Relevance to Water Management

While nutrients loads to the Everglades have been reduced, the P-enriched downstream ecosystem is resilient and resists change. In previous *South Florida Environmental Reports* (SFERs), the results from the CHIP study demonstrated that, by managing the vegetation, we were able to create alternate regimes, which altered biogeochemical cycling and provided foraging areas for wading birds in areas previously inaccessible. However, the herbicides used were broad spectrum, thus desirable vegetation, in addition to cattail, were damaged or killed when areas were resprayed. By switching to a more selective herbicide, we were able to improve upon the original design. Vegetation imagery indicates the relatively rapid succession to a more diverse and desirable community, which in turn may change how TP accumulates in the soils. These open water habitats are proving to provide a sustainable foraging habitat for wading birds, an extremely important refuge when conditions are deeper elsewhere, or when a reversal occurs.

THE FLORIDA BAY PROJECT: WATER QUALITY CONDITIONS AND STATUS

Stephen P. Kelly

Water quality in Florida Bay (eastern, central, and western regions) has been monitored since 1991 (WY1992) to ensure that District operations and projects protect and restore the coastal ecosystem to the extent possible. CERP performance measures focus on Chla concentration, an indicator of algal biomass, as well as the nutrient inputs that initiate and sustain blooms. Operational changes to the South Dade Conveyance System, including implementation of the C-111 South Dade Project, Modified Water Deliveries to ENP (especially Tamiami Trail modifications), and the C-111 Spreader Canal Western Project, which became operational during WY2013, will further change freshwater flow patterns and may alter downstream water quality. Presented here is a brief update of ecologically important parameters and how they have changed in WY2016. For a complete description of water quality assessments in Florida Bay, refer to Chapter 6 of the 2015 SFER – Volume I (Sklar and Dreschel 2015).

Water samples and physical parameters (temperature, salinity, conductivity, pH, and dissolved oxygen) are collected every other month at all sites. Samples are collected at 0.5 m below the surface and processed according to the SFWMD *Field Sampling Quality Manual* (SFWMD 2015b) following Florida Department of Environmental Protection (FDEP) protocols. Physical parameters are collected with a calibrated multi-parameter water quality sonde following SFWMD protocols. Samples are processed on site, stored on ice, and shipped overnight to the SFWMD Analytical Lab in West Palm Beach for analysis according to the SFWMD *Chemistry Laboratory Quality Manual* (SFWMD 2015a) and following FDEP protocols. All sample results are quality assured before being uploaded to DBHYDRO.

There are many factors that influence the nutrient and Chla concentrations and variation in the bay including inflows, storm and wind events, circulation patterns, nutrient recycling, and even construction events. It is not possible to attribute any one of these factors as the most important driver of current conditions, but rather it is likely a synergistic effect of some or all of them (Chapter 12 [Abbot et al. 2007] and Appendix 12-3 [Rudnick et al. 2007] of the 2007 SFER – Volume I). Additionally, starting in July 2015, a large die-off of SAV, primarily turtle grass (*Thallasia testudinum*), occurred in the central region of the bay encompassing approximately 40,000 acres. The consensus among multiple local agencies and institutions including the SFWMD, Everglades National Park, Florida Fish and Wildlife Conservation Commission, National Oceanographic and Atmospheric Administration, Florida International University, and Florida Atlantic University is that the die-off is hypothesized to have been caused by a localized drought in South Florida that began in 2014 and continued in 2015. This resulted in reduced fresh water flows to the bay and, along with extreme temperatures, salinities, and dissolved oxygen levels, likely triggered the die-off. The large quantity of dead seagrass leaves as well as the decaying root systems will likely release nutrients into the water column when temperatures begin to rise in August 2016 (WY2017) and could trigger an algal bloom.

Annual averages of all parameters analyzed—Chla, TP, TN, TOC, dissolved inorganic nitrogen (DIN), and turbidity—continue to be stable during the last seven water years, indicated by little to no interannual concentration changes, and were statistically similar between WY2015 and WY2016 with a few exceptions (**Table 6-6**). The higher nutrients and Chla in the central region may be attributable to the increased precipitation leading to increased freshwater inflows from November 2015 through January 2016 (**Figure 6-11**), the release of nutrients from decaying SAV, or a combination of both. The increase in nitrogen (N) is due exclusively to ammonium (NH_4) at all four sites representing this area in January, February, and April 2016.

Results in WY2016 were compared to the POR and the 25th and 75th percent quartiles. The POR for all analytes with the exception of TN is WY1992 to WY2013. The POR for TN was reduced to WY2009 to WY2013 due to a possible error in the longer-term data set. All analysis were performed at the Districts' in-house analytical lab starting in January 2009. At that time, there was an approximately 30 percent increase in the TN that was not immediately noticed as the concentrations were within the long-term range of TN. No other analytes were affected and, until an intercalibration of the analytical TN methods can be completed to document if this is an analytical error, the POR was reduced. No conclusions or interpretations were affected by this change.

In the figures that follow, the monthly spatial averages of each parameter in the three regions of the bay are compared to the temporal median of the monthly spatial means and the interquartile range for the entire POR (WY1992–WY2013) with the exception of TN as mentioned above. The median and interquartile range was used as a comparison to the last three water year's to reduce the occurrence of outliers that may skew the results. In addition, the legal standards for each basin as set forth in Section 65-302.532, F.A.C., is also included.

The WY2016 results were mixed. In the east, TP was lower than the 25 percent quartile while TN was greater than the 75 percent quartile. Other results in the east were also mixed with Chla, DIN, and turbidity less than the 25 percent quartile and discrete salinity collected at the time of sample collection was above the 75 percent quartile during the first half of the water year. DIN rose to more than the 75 percent quartile and TOC and salinity fell to less than the 25 percent quartile during the second half of the water year (**Figures 6-23** through **6-25**, and **Table 6-7**).

In the central region, TN was greater than the 75 percent quartile and turbidity was less than the 25 percent quartile the entire water year. Discrete salinity and TOC were above the 75 percent quartile and Chla and TP were less than the 25 percent quartile during the first half of the water year. During the second half of the water year, salinity fell to less than the 25 percent quartile while DIN rose to well above the 75 percent quartile. The end of the water year showed elevated Chla, TP, and TOC as well (**Figures 6-23** through **6-25**, and **Table 6-7**). The elevated TOC may be significant as changes in TOC are seasonal, may be due to runoff and storm events, and could be associated with SAV decay releasing nutrients and promoting algae blooms (see 2008 SFER – Volume I, Chapter 12; Rudnick et al. 2008).

