



Salt River Bay National Historical Park & Ecological Preserve, U.S. Virgin Islands Vegetation Mapping Project, 2009

Natural Resource Technical Report NPS/SFCN/NRTR—2011/448



ON THE COVER

2007 U.S. Army Corps of Engineers 30cm resolution orthoimage of Salt River Bay within Salt River Bay National Historical Park & Ecological Preserve.

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Natural Resource Technical Report NPS/SFCN/NRTR—2011/448

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April 2011

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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Please cite this publication as:

Moser, J. G., K. R. T. Whelan, R. B. Shamblin, A. J. Atkinson, J. M. Patterson. 2011. Salt River Bay National Historical Park & Ecological Preserve, U.S. Virgin Islands, Vegetation Mapping Project, 2009. Natural Resource Technical Report. NPS/SFCN/NRTR—2011/448. National Park Service, Fort Collins, Colorado.

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Acknowledgments

We wish to acknowledge the NPS National Vegetation Mapping Inventory Program for the funding of this project. We also gratefully acknowledge the assistance of Joel A. Tutein, Superintendent, Zandy Hillis-Starr, Chief of Resource Management, and the resource management staff of Christiansted National Historic Site, Buck Island Reef National Monument, and Salt River Bay National Historical Park & Ecological Preserve, for their assistance in finding resource materials for this project, for support with project logistics and use of park equipment during field visits, and for review of the resulting products. We thank the U.S. Army Corps of Engineers for providing their orthoimage of Salt River Bay for use in this project. We also wish to thank Dan Clark, currently of USFWS and former NPS Florida / Caribbean Exotic Plant Management Team Specialist, and Tony Pernas, NPS Florida / Caribbean Exotic Plant Management Team Coordinator, both who have worked in the U.S. Virgin Islands, for their insights and experience shared (T. Pernas for review of final product). In addition we express our appreciation to Dr. Jim Fourqurean of Florida International University for providing the Resource Management Intern for this project. This report is deliverable under task agreement J2117072808 cooperative agreement H5000060104. Finally, this project was greatly assisted by the efforts of Raul Urgelles, Brian Witcher, Rachel Vargas, and Steve Wathen.

Summary

The National Park Service Vegetation Mapping Inventory Program (NPS-VMP) funded the NPS South Florida / Caribbean Network (SFCN) to map the terrestrial portions of Salt River Bay National Historical Park & Ecological Preserve in 2007. The mapping project was completed in 2009. SFCN established a cooperative agreement with Florida International University for the Resource Management Intern Program with one of the deliverables being development of a vegetation map of Salt River Bay National Historical Park & Ecological Preserve.

The Salt River vegetation map was made in UTM, NAD 83, zone 20N coordinates with a minimum mapping unit of 400 m². Photo-interpretation was based on aerial imagery of a single U.S. Army Corps of Engineers natural color GeoTIFF orthophoto acquired as part of a larger collection in 2006-2007. SFCN field tests indicate that the horizontal accuracy (RMSE) of the aerial image to be 3.5 m.

The final vegetation map has a total of 58 mapping classes and 247 polygons. A vegetation classification was generated as part of the project which included 32 proposed new Alliances, and two new Associations. A total of 482 terrestrial acres (195 hectares) were mapped in this project including some areas outside of the park boundaries as boundaries were not well established at the time of this project. Four hundred and nine acres (166 hectares) were mapped within the park and include 100% of the terrestrial acreage within the park boundaries. The vegetation classification system was created based on vegetation physiognomic class, Caribbean Formations from Areces-Mallea *et al.* (1999), U.S. Virgin Islands Sub-formations from Gibney *et al.* (2000), and Alliances/Associations defined by the SFCN based on data from vegetation plots and field notes. All proposed new classifications are intended for use within Salt River Bay National Historical Park & Ecological Preserve and are not meant to represent the greater geographic region of Saint Croix or the Virgin Islands.

Also included are photos of map classes, a list of vegetation species observed in the field during this project, and field data sheets. Eighty percent of the polygons either had vegetation data collection or were directly visited and confirmed; consequently SFCN concluded the map meets the NPS-VMP requirement of 80% accuracy with 90% confidence. The final product meets the FGDC (Federal Geographic Data Committee) metadata standard.

