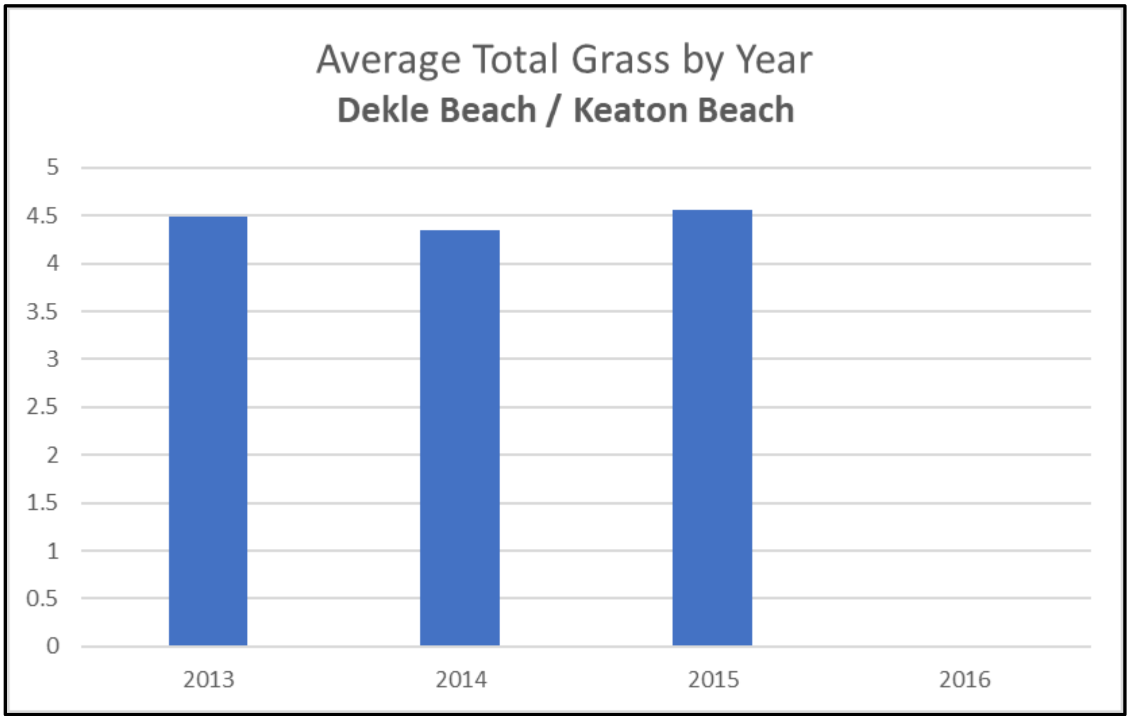


Figure 11: Percent Occurrence of Individual Seagrass Species in Dekle Beach/Keaton Beach Pre - 2017 Site Locations

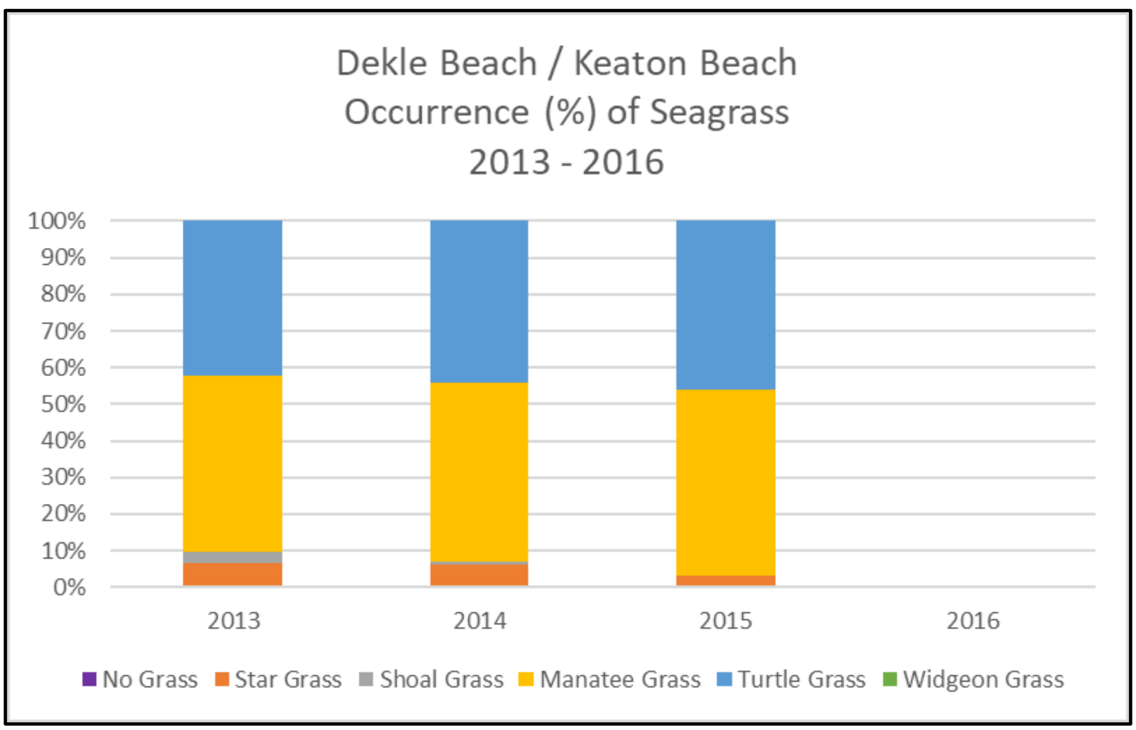
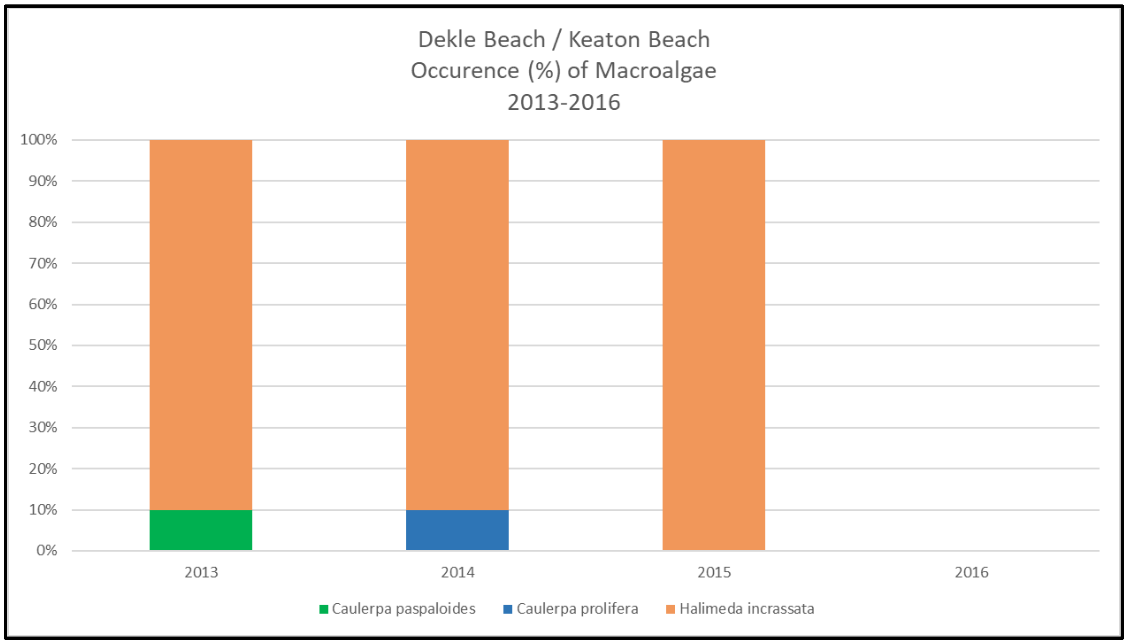


