Executive Summary

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Fish and Wildlife Research Institute

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Executive Summary

Introduction

Florida seagrass beds are an extremely valuable natural resource. Carlson and Madley (2007) determined that approximately 2.2 million acres of seagrass had been mapped in estuarine and nearshore Florida waters. Two of the largest contiguous seagrass beds in the United States occur in Florida waters: Florida Bay, at the southern tip of Florida, and the Big Bend, located between the mouth of the Suwannee River and the mouth of the Apalachicola River along the Gulf Coast. Based on their acreage, seagrass beds in Florida provide ecological services worth more than $20 billion a year (Costanza *et al.*, 1997; Orth *et al.*, 2006). Many economically important fish and shellfish species depend on seagrass beds during critical stages of their life history, and seagrasses play a role in carbon sequestration, nutrient cycles, stabilizing sediments, and maintaining coastal biodiversity. Seagrasses provide food and shelter for endangered mammals and turtles (Orth *et al.*, 2006; Waycott *et al.*, 2009). Seagrass beds are important for recreation in Florida, including fishing, scalloping, wildlife viewing, snorkeling, and scuba diving. Tourism is a primary source of revenue, both public and private, and the maintenance of healthy, diverse, and beautiful seagrass communities provides a great place for vacationers to visit.

With recognition of the multiple values of seagrass beds, many agencies in Florida now monitor and track the health and status of seagrasses. The Seagrass Integrated Mapping and Monitoring (SIMM) program was developed to protect and manage seagrass resources in Florida by providing a collaborative platform for reporting seagrass mapping, monitoring, and data sharing. Given the budget problems that many agencies face, our efforts are directed at leveraging resources as well as reducing and sharing costs for seagrass mapping and monitoring. Elements of the SIMM program include 1) ensuring that all seagrasses in Florida waters are mapped at least every six years, 2) monitoring seagrasses throughout Florida annually, 3) updating and publishing on-line regional chapters continually as new information becomes available, and 4) publishing a comprehensive report every two years that combines site-intensive monitoring data and trends with statewide estimates of seagrass cover and maps showing seagrass gains and losses. This publication is our second comprehensive report.

We hope that this report and the SIMM program will continue to inform and support a number of state, federal, and local programs. Permitting agencies can draw on contacts and data available for their area of interest. Stakeholders, managers, and scientists can download regional reports and explore links to recent mapping and monitoring data on seagrass cover and species composition. Because in many Florida estuaries, the health of seagrass communities are significant resource management metrics, we hope that SIMM reports and data will continue to be used by the Florida Department of Environmental Protection (FDEP) and the U.S. Environmental Protection Agency (EPA) to support the Total Maximum Daily Load (TMDL) Program and to develop numeric nutrient and transparency criteria for Florida estuaries. Data collated by the SIMM program for the first edition of this report proved invaluable in the state and federal response to the 2010 Deepwater Horizon oil spill disaster. Because of previous SIMM efforts supported by FDEP, we immediately provided staff of the National Oceanic and Atmospheric Administration (NOAA) Natural Resource Damage Assessment (NRDA) drafts of our chapters detailing seagrass resources in all Panhandle counties.

In the executive summary, we provide a review of the factors affecting the health of seagrass communities, the status and trends of seagrass communities in Florida, the status of seagrass monitoring and mapping projects in Florida, a description of data–collection methods, and a discussion of future tasks, developing data sources, needs, and challenges.

Causes of seagrass loss in Florida

Seagrasses are vulnerable to many direct and indirect human impacts, especially eutrophication and other processes that reduce water clarity. Worldwide, most seagrass communities are limited by light availability (Dennison, 1987; Duarte, 1991; Ralph *et al*., 2007), and in many locations in Florida, light limitation was the primary cause of the historical declines in seagrass acreage during the 20th century. The amount of light reaching seagrass beds is reduced by the presence of particles (Ralph *et al*., 2007) and color (Gallegos, 1994; Gallegos *et al*., 1990; Gallegos and Kenworthy, 1996; Oestrieich *et al*., 2016) or colored dissolved organic matter (CDOM) in overlying waters.

Sources of particles may be natural or anthropogenic and include suspended sediments and phytoplankton. Sediments may be derived from wind, boat wakes, trawling, and dredging that resuspend loose bottom materials, as well as sediment loads carried to coastal waters in freshwater runoff. Phytoplankton, or single-celled algae, live suspended in the water column, and the density of phytoplankton cells is directly related to levels of available nitrogen and phosphorus in the water. Increasing eutrophication of coastal waters and their watersheds can elevate nutrient contributions to the rivers and streams that drain into coastal waters; elevated nutrients can result in increased levels of phytoplankton and even in blooms in which cells reach very high densities. Water color also attenuates light transmission through the water column, and color originates naturally in wetlands, such as wooded swamps or marshes, where the long residence time of flood waters leaches organic matter from decomposing plant material. Waters in rivers and streams draining wetlands are often dark tan or brown, and river discharge contributes darkly colored freshwater to estuaries, bays, and coastal waters. In Florida, plumes of darkly colored water are easily visible in satellite imagery of coastal regions. During high river flow, both suspended sediments and CDOM are discharged from rivers, compounding light attenuation. Modification of watershed hydrology by dams, channelization, domestic water use, and urban development can alter the amount and timing of freshwater, suspended sediment, and CDOM discharge to coastal waters. In recent years, regional shifts in weather patterns have resulted in greater runoff to estuaries in the Panhandle, while in south Florida drought conditions reduced freshwater inputs to Florida Bay.

While light attenuation in overlying waters is frequently the most important cause of seagrass loss, other factors may be important locally. Historically, dredging and filling of shallow bays for development destroyed seagrass beds, and some dredging continues; effects are now mitigated by seagrass restoration at locations near dredging operations. Scarring of seagrass beds by boat propellers fragments seagrass beds and may persist for years. Tropical cyclones can cause sediment or wrack movement (see also Carlson *et al*., 2010), resulting in burial of seagrass beds in areas experiencing overwash of barrier islands. Wide variations in salinity, whether due to extreme weather events or hydrological modifications in surrounding watersheds, can kill seagrasses or result in a change in the seagrass species composition in a bay or estuary. Hypersalinity, resulting from drought or modified hydrology, and hyperthermal conditions, e.g., cooling water discharge from power plants, can result in seagrass loss. Historically, toxic industrial wastes caused seagrass losses near the point of discharge at some locations, but in recent years, this type of pollution has stopped. Finally, the load of epiphytic organisms living on seagrass blades can affect how much light reaches the blades (Ralph *et al*., 2007). While the term epiphyte is defined as a plant living on a plant, epiphytes on seagrasses are defined as any type of organism living on the green blades. In Florida, common epiphytes include calcareous algae, diatoms (microscopic algae), filamentous algae, bryozoans, *Spirorbis* spp. (a tube-forming polychaete worm), *Corophium* spp. (a tube-forming amphipod), egg cases of various animals, and, where there are many particles in the water, mussels and tunicates. Seagrasses turn over blades fairly frequently, especially during the spring and summer growing season, so the blades with the greatest epiphyte load are often the oldest and are likely less active photosynthetically than younger blades. In areas where light limitation generally does not limit seagrass growth such as the extremely clear waters found in many locations in south Florida, the growth of calcareous algae on blades might shield the blades from excess light. It has been our observation that epiphyte loading is often heavy where waters are clear but nutrient levels are elevated or where high chlorophyll-a concentrations indicate the presence of phytoplankton blooms.

Status and trends of seagrass ecosystems in coastal waters of Florida

Although in recent years concerted efforts to improve water quality and clarity have increased seagrass coverage in some Florida estuaries, total seagrass coverage in Florida's coastal waters remains less than it was in the 1950s, and coverage continues to decline in some areas. Most locations experienced seagrass loss in the past 70 years; the factors causing loss vary from one location to another, and in many cases, loss resulted from the combined effects of two or more factors. With dollars now available from settlements from the Deepwater Horizon Oil Spill, the focus is on seagrass restoration, especially in Panhandle estuaries. Understanding the causes of seagrass loss is vital because the most successful restoration efforts have been those where seagrasses have returned naturally once limiting factors were lessened or removed. To ensure the success of restoration, whether natural or accomplished by planting, it is vital to understand what has caused seagrass loss in a location as well as what factors may now prevent the natural recovery of seagrass, because the roadblocks to seagrass recovery in a particular part of an estuary may not be the same as the original causes of loss. We hope that this summary and the regional chapters of the SIMM report provide timely information to guide management and restoration of Florida seagrass communities.