Introduction

Salt River Bay National Historical Park & Ecological Preserve Vegetation Mapping Project

The National Park Service (NPS) South Florida / Caribbean Inventory and Monitoring Network (SFCN) (<http://science.nature.nps.gov/im/units/sfcn/>) consists of seven NPS units, encompassing 2.5 million acres (Figures 1 and 2, page 20) and includes Salt River Bay National Historical Park & Ecological Preserve. Vegetation mapping is one of the twelve NPS basic inventories produced as part of the NPS Natural Resource Challenge. The NPS Vegetation Mapping Inventory Program (<http://science.nature.nps.gov/im/inventory/veg/>) funded the SFCN to create a vegetation map of the terrestrial portion of Salt River Bay National Historical Park & Ecological Preserve in 2007. The SFCN used the Resource Management Intern Program cooperative agreement at Florida International University to fund the Salt River Bay National Historical Park & Ecological Preserve Vegetation Mapping Project. The deliverable associated with this project was a vegetation map of Salt River Bay. The field work was completed in 2009.

This report documents the steps involved in creating the Salt River Bay National Historical Park & Ecological Preserve vegetation map. These steps are: 1) Previous vegetation literature and reports on Salt River Bay were researched, species data was collected, and documents associated with community classification were gathered. 2) The most current and highest resolution aerial imagery was acquired and the geographic accuracy of the image was assessed through the use of ground control points. 3) Draft vegetation polygons were digitized in ESRI ArcMap based on photo-interpretation of the aerial imagery. 4) Vegetation plots were selected based on draft polygons and field observations and a list of vegetation species observed in the field during this project was created for field use. 5) Pre-selected vegetation plots were visited, additional plots were added while in the field, and significant vegetation data was recorded at each vegetation plot. 6) A database was created based on data collected at each vegetation plot. 7) A vegetation classification system was created based on vegetation physiognomic class, Caribbean Formations from Areces-Mallea *et al.* (1999), U.S. Virgin Islands Sub-formations from Gibney *et al.* (2000), and Alliances/Associations defined by the SFCN based on data from vegetation plots and field notes; 8) The final vegetation map consisting of data accumulated throughout this project was created in ESRI ArcMap and the spatial topology of the vegetation polygons was verified using ESRI ArcMap.

Introduction to Salt River Bay National Historical Park & Ecological Preserve

The 1,015-acre Salt River Bay National Historical Park & Ecological Preserve was created by Congress in 1992 and is jointly managed by the National Park Service and the Territorial Government of the U.S. Virgin Islands. The park is the site of thousands of years of history beginning with several indigenous Caribbean cultures. The Igneri people were hunter-gatherers from South America and inhabited St. Croix from approximately 10 A.D. to 700 A.D. The Taino who inhabited St. Croix from 700 A.D. to the late 1400's gradually absorbed the Igneri. The only Taino ceremonial ball court or plaza found in the Lesser Antilles is at Salt River Bay. The Caribs were a fierce Caribbean-wide indigenous people who conquered and enslaved the Taino around 1425. In 1493, Columbus had a skirmish at Salt River Bay with Caribs marking the first armed resistance by natives to European encroachment in the Americas. The Spanish decreed in 1512 that the Carib tribes should be exterminated. Control over St. Croix has been held by the Danish,

Spanish, English, Dutch, French, and Knights of Malta (Thomas and Devine 2005). Throughout the island's colonization many peoples were enslaved. These slaves were used to cut down timber and clear lands for agricultural production of sugar cane (for molasses and rum), cotton, and indigo. St. Croix became a major sugar producer under Danish rule with plantations still productive into the late 1800's. Sugar cane crops often required extensive clearing of native vegetation. Introduction of African plant species combined with grazing of livestock (cattle, goats, and sheep) caused extensive removal of native vegetation and manipulation of natural resources, vastly changing the originally heavily forested island of St. Croix. These actions resulted in extensive clearing of native vegetation and the introduction of a number of exotic species: primarily Guinea grass (*Urochloa maxima*) and tan-tan (*Leucaena leucocephala*).