Figure 12: Percent Occurrence of Individual Macroalgae Species in Dekle Beach/Keaton Beach Pre - 2017 Site Locations



2017 to Present Assessment

The 2017 average total coverage Braun-Blanquet (B&B) score of seagrass in DBKB was 4.54 (See Figure 13). Manatee grass (*Syringodium filiforme*) and turtle grass (*Thalassia testudinum*) remain the dominant species of seagrass in DBKB; however, the increased distribution throughout the region resulted in a stronger presence of shoal grass (*Halodule wrightii*). Star grass (*Halophila engelmanni*) was still sparsely encountered (See Figure 14).

Figure 13: Average Total Seagrass B&B Score for all sites in Dekle Beach/Keaton Beach

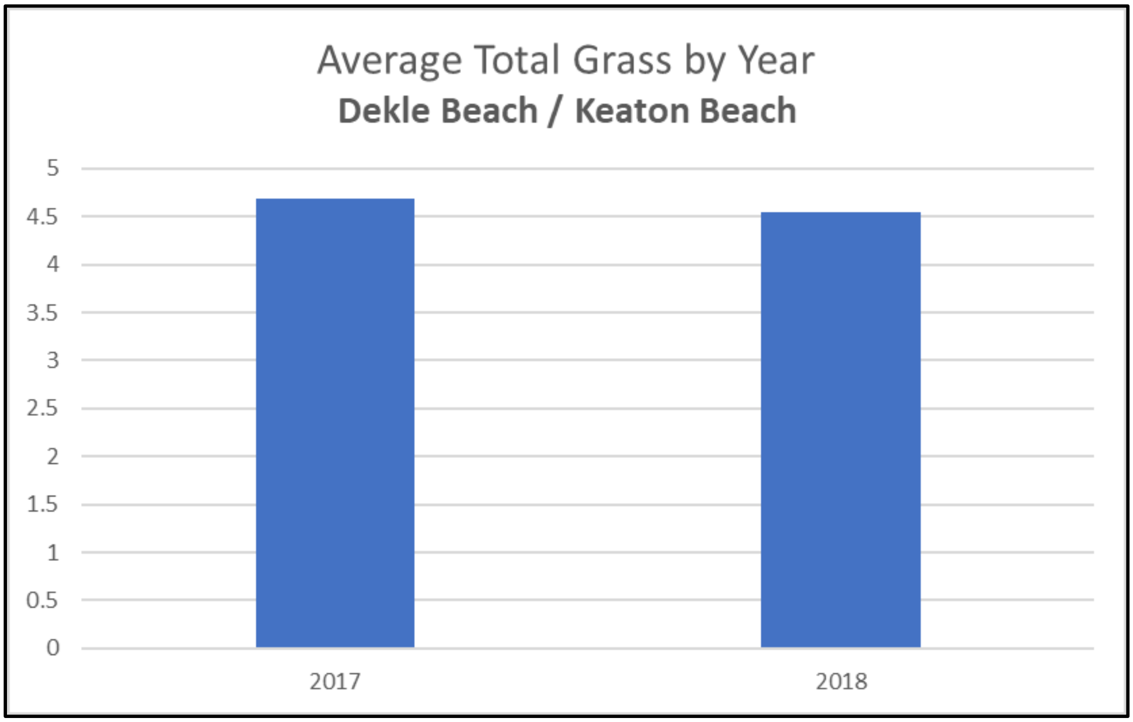
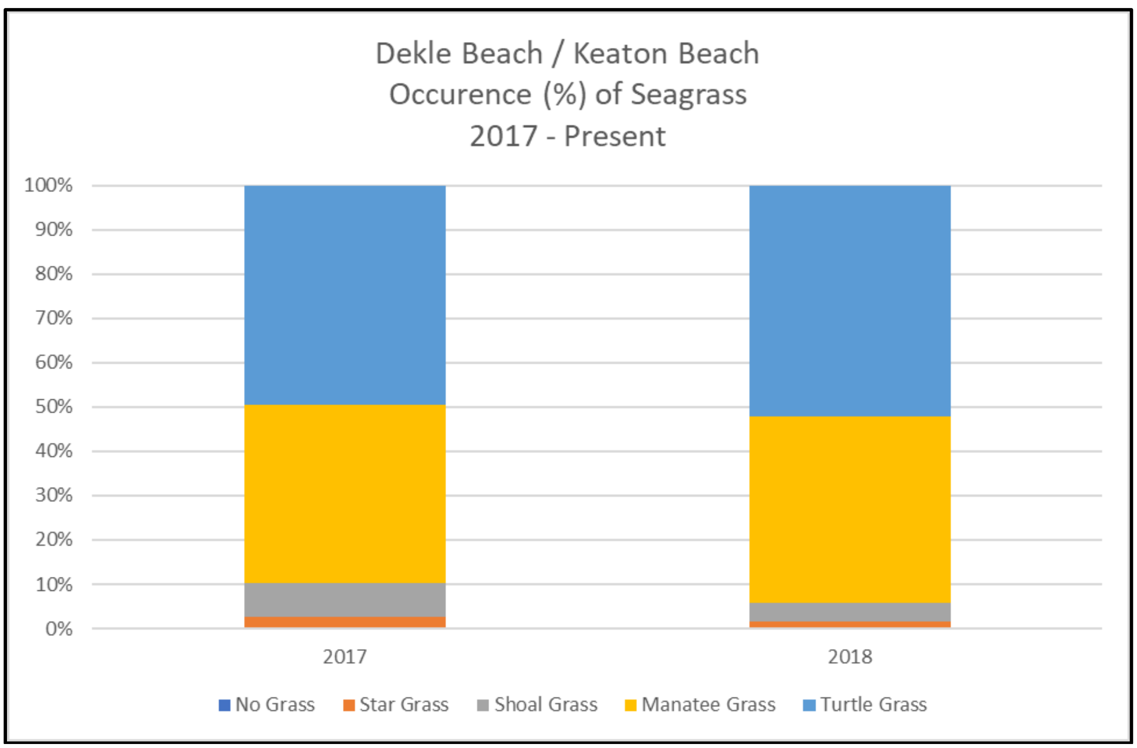
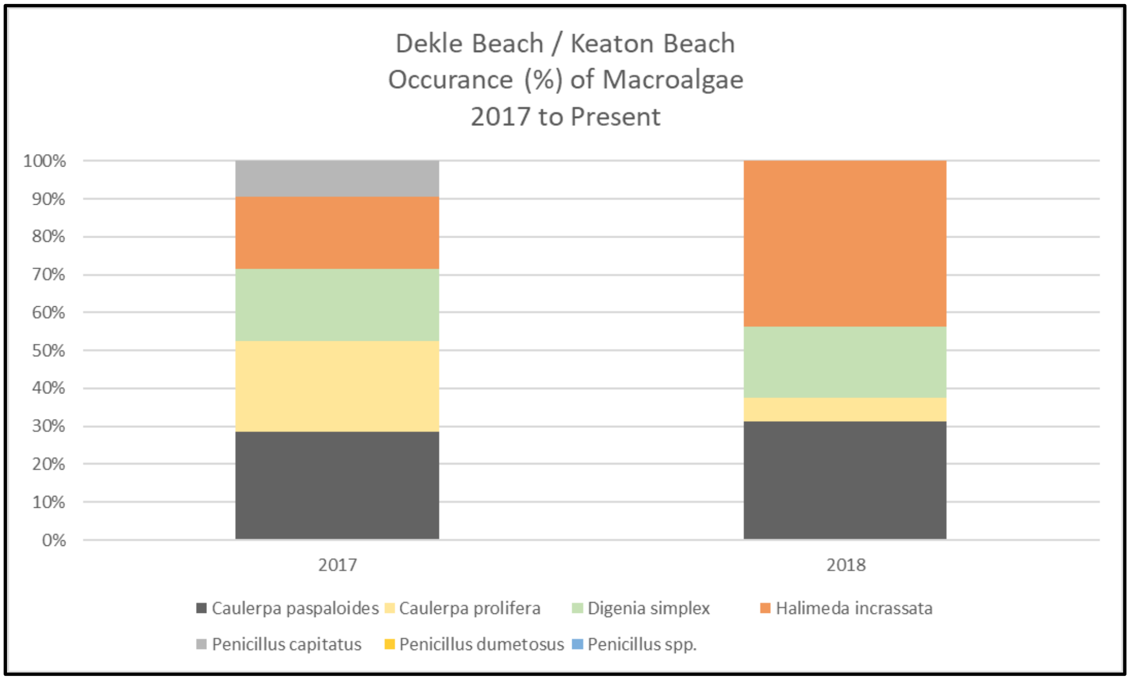