The most common metrics used to evaluate the health of seagrass ecosystems in a specific estuary or region include the spatial cover (acreage) of seagrasses and its change over time, the species composition, the frequency of occurrence of each species, and the estimation of bottom cover using the Braun-Blanquet or percentage cover method. Less commonly reported metrics include measurements of shoot counts or biomass per m^2. We report here on seagrass acreage and species composition of seagrasses because they are measured for all Florida coastal waters. While field monitoring programs all estimate bottom cover either by the Braun-Blanquet or percentage cover method, we do not report these results because the spatial sampling designs and the methods of data analysis vary widely across the state.

Mapping data and seagrass acreage: Seagrasses cover nearly 2.5 million acres of shallow bottom in Florida's coastal waters (Table ES-1; Figure ES-1). This estimate is based on the most recent mapping data available for each estuary or region of Florida and does not include large extents of seagrass located in waters too deep for imagery acquisition on the continental shelf off Big Bend and the southwest coast. While this estimate is greater than the estimate published in the first edition of the SIMM report or the estimate of Carlson and Madley (2007), it might not represent an increase in seagrass acreage. The data shown in Table ES-1 include acreage from the Marquesas Keys and the Dry Tortugas that were not available when the first edition was published, as well as mapping data obtained for many other locations since 2010. Imagery acquisition and photo-interpretation continue to advance in resolution and accuracy (see methods section below), but any set of imagery may include images that are uninterpretable because of glare, turbidity of overlying water due to resuspension of bottom sediment, or darkly colored waters that obscure the bottom and prevent identification of seagrass beds. Locations for which image interpretation is difficult or impossible may differ from one set of mapping data to another set, causing variations in mapped seagrass acreage that are not due to seagrass bed expansion or contraction. Therefore, a difference of 10–15% between estimates of overall acreage is probably within the error of measurement and estimation and likely does not represent a true increase or decrease in seagrass acreage.

Table ES-1 Seagrass acreage in five coastal regions of Florida.

Coastal region	Seagrass cover Acres	% of total
Panhandle	40,482	1.6
Big Bend to Springs Coast	617,921	24.9
Southwest Florida	143,348	5.8
South Florida	1,620,441	65.3
East coast	58,270	2.3
Total	**2,480,462**	100.0

Overall, nearly two-thirds of Florida seagrasses (1.6 million acres) are found in south Florida: in Biscayne Bay, Florida Bay, the Florida Keys, and on the Atlantic side of the Keys (Table ES-1). This is the largest contiguous area of seagrasses in the United States. The Big Bend and Springs Coast regions have the second largest area of seagrasses, about 618,000 acres, or 25% of the seagrass acreage in state waters. Southwest Florida waters, including western Pinellas County and Tampa Bay through the Ten Thousand Islands, contain about 143,300 acres of seagrass. The east coast, from Lake Worth Lagoon through the northern Indian River Lagoon, has about 58,300 acres, while the Panhandle, from Perdido Bay east through Apalachicola Bay and St. George Sound, has nearly 40,500 acres. In addition, there are large areas of unmapped seagrass on the continental shelf of southwest Florida and Big Bend; seagrass beds in these areas are difficult or impossible to map by traditional methods because they are deep, sparse, and populated by the diminutive species *Halophila engelmannii* and *Halophila decipiens*.

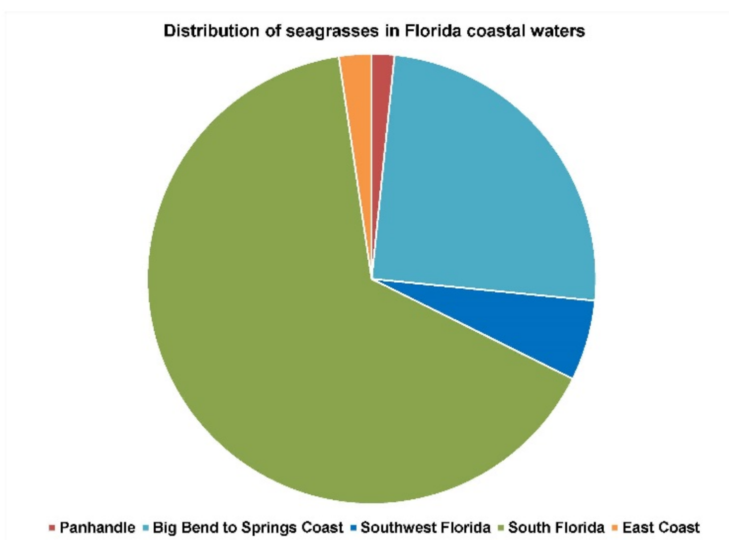

Figure ES-1 Distribution of seagrasses in five regions of Florida coastal waters.

For an estuary or region for which two sets of mapping data were available, we estimated trends in seagrass acreage (Table ES-2, Figure ES-2) by comparing the acreage estimate from the most recent mapping data set with that of the next older data set with the same footprint. We calculated gains or losses in seagrass acreage and the change in area in units of percent per year. By using this unit of change, change can be compared among estuaries or regions even though the period between mapping datasets often varies from one region to another. For the purposes of this summary, any change calculation between -1.0 and 1.0% represents a stable condition, with no change. Two of 29 regions showed losses: Choctawhatchee Bay, and the southern Big Bend. Change estimates for these regions were based on the most recent mapping datasets from 2007, and 2006, respectively: the most recent mapping data are 9 and 10 years old, respectively. Aerial imagery was acquired in these regions in 2015 or 2016, and updated mapping estimates will be available sometime in 2017. But we do not expect to find increases in seagrass acreage with new mapping data because these three regions receive considerable river runoff, which has increased in volume since 2013 due to a persistently wet, stormy weather pattern in the northeastern Gulf of Mexico. Three estuaries in the Panhandle, Perdido Bay, Pensacola Bay, St. Andrew Bay, and St. Joseph Bay, showed increased seagrass acreage, based on the most recent mapping data from 2009 and 2010, and the remaining Panhandle systems had very small changes in acreage. Mapping data for the combined Suwannee, Cedar Keys, Waccasassa region, and the Springs Coast are 15 and 9 years old, respectively, and a previous data set is not available for change analysis. Along the southwest coast of Florida from Pinellas County through Estero Bay, imagery is acquired and mapped frequently by the Southwest Florida Management District (SWFWMD; Pinellas through northern Charlotte Harbor) and by the South Florida Water Management District (SFWMD; southern Charlotte Harbor through Estero Bay). Local National Estuary Programs and the water management districts collaborate with local governments and industry to improve water clarity, and, as a result, seagrass acreage in these estuaries is stable or increasing. In particular, Tampa Bay has had large gains in acreage, and estimates from 2014 exceed estimated pre-development acreage from the 1950s as well as management goals. Seagrass beds are difficult to map in the Ten Thousand Islands and Rookery Bay because the coastal waters there are persistently cloudy. No data are available for the Ten Thousand Islands, and acreage estimates from Rookery Bay are more than 10 years old and based on mapping using a combination of aerial imagery, sidescan sonar, and in-water assessment.

Table ES-2 Mapping estimates of seagrass acreage and change (%/yr) in estuaries and coastal waters of Florida. Change was calculated using the same spatial footprint for each set of data.