The Salt River watershed on the north side of St. Croix is a large and diverse environment encompassing 4,164 acres (1,685 ha), with Salt River Bay at the northern terminus end of the watershed. The watershed holds some of the largest remaining mangrove forests in the Virgin Islands, as well as coral reefs and a submarine canyon, and is home to 21 terrestrial and marine species that have been listed federally and territorially as rare, threatened, or endangered. The water acreage of the park was designated as a National Natural Landmark in 1980. The Salt River estuary opens into the Caribbean Sea through a break in the fringing reef. Outside the reef the benthic community is dominated by rubble and small patch reefs. The Salt River Canyon starts not far from the break in the reef, and splits the shelf as it plunges to a depth of 350 ft (107 m). The walls of the canyon provide large areas for stony corals to grow, and the canyon serves as an aggregation area for many pelagic fish species, turtles, dolphins, and whales.

The park ranges in elevation from sea level to 272 ft (83 m) based on the 1999 USGS 7.5 minute National Elevation Dataset. Approximately 409 acres (166 ha) of the park are terrestrial. Much of the Salt River drainage basin is underlain by limestone (Miocene Kingshill Formation) and the northern portion of the basin and exposed bedrock is Cretaceous Judith's Fancy Formation (Hall 2005). Eleven soil types are located within the park, but it is primarily dominated by stony loams, gravelly loams, frequently-flooded clay loams, and frequently-flooded sandy loams (Kendall *et al.* 2005). Salt River is currently intermittent, flowing after significant or sustained periods of rainfall with discharge rates that rarely exceed 4-6 in/sec (10-15 cm/sec) except after storm events (Hall 2005). Changes in flows, sediment, and nutrient loads are presumed to have occurred due to upstream development. Additionally, flood control measures have been constructed upstream (Estate Mon Bijou, St. Croix, U.S. Virgin Islands Flood Control Project, U.S. Army Corps). The park has numerous inholdings, a marina on the western side of the bay, and popular beaches. Strong winds and sea spray impact the bluffs overlooking the sea. Salt River Bay has been subjected to several major hurricanes including the devastating Hurricane Hugo in 1989, Marilyn and Luis in 1995, George in 1998, Lenny in 1999, and Omar in 2008.

In 2009, the SFCN in collaboration with NPS Florida / Caribbean Exotic Plant Management Program and SARI resource management staff, undertook an experimental treatment of Guinea grass (*Urochloa maxima*) and tan-tan (*Leucaena leucocephala*) at select locations to determine vegetative community response. Additionally, the natural resources of Salt River Bay have been negatively impacted by exotic fauna like the tree rat (*Rattus rattus*), mongoose (*Herpestes javanicus*), white tail deer (*Odocoileus virginianus*), dogs (*Canis lupus familiaris*), cats (*Felis catus*), and grazing by domestic animals such as goats, sheep, and horses. Future plans would

entail exotic plant treatment for the entire park. The control of these exotic species will affect the entire terrestrial ecosystem and is essential to preserve the park's present biodiversity.

An accurate vegetation map will catalog current vegetation conditions and assist resource management decisions in the future. Vegetation changes are anticipated as a result of the removal of exotic species, impacts of new exotic species, inholding changes, park facility development, sea level rise, and storm impacts.

Methods

Project Overview

SFCN conducted the Salt River Bay National Historical Park & Ecological Preserve vegetation mapping project by establishing a cooperative agreement with Florida International University which established the Resource Management Intern Program. The Resource Management Intern created most of the map polygons under the supervision of the SFCN community ecologist (K. Whelan). SFCN staff conducted the field data collection, analysis and vegetation classification development. SFCN consulted with park resource management staff and received considerable assistance with logistical support, important references, and review of the resulting map.