Table 6-6. Annual averages and standard deviations of WY2015 and WY2016 as well as Section 65-302.532, F.A.C., basin standards. Numbers that are statistically different ($p < 0.05$) are in bold.

Parameter [a]	F.A.C. [b,c]	WY2015	WY2016
Eastern Region			
Total Nitrogen (mg/L)	0.65	0.72 ± 0.09	**0.87 ± 0.14**
Dissolved Inorganic Nitrogen (mg/L)		0.07 ± 0.04	**0.15 ± 0.12**
Total Phosphorus (ug/L)	7	2.48 ± 1.24	3.10 ± 0.93
Chlorophyll *a* (µg/L)	0.4	0.27 ± 0.16	0.34 ± 0.13
Total Organic Carbon (mg/L)		7.25 ± 1.54	7.30 ± 1.98
Turbidity (NTU)		2.53 ± 1.2	**5.11 ± 5.98**
Central Region			
Total Nitrogen (mg/L)	0.99	1.13 ± 0.29	**1.49 ± 0.48**
Dissolved Inorganic Nitrogen (mg/L)		0.04 ± 0.01	**0.24 ± 0.30**
Total Phosphorus (ug/L)	19	6.81 ± 2.17	**12.70 ± 5.57**
Chlorophyll *a* (µg/L)	2.2	0.53 ± 0.38	**1.88 ± 1.31**
Total Organic Carbon (mg/L)		12.14 ± 2.89	10.77 ± 3.57
Turbidity (NTU)		2.04 ± 0.66	2.02 ± 1.15
Western Region			
Total Nitrogen (mg/L)	0.37	0.36 ± 0.09	**0.49 ± 0.31**
Dissolved Inorganic Nitrogen (mg/L)		0.02 ± 0.01	0.02 ± 0.01
Total Phosphorus (ug/L)	15	9.91 ± 4.65	10.84 ± 4.96
Chlorophyll *a* (µg/L)	1.4	1.00 ± 1.06	1.52 ± 1.54
Total Organic Carbon (mg/L)		3.84 ± 0.90	4.12 ± 1.37
Turbidity (NTU)		2.76 ± 2.67	3.28 ± 3.18

a. Key to units: µg/L – micrograms per liter, mg/L - milligrams per liter, and NTU – nephelometric turbidity units.
b. Section 65-302.532, F.A.C.
c. Concentrations are based on the annual geometric mean and are basin specific.

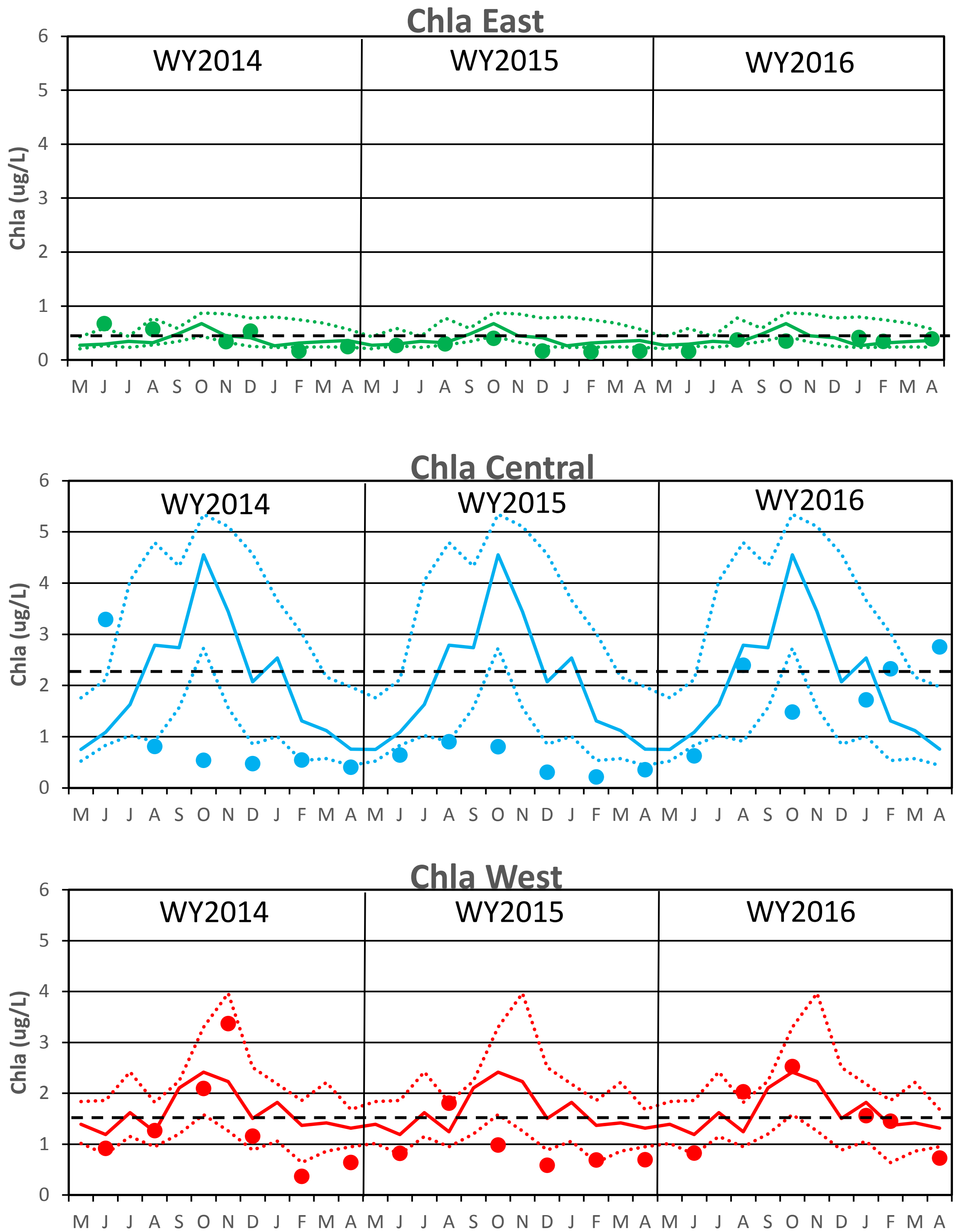

Figure 6-23. Mean Chla concentrations in micrograms per liter (μg/L) in the three regions of the bay studied during WY2014–WY2016 (solid symbols) compared to the monthly median and the interquartile range for the entire POR, WY1992–WY2013 (solid and dotted lines). The legal basin standards as set forth in Section 65-302.532, F.A.C., are also shown (black dashed line).

