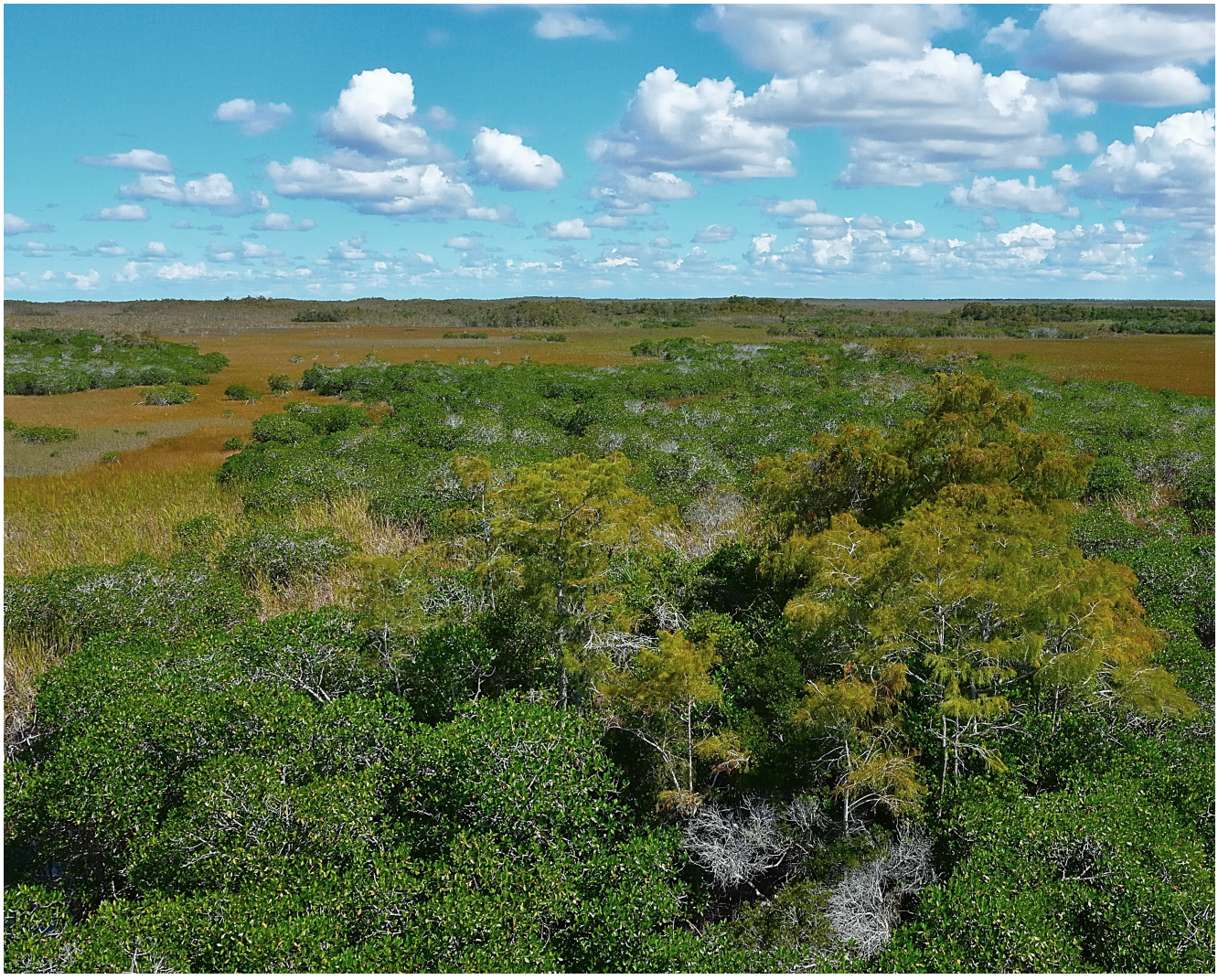
National Park Service
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Natural Resource Stewardship and Science

The Everglades National Park and Big Cypress National Preserve Vegetation Mapping Project

Interim Report—Northwest Coastal Everglades (Region 4), Everglades National Park

Natural Resource Report NPS/SFCN/NRR—2020/2133



ON THE COVER

Photograph of mangrove-marsh boundary showing the transgression of red mangrove into freshwater marsh environments within the Northwest Coastal Everglades, Region 4, Everglades National Park.
Photo credit Craig P. Perry (25 November 2018).

The Everglades National Park and Big Cypress National Preserve Vegetation Mapping Project

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Natural Resource Report NPS/SFCN/NRR—2020/2133

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Month 2020

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Acronyms and Abbreviations

2D:	Two-dimensional
3D:	Three-dimensional
AA:	Accuracy Assessment Point
BICY:	Big Cypress National Preserve
CERP:	Comprehensive Everglades Restoration Plan
CIR:	Color infrared
EVER:	Everglades National Park
FGDC:	Federal Geographic Data Committee
GE:	Greater Everglades
GPS:	Global Positioning System
ha:	Hectare
km:	Kilometers
MAP:	Monitoring and Assessment Plan
NAD:	North American Datum
NIR:	Near-infrared
NPS:	National Park Service
NWCE:	Northwest Coastal Everglades
RECOVER:	REstoration COordination and VERification
RMSE:	Root mean square error
RTKGPS:	Real-time kinematics Global Positioning System
SFWMD:	South Florida Water Management District
TP:	Training Point
USACE:	United States Army Corps of Engineers
VCSFNA:	Vegetation Classification System for South Florida Natural Areas
VMI:	Vegetation Mapping Inventory Program
VP:	Verification Point
WCA:	Water Conservation Areas
WRDA:	Water Resource Development Act

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Executive Summary

The Everglades National Park and Big Cypress National Preserve vegetation mapping project is part of the Comprehensive Everglades Restoration Plan (CERP). It is a cooperative effort between the South Florida Water Management District (SFWMD), the United States Army Corps of Engineers (USACE), and the National Park Service's (NPS) Vegetation Mapping Inventory Program (VMI). The goal of this project is to produce a spatially and thematically accurate vegetation map of Everglades National Park and Big Cypress National Preserve prior to the completion of restoration efforts associated with CERP. This spatial product will serve as a record of baseline vegetation conditions for the purpose of: (1) documenting changes to the spatial extent, pattern, and proportion of plant communities within these two federally-managed units as they respond to hydrologic modifications resulting from the implementation of the CERP; and (2) providing vegetation and land-cover information to NPS park managers and scientists for use in park management, resource management, research, and monitoring.

This mapping project covers an area of approximately 7,400 square kilometers (1.84 million acres [ac]) and consists of seven mapping regions: four regions in Everglades National Park, Regions 1–4, and three in Big Cypress National Preserve, Regions 5–7. The report focuses on the mapping effort associated with the Northwest Coastal Everglades (NWCE), Region 4[1], in Everglades National Park. The NWCE encompasses a total area of 1,278 square kilometers (493.7 square miles [sq mi], or 315,955 ac) and is geographically located to the south of Big Cypress National Preserve, west of Shark River Slough (Region 1), and north of the Southwest Coastal Everglades (Region 3).

Photo-interpretation was performed by superimposing a 50 × 50-meter (164 × 164-feet [ft] or 0.25 hectare [0.61 ac]) grid cell vector matrix over stereoscopic, 30 centimeters (11.8 inches) spatial resolution, color-infrared aerial imagery on a digital photogrammetric workstation. Photo-interpreters identified the dominant community in each cell by applying majority-rule algorithms, recognizing community-specific spectral signatures, and referencing an extensive ground-truth database. The dominant vegetation community within each grid cell was classified using a hierarchical classification system developed specifically for this project. Additionally, photo-interpreters categorized the absolute cover of cattail (*Typha* sp.) and any invasive species detected as either: Sparse (10–49%), Dominant (50–89%), or Monotypic (90–100%).

A total of 178 thematic classes were used to map the NWCE. The most common vegetation classes are Mixed Mangrove Forest-Mixed and Transitional Bayhead Shrubland. These two communities accounted for about 10%, each, of the mapping area. Other notable classes include Short Sawgrass Marsh-Dense (8.1% of the map area), Mixed Graminoid Freshwater Marsh (4.7% of the map area), and Black Mangrove Forest (4.5% of the map area). The NWCE vegetation map has a thematic class accuracy of 88.4% with a lower 90th Percentile Confidence Interval of 84.5%.

[1] The Northwest Coastal Everglades, Region 4, consist of two sections; Region 4 SE, mapped by the South Florida Caribbean Network, and Region 4 NW, mapped by Avineon, Inc. See Figure 1 on page 2.

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The United States Army Corps of Engineers (USACE) and the National Park Service (NPS) National Vegetation Inventory Program provided the funding for this project. Special thanks to Theodore N. Schall, Donna George, Javier Cortes, and April Patterson from USACE. From the National Park Service, we would like to recognize Pedro Ramos, Karl Brown, Jed Redwine, Agnes McLean, David Rudnick, Leonard Pearlstine, Jimi Sadle, Judd Patterson, Robert Muxo, Mario Londoño, Andrea Atkinson, and Matt Patterson. Fred Sklar from the South Florida Water Management District and Daniel Gann from the Geographic Information Systems Center at Florida International University (FIU), provided several of the photogrammetric workstations used in this project. The Geographic Information Systems Center at FIU provided multiple interns on the project as well. Helicopter transportation, logistics, and training provided by Everglades National Park and Big Cypress National Preserve Fire and Aviation: Fred Goodwin, Michael O'Leary, Clayton Camblin, Gary Carnall, Micheal Roof, Henry DelValle, Andrew Gill, Steve Newland, Nicholas Connolly, Ashlee Girardi, and Kevin Logiudice. This is a CERP/RECOVER project.

Introduction

Everglades National Park and Big Cypress National Preserve Vegetation Mapping Project

The Everglades National Park and Big Cypress National Preserve vegetation mapping project is a component of the Comprehensive Everglades Restoration Plan (CERP). It is a cooperative effort between the South Florida Water Management District (SFWMD), the United States Army Corps of Engineers (USACE), and the National Park Service (NPS) Vegetation Mapping Inventory Program (VMI). The goal of the project is to produce a spatially and thematically accurate vegetation map of Everglades National Park and Big Cypress National Preserve. This vegetation map will serve as a record of baseline conditions needed to: (1) document changes to the spatial extent, pattern, and proportion of plant communities within these two federally managed units as they respond to management driven hydrologic modifications resulting from the implementation of the CERP; and (2) provide vegetation and land-cover information to NPS park managers and scientists for use in park management, resource management, research, and monitoring.

This project covers an area of approximately 7,400 square kilometers (2,857 sq mi or 1.83 million ac) and consists of seven mapping regions: four regions in Everglades National Park, Regions 1–4, and three in Big Cypress National Preserve, Regions 5–7 (Figure 1). This project was initiated in 2006 with a subcontract to Avineon, Inc. to map one-third of Big Cypress National Preserve (Region 7; 891 square kilometers [344 sq mi]) and the northwest corner of Region 4, Region 4 NW, (243 square kilometers [93.8 sq mi^2]) in Everglades National Park (Figure 1). The SFWMD completed a 406-square kilometer (156.7-sq mi) section of Region 1 in 2010 that included the northernmost portion of Region 1 (Figure 1). Upon completion of this initial section, the photo-interpretation portion of the remaining sections of the map were transferred to the USACE Jacksonville District office in Jacksonville, Florida, and project data collection and field support were delegated to the South Florida/Caribbean Network (SFCN) in south Florida. In 2015, the network took on the mapping responsibilities associated with Regions 2–6 of this project (Figure 1). This change allowed the project to take advantage of the South Florida/Caribbean Network's institutional knowledge of botany, community ecology, and remote sensing as well as efficiencies afforded by the network's proximity to Everglades National Park and Big Cypress National Preserve. The USACE priorities then shifted toward the completion of Region 1 and assisting the network with the final quality assurance and quality control (QA/QC) of mapped products.

This report focuses on the mapping effort associated with Region 4, the Northwest Coastal Everglades (NWCE), which includes the section map by Avineon, Inc., Region 4 NW, and Region 4 SE mapped by South Florida/Caribbean Network (Figure 1). The NWCE encompasses a total area of 1,278 square kilometers (493.7 square miles [sq mi], or 315,955 acres [ac]) and is geographically located to the south of Big Cypress National Preserve, west of Shark River Slough (Region 1), and north of the Southwest Coastal Everglades (Region 3, Figure 1).

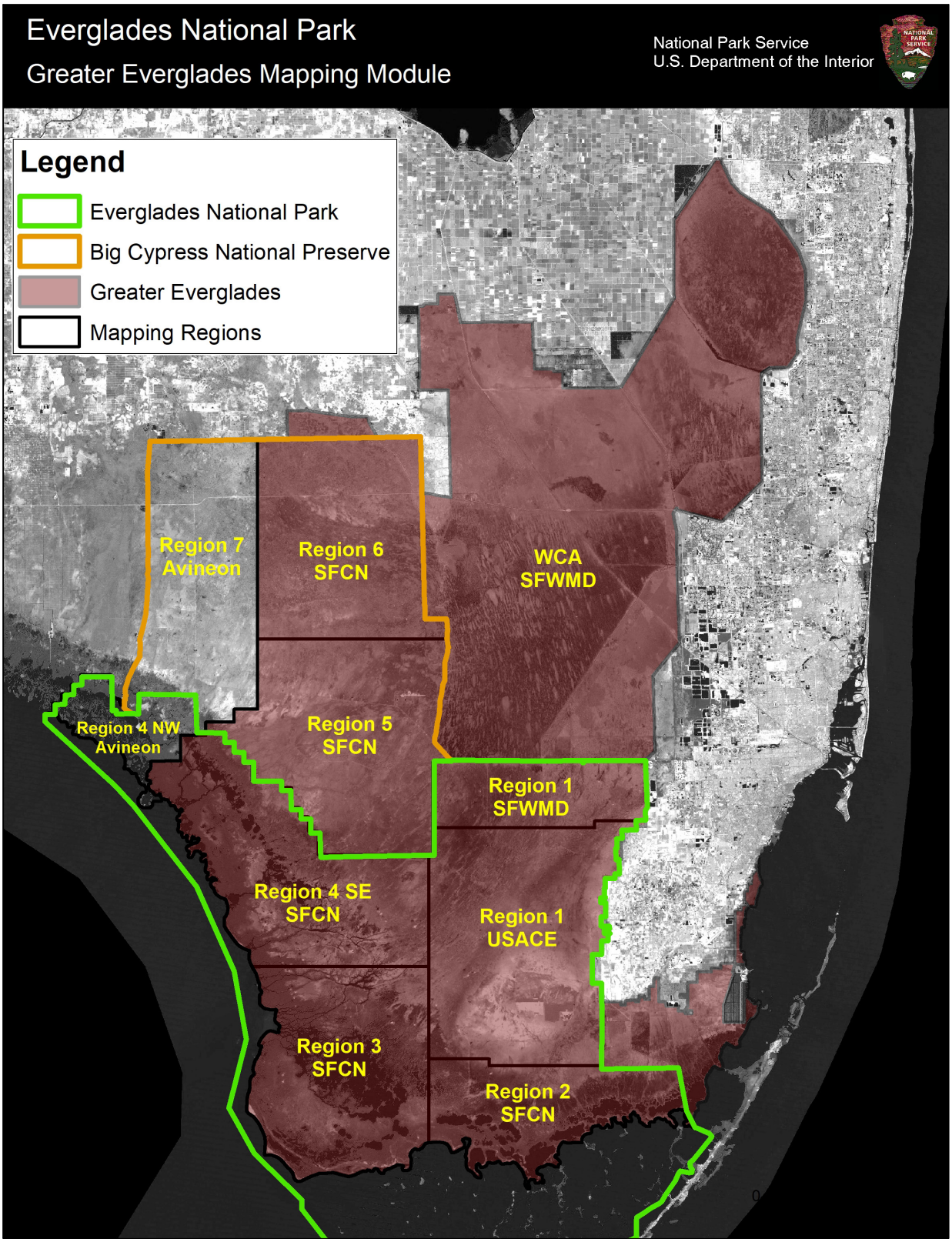


Figure 1. Greater Everglades mapping module and location of mapping regions within Everglades National Park and Big Cypress National Preserve.

Comprehensive Everglades Restoration Plan

Title VI Sec 601 of the Water Resource Development Act (WRDA) of 2000 authorized the Comprehensive Everglades Restoration Plan (CERP) as the framework for the modifications and operational changes needed to restore, preserve, and protect the south Florida ecosystem (Water Resource Development Act 2000). As part of the CERP, Congress authorized the **RE**storation **CO**ordination and **VER**ification (RECOVER) program to: (1) organize and provide scientific and technical support to the interagency body of scientists and managers implementing the CERP, and (2) provide a mechanism, through the Monitoring and Assessment Plan (MAP), for assessing the performance of the CERP (RECOVER 2004). The goal of the CERP MAP is to have a system-wide monitoring and assessment plan that is supported and used by all CERP participants, including tribal nations, to track and measure system wide responses to the implementation of the CERP (RECOVER 2004).

The MAP consists of six monitoring modules designed to document and establish pre-restoration reference conditions for the Greater Everglades (GE) region, which includes Everglades National Park and Big Cypress National Preserve (Figure 1). Monitoring and Assessment Plan Module Number 3.1.3.4 specifically calls for the creation of a spatially and thematically accurate vegetation map of the entire GE project area that would serve, along with other metrics, as baseline conditions to assess the system-wide performance of the CERP over the next several decades (RECOVER 2004).

For more information regarding the CERP, please visit the Comprehensive Everglades Restoration Plan website.

The National Park Service Vegetation Mapping Inventory Program

The National Park Service Vegetation Mapping Inventory Program (NPS VMI) is a national program designed to classify, describe, and map the vegetation communities within all U.S. national park units except Alaska.[2] The NPS VMI program is designed to address the local management needs of each park unit and provide vegetation inventory data for regional and national level management decisions. This program sets guidelines by which all NPS vegetation mapping products must adhere. This ensures consistency throughout all park units and that all VMI mapping projects meet Federal Geographic Data Committee (FGDC) standards on vegetation classification system, metadata, minimum mapping unit, spatial accuracy, and minimum acceptable map accuracy (Owens 1999; Studd et al. 2013).

The NPS Biological Resource Management Division located in Fort Collins, Colorado manages the VMI and maintains a collaborative partnership with the United States Geological Survey Center for Biological Informatics, which provides scientific and technical oversight (Owens 1999). Since its inception in 1992, the NPS VMI has overseen 185 NPS VMI mapping projects. All NPS VMI

[2] National parks in Alaska are being mapped by the Alaska Landcover Inventory Program (https://www.nps.gov/subjects/aknatureandscience/aklandcover.htm).

mapping products are expected to be completed by 2022. For more information regarding the NPS VMI program, please visit the NPS Vegetation Mapping Inventory website.

Everglades National Park and Big Cypress National Preserve

Everglades National Park

Everglades National Park is the third-largest national park within the contiguous United States, and the largest park east of the Mississippi River. Congress authorized the establishment of the park in 1934 to protect an ecosystem threatened by drainage, poaching, agricultural development, and urbanization. This was the first time that Congress authorized a national park for the protection of an ecosystem and its biological value, rather than a geographic feature.

Located on the southern tip of the Florida peninsula at about 2° north of the Tropic of Cancer (25.5° N Latitude), the climate of Everglades National Park is more similar to those of tropical regions than that of the continental United States (Duever et al. 1994). Mean daily temperatures range from 17–25°C (62.6–77°F) with average mean daily temperatures rarely falling below 10°C (50°F) during the winter months (Duever et al. 1994; Obeysekera et al. 1999). However, temperatures at or below freezing do occur. There is a well-defined rainy season, May through October; and a dry season, November through April. Rainfall during the summer rainy season typically accounts for nearly 60% of the annual rainfall, which ranges between 119–157 centimeters (46.8–61.8 inches [in]) per year (Duever et al. 1994).

Ground surface elevations within Everglades National Park range from at or below sea level near the coast, to 4.3 meters (14.1 ft) above the interior forests and tree islands. Vegetation communities are arranged along this narrow elevation gradient creating a patch mosaic of mangrove swamps, graminoid marshes and prairies, hammocks and pine woodlands, where elevational differences in millimeters not only determine inundation frequency and duration, but also the community type.

Because of its geographic location and mild climate, Everglades National Park is home to a unique assemblage of both tropical and temperate species. It is home to 400 species of birds, 800 species of vertebrates, 1,600 species of vascular plants, and 125 species of fish; of which 202 are federally- or state-listed species (Patterson et al. 2008). The park is also the only place in the world where alligators (*Alligator mississippiensis*) and crocodiles (*Crocodylus acutus*) coexist.

Many of the external pressures and challenges that prompted the creation of Everglades National Park are still present today. Management decisions and restoration efforts are tied to water quantity and quality issues. Additional stresses from invasive species like the Burmese Python (*Python bivittatus*) and Brazilian pepper (*Schinus terebinthifolius*), climate change and sea-level rise, and a host of other issues continue to challenge park managers and biologists.

Big Cypress National Preserve

Big Cypress National Preserve was officially established in 1974 to conserve and protect natural resources, ecological functionality, and recreational and native tribal land uses. Its designation as a preserve was the culmination of advocacy from groups of hunters, conservationists, native tribes, and regional water managers. The preserve was established to protect the biodiversity within it, as well as

the watershed that provides freshwater to the downstream estuaries along the Gulf Coast of Everglades National Park. The preserve is surrounded by the Water Conservation Areas (WCA) to the east, the Gulf of Mexico to the west, and Everglades National Park to the south (Figure 1). It is connected to several other natural areas that are managed to conserve and protect natural resources and endangered species, such as the Florida panther (*Puma concolor coryi*).

The vegetation communities of Big Cypress are a mosaic of hardwood hammocks, pine woodlands, swamp forests, including cypress domes, strands, and scrub communities, freshwater marshes and prairies, coastal marshes and mangrove forests. These communities contain a high level of both plant and animal biodiversity, including 122 federally- or state-listed species (Patterson et al. 2008). Hydroperiod, water depth, and water quality (including nutrients and salinity), as well as natural perturbations like fires and windstorms, are the primary drivers shaping the community structure and species composition across the preserve landscape.

The climate of the preserve is typical for south Florida with mean annual temperatures ranging between 23°C (73.4°F) and 25°C (77.0°F; Davey et al. 2007). Mean monthly minimum temperature, during winter, typically ranges between 9°C (48.2°F) and 12°C (53.6°F; Davey et al. 2007). In the summer, the mean monthly maximum averages 32.5°C (90.5°F; Davey et al. 2007). The preserve has a well-defined rainy season (May through October) with mean annual precipitation averaging 136 centimeters (53.5 in; Duever et al. 1986).

Ground elevations in the preserve range from 7 meters (22.9 ft) above sea level in the northern portions of the preserve to 0.3 meters (0.98 ft) along the southern edge of the preserve (Duever et al. 1986). Like Everglades National Park, subtle differences in elevation typically lead to the presence of contrasting vegetation types within a few meters of each other.

Methods

The NWCE, Region 4, vegetation map consists of two Regions; Region 4 SE, mapped by the South Florida/Caribbean Network, and Region 4 NW, mapped by Avineon, Inc. (Figure 1). The methods used by Avineon, Inc. to produce the Region 4 NW vegetation map are outlined in Appendix A. Below are the methods used to produce the Region 4 SE vegetation map and the final NWCE vegetation map that consists of both the SE and NW vegetation maps.

Imagery

The imagery used for this vegetation map, including the other three Regions in Everglades National Park, consists of 30 centimeters (11.8 inches) spatial resolution multispectral digital color-infrared imagery procured by the South Florida Water Management District (SFWMD) in April 2009. The imagery was acquired using a Microsoft-Vexcel UltraCam-X large format digital aerial camera, which provides high resolution multispectral images (red, green, blue, and near-infrared). Images acquisition occurred at an average flight altitude of 4,163 meters (13,658 ft or 2.6 mi) with an average forward overlap of 60% to allow for stereoscopic visualization and estimation of vegetation height through a digital photogrammetric workstation.

A network of 12 aerial targets deployed throughout Everglades National Park was used to verify the accuracy of the Airborne Global Positioning System (GPS) and Internal Measurement Unit onboard the aircraft collecting the 2009 imagery. The horizontal and vertical location of each target was determined by using 1-hour static GPS sessions and post-processing using NGS Opus Rapid Static procedures (https://www.ngs.noaa.gov/OPUS/about.jsp). In addition, for each image exposure location a real-time kinematic GPS (RTKGPS) observation was acquired. The location of the 12 static targets and the 2,106 RTKGPS image exposure locations were adjusted by the SFWMD using standard least-squares method (weighted average), where the locations of the aerial targets were given weighted preference over the RTKGPS image exposure location measurements. Each target and image was referenced relative to the North American Datum (NAD) 1983 High Accuracy Reference Network, State Plane Coordinate System, Florida East Zone 901, and North American Vertical Datum of 1988 (NAVD88). A correlation analysis between the horizontal and vertical location of each aerial target and the imagery indicated that the horizontal and vertical accuracy of the image dataset met or exceeded FGDC standards for horizontal Second Order Class II (Root Mean Square Error [RMSE] of 0.445 m) and vertical Third Order (RMSE of 0.372 m) control points.

Photo-interpretation

This project employs a grid-based, 50 × 50-meter (164 × 164-ft.) grid (.25-hectare [.61-ac]) cell, majority rule mapping approach (Rutchey et al. 2008). In contrast to traditional vector mapping methods, where vegetation communities are delineated based on observable boundaries and a set minimum mapping unit (e.g., 10 square meters [107.76 sq ft] or 50 square meters [538.1 sq ft]), grid-

based mapping relies on the determination of the dominant[3] (majority) community or land cover type present within each grid cell.

At each grid cell, photo-interpreters determine and classify the dominant vegetation community to species level, wherever possible, using the *Vegetation Classification System for South Florida Natural Areas* (Rutchey et al. 2006) as modified in Appendix B. Photo-interpreters additionally categorize the absolute cover of cattail (*Typha* sp.) and any exotic species present in each grid cell as either: Sparse (10–49%), Dominant (50–89%), or Monotypic (90–100%).

Grid-based mapping has significant advantages over the traditional vector mapping approach. For example, it: (1) reduces mapping cost on a per-area basis; (2) reduces photo-interpreter variability; and (3) produces vegetation maps with more landscape heterogeneity since the photo-interpreter must view and classify the dominant vegetation or land cover type within each cell individually and independently of its neighbors (Rutchey and Godin 2009). Grid-based maps are generally better suited for vegetation change analysis and complex map algebra than vector maps (Rutchey and Godin 2009) and provide a standardized method for spatial data collection at multiple scales (Ramsdale et al. 2017). However, because of the aggregative nature of the majority rule, dominant features tend to increase in overall abundance while smaller features tend to decrease in overall abundance becoming less common within the map (He et al. 2002). Consequently, if a grid cell contains two or more community types of nearly equal cover, the less abundant, rare community within the region is selected over a more common community type. For example, in Shark River Slough, American white waterlily (*Nymphaea odorata*) sloughs are less abundant than sawgrass marshes or Gulf Coast spikerush sloughs. Thus, a split cell containing waterlily and another community type like sawgrass or Gulf Coast spikerush, having equal cover within the grid cell, is classified as waterlily to ensure this community is not underrepresented or missed entirely from the mapping product. Similarly, grid cells dominated by non-vegetative or exotic classes like water, mud, tidal flat, Australian pine (*Casuarina equisetifolia*) or Brazilian pepper, for example, with at least 40% (natural) vegetation cover are classified based on the natural vegetation class and not the dominant non-vegetative or exotic class within the cell (Exotics are captured as a modifier class as described in previous paragraph). Lastly, grid cells containing linear features like roads and canals are classified based on the vegetation community south of east-west running linear features (e.g., US Highway 41, Loop Road, and I-75 in Big Cypress) and to the east for linear features oriented north to south of the non-vegetative feature within the grid cell. This ensures consistency between neighboring grid cells and across the entire map.

Photogrammetric Workstation

Photo-interpreters use a digital photogrammetric workstation running Summit Evolution v7.4 to analyze the 2009 4-band multispectral aerial imagery (Photo 1). Summit Evolution is a software package designed for viewing, capturing, and analyzing three-dimensional (3D) information from stereoscopic imagery. This photogrammetric software package integrates seamlessly with ESRI

[3] The community with the greatest percent cover (majority) in the grid cell.

ArcGIS allowing for, but not limited to, the visualization of 3D data, vector data visualization and editing, and attribute population.

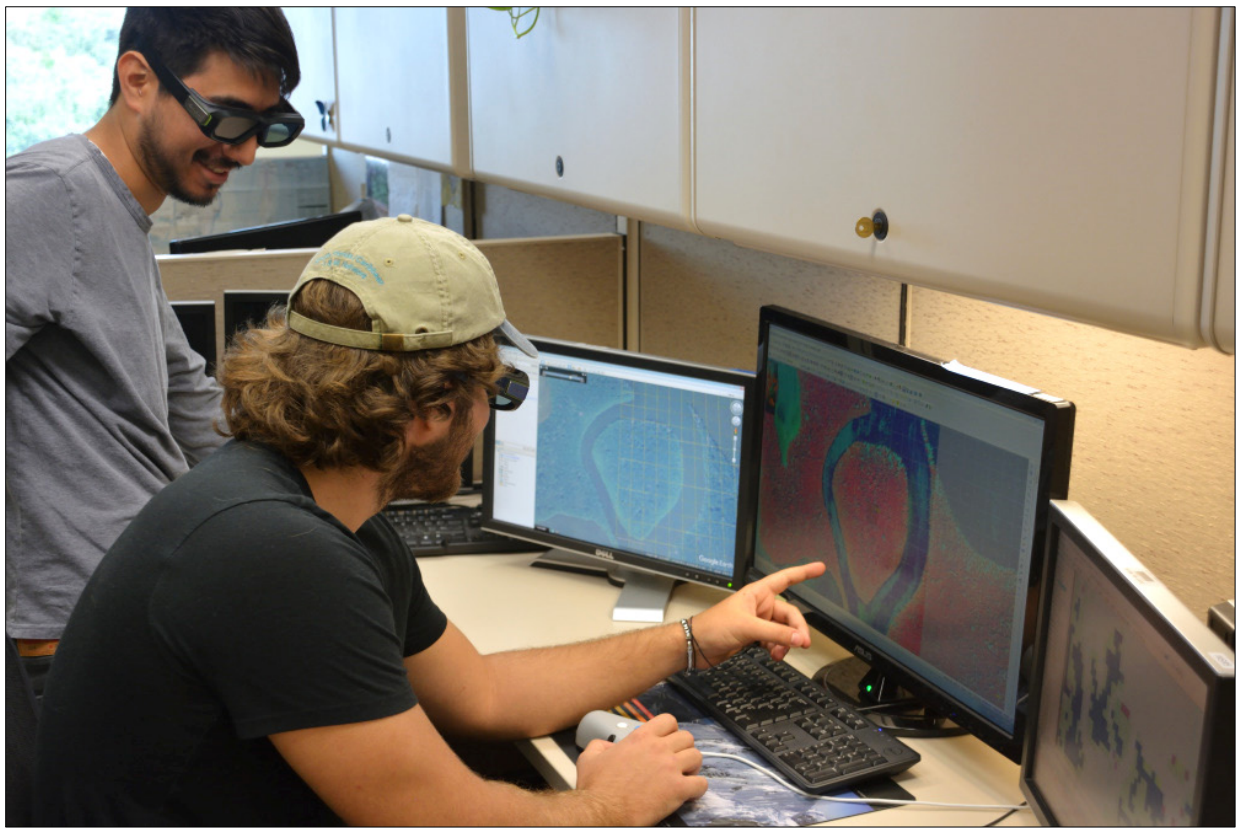


Photo 1. Photo-interpreters (Michael Foguer, left, and Alejandro Arteaga Garcia, right) working on a photogrammetric workstation running Summit Evolution v7.4.