	Previous		Most recent		Change
Estuary/region	Year	Acres	Year	Acres	(%/yr)
Perdido Bay	2002	115	2009	135	**2.5%**
Pensacola Bay System	2003	511	2010	1,053	**15.2%**
Big Lagoon	2003	544	2010	515	**-0.8%**
Santa Rosa Sound	2003	3,032	2010	2,894	**-0.7%**
Choctawhatchee Bay	2003	2,623	2007	1,915	**-6.7%**
St. Andrew Bay	2003	11,233	2010	12,193	**1.2%**
St. Joseph Bay	2006	6,672	2010	7,166	**1.9%**
Franklin County	1992	14,452	2010	14,611	**0.1%**
Northern Big Bend region	2001	149,840	2006	149,140	**-0.1%**
Southern Big Bend region	2001	59,674	2006	56,146	**-1.2%**
Suwannee, Cedar Keys, Waccasassa			2001	33,625	**n/a**
Springs Coast			2007	379,010	**n/a**
Western Pinellas County	2012	25,728	2014	26,214	**0.9%**
Tampa Bay	2012	26,098	2014	31,414	**10.2%**
Sarasota Bay	2012	12,587	2014	13,289	**2.8%**
Lemon Bay	2012	3,106	2014	3,272	**2.7%**
Upper Charlotte Harbor	2012	18,910	2014	19,895	**2.6%**
Lower Charlotte Harbor	2008	41,270	2014	44,553	**1.3%**
Estero Bay	2008	3,590	2014	3,683	**0.4%**
Ten Thousand Islands			n/a	n/a	**n/a**
Rookery Bay Aquatic Preserve			2003/05	1,028	**n/a**
Florida Keys, Marquesas	1992	856,355	2006/11	930,286	**0.5%**
Dry Tortugas			2006/10	9,201	**n/a**
Florida Bay	2004	359,036	2010	380,681	**1.0%**
Biscayne Bay	1992	153,827	2004/05	159,363	**0.3%**
Atlantic side Biscayne			1992	140,910	**n/a**
Lake Worth Lagoon	2001	1,647	2007	1,688	**0.4%**
Southern Indian River Lagoon	2011	7,407	2013	8,073	**4.5%**
Northern Indian River Lagoon	2013	43,084	2015	48,509	**6.3%**
Total seagrass acreage				**2,480,462**	

In south Florida, seagrass acreage is generally stable. Mapping efforts have been less frequent because there has been little change in the last 20 years and because the area to be mapped is so large. But in the summer of 2015 as many as 10,000 acres of seagrass died in northern and western Florida Bay due to extremely high salinities and elevated water temperatures, which led, in turn, to high levels of toxic sulfide in sediments under seagrass beds. Imagery was acquired in 2015, before the die-off, and in 2016, after the episode, and mapping is under way to determine the extent of seagrass loss. Seagrass beds in Biscayne Bay and Lake Worth Lagoon are also stable in acreage. Data from the last two mapping efforts show that seagrass acreage is increasing sharply in both the southern (4.5%) and northern (6.3%) Indian River Lagoon (IRL). Both areas, however, lost large areas of seagrass in 2010 following an intense algal bloom. The southern IRL lost 1,946 acres (21%) between 2009 and 2011 and gained 666 acres between 2011 and 2013, or 34% of what had been lost. The northern IRL lost 31,916 acres between 2009 and 2011 (45%) and gained 4,762 acres between 2011 and 2013, or 15% of what had been lost.

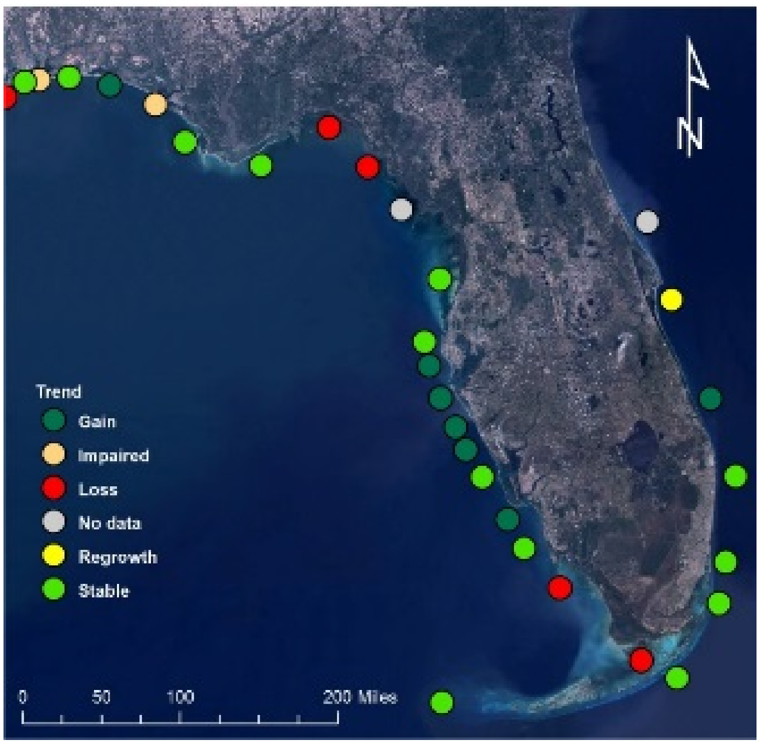

Figure ES-2 Trends in seagrass acreage in Florida coastal waters. Dots are located adjacent to the body of water that each represents.

Since the first edition of the SIMM report was published in 2013 (Yarbro and Carlson, 2013), seagrasses throughout Florida waters have been damaged by a wide variety of events (Figure ES-3). In the Panhandle and the Big Bend, tropical storms and heavy summer rains in 2012 and 2013 produced high volumes of freshwater runoff. Tropical storms Debby (2012) and Andrea (2013) inundated the Big Bend region with heavy rainfall, and elevated runoff persisted throughout both summers. Additionally, stalled cold fronts contributed excessive rainfall and river runoff in the Panhandle and Big Bend in fall and winter 2014. Storm runoff contributed turbidity and color, and generated elevated phytoplankton levels from increased nutrient concentrations, all of which reduced light available to seagrass beds. Sharp decreases in seagrass cover and frequency of occurrence were observed in the Big Bend and in many Panhandle locations. Since 2015, runoff has lessened and water clarity has improved. Mapping of aerial imagery acquired in December 2015 in the Big Bend and in 2016 in the Panhandle will provide much–needed information for assessing the effects of a prolonged period of reduced light to seagrasses. In the fall of 2015, a red tide, a bloom of the harmful alga *Karenia brevis*, occurred in St. Joseph Bay and nearby coastal waters. Effects on seagrass beds are under investigation. South of the Big Bend region, persistent turbidity occurs in Waccasassa Bay due to sediment resuspension, and imagery of seagrass beds has not been collected since 2001. From the Springs Coast through northern Charlotte Harbor, environmental conditions were optimal for seagrass expansion between 2012 and early 2016, resulting in increased seagrass acreage. But in summer 2016, heavy rains from tropical storms Colin and Hermine caused elevated runoff, and more than 250 million gallons of raw and treated sewage were discharged to Tampa Bay, Boca Ciega Bay, and Clearwater Harbor. The effects of these events on seagrass ecosystems are not yet evident. In southwest Florida, from southern Charlotte Harbor through the Ten Thousand Islands, coastal waters received runoff discharged from Lake Okeechobee after heavy winter rains and Tropical Storm Colin in early June 2016. In addition to lowered salinities and elevated turbidities, these discharge waters also contained high levels of algae. Effects of this prolonged event have yet to be determined.

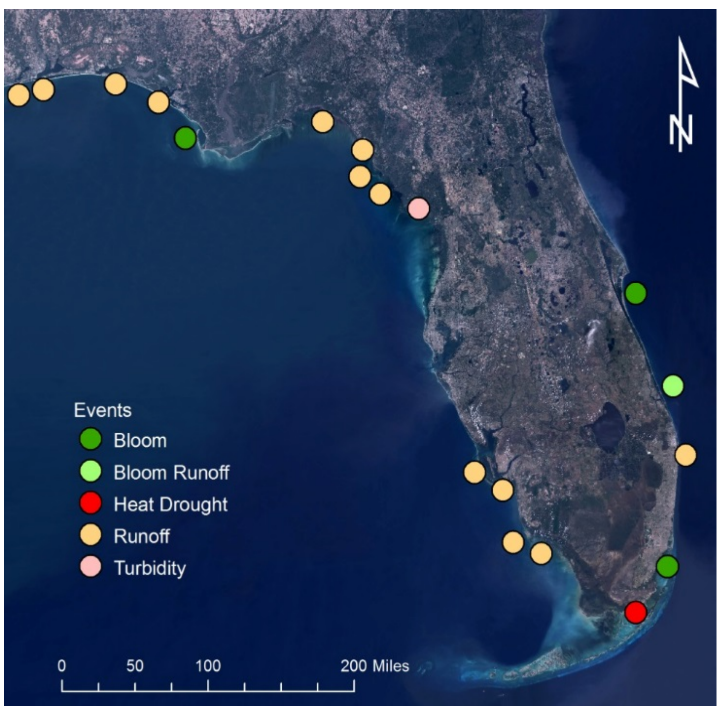

Figure ES-3 *Events that have damaged seagrass beds in Florida waters since 2012. Dots are located adjacent to the body of water that each represents.*

Beginning in July 2015, turtlegrass (*Thalassia testudinum*) began dying in the northern and western regions of Florida Bay. The area was experiencing a prolonged drought, and the summer wet season had not occurred. The combination of elevated temperatures, extreme salinities (as high as 60 psu at some locations) and high concentrations of sulfide in sediments under turtlegrass beds resulted in the die-off of at least 10,000 acres. Normal rainfall and temperatures returned in fall 2015, and some recovery has been observed, with shoalgrass colonizing some of the areas where turtlegrass had died. Dense phytoplankton blooms developed in affected areas in fall 2016 and might cause more seagrass loss. Persistent blooms of phytoplankton and macroalgae have occurred in central and southern parts of Biscayne Bay, reducing seagrass cover. Discharge from Lake Okeechobee in 2016 has also affected Lake Worth Lagoon and the southern Indian River Lagoon, most notably causing thick algal blooms that covered large areas of the water's surface. Algal blooms or brown tide in the northern Indian River Lagoon in 2015 and 2016 continue to affect areas where more than 45,000 acres of seagrass were lost in the massive blooms of 2010 and 2011. The impacts of Hurricane Matthew along Florida's east coast are as yet unknown.