Figure 14: Percent Occurrence of Seagrass Species in Dekle Beach/Keaton Beach



Caulerpa paspaloides, *caulerpa prolifera*, *digenia simplex* and *Halimeda incressata* were the most frequently encountered species of macroalgae. Other species of macro algae that have been observed include: *Codium isthmocladum* and *Penicillus spp.* (See Figure 15). In 2018, *Penicillus capitatus* and *Penicillus dumetosa* were combined into one code: *Penicillus spp.* Drift algae was encountered and documented at most sites; however, since it is not attached to the sea floor, it is not included in the total SAV or total coverage B&B scores.

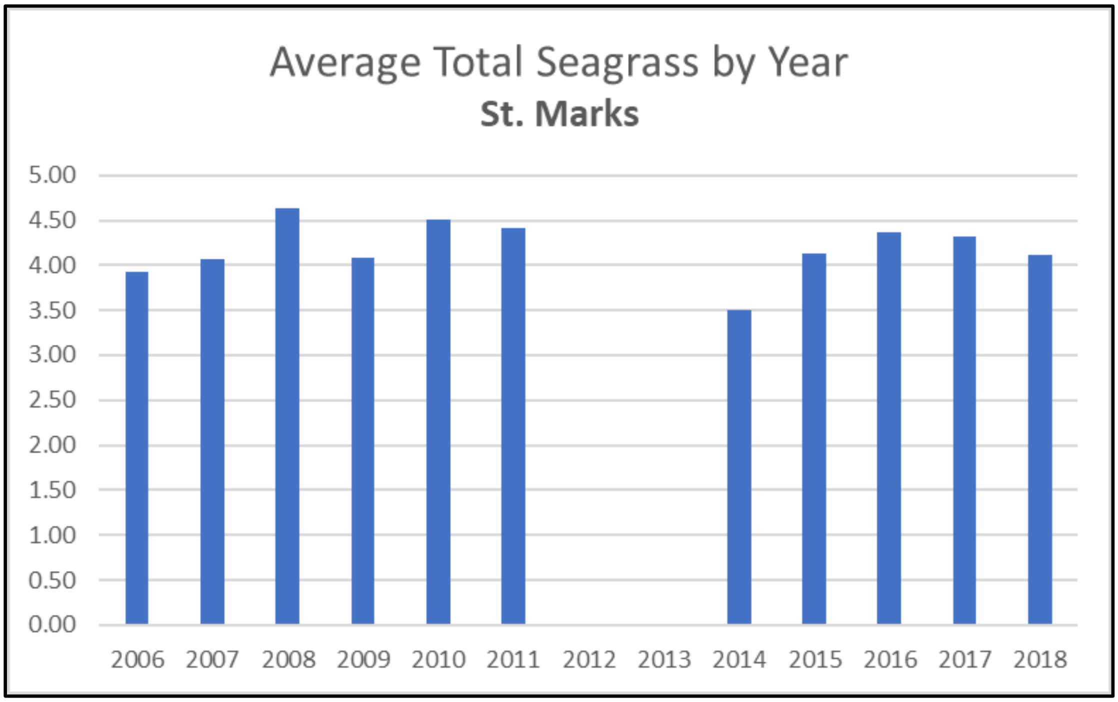
Figure 15: Percent Occurrence of Macroalgae Species in Dekle Beach/Keaton Beach



St. Marks (SMAR)