Band Combinations

Photo-interpreters analyze the spectral signature of each grid cell using one of 11 different customizable channel assignments in Summit Evolution (Table 1). Channel assignments 0, 1, 3, and 5, were the most frequently used to differentiate community types and species within each grid cell. For instance, channel assignment 0, which used the Red, Green, and Blue spectral bands, was effective at indicating the presence of buttonwood within a grid cell; channel assignment 3 was effective in the identification of Transitional Bayhead Swamp Forest or Transitional Bayhead Swamp Shrubland communities; and, channel assignment 5, consisting of the NIR, Blue, and Green spectral bands, excelled at identifying red mangrove within a grid cell (Table 1).

Table 1. Designation of channel assignments and their corresponding spectral band (Red, Green, Blue, Near-Infrared [NIR]) combinations used in the Summit Evolution photogrammetric workstation to identify vegetation communities. Numbers in parentheses correspond to the Summit Evolution assigned image band number.

Summit Channel Assignment	Band Combination
0	Red(0), Green(1), Blue(2)
1	NIR(3), Red(0), Green(1)
2	NIR(3), Green(1), Blue(2)
3	NIR(3), Red(0), Blue(2)
4	Red(0), NIR(3), Green(1)
5	NIR(3), Blue(2), Green(1)
6	Red(0), Blue(2), Red(0)
7	Blue(2), NIR(3), Red(0)
8	NIR(3), Green(1), NIR(3)
9	Red(0), Blue(2), NIR(3)
10	NIR(3), Red(0), Red(0)

Vegetation Cover Estimation

Vegetation cover for each discrete community type present within a grid cell is determined by partitioning the photogrammetric workstation's cursor into 100 equal-sized squares, each 25 square meters (269 sq ft) or 1% of the entire 0.25-hectare (0.61-ac) grid cell. The parameters for the photogrammetric workstation cursor are set to: Grid size = 16.25; Columns = 11; and Rows = 11. This cursor arrangement allows photo-interpreters to count the total number of 25 square meter (269 sq ft) squares occupied by each discrete community type within each grid cell and determine the dominant/majority class present within the 0.25-hectare (0.61-ac) grid cell.

Canopy Height Estimation

The vegetation height of the dominant community type within each grid cell is determined by averaging the vegetation height at a minimum of 10 randomly located points for the dominant community type within each grid cell. Additionally, the zoom factor on the photogrammetric workstation was set to 4x to ensure consistency in canopy height estimation by all photo-interpreters. Canopy height estimation of digital images is scale-dependent, due to the way the imagery is stored as hierarchical, low to high resolution, copies or image pyramids. Thus, using a lower (e.g., 2x or 1x) zoom factor could lead to a less precise estimate of canopy height since a lower resolution image pyramid would be used to estimate canopy height.

Vegetation Data Collection

The vegetation data collected on this project include Training Points (TP), Botanical Training (BT) points, Verification Points (VP), and Accuracy Assessment (AA) data points. The AA points are

discussed later in this document. A total of 1,509 TP, BT, and VP data points were collected within the NWCE (Figure 2). In addition, Avineon, Inc. collected 145 verification points in 2008 for Region 4 NW to assist them with their mapping (Figure 2).

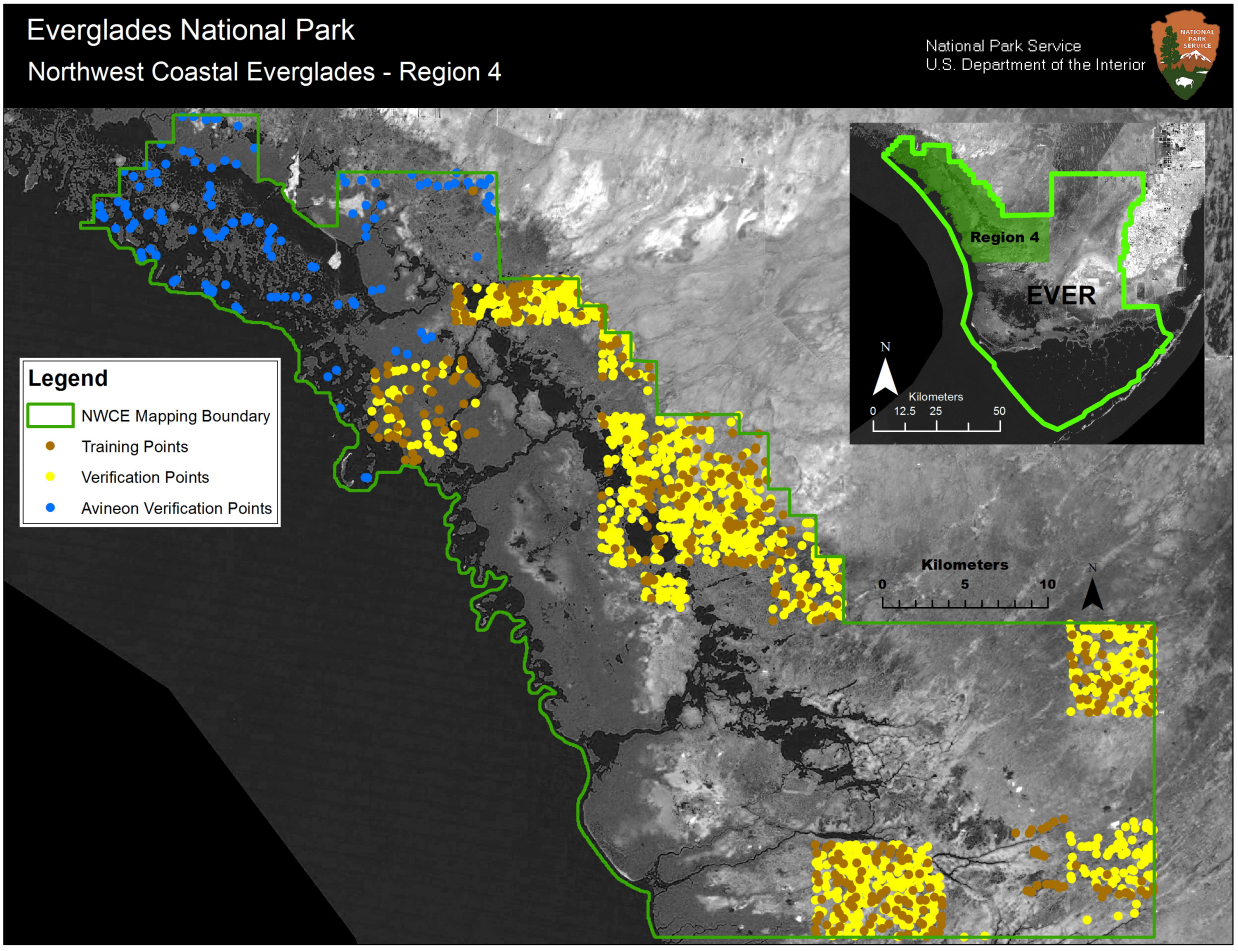


Figure 2. Location of Training Points and Verification Points collected within the Northwest Coastal Everglades, Region 4, Everglades National Park.

The TP data points provide species-specific compositional data and structural information. TP points characterize the dominant community within each grid cell. In some instances, however, they represent plant communities smaller than the 0.25-hectare (0.61-ac) grid cell, e.g., patches of cattails, water lily, or other species-specific community type.

The data collection method for TP and the AA (see Accuracy Assessment section below) data points is identical. Field staff record data on a pre-printed datasheet showing an aerial image of the area being sampled (Figure 3). Data recorded includes visual estimation of canopy height and vegetation cover, the relative cover of each strata (Tree, Shrub, and Herb), the relative cover of the dominant species within each stratum, and the maximum canopy height for each stratum. In addition, digital oblique photos taken at each TP or AA site document the structure and characteristics of the area sampled.

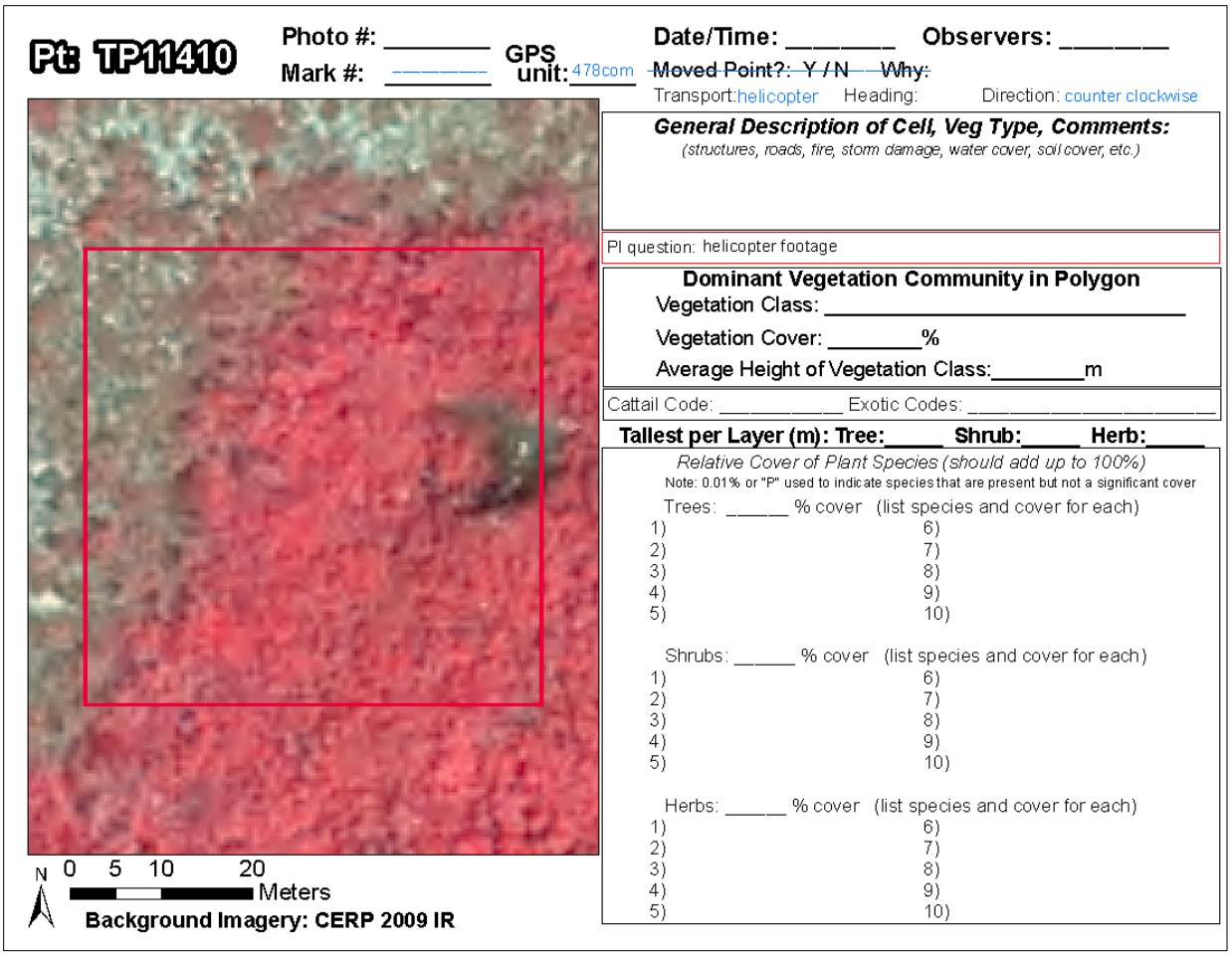


Figure 3. Example of a datasheet used to collect vegetation data on this project.

The other type of field data collected are VP Points. These points complement the TP data collection process and serve two purposes: (1) to confirm a common, typically homogeneous, spectral signature within the landscape, e.g., Temperate Hardwood Hammock or Cypress Forest; and (2) document field observed vegetation information, e.g., clumps of Sand Cordgrass (*Spartina bakeri*) or Black-topped Sedge (*Schoenus nigricans*) within a contrasting vegetation type. Typically, structural and composition data is not collected. However, information about key species and canopy height are often recorded to assist photo-interpreters in recognizing species within the area of interest. The VP points are also used to document past disturbance history, invasive species presence, or any other natural phenomena encountered while conducting data collection missions. These data points take significantly less time to collect than TP points and significantly reduce the cost associated with data collection.

These data, including the AA data points, are stored in an ESRI ArcGIS v10.5 geodatabase and are referenced to the Universal Transverse Mercator (UTM) Zone 17N, North American Datum of 1983 (NAD83).

Vegetation Classification System

The Vegetation Classification System for South Florida Natural Areas (VCSFNA) is a multi-tiered hierarchical classification system developed specifically to map the natural areas occurring within the Greater Everglades (GE) restoration footprint, including the Florida Keys (Rutchey et al. 2006). Creation of the VCSFNA was a multi-year collaborative effort that included many of the top scientists, botanists, and experts on south Florida community ecology and botany. This classification system fills the gap in the level of detail and lack of specificity found within the U.S. National Vegetation Classification System when it comes to the classification of south Florida plant communities (Rutchey et al. 2006). The latest version of the VCSFNA is v6.10.09.

The VCSFNA is a living dynamic document; open to modification as new classes or communities not listed in the classification system are observed in the field. For example, in version v2.1.07 several modifications to the classification system were made in response to field observations and data collected by Ross et al. (2006). Similarly, Ruiz et al. (2008) suggested the inclusion of 21 new classes to the classification system based on their observations and work mapping Biscayne National Park. Since plant associations can be fluid combinations of many species, keeping the VCSFNA open to modification ensures that the classification system remains a useful and comparable way to record plant assemblages over successive generations of vegetation mapping.

The classification system used in this project (Appendix B) is a derivative of the VCSFNA. It differs from its parent system in several ways:

1. The hierarchical pathways between levels were modified to help photo-interpreters consistently reach the same vegetation class and reduce photo-interpreter variability.
2. Several vegetation class definitions were modified to clarify meaning and to reflect regional differences in species composition.
3. Vegetation classes not occurring within the mapping area were removed, while region-specific observed and documented vegetation classes were added.
4. The vegetation classification key for invasive plant species was not included in this document because it includes all possible known invasive plant species present within south Florida.

The top of the classification system, **Level 1** (Class), provides the lowest level of detail about plant communities and is based on dominant physiognomy (physical structure) as follows:

- **Forest (F)**—Stands of trees (5 meters [16.4 ft] or taller) that are of high density (50–100% cover).
- **Woodland (W)**—Stands of trees (5 meters [16.4 ft] or taller) that are of low density (10–49% cover). Trees are evenly spaced out and often in a matrix of sparse shrubs, graminoids, and/or herbaceous vegetation.
- **Shrubland (S)**—Stands of shrubs (shorter than 5 meters [16.4 ft]) that are of high density (50–100% cover).

- **Scrub (C)**—Stands of shrubs (shorter than 5 meters [16.4 ft]) that are of low density (10–49% cover). Shrubs are evenly spaced out and often in a matrix of graminoids and/or herbaceous vegetation.
- **Marsh (M)**—Graminoid and/or herbaceous emergent or floating vegetation in shallow water that stands at or above the ground surface for much of the year. Prairie habitat is included in this class. A marsh can have low density (0–9%) tree and shrub cover.
- **Dune (D)**—Shrub, graminoid and/or herbaceous vegetation associated with a mound or ridge of sediment formed by wind and/or storm deposits.
- **Submerged Aquatic Vegetation (A)**—Vegetation inhabiting a submerged freshwater or marine environment, e.g., *Vallisneria* spp. or *Thalassia* spp.
- **Exotic (E)**—Non-native plant species assemblages.
- **Other (O)**—Anthropogenic or non-vegetative features.

At the next level, **Level 2** (Subclass), the physiognomically defined **Level 1** classification is modified with a hydrologic designation, e.g., Wetland Forest versus Upland Forest; this is a new modification to the classification system not present in v6.10.09. The next tier, **Level 3** (Group), replaces the hydrologically defined **Level 2** with a community designation based on additional physiognomic and environmental factors, e.g., Mangrove Forest, Swamp Forest, or Hardwood Hammock. At **Level 4** (Alliance), communities are defined based on the dominant diagnostic species in the upper most stratum, e.g., Black Mangrove Forest, Buttonwood Forest, or Live Oak Hammock. The remaining three levels of the classification system, **Level 5** (Sub alliance), **Level 6** (Association), and **Level 7** (Sub association), continue to subdivide the previous community types by dominant canopy species composition and the understory species assemblages; for example, a **Level 7** mixed-mangrove scrub community in a matrix of sawgrass would have the following nomenclature: Buttonwood-Red Mangrove Scrub-Sawgrass Marsh.

Taxonomic references in the classification system and this document utilize the Integrated Taxonomic Information System.

Quality Assurance and Accuracy Assessment

Classification errors are a reality in all mapping projects. They are typically caused by confusion associated with one or more of the following factors: the spectral and spatial resolution of the imagery, the spectral separability of the feature(s) or attribute(s) being classified, the classification system, or the skill set of the photo-interpreter team. In a large, complex project with multiple photo-interpreters, managing for errors is critically important to ensure the product meets expectations. Developing tools and techniques to help mitigate and reduce errors is an important aspect of this project.

Photo-interpreter Assessment

Photo-interpreter classification skills and their understanding of south Florida vegetation communities was assessed by having all photo-interpreters classify five randomly distributed mapping clusters, consisting of 100 grid cells each, within Region 4 SW. This procedure allowed for

an evaluation of how well each photo-interpreter understands the mapping methodology as well as the vegetation communities within the region being mapped. It also facilitated an open discussion between all photo-interpreters, creating a peer-to-peer learning environment.

QA/QC of Mapped Products

Quality assurance and quality control (QA/QC) of photo-interpreter mapped products follows the protocol outlined in Rutchey et al. (2008). Two QA/QC photo-interpreters, supervised by the project manager, verified each grid cell in the stereo environment to ensure that no cell was misclassified due to clerical errors, majority rule determination including class exceptions, and that no artificial edges existed between photo-interpreter mapped products and previously checked areas. Mapping inconsistencies were addressed in an open discussion with all photo-interpreters to ensure that these types of errors would be minimized or eliminated in the future.

Accuracy Assessment

The thematic accuracy of the Everglades National Park and Big Cypress National Preserve vegetation map will be assessed using 2,114 randomly selected grid cells across all seven regions collected between 2008 and 2015. The AA data contains the same type of information collected in the TP and BT points discussed previously in this document (see Vegetation Data Collection section), thus its timely collection ensured that temporal vegetation change resulting from natural community succession or perturbation events, like fires and windstorms, would not affect final map accuracy. The AA data for the Region 4 NW vegetation map was collected in 2008 (Appendix A) while the AA data for Region 4 SW was collected between July 2012 and January 2013 (Figure 4).

The thematic accuracy of the NWCE vegetation map was calculated as the total number of assessment locations within Region 4 SW considered acceptable (218) divided by the 250, the total number of assessment (AA) points within Region 4 SW (Figure 4). In addition, a 1-tailed 90% confidence level was calculated using Zar (1999, p. 527) to determine whether the overall map accuracy was equal to or greater than 80% with 90% confidence as required by the NPS Vegetation Mapping Inventory Program.

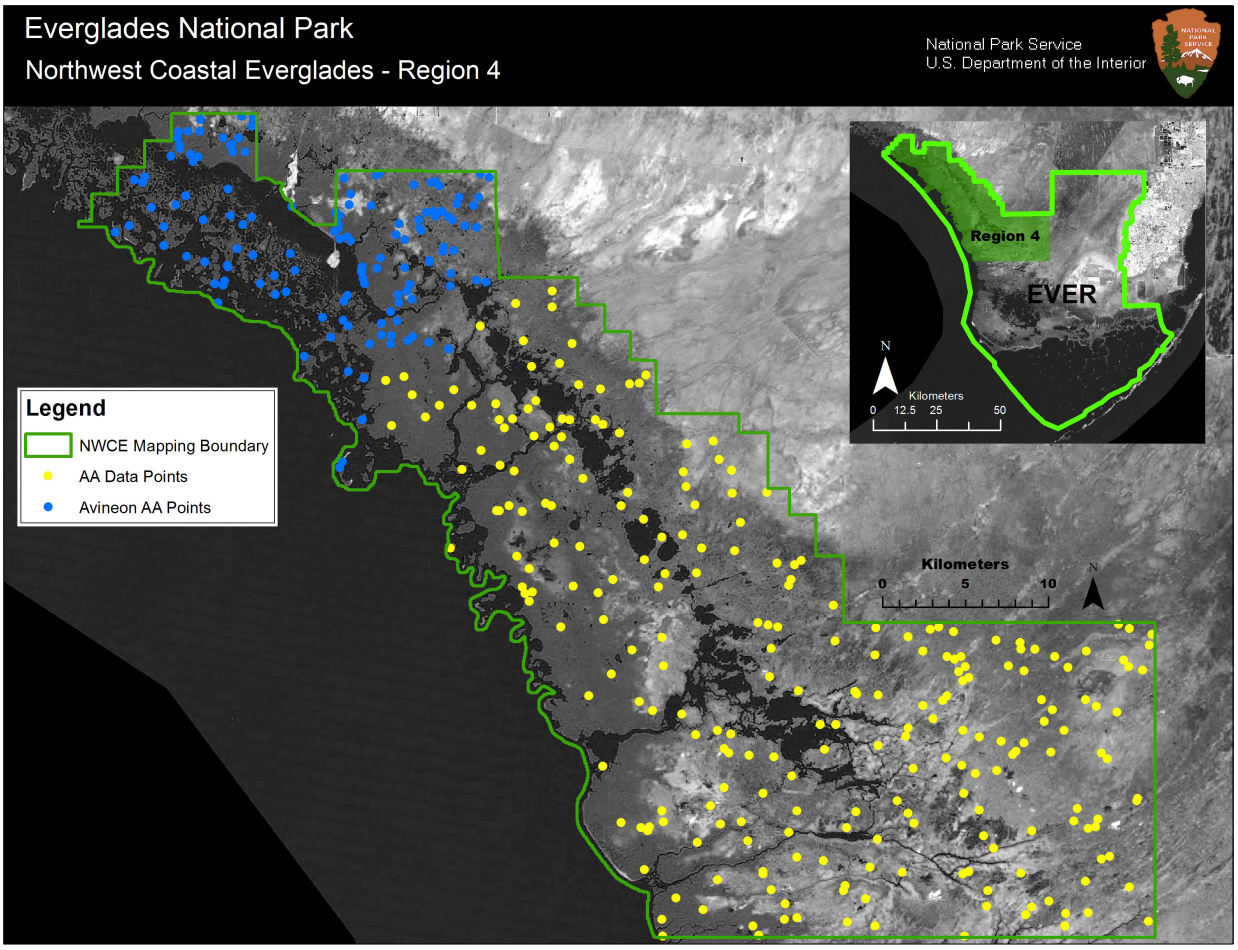


Figure 4. Location of accuracy assessments (AA) points collected within the Northwest Coastal Everglades, Region 4, Everglades National Park. The yellow AA data points were used to determine the accuracy of the Region 4 SW vegetation map. The blue AA data points were used to determine the accuracy of the Region 4 NW vegetation map produced by Avineon.

Grid cells were accepted or rejected based on a thorough review of the AA data, including the photos collected. Acceptable AA points included: (1) those that had a one-to-one match between the vegetation class on the map and the field collected AA point data, and (2) those for which the vegetation class differed from the AA data set, but were considered acceptable because:

1. The vegetation map class was at a more detailed level than the AA classification, but the field notes supported the more detailed label as correct.
2. The AA data indicated that the vegetation label was at the boundary between two classes due to height or cover cutoff parameters, i.e. 5-meters (16.4-ft) height between Shrubland and Forest or 50% cover for Scrub and Shrubland. For example, if a Red Mangrove Shrubland was misclassified as a Red Mangrove Forest, the Red Mangrove Forest was accepted because the species composition was correct. This reasoning would apply to Forest versus Woodland that have a 50% cover cutoff or Marsh versus Scrub that have a 10% woody cover cutoff or for understory graminoid cover.

3. The class modifier for sawgrass, which includes short-dense, short-sparse, tall-dense, and tall-sparse, was misclassified due to cover or height cutoff parameters.
4. The discrepancy between the AA point and the vegetation map classification resulted from the presence of two co-dominant communities, split cell/majority-rule decision, within the grid-cell.

The project manager, lead photo-interpreter, and the photo-interpreters working on the project did not have access to the AA data collected.

Integration of Vegetation Maps.

The Region 4 NW vegetation map used aerial imagery from 2006 and was classified using an older version of the VCSFNA (Rutchey et al. 2006 v5.22.07, see Appendix A). As a result, several of the thematic classes used in the Region 4 NW vegetation map did not match those used in the Region 4 SW vegetation map. Furthermore, there was a three-year difference in the imagery used on both maps, 2006 versus 2009. To mitigate these differences and produce a seamless and temporally consistent map for Region 4, the Region 4 NW vegetation map was updated by the senior photo-interpreter on the project. For each grid cell on the Region 4 NW vegetation map the senior photo-interpreter verified that (1) the thematic classes on the Region 4 NW vegetation map were consistent with the thematic classes used in the Region 4 SW vegetation map, and (2) the thematic class label on every grid cell was consistent with the 2009 imagery. The updated Region 4 NW vegetation map was appended to the Region 4 SW vegetation map to produce the final NWCE Region 4, vegetation map (Figure 5).

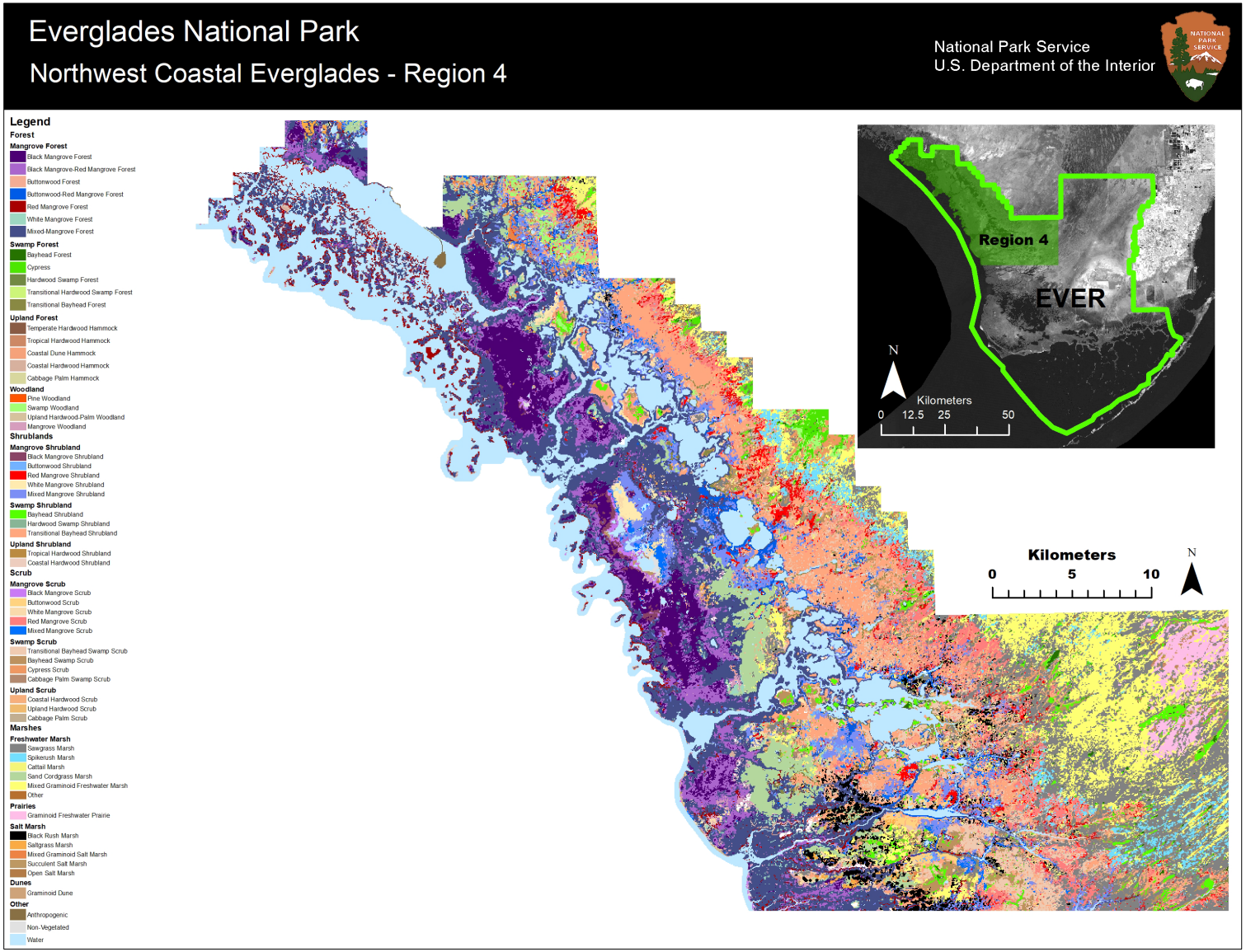


Figure 5. Generalized vegetation map of the Northwest Coastal Everglades, Region 4, Everglades National Park.