Monitoring data—species composition and occurrence: While seagrass cover by species is assessed using square quadrats throughout Florida, the size of the quadrat, the spatial sampling design, and the assessment method used (Braun-Blanquet categories or percentage cover assessment) vary (see methods section below). In addition, data obtained from the field monitoring of quadrats may be analyzed in several ways, resulting in estimates of the frequency of occurrence (the percentage of quadrats in which a species of seagrass is present), or density (average Braun-Blanquet score or average cover in percent). Data common to all monitoring programs are the species present in a quadrat. Using species composition data provided by SIMM chapter authors, we collated information on the dominant seagrass species present in each estuary or region (Table ES-3). A seagrass species was considered dominant or co-dominant if it was the species observed most frequently in quadrats in an estuary, region or sub-region. In the Panhandle, the dominant seagrass found in quadrats varies across estuaries (Figure ES-4). Shoalgrass (*Halodule wrightii*, HW) was dominant in Perdido Bay and in Franklin County, in Alligator Harbor and St. George Sound, and was co-dominant with widgeongrass (*Ruppia maritima*, RM) near Fort Pickens at the mouth of Pensacola Bay and in Choctawhatchee Bay (Figure ES-4). Brackish submerged aquatic vegetation (e.g., *Vallisneria americana*) was found in the upper reaches of Escambia Bay and East Bay of Pensacola Bay where rivers contribute substantial freshwater. Turtlegrass (TT) dominated in several subregions of the Pensacola region, including central Pensacola Bay, Big Lagoon, near Fort McRae at the mouth of Pensacola Bay, and Santa Rosa Sound. It was also the dominant seagrass in St. Andrew Bay, St. Joseph Bay, and in the Carrabelle subregion in Franklin County. Generally, turtlegrass grows where salinities are moderate to high with low variation. Manateegrass (*Syringodium filiforme*, SF) was dominant at some locations in Franklin County waters.

Table ES-3 Most abundant seagrass species found in Florida. HW=Halodule wrightii*; TT*=Thalassia testudinum*; SF*=Syringodium filiforme*; RM*=Ruppia maritima*; HE*=Halophila engelmannii*; HD*=Halophila decipiens*; HJ*=Halophila johnsonii*.*

	Most abundant species		
Estuary	First	Second	Third
Perdido Bay	HW		
Pensacola Bay			
Main	TT	RM	SF, HW
Fort McRae	TT	RM, HW	
Escambia Bay	brackish		
East Bay	brackish		
Big Lagoon	TT	RM, HW	
Santa Rosa Sound	TT	SF	RM
Fort Pickens	RM, HW	TT	
Choctawhatchee Bay	HW, RM		
St. Andrew Bay	TT	HW	RM, SF
St. Joseph Bay	TT	SF, HW	
Franklin County			
Alligator Harbor	HW	TT	
Dog Island	SF	TT, HW	
St. George Sound	HW		
Carrabelle	TT	HW, SF	
Lanark Reef	SF	TT, HW	HE
Turkey Point	SF	TT	HW
Northern Big Bend			
Steinhatchee North	TT	SF	HW
Keaton Beach	SF	TT	HW, HE
Fenholloway	SF	TT	HW
Econfina	TT, SF	HW	HE
Aucilla	TT	SF	HW, HE
St. Marks	TT, SF	HW	HE, RM
Southern Big Bend			
Suwannee	HW	SF	
Horseshoe East	TT	SF	HW, HE
Horseshoe West	TT	SF	HW, RM
Steinhatchee South	TT	SF	HW
Suwannee Sound	Unknown		
Cedar Keys	TT	SF, HW	
Waccasassa Bay	Unknown		

Table ES-3 continued

Estuary	Most abundant species First	Second	Third
Springs Coast	TT	SF	HW
St. Martins Keys	TT	SF, HW	HE
West Pinellas County			
Clearwater Harbor	HW	TT	SF
Boca Ciega Bay	HW	TT	SF
Tampa Bay			
Hillsborough Bay	HW		
Old Tampa Bay	HW	SF	TT
Mid-bay	HW	SF	TT
Lower Bay	TT	HW	SF
Sarasota and Lemon Bays			
Sarasota Bay/Roberts Bay	TT	HW, SF	
Little Sarasota Bay/ Blackburn Bay	HW	SF	
Lemon Bay	HW,TT	SF	
Charlotte Harbor Region	HW	TT	SF, RM
Estero Bay	HW	TT	HE, SF
Rookery Bay			
Cape Romano	TT, HW, HE	SF, HD	
Johnson Bay	TT, HW, HE	SF, HD	
Cocohatchee River	HW		
Naples Bay	HW, HD, HE		
Ten Thousand Islands	TT, HW, HE	SF	
Florida Keys National Marine Sanctuary			
Atlantic Upper Keys	TT	SF	
Atlantic Lower Keys	TT	SF	
Gulf Middle Keys	SF	TT	
Gulf Lower Keys	TT	SF	HW
Tortugas/Marquesas	TT	SF	HW, HD
Florida Bay			
Northeast	TT	HW	
East Central	TT	HW	SF
North Central	TT	HW	SF
South	TT	SF	
West	TT	SF, HW	

Table ES-3 continued

Estuary	Most abundant species First	Second	Third
Biscayne Bay			
Card Sound	TT	HW	
South Biscayne Bay	TT	HW	
North Biscayne Bay	SF	TT, HW	
Lake Worth Lagoon			
North	SF	HW, HD, HJ	TT
Central	HJ		
South	HJ, HD, HW		
Southern Indian River Lagoon			
IR22	HW, SF		
IR23	HW, SF		
IR24	SF	HD, HW	
IR25	SF	HW	TT, HJ
Northern Indian River Lagoon			
Mosquito Lagoon	HW	RM, SF	
Banana River	HW	RM	
Melbourne	HW		
Sebastian Inlet	HW	SF	
Vero Beach	HW		

Along the Big Bend and Springs Coast, turtlegrass and manateegrass generally were the dominant seagrasses (Figure ES-5). Diversity of seagrasses was higher in these regions, and in some quadrats five species of seagrasses and several genera of macroalgae were represented. While not dominant, stargrass (*Halophila engelmannii*, HE) and shoalgrass were widespread, usually at low densities. Shoalgrass was dominant only (and was the only seagrass species found) in the Suwannee sub-region of southern Big Bend, an area strongly influenced by freshwater runoff from the Suwannee River. Further south, turtlegrass was dominant in the Cedar Keys region and along the Springs Coast. No monitoring programs exist for Suwannee Sound and Waccasassa Bay; surface water in these regions is frequently very turbid, so mapping data are lacking as well.

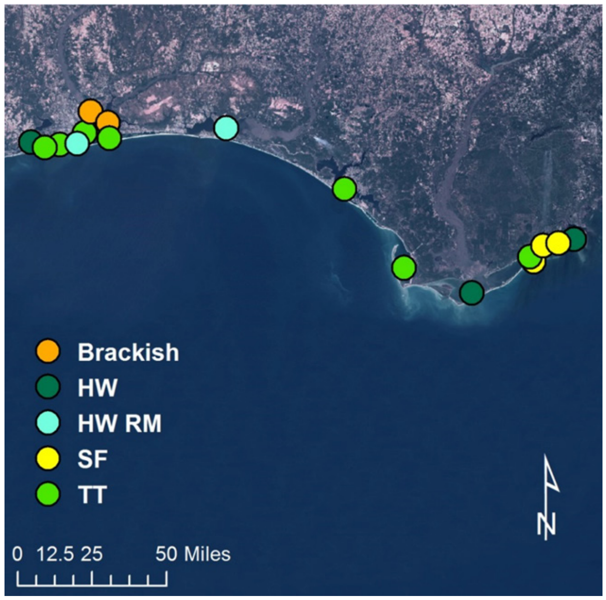

Figure ES-4 Dominant seagrass species observed in field monitoring studies in the Florida Panhandle. HW = Halodule wrightii*; RM =* Ruppia maritima*; SF =* Syringodium filiforme*; TT =* Thalassia testudinum.

