Seagrass Community Assessment of Karen Golonka (formerly Fullerton) Island, Sawfish Island, and Adjacent Areas

2023 Initial Assessment

Prepared by:

Jerry L. Metz
(Jerry.metz@lrecd.org)

May 2024

Loxahatchee River District (LRD)
WildPine Ecological Laboratory
(561) 747-5700
www.loxahatcheeriver.org

Introduction

Seagrasses are a true flowering vascular plant adapted to life in a submerged marine environment. Of the approximately 60 species of seagrasses found in shallow coastal regions world-wide, seven species are known to inhabit Florida's east coast (Dawes *et al*. 1995; Green and Short 2003). As a valued ecosystem component, seagrasses fulfill many ecological functions such as nursery habitat for juvenile fishes and shellfish, food for grazers like manatees and sea turtles, sediment stabilization, and reducing near shore wave energy (Orth *et al*. 2006; Waycott *et al.*). Seagrasses can be sensitive to chronic and acute changes to their environment (Ridler *et al*. 2006). Their vulnerability due to their sensitivity and sessile nature has led them to be identified as a biological indicator of water quality and overall sentinel of ecosystem health (Montague and Ley 1993; Lirman and Cropper 2003). Some state and local agencies conduct monitoring programs that document the distribution, abundance, and composition of seagrass communities to facilitate management decisions related to the protection of this important habitat (Metz *et al*. 2020).

Karen Golonka Island (prior to February 2023 named Fullerton Island) and Sawfish Island are a pair of small islands located in Jupiter Florida at the confluence of northern Lake Worth Creek (Intracoastal Waterway) and the Loxahatchee River Estuary. The islands were once part of the mainland before becoming severed with the construction and dredging of the Intracoastal Waterway in the 1920s.

Throughout the years, the island's outer fringe was lined with red mangroves while its interior had accumulated dense invasive exotic vegetation composed primarily of Brazilian Pepper (*Schinus terebinthfolia*) and Australian Pine (*Casuarina spp.*). In 2008, the Town of Jupiter purchased the property with the intent of restoration by removing the exotics, planting native vegetation, and providing passive recreation activities. Work was conducted at the Karen Galonka Island site in 2013-14 to remove the exotic vegetation and excavate material from the interior of the island to form a shallow lagoon for seagrass restoration and a paddle-through for kayaks and paddleboards. Similar work was conducted more recently at Sawfish Island with the paddling trails completed just days prior to commencement of this seagrass assessment.

The salinity around the islands can be variable depending on recent precipitation and tide cycle and is best described as a mix of marine and brackish water. Two nearby water quality stations that are part of the Loxahatchee River District's Riverkeeper monthly water quality program and bracket the sampling area show a combined 30-year mean salinity of 32 ppt with a range of between 7 ppt to 39 ppt (Figure 1) www.loxahatcheeriver.org/river/river-keeper/). The marine component comes by way of the Jupiter inlet located approximately one mile north and east of the islands. The brackish water comes primarily from the south by way of the northern Lake Worth Creek and Intracoastal waterway which flows northward during falling tide to mix with the water in the Loxahatchee River Estuary. The generally marine to

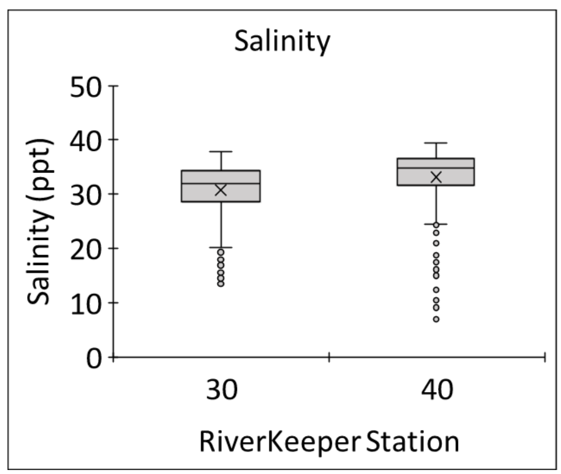


Figure 1. Box and whisker graph shows mean ("X") and range of salinity at Loxahatchee River District's Riverkeeper station 30, located 0.4 mile south of sample area, and station 40, located 0.1 mi northwest of sample area.

brackish salinities have made the region suitable for seagrass establishment and growth.

Since the late 1990s to present the Loxahatchee River District, an independent Special District of the state of Florida, has conducted monitoring and mapping of seagrass throughout the estuary and portions of the southern Indian River Lagoon. However, despite having an immense database documenting seagrasses in the Loxahatchee River Estuary, relatively little was known about seagrass presence and composition around these islands despite their proximity to the estuary.

In support of the restoration work conducted on and around the islands and to add to our knowledge of local seagrass communities, from June through September 2023 the Loxahatchee River District conducted an initial assessment of seagrass presence, abundance, and species composition in the shallow waters surrounding the islands and within the shallow lagoon in the island's interior. This report provides a species-specific assessment of the seagrass community around Karen Golonka Island and Sawfish Island and serve as a baseline for potential future assessments.

Methods

Sample Site Selection

A submerged vegetation survey conducted by Palm Beach County Department of Environmental Resource Management (ERM) in 2007 was used as a general guide to delineate the boundary of this seagrass assessment. The "Fishnet" tool in ESRI's ArcMap (ver 10.6) was used to create a virtual grid within the survey boundary with points spaced 7.6 m (25 ft) apart. This grid produced 2,397 possible sample points, each assigned a unique identification number. A web-based random sequence generator (www.random.org/sequences/) was used to select 250 points from the pool of possible points. 250 points were considered a good compromise between sample size and available resources (staff, field days, etc.). To improve the distribution of sample points within the study area we removed and reassigned any adjacent sample points so the closest possible distance between two points was 15.2 m (50 feet). During the assessment, some points were deemed unsafe for field staff (e.g. in a boating lane or too deep) or were found to be in an area that would have excluded potential seagrass presence (e.g. on the beach) and were moved to an adjacent point and reassigned the respective point identification number. Points found to be unsafe or ineffective for sampling were removed from the main pool to avoid future selection. The 250 selected points were uploaded to ESRI's ArcGIS Online and accessed in the field using a hand-held tablet connected via Bluetooth to an Eos Arrow 100 GPS receiver (eos-gnss.com) providing sub-meter accuracy using real-time differential correction.

Field data collection

From June 29, 2024 through September 22, 2024 species-specific seagrass data were collected in the waters surrounding Sawfish Bay Park, Sawfish Island, and Karen Golonka Island (Figure 2). Data were collected in the field by two teams. The GPS team used the GPS to locate each pre-selected sample point and deploy a weighted marker buoy affixed with a pre-labeled, waterproof field data sheet while the dive team members, using snorkeling gear, placed a collapsible 9 m^2 (3 x 3 m) quadrat centered on each buoy weight (Figure 3). The divers then counted the total number of 1m^2 squares (out of nine) that contained at least one shoot of seagrass.

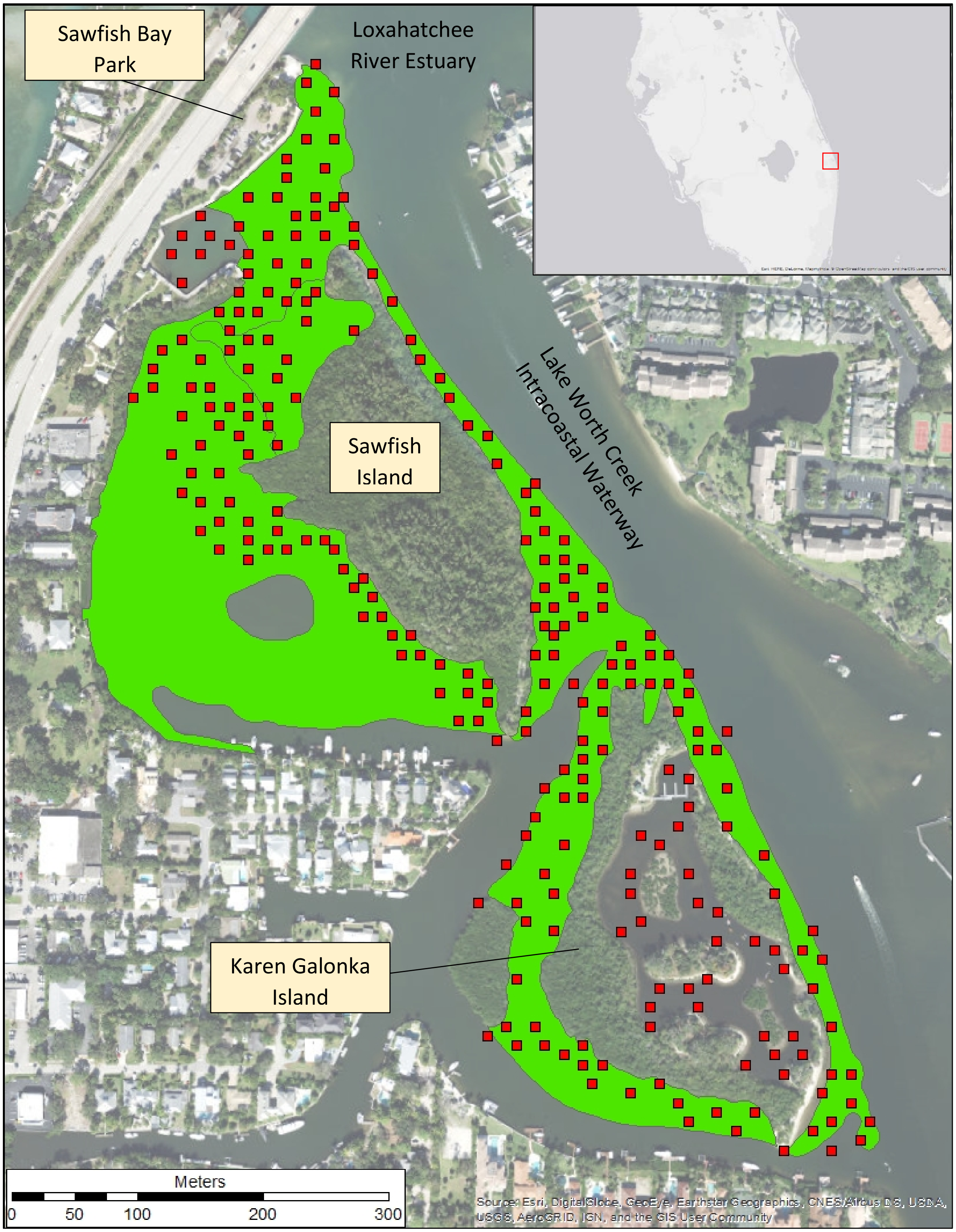


Figure 2. Map showing layout of sampling area. Green shaded area is from the 2007 Palm Beach County ERM submerged vegetation map that was used as a guide. Red squares show completed sample points. Key features within and adjacent to the sampling area are labeled. Inset shows the relative location of survey site.