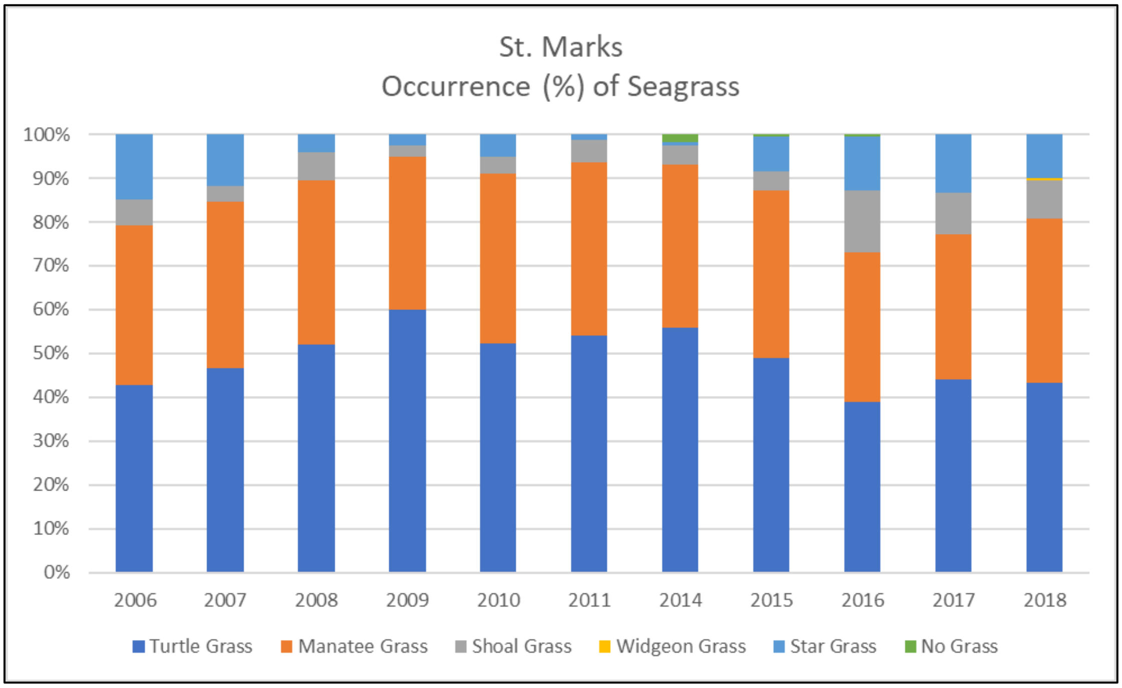
Submerged aquatic vegetation (SAV) monitoring began in 2006 in the St. Marks region. No data was collected in 2012 and 2013 due to the presence of heavy rains and intense tropical weather; output from the St. Marks, Wakulla, Wacissa, and Ecofina Rivers created a dark plume in the Gulf of Mexico, such that the dark water prevented staff from completing sampling. Staff have documented four species of seagrass and ten species of macro algae in the St. Marks region. Since 2006, the average total coverage Braun-Blanquet (B&B) score of seagrass in the St. Marks region ranges from 3.13 – 4.20 (See Figure 16); the 2017 total coverage B&B score for seagrass in St. Marks peaked above this range at 4.31.

Figure 16: Average Total Seagrass B&B Score for all sites in St. Marks



Turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*) are the most commonly encountered species of seagrass in the St. Marks region with turtle grass is the dominant species (See Figure 17). Shoal grass (*Halodule wrightii*) and star grass (*Halophila engelmanni*) have been observed every year, but not to the extent of the other two grasses.   Additionally, the observed trend for star grass was in decline from 2006 to 2011. This trend reversed in 2015 and this species observed more than shoal grass as of 2017 monitoring. Widgeon grass (*Ruppia maritime*) was documented for the first time in 2018 at a site located near shore.

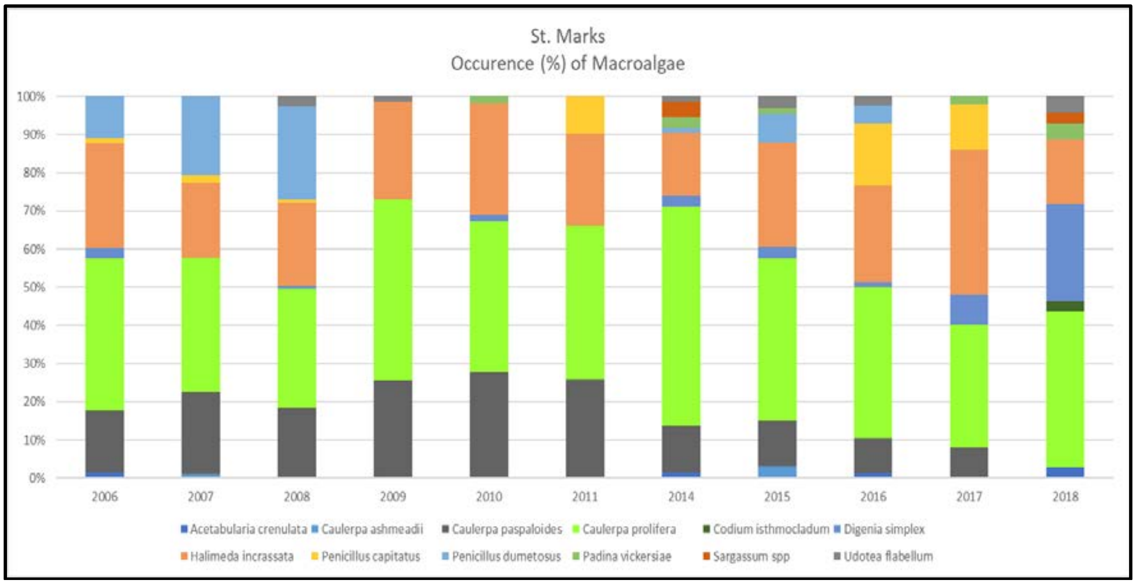
Figure 17: Percent Occurrence of Individual Seagrass Species in St. Marks



****Note: Sampling did not occur in 2012 or 2013**

Major species of macro algae that have been documented include: *Caulerpa paspaloides*, *Caulerpa prolifera*, *Halimeda incrassata*, *Penicillus dumetosus*, and drift algae. AP staff has occasionally observed other macroalgae species: *Acetabularia crenulata*, *Digenia simplex*, *Padina vickersiae*, Penicillus *capitatus*, and *Udotea flabellum*. However, these species are not as abundant, nor are they observed as often as the other macroalgae species (See Figure 18). Interestingly, between 2006 and 2008, *Penicillus dumetosus* was one of the more prominent macroalgae species; however, after 2008, it had not been observed again at any of the monitoring sites until 2015. In 2018, *Penicillus capitatus* and *Penicillus dumetosa* were combined into one code: *Penicillus spp.* In 2014, *Caulerpa prolifera* was the dominant species of macroalgae; however, in 2015, *Caulerpa paspaloides*, *Caulerpa prolifera*, and *Halimeda incrassata* were the major species of macroalgae observed in the region. Drift algae is encountered and documented every year at most sites; however, since it is not attached to the sea floor, it is not included in the total SAV or total coverage B&B scores.

Figure 18: Percent Occurrence of Macroalgae Species in St. Marks



****Note: Sampling did not occur in 2012 or 2013**

8. <u>Notable Trends:</u>

Steinhatchee (STCH)

Staff have noticed changes and declines in seagrass communities at many locations in the Steinhatchee region since 2010. While turtle grass (*Thalassia testudinum*), has become the most prominent seagrass species in the region, star grass (*Halophila engelmanni*) has only been documented once since 2010. Historically, staff would rarely encounter a site where the B&B score would be "0" or assigned "No Grass in the Quad" (NGIQ); however, in 2013, NGIQ was recorded 16 times and 17 times in 2014. Monitoring sites that had previously received B&B scores of 4 or 5 are now receiving much lower scores. More specifically, STCH 08, 16, 17, 18, 22, 23, and 25 have seen drastic declines in seagrass presence and coverage since 2010; although in 2014, seagrass coverage had increased at sites 16, 17, 23, and 25 compared to previous years. (See Figures 19, 20, 21, 22, 23, 24, and 25).