Creation of the map involved the following seven phases which are detailed below:

- Phase 1: Gathering Background Information
- Phase 2: Imagery Acquisition
- Phase 3: Draft Polygon Creation
- Phase 4: Selection of Plots and Creation of Field Data Sheets
- Phase 5: Collection of Field Data
- Phase 6: Database Design and Creation
- Phase 7: Vegetation Classification
- Phase 8: Refinement and Finalization of Polygons

The project was initially funded in 2007; work began in earnest in May of 2008, and was completed in December of 2009.

Phase 1: Gathering Background Information

This vegetation map project began by acquiring materials immediately associated with Salt River Bay vegetation. Previous vegetation literature and reports on Salt River Bay were researched, species data were collected, and documents associated with community classification were gathered.

An interview with Dan Clark discussing the vegetation on SARI (Clark 2008) was used to describe general information about the Salt River Bay watershed with a focus on vegetation. Dan Clark is a former Supervisory Exotic Plant Management Specialist with the Florida / Caribbean Exotic Plant Management Team who is familiar with vegetation around Salt River Bay and Buck Island. Mr. Clark worked at Salt River and Buck Island performing exotic plant removal.

The National Oceanic and Atmospheric Administration (NOAA) Biogeography Program created a vegetation map of SARI, hereinafter referred to as the NOAA map, using NOAA 2000 aerial imagery as part of an ecological characterization of the park conducted in consultation with the National Park Service (NPS) and the Government of the Virgin Islands Department of Planning and Natural Resources (VIDPNR). This ecological characterization is described in the technical report “An Ecological Characterization of Salt River Bay National Historical Park & Ecological Preserve, U.S. Virgin Islands” (Kendall *et al.* 2005). While this is one of the only digital vegetation maps available for the park, SFCN felt that improvement in the level of detail, especially in the upland areas, would further assist park resource management planning, provide

an updated characterization of the terrestrial vegetation of SARI, and enable the park to develop plans for non-native invasive plant control and restoration.

The other vegetation map available for SARI, hereinafter referred to as the UVI map, was completed in 2001 as part of a larger mapping effort and ecological assessment in the U.S. Virgin Islands using 1994 U.S. Army Corps orthophoto datasets. In this effort, detailed maps of the terrestrial vegetation and marine communities of St. Croix, St. John, St. Thomas, and Water Island were completed by The Eastern Caribbean Center, Conservation Data Center, at the University of the Virgin Islands and the University of the Virgin Islands Cooperative Service working in conjunction with a number of agencies (Thomas and Devine 2005). This map consists of 30 map classes that appear similar to the Virgin Island sub-formation level provided in Gibney *et al.* (2000). However, SFCN was unable to obtain metadata for this project including descriptions of map categories, minimum mapping unit, accuracy assessment information, details of imagery used, etc. While this map appears more thorough than the vegetation map contained in the NOAA ecological characterization (Kendall *et al.* 2005), the level of community classification is still not very detailed and the lack of metadata and definitions of map classes makes it difficult to use this map as a baseline characterization for the park.

A comparison of the NPS 2009 map with the two previously discussed maps can be found in the Discussion section near the end of this report.

Some properties/lands are inaccessible (to the NPS) as a result of private ownership. The ‘Salt River Bay National Historical Park & Ecological Preserve Tract and Boundary Data’ shapefile was downloaded from the NPS Data Store website (<http://irma.nps.gov/App/Reference/Profile/1048043>). This shapefile was created by the Land Resources Division and was last updated on March 5, 2009. Several changes were made to the original shapefile in order to illustrate the difficulty of accessing certain portions of the park. Adjacent polygons with the same ownership status were merged together. Two small, unattributed polygons were attributed with a best guess ownership status based on common sense. The modified shapefile was incorporated into a map titled ‘Salt River Bay National Historical Park & Ecological Preserve Ownership Tracts as of March 2009’ (Figure 3, page 21).

A “Vascular plant inventory and mapping of Buck Island, Buck Island Reef National Monument St. Croix, U.S. Virgin Islands” (Ray 2003) and the “Flora of St. John, U.S. Virgin Islands” (Acevedo-Rodriguez 1996) were used to create a list of potential vegetation species for use while surveying vegetation plots at Salt River Bay. Ray (2003) is an unpublished report of a vascular plant inventory of Buck Island contracted by the SFCN. Acevedo-Rodriguez (1996) is a published text that was relied on to identify (key out) unfamiliar vegetation species collected while in the field.