Figure 3. A 9m^2 collapsible sampling quadrat, centered on weighted marker buoy, at low tide. The smaller 1m^2 quadrat is shown for scale. Seagrass categories were based on the number of 1-meter squares within the quadrat occupied by seagrass and include Continuous (7-9), Patchy (4-6), Sparse (1-3), and Absent (0).

The diver then applied the Braun-Blanquet Vegetative Cover (BBVC) scale (Braun-Blanquet 1932; Table 1) to estimate the vegetative cover as a percentage of whole quadrat for both total seagrass and individual seagrass species. The field data was entered into an electronic database for statistical and geospatial analysis.

Table 1. The Braun-Blanquet Vegetative Cover scale used to convey seagrass vegetative density within each 9 m^2 collapsible quadrat.

Braun-Blanquet Vegetative Cover Scale

Score	% cover	Interpretation
0	0	Species absent from quadrat
0.1	<< 1%	Bare minimum presence; 10 or fewer shoots
0.5	< 1%	Species present as only a few shoots (>10)
1	1-5%	Vegetation covers 1-5% of quadrat
2	5-25%	Vegetation covers 5-25% of quadrat
3	25-50%	Vegetation covers 25-50% of quadrat
4	50-75%	Vegetation covers 50-75% of quadrat
5	> 75%	Vegetation covers more than 75% of quadrat

Data Processing

Each diver collected two pieces of information at each sample point: 1) number of 1-meter squares (0-9) occupied by seagrass and 2) estimated vegetative cover as viewed from above using on the BBVC scale.

From these two parameters, we were able to examine the frequency, abundance, and species composition of seagrass within the assessment area.

Frequency of Occurrence

Frequency of occurrence, often interchangeably referred to as percent occurrence, is a coarse scale measure used to quantify the percentage of sample sites visited that contained seagrass. In this report, frequency of seagrass occurrence was determined by adding the number of quadrats in which each seagrass species *i* was present divided by the total number of quadrats assessed and then multiply by 100 to get a percent frequency (F):

$$F_i = \frac{\text{Number of sites where seagrass species } i \text{ was present}}{\text{Total number of sample sites}} \text{ X } 100$$

where $0 \leq F_i \leq 1$.

For example, if 50 sample sites were assessed and 40 of them had some amount of seagrass present, then seagrass occurrence would be 80%. This measure ignores how much seagrass is present, a single shoot or complete coverage within the quadrat counts as seagrass being present at that site.

Categorical Abundance

Categorical Abundance is a finer scale of seagrass presence and describes seagrass patchiness within each quadrat by using the non-zero (i.e. 1-9) score of each seagrass species *i* from each $9m^2$ quadrat. The 1-9 score is evenly divided into three categories that include “Sparse” = 1 – 3, “Patchy” = 4 – 6, and “Continuous” = 7 – 9. Sites with a score of 0 are categorized as “Absent”. Categorical Abundance (CA_i) of each species is calculated as:

$$CA_i = \frac{\text{number of sites within each category for species } i}{\text{number of sample sites where species } i \text{ was present}} \text{ X } 100$$

where $0 \leq CA_i \leq 1$. Appendix 1 at the end of this report provides maps showing the location and categorical score of all quadrats.

Seagrass Co-occurrence

Species co-occurrence is derived from the non-zero seagrass occurrence data (1-9 scores) and is used to describe the solitary and co-occurrence patterns of multiple seagrass species. The examination of species co-occurrence can help in understanding seagrass species interactions as well as provide insight into habitat requirements such as light, salinity, and hydrodynamics.

An individual sample site with seagrass present was either composed of a single species or had more than one species present. In this way, we looked at species co-occurrence as proxy of community structure. We first determined all observed combinations of seagrass species reported:

$$\% \text{ co} - \text{occurrence} = \frac{\text{number of each observed species combination}}{\text{number of quadrats with seagrass present}} X\ 100$$

where the sum of all observed combinations is equal to 100%.

Braun-Blanket Vegetative Cover (BBVC) Score

Vegetative cover was determined using the Braun-Blanket Vegetative Cover (BBCA) scale and is another component that conveys how much seagrass is present. It is based on the BBVC eight-point scale (Table 1) that is widely used in terrestrial and submerged plant studies and is a visual field estimate of vegetative cover as viewed from above (Braun-Blanquet 1932). In the field, the diver estimates the percent cover of each seagrass species inside the entire quadrat and assigns an appropriate BBVC score from the table that corresponds to the estimated percent cover. This report looks at average BBVC score across sample sites and calculated as:

$$\text{BBCA}_i = \frac{\text{sum of BBVC scores for species } i}{\text{number of sample sites where species } i \text{ was present}}$$

The BBVA score can be used in future landscape-scale assessments so that vegetative density comparisons can be made. Appendix 2 at the end of this report provides maps showing the location and BBVC score of all non-zero quadrats.

Results

Seagrass Frequency of Occurrence

The Karen Golonka Island and Sawfish Island seagrass assessment was completed in five non-consecutive days between June 29 and September 22, 2023. A total of 248 points were assessed; two points were omitted during the last day of sampling due to unsafe locations. Of the 248 points, 147 had seagrass present for a total seagrass percent occurrence of 59% (Figure 4) indicating more than half of the quadrats assessed had seagrass present. Five seagrass species were encountered during this assessment and include in order of frequency Paddle Grass (*Halophila decipiens*; 47%), Shoal Grass (*Halodule wrightii*; 21%), Johnson's Grass (*Halophila ovalis*; 13%) Turtle Grass (*Thalassia testudinum*; 4%), and Manatee Grass (*Syringodium filiforme*; 2%).

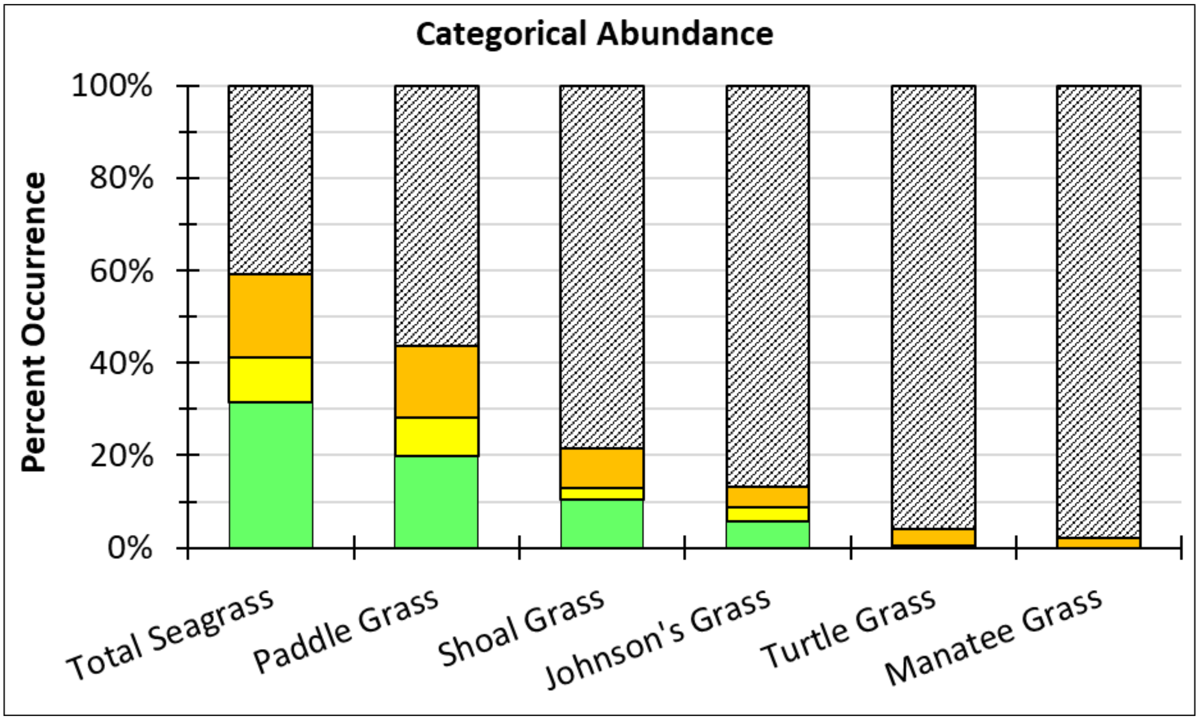


Figure 4. Categorical Abundance as percentage of quadrats with seagrass present for each category and for each species. Seagrass categories were based on the number of 1-meter squares within each quadrat occupied by seagrass and include Continuous (7-9), Patchy (4-6), Sparse (1-3). Bar colors correspond to maps in Appendix 1.