Figure 19: Average B&B Total Seagrass at STCH 08

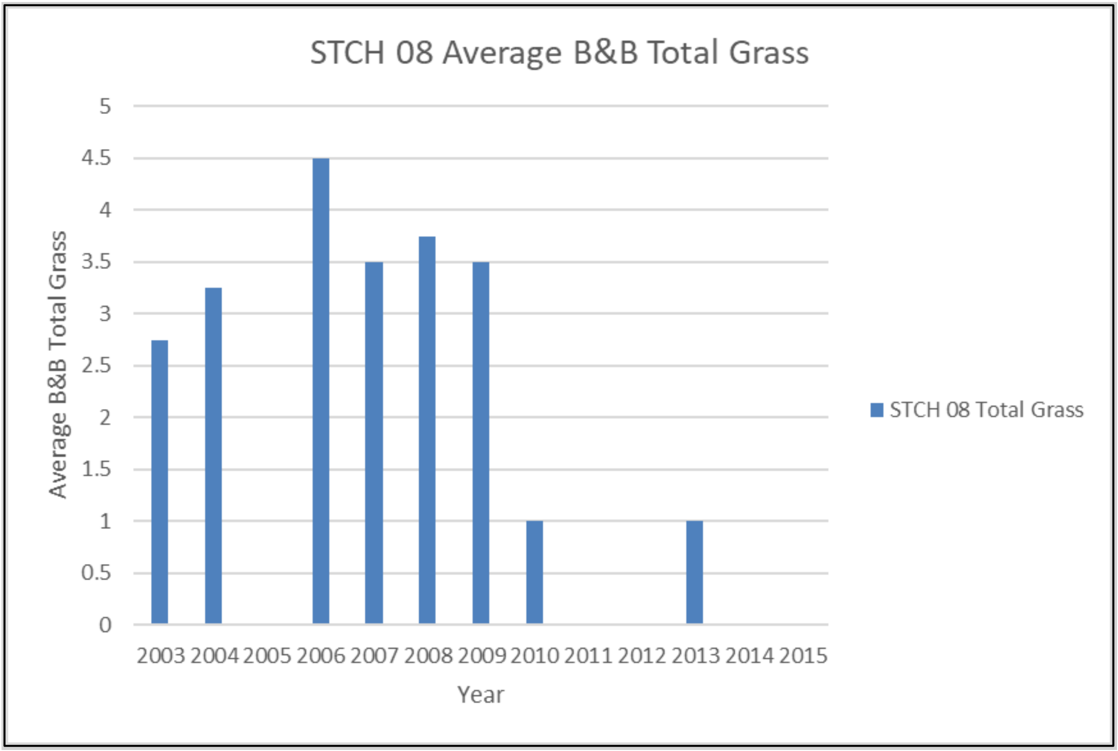


Figure 20: Average B&B Total Seagrass at STCH 16

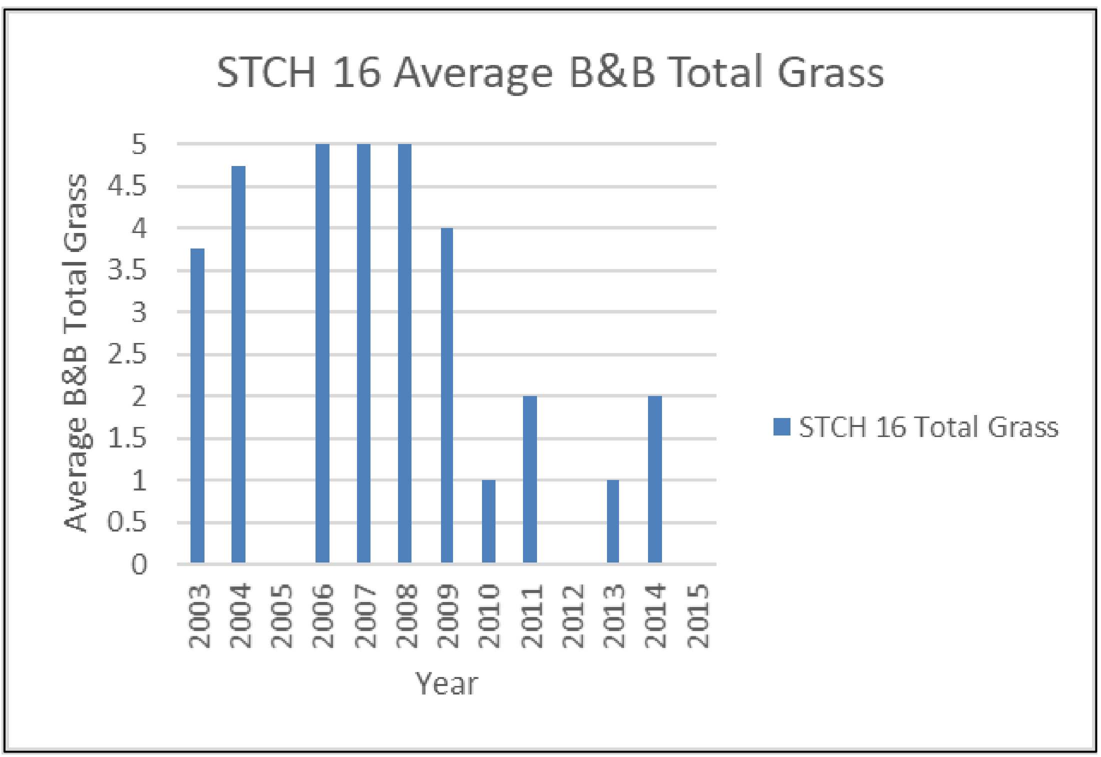