“A guide to Caribbean vegetation types: preliminary classification system and descriptions” (Areces-Mallea *et al.* 1999) and “U.S. Virgin Islands vegetation community classification: basic community descriptions – habitat mapping in support of land use and biodiversity planning in the Virgin Islands” (Gibney *et al.* 2000; see Appendix E) were used to establish and create the vegetation classification used for this vegetation mapping project. “A guide to Caribbean vegetation types: preliminary classification system and descriptions” by Areces-Mallea *et al.*

(1999) is a published preliminary classification system with descriptions of Caribbean vegetation communities at the “Formation” level using the conventions found in the National Vegetation Classification System. “U.S. Virgin Islands vegetation community classification: basic community descriptions – habitat mapping in support of land use and biodiversity planning in the Virgin Islands” by Gibney *et al.* (2000) is an unpublished document discussing basic community descriptions occurring in the U.S. Virgin Islands. No species were included in any of the community descriptions of this document.

Phase 2: Imagery Acquisition

Orthophotos acquired by the U.S. Army Corps of Engineers in 2006-2007 were determined to be the most current and detailed imagery available. The imagery used in this project was a small extract from a collection of natural color GeoTIFF orthophotos that covers the islands of Puerto Rico, Culebra, Vieques, St. Thomas, St. John, and St. Croix. An orthophoto is remotely-sensed image data in which displacement of features in the image caused by terrain relief and sensor orientation have been mathematically removed. Orthophotography combines the image characteristics of a photograph with the geometric qualities of a map. The source imagery was obtained from November 2006 through March 2007 and used to produce orthophotos with a one foot ground sample distance (GSD). Imagery was acquired at 0.9 foot GSD resolution. Flight height maintained during mission was 8,650 feet AGL. The imagery was captured at 12-bit radiometric resolution and converted to 8-bit radiometric resolution during post processing. The imagery was captured with 30% side lap between all adjacent flight lines. The imagery was obtained and processed by all digital means beginning with data acquisition using an ADS40 digital sensor. The orthophotos are available in GeoTIFF format. The original projected coordinate system was State Plane Puerto Rico / US Virgin Islands (Zone 5200), NAD 83, GRS 80, Units Meters. These orthophotos were originally collected for the U.S. Army Corps of Engineers. A single orthophoto captured the entirety of Salt River Bay and is included in the project files as *sariortho.zip*.

SFCN verified the horizontal accuracy of the imagery by analyzing 15 control point locations in the imagery. Locations were considered to be suitable control points if they were visible in the orthoimage and had a well-defined corner (e.g. dock or corner of building). A field crew visited each control point in July 2009 with a Garmin 60CSx handheld Global Positioning System (GPS) unit. After locating a control point location, the field crew collected a single GPS point by allowing the GPS unit to average 120 positions.

To determine the horizontal accuracy of the imagery, the shapefile of corrected control points was overlaid on the orthoimage in ESRI ArcMap. The ruler tool was used to measure the distance in meters between each corrected control point and the expected position of the control point on the image. The root mean square error (RMSE) was calculated by squaring the offsets, averaging these squared offsets, and finally taking the square root of that average.

The results of the horizontal accuracy check performed by the SFCN indicated that positions of well-defined points were within 3.5 m of their true location.

Phase 3: Draft Polygon Creation

Polygons were digitized in ESRI ArcMap for the entirety of Salt River Bay based on an initial photo-interpretation of the digital orthoimage at a scale of no less than 1:200 and no more than 1:7000. The variation in scale proved helpful in defining larger polygons at larger scales and vice versa. Vegetation polygons in general were digitized with a minimum mapping unit of 400 m². However, 39 polygons were digitized at a scale smaller than the minimum mapping unit. Many of these 39 polygons had a high degree of certainty in their mapping class and location (e.g., mangrove islands, edges of salt ponds, etc.).