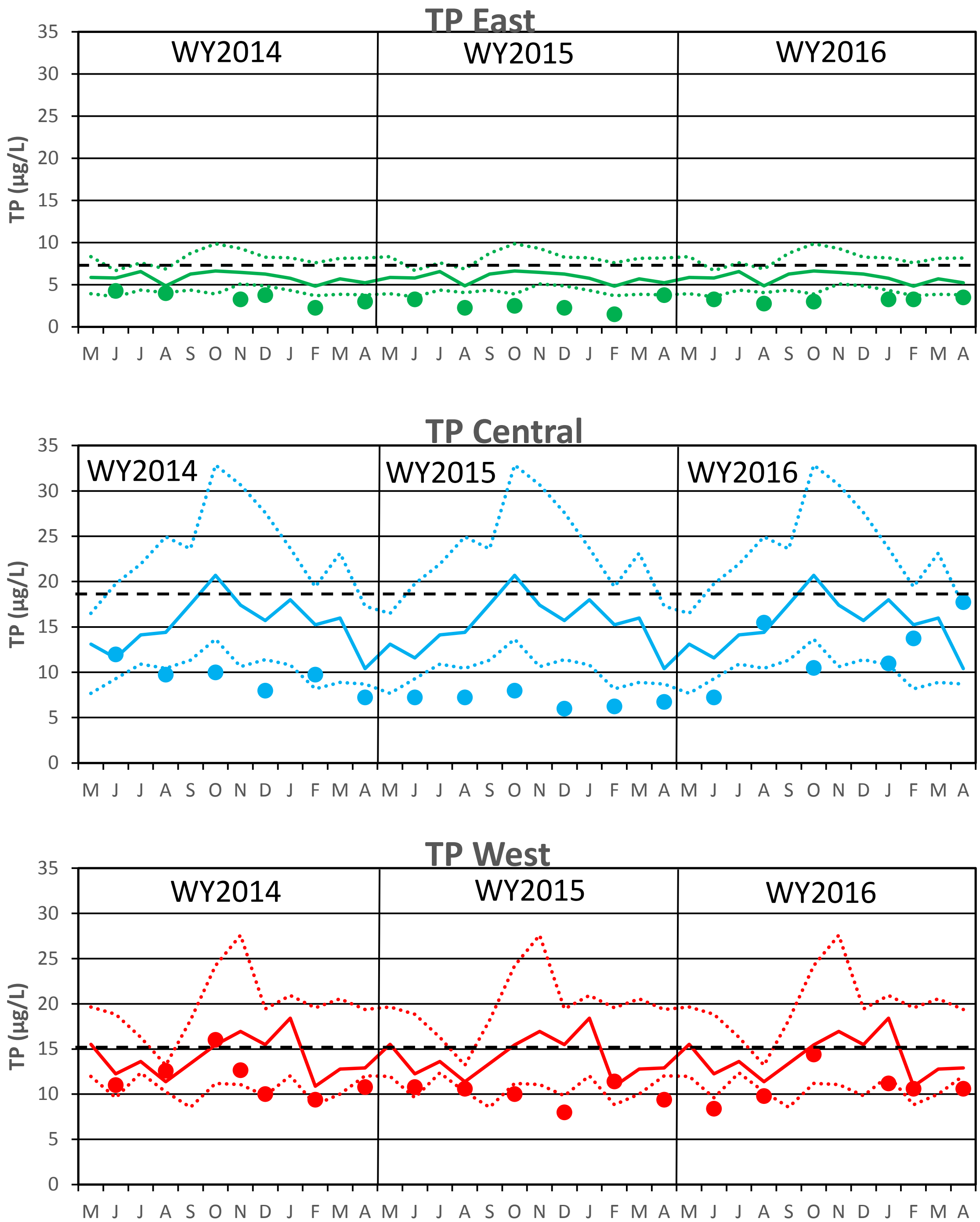

Figure 6-24. Mean TP concentrations in micrograms per liter (µg/L) in the three regions of the bay studied during WY2014–WY2016 (solid symbols) compared to the monthly median and the interquartile range for the entire POR, WY1992–WY2013 (solid and dotted lines). The legal basin standards as set forth in Section 65-302.532, F.A.C., are also shown (black dashed line).