Figure 21: Average B&B Total Seagrass at STCH 17

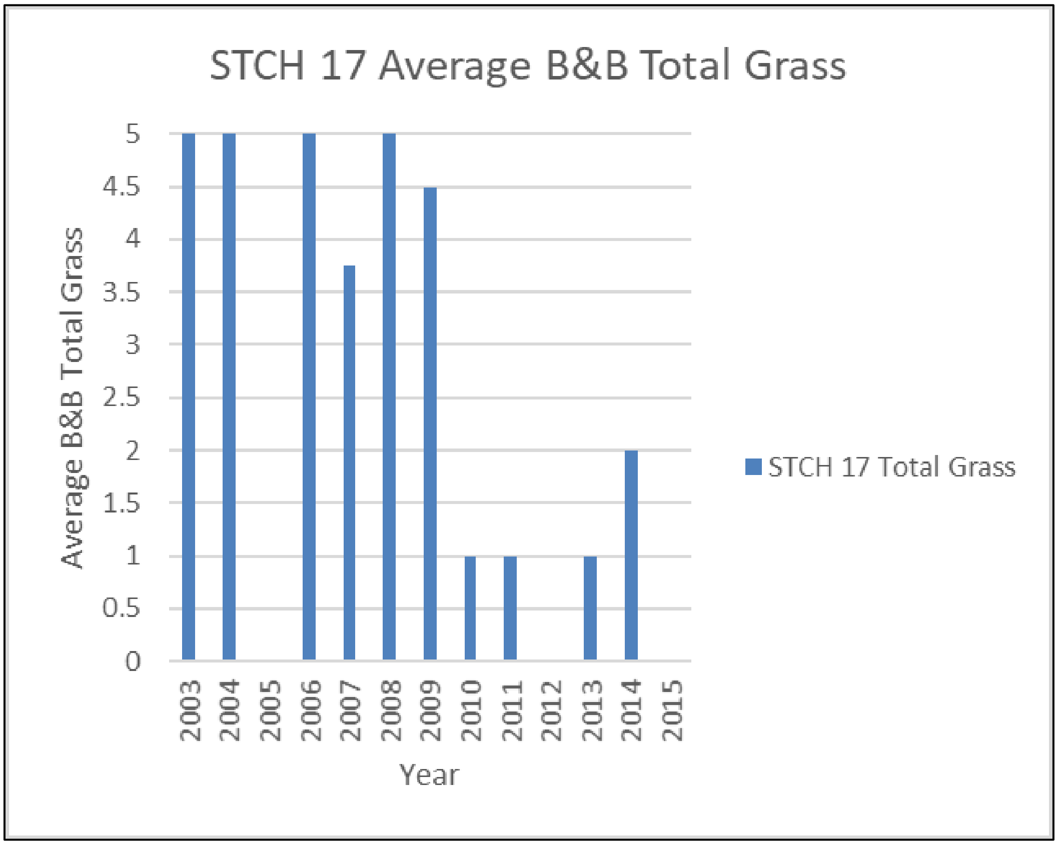


Figure 22: Average B&B Total Seagrass at STCH 18

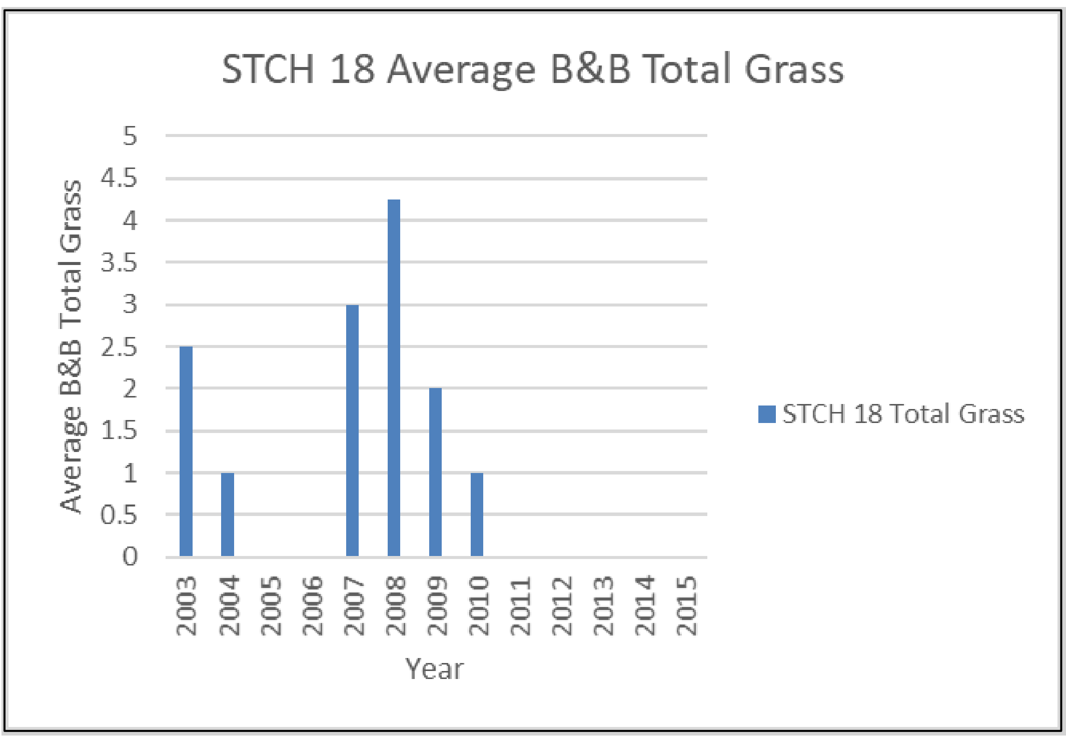


Figure 23: Average B&B Total Seagrass at STCH 22