Total Seagrass Categorical Abundance

Total seagrass scored as "Continuous" accounting for 32% of the quadrats while 18% of the quadrats were "Sparse" (Figure 4). The "Patchy" category accounted for 10% of the quadrats. For the three most abundant seagrass species that include Paddle Grass, Shoal Grass, and Johnson's Grass, the categorical abundance generally followed the same pattern as Total Seagrass, meaning most quadrats were either Continuous or Sparse distribution with a much lower percentage of quadrats having Patchy distribution. Paddle Grass, the most frequently encountered seagrass, also had the highest percentage of Continuous abundance at 20%, while 19% were Sparse. Also see maps in Appendix 1a-f.

Seagrass Species Co-Occurrence

An examination of seagrass community composition shows that the most frequently observed seagrass, Paddle Grass, was most often recorded as a monospecific bed. Paddle Grass was the lone occupant in 56% of the quadrats in which this seagrass was found (Figure 5). The next most common species found by itself was Shoal Grass at a distant 4%. Each of the remaining seagrasses were found as a single species in 2% or less of the quadrats in which they were found. Paddle Grass was the only seagrass found to co-occur with each of the four other seagrasses observed in the assessment.

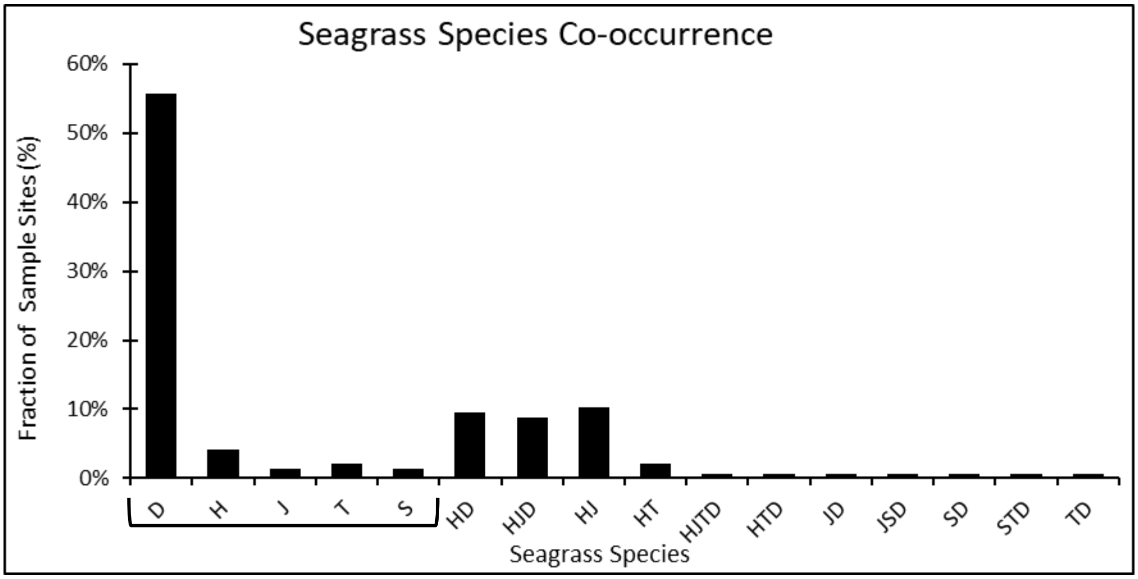


Figure 5. Graph shows combinations of seagrass species observed within each quadrat. Bars represent fraction of quadrats having each species combination among quadrats having seagrass present. Bracket indicates fraction of sites with a single species present. D= *Paddle Grass*, H= *Shoal Grass*, J= *Johnson's Grass*, T= *Turtle Grass,* S= *Manatee Grass*.

Braun-Blanket Vegetative Cover (BBVC) Score

The BBVC percentages show that seagrass vegetative cover was sparse within most of the quadrats for most species (Figure 6). The most frequently recorded score showed that most quadrats were less than

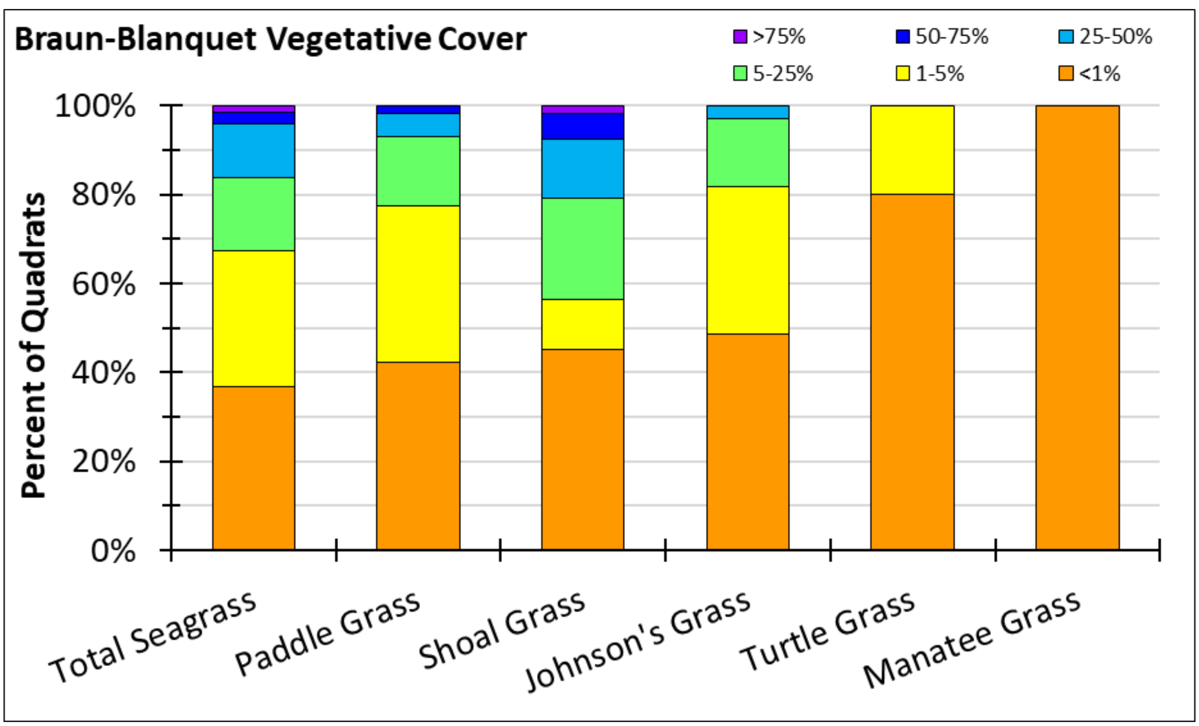


Figure 6. Braun-Blanquet Vegetative Cover for each species. Columns indicate the percent of quadrats where species was present within each percent cover class (see Table 2). Bar colors correspond to maps in Appendix 2. For clarity, the "<<1%" and "<1%" cover ranges were combined to just show vegetative cover of less than 1%.

1% vegetative cover throughout the sampling area. This included the most frequently encountered and most abundant seagrass, Paddle Grass. Despite Paddle Grass accounting for the greatest abundance, it still had an average vegetative cover of less than 5%. Shoal Grass and Johnson's Grass also averaged less than 5% vegetative cover in most of the quadrats in which these seagrasses were present. The two least frequently encountered seagrasses, Turtle Grass and Manatee Grass, had less than 5% and 1% vegetative cover, respectively, in all quadrats in which they were present. Paddle Grass and Shoal Grass were the only seagrasses with vegetative cover greater than 50% within individual quadrats. Examination of the maps in Appendix 2 show that the region with the most vegetative cover were located near the northern end of Sawfish Island and arouns Sawfish Bay Park.

To examine patterns of vegetative cover more closely, the sampling area was partitioned into zones to examine water energy exposure in relation to seagrass vegetative abundance (Figure 6). The zones were partitioned into high-energy, high-water movement region located along the channelized Intracoastal waterway ("A" zones) and low-energy, low-water movement region located on the leeward side of the islands ("B" zones). The interior of Karen Galonka Island was designated as zone "C" and was characterized as completely protected from wave energy and has minimal water movement beside that of semidiurnal tidal changes. Shoal Grass and Paddle Grass were the only seagrasses represented in each of the seven zones; Johnson's Grass was not detected in Zone 1B (Figure 8). The highest vegetative cover was found to be Shoal Grass located in zones 1A (25-50%) and 2A (5-25%), two of the three zones nearest the intracoastal waterway. Paddle Grass vegetative cover was highest in zone 2B on the relatively calm leeward side of Sawfish Island. Johson's Grass did not exceed 5% vegetative cover in any of the zones in which it was encountered. While the interior of Galonka Island, zone 3C, had three seagrass species present, no seagrasses were found to have vegetative cover greater than 1% and was the only zone in which 1% cover was not exceeded. Generally, the highest seagrass vegetative cover tended to be near the northern end of the sampling area closest to the Loxahatchee River Estuary and regions closest to the channelized intracoastal waterway where it should be noted that despite high-density boat traffic, this area of the waterway is a "Slow Speed" zone so boat wake is minimized.