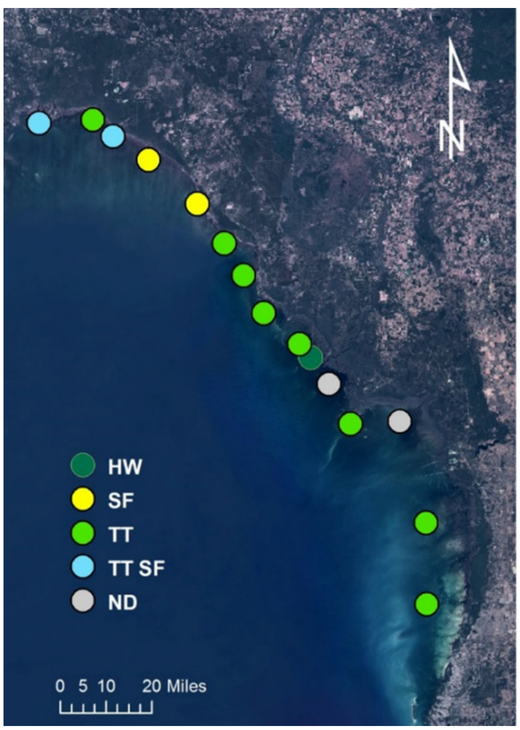

Figure ES-5 Dominant seagrass species observed in field monitoring studies in the Big Bend and Springs Coast. HW = Halodule wrightii*; SF =* Syringodium filiforme*; TT =* Thalassia testudinum*; ND = no data. Note that dots might be next to rather in the water body each represents.*

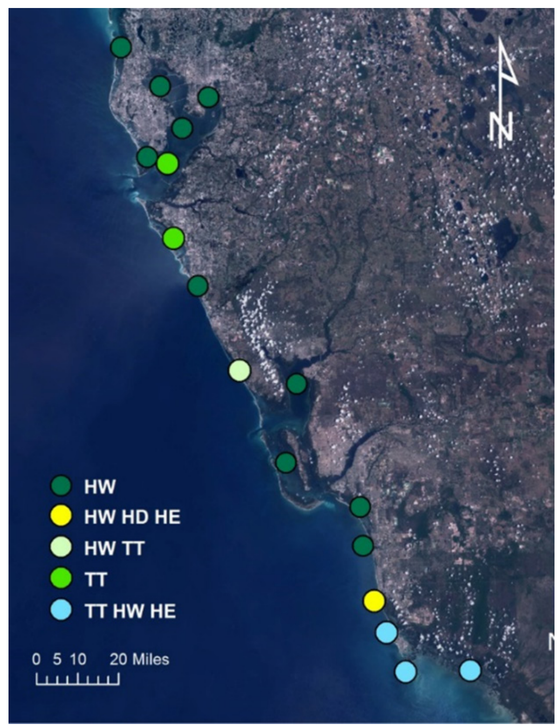

Figure ES-6 Dominant seagrass species observed in field monitoring studies in southwest Florida coastal waters. HW = Halodule wrightii*; HD =* Halophila decipiens*; HE =* Halophila engelmannii*; TT =* Thalassia testudinum*. Note that dots might be next to rather than in the water body each represents.*

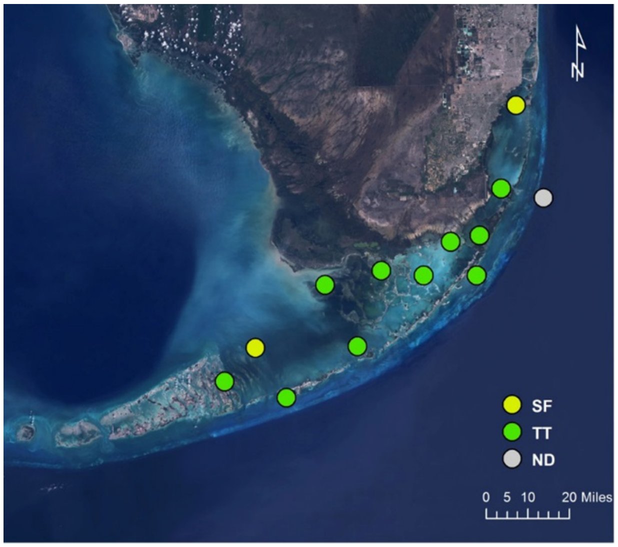

Figure ES-7 Dominant seagrass species observed in field monitoring studies in south Florida coastal waters. SF = Syringodium filiforme*; TT =* Thalassia testudinum*; ND = no data.*

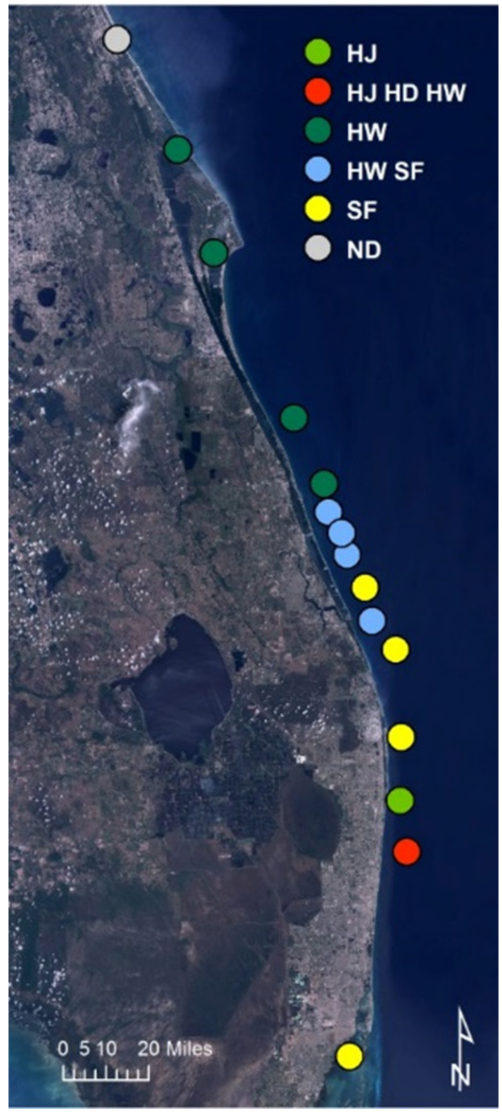

*Figure ES-8 Dominant seagrass species observed in field monitoring studies along the east coast of Florida. HJ=*Halophila johnsonii*; HD=*Halophila decipiens*; HW=*Halodule wrightii*; SF=*Syringodium filiforme*; ND=no data. Note that dots are next to the water body each represents.*

Shoalgrass dominated most locations along the southwest coast of Florida, from Clearwater Harbor south through Cocohatchee Bay in the Rookery Bay National Estuarine Research Reserve (Figure ES-6). In the Tampa Bay region, shoalgrass was the dominant seagrass except in lower Tampa Bay where turtlegrass occurred most frequently. Turtlegrass dominated Sarasota Bay and was co-dominant with shoalgrass in Lemon Bay, located just north of Charlotte Harbor. In Rookery Bay and the Ten Thousand Islands, no species dominated: turtlegrass, shoalgrass, and stargrass occurred together at similar densities. In Naples Bay, paddlegrass (*Halophila decipiens*, HD) occurred with shoalgrass and stargrass.

In south Florida, turtlegrass was the dominant seagrass present everywhere except in northern Biscayne Bay and on the Gulf side of the middle Keys, where manateegrass dominated (Figure ES-7). In the summer of 2015, however, large areas of turtlegrass in northern and western Florida Bay experienced die-off. After a similar die-off episode in the late 1980's, shoalgrass recolonized bare areas that had been covered by turtlegrass; some re-vegetation by shoalgrass in areas denuded in 2015 has already been observed. After the 1980's die-off, shoalgrass was gradually replaced by turtlegrass, so that by early 2015, turtlegrass occurred in dense beds in previous die-off locations.