Phase 4: Selection of Plots and Creation of Field Data Sheets

Locations of field vegetation plots were selected with the primary goal of visiting as many polygons as possible, while ensuring each plot was representative of the visited polygon. Anticipating feasibility of reaching plots given the steep terrain and large amount of private property of Salt River Bay was challenging. The degree of difficulty of reaching a given plot was hard to predetermine as will be discussed further in the next section. Prior to field analysis, potential plots were preselected in ESRI ArcMap using the following guidelines: (1) Each plot was a minimum distance of five meters inside the targeted polygon; (2) Each plot was in a part of the targeted polygon with a distinct visual pattern compared with other surrounding polygons (i.e., ecotones were avoided); (3) Each plot was (to the best of our knowledge) accessible with a reasonable amount of effort; (4) Each plot was inside a polygon of a significant size and visual (pattern) significance.

A field data sheet was created prior to field work (Appendix D) to collect the following data to assist vegetation mapping: Location of the Plot (Park, GPS Mark #, Training Point #, and Polygon #), Dominant Species Present in Overstory and Understory, Average Canopy Height, Canopy Cover Percent Cover, Community Type, Area Description/Sub Strata, and Successional Stage. Additional data was recorded when applicable to the vegetation plot (# of Pictures Taken/Description, Disturbance, Representative of Polygon, and Remarks/Point Changed). In October 2008, Hurricane Omar passed over the northeast end of St. Croix, U.S. Virgin Islands including Salt River Bay. In general, minor to moderate vegetation damage (Table 3, page 28) was observed and thus the level of disturbance was also recorded during the October 2008 field work.

A list was made of vegetation species observed in the field during this project (Appendix C). The vegetation species list for Salt River Bay National Historical Park & Ecological Preserve includes a six letter species code. This code was created using the first three letters of the genus name and first three letters of the specific epithet name, and did not necessarily match Integrated Taxonomic Information System (ITIS) species codes. However, vegetation species names were subsequently checked and updated to the current species names in ITIS.

Phase 5: Collection of Field Data

All vegetation plots were reached via hiking, often traversing steep slopes amongst thorny/poisonous vegetation while avoiding private property. Data was collected from vegetation plots that were both preselected (potential, selected in the office) and non-preselected (selected out on the field). Preselected plots were selected using ESRI ArcMap prior to field work (see Phase 4). A Garmin GPSMap 60CSx Handheld GPS Navigator was used to navigate to

preselected plots. Upon arriving at the plot, a new GPS coordinate was taken. Standing at the center of the plot, the primary observer visually evaluated a circular area with an average radius of 10 meters from the center of the plot, representing approximately an area of 300m². Some polygons were too narrow and the area evaluated was adjusted accordingly. The primary observer dictated the information for the field data sheet which was filled out by an assistant observer and photos were taken that visually represented the plot. Additional photos were taken while traveling between plots. Plant species that were unable to be identified in the field were bagged and later keyed out by SFCN botanist R. Shamblin using the *Flora of St. John, U.S. Virgin Islands* and checked with USDA/NRCS St. Croix, Virgin Islands botanist Rudy G. O'Reilly, Jr.. Additional, non-preselected plots were sometimes recorded in areas of interest as determined in the field when reaching the selected point was not feasible, or an area of vegetation visited had no other field points but was clearly different. These plots were treated in the same manner as preselected plots aside from not being preselected prior to field work.

Some non-preselected plots were observed from a distance and thus were not able to have a GPS coordinate taken. In the field these “offset” plots were observed from a distance in an attempt to gather data about viewable but difficult to reach or dangerous points. The field data sheet was completed by observation using binoculars from distances of around 10 meters, with a few extreme exceptions. Approximate “offset” plot locations were determined in ESRI ArcMap through a combination of field notes, estimated distances, and discussion with the primary observer. “Offset” plots initially observed from long distances were later confirmed with nearby field plots.

There was a degree of flexibility in field visits. The primary cause for not going to a preselected plot, going to a non-preselected plot, or observing from afar was inaccessibility and time-effort effectiveness. Though most vegetated polygons were able to be sampled with at least one plot, some polygons were inaccessible and due to time constraints were unable to be sampled. Through the use of offset plots, the number of polygons without vegetation data was minimized.