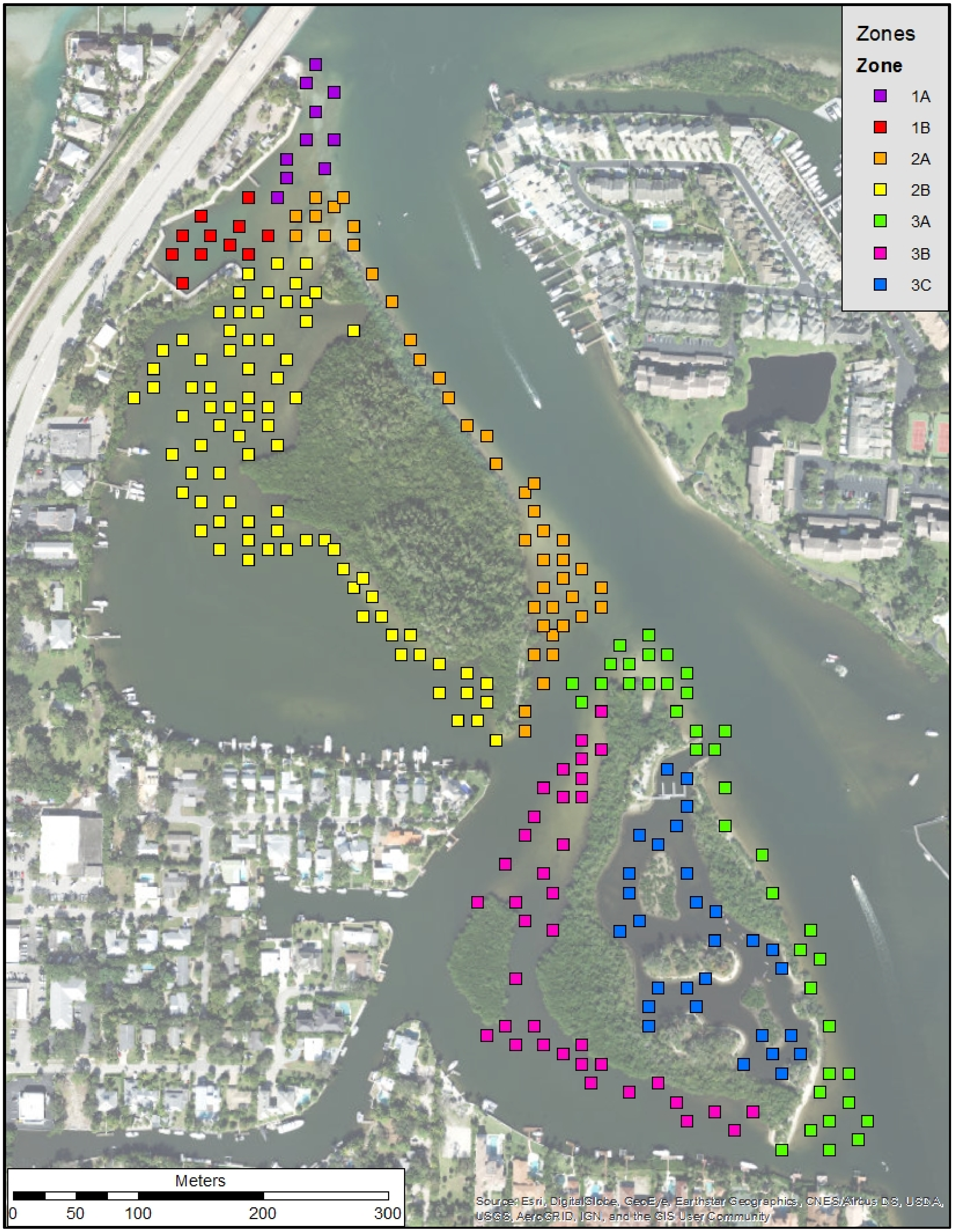


Figure 7. The map above divides the sampling area into zones based mostly on physical water exposure. The "A" zones included sample points located along the channelized Intracoastal Waterway and experience more water movement, while the "B" zones were on the leeward side of the islands and experience calmer conditions with less water movement. The "C" zone includes the recently created interior of Karen Galonka Island.

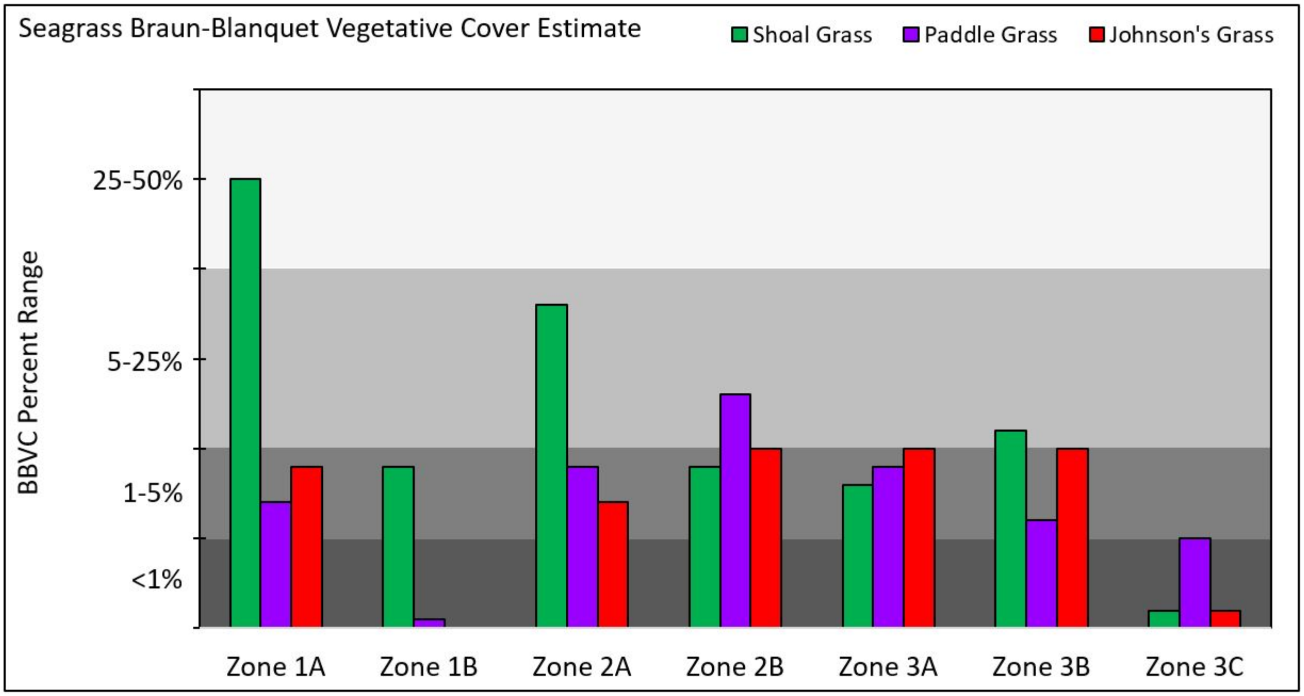


Figure 8. The bar graph above shows the mean BBVC range for Shoal Grass (green), Paddle Grass (purple), and Johnson's Grass (red) within each of the seven zones; Manatee Grass and Turtle Grass were omitted due to sparse presence. Values were derived by using the mean field score (e.g. 0.1-5) then assigned the field score on the vertical axis with corresponding BBVC percent range (shaded horizontal bars).

Discussion

This assessment documented seagrass abundance and species composition around Karen Golonka and Sawfish Islands and surrounding areas. Of the seven seagrass species known to inhabit Florida's coastal waters, we documented five within the assessment area, and of those, Paddle Grass was by far the most common seagrass encountered. Seagrass tended to be more abundant around Sawfish Island and adjacent Sawfish Bay Park. One possible explanation for this might be its proximity to the Loxahatchee River Estuary, Jupiter Inlet, and less boat traffic because of the shallow waters west of the island. This area often experiences the clear marine water that flows in through nearby Jupiter Inlet during flood tide.

Paddle Grass was spread throughout the sampling area but seemed to be most abundant on the westward side of the islands where the overlaying water column tended to be a bit more turbid compared to water along the Intracoastal waterway. One explanation for Paddle Grass occupying this area is possibly due to Paddle Grass' lower light requirement which is near the lowest among all seagrass species, and lower tolerance for high irradiences such as that which occur in shallow or clear water, that enables it to grow in conditions unsuitable for other seagrass species (Dennison et al 1993; Durako et al 2003). Paddle Grass was most frequently found as a solitary species within the deeper portions of the sampling area.

Seagrass was also found within the shallow bay inside Karen Golonka Island. While we encountered three species inside this bay, Paddle Grass was by far the most common seagrass, as it was found at 9 of the 27 quadrats that were sampled there. Shoal Grass and Johnson's Grass was also present, but each species occupied only a single quadrat. Generally, seagrass frequency and abundance tended to decrease as the sampling moved further into the interior. Restoration work had recently been completed at Sawfish Island that removed material from the island's interior to provide kayak and paddleboard access (Figure 9). This project was too recent to appear on any of the available aerial imagery. No attempt was made to look for seagrass as it was too soon following construction for seagrass to establish. However, parts of the lagoon that we did enter had very deep sediment reaching as high as mid-thigh. Perhaps these sediments will compact and facilitate seagrass recruitment in the future.

Figure 9. Photo shows recent completion of the interior paddling trails of Sawfish Island. Work was completed just as this assessment was started.

We offer this report as an initial species-specific record of seagrass presence, abundance, and composition around Karen Golonka and Sawfish Islands as well as adjoining Sawfish Bay Park. This report may serve as a baseline for future assessments. Additional restoration activities are anticipated in the coming years, as well as additional recreation opportunities. Increased seagrass abundance, and the varied wildlife associated with seagrass, demonstrates restoration success and would enhance the user's experience.