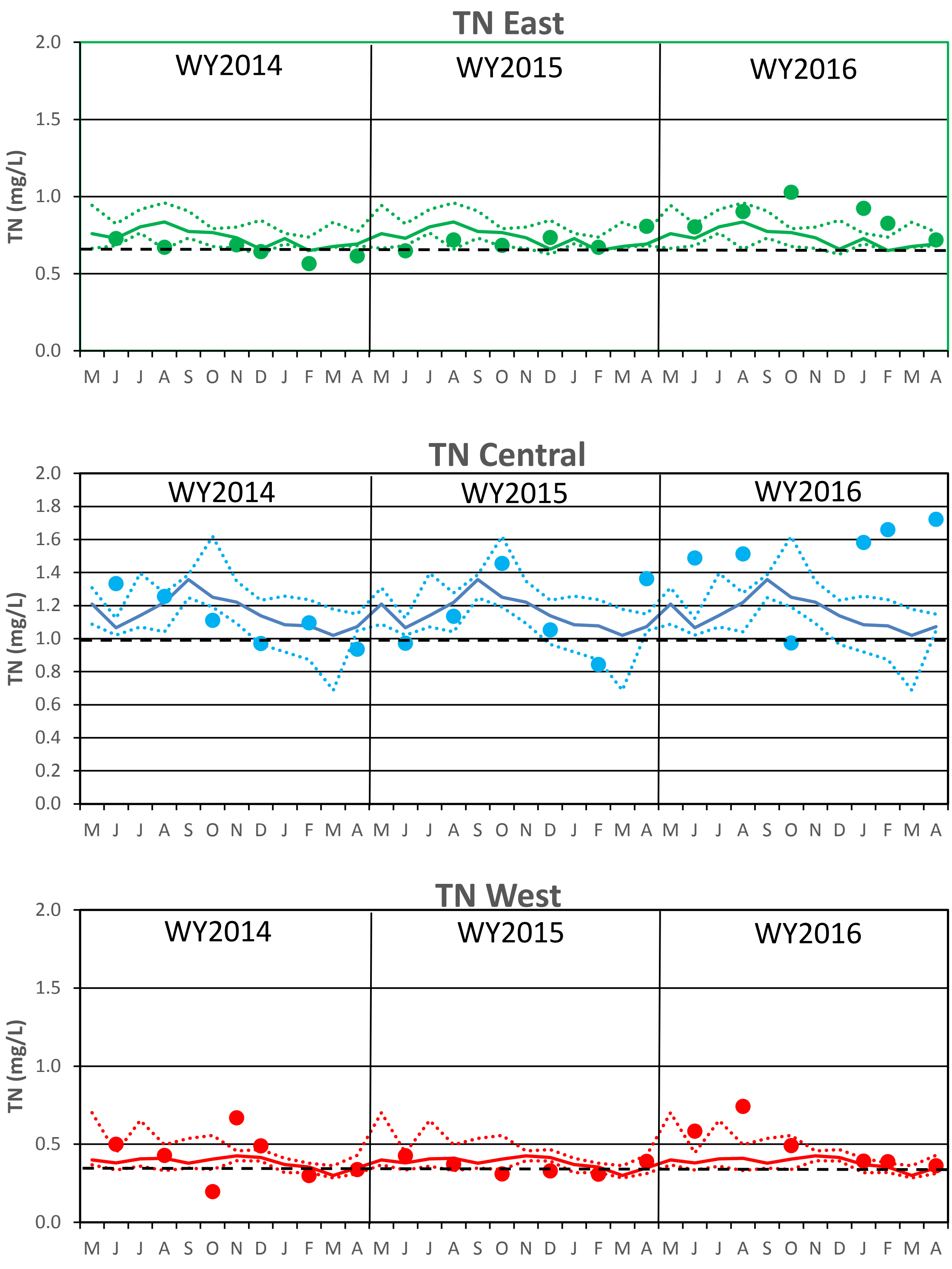

Figure 6-25. Mean TN concentrations in milligrams per liter (µm/L; µM) in the three regions of the bay studied during WY2014–WY2016 (solid symbols) compared to the monthly median and the interquartile range for the revised POR, WY2009–WY2013 (solid and dotted lines). The legal basin standards as set forth in Section 65-302.532, F.A.C., are also shown (black dashed line).

Table 6-7. Deviation of WY2016 from the POR (WY1992–WY2015) averages unless otherwise noted. Numbers in bold italics are statistically different ($p < 0.05$). [a]

Region	TN [a]	DIN	TP	Chla	TOC	Salinity	Turbidity
Eastern	***121 %***	129 %	***45 %***	71 %	87 %	***117 %***	61 %
Central	***134 %***	***266 %***	73 %	77 %	***83 %***	***114 %***	***28 %***
Western	***126 %***	99 %	***67 %***	84 %	***80 %***	102 %	44 %

a. TN POR WY2009–WY2013.

To the west, TP, TOC, Chla (with the exception of August), and turbidity were equal to the median or close to the 25 percent quartile while TN and DIN were equal to the median or close to the 75 percent quartile during the entire water year. Discrete salinity was above the 75 percent quartile during the first half of the water year, falling to the 25 percent quartile during the second half of the water year (**Figures 6-23** through **6-25**, and **Table 6-7**).

In summary, all three regions of the bay had elevated discrete salinities during the first half of the water year followed by lower salinities during the second half of the water year. The extended drought in this area, which began in WY2014 and stretched into WY2016, finally abated with the heavy precipitation in November 2015 through January 2016 (**Figure 6-10**). Chla, TP, and turbidity across the bay were at the long-term median or close to the 25 percent quartile with the exceptions noted above. TOC in the east and west were at the long-term median or close to the 25 percent quartile while the central region had mixed results. DIN was elevated baywide at some times during WY2016. It will be important to monitor these water quality parameters for changing nutrient conditions that may lead to algal blooms, especially in the central bay, which experienced the SAV die-off.

Relevance to Water Management

As mentioned earlier, there are many factors that influence the nutrient and Chla concentrations and variation in the bay including inflows. These inflows can be caused by precipitation and also by water management changes upstream of the bay. The localized drought in South Florida that began in 2014 and continued in 2015 resulted in reduced freshwater flows to the bay (**Figure 6-11**). These flows rapidly increased during the very wet dry season beginning in late November 2015. In addition, a temporary emergency deviation to the WCA-3A and WCA-3B water control plan beginning on February 12, 2016, resulted in additional water flowing into ENP and likely Florida Bay. The higher nutrients and Chla in the central region at the end of WY2016 may be attributable to the increased precipitation and freshwater inflows, the release of nutrients from decaying SAV, or a combination of both. It should be noted that Chla and TP are well below the legal standards as set forth in Section 65-302.532, F.A.C. TN, however, is above this standard in all three regions of the bay. As mentioned earlier, this could be attributable to increased precipitation leading to increased freshwater runoff, the release of nutrients from decaying SAV, changes in water management operations, or a combination of all three.

THE FLORIDA BAY PROJECT: *RUPPIA* IN THE MANGROVE TRANSITION ZONE

Christopher Madden and Theresa Strazisar[7]

The maintenance of healthy *Ruppia maritima* (widgeon grass) habitat at the transition zone is critical to ecosystem processes and creates a three-dimensional structure that supports a prey base for wading birds, wintering waterfowl, and other secondary producers (Tabb et al. 1962, Zieman et al. 1989). This species historically dominated the northern Florida Bay transition zone based on its affinity for the lower salinities adjacent to the freshwater Everglades wetlands that inhibit other habitat-forming seagrasses in Florida Bay. Widgeon grass is therefore a valued ecosystem component of the Florida Bay transition zone as a measure of ecosystem health and is a sentinel indicator for the Florida Bay MFL assessment because it requires low salinities during at least part of the year.