Along Florida's east coast, the dominant seagrass varied by location, and turtlegrass did not dominate anywhere (Figure ES-8). Johnson's seagrass (*Halophila johnsonii*, HJ) dominated central Lake Worth Lagoon and shared dominance with paddlegrass and shoalgrass in southern Lake Worth Lagoon. In the Southern Indian River Lagoon (SIRL), manateegrass dominated in the southern portion near Jupiter Inlet, and in the central and northern SIRL shoalgrass and manateegrass were co–dominant. Shoalgrass was the dominant seagrass throughout the Northern Indian River Lagoon.

Mapping and monitoring methods

Mapping methods: Seagrass mapping has traditionally depended on the acquisition of high-resolution imagery collected by fixed-winged aircraft. This method requires clear skies, clear waters overlying seagrass beds, and a low sun angle and minimal winds to reduce glare and sunglint. To compare data collected at different times, imagery must be collected during the same season for each acquisition. Fixed-wing aircraft now obtain geo-rectified color (3 or 4–band) digital images of coastal waters; before the 1990s, images were black and white and collected by traditional photography. New methods of imagery collection are available: 1) the cost of satellite imagery has recently decreased substantially, while spatial resolution has greatly improved; 2) some researchers obtain hyperspectral imagery, either by aircraft or satellite, to aid in interpretation of seagrass beds; and 3) the use of drone aircraft for small-area, high-resolution image acquisition is under development and holds promise for evaluation of local areas undergoing rapid change. Where waters are too cloudy to obtain images of the bottom from airplanes or satellites, researchers have used sidescan sonar. Across Florida, maps and estimates of seagrass acreage have resulted from a variety of data acquisition methods (Figure ES-9). Most imagery has been acquired using aircraft. Satellites were used to acquire hyperspectral imagery of St. Joseph Bay and four-band (red, green, blue, infrared) imagery has been acquired for the Big Bend and deeper waters and a portion of Springs Coast. Sidescan sonar was used to map seagrasses in Rookery Bay NERR and the Ten Thousand Islands where turbidity in the water column prohibited the use of aerial imagery. Poor water clarity also prohibited the collection of aerial imagery in Lake Worth Lagoon in recent years. To obtain an estimate of the change in seagrass acreage there, researchers assessed

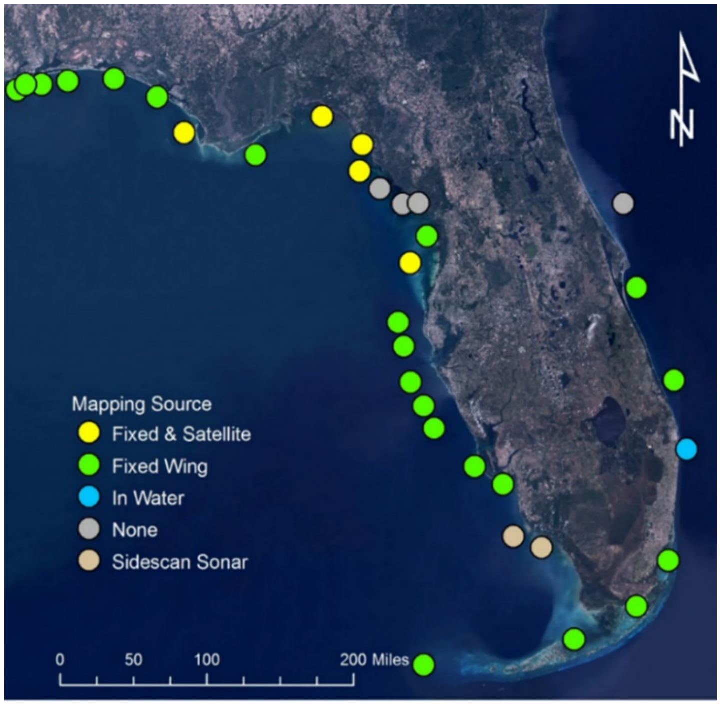

Figure ES-9 *Methods of image acquisition for mapping seagrasses in Florida coastal waters. Note that dots might be next to rather than in the water body each represents.*

a large number of quadrats in beds that were mapped from 2007 imagery and then calculated the change in quadrat cover and applied this to mapping data from 2007.

The frequency of imagery acquisition, the age of the most recent imagery set, and the status of mapping the most recent imagery vary widely across Florida coastal waters (Table ES-4). In 2015, imagery of Panhandle coastal waters was acquired by collaboration with the National Agricultural Imagery Program (NAIP) of the U.S. Department of Agriculture, and a State Wildlife Grant funded imagery collection in Big Bend. These imagery sets are being interpreted, and mapping data will be available early in 2017. New mapping data are much needed because the most recent maps for Panhandle seagrass beds are from 6 to 9 years old, and, in the Big Bend, it has been 10 years since the last mapping effort.

The Big Bend has likely lost seagrass acreage because of poor water clarity between 2012 and 2015. Mapping data are 15 years old for coastal waters near the Cedar Keys and in Waccasassa Bay, and there are no plans to acquire imagery in the near future. In particular, waters remain turbid in Waccasassa Bay, precluding aerial imagery acquisition. Seagrass beds in the Springs Coast region are considered to be stable, and as a result mapping data for the entire region has not been updated since 2007. Satellite imagery was collected in 2011 for a small area of Springs Coast, and these data were interpreted by Baumstark *et al.* (2013). Imagery is collected and interpreted every two years for Tampa Bay south through Charlotte Harbor North which are in the jurisdiction of the Southwest Florida Water Management District (SWFWMD). The South Florida Water Management

Table ES-4 Seagrass imagery acquisition dates and mapping status for Florida coastal waters.

	Imagery acquisition		
Estuary	Most recent	Agency	Most recent maps
Perdido Bay	2015	USDA NAIP	2009
Big Lagoon	2015	USDA NAIP	2010
Pensacola Bay System	2015	USDA NAIP	2010
Santa Rosa Sound	2015	USDA NAIP	2010
Choctawhatchee Bay	2015	USDA NAIP	2007
St. Andrew Bay	2015	USDA NAIP	2010
St. Joseph Bay	2015	USDA NAIP	2010
Franklin County	2015	USDA NAIP	2010
Big Bend Region	2015	FWC/FWRI SIMM	2006
Cedar Keys and Waccasassa	2001	SRWMD	2001
Springs Coast	2007, 2011	SWFWMD	2007, 2011
Tampa Bay	2016	SWFWMD	2014
Sarasota Bay	2016	SWFWMD	2014
Lemon Bay	2016	SWFWMD	2014
Charlotte Harbor North	2016	SWFWMD	2014
Charlotte Harbor South	2014	SFWMD	2008
Pine Island Sound	2014	SFWMD	2008
Matlacha Pass	2014	SFWMD	2008
Caloosahatchee Estuary	2014	SFWMD	2008
Estero Bay	2014	SFWMD	2008
Rookery Bay	2013	SFWMD; Rookery Bay NERR	2013
Ten Thousand Islands	2009	SFWMD; Rookery Bay NERR	partial, 2005
Florida Bay	2010–2011	Everglades NP	2010–2011
Gulf Upper Keys	2006–2011	NOAA NCCOS*	2006–2011
Gulf Lower Keys, Marquesas	2006–2011	NOAA NCCOS*	2006–2011
Tortugas	2010	NOAA NCCOS*	2010
Atlantic Lower Keys	2006–2011	NOAA NCCOS*	2006–2011
Atlantic Upper Keys	2006–2011	NOAA NCCOS*	2006–2011
Biscayne Bay	2005	FWC/FWRI SIMM	2005
Lake Worth Lagoon	2007	SFWMD	2013**
Southern Indian River Lagoon	2013	SFWMD	2013
Northern Indian River Lagoon	2015	SJRWMD	2013

*NCCOS = National Centers for Coastal Ocean Science

**field assessment of seagrass beds to estimate change from 2007

District (SFWMD) has an extensive seagrass mapping program than includes the region of Charlotte Harbor South through Rookery Bay on the southwest coast, and, on the east coast, Lake Worth Lagoon and the southern Indian River Lagoon. Imagery collected in 2014 for the southwest Florida estuaries has been mapped and will be released publicly in early 2017. Waters were too turbid in 2013 to collect imagery in Lake Worth Lagoon, and an alternative mapping effort was carried out using detailed field assessment of seagrass beds to estimate change in acreage compared with that in 2007. The extensive seagrass beds in south Florida, including those located in the Florida Keys National Marine Sanctuary, Florida Bay, the Tortugas and Marquesas, Biscayne Bay, and waters on the Atlantic Ocean side of the Keys have generally been considered stable in acreage, and the most recent maps were obtained from imagery acquired in 2005 for Biscayne Bay and in 2010-2011 for the remaining area. Mapping efforts are under way to assess how much seagrass was lost in Florida Bay in the summer of 2015. Seagrass beds in the northern Indian River Lagoon are mapped every two years by the St. Johns River Water Management District (SJRWMD), and mapping data from imagery collected in 2015 will be released soon.