References

Braun-Blanquet, J. 1932. Plant sociology. The study of plant communities. *Plant sociology. The study of plant communities. First ed.* 539 pp.

Dawes, C.J., D. Hanisak, and J.W. Kenworthy. 1995. Seagrass biodiversity in the Indian River Lagoon. Bul. Mar. Sci. 57(1), 59–66.

Dennison, W.C., R.J. Orth, K.A. Moore, J.C. Stevenson, V. Carter, S. Kollar, P.W. Bergstrom, and R.A. Batiuk. 1993. Assessing water quality with submersed aquatic vegetation. Bio. Sci. 43(2), 86-94.

Durako, M.J., J.I. Kunzelman, W.J. Kenworthy, and K.K. Hammerstrom. 2003. Depth-related variability in the photobiology of two populations of *Halophila johnsonii* and *Halophila decipiens*. Mar. Bio. 142, 1219-1228.

Green, E. P., F. T. Short, & T. Frederick. 2003. *World atlas of seagrasses*. Univ of California Press.

Lirman, D., W. P. Cropper. 2003. The influence of salinity on seagrass growth, survivorship, and distribution within Biscayne Bay, Florida: Field, experimental, and modeling studies. Estuaries 26 (1) 131-141.

Metz, J.L., R.J. Harris, and D.A. Arrington. 2020. Seasonal Occurrence Patterns of Seagrass Should Influence Resource Assessment and Management Decisions: A Case Study in the Indian River Lagoon and Loxahatchee River Estuary, Florida. Regional Studies in Marine Science 34:101093

Montague, C.L., Ley, J.A., 1993. A possible effect of salinity fluctuation on abundance of benthic vegetation and associated fauna in Northeastern Florida Bay. Estuaries 16,703–717.

Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L.A. Heck, R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott, and S.L. Williams. 2006. A global crisis for seagrass ecosystems. Bioscience 56(12), 987–996.

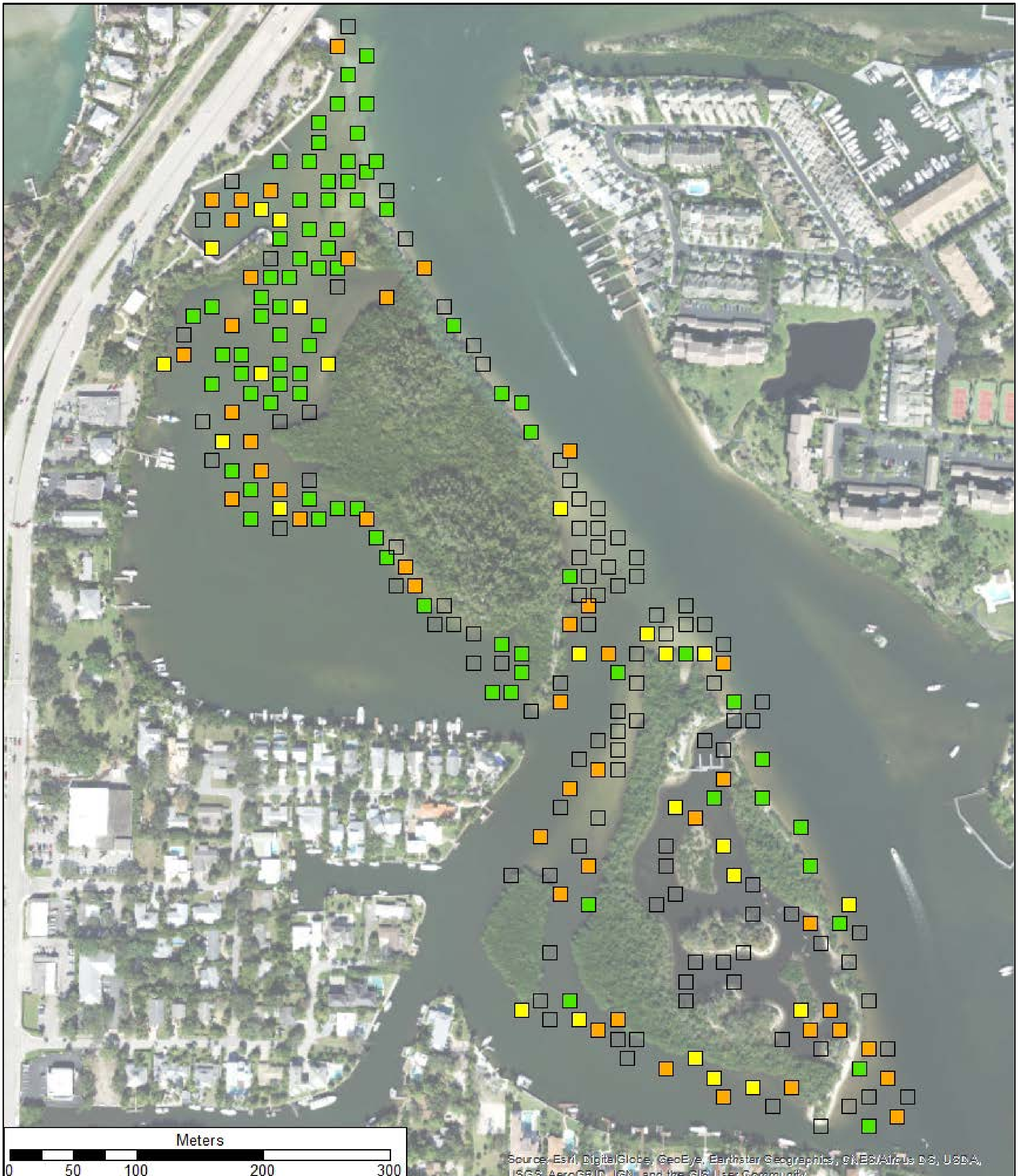
Ridler, M.S., R.C. Dent, and D.A. Arrington. 2006. Effects of Two Hurricanes on *Syringodium filiforme*, Manatee Grass, Within the Loxahatchee River Estuary, Southeast Florida. Estuaries and Coasts 29:1019-1025.

Stoner, E., and D.A. Arrington. 2017. Nutrient inputs from an urbanized landscape may drive water quality degradation. Sustainability of Water Quality and Ecology 9-10:136-150

Waycott, M., C.M. Duarte, T.J.B. Carruthers, R.J. Orth, W.C. Dennison, S. Olyarnik, A. Calladine, J.W. Fourqurean, K.L. Heck, A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, F.T. Short, and S.L. Williams. 2009. Accelerating loss of seagrasses across the globe threatens coastal ecosystems. PNAS 106(30), 12377–12381.

Appendix 1

Categorical Presence



Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Total Seagrass
- Continuous
- Patchy
- Sparse
- Absent

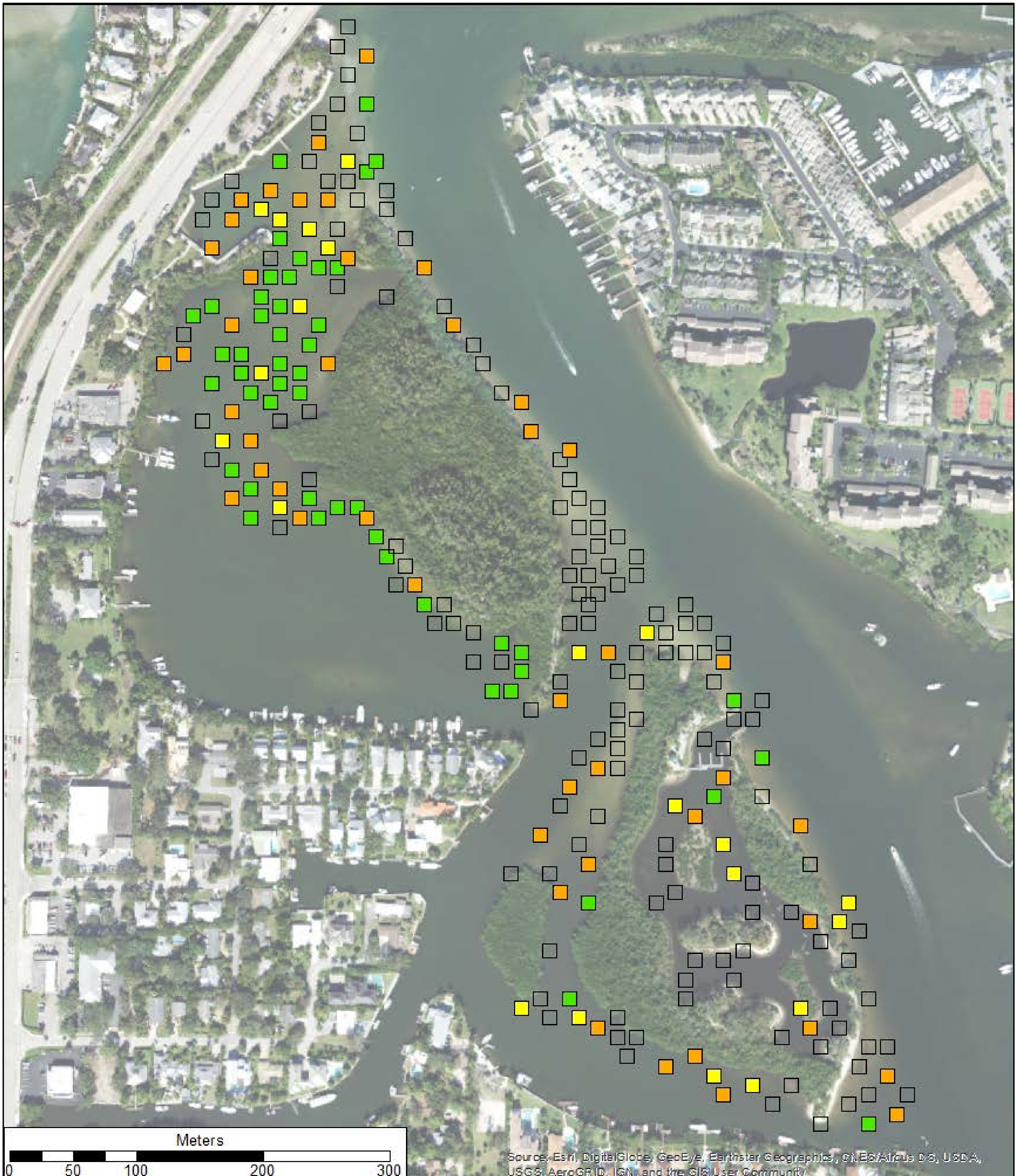
The above map shows the categorical presence of total seagrass based on the number of squares (0-9) occupied by seagrass in a 3m x 3m collapsible quadrat. Survey performed during summer 2023.