The MFL regulatory framework is intended to prevent significant harm to the ecosystem by requiring a minimum amount of freshwater flow to the Florida Bay estuary.

Methods

A series of field transplant experiments examined the *Ruppia* community to determine factors that favor recruitment of seedlings to the adult plant population from sexual reproduction, seed germination, seedling and adult survival, and clonal reproduction of new short shoots. At five sites in the transition zone (three eastern and two western) we examined site-specific salinity, temperature, light, and nutrient conditions relative to seedling and adult survival in CY2013–CY2014 (**Figure 6-26**). At each site, five *Ruppia* adults and 25 seedlings were transplanted from the wild to containers in situ. To determine effect of interspecific competition, the plants were replanted either in the presence or absence of the dominant co-occurring SAV at the site (n = 8 and n = 4, respectively). We also examined effects of sediment phosphorus limitation in the eastern ecotone sites where sediment P is 2 to 3 times lower than the western ecotone and apparently limiting to growth (Strazisar et al. 2013). Sediment N is high relative to P and not assessed for limitation. Timed release fertilizer (Hi-Yield® superphosphate) was added to sediments of an additional set of adult and seedling transplants and enhanced *Ruppia* leaf tissue P (1,300 milligrams per kilogram [mg/kg]) to within the range in the western concentrations (840 to 1,615 mg/kg) and reduced carbon (C):P and N:P ratios to 648 and 26, respectively, below maxima in the west (778 and 31, respectively). In CY2014, recruitment was further examined during a large, meadow-forming event covering several hectares in Long Lake that is representative of many meadows in the western chain of lakes between April and August (**Figure 6-26**).

[7] Department of Biology, Florida Atlantic University, Boca Raton, FL.

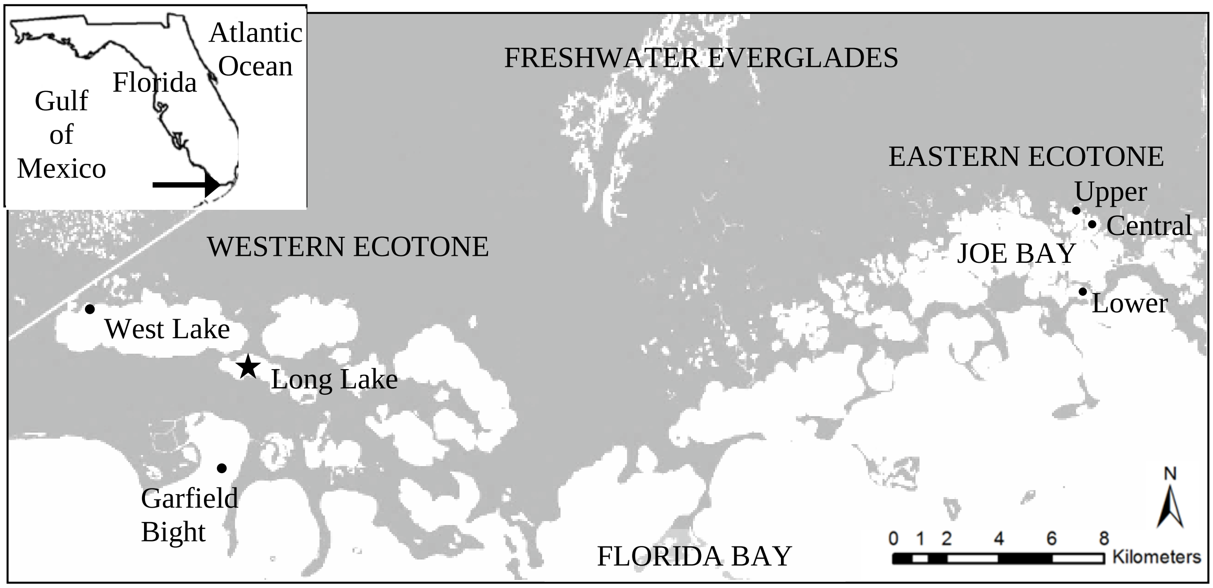

Figure 6-26. Field experiments examined *Ruppia maritima* seedling and adult survival and clonal reproduction of new short shoots across a range of environmental conditions (salinity, temperature, light, nutrients, and other SAV) at five sites across the Everglades-Florida Bay transition zone in CY2013–CY2014 (dots). *Ruppia maritima* recruitment was further examined in a large reproductive meadow in the western transition zone at a site in Long Lake between April and August 2014 (star).

Results

By experimentally increasing sediment P at the eastern sites through fertilizer addition, seedling survival was increased by a factor of 2 to 5 ($p < 0.001$–0.04), reaching 19 surviving seedlings while the density of short shoots nearly doubled at most sites through vegetative reproduction ($p < 0.05$), although sexual reproduction was minimal.

In the West Lake site, sediment P was 2 to 3 times greater than in the east and likely not the limiting resource. Salinity stress was also low there and varied little from 9 there during the year-long study, while variability was extreme in the downstream western site, Garfield Bight, ranging from 7.4 to over 55. In the eastern sites, salinity was highly variable, spanning two orders of magnitude at every site in every season. High salinity variability has been shown to be limiting to productivity due to osmotic stress (Strazisar et al. 2015).

In West Lake, light at canopy height was the primary factor limiting to growth (< 7,000 lumens per square meter [m^2]), as salinities were stable and nutrients were not limiting. Sight-specific light levels were consistently lower at this site than the eastern sites, by as much as an order of magnitude (10,000–53,000 lumens/m^2). Adult survival in the west was generally lower (< 3 of 5 initial individuals) than the east, where up to 5 living adults were observed per site. Vegetative reproduction could only maintain or slightly increase short shoot density in the west (16–30 shoots), while up to 3 times more short shoots were produced vegetatively at eastern sites (≤ 92). When the macroalga *Chara hornemannii* was present in West Lake, light at the canopy dropped to 5 percent surface irradiance, both seedling and adult survival declined to < 1 living individual, on average, and shoot density to ~10, half the initial 20 shoots. However, when the water column cleared and light was not limiting in the western sites, *Ruppia* density increased by an order of magnitude, forming large meadows throughout the lakes, a phenomenon that did not occur in the east.