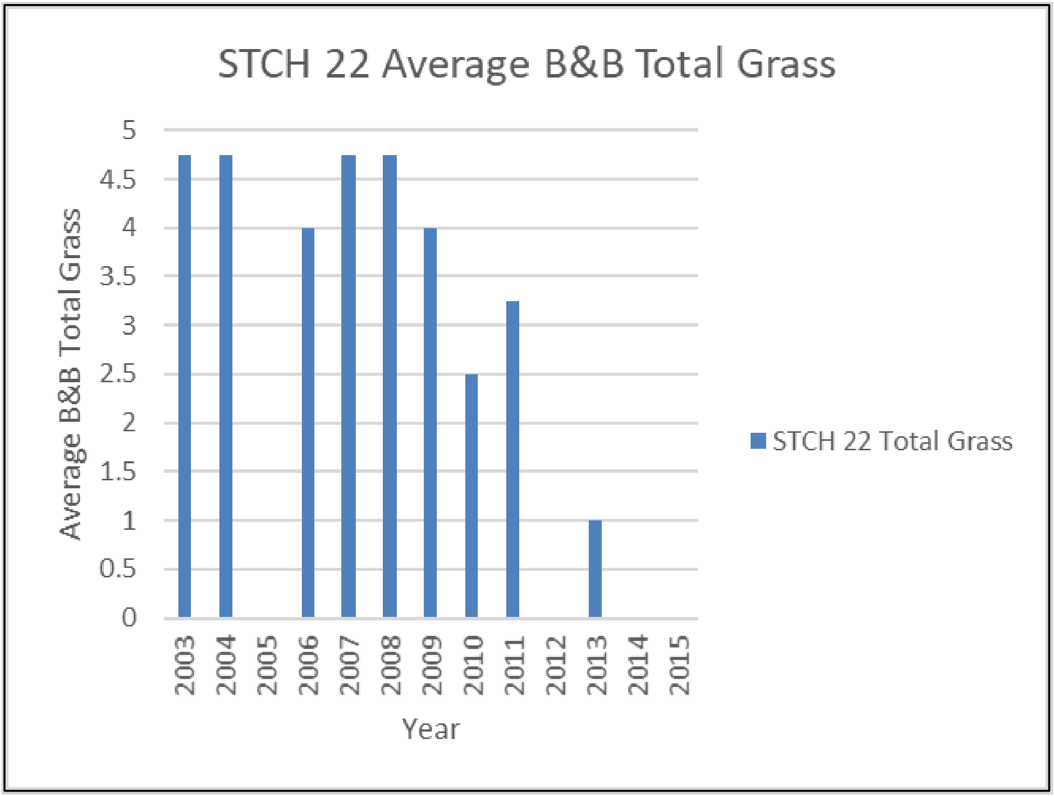


Figure 24: Average B&B Total Seagrass at STCH 23

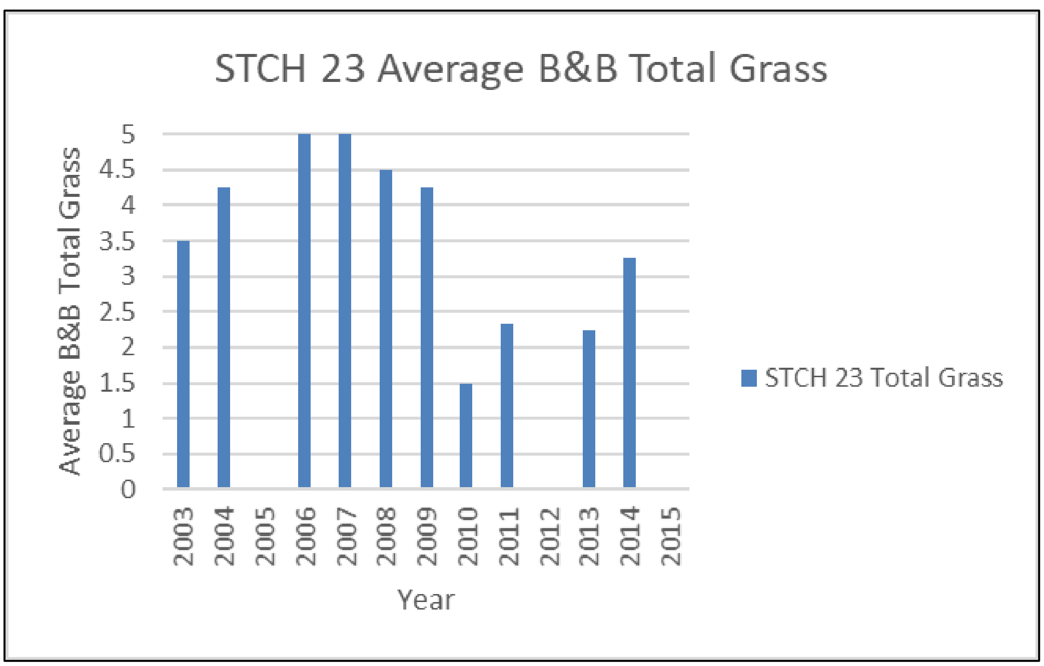
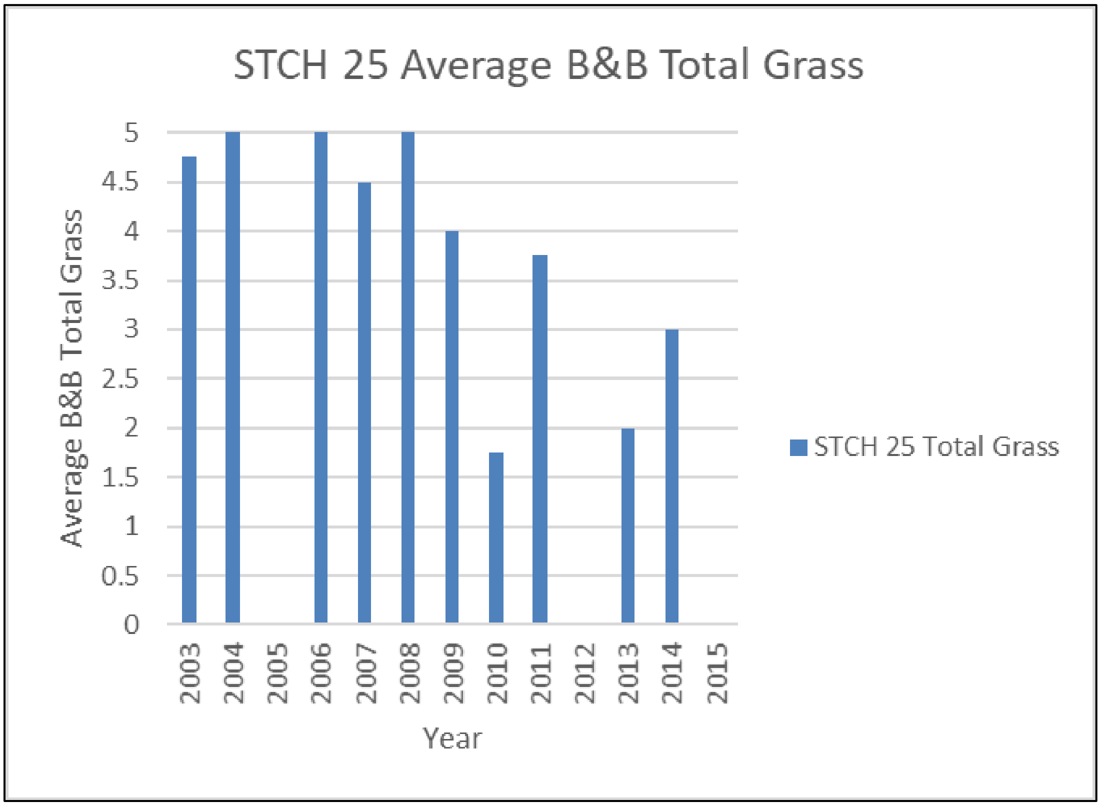