N

Aerial: 2021

Drawn By: Jerry Metz Date:5/20/2024

Appendix 1a



Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Paddle Grass
- Continuous
- Patchy
- Sparse
- Absent

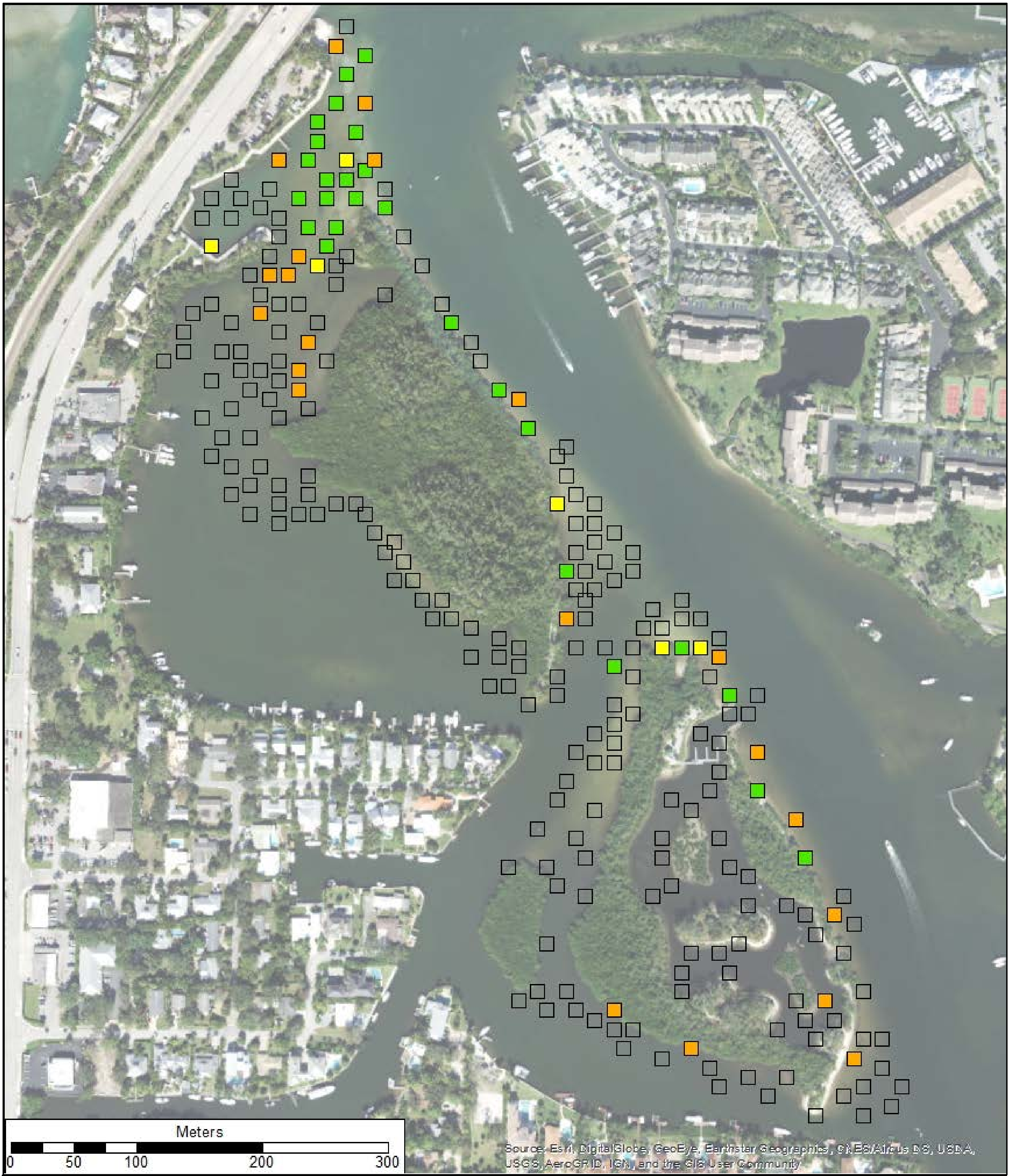
The above map shows the categorical presence of Paddle Grass (*Halophila decipiens*) based on the number of squares (0-9) occupied by seagrass in a 3m x 3m collapsible quadrat. Survey performed during summer 2023.

Drawn By: Jerry Metz Date:5/20/2024

N

Aerial: 2021

Appendix 1b



Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Shoal Grass
- Continuous
- Patchy
- Sparse
- Absent

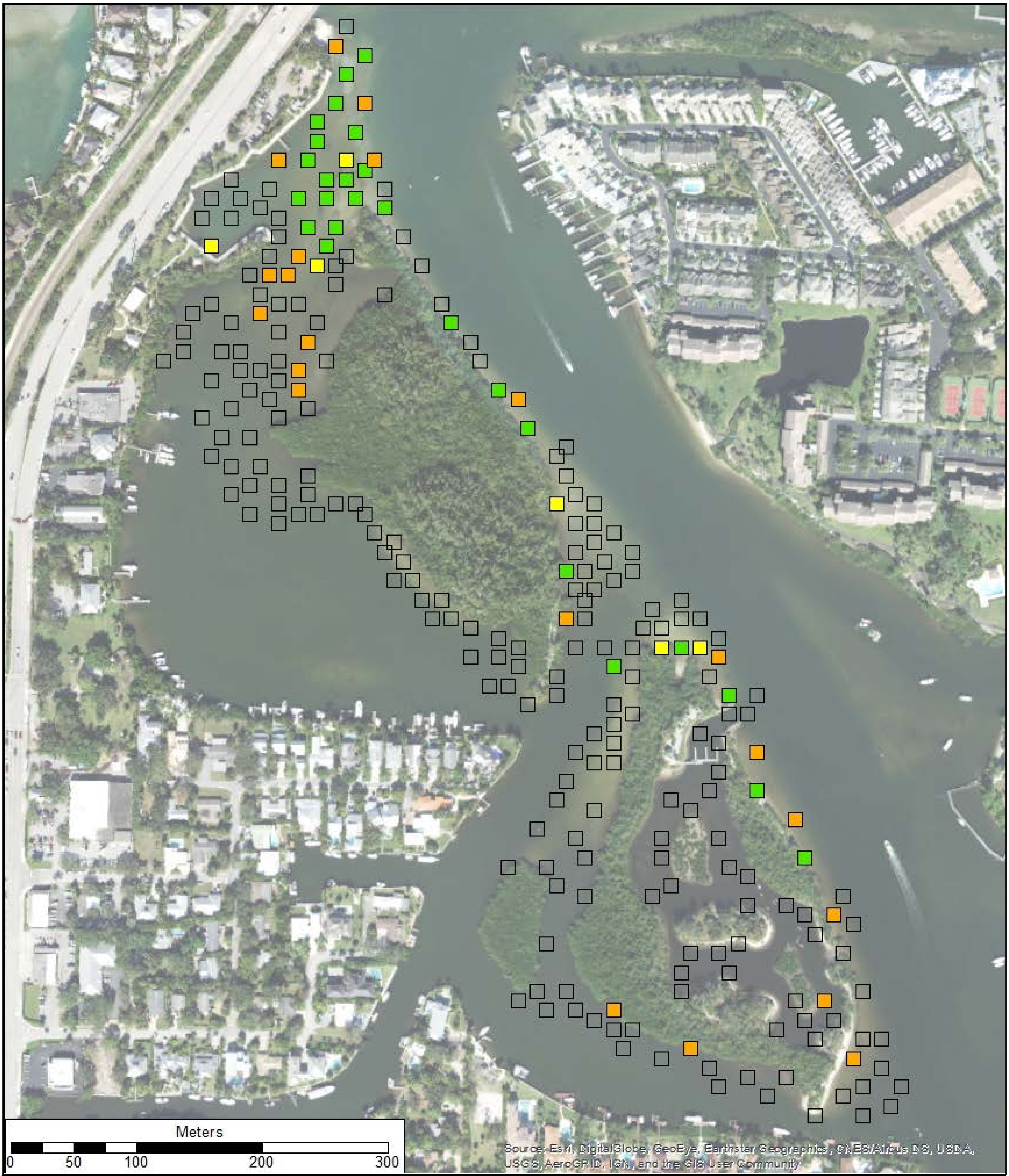
The above map shows the categorical presence of Shoal Grass (*Halodule wrightii*) based on the number of squares (0-9) occupied by seagrass in a 3m x 3m collapsible quadrat. Survey performed during summer 2023.