In CY2014, one of these large meadows in Long Lake was studied to examine the process of seed recruitment. Inspection of the sediments revealed a large seed bank with twice as many viable seeds as just outside the meadow (**Figure 6-27**). Thirty-five percent of seed germinations successfully developed into seedlings that created the dense meadow. During the growing season, all meadow vegetation, including new seedlings, gradually died off and by August, there was no standing vegetation. However, viable seeds in the seedbank quadrupled during the growing season (**Figure 6-27**) indicating that the process of relatively brief meadow formation and sexual reproduction is likely to be important in maintaining the population in the west via seed bank replenishment, providing a base for recruitment in subsequent growing seasons. These meadows may represent hotspots of meadow formation where the seedbank is self-sustaining through rapid adult growth during light-sufficient periods, followed by high seed production.

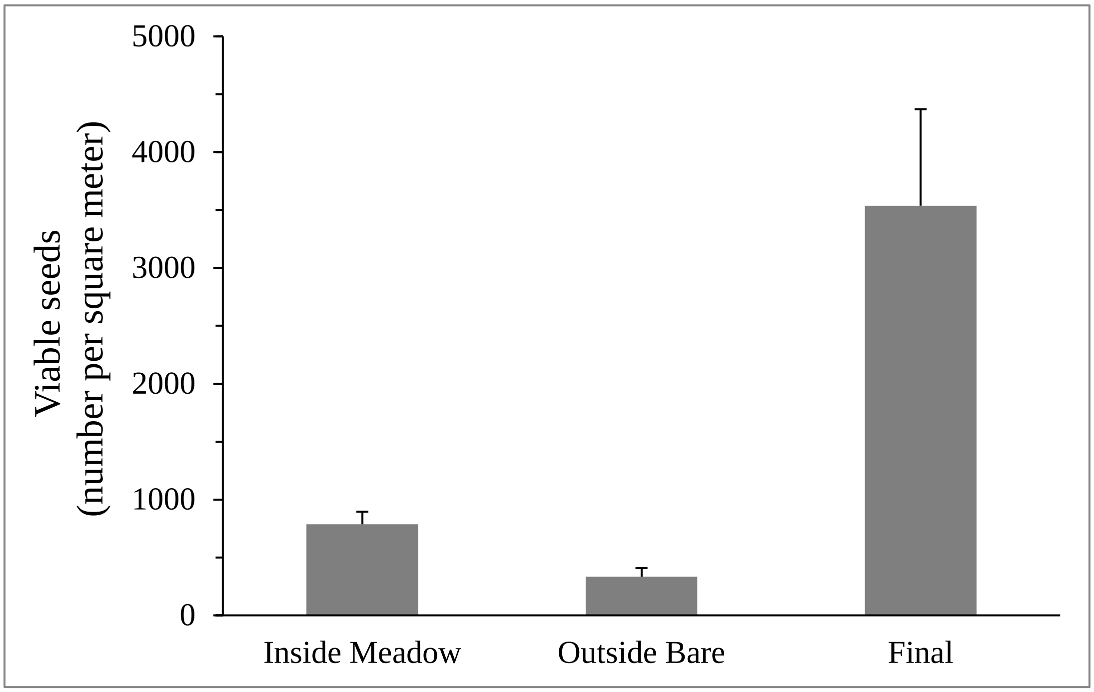

Figure 6-27. Viable *Ruppia maritima* seed densities in the sediment seed bank throughout a large-scale reproductive event in the western Everglades-Florida Bay ecotone in CY2014 (mean ± standard error; n = 20). Sediment seed bank densities were sampled inside a large reproductive *R. maritima* meadow (Inside Meadow) and outside the meadow where vegetation was absent (Outside Bare) on April 3, 2014. Following dieback of vegetation on August 5, 2014, the sediment seed bank was resampled to determine final viable seed bank densities (Final) following the reproductive event.

Relevance to Water Management

It is important to know the salinity tolerance of each growth stage of *Ruppia* so that management of freshwater flows can be optimized to enhance the survival of the population. Resiliency of the *Ruppia* community via the seedbank enables continuation of the population following disruptive events. Adult *Ruppia* can tolerate polyhaline environments for a limited time but because seed germination and seedling survival depends on a low salinity phase, the transition from seed to adult represents a “bottleneck” to recruitment of adult plants. Adult survival and clonal reproduction of new short shoots increases *Ruppia* coverage vegetatively, essential to maintenance of the population. But continued persistence of *Ruppia* in the transition zone appears to depend upon both vegetative production and recruitment of new adults from seed.

FLORIDA BAY PROJECT: FLORIDA BAY BENTHIC VEGETATION

Joseph Stachelek and Amanda McDonald

Benthic vegetation, composed of seagrass and benthic macroalgae, provides habitat structure in Florida Bay and its associated creeks, ponds, swamp forests, and marshes of the mangrove transition zone. Monitoring and research of benthic vegetation is critical to understanding the effects of water management and restoration on wetland and estuarine ecosystems. Results from these efforts are used in assessing the effectiveness of the current Florida Bay MFL rule (see **Figure 6-11** in the *Florida Bay Watershed Hydrology and Salinity* section), which was developed upon the salinity tolerance of widgeon grass (*Ruppia maritima*). These surveys are used to provide ecosystem status updates for RECOVER, assessments of District operations, and calibrate and verify the Florida Bay Seagrass Community Model (SEACOM).

Methods

Benthic vegetation is monitored regionally in select locations using a randomized design where several 0.25-m^2 quadrats are assessed for benthic vegetation using indices of percent cover. Three separate monitoring programs cover different areas in Florida Bay. The South Florida Fish Habitat Assessment Program (FHAP) and the Miami-Dade County Department of Environment Resources Management (DERM) provide estimates of benthic vegetation cover using a visual index of bottom occlusion at random sites within each basin. FHAP monitors 17 basins throughout Florida Bay and along the southwestern coast every May while DERM monitors the nearshore embayments of northeastern Florida Bay quarterly. In addition, both programs visit fixed sampling locations twice a year, once in the spring and once in the fall. Audubon of Florida monitors SAV using a point-intercept method every other month at sites along nine transects extending from the freshwater marshes of the southern Everglades to Florida Bay. A more complete description of the monitoring programs and the methodologies are presented in Chapter 12 of the 2011 SFER – Volume I (Alleman 2011).