Results

Vegetation

The NWCE vegetation map contains of 511,101 0.25-hectare (.61-ac) grid-cells and consists of 178 thematic classes (Figure 5). The majority of classes, 157 out of 178 (88% of all the thematic classes), account for less than 1% each of the total area mapped and combine for approximately 16% (20,718 hectares [51,196 ac]) of the map (Appendix C). The most common vegetative thematic classes are Transitional Bayhead Shrubland (SSBT) and Mixed Mangrove Forest-Mixed (FMXX). These two classes account for 9.5% each of the area mapped (Appendix C). Short Sawgrass Marsh-Dense (MFGcSD) was the next dominant community type mapped and accounted for approximately 8% of the area mapped (Appendix C). Water (ONW), the dominant thematic classes mapped, accounted for 17.5% of the map.

Forest and Woodlands

Forests are the dominant community types found within the NWCE. They account for more than a quarter (27.4%) of the map area and consist of Hardwood Hammocks (398 hectares [983 ac], 0.3% of the area mapped), Mangrove Forests (32,855 hectares [81,186 ac], 25.7% of the area mapped), Cypress Forests (388 hectares [959 ac], 0.3% of the area mapped), and Swamp Forests (1,373 hectares [3,392 ac], 1.1% of the area mapped, Table 2).

Mangrove Forests are the dominant plant community in the NWCE. They consist of 11 community types differentiated by species composition (Table 2). The dominant Mangrove Forest community type is Mixed Mangrove Forest-Mixed (FMXX). It accounts for 9.5% of the area mapped (Table 2). It is followed by Black Mangrove Forest (FMa, 4.5% of the area mapped), Black Mangrove-Red Mangrove Forest (FMXar, 3.5% of the area mapped), and White Mangrove-Red Mangrove Forest (FMXlr, 4% of the area mapped, Table 2). Mixed Mangrove Forest-Mixed and the latter three community types account for 84% of the total Mangrove Forests found within the NWCE. Swamp Forest consists of four community types: Bayhead Forest, Hardwood Swamp Forest, Transitional Bayhead Forest, and Transitional Hardwood Swamp Forest. These four community types account for 1% of the total area mapped within the NWCE (Table 2). Hardwood Hammock communities account for 0.3% of the area mapped and consists of Cabbage Palm Hammocks, Coastal Hammocks, Tropical Hardwood Hammocks, and Temperate Hardwoods (Table 2). Cypress Forest communities, found along the northern park boundary with Big Cypress National Preserve, account for 0.3% of the area mapped (Table 2). Cypress Forest communities include Strands, Domes, and Cypress with Pines and Hardwoods.

Table 2. Total area in hectares (ha) and acres (ac) and percent total area mapped of Forest communities in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Hardwood Hammock	Hardwood Hammock Total	398	983	0.31%
	Cabbage Palm Hammock	3	8	0.00%
	Coastal Dune Hammock	10	23	0.01%
	Coastal Hardwood Hammock	171	443	0.14%
	Temperate Hardwood Hammock	2	4	0.00%
	Tropical Hardwood Hammock	212	524	0.17%
Mangrove Forest	Mangrove Forest Total	32,855	81,186	25.70%
	Black Mangrove Forest	5,754	14,219	4.50%
	Black Mangrove-Buttonwood Forest	255	630	0.20%
	Black Mangrove-Red Mangrove Forest	4,495	11,108	3.52%
	Black Mangrove-White Mangrove Forest	1,045	2,582	0.82%
	Buttonwood Forest	34	84	0.03%
	Buttonwood-Red Mangrove Forest	1,193	2,947	0.93%
	Buttonwood-White Mangrove Forest	131	323	0.10%
	Mixed Mangrove Forest-Mixed	12,142	30,002	9.50%
	Red Mangrove Forest	2,139	5,285	1.67%
	White Mangrove Forest	608	1,502	0.48%
	White Mangrove-Red Mangrove Forest	5,060	12,503	3.96%
Cypress Forest	Cypress Forest Total	388	959	0.30%
	Cypress Forest-Dome	3	8	0.00%
	Cypress Forest-Dominant	323	799	0.25%
	Cypress Forest-Strand	15	36	0.01%
	Cypress-Hardwood Forest	44	109	0.03%
	Cypress-Pine Forest	3	6	0.00%
Swamp Forest	Swamp Forest Total	1,373	3,394	1.07%
	Bayhead Forest	317	783	0.25%
	Hardwood Swamp Forest	21	52	0.02%
	Transitional Bayhead Forest	1,035	2,558	0.81%

Table 2 (continued). Total area in hectares (ha) and acres (ac) and percent total area mapped of Forest communities in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Swamp Forest (continued)	Transitional Hardwood Swamp Forest	0.3	0.6	< 0.01%
Forest Total	–	3,5014	8,6522	27.38%

Woodlands account for 1.1% (1,356 hectares [3,351 ac]) of the total area mapped and consists of Pine Woodlands (< 0.01%, 3 hectares [7 ac]), Upland Hardwood-Palm Woodlands (0.01%, 10 hectares [25 ac]), Mangrove Woodlands (0.54%, 685 hectares [1,694 ac]), and Swamp Woodlands (0.52%, 660 hectares [1,631 ac], Table 3). The dominant Woodland community type is Cypress Woodland-Graminoid Marsh (WStG, Table 3). This community accounts for 0.19% of the area mapped (240 hectares [593 ac], Table 3).

Table 3. Total area in hectares (ha) and acres (ac) and percent total area mapped of Woodland in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Pine Woodland	Pine Woodland Total	3	7	< 0.01%
	Pine Flatwoods-Shrubs	2	5	< 0.01%
	Pine Lowland-Shrubs	1	2	< 0.01%
Upland Hardwood-Palm Woodland	Upland Hardwood-Palm Woodland Total	10	25	0.01%
	Cabbage Palm Upland-Graminoid Prairie	10	25	0.01%
Mangrove Woodland	Mangrove Woodland Total	685	1,694	0.54%
	Black Mangrove Woodland-Graminoid Marsh	216	535	0.17%
	Black Mangrove Woodland-Open	48	119	0.04%
	Black Mangrove Woodland-Succulent Marsh	61	151	0.05%
	Black Mangrove-Buttonwood Woodland-Graminoid Marsh	22	53	0.02%
	Black Mangrove-Red Mangrove Woodland-Graminoid Marsh	42	103	0.03%
	Black Mangrove-Red Mangrove Woodland-Open	44	109	0.03%

Table 3 (continued). Total area in hectares (ha) and acres (ac) and percent total area mapped of Woodland in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Mangrove Woodland (continued)	Black Mangrove-Red Mangrove Woodland-Succulent Marsh	17	41	0.01%
	Black Mangrove-White Mangrove Woodland-Open Marsh	67	165	0.05%
	Black Mangrove-White Mangrove Woodland-Succulent Marsh	7	18	0.01%
	Buttonwood Woodland-Graminoid Marsh	2	4	< 0.01%
	Buttonwood Woodland-Open Marsh	1	3	< 0.01%
	Mixed Mangrove Woodland-Mixed-Graminoid Marsh	27	67	0.02%
	Mixed Mangrove Woodland-Mixed-Open Marsh	21	51	0.02%
	Mixed Mangrove Woodland-Mixed-Succulent Marsh	19	46	0.01%
	Red Mangrove Woodland-Graminoid Marsh	8	20	0.01%
	Red Mangrove Woodland-Open Marsh	43	105	0.03%
	Red Mangrove Woodland-Succulent Marsh	11	27	0.01%
	White Mangrove Woodland-Graminoid Marsh	8	19	0.01%
	White Mangrove Woodland-Open Marsh	6	15	< 0.01%
	White Mangrove-Red Mangrove Woodland-Graminoid Marsh	16	38	0.01%
	White Mangrove-Red Mangrove Woodland-Open Marsh	2	4	< 0.01%
Swamp Woodland	Swamp Woodland Total	660	1,631	0.52%
	Cabbage Palm Lowland-Graminoid Marsh	3	7	< 0.01%
	Cabbage Palm Lowland-Mixed	202	499	0.16%
	Cabbage Palm Lowland-Shrubs	215	532	0.17%
	Cypress Woodland-Graminoid Marsh	240	593	0.19%
Woodland Total	–	1,358	3,357	1.06%

Shrublands

Shrublands account for 18.2% (23,246 hectares [57,441 ac]) of the area mapped and consist of Coastal Hardwood Shrubland (33 hectares [82 ac]), Tropical Hardwood Shrubland (33 hectares [82 ac]), Mangrove Shrublands (9,144 hectares [22,595 ac]), and Swamp Shrublands (14,035 hectares [34,682 ac]). Swamp Shrublands are the dominant Shrubland community types found in the NWCE (Table 4). They account for 11% of the total area mapped. The dominant Swamp Shrubland community is Transitional Bayhead Shrubland (SSBT)—shrubland community consisting of a mix of mangrove and bayhead species (Table 4). Mangrove Shrublands accounted for 7.2% of the area mapped and consisted of several community types differentiated by species composition (Table 4). The dominant Mangrove Shrubland community is Buttonwood-Red Mangrove Shrubland (Table 4).

Table 4. Total area in hectares (ha) and acres (ac) and percent total area mapped of Shrubland in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Coastal Hardwood Shrubland	Coastal Hardwood Shrubland Total	33	82	0.03%
Tropical Hardwood Shrubland	Tropical Hardwood Shrubland Total	33	82	0.03%
Mangrove Shrubland	Mangrove Shrubland Total	9,144	22,595	7.15%
	Black Mangrove Shrubland	344	851	0.27%
Mangrove Shrubland (continued)	Black Mangrove-Buttonwood Shrubland	5	12	< 0.01%
	Black Mangrove-Red Mangrove Shrubland	12	28	0.01%
	Black Mangrove-White Mangrove Shrubland	485	1,197	0.38%
	Buttonwood Shrubland	194	480	0.15%
	Buttonwood-Red Mangrove Shrubland	2,271	5,612	1.78%
	Buttonwood-White Mangrove Shrubland	394	974	0.31%
	Mixed Mangrove Shrubland-Mixed	1,472	3,638	1.15%
	Red Mangrove Shrubland	2,136	5,279	1.67%
	White Mangrove Shrubland	628	1,553	0.49%
	White Mangrove-Red Mangrove Shrubland	1,203	2,973	0.94%
Swamp Shrubland	Swamp Shrubland Total	14,035	34,682	10.98%
	Bayhead Shrubland	1,459	3,606	1.14%
	Cocoplum Shrubland	7	16	0.01%
	Hardwood Swamp Shrubland	12	28	0.01%

Table 4 (continued). Total area in hectares (ha) and acres (ac) and percent total area mapped of Shrubland in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Swamp Shrubland (continued)	Transitional Bayhead Shrubland	12,200	30,147	9.54%
	Wax Myrtle Shrubland	7	17	0.01%
	Willow Shrubland	351	867	0.27%
Shrubland Total	–	23,246	57,441	18.18%

Scrub and Dunes

Scrub and Dune communities account for 10.3% (13,205 hectares [32,629 ac]) of the area mapped and consist of six types: Upland Hardwood Scrub (36 hectares [90 ac]), Cabbage Palm Upland Scrub (27 hectares [67 ac]), Coastal Hardwood Scrub (11 hectares [27 ac]), Graminoid Dune (14 hectares [35 ac]), Mangrove Scrub (6,674 hectares [16,491 ac]), and Swamp Scrub (6,444 hectares [15,924 ac], Table 5). Mangrove Scrub is the dominant Scrub community found within the NWCE (Table 5). It consists of 18 different community types of which Red Mangrove Scrub-Graminoid Marsh (CMrGc) is the dominant type (2.5%, 3,248 hectares [8,027 ac]). However, Transitional Bayhead Swamp Scrub-Graminoid Marsh (CSBTGc)—scrub community consisting of a mix of mangrove and bayhead species—is the overall dominant Scrub community within the NWCE. It accounts for 3.0% of the area mapped (3,827 hectares [9,457 ac], Table 5). The Dune community was found along the shoreline and on several islands. This community accounted for 0.01% of the area mapped (Table 5).

Table 5. Total area in hectares (ha) and acres (ac) and percent total area mapped of Scrub and Dune communities in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Upland Hardwood Scrub	Upland Hardwood Scrub Total	36	90	0.03%
	Upland Hardwood Scrub-Graminoid Prairie	18	43	0.01%
	Upland Hardwood Scrub-Sawgrass Marsh	19	46	0.01%
Cabbage Palm Upland Scrub	Cabbage Palm Upland Scrub Total	27	67	0.02%
	Cabbage Palm Scrub-Mixed Graminoid Prairie	3	6	< 0.01%
	Cabbage Palm Upland Scrub-Graminoid Prairie	25	61	0.02%
Coastal Hardwood Scrub	Coastal Hardwood Scrub Total	11	27	0.01%
Graminoid Dune	Graminoid Dune Total	14	35	0.01%

Table 5 (continued). Total area in hectares (ha) and acres (ac) and percent total area mapped of Scrub and Dune communities in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Mangrove Scrub	Mangrove Scrub Total	6,674	16,491	5.22%
	Black Mangrove Scrub-Open Marsh	82	202	0.06%
	Black Mangrove Scrub-Succulent Marsh	188	464	0.15%
	Black Mangrove-Red Mangrove Scrub	8	20	0.01%
	Black Mangrove-White Mangrove Scrub	184	454	0.14%
	Buttonwood Scrub-Graminoid Marsh	517	1,278	0.40%
	Buttonwood Scrub-Open Marsh	4	10	< 0.01%
	Buttonwood Scrub-Succulent	4	9	< 0.01%
	Buttonwood-Red Mangrove Scrub	480	1,187	0.38%
	Buttonwood-White Mangrove Scrub	109	270	0.09%
	Mixed Mangrove Scrub-Mixed	96	236	0.07%
	Red Mangrove Scrub-Dominant	141	348	0.11%
	Red Mangrove Scrub-Graminoid Marsh	3,248	8,027	2.54%
	Red Mangrove Scrub-Open Marsh	912	2,254	0.71%
	White Mangrove Scrub-Dominant	3	7	< 0.01%
	White Mangrove Scrub-Graminoid Marsh	447	1,103	0.35%
	White Mangrove Scrub-Open Marsh	80	197	0.06%
	White Mangrove Scrub-Succulent Marsh	35	85	0.03%
	White Mangrove-Red Mangrove Scrub	138	341	0.11%
Swamp Scrub	Swamp Scrub Total	6,444	15,924	5.04%
	Bayhead Swamp Scrub-Graminoid Marsh	1,956	4,833	1.53%
	Cabbage Palm Swamp Scrub-Graminoid Marsh	32	80	0.03%
	Cypress Scrub-Graminoid Marsh	362	894	0.28%
	Cypress Scrub-Graminoid Prairie	6	14	< 0.01%
	Pond Apple Scrub-Graminoid	42	104	0.03%
	Transitional Bayhead Swamp Scrub-Graminoid Marsh	3,827	9,457	2.99%

Table 5 (continued). Total area in hectares (ha) and acres (ac) and percent total area mapped of Scrub and Dune communities in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Swamp Scrub (continued)	Wax Myrtle Scrub-Graminoid Marsh	17	43	0.01%
	Willow Scrub-Graminoid Marsh	202	500	0.16%
Scrub Total	–	13,206	32,633	10.33%

Marshes

Marsh communities accounted for 25.2% (32,256 hectares [79,707 ac]) of the map and consist of seven types: Broadleaf Emergent Marsh (4 hectares [9 ac]), Floating Emergent Marsh (17 hectares [43 ac]), Mixed Graminoid-Broadleaf Freshwater Marsh (45 hectares [111 ac]), Graminoid Freshwater Marsh (27,740 hectares [68,547 ac]), Graminoid Freshwater Prairie (1,652 hectares [4,081 ac]), Graminoid Salt Marsh (2,733 hectares [6,753 ac]), and Succulent Salt Marsh (66 hectares [164 ac], Table 6). Graminoid Freshwater Marshes are the dominant form of marsh found within the NWCE (Table 6). They account for 21.7% of the total area map and consist of 13 different community types. Sawgrass marshes are the dominant Freshwater Marshes mapped (Table 5). Mixed Graminoid Freshwater Marsh (MFGX) is the 2nd most common marsh found within the NWCE followed by Sand Cordgrass Marsh (MFGn, Table 5). Salt Marsh communities accounted for 2.1% of the area mapped with Black Rush Marsh (MSGj) being the dominant community type (Table 6).

Table 6. Total area in hectares (ha) and acres (ac) and percent total area mapped of Marsh communities in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Broadleaf Emergent Marsh	Broadleaf Emergent Marsh Total	4	9	< 0.01%
Floating Emergent Marsh	Floating Emergent Marsh Total	17	43	0.01%
	Waterlily Marsh	17	43	0.01%
Mixed Graminoid-Broadleaf Freshwater Marsh	Mixed Graminoid-Broadleaf Freshwater Marsh Total	45	111	0.04%
Graminoid Freshwater Marsh	Graminoid Freshwater Marsh Total	27,740	68,547	21.70%
	Cattail Marsh	388	958	0.30%
	Common Reed Marsh	16	38	0.01%
	Kissimmeegrass Marsh	4	9	< 0.01%

Table 6 (continued). Total area in hectares (ha) and acres (ac) and percent total area mapped of Marsh communities in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Community	Community Type	Area (ha)	Area (Ac)	Percent Area Mapped
Graminoid Freshwater Marsh (continued)	Mixed Graminoid Freshwater Marsh	6,104	15,084	4.77%
	Sand Cordgrass Marsh	3,656	9,034	2.86%
	Sawgrass-Beakrush Marsh	1,424	3,519	1.11%
	Sawgrass-Black Rush Marsh	589	1,455	0.46%
	Sawgrass-Cattail Marsh	980	2,423	0.77%
	Sawgrass-Sand Cordgrass Marsh	532	1,314	0.42%
	Short Sawgrass Marsh	11,383	28,129	8.90%
	Spikerush Marsh	2,354	5,816	1.84%
	Tall Sawgrass Marsh	223	551	0.17%
	Open Freshwater Marsh	88	218	0.07%
Graminoid Freshwater Prairie	Graminoid Freshwater Prairie Total	1,652	4,081	1.29%
	Black Sedge Prairie	131	325	0.10%
	Graminoid Freshwater Prairie	1,520	3,757	1.19%
Graminoid Salt Marsh	Graminoid Salt Marsh Total	2,733	6,753	2.11%
	Black Rush Marsh	2,009	4,965	1.57%
	Black Rush-Sand Cordgrass Marsh	41	102	0.03%
	Mixed Graminoid Salt Marsh	289	714	0.23%
	Saltgrass Marsh	341	844	0.27%
	Saltgrass-Sand Cordgrass Marsh	12	29	0.01%
	Open Salt Marsh	41	100	0.03%
Succulent Salt Marsh	Succulent Salt Marsh Total	66	164	0.05%
Marsh Total	–	32,256	79,707	25.23%

A total of 388 hectares (958 ac) were mapped as Cattail Marsh (MFGt). However, 5,983 hectares (14,784 ac) were found to contain Cattail in densities greater than 10% (Figure 6). When present, cattail densities were generally below 50% (5,502 hectares [13,598 ac]). Cattail densities exceeded 50% in about 8% (480 hectares [1,187 ac]) of the total area identified as having cattails (Figure 6).

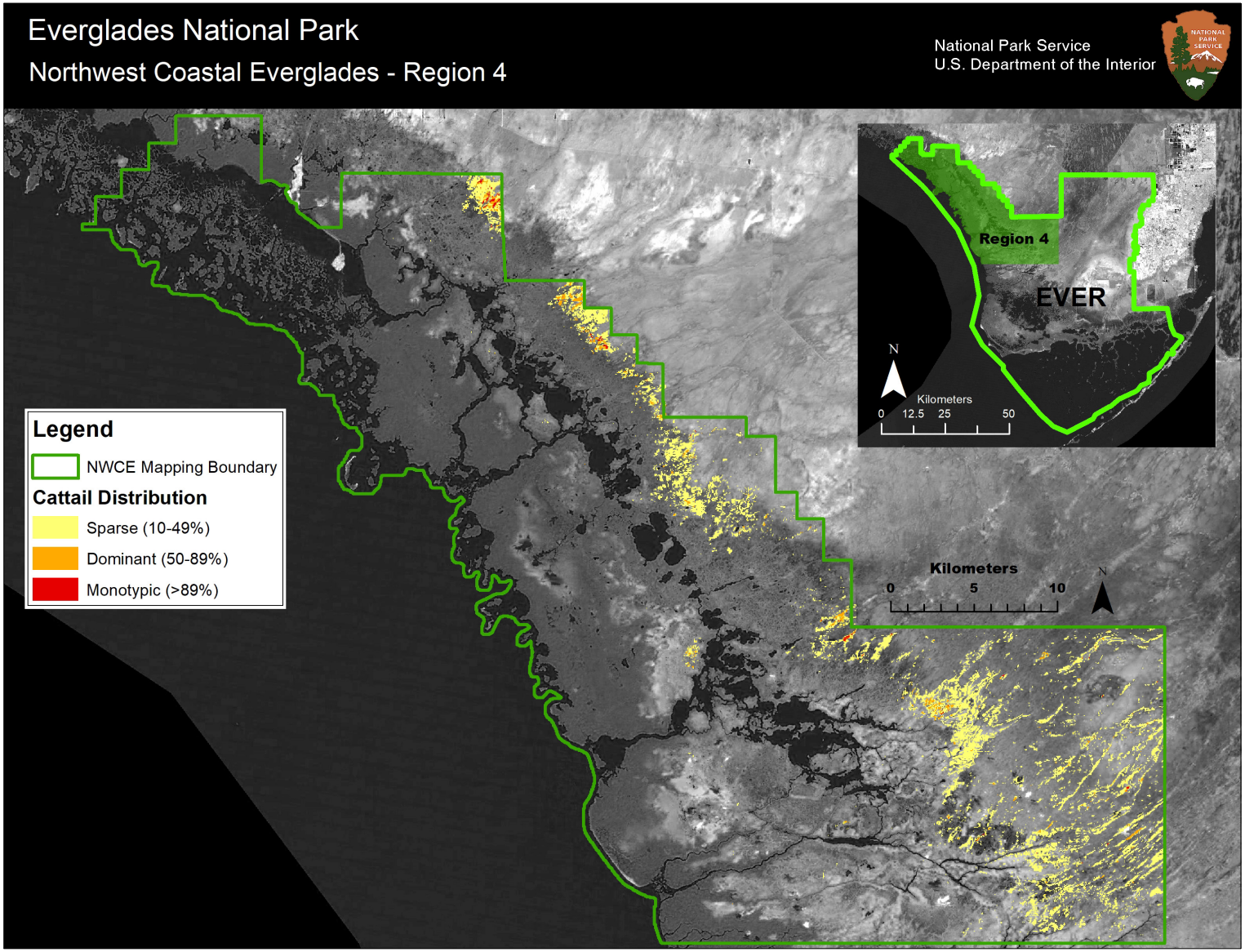


Figure 6. Distribution map and density of cattail in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Invasive Species

Two invasive plant species were encountered within the NWCE; Brazilian pepper (*Schinus terebinthifolius*) and Old World climbing fern *(Lygodium* sp.). Brazilian pepper is found throughout the NWCE in the interior marshes and shrublands and along the banks of the many rivers and creeks that wind through the region (Figure 7). It has an areal coverage of 10,258 ha (25,347 ac). When present, its infestation density, per grid-cell, was generally below 50% (9,559 hectares [23,621 ac]). However, monotypic stands with greater than 89% infestation density were documented for approximately 67 ha (164 ac, Figure 7). Old World climbing fern was detected on the TP/VP aerial surveys (Figure 8). It was found intermixed with sawgrass or overtopping tree islands like in the SWCE, Region 3 (Ruiz et al. 2018). And, similar to the SWCE, it was not evident in the aerial imagery, except for two locations. In those location its infestation density was below 50%.

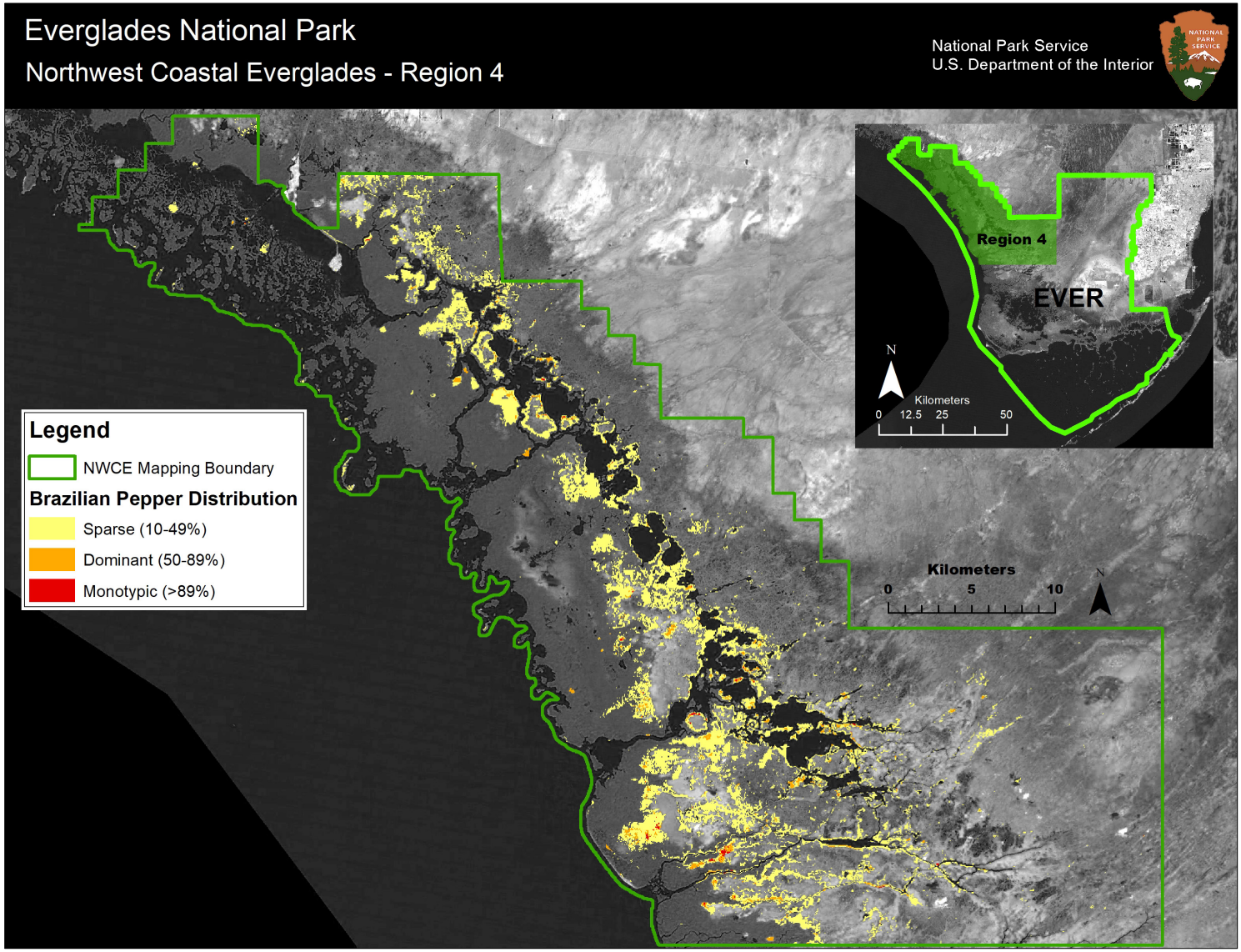


Figure 7. Distribution map and density of Brazilian pepper (*Schinus terebinthifolius*) in the Northwest Coastal Everglades, Region 4, Everglades National Park.

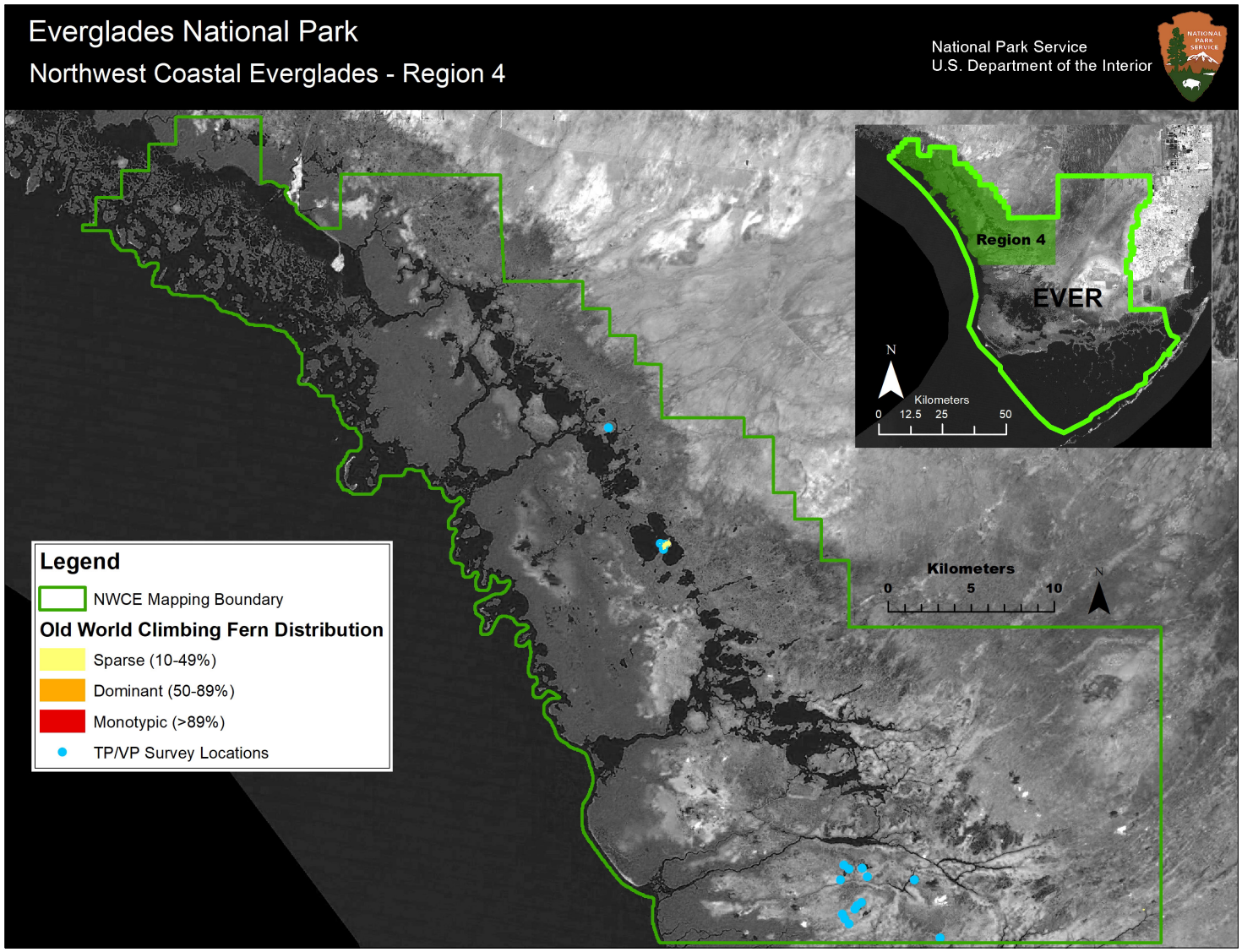


Figure 8. Locations within the Northwest Coastal Everglades (NWCE), Region 4, Everglades National Park where field crews and photo-interpreters documented the presence of Old World climbing fern (*Lygodium* sp.). This is an incomplete census, not indicative of the true range and distribution of *Lygodium* within the NWCE.