Collaboration among agencies collecting aerial imagery in Florida results in significant cost savings. The Florida Department of Regulation and the Department of Transportation collect aerial imagery of land in all Florida counties on a regular basis. The NAIP also acquires imagery across Florida. Indeed, it is imagery acquired by NAIP in 2015 over south Florida that will provide pre-die-off mapping data for the locations in Florida Bay that experienced die-off in summer 2015. With a small increase in costs, imagery of coastal waters can be collected during these routine flights, often simply by leaving cameras on over water and extending flight lines already in place so that coastal waters are photographed. We have found that pilots will make every effort to collect imagery over water under optimal conditions for imagery interpretation as well.

Traditionally, image interpretation methods used manual delineation and identification of seagrass beds; now interpretation relies more on supervised software interpretation, followed by completion of unmapped areas and verification using ground–truth data by a photo-interpreter. Most photointerpretation uses a variation of the categories established by the Florida Land Use Cover and Forms Classification System (FLUCCS) of the Florida Department of Transportation (1999) which specifies whether a seagrass bed is dense or sparsely covered and whether beds are patchy or continuous. It is impossible to classify seagrass beds visible in imagery by species or, in most cases, to differentiate seagrass from attached macroalgae. An alternative system, used frequently for imagery collected in the Panhandle, is the imagery classification system of the National Wetlands Center of the U.S. Geological Survey. The Coastal and Marine Ecological Classification Standard (CMECS) has been developed by the National Oceanic and Atmospheric Administration (NOAA) and is the standard for projects funded by Deepwater Horizon penalty money. With the use of supervised software, ground-truthing data are essential to confirm identification of seagrass beds. Some researchers hope to develop algorithms that will use hyperspectral imagery to identify the taxa of seagrass or macroalgae present in seagrass beds.

Monitoring methods: Field monitoring programs exist for most seagrass beds in Florida coastal waters. We collated information provided by collaborators for each region or estuary, and details are shown in Table ES-5. Seagrasses are not monitored in Apalachicola Bay, Ochlockonee Bay, Waccasassa Bay, or Volusia County primarily because few beds exist in these turbid estuaries. Generally, locations in aquatic preserves, estuary programs, the Florida Keys National Marine Sanctuary, or National Estuarine Research Reserves have ongoing field monitoring programs that are supported by programmatic funding. Locations managed by SWFWMD, SFWMD, and SJRWMD also have routine monitoring programs. In the Panhandle and Big Bend, monitoring programs of the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) are grant-funded, and monies are not guaranteed after 2017. All field monitoring programs use a variant of the Braun-Blanquet method (Poore, 1955) with square quadrats for assessing seagrass abundance and species composition, but quadrat size varies from 0.25 to 1 m², and Braun-Blanquet assessment is done by using the original method with five categories of cover or by using a variation of the method which estimates percentage cover. Spatial sampling design in monitoring programs across Florida varies widely, but most use sampling points or sampling locations along transects (Figure ES-10). When field monitoring programs were first implemented, many agencies established transects across seagrass beds and evaluated quadrats at regular intervals along each transect. This type of sampling design is especially useful in areas for which the deep edge of seagrass beds is used as a management metric or in water bodies that are narrow, such as the Indian River Lagoon. For regions or estuaries that cover a large area, such as Florida Bay or the Big Bend region, a spatially-distributed randomly-located sampling point design, modeled after that of the EPA's Estuarine Assessment and Monitoring Program (EMAP), provides the spatial coverage to assess seagrass status and also allows the use of parametric statistics in data analysis. Many agencies have recently begun to use a spatially distributed point design while continuing to monitor locations along established transects to maintain continuity.

At a sampling location, all monitoring programs assess cover by species. Many programs also identify what macroalgae, if any, are present. Other measurements that are less frequently taken include shoot counts inside quadrats, evaluation of epiphyte load on seagrass blades, and notation of sediment type. Only a few programs measure seagrass biomass per m², because the analysis is so labor intensive. All programs collect some data on water quality, which might include water temperature, salinity, dissolved oxygen concentration, pH, water depth, Secchi depth, and ambient light attenuation with depth. Some programs also collect water samples for measurement of nutrient levels, chlorophyll-a concentrations, turbidity, total suspended solids, and color or CDOM.

Table ES-5 Field monitoring programs in Florida coastal waters.

Estuary or subregion	Lead agency	Frequency	Status	Random or fixed?	Transect or point?	Braun-Blanquet or % cover	Shoot counts	Biomass	Water quality & clarity
Perdido Bay	Dauphin Island Sea Lab	3 times, 2014	Inactive	Fixed	Point	Yes	No	Yes	
Perdido Bay	Dauphin Island Sea Lab	Monthly, June 2012–October 2014	Inactive	Fixed	Point	Yes	No		
Perdido Bay	FWRI/ Dauphin Island Sea Lab	Summer 2016	2016 only	Fixed	Point	Yes	No	No	Yes
Big Lagoon	FWRI/ Dauphin Island Sea Lab	Summer 2016	2016 only	Fixed	Point	Yes	No	No	Yes
Big Lagoon	Dauphin Island Sea Lab	Annual, 2012–2016	Active	Fixed	Point	Yes	No	Some	Some
Big Lagoon	FWRI	Annual, 2011, 2014	Inactive	Fixed	Point	Yes	No	No	Yes
Pensacola Bay	FWRI/ University of West Florida	Summer 2016	2016 only	Fixed	Point	Yes	No	No	Yes
Pensacola Bay	FWRI	Annual, 2011, 2014	Inactive	Fixed	Point	Yes	No	No	Yes
Santa Rosa Sound	FWRI/ University of West Florida	Summer 2016	2016 only	Fixed	Point	Yes	No	No	Yes
Santa Rosa Sound	FWRI	Annual, 2011, 2014	Inactive	Fixed	Point	Yes	No	No	Yes
Santa Rosa Sound	Dauphin Island Sea Lab	Annual, 2012–2016	Active	Fixed	Point	Yes	No	Some	Some
Choctawhatchee Bay	FWRI/ Choctawhatchee Basin Alliance	Summer 2016	2016 only	Fixed	Point	Yes	No	No	Yes
Choctawhatchee Bay	FWRI	Annual, 2011, 2014	Inactive	Fixed	Point	Yes	No	No	Yes

Table ES-5 continued.

Estuary or subregion	Lead agency	Frequency	Status	Random or fixed?	Transect or point?	Braun-Blanquet or % cover	Shoot counts	Biomass	Water quality & clarity
St. Andrew Bay	Gulf Coast State College	Annual	Active				Yes	No	No
St. Andrew Bay	FWRI	Annual, 2011, 2014	Inactive	Fixed	Point	Yes	No	No	Yes
St. Andrew Bay	FWRI/St. Andrew Bay Marine Resources Association	Summer 2016	2016 only	Fixed	Point	Yes	No	No	Yes
St. Joseph Bay	Central Panhandle Aquatic Preserves	Annual, start 2016	Start 2016	Fixed	Transects and points	Yes	Yes	No	Yes
St. Joseph Bay	FWRI	Annual, 2011, 2014	Inactive	Fixed	Point	Yes	No	No	Yes
Apalachicola Bay	no program								
St. George Sound	FWC Habitat and Species Conservation	Annual, 2008–2014	Inactive	Fixed	Point	Yes	No	No	Yes
St. George Sound	FWRI/FSU Coastal and Marine Laboratory	Summer 2016	2016 only	Fixed	Point	Yes	No	No	Yes
Franklin County	FWC Habitat and Species Conservation	Annual, 2008–2014	Inactive	Fixed	Point	Yes	No	No	Yes
Franklin County	FWRI/FSU Coastal and Marine Laboratory	Summer 2016	2016 only	Fixed	Point	Yes	No	No	Yes
Ochlockonee Bay	no program								
St. Marks River estuary	Big Bend Seagrasses Aquatic Preserves	Annual, 2006–present	Active	Fixed	Point	Yes	No	No	Yes
St. Marks River estuary	FWRI	Annual, 2004–present	Active	Fixed	Point	Yes	No	No	Yes

Table ES-5 continued.