Results

Salinity and water level dynamics during WY2016 in the upper transition zone were very unusual. Extremely high salinities relative to long-term records were observed in the wet season while extremely low salinities were recorded in the dry season (see the *Florida Bay Hydrology* subsection in the *Hydrologic Patterns for Water Year 2016* section).

Two notable trends in SAV cover carried over into WY2016 from previous water years. First, cover of *Ruppia maritima* still did not rebound from the dramatic declines observed following record high cover in WY2011 and WY2012. In fact, *R. maritima* cover during the past two water years (2015 and 2016) were at their lowest level since monitoring began in 1996. In Taylor River, these decreases were tracked by the cover of other saltwater intolerant species such as *Chara hornemanni*. However, along the eastern transects of the monitoring program (Joe Bay and Highway Creek), cover of *C. hornemanni* remained relatively stable and even increased at some sites. Second, cover of *Thalassia testudinum* continues to increase at the downstream end of the many monitoring transects. Increases were particularly evident at Taylor River and Highway Creek. Average cover at Taylor River equaled the record high for this transect set in WY2015 (20 percent).

During summer 2015, within central and western Florida Bay, the elevated salinities and above average temperatures initiated a seagrass die-off reminiscent of the die-off event of the late-1980s (Hall and Durako 2016). The May 2015 sampling event found normal conditions within Florida Bay, but a reconnaissance trip in late August 2015 revealed large areas of dead seagrass within Garfield Bight, Rankin Lake, and Johnson Key Basin (**Figure 6-28**). The fixed sampling locations within Garfield Bight and Rankin Lake showed a large decrease in *T. testudinum* cover in October 2015 (**Figure 6-29**). An extra mapping effort was undertaken in October 2015 with the FHAP team revisiting the May 2015 random sampling locations in Rankin Lake, Whipray Basin, Johnson Key Basin, and Rabbit Key Basin. These data were not yet available for the writing of this report. In addition, aerial photographs of the die-off area were acquired through a partnership between FWC, ENP, and the District in April 2016. These photos are being processed and analyzed by FWC.

Figure 6-28. Path for August 2015 reconnaissance trip in central and western Florida Bay after reports of seagrass die-off. Green circles represent areas where divers did not note any apparent die-off and red circles represent areas where die-off patches of *Thalassia testudinum* were noted.

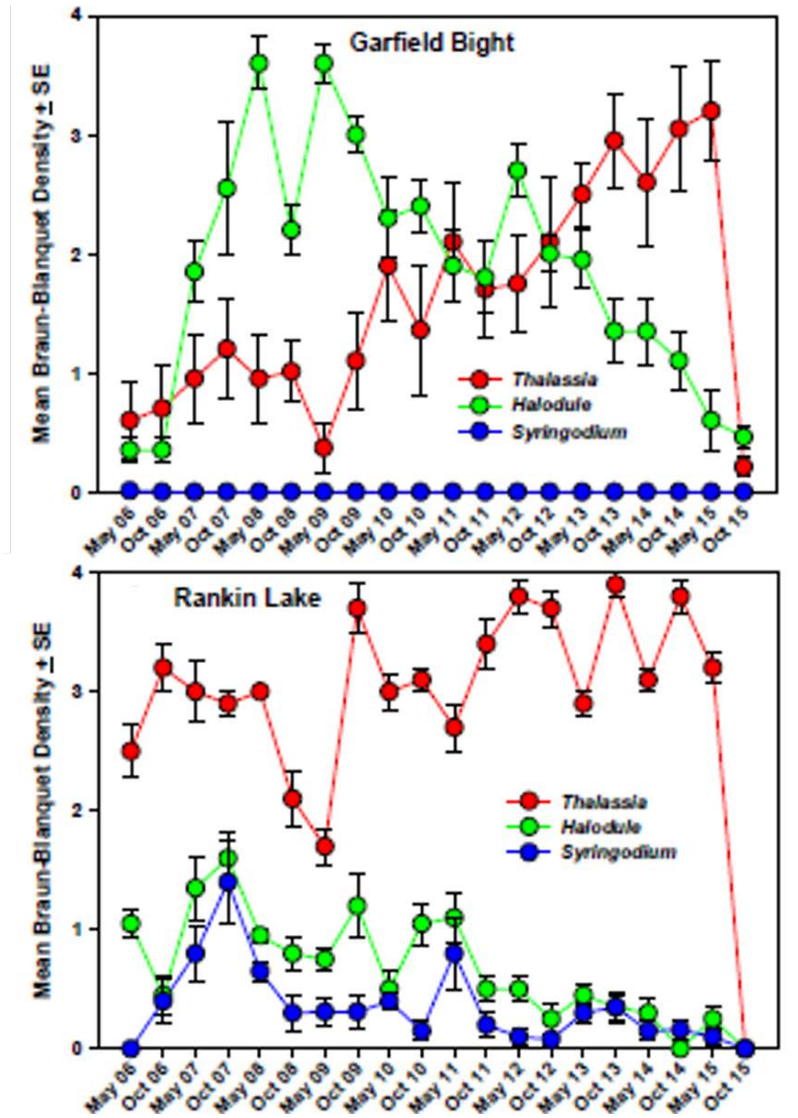

Figure 6-29. Mean Braun-Blanquet Density data (± standard error) for the 3 main species of seagrass in central Florida Bay (*Thalassia testudinum*, *Halodule wrightii*, and *Syringodium filiforme*) at the fixed sampling locations within Garfield Bight and Rankin Lake. Both areas are within the region of the recent (2015) seagrass die-off and experienced a significant decrease in *T. testudinum* (the red line). Excerpted from Hall and Durako (2016).

Relevance to Water Management

SAV dynamics in the transition zone were similar to previous water years and the continued low *Ruppia maritima* cover was expected as a result of the high salinities and the violation of the Florida Bay MFL criterion. Within Florida Bay, the seagrass die-off will have multi-year impacts as the community attempts to recover. Future monitoring will be essential to detect and assess any continuing and cascading effects of the drought and the record high salinities of WY2016 on the benthic community and water quality.