Anthropogenic and Non-vegetative Classes

Anthropogenic and Non-vegetative classes account for approximately 17.6% of the total mapping area (Table 7). Anthropogenic features like roads, buildings, campgrounds, etc., account for 0.05% of the entire mapped area (Table 7). Non-vegetative classes account for the majority of the area mapped (17.6%), where open water, in the form of lakes, bays, and creeks, accounted for 17.5% of the entire mapping area.

Table 7. Total area in hectares (ha) and acres (ac) and percent total area mapped of Anthropogenic and Non-Vegetative classes in the Northwest Coastal Everglades, Region 4, Everglades National Park.

Class	Class Type	Area (ha)	Area (Ac)	Percent Area Mapped
Anthropogenic	Anthropogenic Total	70	173	0.05%
Non-Vegetative	Non-Vegetative Total	22,457	55,491	17.6%
	Barren Salt Flat	10	25	0.01%
	Beach	27	67	0.02%
	Soil	93	231	0.07%
	Water	22,326	55,169	17.5%
Total	–	22,525	55,661	17.6%

Fire and Windstorm

Fire and windstorm damage was evident throughout the NWCE (Figure 9). Fires were restricted to coastal sawgrass and sand cordgrass marshes. The total area burned equaled 3,320 hectares (8,203 ac, Figure 9). Approximately 2,207 hectares (5,452 ac) of mostly coastal mangrove forest exhibited evidence of windstorm damage (Figure 9). The windstorm damage observed in the NWCE is likely the result of the 2005 Atlantic hurricane season which brought two hurricanes, Hurricane Katrina and Hurricane Wilma, over south Florida. Windstorm damage in the NWCE was less extensive than in the Southwest Coastal Everglades, Region 3, and Southeast Saline Everglades, Region 2 (Ruiz et al. 2017; Ruiz et al. 2018).

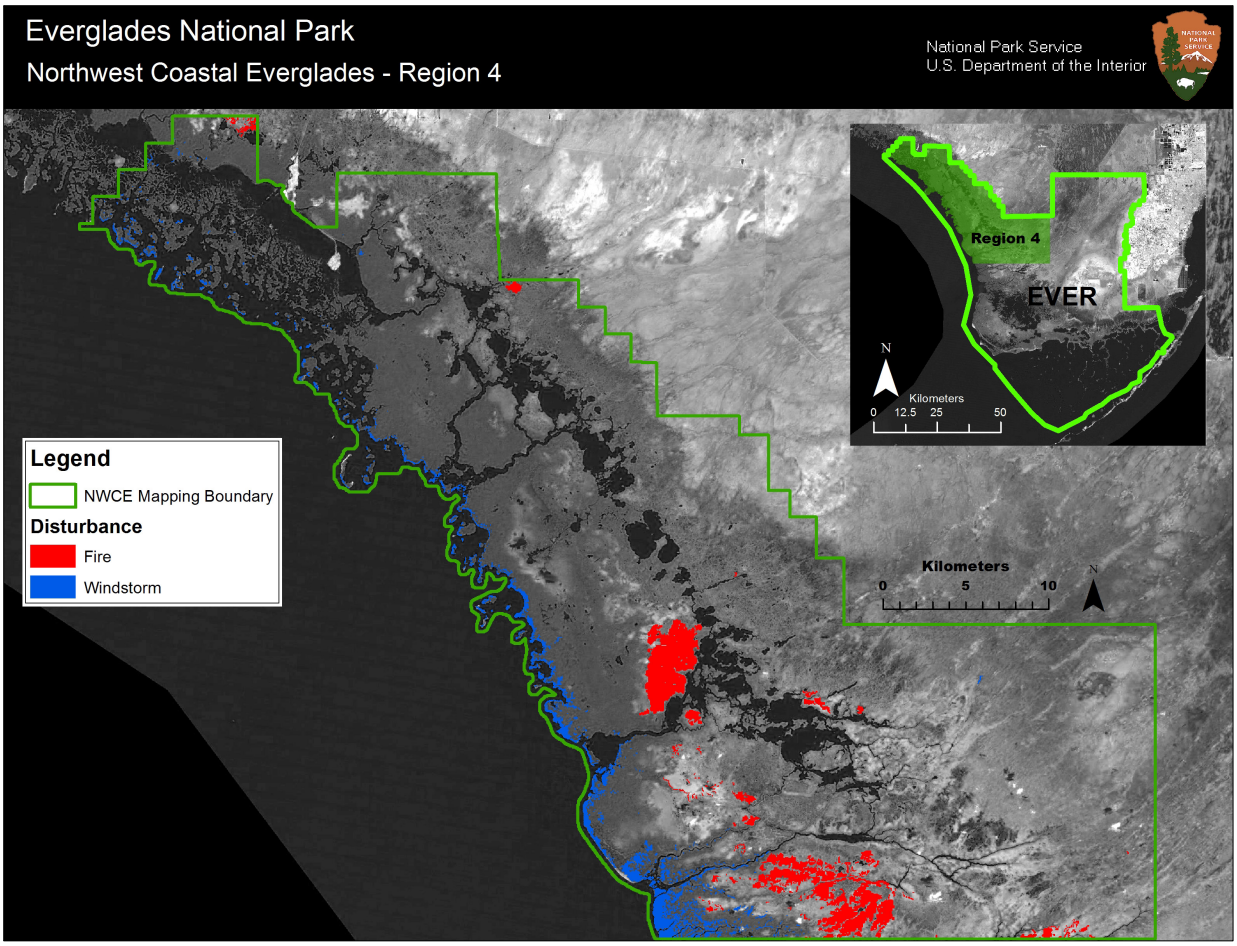


Figure 9. Grid cells within the Northwest Coastal Everglades, Region 4, Everglades National Park, showing evidence of fire or windstorm damage. Windstorm damage is presumed to have occurred during the 2005 Atlantic hurricane season.

Accuracy Assessment

An exact one-to-one match between the Accuracy Assessment (AA) points and the vegetation code on the Region 4 SW vegetation map (complete agreement between the AA classified point and the grid cell label) occurred for 126 of the 250 AA points (50.4%) selected (Appendix D). The 124 grid cells that did not have a one-to-one correlation were re-examined to determine whether they could be deemed acceptable based on the conditions described in the methods section. This review yielded an additional 95 matching points, increasing the total number of acceptable points to 221. The majority of points (89%) were deemed acceptable because they were at the cutoff boundary, either cover percentage or canopy height, between two similar classes, e.g., Black Mangrove Shrubland versus Black Mangrove Forest or Woodland.

Based on the total number of accepted AA points (221), the accuracy of the map, regardless of categorical level, is 88.4% with a lower 90th Percentile Confidence Interval of 84.5% (Table 8). Map accuracy decreases as a function of classification level, with less detailed levels (Levels 1–5) having

greater accuracy than more detailed levels (6–7, Table 8). Classification level accuracy was above 87% for all levels except Level 6 (78.1%) and Level 7 (50%, Table 8).

Table 8. Results of the accuracy assessment for each level in the classification system.

Classification Level	Number of Points Acceptable	Number of AA Points	Percent Correct	Lower 90th Percentile Confidence Interval
Level 1	237	250	94.8%	91.9%
Level 2	225	250	90.4%	86.8%
Level 3	223	249	89.2%	85.8%
Level 4	208	234	88.9%	84.9%
Level 5	122	139	87.8%	82.2%
Level 6	57	73	78.1%	68.6%
Level 7	1	2	50.0%	2.5%
Overall	221	250	88.4%	84.5%

Out of the 178 thematic classes used on the map, 53 (29.7%) could be verified with at least one AA point (Table 9). These 53 classes account for 93% of the map area. The thematic class accuracy for these classes ranged from 100% to 0% with most classes (45 out of 53, 85%) having an estimated class accuracy of 80% or greater (Table 9). Three classes were found to have an estimated accuracy of 0%; White Mangrove Scrub-Sand Cordgrass Marsh, White Mangrove Shrubland, and Mixed Mangrove Shrubland-Mixed (Table 9). These three classes were assessed with a single assessment location each. Seven of the eight classes whose accuracy fell below 80% were assessed with eight or fewer assessment locations (Table 9). The lone exception being the Transitional Bayhead Shrubland class. This class has and estimated accuracy of 70% and was assessed with 30 assessment points (Table 9). This class is floristically, structurally, and spectrally similar to several other thematic classes like Buttonwood-Red Mangrove Shrubland, Buttonwood Shrubland, and Bayhead Shrubland where subtle differences in species composition determine their thematic class designation. Discriminating between these three classes is particularly difficult at the transition zone where both freshwater hardwood species and mangrove species coexists and intermix to form novel community types.

Table 9. Number of accuracy assessment locations, class accuracy, and percent map area for all the accuracy assessment points visited within the Northwest Coastal Everglades, Region 4, Everglades National Park.

Vegetation Class	Number of AA Points	Class Accuracy (%)	Percent Map Area
Transitional Bayhead Shrubland (SSBT)	30	70%	9.54%
Short Sawgrass Marsh-Dense (MFGcSD)	27	89%	8.14%
Mixed Graminoid Freshwater Marsh (MFGX)	21	100%	4.77%
Mixed Mangrove Forest-Mixed (FMXX)	20	100%	9.49%
Bayhead Swamp Scrub-Sawgrass Marsh (CSBGc)	11	82%	1.48%
Black Mangrove Forest (FMa)	10	100%	4.50%
Sand Cordgrass Marsh (MFGn)	9	89%	2.86%
Buttonwood-Red Mangrove Shrubland (SMXcr)	8	100%	1.78%
Transitional Bayhead Swamp Scrub-Sawgrass Marsh (CSBTGc)	8	50%	2.77%
Black Mangrove-Red Mangrove Forest (FMXar)	7	100%	3.50%
Graminoid Freshwater Prairie (MFGP)	7	71%	1.19%
Spikerush Marsh (MFGe)	7	100%	1.84%
White Mangrove-Red Mangrove Forest (FMXlr)	6	100%	3.96%
Bayhead Shrubland (SSB)	5	80%	1.14%
Black Rush Marsh (MSGj)	5	80%	1.57%
Red Mangrove Shrubland (SMr)	5	80%	1.67%
Black Mangrove Shrubland (SMa)	4	100%	0.27%
Black Mangrove Woodland-Graminoid Marsh (WMaG)	4	100%	0.17%
Red Mangrove Scrub-Sawgrass Marsh (CMrGc)	4	100%	1.19%
Red Mangrove Scrub-Spikerush Marsh (CMrGe)	4	100%	1.00%
Sawgrass-Cattail Marsh (MFGXct)	4	75%	0.77%
Water (ONW)	4	100%	17.46%
Bayhead Forest (FSB)	3	100%	0.25%
Buttonwood Scrub-Black Rush Marsh (CMcGj)	3	100%	0.12%
Buttonwood-Red Mangrove Forest (FMXcr)	2	100%	0.93%
Cypress Forest-Monotypic (FStM)	2	100%	0.25%
Red Mangrove Scrub-Dominant (CMrD)	2	100%	0.11%

Table 9 (continued). Number of accuracy assessment locations, class accuracy, and percent map area for all the accuracy assessment points visited within the Northwest Coastal Everglades, Region 4, Everglades National Park.

Vegetation Class	Number of AA Points	Class Accuracy (%)	Percent Map Area
Sawgrass-Beakrush Marsh (MFGXcr)	2	100%	1.11%
Sawgrass-Black Rush Marsh (MFGXcj)	2	50%	0.46%
Black Mangrove Scrub-Succulent Marsh (CMaS)	1	100%	0.15%
Black Mangrove-Buttonwood Woodland-Graminoid Marsh (WMXacG)	1	100%	0.02%
Black Mangrove-Red Mangrove Woodland-Graminoid Marsh (WMXarG)	1	100%	0.03%
Black Mangrove-Red Mangrove Woodland-Open (WMXarO)	1	100%	0.03%
Black Mangrove-White Mangrove Forest (FMXal)	1	100%	0.82%
Black Mangrove-White Mangrove Shrubland (SMXal)	1	100%	0.38%
Brazilian Pepper (Es)	1	100%	0.20%
Buttonwood Scrub-Sand Cordgrass Marsh (CMcGn)	1	100%	0.03%
Buttonwood Shrubland (SMc)	1	100%	0.15%
Buttonwood-Red Mangrove Scrub-Sawgrass Marsh (CMXcrGc)	1	100%	0.22%
Buttonwood-White Mangrove Forest (FMXcl)	1	100%	0.10%
Buttonwood-White Mangrove Shrubland (SMXcl)	1	100%	0.31%
Cypress Scrub-Spikerush Marsh (CStGe)	1	100%	0.02%
Mixed Mangrove Shrubland-Mixed (SMXX)	1	0%	1.15%
Pond Apple Scrub-Sawgrass Marsh (CSaGc)	1	100%	0.03%
Red Mangrove Forest (FMr)	1	100%	1.67%
Sawgrass-Sand Cordgrass Marsh (MFGXcn)	1	100%	0.42%
Short Sawgrass Marsh-Sparse (MFGcSS)	1	100%	0.77%
White Mangrove Forest (FMl)	1	100%	0.48%
White Mangrove Scrub-Open Marsh (CMlO)	1	100%	0.06%
White Mangrove Scrub-Sand Cordgrass Marsh (CMlGn)	1	0%	0.16%
White Mangrove Scrub-Sawgrass Marsh (CMlGc)	1	100%	0.05%
White Mangrove Shrubland (SMl)	1	0%	0.49%
White Mangrove-Red Mangrove Shrubland (SMXlr)	1	100%	0.94%

Conclusion

The accuracy of the NWCE vegetation map, 88.4% with a lower 90th Percentile Confidence Interval of 84.5%, met and exceeded NPS VMI standards. This accuracy is similar to the estimated accuracy of the previous two vegetation maps of the Southeast Saline Everglades, Region 2, and the Southwest Coastal Everglades, Region 3, in Everglades National Park. The majority, 85% (45 out of 53), of all thematic classes assessed, regardless of the number of AA points, had an estimated accuracy greater than or equal to 80%. The few classes that did not, were evaluated by eight or fewer assessment points each. The design of the accuracy assessment, a random draw of approximately 250 assessment points per region, did not permit the assessment of every individual thematic class found within this project. This is a known limitation of the project and a cost compromise needed to ensure that this project would be practical.

This vegetation map and report is the third of four regional maps for Everglades National Park. It marks the completion of the SFCN's vegetation mapping effort in Everglades National Park and Big Cypress National Preserve. The Southeast Saline Everglades, Region 2, Southwest Coastal Everglades, Region 3, and eastern Big Cypress, Regions 5 and 6, vegetation maps are complete and available for download from the NPS Integrated Resource Management Applications Data Store. The western Big Cypress vegetation map is pending publication. Work on the remaining Region, Shark River Slough/Long Pine Key, Region 1, in Everglades National Park is ongoing and under the direction of the United States Army Corps of Engineers (USACE).

This map and those previously produced provide land-cover information to NPS park managers and scientists for use in park management, resource management, research, and monitoring. It serves as a baseline of plant communities prior to the implementation CERP. It also provides a cost-effective mechanism by which managers can track and document the rate and direction of vegetation change resulting from natural successional processes, disturbance events, sea level rise, and/or management, by allowing for the systematic monitoring of individual grid-cells overtime. Furthermore, this map, coupled with LiDAR, will allows hydrologist and ecologists to run fine-scale predictive models of potential vegetation change within Everglades National Park and Big Cypress National Preserve in response to hydrologic manipulation at a 0.25-hectare (0.61-ac) scale.

Summary of Final Product and Deliverables

The NWCE vegetation map covers an area of 1,278 square kilometers (493.7 square miles [sq mi], or 315,955 acres [ac]). It has an estimated thematic class accuracy of 88.4% with a lower 90th Percentile Confidence Interval of 84.5%. This report and the geospatial products developed in the preparation of the NWCE vegetation map are available from the NPS Integrated Resource Management Applications Data Store. In addition, a digital product, DVD or flash drive, containing the report and all of the digital data, including the field data and photographs, and META data, is available upon request from South Florida/Caribbean Network.[4]

The geospatial data collected and created in this project are stored in an ESRI ArcGIS v10.5 personal geodatabase and are referenced to the Universal Transverse Mercator (UTM) Zone 17N, North American Datum of 1983 (NAD83).

[4] South Florida Caribbean Network, 18001 Old Cutler Road, Suite 419, Palmetto Bay Florida 33157-6435 Phone: 305.252.0347

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Appendix A. Mapping Methodology and Accuracy Assessment of the Avineon, Inc. Vegetation Map of Region 4 NW

Introduction

Appendix A describes the methods used by Avineon, Inc. to map Region 4 NW and the results of the accuracy assessment conducted by the South Florida/Caribbean Network (SFCN). The text that follows are excerpts, with some modifications, taken from unpublished reports written by Avineon and the network.

Avineon, Inc. Mapping Methodology

Aerial Photography and Aerotriangulation

The base imagery for Region 4 NW consisted of 1:24,000 scale film-based color infrared aerial photography acquired on February 1, 2006. The aerial photography was acquired using a Wild RC30 aerial camera at a flight height of 12,020 feet (3,664 meters [m]) above mean terrain.

Ground control for the aerial photography was derived using a combination of airborne GPS coordinates acquired during acquisition and photo-identifiable ground control coordinates surveyed in the field after aerial photography acquisition.

Aerotriangulation was accomplished so that the resultant spatial accuracy is much better than the contractually required specification of USGS National Map Accuracy Standards (NMAS) for 1:12,000 scale map products. The root mean square error (RMSE) of the ground control point residuals in METERS are as follows: RMSE-X 0.370, RMSE-Y 0.273, and RMSE-Z 0.278.

Aerotriangulation Quality Assurance

The results of aerotriangulation were carefully inspected prior to mapping. Adjusted coordinate residuals were inspected to ensure compliance with the project's accuracy requirements of USGS National Map Accuracy Standards (NMAS) for 1:12,000 scale map products.

The rectified imagery was again tested against existing Collier County's high accuracy digital orthophotography. Photo-identifiable points which were visible on both the project's imagery and Collier County's imagery were compared to ensure that only minor offsets existed. The project's imagery was also compared to USGS Digital Orthophoto Quarter Quads (DOQQ) to ensure accuracy.

The aerotriangulation solution is also constantly tested in the field by Avineon's photo-interpreters. The field crew selects field point coordinates from the rectified aerial photography appearing within the stereoplotter. They then visit the field point coordinates using GPS to document vegetation. The field points have continuously aligned to the photo-identifiable features apparent on the aerial photography.

Photointerpretation

The photointerpretation process begins with loading adjacent pairs of aerial photos (or stereo pairs) onto the analytical stereoplotter stages so that they can be viewed as three dimensional images in stereo. The overlapping portion of adjacent photographs is called a model. The photo-interpreter can collect any data that is viewable within the model.

Prior to photointerpretation the aerial photographic model must be oriented so that all coordinate positions on the model can be tied to real ground coordinates on the Earth. The orientation software used at Avineon is P-CAP, available from Z/I Imaging Corporation. The software requires the measurement and input of the inner, then the relative, and finally the absolute orientation of the stereo pair. The inner orientation measures the corner and side fiducials of the photographs wherever they have been placed on the stereoplotter plates so that they are oriented to the stereoplotter. This establishes an X-Y coordinate system for the photos with the principle point acting as the origin. The relative orientation requires the user to identify matching features between the two photos so that they are oriented to each other. This results in an un-scaled and un-georeferenced model of the two photographs. The relative angles between the photos themselves and any features viewed on the photos are then anchored relative to one another. The final orientation step is referred to as absolute orientation. Absolute orientation is performed by locating/inputting ground control points used for aerotriangulation. This step orients the photography to the real-world coordinate system which in this case is Universal Transverse Mercator (UTM).

All control points used during the model set-up process have their coordinates stored in a ground control file which is imported into P-CAP during the orientation process. When a point is measured and named during absolute orientation, P-CAP looks up the name in the control point file and links coordinates to that point. After the control points are measured, the model is oriented in space and P-CAP can then report the real world XYZ coordinates of any position driven to in the model.

As photointerpretation commences, vegetation cover types are carefully analyzed by the photo-interpreter within each independent grid cell appearing over the stereo models. Each grid cell is then attributed (i.e., labeled) according the Vegetation Classification System for South Florida National Parks. Approximately, three-thousand 0.25 hectare-(0.61-acre [ac]) grid cells exist within one stereo model. Each grid cell requires photointerpretation and attribution.

In order speed up the attribution process, Avineon completed several software applications aimed at streamlining the process. We previously created a “drive file” for the stereoplotters based on the 0.25-hectare (0.61 ac) grid spacing. Typically, a drive file is used within photogrammetric workstations to capture digital terrain models (i.e., elevation values) at equidistant posting locations throughout the stereo model. We have utilized the same process for the attribution of the grid cells. Specifically, the software drives the stereo models so that the cursor (or stereoplotter reticle) moves from one position to the next along a straight line without the need for the photo-interpreter to do this manually. The process allows the photo-interpreter to attribute a grid cell and automatically move to the exact center of the next grid cell. The next grid cell is then attributed and the cursor moves to the following grid cell center. This process is continued until all grid cells within the photographic model

are attributed. The application also allows the photo-interpreter to complete attribution without using the drive file where necessary.

Avineon utilizes MicroStation V8 software (Bentley Microsystems, Inc) coupled with our analytical stereoplotters to store graphic and attribute information during photointerpretation. The workstations allow for the direct capture of digital data in MicroStation which is then imported to ArcGIS software.

Field Methods

The field work process allows the photo-interpreters to correlate signatures (i.e., colors, tones, and textures) on the photography with in-field conditions to determine exact grid cell classification. It is necessary to correlate aerial photography signatures with field conditions so that exact classification can be accomplished regardless of any environmental differences within the study area and regardless of any differences between flight lines.

Field work is designed to (1) ensure that ***signature identification*** is accomplished prior to photointerpretation; and (2) accomplish problem resolution and ***groundtruthing*** during photointerpretation.

Signature identification field work is conducted prior to photointerpretation. This phase of field work is conducted so that photographic signatures can be verified and compared to field conditions. ***Groundtruthing field work*** is conducted after or during draft photointerpretation in order to solve classification and boundary problems uncovered during the process of photointerpretation. Avineon has found that as photointerpretation commences, questions can arise in determining exact breaks between signatures and cover types particularly within mixed community situations. These questions can sometimes only be resolved by once again visiting the field.

Prior to visiting the field, the photo-interpreters visually review various grid cells within the stereoplotter in order to locate potential problem areas. Check sites which represent numerous vegetative signatures are selected during this process. The coordinates used for each field check site are equivalent to the grid centroid coordinates. The grid cell centroid coordinates are then loaded into GPS equipment so that they can be visited in the field. This process ensures that checksites chosen in the office are accurately located in the field. The process also ensures that field analysis starts at a grid centroid thus ensuring that classification is accurately accomplished with the cell. During this pre-field preparation task, a field route is planned in accordance with the number and location of check sites within the areas to be visited.

Avineon has also produced 1-meter (3.3 ft) pixel resolution digital orthophotographs so that they can be taken to the field and analyzed. These are loaded within ArcMap software run on a laptop computer. A GPS module is integrated within the equipment platform so that the photo-interpreter can see his coordinate position in the field superimposed over the orthophoto imagery. The laptop displays the vector-based grid, the imagery, and the classification attributes determined on the stereoplotter. This process enables Avineon to accurately see the field site bounded by the grid square in relation to the position of the helicopter.

While in the field, classification is determined and entered manually on a Field Data Sheet and then entered into the GIS Field work Shapefile developed for the project. The Field Data Sheet serves as a backup in case the digital data is lost or corrupted. A digital photograph is taken at each field site and included with the deliverables.

Quality Assurance Procedures

In-Process Photointerpretation Quality Assurance

Photointerpretation quality control reviews were on-going during the creation of the maps. Avineon's lead photointerpreter systematically reviewed each completed model directly after completion to ensure adherence to classification specifications and consistency among the photo-interpreters. Suggested corrections were pointed out to the original photo-interpreter or to the entire photointerpretation team as necessary.

An analytical stereoplotter with dual optics was also used. This instrument allows two photo-interpreters to view the images simultaneously to aid in training and classification discussion.

Digital Data Quality Control

Automated quality control software programs were developed by Avineon to check for errors. One check identifies missing grid cell labels. Another check identifies and flags classification codes not appearing within the classification system. If found, these errors are corrected using the imagery and the stereoplotter.

Each MicroStation design file was checked against the project's established data model to ensure that all data is formatted within the correct MicroStation level and is portrayed according to the graphics definitions supplied for the project. Model specific grid files were checked against adjacent model files to ensure that no overlaps occurred.

ArcGIS files were also checked to ensure that the attribution tables were in accordance with NPS specifications and that the files are projected correctly.

South Florida/Caribbean Network (SFCN) Accuracy Assessment Results.

Overall accuracy assessment

The South Florida/Caribbean Network (SFCN) projected 180 accuracy assessment points collected by the Institute for Regional Conservation on to the Region 4 NW vegetation map. There was an exact match in classification (complete agreement) for 62 of the 180 points (34.4%) and there was some form of disagreement for 118 of the 180 points. The network then checked all 118 of these points to determine the type and degree of difference between the field classification and the map classification and whether the map classification would be acceptable. For all 118 accuracy assessment points, the South Florida/Caribbean Network noted the reasoning for either accepting the map classification or rejecting the map classification based upon the field data and classification. A total of 30 accuracy assessment points were not acceptable. An additional 88 were accepted as having similar habitat classification for a total of 150 points (Table 1). Examples of reasons for "accepting" a non-matching classification include:

1. the field classification was at a lower level than the map classification but the map classification was at an acceptable level.
2. the map classification was at a lower level than the field classification and the field notes showed the map classification was within the realm of possibility.
3. if a Forest was misclassified as a Woodland or vice versa and the % cover in the field data was near the cutoff of 60% cover, the point was accepted as accurate. Similar reasoning was applied to the Shrubland versus Forest distinction when height was close to the 5-meter cutoff between the classes.
4. the field data showed the vegetation was on a boundary (ecotone) between the two vegetation categories in the map classification and field classification (Mixed cell).
5. although co-dominant mixes of mangrove classes (level 4 FMXac, FMXal, FMXar, FMXcl, FMXcr, FMXlr) should have only up to a 60/40% split to qualify for the various FMX categories, splits of up to a 80/20% were "accepted."

The initial Region 4 NW classification accuracy was assessed to be 83% (150/180 points) with a lower 90% confidence level of 79% accuracy. To achieve the acceptable level of accuracy, 80% accuracy with 90% confidence, the L-4 Mixed Mangrove Forest classes were rolled up to the Level-3 Mixed Mangrove classification. This resulted in the acceptance of an additional four assessment points. The final Region 4 NW classification accuracy was determined to be 86% (154/180 points) with a lower 90% confidence level of 82% accuracy.

Table A-1. IRC field classification versus Avineon map code.

IRC Field Classification	Avineon Map Code	Acceptable	Not Acceptable	Grand Total
BCH	ITF	1	–	1
BCH Total	–	1	–	1
CSmGc	SM	–	1	1
CSmGc Total	–	–	1	1
CSsG	MFG,MFGtS	–	1	1
CSsG Total	–	–	1	1
CStGPs	CStG	1	–	1
	MFGP	1	–	1
CStGPs Total	–	2	–	2
CStGs	WStG	–	1	1
CStGs Total	–	–	1	1
EsM	WM	1	–	1
EsM Total	–	1	–	1

Table A-1 (continued). IRC field classification versus Avineon map code.

IRC Field Classification	Avineon Map Code	Acceptable	Not Acceptable	Grand Total
FHM	FHM	1	–	1
FHM Total	–	1	–	1
FM	FMa	–	1	1
	FMr	2	1	3
	FMXal	1	–	1
	FMXar	1	1	2
	FMXlr	2	–	2
	WM	1	–	1
FM Total	–	7	3	10
FMa	FMa	17	–	17
	FMX	–	1	1
	FMXal	–	1	1
	FMXar	3	2	5
	SMa	–	1	1
	WM	2	–	2
FMa Total	–	22	5	27
FMc	WMc	3	–	3
FMc Total	–	3	–	3
FMl	FMa	–	3	3
	FMl	1	–	1
	FMr	–	1	1
	FMXal	–	2	2
	FMXlr	2	–	2
	WM	1	–	1
FMl Total	–	4	6	10
FMr	FMr	11	–	11
	FMXar,EsS	1	–	1
	FMXlr	1	–	1
FMr Total	–	13	–	13

Table A-1 (continued). IRC field classification versus Avineon map code.

IRC Field Classification	Avineon Map Code	Acceptable	Not Acceptable	Grand Total
FMX	FMa	1	–	1
	FMr	5	–	5
	FMXal	2	–	2
	FMXar	1	–	1
	FMXlr	3	–	3
FMX Total	–	12	–	12
FMXal	FMXal	1	–	1
	FMXar	1	–	1
	FMXlr	–	1	1
FMXal Total	–	2	1	3
FMXar	FMX	1	–	1
	FMXar	6	–	6
FMXar Total	–	7	–	7
FMXlr	FMr	3	1	4
	FMX	1	–	1
FMXlr Total	–	4	1	5
FStH	FStH	1	–	1
FStH Total	–	1	–	1
FStp	WStG	1	–	1
FStp Total	–	1	–	1
FStS	FStS	3	–	3
	WStG	1	–	1
FStS Total	–	4	–	4
MFGh	MFG	2	–	2
MFGh Total	–	2	–	2
MFGP	MFGP	7	–	7
MFGP Total	–	7	–	7
MFGt	MFG,MFGtD	1	–	1
MFGt Total	–	1	–	1

Table A-1 (continued). IRC field classification versus Avineon map code.