Estuary or subregion	Lead agency	Frequency	Status	Random or fixed?	Transect or point?	Braun-Blanquet or % cover	Shoot counts	Biomass	Water quality & clarity
Northern Big Bend	FWRI	Annual, 2004–present	Active	Fixed	Point	Yes	No	No	Yes
Northern Big Bend	Big Bend Seagrasses Aquatic Preserves	Annual, 2000–present	Active	Fixed	Point	Yes	No	No	Yes
Southern Big Bend	FWRI	Annual, 2004–present	Active	Fixed	Point	Yes	No	No	Yes
Cedar Keys	Big Bend Seagrasses Aquatic Preserves	Annual, 2006–present	Active	Fixed	Point	Yes	No	No	Yes
Waccasassa Bay	no program								
St. Martins Marsh	Big Bend Seagrasses Aquatic Preserves	Annual, 1997–present	Active	Fixed	Point	Yes	No	No	Yes
Springs Coast	FWRI	Annual, 2012–2014	Inactive	Random	Point	Yes	No	No	Yes
Western Pinellas	Pinellas County	Annual	Active	Fixed	Transect	Yes	Yes	No	Yes
Tampa Bay	Tampa Bay Estuary Program collaborators	Annual	Active	Fixed	Transect	Yes	Yes	No	Yes
Sarasota Bay	Florida Department of Environmental Protection	Annual, fall, since 1999	Active	Fixed	Transect	Yes	No	No	Yes
Sarasota Bay	Sarasota County	Twice a year	Active	Both	Point	Yes	No	No	No
Lemon Bay	Charlotte Harbor Aquatic Preserves	Annual, fall	Active	Fixed	Transect	Yes	Yes	No	Yes
Charlotte Harbor North	Charlotte Harbor Aquatic Preserves	Annual, fall	Active	Fixed	Transect	Yes	Yes	No	Yes
Charlotte Harbor South	Charlotte Harbor Aquatic Preserves		Active	Fixed	Transect	Yes		No	

Table ES-5 continued.

Estuary or subregion	Lead agency	Frequency	Status	Random or fixed?	Transect or point?	Braun-Blanquet or % cover	Shoot counts	Biomass	Water quality & clarity
Estero Bay	Estero Bay Aquatic Preserve	Twice a year	Active	Fixed	Transect	Yes	Yes	No	Yes
Rookery Bay	Rookery Bay National Estuarine Research Reserve	variable	Active	Fixed	Transect	Yes		No	Yes
Naples Bay	City of Naples	Twice a year, since 2006	Active	Fixed	Transect	Yes	Yes	No	Yes
Ten Thousand Islands	Rookery Bay National Estuarine Research Reserve	1998–2005	Inactive	Fixed	Transect	Yes		No	
Florida Keys National Marine Sanctuary	Florida International University	Quarterly or annual, since 1996	Active	Both	Point	Yes		Yes	Yes
Florida Bay	FWRI	Annual, since 1995	Active	Both	Point	Yes	No	No	Yes
Biscayne Bay	Miami–Dade County	Annual	Active	Fixed	Transect	Yes	Yes	No	Yes
Biscayne Bay	University of Miami	Twice a year, 2009–present	Active	Both	Point	Yes	No	No	Yes
Biscayne Bay	FWRI	Twice a year, 2005–2009	Inactive	Fixed	Point	Yes	No	No	Yes

Table ES-5 continued.

Estuary or subregion	Lead agency	Frequency	Status	Random or fixed?	Transect or point?	Braun-Blanquet or % cover	Shoot counts	Biomass	Water quality & clarity
Lake Worth Lagoon	Palm Beach County	Annual, 2000–present	Inactive	Fixed	Transect	Yes		No	Yes
Lake Worth Lagoon	FWRI	Annual, 2006–2012	Inactive	Fixed	Point	Yes		No	Yes
Lake Worth Lagoon	South Florida Water Management District	Variable	Active	Fixed	Point	Yes	No	No	Yes
Southern Indian River Lagoon	South Florida Water Management District	Twice a year, since 1994	Active	Fixed	Transect	Yes	No	No	Yes
Northern Indian River Lagoon	St. Johns River Water Management District	Twice a year, since 1994	Active	Fixed	Transect	Yes	Yes	No	Yes
Volusia County	no program								

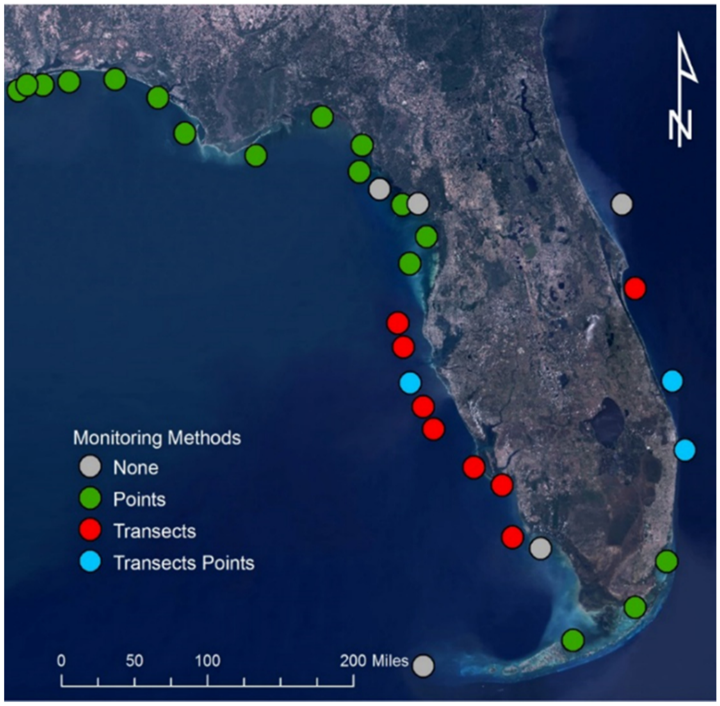

Figure ES-10 Spatial sampling design for field monitoring studies in Florida coastal waters. Note that dots might be next to rather than in the water body each represents.

Updates to the SIMM report

For the second edition, we have updated for each region and the state as a whole:

- The list of collaborators and chapter authors;
- Mapping and monitoring data;
- Assessments of the status and trends of seagrasses;
- The inventory of active mapping and monitoring programs;
- The spatial and temporal gaps in mapping and monitoring programs;
- The metrics of seagrass distribution, abundance, and health collated from monitoring data;
- Methods of field monitoring, imagery acquisition, and mapping;
- Links to technical, peer-reviewed, and public publications and websites.

In addition, we added information on:

- Water quality and clarity data and summaries;
- Management plans for each region.

Future tasks, needs, and challenges

The SIMM program is funded through 2017 by a grant from the National Fish and Wildlife Foundation. With this money, we have continued field monitoring studies in the Big Bend and the Panhandle, and we have acquired imagery in the Panhandle. Mapping data from recent imagery of Big Bend and the Panhandle will be available in spring 2017. These data and water clarity data gathered from these regions will contribute information to the Virtual Buoy System (see Hu *et al.*, 2014) developed by the Optical Oceanography Laboratory of the University of South Florida and to the Seagrass Recovery Potential model under development by FWRI staff. Both of these data products, along with the SIMM report and chapters, provide managers, stakeholders, collaborators, and researchers with information needed to evaluate the condition of Florida's seagrasses and guide decision making regarding seagrass restoration. As we continually update information on the web, we plan to expand the information and resource links provided in each regional chapter. Topics that we wish to expand or add include optical and nutrient water quality data or links to databases, description of management plans, data and information on fisheries and resource use of seagrass beds, and information on the fauna found in local seagrass ecosystems. We also want to be able to quickly provide information about the status of seagrasses when events such as tropical cyclones, algal blooms, and storm runoff damage them.

We have great collaboration with our authors and contributors throughout Florida, and we are always exploring ways to leverage funds and mapping and monitoring efforts to gather data on Florida's seagrasses. We hope that the SIMM program continues to serve timely information on the web. Our greatest need is continuity. As often happens, the SIMM program faces the challenge of long-term support.

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