FLORIDA BAY PROJECT: 2015–2016 SAV INDICATORS FOR FLORIDA BAY

Christopher Madden and Amanda McDonald

Introduction and Methods

Status indicators for SAV are calculated each year and color-coded relative to a desired reference condition to summarize the status and trends of benthic vegetation in Florida Bay. Overall the SAV indicators showed a decline for some areas in WY2015 and WY2016 relative to prior years, likely the result of low rainfall and low freshwater input to the bay beginning in 2014. A severe drought in summer 2016 further reduced the indicator status for WY2017 as SAV die-off occurred in substantial portions of the central and western bay.

The indicators for SAV combine an Abundance Index based on underlying measures of areal extent and density, and a Species Index based on measures of species diversity and the presence of desired species. These values are calculated on a basin scale and spatially averaged across representative zones within the bay: Northeast, Transition, Central, Southern, and Western. The Abundance and Species indices are combined to generate an overall Composite score per zone.

Results

Abundance

The Abundance Index remained in the good (green) range for the Northeast Zone during WY2015, WY2016, and WY2017 (**Table 6-8**). The underlying spatial extent component of this score was in the good range for all basins in the Northeast Zone. However, due to deterioration in the underlying density score for several basins, there were notable declines in Index A scores at the basin level: Duck Key declined to fair (yellow) in WY2015 then rebounded in WY2016–WY2017; Barnes Sound declined to fair in WY2016 and WY2017. Eagle Key Basin declined to fair in all three years. For the Transition Zone, the Abundance Index continued fair in WY2015–WY2017 after declining from good a decade ago. All basins had spatial extent scores of good except Highway Creek, which declined dramatically from good to poor (red) in WY2016, rebounding to fair in WY2017. The density component remained at fair for most basins and good for Little Madeira Bay.

The Abundance Index in the Central Zone remained in the fair range for WY2015–WY2017, since it improved from poor in WY2008. Spatial extent was good in all basins until WY2017 when die-off affected Rankin Lake, depleting SAV abundance. Density declined to poor in Rankin, remained poor in Madeira, and was fair in most other basins, reducing the overall Abundance Index score for the Central Zone to fair. The Southern Zone continued to reflect a poor rating in the Abundance Index in WY2015–WY2017. Despite high scores for the underlying spatial extent metric in all southern basins, Abundance Index scores were reduced by underlying density component scores in Twin (poor) and Crane Key (fair). The Western Zone Abundance Index A improved to good in WY2016 after three years in the fair range but declined again to fair in WY2017 due to die-off in Johnson reducing the extent and density scores to fair in WY2017.

Species

The aggregate Species Index in the Northeast Zone fell to fair for WY2015–WY2017 (**Table 6-8**), with scores of fair (Barnes, Blackwater, and little Blackwater) or poor (Duck, Manatee, and Eagle Key) in most basins for the underlying species dominance score, meaning that mixed communities are not well-established. The underlying target species score averaged in the low good range for the Northeast overall with fair scores for Blackwater, Manatee, Duck, and Eagle Key and good for Little Blackwater and Barnes

Sound. The Species Index in the Transition Zone also declined to fair for WY2015–WY2017 as salinity conditions deteriorated in this region in recent years. The underlying species dominance component was almost universally poor in all zones from WY2015 through WY2017. The target species component for the zone remained at good although Long Sound dropped to fair, and Davis Cove to poor while Alligator improved to fair. Joe Bay and Little Madeira remained good for all years.

Table 6-8. Florida Bay SAV Indicator Status for WY2013-WY2017.
The indicator colors reflect the current status of the resource as compared to historic or targeted status as follows: red – poor, yellow – fair, and green – good.

Performance Measure	**Water Year**				
	2013	**2014**	**2015**	**2016**	**2017**
Northeast Zone					
Abundance	🟢	🟢	🟢	🟢	🟢
Target Species	🟢	🟢	🟡	🟡	🟡
Transition Zone					
Abundance	🟡	🟡	🟡	🟡	🟡
Target Species	🟡	🟢	🟡	🟡	🟡
Central Zone					
Abundance	🟡	🟡	🟡	🟡	🟡
Target Species	🟢	🟢	🟡	🟡	🟡
Southern Zone					
Abundance	🔴	🔴	🔴	🔴	🔴
Target Species	🟡	🟡	🟡	🟡	🟡
Western Zone					
Abundance	🟡	🟡	🟡	🟢	🟡
Target Species	🟢	🟢	🟢	🟢	🟢

Species Index fell to fair for the Central Zone in WY2015 through WY2016 then improved to good in WY2017 possibly as a result of die-off reducing the presence of *Thalassia* relative to *Halodule* and the target species component remained good for all years, showing evidence of a mixed community even in some basins affected by die-off. Species identified as desired targets for increase in abundance are *Ruppia maritima* in the Transition Zone and *Halodule wrightii* in all parts of the bay. Index B remained in the fair range in the Southern Zone since WY2009 after several years in the poor range. The species dominance component fell to poor in WY2016 and WY2017 due to a buildup of *Thalassia* in Twin Key and despite improvement to fair for Crane Key in both years. The target species component fell to poor in the Southern zone in WY2016 and WY2017.

Overall

The Composite Index combines both the Abundance Index and Species Index scores and gives a color-coded summary of overall status for SAV in each zone (**Figure 6-31**). The Composite Index shows that relative to WY2013-WY2014 (**Figure 6-31A**), the overall status of SAV in WY2015–WY2017 declined in the Transition, Central Bay, and Western zones (**Figure 6-31B**) as SAV was impacted by poor conditions in WY2015–WY2016 and die-off in WY2016–WY2017. The affected zones are the most sensitive of the entire bay to low freshwater input and elevated salinity.

Relevance to Water Management

The gains in the quality of SAV habitat over the past several years are precarious and can be reversed within an annual timescale. The steady rebound of the SAV community from losses due to a severe algal bloom in the eastern bay in WY2005–WY2008 and a seagrass die-off in WY1987 were reflected in improving scores in the late 2000s and early 2010s. The relatively wet years of WY2012 and WY2013 resulted in lower salinities, favorable conditions, and further improved SAV status in Florida Bay. The dry years that followed in WY2014 and WY2015 are characterized here by a decline in SAV status indicators. The extreme drought of WY2015–WY2016 will continued this negative trend with severe die-off the result. Water management initiatives such as the C-111 Spreader Canal Western Project and the Florida Bay Restoration Project are designed to reduce the impacts of high salinity by retaining more water in Taylor Slough and supplying more fresh water to central Florida Bay.