IRC Field Classification	Avineon Map Code	Acceptable	Not Acceptable	Grand Total
MFO	MFG	5	–	5
	SMr	1	–	1
MFO Total	–	6	–	6
MFPO	MFGP	1	–	1
MFPO Total	–	1	–	1
MSG	MSG	1	–	1
MSG Total	–	1	–	1
MSGd	MSG	3	–	3
	MSO	–	1	1
MSGd Total	–	3	1	4
MSGs	CMG	–	1	1
	MFG	–	1	1
	MSG	2	–	2
	MSGs	1	–	1
MSGs Total	–	3	2	5
OW	FMr	1	–	1
	ITF	2	–	2
	MSO	1	–	1
	OW	6	–	6
	WMc	–	2	2
OW Total	–	10	2	12
SM	SMr	1	–	1
SM Total	–	1	–	1
SMc	FMc	1	–	1
	SMa	–	1	1
	WM	–	1	1
SMc Total	–	1	2	3
SMr	FMr	1	–	1
SMr Total	–	1	–	1

Table A-1 (continued). IRC field classification versus Avineon map code.

IRC Field Classification	Avineon Map Code	Acceptable	Not Acceptable	Grand Total
SSm	SMX	–	1	1
SSm Total	–	–	1	1
SSs	FStS	1	–	1
	SSs,MFGtS	1	–	1
SSs Total	–	2	–	2
WM	BCH	1	–	1
	FMa	–	1	1
	FMX	1	–	1
	WM	2	–	2
	WMc	1	–	1
WM Total	–	5	1	6
WMa	FMXar	2	–	2
WMa Total	–	2	–	2
WMc	FMX	–	1	1
	SMc	1	–	1
	WM	1	–	1
	WMc	1	–	1
	WSsS	1	–	1
WMc Total	–	4	1	5
WMcG	WSsS	1	–	1
WMcG Total	–	1	–	1
WMr	FM	1	–	1
WMr Total	–	1	–	1
WS	WSsS	1	–	1
WS Total	–	1	–	1
WSp	WSpG	1	–	1
WSp Total	–	1	–	1
WSpG	WSpG	1	–	1
WSpG Total	–	1	–	1

Table A-1 (continued). IRC field classification versus Avineon map code.

IRC Field Classification	Avineon Map Code	Acceptable	Not Acceptable	Grand Total
WSpX	WSpG	2	–	2
WSpX Total	–	2	–	2
WStG	CStGP	2	–	2
	FStS	3	–	3
WStG Total	–	5	–	5
WStO	FStD	1	–	1
WStO Total	–	1	–	1
WU	WU	2	–	2
WU Total	–	2	–	2
WUs	WMc	–	1	1
WUs Total	–	–	1	1
Grand Total	–	150	30	180

Appendix B. Vegetation Classification Key for the Northwest Coastal Everglades, Region 4, Vegetation Map of Everglades National Park



Version R4-2019.1201

On the Cover

Landscape scene showing pines, palms, shrubs, and graminoids in Big Cypress National Preserve. Photo credit Pablo L Ruiz (4 December 2014).

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Introduction

This vegetation classification key was designed to be used in the Everglades National Park (EVER) and Big Cypress National Preserve (BICY) vegetation mapping project to help photo-interpreters determine the appropriate vegetation class within 0.25 ha vegetation mapping cells, the minimum mapping unit (MMU) for this project. This key is modeled after the *Vegetation Classification System for South Florida Natural Areas v6.15.09* (Rutchey et al. 2006)[5] which was developed and used to map wetland and upland plant communities in other regions of the Everglades (Rutchey et al. 2008). The classification key presented herein differs from its parent system in several ways: (1) the hierarchical pathway has been streamlined to help photo-interpreters consistently reach the same vegetation class and reduce photo-interpreter variability; (2) vegetation class definitions have been modified to clarify meaning and to reflect regional differences in species composition; (3) vegetation classes not occurring within the mapping area have been removed while region-specific vegetation classes have been added; and (4) the vegetation classification key for exotic plant species is currently not included in this version—users are asked to reference the exotic plant species section in the *Vegetation Classification System for South Florida Natural Areas* (Rutchey et al. 2006) for now. A more detailed list of modifications can be found in the Appendix section at the end of this document.

It is expected that all users of this key will be familiar with most, if not all, of the plant species listed herein and have a general knowledge of the vegetation communities within EVER and BICY and their general distribution. It is expected that all users will have comparable abilities to accurately and precisely estimate vegetation cover and height within the MMU. Discrepancies of ± 5% in vegetation cover and height estimates are acceptable between photo-interpreters.

This key is not perfect and is a work in progress. A photo-interpreter should confirm the final keyed answer by reading the vegetation class description and determining whether the answer is plausible. If it is not, the photo-interpreter should revise the answer by examining other possible pathways in the key based on their best professional judgment of possible community types and on the structural and spectral information available. This key should be used hand-in-hand with the photo-interpreter's key, a tool similar to this key but specifically designed to assist in the photo-interpretation of vegetation communities directly from aerial photography based on a community's specific spectral and structural signature.

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[5] The *Vegetation Classification System for South Florida Natural Areas* is a majority rule, hierarchical, and structurally driven classification system. Using this system, community types are keyed out based on their majority cover, average vegetation height, and vegetation density within a minimum mapping unit. This classification system is best applied when using a photogrammetric 3D workstation that allows optimal visualization of the three-dimensional imagery to assist in determination of vegetation height and density.

Glossary

Cover (absolute)—The area covered by the vertical projection of a plant's crown, or community, expressed as a percentage of the total area it occupies within a region of finite size. The absolute cover for all species present shall always add up to 100%.

Cover (density)—The percentage of the area being classified that is occupied by an individual plant species or multiple plant species.

Co-dominant (mixed)—Two or more species that are equally distributed throughout a region of finite size with no significant difference in their absolute cover.

Dominant (dominated by)—The individual species having the highest cover of any species within the area being classified.

Dominant—Species cover between 50-89%. This term is typically used to classify cattail and exotic species cover.

Graminoids—Grasses and grass-like plant species such as sedges and rushes.

Herbaceous—Non-woody vascular plants species (graminoids excluded) typically persisting for only one growing season.

Monotypic—Species cover 90-100%. This term is typically used to classify cattail and exotic species cover.

Tree—Woody plant that is at least 5 meters tall.

Shrub—Woody plant that is shorter than 5 meters.

Sparse—Species cover 10-49%. This term is typically used to classify cattail and exotic species cover. In the marsh context it usually means less than 15%.

Uplands—Rarely flooded communities consisting of semi-flood-tolerant or flood-intolerant plant species.

Wetlands—Regularly flooded communities consisting of flood-tolerant plant species.

Vegetation Classification Key

L1 – Forest (F) – Stands of trees (5 meters or taller) that are of high density (50-100% cover). For exceptions to this rule please refer to Appendix A.

L1 – Woodland (W) – Stands of trees (5 meters or taller) that are of low density (10-49% cover). Trees are evenly spaced out and often in a matrix of sparse shrubs, graminoids, and/or herbaceous vegetation. For exceptions to this rule please refer to Appendix A.

L1 – Shrubland (S) – Stands of shrubs (shorter than 5 meters) that are of high density (50-100% cover). For exceptions to this rule please refer to Appendix A.

L1 – Scrub (C) – Stands of shrubs (shorter than 5 meters) that are of low density (10-49% cover). Shrubs are evenly spaced out and often in a matrix of graminoids and/or herbaceous vegetation. For exceptions to this rule please refer to Appendix A.

L1 – Marsh (M) – Graminoid and/or herbaceous emergent or floating vegetation in shallow water that stands at or above the ground surface for much of the year. Prairie habitat is included in this class. A marsh can have low density (0-9%) tree and shrub cover.

L1 – Exotic (E) – Non-native plant species assemblages.

L1 – Other (O) – Anthropogenic or non-vegetative features.

L1 – Forest (F)

Stands of trees (5 meters or taller) that are of high density (50-100% cover). For exceptions to this rule please refer to Appendix A.

I. Regularly flooded forest consisting of flood tolerant tree species. Most common forest type found in the Everglades.

L2 – <u>Wetland Forest</u> (FW)

1. Regularly flooded forests consisting of salt tolerant tree species. These communities are typically found along saltwater shorelines, interior tidal rivers and creeks, or estuarine zones.

L3 – <u>Mangrove Forest</u> (FM)

2. Seasonally to semi-permanently flooded freshwater forests primarily found in interior wetlands but may extend well into coastal areas.

L3 – <u>Swamp Forest</u> (FS)

II. Rarely flooded forests consisting of flood intolerant hardwood tree species of both temperate and tropical origins. These communities are found throughout the Everglades along coastal areas and offshore islands, pine woodlands, and interior marshes.

L2 – <u>Upland Forest</u> (FU)

1. Rarely flooded forest associated with flood intolerant trees of both temperate and tropical origins. Species composition is highly diverse but varies throughout the region.

L3 – <u>Hardwood Hammock</u> (FH)

L2 – Wetland Forest (FW)

<u>L3 – Mangrove Forest (FM)</u>

1a. Black Mangrove (*Avicennia germinans*) dominant forest. This community is usually characterized by a minimum of 50% Black Mangrove (*A. germinans*) trees and shrubs found in a matrix of other species.

L4 – Black Mangrove Forest (FMa)

1b. Buttonwood (*Conocarpus erectus*) dominant forest. This community is usually characterized by a minimum of 50% Buttonwood (*C. erectus*) trees and shrubs found in a matrix of other species.

L4 – Buttonwood Forest (FMc)

1c. White Mangrove (*Laguncularia racemosa*) dominant forest. This community is usually characterized by a minimum of 50% White Mangrove (*L. racemosa*) trees and shrubs found in a matrix of other species.

L4 – White Mangrove Forest (FMl)

1d. Red Mangrove (*Rhizophora mangle*) dominant forest. This community is usually characterized by a minimum of 50% Red Mangrove (*R. mangle*) trees and shrubs found in a matrix of other species.

L4 – Red Mangrove Forest (FMr)

1e. Mix of mangrove tree species with no particular species having dominance.

L4 – Mixed Mangrove Forest (FMX)

1e.1. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Buttonwood (*Conocarpus erectus*) trees.

L5 – Black Mangrove-Buttonwood Forest (FMXac)

1e.2. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and White Mangrove (*Laguncularia racemosa*) trees.

L5 – Black Mangrove-White Mangrove Forest (FMXal)

1e.3. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Red Mangrove (*Rhizophora mangle*) trees.

L5 – Black Mangrove-Red Mangrove Forest (FMXar)

1e.4. Co-dominant mix (20% or less difference in percent cover) of Buttonwood (*Conocarpus erectus*) and White Mangrove (*Laguncularia racemosa*) trees.

L5 – Buttonwood-White Mangrove Forest (FMXcl)

1e.5. Co-dominant mix (20% or less difference in percent cover) of Buttonwood (*Conocarpus erectus*) and Red Mangrove (*Rhizophora mangle*) trees.

L5 – Buttonwood-Red Mangrove Forest (FMXcr)

1e.6. Co-dominant mix (20% or less difference in percent cover) of White Mangrove (*Laguncularia racemosa*) and Red Mangrove (*Rhizophora mangle*) trees.

L5 – White Mangrove-Red Mangrove Forest (FMXlr)

1e.7. Co-dominant mix consisting of three or more mangrove tree species. This community is characterized by having no particular species in dominance, meaning there is 20% or less difference in percent cover between the most and least abundant mangrove tree species.

L5 – Mixed Mangrove Forest-Mixed (FMXX)

L3 – Swamp Forest (FS)

2a. Seasonally to semi-permanently flooded dominant to monotypic stands of Willow (*Salix caroliniana*) trees and shrubs in association with Leather Fern (*Acrostichum danaeifolium*), Cattail (*Typha* spp.), Sawgrass (*Cladium jamaicense*), Arrowhead (*Sagittaria* spp.), as well as other freshwater marsh species. This community is usually characterized by a minimum of 50% Willow (*Salix caroliniana*) trees and shrubs. This is an exception to the Forest class because even in the case of Forest height (5 meters or taller) this community is still considered **L1 – Shrubland (S)**.

L4 – Willow Shrubland (SSs)

2b. Seasonally flooded, dominant to monotypic (≥ 50% cover) stands of Cocoplum (*Chrysobalanus icaco*) trees (≥ 5 meters) and shrubs in association with other wetland species, e.g., Swamp Bay (*Persea palustris*), Red Bay (*P. borbonia*), Dahoon Holly (*Ilex cassine*), Willow (*Salix caroliniana*), Wax Myrtle (*Morella cerifera*), Sweetbay (*Magnolia virginiana*), Cypress (*Taxodium* spp.), and/or Pond Apple (*Annona glabra*), or upland tree species like Poisonwood (*Metopium toxiferum*) and/or Pigeon Plum (*Coccoloba diversifolia*). This community is an exception to the L1 – Forest Class and falls under **L1 – Shrubland (S)**.

L4 – Cocoplum Shrubland (SSy)

2c. Cypress (*Taxodium* spp.) dominant forest with understory vegetation consisting of Pond Apple (*Annona glabra*), Wax Myrtle (*Morella cerifera*), Pop Ash (*Fraxinus caroliniana*), Cocoplum (*Chrysobalanus icaco*), and Leather Fern (*Acrostichum danaeifolium*).

L4 – Cypress Forest (FSt)

2c.1. Cypress (*Taxodium* spp.) forest with at least 90% cypress cover (relative).

L5 – Cypress Forest-Monotypic (FStM)

2c.2. Cypress (*Taxodium* spp.) dominant forest typically found in a pond-like depression.

L5 – Cypress Forest-Dome (FStD)

2c.3. Cypress (*Taxodium* spp.) dominant forest typically found in an elongated slough-like or open-ended depression.

L5 – Cypress Forest-Strand (FStS)

2c.4. Co-dominant mix (20% or less difference in percent cover) of Cypress (*Taxodium* spp.) with other lowland hardwood trees such as Red Maple (*Acer rubrum*), Pond Apple (*Annona glabra*), Pop Ash (*Fraxinus caroliniana*), Willow (*Salix caroliniana*), and Cabbage Palm (*Sabal palmetto*) with common understory vegetation consisting of Pond Apple (*Annona glabra*), Wax Myrtle (*Myrica cerifera*), Pop Ash (*Fraxinus caroliniana*), Cocoplum (*Chrysobalanus icaco*), and Leather Fern (*Acrostichum danaeifolium*).

L5 – Cypress-Hardwood Forest (FStH)

2c.5. Co-dominant mix (20% or less difference in percent cover) of Cypress (*Taxodium* spp.) with Slash Pine (*Pinus elliottii*). Common understory vegetation can include mixed hardwood shrubs and/or graminoids.

L5 – Cypress-Pine Forest (FStp)

2d. Mix of Swamp Bay (*Persea palustris*), Red Bay (*P. borbonia*), Cocoplum (*Chrysobalanus icaco*), Dahoon Holly (*Ilex cassine*), Willow (*Salix caroliniana*), Wax Myrtle (*Morella cerifera*), Sweetbay (*Magnolia virginiana*), Cypress (*Taxodium* spp.), Pond Apple (*Annona glabra*), and occasionally Buttonwood (*Conocarpus erectus*).

L4 – Bayhead Forest (FSB)

2e. Mix of trees characterized by Buttonwood (*Conocarpus erectus*), Red Mangrove (*Rhizophora mangle*), Cocoplum (*Chrysobalanus icaco*), Wax Myrtle (*Morella cerifera*), Poisonwood (*Metopium toxiferum*), and occasionally West Indian Mahogany (*Swietenia mahagoni*), Swamp Bay (*Persea palustris*), Red Bay (*P. borbonia*), Sweetbay (*Magnolia virginiana*), and Dahoon Holly (*Ilex cassine*). The signatures for Buttonwood (*C. erectus*) and Dahoon Holly (*I. cassine*) are often confused in regions where the two species co-exist, leaving Red Mangrove (*R. mangle*) as the distinguishing component between the Transitional Bayhead and Bayhead classes in regions where both classes are likely to be found. The significant presence (at least 30% cover) of Buttonwood (*C. erectus*) or Red Mangrove (*R. mangle*) evenly distributed throughout the vegetation matrix sets this class apart from the Bayhead Forest class. Note that when these species are confined to the outside fringe they are not considered indicative of a Transitional Bayhead.

L4 – Transitional Bayhead Forest (FSBT)

2f. Mix of lowland hardwood trees such as Red Maple (*Acer rubrum*), Pop Ash (*Fraxinus caroliniana*), Swamp Bay (*Persea palustris*) and/or Red Bay (*P. borbonia*), Sweetbay (*Magnolia virginiana*), Pond Apple (*Annona glabra*), Willow *(Salix caroliniana)*, Laurel Oak (*Quercus laurifolia*), and cabbage Palm (*Sabal palmetto*). Cocoplum (*Chrysobalanus icaco*) commonly found in the understory.

L4 – Hardwood Swamp Forest (FSH)

2g. Mix of lowland hardwood trees such as Red Maple (*Acer rubrum*), Pop Ash (*Fraxinus caroliniana*), Swamp Bay (*Persea palustris*) and/or Red Bay (*P. borbonia*), Sweetbay (*Magnolia virginiana*), Pond Apple (*Annona glabra*), Willow *(Salix caroliniana)*, Laurel Oak (*Quercus laurifolia*), and cabbage Palm (*Sabal palmetto*) with at least 30% mangrove cover. Mangrove species may include Red magnrove (*Rhizophora mangle*), White mangrove (*Laguncularia racemose*), Black mangrove (*Avicennia germinans*) and/or Buttonwood (*Conocarpus erectus*).

L4 – Transitional Hardwood Swamp Forest (FSHT)

L2 – Upland Forest (FU)

L3 – Pine Upland (WUp)

Stands of Slash Pine (*Pinus elliottii*) trees (10-100% cover) in a matrix composed of upland graminoids, herbs, and/or shrubs. Also known as a mesic pine flatwoods. This is an exception to the Woodland class because even in the case of Forest density (50-100% cover) this community is still considered **L1 – Woodland (W)**.

L3 – Hardwood Hammock (FH)

1a. Coastal hardwood forest containing a species rich assemblage of tropical and temperate broad-leaved trees typified by the presence of Pigeon Plum (*Coccoloba diversifolia*), False Mastic (*Sideroxylon foetidissimum*), Gumbo Limbo (*Bursera simaruba*), Strangler Fig (*Ficus aurea*), White Stopper (*Eugenia axillaris*), Jamaican Dogwood (*Piscidia piscipula*), Buttonwood (*Conocarpus erectus*), Spanish Stopper (*E. foetida*), West Indian Mahogany (*Swietenia mahagoni*), Cabbage Palm (*Sabal Palmetto*), Soapberry (Sapindus saponaria), Satinleaf (Chrysophyllum olivoforme), Wild Lime (*Zanthoxylum fagara*), Blackbead (*Pithecellobium keyense*), Spanish Bayonet (*Yucca aloifolia*), Catclaw Blackbead (*P. unguis-cati*), Triangle Cactus (*Acanthocereus tetragonus*), Prickly Pear (*Opuntia stricta*), Wild Cinnamon (*Canella winterana*), Sea Grape (*C. uvifera*), Geigertree (*Cordia sebestena*), Milk Bark (*Drypetes lateriflora*), Seven Year Apple (*Genipa clusiifolia*), Crabwood (*Gymnanthes lucida*), Manchineel (*Hippomane mancinella*), Joewood (*Jacquinia keyensis*), Thach Palm species (*Leucothrinax morrisii* or *Thrinax radiata*), Poisonwood (*Metopium toxiferum*), and Florida bully (*Sideroxylon reclinatum*), among other species.

L4 – Coastal Hammock (FHC)

1a.1. Coastal upland forest containing a mixture of tropical and temperate broad-leaved trees such as Pigeon Plum (*Coccoloba diversifolia*), False Mastic (*Sideroxylon foetidissimum*), Gumbo Limbo (*Bursera simaruba*), Strangler Fig (*Ficus aurea*), White Stopper (*Eugenia axillaris*), Jamaican Dogwood (*Piscidia piscipula*), Spanish Stopper (*E. foetida*), West Indian Mahogany (*Swietenia mahagoni*), Cabbage Palm (*Sabal Palmetto*), Soapberry (Sapindus saponaria), Satinleaf (Chrysophyllum olivoforme), Wild Lime (*Zanthoxylum fagara*), Spanish Bayonet (*Yucca aloifolia*), Triangle Cactus (*Acanthocereus tetragonus*), Prickly Pear (*Opuntia stricta*), Wild Cinnamon (*Canella winterana*), Thach Palm (*Thrinax radiata*), Poisonwood (*Metopium toxiferum*), and Florida bully (*Sideroxylon reclinatum*) among other. This community is generally found along coastal creeks and interior mangrove forest on calcerous substrate and/or shells.

L5 – Coastal Hardwood Hammock (FHCC)

1a.2. Hammock forests containing a mixture of tropical broad-leaved trees such as False Mastic (*Sideroxylon foetidissimum*), Gumbo Limbo (*Bursera simaruba*), Strangler Fig (*Ficus aurea*), White Stopper (*Eugenia axillaris*), Jamaican Dogwood (*Piscidia piscipula*), Spanish Stopper (*E. foetida*), Wild Lime (*Zanthoxylum fagara*), Blackbead (*Pithecellobium keyense*), Spanish Bayonet (*Yucca aloifolia*), Catclaw Blackbead (*P. unguis-cati*), Triangle Cactus

(*Acanthocereus tetragonus*), and Prickly Pear (*Opuntia stricta*), among others found along coastal areas on sandy dunes (shell mounds excluded).

L5 – Coastal Dune Hammock (FHCD)

1b. Cabbage Palm (*Sabal palmetto*) dominated forest with sparse, generally less than 25%, Laurel Oak (*Quercus laurifolia*), Live Oak (*Q. virginiana*), Strangler Fig (*Ficus aurea*), and Swamp Fern (*Blechnum* spp.) as a common understory component. This community is usually characterized by a minimum of 50% Cabbage Palm (*S. palmetto*) trees and shrubs found in a matrix of other species.

L4 – Cabbage Palm Hammock (FHo)

1c. Mix species assemblage of False Tamarind (*Lysiloma latisiliquum*), Gumbo Limbo (*Bursera simaruba*), Poisonwood (*Metopium toxiferum*), Pigeon Plum (*Coccoloba diversifolia*), False Mastic (*Sideroxylon foetidissimum*), Live Oak (*Quercus virginiana*), Sugarberry (*Celtis laevigata*), White Stopper (*Eugenia axillaris*) and Lancewood (*Nectandra coriacea*). May also contain Strangler Fig (*Ficus aurea*), Swamp Bay (*Persea borbonia*), Dahoon Holly (*Ilex Cassine*), Wax Myrtle (*Morella cerifera*), Myrsine (*Myrsine floridana*), and Willow Bustic (*Sideroxylon salicifolium*). Water Oak (*Q. nigra*), Red Maple (*Acer rubrum*), and Laurel Oak (*Q. laurifolia*) may be present as single individuals.

L4 – Tropical Hardwood Hammock (FHS)

1d. Mix species assemblage of Laurel Oak (*Quercus laurifolia*), Live Oak (*Quercus virginiana*), Cabbage Palm (*Sabal palmetto*), and occasionally Strangler Fig (*Ficus aurea*), Red Mulberry (*Morus rubra*), Common Persimmon (*Diospyros virginiana*), and Saw Palmetto (*Serenoa repens*) in the understory.

L4 – Temperate Hardwood Hammock (FHT)

L1 – Woodland (W)

Stands of trees (5 meters or taller) that are of low density (10-49% cover). Trees are evenly spaced out and often in a matrix of sparse shrubs (<50%), graminoids, and/or herbaceous vegetation. If understory shrub cover ≥ 50%, then the community is treated as a L1 – Shrubland.

I. Regularly flooded low density stands of trees consisting of flood tolerant tree species.

L2 – <u>Wetland Woodland</u> (WW)

1. Regularly flooded low density stands of trees consisting of salt tolerant tree species.

L3 – <u>Mangrove Woodland</u> (WM)

2. Seasonally to semi-permanently flooded low density stands of freshwater tree species.

L3 – <u>Swamp Woodland</u> (WS)

II. Briefly flooded low density stands of trees consisting of semi-flood tolerant or flood intolerant woody species.

L2 – <u>Upland Woodland</u> (WU)

1. Stands of Slash Pine (*Pinus elliottii*) trees (10-100% cover) in a matrix composed of upland graminoids, herbs, and/or shrubs. Also known as a mesic pine flatwoods. This is an exception to the Woodland class because even in the case of Forest density (50-100% cover) this community is still considered **L1 – <u>Woodland</u> (W)**.

L3 – <u>Pine Woodland</u> (WUp)

2. Rarely inundated and well drained open canopy woodland containing a mixed species assemblage of tropical and temperate broad-leaved trees.

L3 – <u>Upland Hardwood Woodland</u> (WUH)

L2 – Wetland Woodland (WW)

<u>L3 – Mangrove Woodland (MW)</u>

1a. Black Mangrove (*Avicennia germinans*) in a matrix composed of salt marsh graminoids, herbs, and/or succulents.

L4 – Black Mangrove Woodland (WMa)

1a.1. Black Mangrove (*Avicennia germinans*) in a matrix composed predominately of graminoids.

L5 – Black Mangrove Woodland-Graminoid Marsh (WMaG)

1a.2. Black Mangrove (*Avicennia germinans*) in a matrix composed predominately of succulents.

L5 – Black Mangrove Woodland-Succulent Marsh (WMaS)

1a.3. Black Mangrove (*Avicennia germinans*) in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L5 – Black Mangrove Woodland-Open (WMaO)

1b. Buttonwood (*Conocarpus erectus*) in a matrix composed of salt marsh graminoids, herbs, and/or succulents.

L4 – Buttonwood Woodland (WMc)

1b.1. Buttonwood (*Conocarpus erectus*) in a matrix composed predominately of graminoids.

L5 – Buttonwood Woodland-Graminoid Marsh (WMcG)

1b.2. Buttonwood (*Conocarpus erectus*) in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation. Mangroves can occur in both salt and freshwater dominated marshes.

L5 – Buttonwood Woodland-Open Marsh (WMcO)

1c. White Mangrove (*Laguncularia racemosa*) in a matrix composed of salt marsh graminoids, herbs, and/or succulents.

L4 – White Mangrove Woodland (WMl)

1c.1. White Mangrove (*Laguncularia racemosa*) in a matrix composed predominately of graminoids.

L5 – White Mangrove Woodland-Graminoid Marsh (WMlG)

1c.2. White Mangrove (*Laguncularia racemosa*) in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation. Mangroves can occur in both salt and freshwater dominated marshes.

L5 – White Mangrove Woodland-Open Marsh (WMlO)

1d. Red Mangrove (*Rhizophora mangle*) in a matrix composed of salt marsh graminoids, herbs, and/or succulents.

L4 – Red Mangrove Woodland (WMr)

1d.1. Red Mangrove (*Rhizophora mangle*) in a matrix composed predominately of graminoids.

L5 – Red Mangrove Woodland-Graminoid Marsh (WMrG)

1d.2. Red Mangrove (*Rhizophora mangle*) in a matrix composed predominately of succulents.

L5 – Red Mangrove Woodland-Succulent Marsh (WMrS)

1d.3. Red Mangrove (*Rhizophora mangle*) in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L5 – Red Mangrove Woodland-Open (WMrO)

1e. Co-dominant mix (20% or less difference in percent cover) between two mangrove tree species in a matrix composed of salt marsh graminoids, herbs, and/or succulents.

L4 – Mixed Mangrove Woodland (WMX)

1e.1. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Buttonwood (*Conocarpus erectus*) trees.

L5 – Black Mangrove-Buttonwood Woodland (WMXac)

1e.1*i*. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Buttonwood (*Conocarpus erectus*) trees in a matrix of graminoids.

L6 – Black Mangrove-Buttonwood Woodland-Graminoid Marsh (WMXacG)

1e.2. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and White Mangrove (*Laguncularia racemosa*) trees.

L5 – Black Mangrove-White Mangrove Woodland (WMXal)

1e.2*i*. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and White Mangrove (*Laguncularia racemosa*) trees in a matrix of graminoids.

L6 – Black Mangrove-White Mangrove Woodland-Graminoid Marsh (WMXalG)

1e.2*ii*. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and White Mangrove (*Laguncularia racemosa*) trees in a matrix of succulents.

L6 – Black Mangrove-White Mangrove Woodland-Succulent Marsh (WMXalS)

1e.2*iii*. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and White Mangrove (*Laguncularia racemosa*) trees with an open understory.

L6 – Black Mangrove-White Mangrove Woodland-Open (WMXalO)

1e.3. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Red Mangrove (*Rhizophora mangle*) trees.

L5 – Black Mangrove-Red Mangrove Woodland (WMXar)

1e.3*i*. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Red Mangrove (*Rhizophora mangle*) trees in a matrix of graminoids.

L6 – Black Mangrove-Red Mangrove Woodland-Graminoid Marsh (WMXarG)

1e.3*ii*. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Red Mangrove (*Rhizophora mangle*) trees in a matrix of succulents.

L6 – Black Mangrove-Red Mangrove Woodland-Succulent Marsh (WMXarS)

1e.3*iii*. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Red Mangrove (*Rhizophora mangle*) trees with an open understory.

L6 – Black Mangrove-Red Mangrove Woodland-Open (WMXarO)

1e.4. Co-dominant mix (20% or less difference in percent cover) of White Mangrove (*Laguncularia racemosa*) and Red Mangrove (*Rhizophora mangle*) trees.

L5 – White Mangrove-Red Mangrove Woodland (WMXlr)

1e.4*i*. Co-dominant mix (20% or less difference in percent cover) of Buttonwood (*Conocarpus erectus*) and Red Mangrove (*Rhizophora mangle*) trees in a matrix of graminoids.

L6 – White Mangrove-Red Mangrove Woodland-Graminoid Marsh (WMXlrG)

1e.4*ii*. Co-dominant mix (20% or less difference in percent cover) of Buttonwood (*Conocarpus erectus*) and Red Mangrove (*Rhizophora mangle*) trees in a matrix of succulents.

L6 – White Mangrove-Red Mangrove Woodland-Succulent Marsh (WMXlrS)

1e.4*iii*. Co-dominant mix (20% or less difference in percent cover) of Buttonwood (*Conocarpus erectus*) and Red Mangrove (*Rhizophora mangle*) trees with an open understory.