Figure 25. Average B&B Total Seagrass at STCH 25



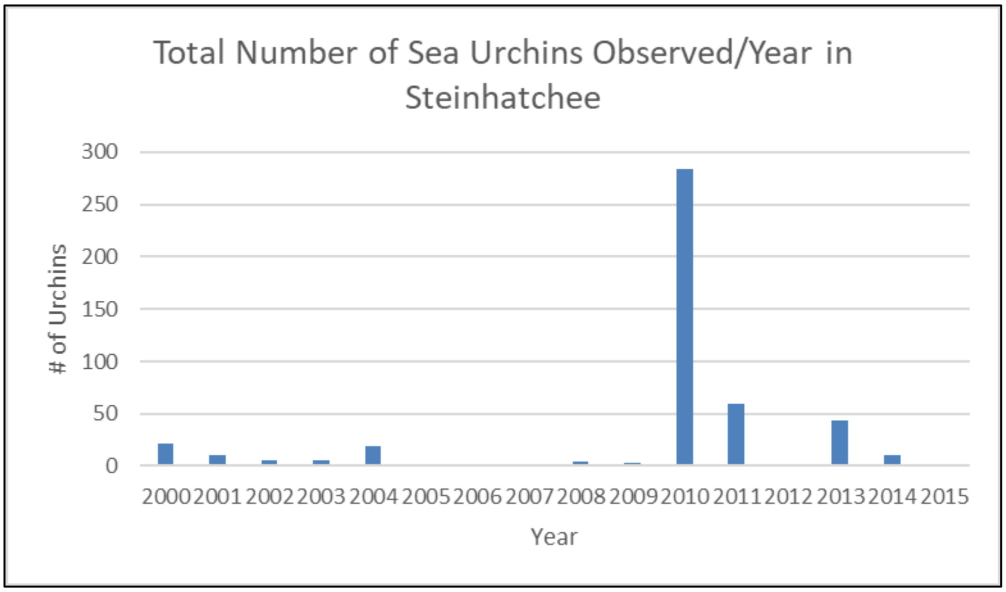
Since 2010, major storm events have brought heavy rains, which in turn increased the tannins coming out of the Steinhatchee River. The darker water is suspected to be negatively impacting seagrass growth. Sediments entering the bay can affect water column turbidity and light penetration, potentially diminishing seagrass productivity. The amount of light available to seagrasses is one of the primary determinants of the maximum depth at which these plants can grow and some species of seagrass require higher levels of light than others to thrive. Where water quality and clarity are poor, seagrasses may only be found in the shallowest waters (FWC, 2014). This may be one possible explanation of seagrass loss at some of the deeper sites (ex. STCH 18), especially since water quality and clarity have been greatly reduced with increased output from the Steinhatchee River since 2010.

In addition to reduced light penetration, lower salinities may be impacting seagrass growth, and potentially causing SAV dieback. Most seagrasses thrive between 17 and 36 parts per thousand (ppt); however, species like shoal grass can withstand a much broader range of salinities (4 – 42ppt) (Gulf Coast State College 2014). The spring-summer seagrass growing season coincides with Florida's wet season, and local salinities often drop below this optimum during this period. Seagrasses can survive exposure to lower salinities, but growth is impacted. If low-salinity conditions persist for an extended period, seagrass health will suffer and dieback is likely (Hanisak 2002). Thus, it seems possible that continual lower salinities in coastal waters of the Steinhatchee region may be responsible for seagrass loss. A further analysis of water quality, depth, and light requirements of seagrass may be needed; more sophisticated optical models are needed to identify specific water quality constituents affecting the light environment of seagrasses (Kenworthy and Fonseca 1996).

Furthermore, AP staff have documented the presence of sea urchins (*Lytechinus variegatus*) at many of the sampling sites annually, especially the sites located further south. Coincidentally, at these sites, seagrass presence and abundance has diminished. *L.* variegatus is largely herbivorous, feeding on the seagrass *Thalassia spp* (Wikipedia 2014). In turtle grass beds, *L. variegatus* can reach extremely high numbers; densities of *L. variegatus* have been reported at 636 individuals per square meter (Camp et al. 1973). An increased number of urchins consuming seagrass is thought to be a cause of seagrass loss in the Steinhatchee region.

Between 2000 and 2009, staff would typically record 0-20 total urchins; however, in 2010, staff encountered 284 urchins while sampling. The majority of urchins observed was at the more southern monitoring sites STCH15 – STCH25. In 2011, 2013 and 2014, the number of urchins observed was lower (59, 44, and 10, respectively), but still much higher than historic numbers (See Figure 26). The majority of urchins encountered in 2013 were at STCH22 and STCH23, two of the southernmost monitoring stations in the Steinhatchee region.

Figure 26: Total Number of Sea Urchins Observed per Year in Steinhatchee



St. Marks (SMAR)

Sampling did not occur in 2012 or 2013 due to heavy rainfall resulting in a significant increase in output from the St. Marks, Wakulla, Wacissa, and Ecofina Rivers. This increase created a dark plume of turbid, tannic water in the Gulf of Mexico, reducing visibility to almost zero. The increased turbidity subsequently decreased light availability, which may have resulted in the notable seagrass decline recorded in 2014, once sampling resumed. Sampling in 2014, 2015 and 2016 resulted in monitoring sites where "No Grass in Quad" (NGIQ) was recorded. Prior to these high rain events, no NGIQ quadrats were documented.

In addition to the lack of SAV coverage, a notable decrease in the average B&B score for seagrass from 2011 of 4.42 to 3.51 in 2014. Accompanying this trend, a notable shift in species composition was noted. In 2011, turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*) were the dominant species, with shoal grass (*Halodule wrightii*) and star grass (*Halophila engelmannii*) showing presence in very small number. In 2015 and 2016, turtle grass and manatee remain the dominant species; however the percent occurrence shifts to show up to a 10% increase in both shoal grass and star grass independently.

9. **Major Storm Events:**

Major tropical events have the potential to disrupt the productivity of seagrasses. Tropical weather events can directly and indirectly affect seagrass communities; heavy rains can alter salinity regimes and increase turbidity in coastal waters. All major storms (Tropical Depression, Tropical Storms, and Hurricanes) that may have impacted the St. Martins Marsh and Big Bend Seagrasses Aquatic Preserves are listed in Table 9.

Table 9: Major Storm Events in the Big Bend Region of Florida since 2002

Storm Name	Date(s) of Impact	Storm Classification	Max Winds (mph)
Edouard	September 1-6, 2002	Tropical Depression	55 mph
Henri	September 3-8, 2003	Tropical Storm	50 mph
Bonnie	April 11-13, 2004	Tropical Storm	55 mph
Frances	September 5-7, 2004	Hurricane	125 mph
Ivan	September 15-16, 2004	Hurricane	145 mph
Jeanne	September 26-27, 2004	Hurricane	105 mph
Alberto	June 12-13, 2006	Tropical Storm	60 mph
Betty	June 2, 2007	Tropical Storm	50 mph
Fay	August 22-23, 2008	Tropical Storm	60 mph
Claudette	August 16-17, 2008	Tropical Storm	50 mph
Beryl	May 28-29, 2012	Tropical Storm	60 mph
Debbie	June 24-27, 2012	Tropical Storm	55 mph
Andrea	June 5-6, 2013	Tropical Storm	65 mph
Colin	June 5-7, 2016	Tropical Storm	50 mph
Hermine	September 1-3, 2016	Hurricane	70 mph
Irma	September 9-12, 2017	Hurricane	155 mph

10. Other Remarks/Notes

a) Electronic copies of data can be obtained through the Principal Investigator.
b) Accreditation must be given to Florida Department of Environmental Protection's Florida Coastal Office staff of the Big Bend Seagrasses and St. Martins Marsh Aquatic Preserves for all data used.
c) Calibration of dissolved oxygen was performed on the day of deployment.

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