Phase 6: Database Design and Creation

After returning from the field, all GPS units used for vegetation mapping were downloaded creating an ESRI ArcMap shapefile for each visit. A database was created including the fields given in Table 1 (page 27) with additional descriptions provided in Tables 2 and 3 (page 28). Data recorded on field data sheets and notes were entered in the database. A ThumbsPlus 7[®] database was used to catalog all photos taken during each day of the field visit, allowing data from field data sheets to be digitally associated with each individual photo.

Phase 7: Vegetation Classification

The National Vegetation Classification System (NVCS) hierarchy is currently under revision and is especially underdeveloped in the areas of the U.S. Virgin Islands and sub-tropical Florida. SFCN was able to locate two previous vegetation classification documents: Areces-Mallea *et al.* (1999) and Gibney *et al.* (2000). The Areces-Mallea *et al.* (1999) document provides a NVCS classification, including Caribbean Formations, Alliances, and Associations, however the Alliances and Associations described are not found on Salt River Bay. Gibney *et al.* (2000) provides Areces-Mallea *et al.* (1999) Caribbean Formations and then additional sub-divisions (called Virgin Islands Sub-formations for the purpose of this document) that provided extra

specificity between the Formation level and the Alliance level. Neither classification describes vegetation to the Alliance or Association level for Virgin Islands vegetation communities.

The vegetation classification created for this project incorporates material from Areces-Mallea *et al.* (1999) and Gibney *et al.* (2000) but adds proposed Alliances or, where possible, Associations described by SFCN botanist R. Shamblin. Vegetation communities were categorized in the following hierarchy:

Vegetation Physiognomic Class (NVCS)
 Caribbean Formation (Areces-Mallea *et al.* 1999)
 Virgin Islands Sub-formation (Gibney *et al.* 2000)
 Alliance or Association (R. Shamblin)

Six vegetation physiognomic classes (Forest, Woodland, Shrubland, Grassland, Sparse Vegetation, and Hierarchy Placement Undetermined) were used as a broad division of classification. Twenty-one Caribbean Formations defined by Areces-Mallea *et al.* (1999) were used to maintain linkage between the National Vegetation Classification System and the unique Virgin Islands communities. Twenty-two Virgin Islands vegetation communities defined by Gibney *et al.* (2000) were incorporated as Virgin Islands Sub-formations. An additional 12 Virgin Islands Sub-formations (Coastal Evergreen Forest, Coastal Evergreen Shrubland, Coastal Hardwood Shrubland, Semi-deciduous Shrubland, Fringing Freshwater Grassland, Rock Cliff, Rocky Outcrop, Seasonal Mud Flat, Tidal Mud Flat, Marsh, Road, and Salt Marsh) were created by R. Shamblin to define communities that were absent in Gibney *et al.* (2000). Thirty-two Alliances and two Associations were defined by R. Shamblin with the former having descriptions of characteristic species in the overstory and the latter also including characteristic species in the understory based upon vegetation plot data collected at Salt River Bay National Historical Park & Ecological Preserve. Fourteen of the Salt River Bay National Historical Park & Ecological Preserve vegetation map Virgin Island Sub-formations were also used in the 2009 Buck Island Reef National Monument vegetation map (Moser *et al.* 2010). Eight of the 58 map classes were the same as those used in the 2009 Buck Island Reef National Monument vegetation map (Moser *et al.* 2010). Field plot data collection included canopy height, dominant species for canopy overstory and understory (when possible and applicable), and additional species present (Phase 5).

The vegetation classification hierarchy is given in Table 5 (page 30). Appendix A provides the vegetation classification key and descriptions of all Virgin Islands Sub-formations, Alliances, and Associations, including:

Alliance/Association Name:	Name using scientific names.
Name, translated:	Name using common names.
Vegetation	Describes dominant overstory species and where possible understory species at Salt River Bay National Historical Park & Ecological Preserve. Other characteristic species, canopy height and canopy cover are also included.
Environment	Describes location/environment at Salt River Bay National Historical Park & Ecological Preserve. Please note:

some additional environmental descriptions of U.S. Virgin Islands Dry Forests, Shrublands, etc. is provided in Gibney *et al.* (2000).