L6 – White Mangrove-Red Mangrove Woodland-Open (WMXlrO)

1e.5. Co-dominant mix of trees of three or more mangrove species including Black Mangrove (*Avicennia germinans*), Buttonwood (*Conocarpus erectus*), Red Mangrove (*Rhizophora mangle*), and White Mangrove (*Laguncularia racemosa*). This community is characterized by having no particular species in dominance, meaning there is 30% or less difference in percent cover between the most and least abundant mangrove tree species.

L5 – Mixed Mangrove Woodland-Mixed (WMXX)

1e.5*i*. Co-dominant mix (30% or less difference in percent cover) of trees of three or more mangrove species in a matrix of graminoids.

L6 – Mixed Mangrove-Graminoid Marsh (WMXXG)

1e.5ii. Co-dominant mix (30% or less difference in percent cover) of trees of three or more mangrove species in a matrix of succulents.

L6 – Mixed Mangrove-Succulent Marsh (WMXXS)

1e.5*iii*. Co-dominant mix (30% or less difference in percent cover) of trees of three or more mangrove species, with an open understory.

L6 – Mixed Mangrove-Open Marsh (WMXXO)

<u>L3 – Swamp Woodland (WS)</u>

1a. Cabbage Palm (Sabal palmetto) in a matrix composed of marsh graminoids, herbs, and/or shrubs.

L4 – Cabbage Palm Lowland (WSo)

1a.1. Cabbage Palm (*Sabal palmetto*) in a matrix composed predominately of marsh graminoids, such as Sawgrass (*Cladium jamaicense*), Muhly Grass (*Muhlenbergia capillaris*), among others.

L5 – Cabbage Palm Lowland-Graminoid Marsh (WSoG)

2a.2. Cabbage Palm (*Sabal palmetto*) in a matrix composed predominately of marsh shrubs, such as Buttonwood (*Conocarpus erectus*), Wax Myrtle (*Myrica cerifera*), or other shrubss.

L5 – Cabbage Palm Lowland-Shrubs (WSoS)

1a.3. Cabbage Palm (*Sabal palmetto*) in a matrix composed of a co-dominant mix (20% or less difference in percent cover) of marsh graminoids and shrubs.

L5 – Cabbage Palm Lowland-Mixed (WSoX)

1b. Cypress (*Taxodium* spp.) in a matrix composed of Open Freshwater Marsh, graminoids, herbs, and/or shrubs.

L4 – Cypress Woodland (WSt)

1b.1. Cypress (*Taxodium* spp.) in a matrix composed predominately of graminoids, such as Sawgrass (*Cladium jamaicense*), Switchgrass (*Panicum virgatum*), Maidencane (*P. hemitomon*), among others.

L5 – Cypress Woodland-Graminoid Marsh (WStG)

L2 – Upland Woodland (WU)

L3 – Pine Woodland (WUp)

1a. Slash Pine (*Pinus elliottii*) in a matrix composed of marsh graminoids, herbs, and/or shrubs. This community is commonly referred to as hydric pine flatwoods.

L4 – Pine Lowland (WSp)

1a.1. Slash Pine (*Pinus elliottii*) in a matrix composed predominately of shrubs and trees, such as Wax Myrtle (*Myrica cerifera*), Cabbage Palm (*Sabal palmetto*), Dahoon Holly (*Ilex cassine*), Red Bay (*Persea borbonia*), and Buttonbush (*Cephalanthus occidentalis*) , among others.

L5 – Pine Lowland-Shrubs (WSpS)

1b. Pine Upland found on moderately to well-drained sandy soils.

L4 – Pine Flatwoods (WUpF)

1b.1. Pine Flatwoods in a matrix composed predominately of shrubs and trees, such as Wax Myrtle (*Myrica cerifera*), Saw Palmetto (*Serenoa repens*), Cabbage Palm (*Sabal palmetto*),

Fetterbush (*Lyonia lucida*), Tarflower (*Bejaria racemosa*), Rusty Staggerbush (*Lyonia ferruginea*), St. John's Wort (*Hypericum* spp.), and other upland hardwood species.

L5 – Pine Flatwoods-Shrubs (WUpFS)

L3 – Upland Hardwood / Palm Woodland (WUH)

2a. Cabbage Palm (*Sabal palmetto*) in a matrix composed of upland graminoids, herbs, and/or shrubs.

L4 – Cabbage Palm Upland (WUo)

2a.1. Cabbage Palm (*Sabal palmetto*) in a matrix composed predominately of upland graminoids.

L5 – Cabbage Palm Upland-Graminoid Marsh (WUoG)

L1 – Shrubland (S)

Stands of shrubs (shorter than 5 meters) that are of high density (50-100% cover). Mangrove communities with mean canopy heights of 2 meters or less with canopy cover greater than 10% are an exception to the Shrubland Class and fall under L1 – Scrub class.

I. Shrubs adapted to regularly flooded conditions.

L2 – Wetland Shrubland (SW)

1. Regularly flooded salt tolerant shrubs. These communities are typically found along saltwater shorelines, interior tidal rivers and creeks, or estuarine zones. Mangrove shrubs (taller than 2 meters but shorter than 5 meters) that are of high density (50-100% cover) are considered **L1 – Shrubland (S)**, and if they are of low density (10-49% cover) they are considered **L1 – Scrub (C)**. Dwarf mangrove shrubs (2 meters or shorter) are an exception to the Shrubland class because regardless of density (10-100% cover) they are **L1 – Scrub (C)**.

L3 – Mangrove Shrubland (SM)

2. Seasonally to semi-permanently flooded freshwater shrubs primarily found in interior wetlands but may extend well into coastal zone.

L3 – Swamp Shrubland (SS)

II. Rarely flooded shrub communities consisting of semi-flood tolerant or flood intolerant woody species.

L2 – Upland Shrubland (SU)

1. Mix of Gumbo Limbo (*Bursera simaruba*), Poisonwood (*Metopium toxiferum*), Pigeon Plum (*Coccoloba diversifolia*), White Stopper (*Eugenia axillaris*), Strangler Fig (*Ficus aurea*), Red Bay (*Persea borbonia*), Dahoon Holly (*Ilex Cassine*), Saffron Plum (*Sideroxylon celastrinum*), Sugarberry (*Celtis laevigata*), False Mastic (*Sideroxylon foetidissimum*), Wax Myrtle (*Myrica cerifera*), and Myrsine (*Myrsine floridana*). Similar to **L4 – Tropical Hardwood Hammock (FHS)** except average vegetation height is less than 5 meters.

L3 – Tropical Hardwood Shrubland (SUH)

2. Coastal Shrubland characterized by a mixed species assemblage of Sea Grape (*Coccoloba uvifera*), Gumbo Limbo (*Bursera simaruba*), West Indian Mahogany (*Swietenia mahagoni*), Spanish Stopper (*Eugenia foetida*), Poisonwood (*Metopium toxiferum*), Willow Bustic (*Sideroxylon salicifolium*), Jamaican Dogwood (*Piscidia piscipula*), Florida Thatch Palm (*Thrinax radiata*). Common understory components include Pricklypear (*Opuntia stricta*), Triangle Cactus (*Acanthocereus tetragonus*), among others.

L3 – Coastal Hardwood Shrubland (SUC)

L2 – Wetland Shrubland (SW)

L3 – Mangrove Shrubland (SM)

1a. Black Mangrove (*Avicennia germinans*) dominant Shrubland.

L4 – Black Mangrove Shrubland (SMa)

1b. Buttonwood (*Conocarpus erectus*) dominant Shrubland.

L4 – Buttonwood Shrubland (SMc)

1c. White Mangrove (*Laguncularia racemosa*) dominant Shrubland.

L4 – White Mangrove Shrubland (SMl)

1d. Red Mangrove (*Rhizophora mangle*) dominant Shrubland.

L4 – Red Mangrove Shrubland (SMr)

1e. Mix of mangrove tree species with no particular species having dominance.

L4 – Mixed Mangrove Shrubland (SMX)

1e.1. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Buttonwood (*Conocarpus erectus*) shrubs.

L5 – Black Mangrove-Buttonwood Shrubland (SMXac)

1e.2. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and White Mangrove (*Laguncularia racemosa*) shrubs.

L5 – Black Mangrove-White Mangrove Shrubland (SMXal)

1e.3. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Red Mangrove (*Rhizophora mangle*) shrubs.

L5 – Black Mangrove-Red Mangrove Shrubland (SMXar)

1e.4. Co-dominant mix (20% or less difference in percent cover) of Buttonwood (*Conocarpus erectus*) and White Mangrove (*Laguncularia racemosa*) shrubs.

L5 – Buttonwood-White Mangrove Shrubland (SMXcl)

1e.5. Co-dominant mix (20% or less difference in percent cover) of Buttonwood (*Conocarpus erectus*) and Red Mangrove (*Rhizophora mangle*) shrubs.

L5 – Buttonwood-Red Mangrove Shrubland (SMXcr)

1e.6. Co-dominant mix (20% or less difference in percent cover) of White Mangrove (*Laguncularia racemosa*) and Red Mangrove (*Rhizophora mangle*) shrubs.

L5 – White Mangrove-Red Mangrove Shrubland (SMXlr)

1e.7. Co-dominant mix consisting of three or more mangrove tree species. This community is characterized by having no particular species in dominance, meaning there is 20% or less difference in percent cover between the most and least abundant mangrove tree species.

L5 – Mixed Mangrove Shrubland-Mixed (SMXX)

L3 – Swamp Shrubland (SS)

2a. Cypress (*Taxodium* spp.) shrubs, < 5 meter tall, with 10-100% cover are considered **L1 – Scrub (C)**.

L4 – Cypress Scrub (CSt)

2b. Wax Myrtle (*Morella cerifera*) dominant Shrubland.

L4 – Wax Myrtle Shrubland (SSm)

2c. Seasonally to semi-permanently flooded dominant to monotypic stands of Willow (*Salix caroliniana*) trees and shrubs in association with Leather Fern (*Acrostichum danaeifolium*), Cattail (*Typha* spp.), Sawgrass (*Cladium jamaicense*), Arrowhead (*Sagittaria* spp.), as well as other freshwater marsh species. This community is usually characterized by a minimum of 50% Willow (*Salix caroliniana*) trees and shrubs. This is an exception to the Forest class because even in the case of Forest height (5 meters or taller) this community is still considered **L1 – Shrubland (S)**.

L4 – Willow Shrubland (SSs)

2d. Seasonally flooded dominant to monotypic stands of Cocoplum (*Chrysobalanus icaco*) trees and shrubs in association with other wetland species, e.g., Swamp Bay (*Persea palustris*), Red Bay (*P. borbonia*), Dahoon Holly (*Ilex cassine*), Willow (*Salix caroliniana*), Wax Myrtle (*Morella cerifera*), Sweetbay (*Magnolia virginiana*), Cypress (*Taxodium* spp.), and/or Pond Apple (*Annona glabra*), or upland tree species at higher elevation sites, e.g., Poisonwood (*Metopium toxiferum*) and/or Pigeon Plum (*Coccoloba diversifolia*). This community is usually characterized by a minimum of 50% Cocoplum (*C. icaco*) trees and shrubs. This is an exception to the Forest class because even if average vegetation height is 5 meters or taller is still considered **L1 – Shrubland (S)**.

L4 – Cocoplum Shrubland (SSy)

2e. Mix of flood tolerant fresh water tree and shrub species like Swamp Bay (*Persea palustris*), Red Bay (*P. borbonia*), Cocoplum (*Chrysobalanus icaco*), Dahoon Holly (*Ilex cassine*), Willow (*Salix caroliniana*), Wax Myrtle (*Morella cerifera*), Sweetbay (*Magnolia virginiana*), Cypress (*Taxodium spp.*), Pond Apple (*Annona glabra*), and occasionally Buttonwood (*Conocarpus erectus*).

L4 – Bayhead Shrubland (SSB)

2f. Mixed assemblage of shrubs characterized by Buttonwood (*Conocarpus erectus*), Red Mangrove (*Rhizophora mangle*), Cocoplum (*Chrysobalanus icaco*), Wax Myrtle (*Morella cerifera*), Poisonwood (*Metopium toxiferum*), Swamp Bay (*Persea palustris*), Red Bay (*P. borbonia*), Sweetbay (*Magnolia virginiana*), Dahoon Holly (*Ilex cassine*), and occasionally West Indian Mahogany (*Swietenia mahagoni*). The signatures for Buttonwood and Dahoon Holly (*I. cassine*) are often confused in regions where the two species co-exist, leaving Red Mangrove (*R. mangle*) as the distinguishing component between the Transitional Bayhead and Bayhead classes in regions where both classes are likely to be found. The significant presence (at least 30% cover) of Buttonwood (*C. erectus*) or Red Mangrove (*R. mangle*) evenly distributed throughout the vegetation matrix sets this class apart from the Bayhead Shrubland class. Note that when these species are confined to the fringe they are not considered indicative of a Transitional Bayhead.

L4 – Transitional Bayhead Shrubland (SSBT)

2g. Mix of lowland hardwood trees such as Red Maple (*Acer rubrum*), Pop Ash (*Fraxinus caroliniana*), Red Bay (*Persea borbonia*), Swamp Bay (*P. palustris*), Sweetbay (*Magnolia virginiana*), Pond Apple (*Anona glabra*), Willow (*Salix caroliniana*), Cocoplum (*Chrysolabanus icaco*), Cabbage Palm (*Sabal palmetto*), Wax Myrtle (*Morella cerifera*), Dahoon Holly (*Ilex cassine*), and Cypress (*Taxodium* spp.).

L4 – Hardwood Swamp Shrubland (SSH)

L2 – Upland Shrubland (SU)

1. Mix of Gumbo Limbo (*Bursera simaruba*), Poisonwood (*Metopium toxiferum*), Pigeon Plum (*Coccoloba diversifolia*), White Stopper (*Eugenia axillaris*), Strangler Fig (*Ficus aurea*), Swamp Bay (*Persea borbonia*), Dahoon Holly (*Ilex Cassine*), Saffron Plum (*Sideroxylon celastrinum*), Sugarberry (*Celtis laevigata*), False Mastic (*S. foetidissimum*), Wax Myrtle (*Morella cerifera*), and Myrsine (*Myrsine floridana*); similar to **L4 – <u>Tropical Hardwood Hammock</u> (FHS)** except canopy heights are less than 5 meters.

L3 – Tropical Hardwood Shrubland (SUH)

2. Coastal Shrubland characterized by a mixed species assemblage of Sea Grape (*Coccoloba uvifera*), Gumbo Limbo (*Bursera simaruba*), West Indian Mahogany (*Swietenia mahagoni*), Spanish Stopper (*Eugenia foetida*), Poisonwood (*Metopium toxiferum*), Willow Bustic (*Sideroxylon salicifolium*), Jamaican Dogwood (*Piscidia piscipula*), Florida Thatch Palm (*Thrinax radiata*). Common understory components include Pricklypear (*Opuntia stricta*), Triangle Cactus (*Acanthocereus tetragonus*), among others.

L3 – Coastal Hardwood Shrubland (SUC)

L1 – Scrub (C)

Stands of shrubs (shorter than 5 meters) that are of low density (10-49% cover) and evenly spaced out in a matrix of graminoids and/or herbaceous vegetation. Mangrove communities with mean canopy heights of 2 meters or less with canopy cover greater than 10% are an exception to the Shrubland Class and fall under L1 – Scrub class.

I. Shrubs adapted to regularly flooded conditions.

L2 – Wetland Scrub (CW)

1. Regularly flooded salt tolerant shrubs. These communities are typically found along saltwater shorelines, interior tidal rivers and creeks, or estuarine zones. Mangrove shrubs (taller than 2 meters but shorter than 5 meters) that are of high density (50-100% cover) are considered **L1 – Shrubland (S)**, and if they are of low density (10-49% cover) they are considered **L1 – Scrub (C)**. Dwarf mangrove shrubs (2 meters or shorter) are an exception to the Shrubland class because regardless of density (10-100% cover) they are **L1 – Scrub (C)**.

L3 – Mangrove Scrub (CM)

2. Seasonally to semi-permanently flooded freshwater shrubs primarily found in interior wetlands but may extend well into coastal zone.

L3 – Swamp Scrub (CS)

II. Rarely flooded shrub communities consisting of semi-flood tolerant or flood intolerant woody species found on marl or rocky substrate.

L2 – Upland Scrub (CU)

1. Coastal Scrub characterized by a mixed species assemblage of Sea Grape (*Coccoloba uvifera*), Gumbo Limbo (*Bursera simaruba*), West Indian Mahogany (*Swietenia mahagoni*), Spanish Stopper (*Eugenia foetida*), Poisonwood (*Metopium toxiferum*), Willow Bustic (*Dipholis salicifolia*), Jamaican Dogwood (*Piscidia piscipula*), Florida Thatch Palm (*Thrinax radiata*), Bahama Maidenbush (*Savia bahamensis*), Florida Swampprivet (*Forestiera segregata*), Pride-of-Big-Pine (*Strumpfia maritima*), and Yellow Necklacepod (*Sophora tomentosa*).

L3 – Coastal Hardwood Scrub (CUC)

2. Mix of dwarf trees and/or shrubs such as Poisonwood (*Metopium toxiferum*), Red Bay (*Persea borbonia*), Myrsine (*Myrsine floridana*), Wax Myrtle (*Morella cerifera*), Dahoon Holly (*Ilex cassine*), Buttonwood (*Conocarpus erectus*), Cocoplum (*Chrysobalanus icaco*), Varnish Leaf (*Dodonaea viscosa*), Cabbage Palm (*Sabal palm*etto), West Indian Mahogany (*Swietenia mahagoni*), an/or Saffron Plum (*Sideroxylon celastrinum*) in a matrix of prairie grasses, herbs, and, at times, including various species of vines. Canopy density will range

from 10-49%. This community is typically found in marl prairie environments or along the edge of pine rocklands on marl or rocky soils.

L3 – <u>Upland Hardwood Scrub</u> (CUW)

3. Cabbage Palm (*Sabal palmetto*) dominant scrub.

L3 – <u>Cabbage Palm Upland Scrub</u> (CUo)

L2 – Wetland Scrub (CW)

<u>L3 – Mangrove Scrub (CM)</u>

1a. Black Mangrove (*Avicennia germinans*) dominant scrub.

L4 – Black Mangrove Scrub (CMa)

1a.1. Black Mangrove (*Avicennia germinans*) scrub in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L5 – Black Mangrove Scrub-Open Marsh (CMaO)

1a.2. Black Mangrove (Avicennia germinans) scrub in a matrix composed predominately of succulents.

L5 – Black Mangrove Scrub-Succulent Marsh (CMaS)

1b. Buttonwood (*Conocarpus erectus*) dominant scrub.

L4 – Buttonwood Scrub (CMc)

1b.1. Buttonwood (*Conocarpus erectus*) scrub in a matrix composed predominately of graminoids.

L5 – Buttonwood Scrub-Graminoid Marsh (CMcG)

1b.1*i*. Buttonwood (*Conocarpus erectus*) scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – Buttonwood Scrub-Sawgrass Marsh (CMcGc)

1b.1*ii*. Buttonwood (*Conocarpus erectus*) scrub in a matrix composed predominately of Saltgrass (*Distichlis spicata*).

L6 – Buttonwood Scrub-Saltgrass Marsh (CMcGd)

1b.1*iii*. Buttonwood (*Conocarpus erectus*) scrub in a matrix composed predominately of Spikerush (*Eleocharis* spp.).

L6 – Buttonwood Scrub-Spikerush Marsh (CMcGe)

1b.1*iv*. Buttonwood (*Conocarpus erectus*) scrub in a matrix composed predominately of Black Rush (*Juncus roemerianus*).

L6 – Buttonwood Scrub-Black Rush Marsh (CMcGj)

1b.1*v*. Buttonwood (*Conocarpus erectus*) scrub in a matrix composed predominately of Sand Cordgrass (*Spartina bakeri*).

L6 – Buttonwood Scrub-Sand Cordgrass Marsh (CMcGn)

1b.2. Buttonwood (*Conocarpus erectus*) scrub in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L5 – Buttonwood Scrub-Open Marsh (CMcO)

1b.3. Buttonwood (*Conocarpus erectus*) scrub in a matrix composed predominately of succulents.

L5 – Buttonwood Scrub-Succulent Marsh (CMcS)

1c. White Mangrove (*Laguncularia racemosa*) dominant scrub.

L4 – White Mangrove Scrub (CMl)

1c.1. White Mangrove (*Laguncularia racemosa*) scrub in a matrix composed predominately of succulents.

L5 – White Mangrove Scrub- Graminoid Marsh (CMlG)

1c.1*i*. White Mangrove (*Laguncularia racemosa*) scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – White Mangrove Scrub-Sawgrass Marsh (CMlGc)

1c.1*ii*. White Mangrove (*Laguncularia racemosa*) scrub in a matrix composed predominately of Saltgrass (*Distichlis spicata*).

L6 – White Mangrove Scrub-Saltgrass Marsh (CMlGd)

1c.1*iii*. White Mangrove (*Laguncularia racemosa*) scrub in a matrix composed predominately of Black Rush (*Juncus roemerianus*).

L6 – White Mangrove Scrub-Black Rush Marsh (CMlGj)

1d.1*iv*. White Mangrove (*Laguncularia racemosa*) scrub in a matrix composed predominately of Sand Cordgrass (*Spartina* bakeri).

L6 – White Mangrove Scrub-Sand Cordgrass Marsh (CMlGn)

1d.2. White Mangrove (*Laguncularia racemosa*) scrub in a matrix composed predominately of succulents.

L5 – White Mangrove Scrub-Succulent Marsh (CMlS)

1d.3. White Mangrove (*Laguncularia racemosa*) scrub in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L5 – White Mangrove Scrub- Open Marsh (CMlO)

1d.4. White Mangrove (*Laguncularia racemosa*) scrub with an average height up to 2m, and mangrove cover of 85% or more.

L5 – White Mangrove Scrub-Dominant (CMlD)

1d. Red Mangrove (*Rhizophora mangle*) dominant scrub.

L4 – Red Mangrove Scrub (CMr)

1d.1. Red Mangrove (*Rhizophora mangle*) scrub in a matrix composed predominately of graminoids.

L5 – Red Mangrove Scrub-Graminoid Marsh (CMrG)

1d.1*i*. Red Mangrove (*Rhizophora mangle*) scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – Red Mangrove Scrub-Sawgrass Marsh (CMrGc)

1d.1*ii*. Red Mangrove (*Rhizophora mangle*) scrub in a matrix composed predominately of Spikerush (*Eleocharis* spp.).

L6 – Red Mangrove Scrub-Spikerush Marsh (CMrGe)

1d.1*iii*. Red Mangrove (*Rhizophora mangle*) scrub in a matrix composed predominately of Black Rush (*Juncus roemerianus*).

L6 – Red Mangrove Scrub-Black Rush Marsh (CMrGj)

1d.1i*v*. Red Mangrove (*Rhizophora mangle*) scrub in a matrix composed predominately of Cordgrass (*Spartina* spp.).

L6 – Red Mangrove Scrub-Cordgrass Marsh (CMrGn)

1d.1*v*. Red Mangrove (*Rhizophora mangle*) scrub in a matrix composed predominately of Cattail (*Typha* spp.).

L6 – Red Mangrove Scrub-Cattail Marsh (CMrGt)

1d.2. Red Mangrove (*Rhizophora mangle*) scrub in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation. Mangroves can occur in both salt and freshwater dominated marshes.

L5 – Red Mangrove Scrub-Open Marsh (CMrO)

1d.3. Red Mangrove (*Rhizophora mangle*) scrub with an average height up to 2m, and mangrove cover of 85% or more.

L5 – Red Mangrove Scrub-Dominant (CMrD)

1e. Co-dominant mix (20% or less difference in percent cover) between two mangrove tree species with no particular species having dominance.

L4 – Mixed Mangrove Scrub (CMX)

1e.1. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and White Mangrove (*Laguncularia racemosa*) scrub.

L5 – Black Mangrove-White Mangrove Scrub (CMXal)

1e.1*i*. Black Mangrove-White Mangrove Scrub in a matrix composed predominately of graminoids.

L6 – Black Mangrove-White Mangrove Scrub-Graminoid Marsh (CMXalG)

1e.1*i.a.* Black Mangrove-White Mangrove Scrub in a matrix composed predominately of Saltgrass (*Distichlis spicata*).

L7 – Black Mangrove-White Mangrove Scrub-Saltgrass Marsh (CMXalGd)

1e.1*i.b.* Black Mangrove-White Mangrove Scrub in a matrix composed predominately of Sand Cordgrass (*Spartina bakeri*).

L7 – Black Mangrove-White Mangrove Scrub-Sand Cordgrass Marsh (CMXalGn)

1e.1*ii*. Black Mangrove-White Mangrove Scrub in a matrix composed predominately of succulents.

L6 – Black Mangrove-White Mangrove Scrub-Succulent Marsh (CMXalS)

1e.1*iii*. Black Mangrove-White Mangrove Scrub in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L6 – Black Mangrove-White Mangrove Scrub-Open Marsh (CMXalO)

1e.2. Co-dominant mix (20% or less difference in percent cover) of Black Mangrove (*Avicennia germinans*) and Red Mangrove (*Rhizophora mangle*) scrub.

L5 – Black Mangrove-Red Mangrove Scrub (CMXar)

1e.2*i*. Black Mangrove-Red Mangrove Scrub in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L6 – Black Mangrove-Red Mangrove Scrub-Open Marsh (CMXarO)

1e.3. Co-dominant mix (20% or less difference in percent cover) of Buttonwood (*Conocarpus erectus*) and White Mangrove (*Laguncularia racemosa*) scrub.

L5 – Buttonwood-White Mangrove Scrub (CMXcl)

1e.3*i*. Buttonwood-White Mangrove Scrub in a matrix composed predominately of graminoids.

L6 – Buttonwood-White Mangrove Scrub-Graminoid Marsh (CMXclG)

1e.3*i.a.* Buttonwood-White Mangrove Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L7 – Buttonwood-White Mangrove Scrub-Sawgrass Marsh (CMXclGc)

1e.3*i*.b. Buttonwood-White Mangrove Scrub in a matrix composed predominately of Black Rush (*Juncus roemerianus*).

L7 – Buttonwood-White Mangrove Scrub-Black Rush Marsh (CMXclGj)

1f.3*i*.c. Buttonwood-White Mangrove Scrub in a matrix composed predominately of Sand Cordgrass (*Spartina bakeri*).

L7 – Buttonwood-White Mangrove Scrub-Sand Cordgrass Marsh (CMXclGn)

1e.4. Co-dominant mix (20% or less difference in percent cover) of Buttonwood (*Conocarpus erectus*) and Red Mangrove (*Rhizophora mangle*) scrub.

L5 – Buttonwood-Red Mangrove Scrub (CMXcr)

1e.4*i.* Buttonwood-Red Mangrove Scrub in a matrix composed predominately of graminoids.

L6 – Buttonwood-Red Mangrove Scrub-Graminoid Marsh (CMXcrG)

1e.4*i.a.* Buttonwood-Red Mangrove Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L7 – Buttonwood-Red Mangrove Scrub-Sawgrass Marsh (CMXcrGc)

1e.4*i.b*. Buttonwood-Red Mangrove Scrub in a matrix composed predominately of Black Rush (*Juncus roemerianus*).

L7 – Buttonwood-Red Mangrove Scrub-Black Rush Marsh (CMXcrGj)

1e.4*i.c*. Buttonwood-Red Mangrove Scrub in a matrix composed predominately of Sand Cordgrass (*Spartina bakeri*).

L7 – Buttonwood-Red Mangrove Scrub-Sand Cordgrass Marsh (CMXcrGn)

1e.4*ii*. Buttonwood-Red Mangrove Scrub in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L6 – Buttonwood-Red Mangrove Scrub-Open Marsh (CMXcrO)

1e.5. Co-dominant mix (20% or less difference in percent cover) of White Mangrove (*Laguncularia racemose*) and Red Mangrove (*Rhizophora mangle*) scrub.

L5 – White Mangrove-Red Mangrove Scrub (CMXlr)

1e.5*i.* White Mangrove-Red Mangrove Scrub in a matrix composed predominately of graminoids.

L6 – White Mangrove-Red Mangrove Scrub-Graminoid Marsh (CMXlrG)

1e.5*i.a.* White Mangrove-Red Mangrove Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L7 – White Mangrove-Red Mangrove Scrub-Sawgrass Marsh (CMXlrGc)

1e.5*i.b*. White Mangrove-Red Mangrove Scrub in a matrix composed predominately of Black Rush (*Juncus roemerianus*).

L7 – White Mangrove-Red Mangrove Scrub-Black Rush Marsh (CMXlrGj)

1e.5*i.c*. White Mangrove-Red Mangrove Scrub in a matrix composed predominately of Sand Cordgrass (*Spartina bakeri*).

L7 – White Mangrove-Red Mangrove Scrub-Sand Cordgrass Marsh (CMXlrGn)

1e.5*ii*. White Mangrove-Red Mangrove Scrub in a matrix composed predominately of succulents.

L6 – White Mangrove-Red Mangrove Scrub-Succulent Marsh (CMXlrS)

1e.5*iii*. White Mangrove-Red Mangrove Scrub in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L6 – White Mangrove-Red Mangrove Scrub-Open Marsh (CMXlrO)

1e.5*iv*. White Mangrove-Red Mangrove Scrub with an average height up to 2 meters, and mangrove cover of 85% or more.

L6 – White Mangrove-Red Mangrove Scrub-Dominant (CMXlrD)

1e.6. Co-dominant mix consisting of three or more mangrove tree species. This community is characterized by having no particular species in dominance, meaning there is 20% or less difference in percent cover between the most and least abundant mangrove tree species.

L5 – Mixed Mangrove Scrub-Mixed (CMXX)

1e.6*i*. Mixed Mangrove Scrub-Mixed in a matrix composed predominately of graminoids.

L6 – Mixed Mangrove Scrub-Mixed-Graminoid Marsh (CMXXG)

1e.6*i.a.* Mixed Mangrove Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L7 – Mixed Mangrove Scrub-Sawgrass Marsh (CMXXGc)

1e.6*i.b.* Mixed Mangrove Scrub in a matrix composed predominately of Saltgrass (*Distichlis spicata*).

L7 – Mixed Mangrove Scrub-Saltgrass Marsh (CMXXGd)

1e.6*i.c*. Mixed Mangrove Scrub in a matrix composed predominately of Black Rush (*Juncus roemerianus*).