Drawn By: Jerry Metz Date:5/20/2024

N

Aerial: 2021

Appendix 1c



Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Johnson's Grass
- Continuous
- Patchy
- Sparse
- Absent

The above map shows the categorical presence of Johnson's Grass (*Halophila ovalis*) based on the number of squares (0-9) occupied by seagrass in a 3m x 3m collapsible quadrat. Survey performed during summer 2023.

N

Aerial: 2021

Drawn By: Jerry Metz Date:5/20/2024

Appendix 1d

Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Turtle Grass
- Continuous
- Patchy
- Sparse
- Absent

The above map shows the categorical presence of Turtle Grass (*Thalassia testudinum*) based on the number of squares (0-9) occupied by seagrass in a 3m x 3m collapsible quadrat. Survey performed during summer 2023.

Aerial: 2021

Drawn By: Jerry Metz Date:5/20/2024

Appendix 1e

Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Manatee Grass
- Continuous
- Patchy
- Sparse
- Absent

The above map shows the categorical presence of Manatee Grass (*Syringodium filiforme*) based on the number of squares (0-9) occupied by seagrass in a 3m x 3m collapsible quadrat. Survey performed during summer 2023.

N

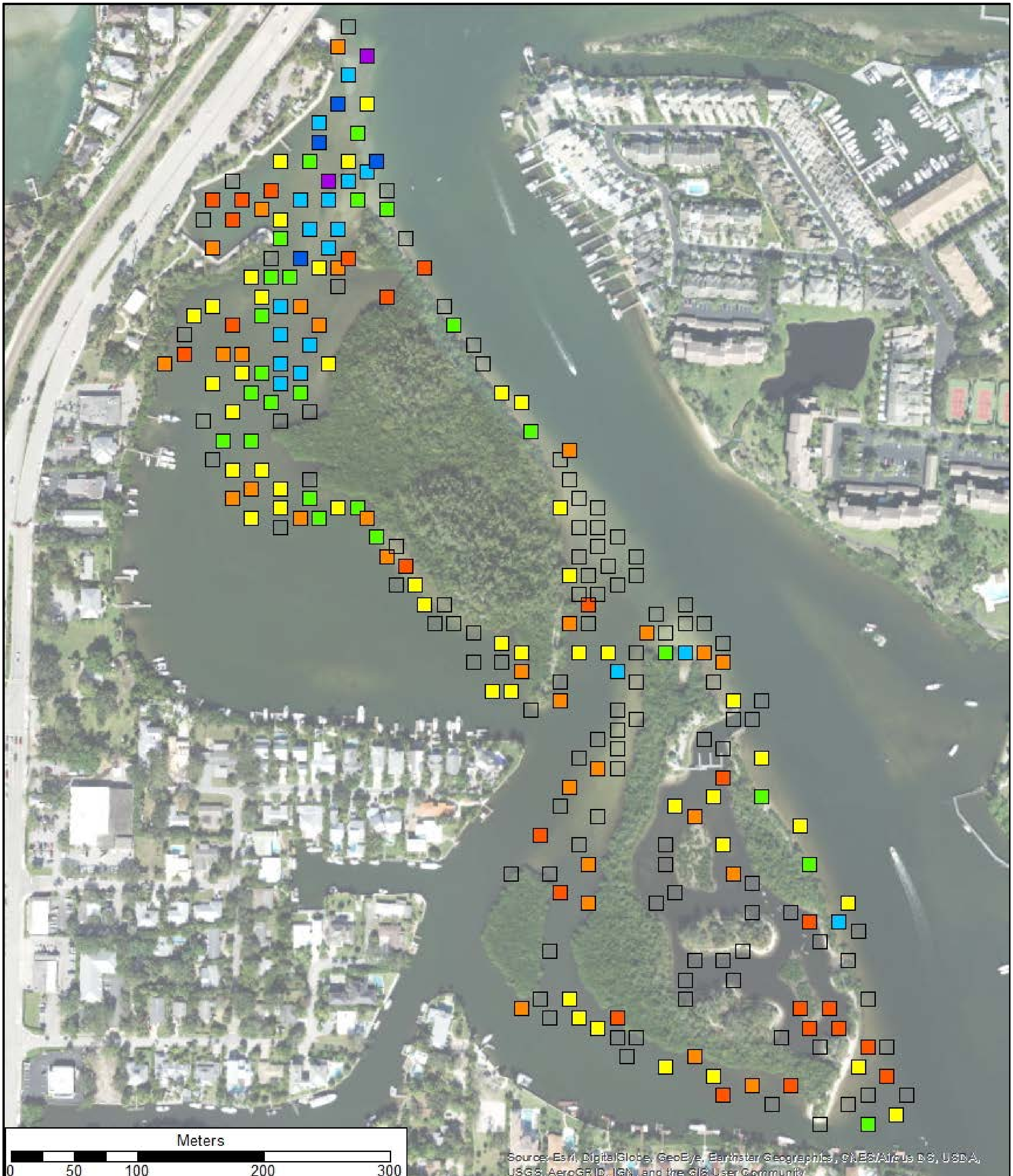
Aerial: 2021

Drawn By: Jerry Metz Date:5/20/2024

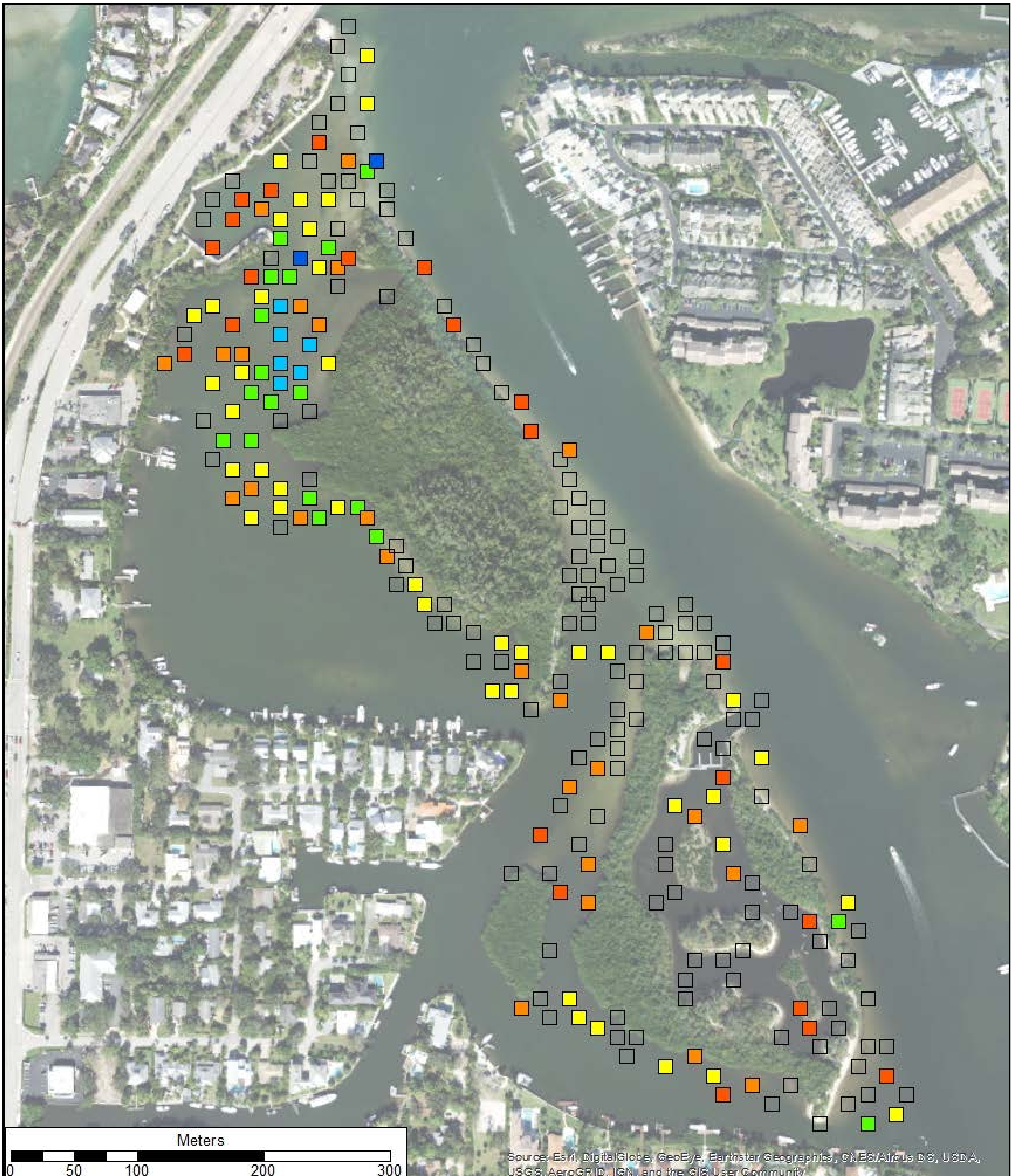
Appendix 1f

Appendix 2

Braun-Blanquet Vegetative Cover



Loxahatchee River District	Total Seagrass			N
2500 Jupiter Park Dr.	>75%	1-5%	The above map shows the percent vegetation cover for total seagrass using the 8-point Braun-Blanquet scale. Empty squares indicate seagrass species was not present.	
Jupiter, FL. 33458	50-75%	<1%		
(561) 747-5700	25-50%	<<1%		Aerial: 2021
www.loxahatcheeriver.org	5-25%	Absent	Drawn By: Jerry Metz Date:5/20/2024	Appendix 2a



Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Paddle Grass

- >75%
- 50-75%
- 25-50%
- 5-25%
- 1-5%
- <1%
- <<1%
- Absent

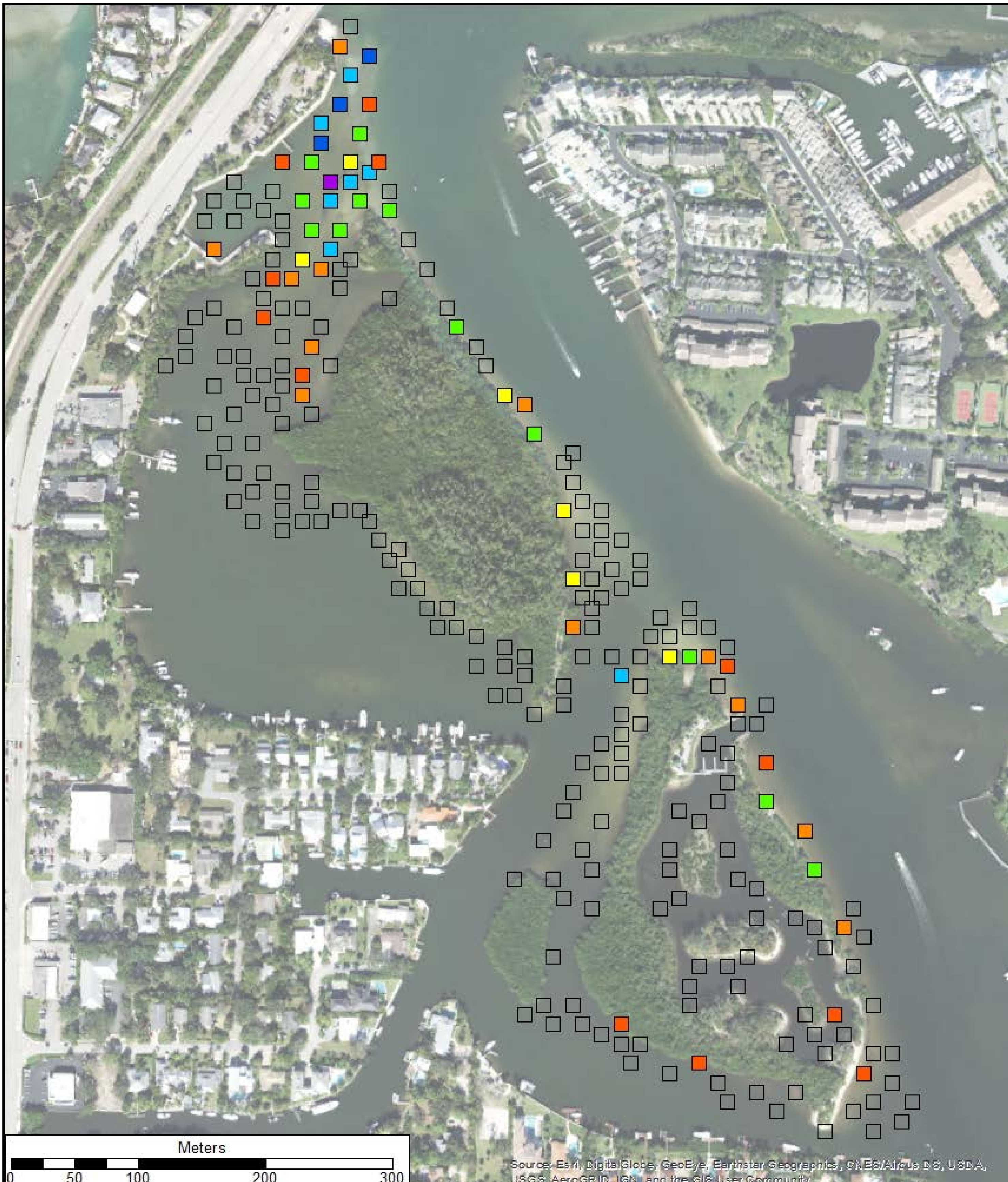
The above map shows the percent vegetation cover for Paddle Grass (*Halophila decipiens*) using the 8-point Braun-Blanquet scale. Empty squares indicate seagrass species was not present.

Drawn By: Jerry Metz Date:5/20/2024

N

Aerial: 2021

Appendix 2b



Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Shoal Grass

- >75%
- 50-75%
- 25-50%
- 5-25%
- 1-5%
- <1%
- <<1%
- Absent

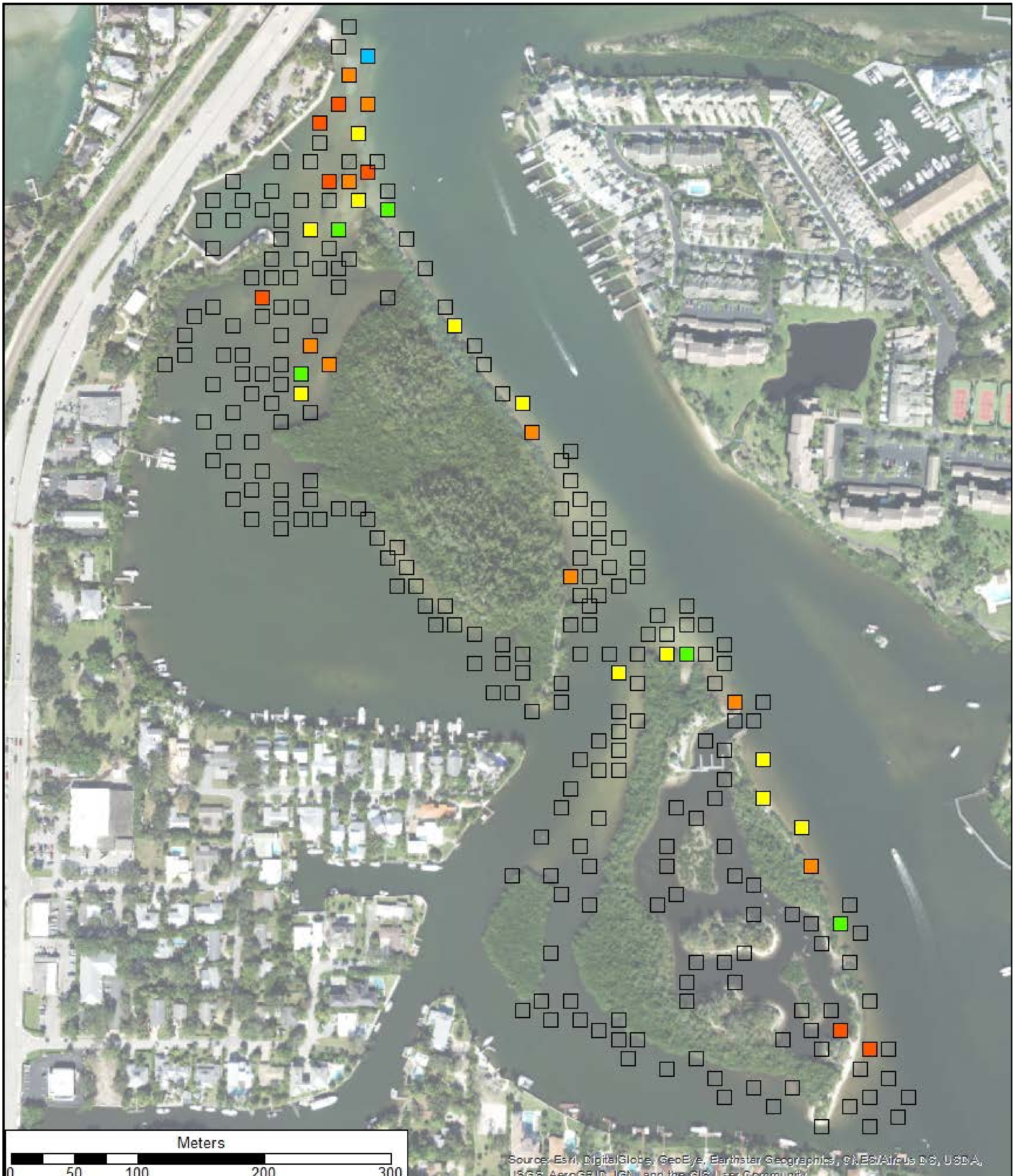
The above map shows the percent vegetation cover for Shoal Grass (*Halodule wrightii*) using the 8-point Braun-Blanquet scale. Empty squares indicate seagrass species was not present.

N

Aerial: 2021

Drawn By: Jerry Metz Date:5/20/2024

Appendix 2c



Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Johnson's Grass

- >75%
- 50-75%
- 25-50%
- 5-25%
- 1-5%
- <1%
- <<1%
- Absent

The above map shows the percent vegetation cover for Johnson's Grass (*Halophila ovalis*) using the 8-point Braun-Blanquet scale. Empty squares indicate seagrass species was not present.

Drawn By: Jerry Metz Date:5/20/2024

N

Aerial: 2021

Appendix 2d

Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Turtle Grass

- >75%
- 50-75%
- 25-50%
- 5-25%
- 1-5%
- <1%
- <<1%
- Absent

The above map shows the percent vegetation cover for Turtle Grass (*Thalassia testudinum*) using the 8-point Braun-Blanquet scale. Empty squares indicate seagrass species was not present.

N

Aerial: 2021

Drawn By: Jerry Metz Date:5/20/2024

Appendix 2e

Loxahatchee River District
2500 Jupiter Park Dr.
Jupiter, FL. 33458
(561) 747-5700
www.loxahatcheeriver.org

Manatee Grass

>75%	1-5%
50-75%	<1%
25-50%	<<1%
5-25%	Absent

The above map shows the percent vegetation cover for Manatee Grass (*Syringodium filiforme*) using the 8-point Braun-Blanquet scale. Empty squares indicate seagrass species was not present.

Drawn By: Jerry Metz Date:5/20/2024

N

Aerial: 2021

Appendix 2f