L7 – Mixed Mangrove Scrub-Black Rush Marsh (CMXXGj)

1e.6*i.d*. Mixed Mangrove Scrub in a matrix composed predominately of Sand Cordgrass (*Spartina bakeri*).

L7 – Mixed Mangrove Scrub-Cordgrass Marsh (CMXXGn)

1e.6*ii*. Mixed Mangrove Scrub-Mixed in a matrix composed predominately of succulents.

L6 – Mixed Mangrove Scrub-Mixed-Succulent Marsh (CMXXS)

1e.6*iii*. Mixed Mangrove Scrub-Mixed in a matrix composed predominately of Open Freshwater Marsh or Open Saltwater Marsh, both of which have less than 15% marsh vegetation.

L6 – Mixed Mangrove Scrub-Mixed-Open Marsh (CMXXO)

<u>L3 – Swamp Scrub (CS)</u>
2a. Pond Apple (*Annona glabra*) characterized by canopy densities from 10-49% in a matrix of graminoids and/or herbaceous vegetation.

L4 – Pond Apple Scrub (CSa)

2a.1. Pond Apple Scrub in a matrix composed predominately of Freshwater Graminoid Marsh.

L5 – Pond Apple Scrub-Graminoid Marsh (CSaG)

2a.1*i*. Pond Apple Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – Pond Apple Scrub-Sawgrass Marsh (CSaGc)

2b. Mixed assemblage of dwarf trees and/or shrubs such as Red Bay (*Persea borbonia*), Sweet Bay (*Magnolia virginiana*), Pond Apple (*Annona glabra*), Willow (*Salix caroliniana*), Wax Myrtle (*Morella cerifera*), Dahoon Holly (*Ilex cassine*), and/or Cocoplum (*Chrysobalanus icaco*) in a matrix of long-hydroperiod grasses, herbs, and, at times, including various species of vines. Canopy density will range from 10-49%. This community is typical of tree island tails or drainage areas with peat soils.

L4 – Bayhead Swamp Scrub (CSB)

2b.1. Bayhead Swamp Scrub in a matrix composed predominately of Freshwater Graminoid Marsh.

L5 – Bayhead Swamp Scrub-Graminoid Marsh (CSBG)

2b.1*i*. Bayhead Swamp Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – Bayhead Swamp Scrub-Sawgrass Marsh (CSBGc)

2b.1*ii*. Bayhead Swamp Scrub in a matrix composed predominately of Spikerush (*Eleocharis* spp.).

L6 – Bayhead Swamp Scrub-Spikerush Marsh (CSBGe)

2b.1*iii*. Bayhead Swamp Scrub in a matrix composed predominately of Black Rush (*Juncus roemerianus*).

L6 – Bayhead Swamp Scrub-Black Rush Marsh (CSBGj)

2b.1*iv*. Bayhead Swamp Scrub in a matrix composed predominately of Cordgrass (*Spartina bakeri*).

L6 – Bayhead Swamp Scrub-Cordgrass Marsh (CSBGn)

2b.1*v*. Bayhead Swamp Scrub in a matrix composed predominately of Cattail (*Typha* spp.).

L6 – Bayhead Swamp Scrub-Cattail Marsh (CSBGt)

2c. Mixed assemblage of shrubs characterized by Buttonwood (*Conocarpus erectus*), Red Mangrove (*Rhizophora mangle*), Cocoplum (*Chrysobalanus icaco*), Wax Myrtle (*Morella cerifera*), Poisonwood (*Metopium toxiferum*), and occasionally West Indian Mahogany (*Swietenia mahagoni*), Swamp Bay (*Persea palustris*), Red Bay (*P. borbonia*), Sweetbay (*Magnolia virginiana*), and Dahoon Holly (*Ilex cassine*). The signatures for Buttonwood and Dahoon Holly (*I. cassine*) are often confused in regions where the two species co-exist, leaving Red Mangrove (*R. mangle*) as the distinguishing component between the Transitional Bayhead and Bayhead classes in regions where both classes are likely to be found. The significant presence (at least 30% cover) of Buttonwood (*C. erectus*) or Red Mangrove (*R. mangle*) evenly distributed throughout the vegetation matrix sets this class apart from the Bayhead Scrub class. Note that when these species are confined to the outside fringe they are not considered indicative of a Transitional Bayhead. Shrub cover will range from 10-49%.

L4 – Transitional Bayhead Swamp Scrub (CSBT)

2c.1. Transitional Bayhead Swamp Scrub in a matrix composed predominately of Freshwater Graminoid Marsh.

L5 – Transitional Bayhead Swamp Scrub-Graminoid Marsh (CSBTG)

2c.1*i*. Transitional Bayhead Swamp Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – Transitional Bayhead Swamp Scrub-Sawgrass Marsh (CSBTGc)

2c.1*ii*. Transitional Bayhead Swamp Scrub in a matrix composed predominately of Spikerush (*Eleocharis* spp.).

L6 – Transitional Bayhead Swamp Scrub-Spikerush Marsh (CSBTGe)

2c.1*iii*. Transitional Bayhead Swamp Scrub in a matrix composed predominately of Black Rush (*Juncus roemerianus*).

L6 – Transitional Bayhead Swamp Scrub-Black Rush Marsh (CSBTGj)

2c.1*i*. Transitional Bayhead Swamp Scrub in a matrix composed predominately of Cordgrass (*Spartina bakeri*).

L6 – Transitional Bayhead Swamp Scrub-Cordgrass Marsh (CSBTGn)

2d. Wax Myrtle (*Myrica cerifera*) characterized by canopy densities from 10-49% in a matrix of graminoids and/or herbaceous vegetation.

L4 – Wax Myrtle Scrub (CSm)

2d.1. Wax Myrtle Scrub in a matrix composed predominately of Freshwater Graminoid Marsh.

L5 – Wax Myrtle Scrub-Graminoid Marsh (CSmG)

2d.1*i*. Wax Myrtle Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – Wax Myrtle Scrub-Sawgrass Marsh (CSmGc)

2d.1*ii*. Wax Myrtle Scrub in a matrix composed predominately of Cattail (*Typha* spp.).

L6 – Wax Myrtle Scrub-Cattail Marsh (CSmGt)

2e. Cabbage Palm (Sabal palmetto) Scrub characterized by canopy densities from 10-49% in a matrix of graminoids and/or herbaceous vegetation.

L4 – Cabbage Palm Swamp Scrub (CSo)

2e.1. Cabbage Palm Scrub in a matrix composed predominately of Freshwater Graminoid Marsh.

L5 – Cabbage Palm Swamp Scrub-Graminoid Marsh (CSoG)

2e.1*i*. Cabbage Palm Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – Cabbage Palm Swamp Scrub-Sawgrass Marsh (CSoGc)

2f. Willow (*Salix caroliniana*) characterized by canopy densities from 10-49% in a matrix of graminoids and/or herbaceous vegetation.

L4 – Willow Scrub (CSs)

2f.1. Willow Scrub in a matrix composed predominately of Freshwater Graminoid Marsh.

L5 – Willow Scrub-Graminoid Marsh (CSsG)

2f.1*i*. Willow Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – Willow Scrub-Sawgrass Marsh (CSsGc)

2f.1ii. Willow Scrub in a matrix composed predominately of Sand Cordgrass (*Spartina bakeri*).

L6 – Willow Scrub-Sand Cordgrass Marsh (CSsGn)

2f.1iii. Willow Scrub in a matrix composed predominately of Cattail (*Typha* spp.).

L6 – Willow Scrub-Cattail Marsh (CSsGt)

2g. Cypress (*Taxodium* spp.) shrubs with 10-100% cover. This is an exception to the Shrubland class because even in the case of Shrubland density (50-100% cover) this community is still considered **L1 – <u>Scrub</u> (C)**.

L4 – Cypress Scrub (CSt)

2g.1. Cypress Scrub in a matrix composed predominately of Freshwater Graminoid Marsh.

L5 – Cypress Scrub-Graminoid Marsh (CStG)

2g.1*i*. Cypress Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L6 – Cypress Scrub-Sawgrass Marsh (CStGc)

2g.1*ii*. Cypress Scrub in a matrix composed predominately of Spikerush (*Eleocharis* spp.).

L6 – Cypress Scrub-Spikerush Marsh (CStGe)

2g.2. Cypress (*Taxodium* spp.) Scrub in a matrix composed predominately of Freshwater Graminoid Prairie species.

L5 – Cypress Scrub-Graminoid Prairie (CStGP)

L2 – Upland Scrub (CU)

L3- Coastal Hardwood Scrub (CUC)

1. Coastal Scrub characterized by a mixed species assemblage of Sea Grape (*Coccoloba uvifera*), Gumbo Limbo (*Bursera simaruba*), West Indian Mahogany (*Swietenia mahagoni*), Spanish Stopper (*Eugenia foetida*), Poisonwood (*Metopium toxiferum*), Willow Bustic (*Dipholis salicifolia*), Jamaican Dogwood (*Piscidia piscipula*), Florida Thatch Palm (*Thrinax radiata*), Bahama Maidenbush (*Savia bahamensis*), Florida Swampprivet (*Forestiera segregata*), Pride-of-Big-Pine (*Strumpfia maritima*), and Yellow Necklacepod (*Sophora tomentosa*). Common understory components include Pricklypear (*Opuntia stricta*), Triangle Cactus (*Acanthocereus tetragonus*), among others.

L3 – Upland Hardwood Scrub (CUW)

2a. Upland Hardwood Scrub in a matrix of Freshwater Graminoid Marsh.

L4 – Upland Hardwood Scrub-Graminoid Marsh (CUWG)

2a.1. Upland Hardwood Scrub in a matrix composed predominately of Sawgrass (*Cladium jamaicense*).

L5 – Upland Hardwood Scrub-Sawgrass Marsh (CUWGc)

2b. Upland Hardwood Scrub in a matrix of short-hydroperiod graminoids species such as Muhly Grass (*Muhlenbergia capillaris* var. *filipes*), Sawgrass (*Cladium jamaicense*), and/or Little Bluestem (*Schizachyrium* spp.), among others. Pond Apple and Willow may be present in solutions holes or depressions.

L4 – Upland Hardwood Scrub-Graminoid Prairie (CUWGP)

L3 – Cabbage Palm Upland Scrub (CUo)

3. Cabbage Palm (*Sabal palmetto*) Scrub in a matrix of short-hydroperiod graminoids species such as Muhly Grass (*Muhlenbergia capillaris* var. *filipes*), Sawgrass (*Cladium jamaicense*), Little Bluestem (*Schizachyrium* spp.), among others.

L4 – Cabbage Palm Upland Scrub-Graminoid Prairie (CUoGP)

L1 – Marsh (M)

Graminoid and/or herbaceous emergent or floating vegetation in shallow water that stands at or above the ground surface for much of the year. Prairie habitat is included in this class. A marsh can have low density (0-9%) tree and shrub cover.

I. A saline wetland consisting of salt tolerant graminoid and/or herbaceous vegetation.

L2 – Salt Marsh (MS)

1. Saltgrass (*Distichlis spicata*), Black Rush (*Juncus roemerianus*), Keysgrass (*Monanthochloe littoralis*), Gulf Cordgrass (*Spartina spartinae*), Marshhay Cordgrass (*S. patens*), and/or Dropseed (*Sporobolus* spp.) dominated salt marsh.

L3 – Graminoid Salt Marsh (MSG)

2. Saltwort (*Batis maritima*), Glasswort (*Salicornia* spp.), and/or Sea Purslane (*Sesuvium* spp.) dominated salt marsh.

L3 – Succulent Salt Marsh (MSS)

3. Open (less than 15% vegetation) dominated salt marsh often with a mix of sparse graminoids and/or herbaceous salt marsh vegetation, such as Black Rush (*Juncus roemerianus*) and/or Cordgrass (*Spartina* spp.).

L3 – Open Salt Marsh (MSO)

II. Freshwater graminoid and/or herbaceous marsh.

L2 – Freshwater Marsh (MF)

1. Golden Leather Fern (*Acrostichum aureum*), Leather Fern (*A. danaeifolium*), Pickerelweed (*Pontederia cordata*), Lanceleaf Arrowhead (*Sagittaria lancifolia*), and/or Alligator Flag (*Thalia geniculata*) broadleaf emergent dominated freshwater marsh.

L3 – Broadleaf Emergent Marsh (MFB)

2. Long hydroperiod marsh consisting of Sawgrass (*Cladium jamaicense*), Spikerush (*Eleocharis* spp.), Soft Rush (*Juncus effusus*), Maidencane (*Panicum hemitomon*), Common Reed (*Phragmites australis*), Cattail (*Typha* spp.) and/or Sand Cordgrass (*Spartina bakeri*), among others.

L3 – Graminoid Freshwater Marsh (MFG)

3. Short hydroperiod marsh characterized by a mix of graminoids that includes low-stature Sawgrass (*Cladium jamaicense*), Muhly Grass (*Muhlenbergia capillaris* var. *filipes*), Little Bluestem (*Schizachyrium rhizomatum*), and Black Sedge (*Schoenus nigricans*), among others.

L3 – Graminoid Freshwater Prairie (MFGP)

4. Floating emergent dominated freshwater marsh.

L3 – <u>Floating Emergent Marsh</u> (MFF)

5. Open water with less than 15% vegetation cover consisting of a mix of sparse graminoids, herbaceous, and/or emergent freshwater vegetation, such as Spikerush (*Eleocharis* spp.), Panicgrass (*Panicum* spp.), Sawgrass (*Cladium jamaicense*), Cattail (*Typha* spp.), Arrowhead (*Sagittaria* spp.), Pickerelweed (*Pontederia cordata*), Waterlily (*Nymphaea* spp.), Green Arum (*Peltandra virginica*), Swamp-Lily (*Crinum americanum*), Spider-lilies (*Hymenocallis* spp.), among others.

L3 – <u>Open Freshwater Marsh</u> (MFO)

6. Co-dominant mix (20% or less difference in percent cover) of two or more long hydroperiod freshwater graminoid such as sawgrass (*Cladium jamaicense*), cattail (*Typha* spp*.),* and/or spikerush (*Eleocharis* spp.) in association with broadleaf species such as *Alligator* Flag (*Thalia geniculata*), Arrowhead (*Sagittaria* spp.), and/or Pickerelweed (*Pontederia cordata*), for example.

L3 – <u>Mixed Graminoid-Broadleaf Freshwater Marsh</u> (MFXGB)

L2 – Salt Marsh (MS)

<u>L3 – Graminoid Salt Marsh (MSG)</u>

1a. Saltgrass (*Distichlis spicata*) dominated salt marsh.

L4 – Saltgrass Marsh (MSGd)

1b. Black Rush (*Juncus roemerianus*) dominated salt marsh.

L4 – Black Rush Marsh (MSGj)

1c. Co-dominant mix of two or more graminoid marsh species like Saltgrass (*Distichlis spicata*), Black Rush (*Juncus roemerianus*), and/or Sand Cordgrass (*Spartina bakeri*). This community is characterized by having no particular graminoid species in dominance, meaning there is 15% or less difference in percent cover between two or more graminoid species.

L4 – Mixed Graminoid Salt Marsh (MSGX)

1c.1. Co-dominant mix of Saltgrass (*Distichlis spicata*) and Sand Cordgrass (*Spartina bakeri*). This community is characterized by having no particular graminoid species in dominance, meaning there is 15% or less difference in percent cover between two or more graminoid species.

L5 – Saltgrass-Sand Cordgrass Marsh (MSGXdn)

1d.2. Co-dominant mix of Black Rush (*Juncus roemerianus*) and Sand Cordgrass (*Spartina bakeri*). This community is characterized by having no particular graminoid species in

dominance, meaning there is 15% or less difference in percent cover between two or more graminoid species.

L5 – Blackrush-Sand Cordgrass Marsh (MSGXjn)

L3 – Succulent Salt Marsh (MSS)
Saltwort (*Batis maritima*), Glasswort (Salicornia spp.), and/or Sea Purslane (*Sesuvium* spp.) dominated salt marsh.

L3 – Open Salt Marsh (MSO)
Open (less than 15% vegetation) dominated salt marsh often with a mix of sparse graminoids and/or herbaceous salt marsh vegetation, such as Black Rush (*Juncus roemerianus*) and/or Cordgrass (*Spartina* spp.), among others.

L2 – Freshwater Marsh (MF)

L3 – Broadleaf Emergent Marsh (MFB)
1. Golden Leather Fern (*Acrostichum aureum*), Leather Fern (*A. danaeifolium*), Pickerelweed (*Pontederia cordata*), Lanceleaf Arrowhead (*Sagittaria lancifolia*), and/or Alligator Flag (*Thalia geniculata*) broadleaf emergent dominated freshwater marsh.

L3 – Graminoid Freshwater Marsh (MFG)
2. Long hydroperiod marsh consisting of Sawgrass (*Cladium jamaicense*), Spikerush (*Eleocharis* spp.), Soft Rush (*Juncus effusus*), Maidencane (*Panicum hemitomon*), Common Reed (*Phragmites australis*), Cattail (*Typha* spp.) and/or Sand Cordgrass (*Spartina bakeri*), among others.

2a. Sawgrass (*Cladium jamaicense*) dominated marsh.

L4 – Sawgrass Marsh (MFGc)

2a.1. Sawgrass Marsh with average height of 2 meters or taller.

L5 – Tall Sawgrass Marsh (MFGcT)

2a.1*i*. Tall Sawgrass Marsh with 50-100% Sawgrass (*Cladium jamaicense*) cover.

L6 – Tall Sawgrass Marsh-Dense (MFGcTD)

2a.2. Sawgrass Marsh with average height shorter than 2 meters.

L5 – Short Sawgrass Marsh (MFGcS)

2a.2*i*. Sawgrass Marsh with 50-100% Sawgrass (*Cladium jamaicense*) cover. Spikerush (*Eleocharis cellulosa*) and Beakrush (*Rhynchospora* sp.) maybe present as well (10-25% cover).

L6 – Short Sawgrass Marsh-Dense (MFGcSD)

2a.2*ii*. Short statured (< 1 m tall) Sawgrass Marsh with 15-49% Sawgrass (*Cladium* jamaicense) cover. Spikerush (*Eleocharis cellulosa*), Beakrush (*Rhynchospora* sp.), and/or Panicgrass (*Panicum* sp.), among others, maybe be present. However, their combined cover does not exceed that of Sawgrass. This class differs from **Mixed Graminoid Freshwater Marsh** (MFGX) in that Sawgrass is the dominant graminoid species present, otherwise MFGX.

L6 – Short Sawgrass Marsh-Sparse (MFGcSS)

2b. Coastal Spikerush (*Eleocharis cellulosa*), Slim Spikerush (*E. elongata*), and/or Knotted Spikerush (*E. interstincta*) dominated marsh.

L4 – Spikerush Marsh (MFGe)

2c. Kissimmeegrass (*Paspalidium geninatum*) dominated marsh.

L4 – Kissimmeegrass Marsh (MFGu)

2d. Common Reed (*Phragmites australis*) dominated marsh.

L4 – Common Reed Marsh (MFGg)

2e. Cattail (*Typha* spp.) dominated marsh.

L4 – Cattail Marsh (MFGt)

2f. Sand Cordgrass (*Spartina bakeri*) dominated freshwater marsh.

L4 – Sand Cordgrass Marsh (MFGn)

2g. Co-dominant mix of two or more graminoid marsh species like Spikerush (*Eleocharis* spp.), Panicgrass (*Panicum* spp.), Sawgrass (*Cladium jamaicense*), and/or Beakrush (*Rhynchospora* spp.), among others. This community is characterized by having no particular graminoid species in dominance, meaning there is 15% or less difference in percent cover between two or more graminoid species.

L4 – Mixed Graminoid Freshwater Marsh (MFGX)

2g.1. Co-dominant mix of Sawgrass (*Cladium jamaicense*) and Black Rush (*Juncus roemerianus*). This community is characterized by having no particular graminoid species in dominance, meaning there is 15% or less difference in percent cover between two or more graminoid species.

L5 – Sawgrass-Sand Cordgrass Marsh (MSGXcj)

2g.2. Co-dominant mix of Sawgrass (*Cladium jamaicense*) and Beakrush (*Rhynchospora tracyi*). This community is characterized by having no particular graminoid species in

dominance, meaning there is 15% or less difference in percent cover between two or more graminoid species.

L5 – Sawgrass-Rhynchospora Marsh (MFGXcr)

2g.3. Co-dominant mix of Sawgrass (*Cladium jamaicense*) and Cattail (*Typha* spp.). This community is characterized by having no particular graminoid species in dominance, meaning there is 15% or less difference in percent cover between two or more graminoid species.

L5 – Sawgrass-Cattail Marsh (MFGXct)

2g.4. Co-dominant mix of Sawgrass (*Cladium jamaicense*) and Sand Cordgrass (*Spartina bakeri*). This community is characterized by having no particular graminoid species in dominance, meaning there is 15% or less difference in percent cover between two or more graminoid species.

L5 – Sawgrass- Sand Cordgrass Marsh (MFGXcn)

L3 – Graminoid Freshwater Prairie (MFGP)

3. Short hydroperiod marsh characterized by a mix of graminoids that includes low-stature Sawgrass (*Cladium jamaicense*), Muhly Grass (*Muhlenbergia capillaris* var. *filipes*), Little Bluestem (*Schizachyrium rhizomatum*), and Black Sedge (*Schoenus nigricans*), among others.

3a. Black Sedge (*Schoenus nigricans*) dominated wet prairie.

L4 – Black Sedge Prairie (MFGPh)

L3 – Floating Emergent Marsh (MFF)

4. Floating emergent dominated freshwater marsh.

4a. Waterlily (*Nymphaea odorata*) dominated marsh.

L4 – Waterlily Marsh (MFFy)

L3 – Open Freshwater Marsh (MFO)

5. Open water with less than 15% vegetation cover consisting of a mix of sparse graminoids, herbaceous, and/or emergent freshwater vegetation, such as Spikerush (*Eleocharis* spp.), Panicgrass (*Panicum* spp.), Sawgrass (*Cladium jamaicense*), Cattail (*Typha* spp.), Arrowhead (*Sagittaria* spp.), Pickerelweed (*Pontederia cordata*), Waterlily (*Nymphaea* spp.), Green Arum (*Peltandra virginica*), Swamp-Lily (*Crinum americanum*), Spider-lilies (*Hymenocallis* spp.), among others.

L3 – Mixed Graminoid-Broadleaf Freshwater Marsh (MFXGB)

6. Co-dominant mix (20% or less difference in percent cover) of two or more long hydroperiod freshwater graminoid such as sawgrass (*Cladium jamaicense*), cattail (*Typha* spp.), and/or spikerush (*Eleocharis* spp.) in association with broadleaf species such as Alligator Flag (*Thalia geniculata*), Arrowhead (*Sagittaria* spp.), and/or Pickerelweed (*Pontederia cordata*), for example.

L1 – Dune (D)

Shrub, graminoid and/or herbaceous vegetation associated with a mound or ridge of sediment formed by wind and/or storm deposits.

I. Graminoid dominated coastal dune.

L2 – Graminoid Dune (DG)

L1 – Exotic (E)

Non-native species assemblages. A cell label should reflect its native vegetation whenever possible with exotic codes being secondary. Level 2 codes for the exotic species present in this map are listed below. Level 3 codes designate the density or coverage of the exotic within the grid cell: Sparse (10-49% cover), Dominant (50-89% cover), and Monotypic (90-100% cover). Users are asked to reference exotic plant species codes in the *Vegetation Classification System for South Florida Natural Areas* (Rutchey et al. 2006) for a comprehensive list of potential exotic plant communities.

L2 – Brazilian Pepper (Es) (*Schinus terebinthifolius*)

L1 – Other (O)

Anthropogenic or non-vegetative features.

I. Non-Vegetative cover.

L2 – Non-Vegetative (ON)

1. Ground covered in sand that is adjacent to lakes, bays, oceans, or other large bodies of water.

L3 – Beach (ONB)

2. Exposed open ground or peat, particularly in hurricane damaged mangrove forests with < 10% vegetation cover.

L3 – Soil (ONO)

3. Barren, generally hypersaline, flats found above the high tide mark created by storm-driven tidal events.

L3 – Barren Salt Flat (ONS)

4. Open water areas such as ponds, lakes, rivers, bays, and estuaries.

L3- Water (ONW)

II. Non-natural coverage associated with human infrastructure and/or activities.

L2 – Anthropogenic (OA)

1. A long, narrow stretch with a smoothed or paved surface, made for traveling by motor vehicle, carriage, etc., between two or more points; a street or highway.

L3- Road (OATr)

References

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Appendix A-1 in Appendix B: Exceptions to Level 1 Classes

L1 – <u>Forest</u> (F) – Stands of trees (5 meters or taller) that are of high density (50-100% cover).

Exceptions:

Stands of Slash Pine (*Pinus elliottii var. densa*) trees of Forest density are considered Woodland.

Stands of Willow (*Salix caroliniana*) trees of Forest density are considered Shrubland.

Stands of Cocoplum (*Chrysobalanus icaco*) trees of Forest density are considered Shrubland.

L1 – <u>Woodland</u> (W) – Stands of trees (5 meters or taller) that are of low density (10-49% cover). Trees are evenly spaced out and often in a matrix of sparse shrubs, graminoids, and/or herbaceous vegetation.

Exceptions:

If a Woodland contains dense shrub cover (50% or more), it is considered Shrubland. This does not apply to pineland and Cypress (*Taxodium* spp.) communities – these can have a dense shrub understory and still be considered Woodland.

Stands of Slash Pine (*Pinus elliottii var. densa*) trees of Forest density are considered Woodland.

L1 – <u>Shrubland</u> (S) – Stands of shrubs (shorter than 5 meters) that are of high density (50-100% cover).

Exceptions:

Stands of Cypress (*Taxodium* spp.) shrubs of Shrubland density are considered Scrub.

Stands of Sea-Oxeye (*Borrichia arborescens*) shrubs of Shrubland density are considered Scrub.

Stands of Buttonbush (*Cephalanthus occidentalis*) shrubs of Shrubland density are considered Scrub.

Mangrove communities averaging heights of 2 meters or shorter, regardless of density (10-100% cover) are considered Scrub.

Stands of Willow (*Salix caroliniana*) trees of Forest density are considered Shrubland.

Stands of Cocoplum (*Chrysobalanus icaco*) trees of Forest density are considered Shrubland.

If a Woodland contains dense shrub cover (50% or more), it is considered Shrubland. This does not apply to pineland and Cypress (*Taxodium* spp.) communities – these can have a dense shrub understory and still be considered Woodland.

L1 – <u>Scrub</u> (C) – Stands of shrubs (shorter than 5 meters) that are of low density (10-49% cover). Shrubs are evenly spaced out and often in a matrix of graminoids and/or herbaceous vegetation.

Exceptions:

Stands of Cypress (*Taxodium* spp.) shrubs of Shrubland density are considered Scrub.

Stands of Sea-Oxeye (*Borrichia arborescens*) shrubs of Shrubland density are considered Scrub.

Stands of Buttonbush (*Cephalanthus occidentalis*) shrubs of Shrubland density are considered Scrub.

Mangrove communities averaging heights of 2 meters or shorter, regardless of density (10-100% cover) are considered Scrub.

Appendix C. Area, Percentage, and Frequency of all Thematic Classes Mapped in the Northwest Coastal Everglades, Region 4, Vegetation Map of Everglades National Park

Table C-1. Thematic class area, percentage, and frequency [ha—hectare; ac—acre].

Thematic Class	Thematic Class Code	Area (ha)	Area (ac)	Percent Area	Number of Mapped Cells
Anthropogenic	OA	61	151	0.05%	244
Barren Salt Flat	ONS	10	25	0.01%	40
Bayhead Forest	FSB	317	783	0.25%	1,267
Bayhead Shrubland	SSB	1,459	3,606	1.14%	5,834
Bayhead Swamp Scrub-Black Rush Marsh	CSBGj	15	37	0.01%	60
Bayhead Swamp Scrub-Cattail Marsh	CSBGt	19	46	0.01%	74
Bayhead Swamp Scrub-Cordgrass Marsh	CSBGn	33	82	0.03%	132
Bayhead Swamp Scrub-Sawgrass Marsh	CSBGc	1,887	4,662	1.48%	7,542
Bayhead Swamp Scrub-Spikerush Marsh	CSBGe	3	6	< 0.01%	10
Beach	ONB	27	67	0.02%	108
Black Mangrove Forest	FMa	5,754	14,219	4.50%	23,002
Black Mangrove Scrub-Open Marsh	CMaO	82	202	0.06%	326
Black Mangrove Scrub-Succulent Marsh	CMaS	188	464	0.15%	751
Black Mangrove Shrubland	SMa	344	851	0.27%	1,376
Black Mangrove Woodland-Graminoid Marsh	WMaG	216	535	0.17%	865
Black Mangrove Woodland-Open Marsh	WMaO	48	119	0.04%	192
Black Mangrove Woodland-Succulent Marsh	WMaS	61	151	0.05%	244
Black Mangrove-Buttonwood Forest	FMXac	255	630	0.20%	1,019
Black Mangrove-Buttonwood Shrubland	SMXac	5	12	< 0.01%	19
Black Mangrove-Buttonwood Woodland-Graminoid Marsh	WMXacG	22	53	0.02%	86
Black Mangrove-Red Mangrove Forest	FMXar	4,495	11,108	3.52%	17,968
Black Mangrove-Red Mangrove Scrub-Open Marsh	CMXarO	8	20	0.01%	32

Table C-1 (continued). Thematic class area, percentage, and frequency [ha—hectare; ac—acre].

Thematic Class	Thematic Class Code	Area (ha)	Area (ac)	Percent Area	Number of Mapped Cells
Black Mangrove-Red Mangrove Shrubland	SMXar	12	28	0.01%	46
Black Mangrove-Red Mangrove Woodland-Graminoid Marsh	WMXarG	37	92	0.03%	149
Black Mangrove-Red Mangrove Woodland-Open	WMXarO	44	109	0.03%	176
Black Mangrove-Red Mangrove Woodland-Succulent Marsh	WMXarS	17	41	0.01%	66
Black Mangrove-White Mangrove Forest	FMXal	1,045	2,582	0.82%	4,176
Black Mangrove-White Mangrove Scrub-Cordgrass Marsh	CMXalGn	17	41	0.01%	66
Black Mangrove-White Mangrove Scrub-Open Marsh	CMXalO	114	283	0.09%	457
Black Mangrove-White Mangrove Scrub-Saltgrass Marsh	CMXalGd	18	43	0.01%	70
Black Mangrove-White Mangrove Scrub-Succulent Marsh	CMXalS	36	88	0.03%	142
Black Mangrove-White Mangrove Shrubland	SMXal	485	1,197	0.38%	1,937
Black Mangrove-White Mangrove Woodland-Graminoid Marsh	WMXalG	67	165	0.05%	267
Black Mangrove-White Mangrove Woodland-Open Marsh	WMXalO	7	18	0.01%	29
Black Mangrove-White Mangrove Woodland-Succulent Marsh	WMXalS	5	11	< 0.01%	18
Black Rush Marsh	MSGj	2,009	4,965	1.57%	8,031
Black Rush-Sand Cordgrass Marsh	MSGXjn	41	102	0.03%	165
Black Sedge Prairie	MFGPh	131	325	0.10%	525
Brazilian Pepper	Es	255	630	0.20%	1,019
Broadleaf Emergent Marsh	MFB	4	9	< 0.01%	14
Buttonwood Forest	FMc	34	84	0.03%	136
Buttonwood Scrub-Black Rush Marsh	CMcGj	159	393	0.12%	635
Buttonwood Scrub-Cordgrass Marsh	CMcGn	40	99	0.03%	160
Buttonwood Scrub-Open Marsh	CMcO	4	10	< 0.01%	16

Table C-1 (continued). Thematic class area, percentage, and frequency [ha—hectare; ac—acre].

Thematic Class	Thematic Class Code	Area (ha)	Area (ac)	Percent Area	Number of Mapped Cells
Buttonwood Scrub-Saltgrass Marsh	CMcGd	60	148	0.05%	239
Buttonwood Scrub-Sawgrass Marsh	CMcGc	227	561	0.18%	907
Buttonwood Scrub-Spikerush Marsh	CMcGe	32	78	0.02%	126
Buttonwood Scrub-Succulent	CMcS	4	9	< 0.01%	14
Buttonwood Shrubland	SMc	194	480	0.15%	777
Buttonwood Woodland-Graminoid Marsh	WMcG	2	4	< 0.01%	7
Buttonwood Woodland-Open Marsh	WMcO	1	3	< 0.01%	5
Buttonwood-Red Mangrove Forest	FMXcr	1,193	2,947	0.93%	4,767
Buttonwood-Red Mangrove Scrub-Black Rush Marsh	CMXcrGj	113	280	0.09%	453
Buttonwood-Red Mangrove Scrub-Cordgrass Marsh	CMXcrGn	13	32	0.01%	51
Buttonwood-Red Mangrove Scrub-Open Marsh	CMXcrO	74	184	0.06%	297
Buttonwood-Red Mangrove Scrub-Sawgrass Marsh	CMXcrGc	280	692	0.22%	1119
Buttonwood-Red Mangrove Shrubland	SMXcr	2,271	5,613	1.78%	9,079
Buttonwood-White Mangrove Forest	FMXcl	131	323	0.10%	522
Buttonwood-White Mangrove Scrub-Black Rush Marsh	CMXclGj	31	75	0.02%	122
Buttonwood-White Mangrove Scrub-Cordgrass Marsh	CMXclGn	62	153	0.05%	248
Buttonwood-White Mangrove Scrub-Sawgrass Marsh	CMXclGc	17	41	0.01%	66
Buttonwood-White Mangrove Shrubland	SMXcl	394	974	0.31%	1,575
Cabbage Palm Hammock	FHo	3	8	< 0.01%	13
Cabbage Palm Lowland-Graminoid Marsh	WSoG	3	7	< 0.01%	12
Cabbage Palm Lowland-Mixed	WSoX	202	500	0.16%	809
Cabbage Palm Lowland-Shrubs	WSoS	215	532	0.17%	860
Cabbage Palm Swamp Scrub-Sawgrass Marsh	CSoGc	32	80	0.03%	129
Cabbage Palm Upland Scrub-Graminoid Prairie	CUoGP	27	67	0.02%	109

Table C-1 (continued). Thematic class area, percentage, and frequency [ha—hectare; ac—acre].

Thematic Class	Thematic Class Code	Area (ha)	Area (ac)	Percent Area	Number of Mapped Cells
Cabbage Palm Upland-Graminoid Marsh	WUoG	10	25	0.01%	40
Cattail Marsh	MFGt	388	958	0.30%	1,550
Coastal Dune Hammock	FHCD	10	23	0.01%	38
Coastal Hardwood Hammock	FHCC	171	423	0.13%	685
Coastal Hardwood Scrub	CUC	11	27	0.01%	43
Coastal Hardwood Shrubland	SUC	33	82	0.03%	133
Cocoplum Shrubland	SSy	7	16	0.01%	26
Common Reed Marsh	MFGg	16	38	0.01%	62
Cypress Forest-Dome	FStD	3	8	< 0.01%	13
Cypress Forest-Monotypic	FStM	323	799	0.25%	1,293
Cypress Forest-Strand	FStS	15	36	0.01%	58
Cypress Scrub-Graminoid Prairie	CStGP	6	14	< 0.01%	22
Cypress Scrub-Sawgrass Marsh	CStGc	337	833	0.26%	1,348
Cypress Scrub-Spikerush Marsh	CStGe	25	61	0.02%	98
Cypress Woodland-Graminoid Marsh	WStG	240	593	0.19%	959
Cypress-Hardwood Forest	FStH	44	109	0.03%	177
Cypress-Pine Forest	FStp	3	6	< 0.01%	10
Graminoid Dune	DG	14	35	0.01%	56
Graminoid Freshwater Prairie	MFGP	1,520	3,757	1.19%	6,077
Hardwood Swamp Forest	FSH	21	52	0.02%	84
Hardwood Swamp Shrubland	SSH	12	28	0.01%	46
Kissimmeegrass Marsh	MFGu	4	9	< 0.01%	14
Mixed Graminoid Freshwater Marsh	MFGX	6,104	15,084	4.77%	24,400
Mixed Graminoid Salt Marsh	MSGX	289	713	0.23%	1,154
Mixed Graminoid-Broadleaf Freshwater Marsh	MFXGB	45	111	0.04%	179
Mixed Mangrove Forest-Mixed	FMXX	12,142	30,002	9.50%	48,533
Mixed Mangrove Scrub-Mixed-Black Rush Marsh	CMXXGj	18	44	0.01%	71
Mixed Mangrove Scrub-Mixed-Cordgrass Marsh	CMXXGn	28	69	0.02%	112

Table C-1 (continued). Thematic class area, percentage, and frequency [ha—hectare; ac—acre].

Thematic Class	Thematic Class Code	Area (ha)	Area (ac)	Percent Area	Number of Mapped Cells
Mixed Mangrove Scrub-Mixed-Open Marsh	CMXXO	32	79	0.02%	127
Mixed Mangrove Scrub-Mixed-Saltgrass Marsh	CMXXGd	4	9	< 0.01%	15
Mixed Mangrove Scrub-Mixed-Sawgrass Marsh	CMXXGc	9	22	0.01%	35
Mixed Mangrove Scrub-Mixed-Succulent Marsh	CMXXS	6	14	< 0.01%	22
Mixed Mangrove Shrubland-Mixed	SMXX	1,472	3,637	1.15%	5,884
Mixed Mangrove Woodland-Mixed-Graminoid Marsh	WMXXG	27	67	0.02%	109
Mixed Mangrove Woodland-Mixed-Open Marsh	WMXXO	21	51	0.02%	83
Mixed Mangrove Woodland-Mixed-Succulent Marsh	WMXXS	19	46	0.01%	75
Open Freshwater Marsh	MFO	88	218	0.07%	353
Open Salt Marsh	MSO	41	100	0.03%	162
Pine Flatwoods-Shrubs	WUpFS	2	5	< 0.01%	8
Pine Lowland-Shrubs	WSpS	1	2	< 0.01%	3
Pond Apple Scrub-Sawgrass Marsh	CSaGc	42	104	0.03%	169
Red Mangrove Forest	FMr	2,139	5,287	1.67%	8,552
Red Mangrove Scrub-Black Rush Marsh	CMrGj	273	675	0.21%	1,092
Red Mangrove Scrub-Cattail Marsh	CMrGt	134	330	0.10%	534
Red Mangrove Scrub-Cordgrass Marsh	CMrGn	35	86	0.03%	139
Red Mangrove Scrub-Dominant	CMrD	141	348	0.11%	563
Red Mangrove Scrub-Open Marsh	CMrO	912	2,254	0.71%	3,646
Red Mangrove Scrub-Sawgrass Marsh	CMrGc	1,522	3,761	1.19%	6,084
Red Mangrove Scrub-Spikerush Marsh	CMrGe	1,285	3,174	1.00%	5,135
Red Mangrove Shrubland	SMr	2,136	5,277	1.67%	8,537
Red Mangrove Woodland-Graminoid Marsh	WMrG	8	20	0.01%	32
Red Mangrove Woodland-Open Marsh	WMrO	43	105	0.03%	170
Red Mangrove Woodland-Succulent Marsh	WMrS	11	27	0.01%	44
Road	OATr	9	22	0.01%	36

Table C-1 (continued). Thematic class area, percentage, and frequency [ha—hectare; ac—acre].

Thematic Class	Thematic Class Code	Area (ha)	Area (ac)	Percent Area	Number of Mapped Cells
Saltgrass Marsh	MSGd	341	844	0.27%	1,365
Saltgrass-Sand Cordgrass Marsh	MSGXdn	12	29	0.01%	47
Sand Cordgrass Marsh	MFGn	3,656	9,035	2.86%	14,615
Sawgrass-Beakrush Marsh	MFGXcr	1,424	3,519	1.11%	5,692
Sawgrass-Black Rush Marsh	MFGXcj	589	1,455	0.46%	2,353
Sawgrass-Cattail Marsh	MFGXct	980	2,423	0.77%	3,919
Sawgrass-Sand Cordgrass Marsh	MFGXcn	532	1,314	0.42%	2,125
Short Sawgrass Marsh-Dense	MFGcSD	10,402	25,704	8.14%	41,579
Short Sawgrass Marsh-Sparse	MFGcSS	981	2,425	0.77%	3,923
Soil	ONO	93	231	0.07%	373
Spikerush Marsh	MFGe	2,354	5,816	1.84%	9,408
Succulent Salt Marsh	MSS	66	164	0.05%	265
Tall Sawgrass Marsh-Dense	MFGcTD	223	551	0.17%	891
Temperate Hardwood Hammock	FHT	2	4	< 0.01%	6
Transitional Bayhead Forest	FSBT	1,035	2,558	0.81%	4,138
Transitional Bayhead Shrubland	SSBT	12,200	30,147	9.54%	48,767
Transitional Bayhead Swamp Scrub-Black Rush Marsh	CSBTGj	170	420	0.13%	679
Transitional Bayhead Swamp Scrub-Cordgrass Marsh	CSBTGn	91	226	0.07%	365
Transitional Bayhead Swamp Scrub-Sawgrass Marsh	CSBTGc	3,542	8,753	2.77%	14,159
Transitional Bayhead Swamp Scrub-Spikerush Marsh	CSBTGe	24	59	0.02%	95
Transitional Hardwood Swamp Forest	FSHT	0	1	< 0.01%	1
Tropical Hardwood Hammock	FHS	212	524	0.17%	848
Tropical Hardwood Shrubland	SUH	33	82	0.03%	132
Upland Hardwood Scrub-Graminoid Prairie	CUWGP	18	43	0.01%	70
Upland Hardwood Scrub-Sawgrass Marsh	CUWGc	19	46	0.01%	75

Table C-1 (continued). Thematic class area, percentage, and frequency [ha—hectare; ac—acre].

Thematic Class	Thematic Class Code	Area (ha)	Area (ac)	Percent Area	Number of Mapped Cells
Water	ONW	22,326	55,169	17.46%	89,244
Waterlily Marsh	MFFy	17	43	0.01%	69
Wax Myrtle Scrub-Cattail Marsh	CSmGt	1	3	< 0.01%	5
Wax Myrtle Scrub-Sawgrass Marsh	CSmGc	16	40	0.01%	64
Wax Myrtle Shrubland	SSm	7	17	0.01%	28
White Mangrove Forest	FMl	608	1,502	0.48%	2,429
White Mangrove Scrub-Black Rush Marsh	CMlGj	113	279	0.09%	452
White Mangrove Scrub-Cordgrass Marsh	CMlGn	205	506	0.16%	818
White Mangrove Scrub-Dominant	CMlD	3	7	< 0.01%	11
White Mangrove Scrub-Open Marsh	CMlO	80	197	0.06%	318
White Mangrove Scrub-Saltgrass Marsh	CMlGd	70	174	0.05%	281
White Mangrove Scrub-Sawgrass Marsh	CMlGc	59	145	0.05%	234
White Mangrove Scrub-Succulent Marsh	CMlS	35	85	0.03%	138
White Mangrove Shrubland	SMl	628	1,552	0.49%	2,511
White Mangrove Woodland-Graminoid Marsh	WMlG	8	19	0.01%	31
White Mangrove Woodland-Open Marsh	WMlO	6	15	< 0.01%	24
White Mangrove-Red Mangrove Forest	FMXlr	5,060	12,503	3.96%	20,226
White Mangrove-Red Mangrove Scrub-Black Rush Marsh	CMXlrGj	87	215	0.07%	347
White Mangrove-Red Mangrove Scrub-Cordgrass Marsh	CMXlrGn	11	28	0.01%	45
White Mangrove-Red Mangrove Scrub-Dominant	CMXlrD	5	12	< 0.01%	20
White Mangrove-Red Mangrove Scrub-Open Marsh	CMXlrO	9	23	0.01%	37
White Mangrove-Red Mangrove Scrub-Sawgrass Marsh	CMXlrGc	23	56	0.02%	91
White Mangrove-Red Mangrove Scrub-Succulent Marsh	CMXlrS	3	7	< 0.01%	12
White Mangrove-Red Mangrove Shrubland	SMXlr	1,203	2,973	0.94%	4,810

Table C-1 (continued). Thematic class area, percentage, and frequency [ha—hectare; ac—acre].

Thematic Class	Thematic Class Code	Area (ha)	Area (ac)	Percent Area	Number of Mapped Cells
White Mangrove-Red Mangrove Woodland-Graminoid Marsh	WMXlrG	3	6	< 0.01%	10
White Mangrove-Red Mangrove Woodland-Open Marsh	WMXlrO	13	32	0.01%	52
White Mangrove-Red Mangrove Woodland-Succulent Marsh	WMXlrS	2	4	< 0.01%	6
Willow Scrub-Cattail Marsh	CSsGt	49	121	0.04%	195
Willow Scrub-Sand Cordgrass Marsh	CSsGn	4	9	< 0.01%	14
Willow Scrub-Sawgrass Marsh	CSsGc	150	371	0.12%	600
Willow Shrubland	SSs	351	867	0.27%	1,402

Appendix D. Accuracy Assessment Table for the Northwest Coastal Everglades, Region 4, Vegetation Map of Everglades National Park

Table D-1. Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Black Mangrove Scrub-Succulent Marsh (CMaS)	Black Mangrove Woodland-Open Marsh[2]	0	1	1	–	–
	Black Mangrove Scrub-Succulent Marsh Total	0	1	1	0	100
Buttonwood Scrub-Black Rush Marsh (CMcGj)	Buttonwood Scrub-Black Rush Marsh	3	3	3	–	–
	Buttonwood Scrub-Black Rush Marsh Total	3	3	3	100	100
Buttonwood Scrub-Sand Cordgrass Marsh (CMcGn)	Buttonwood Scrub-Black Rush Marsh[2]	0	1	1	–	–
	Buttonwood Scrub-Sand Cordgrass Marsh Total	0	1	1	0	100
White Mangrove Scrub-Sawgrass Marsh (CMlGc)	White Mangrove Scrub-Sawgrass Marsh	1	1	1	–	–
	White Mangrove Scrub-Sawgrass Marsh Total	1	1	1	100	100
White Mangrove Scrub-Sand Cordgrass Marsh (CMlGn)	Black Mangrove Woodland-Open Marsh	0	0	1	–	–
	White Mangrove Scrub-Sand Cordgrass Marsh Total	0	0	1	0	0
White Mangrove Scrub-Open Marsh (CMlO)	White Mangrove Scrub-Open Marsh	1	1	1	–	–
	White Mangrove Scrub-Open Marsh Total	1	1	1	100	100

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Red Mangrove Scrub-Dominant (CMrD)	Red Mangrove Scrub-Dominant[2]	0	1	1	–	–
	Red Mangrove Shrubland[2]	0	1	1	–	–
	Red Mangrove Scrub-Dominant Total	0	2	2	0	100
Red Mangrove Scrub-Sawgrass Marsh (CMrGc)	Red Mangrove Scrub	1	1	1	–	–
	Red Mangrove Scrub-Sawgrass Marsh	3	3	3	–	–
	Red Mangrove Scrub-Sawgrass Marsh Total	4	4	4	100	100
Red Mangrove Scrub-Spikerush Marsh (CMrGe)	Red Mangrove Scrub-Spikerush Marsh	4	4	4	–	–
	Red Mangrove Scrub-Spikerush Marsh Total	4	4	4	100	100
Buttonwood-Red Mangrove Scrub-Sawgrass Marsh (CMXcrGc)	Buttonwood-Red Mangrove Scrub-Sawgrass Marsh	1	1	1	–	–
	Buttonwood-Red Mangrove Scrub-Sawgrass Marsh Total	1	1	1	100	100
Pond Apple Scrub-Sawgrass Marsh (CSaGc)	Pond Apple Scrub-Sawgrass Marsh	1	1	1	–	–
	Pond Apple Scrub-Sawgrass Marsh Total	1	1	1	100	100
Bayhead Swamp Scrub-Sawgrass Marsh (CSBGc)	Bayhead Swamp Scrub-Sawgrass Marsh	2	2	2	–	–
	Transitional Bayhead Swamp Scrub-Sawgrass Marsh[2]	0	2	2	–	–

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Bayhead Swamp Scrub-Sawgrass Marsh (CSBGc) (continued)	Buttonbush Scrub-Sawgrass Marsh	0	0	1	–	–
	Wax Myrtle Scrub-Sawgrass Marsh[2]	1	2	2	–	–
	Falsewillow Scrub-Sawgrass Marsh[2]	1	3	3	–	–
	Tall Sawgrass Marsh-Dense	0	0	1	–	–
	Bayhead Swamp Scrub-Sawgrass Marsh Total	4	9	11	36	82
Transitional Bayhead Swamp Scrub-Sawgrass Marsh (CSBTGc)	Buttonwood Scrub-Sawgrass Marsh	0	0	2	–	–
	Red Mangrove Scrub-Sawgrass Marsh	0	0	1	–	–
	Buttonwood-White Mangrove Scrub-Sawgrass Marsh	0	0	1	–	–
	Transitional Bayhead Swamp Scrub-Sawgrass Marsh	3	3	3	–	–
	Wax Myrtle Scrub-Sawgrass Marsh[2]	0	1	1	–	–
	Transitional Bayhead Swamp Scrub-Sawgrass Marsh Total	3	4	8	38	50
Cypress Scrub-Spikerush Marsh (CStGe)	Cypress Scrub-Spikerush Marsh	1	1	1	–	–
	Cypress Scrub-Spikerush Marsh Total	1	1	1	100	100

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Brazilian Pepper (Es)	Brazilian Pepper	1	1	1	–	–
	Brazilian Pepper Total	1	1	1	100	100
Black Mangrove Forest (FMa)	Black Mangrove Forest	8	8	8	–	–
	Black Mangrove-Red Mangrove Forest[2]	0	2	2	–	–
	Black Mangrove Forest Total	8	10	10	80	100
White Mangrove Forest (FMl)	White Mangrove-Red Mangrove Forest[2]	0	1	1	–	–
	White Mangrove Forest Total	0	1	1	0	100
Red Mangrove Forest (FMr)	Red Mangrove Forest	1	1	1	–	–
	Red Mangrove Forest Total	1	1	1	100	100
Black Mangrove-White Mangrove Forest (FMXal)	Black Mangrove-White Mangrove Forest	1	1	1	–	–
	Black Mangrove-White Mangrove Forest Total	1	1	1	100	100
Black Mangrove-Red Mangrove Forest (FMXar)	Black Mangrove Forest[2]	0	2	2	–	–
	Black Mangrove-Red Mangrove Forest	5	5	5	–	–
	Black Mangrove-Red Mangrove Forest Total	5	7	7	71	100

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Buttonwood-White Mangrove Forest	Buttonwood-White Mangrove Forest	1	1	1	–	–
	Buttonwood-White Mangrove Forest Total	1	1	1	100	100
Buttonwood-Red Mangrove Forest (FMXcr)	Red Mangrove Forest[2]	0	1	1	–	–
	Mixed Mangrove Forest-Mixed[2]	0	1	1	–	–
	Buttonwood-Red Mangrove Forest Total	0	2	2	0	100
White Mangrove-Red Mangrove Forest (FMXlr)	White Mangrove Forest[2]	0	1	1	–	–
	Red Mangrove Forest[2]	0	2	2	–	–
	White Mangrove-Red Mangrove Forest	1	1	1	–	–
	Mixed Mangrove Forest-Mixed[2]	0	2	2	–	–
	White Mangrove-Red Mangrove Forest Total	1	6	6	17	100
Mixed Mangrove Forest-Mixed (FMXX)	Black Mangrove Forest[2]	0	1	1	–	–
	Black Mangrove-Red Mangrove Forest[2]	0	2	2	–	–
	Buttonwood-Red Mangrove Forest[2]	0	1	1	–	–
	White Mangrove-Red Mangrove Forest[2]	0	2	2	–	–
	Mixed Mangrove Forest-Mixed	14	14	14	–	–
	Mixed Mangrove Forest-Mixed Total	14	20	20	70	100

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Bayhead Forest (FSB)	Bayhead Forest	3	3	3	–	–
	Bayhead Forest Total	3	3	3	100	100
Cypress Forest-Monotypic (FStM)	Cypress Forest-Monotypic	2	2	2	–	–
	Cypress Forest-Monotypic Total	2	2	2	100	100
Short Sawgrass Marsh-Dense (MFGcSD)	Red Mangrove Scrub-Sawgrass Marsh	0	0	1	–	–
	Bayhead Swamp Scrub-Sawgrass Marsh	0	0	1	–	–
	Transitional Bayhead Swamp Scrub-Sawgrass Marsh	0	0	1	–	–
	Short Sawgrass Marsh[1]	0	1	1	–	–
	Short Sawgrass Marsh-Dense	3	3	3	–	–
	Short Sawgrass Marsh-Sparse[3]	0	16	16	–	–
	Tall Sawgrass Marsh-Dense[3]	0	3	3	–	–
	Mixed Graminoid Freshwater Marsh[2]	0	1	1	–	–
	Short Sawgrass Marsh-Dense Total	3	24	27	11	89
Short Sawgrass Marsh-Sparse (MFGcSS)	Mixed Graminoid Freshwater Marsh[2]	0	1	1	–	–
	Short Sawgrass Marsh-Sparse Total	0	1	1	0	100

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Spikerush Marsh (MFGe)	Red Mangrove Scrub-Spikerush Marsh[2]	0	1	1	–	–
	Spikerush Marsh	5	5	5	–	–
	Mixed Graminoid Freshwater Marsh[2]	0	1	1	–	–
	Spikerush Marsh Total	5	7	7	71	100
Sand Cordgrass Marsh (MFGn)	Transitional Bayhead Swamp Scrub-Sawgrass Marsh	0	0	1	–	–
	Sand Cordgrass Marsh	8	8	8	–	–
	Sand Cordgrass Marsh Total	8	8	9	89	89
Graminoid Freshwater Prairie (MFGP)	Bayhead Swamp Scrub	0	0	1	–	–
	Short Sawgrass Marsh-Sparse	0	0	1	–	–
	Graminoid Freshwater Prairie	5	5	5	–	–
	Graminoid Freshwater Prairie Total	5	5	7	71	71
Mixed Graminoid Freshwater Marsh (MFGX)	Short Sawgrass Marsh-Sparse[2]	0	4	4	–	–
	Spikerush Marsh[2]	0	2	2	–	–
	Beakrush Marsh[2]	0	8	8	–	–
	Mixed Graminoid Freshwater Marsh	7	7	7	–	–
	Mixed Graminoid Freshwater Marsh Total	7	21	21	33	100

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Sawgrass-Black Rush Marsh (MFGXcj)	Short Sawgrass Marsh-Sparse[2]	0	1	1	–	–
	Graminoid Salt Marsh	0	0	1	–	–
	Sawgrass-Black Rush Marsh Total	0	1	2	0	50
awgrass-Sand Cordgrass Marsh (MFGXcn)	Sand Cordgrass Marsh[2]	0	1	1	–	–
	Sawgrass-Sand Cordgrass Marsh (MFGXcn Total)	0	1	1	0	100
Sawgrass-Beakrush Marsh (MFGXcr)	Short Sawgrass Marsh-Sparse[2]	0	1	1	–	–
	Sawgrass-Beakrush Marsh	1	1	1	–	–
	Sawgrass-Beakrush Marsh Total	1	2	2	50	100
Sawgrass-Cattail Marsh (MFGXct)	Bayhead Swamp Scrub-Sawgrass Marsh	0	0	1	–	–
	Sawgrass-Cattail Marsh	0	3	3	–	–
	Sawgrass-Cattail Marsh Total	0	3	4	0	75
Black Rush Marsh (MSGj)	Red Mangrove Scrub-Sawgrass Marsh	0	0	1	–	–
	Black Rush Marsh	4	4	4	–	–
	Black Rush Marsh Total	4	4	5	80	80
Water (ONW)	Water	4	4	4	–	–
	Water Total	4	4	4	100	100

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Black Mangrove Shrubland (SMa)	Black Mangrove Scrub-Open Marsh[2]	0	1	1	–	–
	Black Mangrove Scrub-Succulent Marsh[2]	0	1	1	–	–
	Black Mangrove Forest[2]	0	2	2	–	–
	Black Mangrove Shrubland Total	0	4	4	0	100
Buttonwood Shrubland (SMc)	Buttonwood Shrubland	1	1	1	–	–
	Buttonwood Shrubland Total	1	1	1	100	100
White Mangrove Shrubland (SMl)	Mixed Mangrove Shrubland-Mixed	0	0	1	–	–
	White Mangrove Shrubland Total	0	0	1	0	0
Red Mangrove Shrubland (SMr)	Red Mangrove Scrub-Sawgrass Marsh	0	0	1	–	–
	Red Mangrove Shrubland	4	4	4	–	–
	Red Mangrove Shrubland Total	4	4	5	80	80
Black Mangrove-White Mangrove Shrubland (SMXal)	Black Mangrove Woodland-Open Marsh	0	1	1	–	–
	Black Mangrove-White Mangrove Shrubland Total	0	1	1	0	100
Buttonwood-White Mangrove Shrubland (SMXcl)	Buttonwood-White Mangrove Forest	0	1	1	–	–
	Buttonwood-White Mangrove Shrubland Total	0	1	1	0	100

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Buttonwood-Red Mangrove Shrubland (SMXcr)	Buttonwood Shrubland	0	1	1	–	–
	Buttonwood-Red Mangrove Shrubland	6	6	6	–	–
	Transitional Bayhead Shrubland	0	1	1	–	–
	Buttonwood-Red Mangrove Shrubland Total	6	8	8	75	100
White Mangrove-Red Mangrove Shrubland (SMXlr)	Red Mangrove Shrubland	0	1	1	–	–
	White Mangrove-Red Mangrove Shrubland Total	0	1	1	0	100
Mixed Mangrove Shrubland-Mixed (SMXX)	Red Mangrove Shrubland	0	0	1	–	–
	Mixed Mangrove Shrubland-Mixed Total	0	0	1	0	0
Bayhead Shrubland (SSB)	Bayhead Swamp Scrub-Sawgrass Marsh[2]	0	1	1	–	–
	Buttonwood Shrubland	0	0	1	–	–
	Bayhead Shrubland	1	1	1	–	–
	Transitional Bayhead Shrubland[2]	0	2	2	–	–
	Bayhead Shrubland Total	1	4	5	20	80

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Transitional Bayhead Shrubland (SSBT)	Red Mangrove Scrub-Spikerush Marsh	0	0	1	–	–
	Buttonwood-Red Mangrove Scrub-Open Marsh	0	0	1	–	–
	Bayhead Swamp Scrub-Sawgrass Marsh[2]	0	1	1	–	–
	Transitional Bayhead Swamp Scrub-Sawgrass Marsh[2]	1	5	5	–	–
	Short Sawgrass Marsh-Sparse[4]	0	1	1	–	–
	Buttonwood Shrubland	0	0	4	–	–
	Red Mangrove Shrubland	0	0	1	–	–
	Buttonwood-Red Mangrove Shrubland	0	0	1	–	–
	Transitional Bayhead Shrubland	14	14	14	–	–
	Black Mangrove-Red Mangrove Woodland	0	0	1	–	–
	Transitional Bayhead Shrubland Total	15	21	30	50	70
Black Mangrove Woodland-Graminoid Marsh (WMaG)	Black Mangrove Woodland[1]	0	1	1	–	–
	Black Mangrove Woodland-Graminoid Marsh	1	1	1	–	–
	Black Mangrove Woodland-Open Marsh[2]	0	2	2	–	–
	Black Mangrove Woodland-Graminoid Marsh Total	1	4	4	25	100

Table D-1 (continued). Accuracy assessment table for the eastern Big Cypress vegetation map. Superscripts identify the acceptance criteria as outlined in the methods section of the report and are as follows: [1]vegetation map class correct at level mapped; [2]vegetation map class more detailed than assessment points; [3]assessment point at boundary between two similar classes, height or cover, difference; [4]sawgrass class modifier; [5]split cell/majority rule decision.

Map Annotation	Accuracy Assessment Annotation	One-to-One Match	Number of Accepted Points	Number of Accuracy Assessment Points	One-to-One Match Correct (%)	Final Map Annotation Assessment (%)
Black Mangrove-Buttonwood Woodland-Graminoid Marsh (WMXacG)	Buttonwood Shrubland[2]	1	1	1	–	–
	Black Mangrove-Buttonwood Woodland-Graminoid Marsh Total	1	1	1	100	100
Black Mangrove-Red Mangrove Woodland-Graminoid Marsh (WMXarG)	Black Mangrove Woodland-Open Marsh[2]	0	1	1	–	–
	Black Mangrove-Red Mangrove Woodland-Graminoid Marsh Total	0	1	1	0	100
Black Mangrove-White Mangrove Woodland-Open Marsh (WMXarO)	Mixed Mangrove Forest-Mixed[2]	0	1	1	–	–
	Black Mangrove-White Mangrove Woodland-Open Marsh Total	0	1	1	0	100
Total	–	109	221	250	44	88

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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