Plots: SFCN field plot identification labels for plots on which description is based.

The Virgin Islands Sub-formations, Alliances, and Associations described in this report are considered provisional as they have not been officially accepted into the National Vegetation Classification System at this time. This report makes no attempt to extrapolate ranges beyond Salt River Bay National Historical Park & Ecological Preserve or make assumptions about other species that might be present at other places. SFCN assumes that the detailed formatting and descriptions necessary to complete descriptions for the National Vegetation Classification System will be provided separately by the NPS Vegetation Mapping Inventory Program once the NVCS revisions are complete.

Phase 8: Refinement and Finalization of Polygons

Polygons were re-digitized for the entirety of Salt River Bay based on a combination of photo-interpretation, vegetation plots, and field notes. Some polygons were mapped in the field independent from photo-interpretation of the imagery. The attributes table for the polygon shapefile includes the following fields: Level_1, Level_2, Level_3, Level_4, and Level_4_L (Table 4, page 29).

Level_1 = Vegetation physiognomic class.

Level_2 = Caribbean Formation (Areces-Mallea *et al.* 1999).

Level_3 = Virgin Islands Sub-formation (Gibney *et al.* 2000; with additions by SFCN).

Level_4 = Alliance/Association using species codes (SFCN); if no Alliance/Association classification made, then Level_3 classification used.

Level_4_L = Alliance/Association using species scientific names (SFCN); if no Alliance/Association classification made, then Level_3 classification used.

Vegetation classifications were assigned to each polygon based on vegetation plots, field notes, photos, and vegetation data from Kendall *et al.* (2005). The Kendall *et al.* (2005) vegetation data was used as a secondary source during the few cases when there was no familiarity with a polygon, i.e., when no vegetation plots were taken in a polygon or no walk through of that polygon occurred at any time during vegetation mapping. Vegetation data from Kendall *et al.* (2005) was used in identifying well-known dominant communities to aid in classifying to the Virgin Islands Sub-formation level of the unknown polygon. An Alliance or Association classification was never made using the Kendall *et al.* (2005) vegetation data.

The spatial topology of the final polygon shapefile was checked using ESRI ArcMap to find any slivers or overlaps which often occur during the drawing of polygons. This finalized polygon shapefile was color coded based on the Level_4_L field, all values in effect representing vegetation map classes.

Results

Area mapped

A total of 482 terrestrial acres (195 hectares) were mapped in this project including some areas outside of the park boundaries as boundaries were not well established at the time of this project. 409 acres (166 hectares) were mapped within the park and include 100% of the terrestrial acreage within the park boundaries.

Plots

A total of 150 vegetation plots were visited over three trips (Figure 4, page 22). The first trip in October 2008 (post Hurricane Omar) resulted in 11 vegetation plots, the second trip in January 2009 afforded 37 vegetation plots, and the third trip in July 2009 visited 102 vegetation plots. One hundred forty-three of the plots were directly visited while 7 were recorded from “off-set” locations. Appendix C lists the 76 vegetation species observed in the field during this project.

Mapping Classes

There were a total of 58 mapping classes used in classifying all polygons that were digitized (Table 6, page 32). Of the 58 mapping classes, there were 24 Virgin Islands Sub-formations, 32 Alliances, and two Associations that are described in the Vegetation Classification (Appendix A). Forty-four of the 58 mapping classes had one or more vegetation plots representing them (Table 6, page 32). Nine of the 14 mapping classes lacking vegetation plots were directly visited and confirmed, although formal vegetation plot data collection did not occur (Beach, Beach Dune, *Cocos nucifera* Coastal Evergreen Forest Alliance, *Rhizophora mangle* Mangrove Woodland Alliance, Road, Rock Cliff, Rocky Outcrop, Salt Pond, and Seasonal Mud Flat). Two of the 14 mapping classes lacking vegetation plots were walked through on the way to other vegetation plots (Evergreen Woodland and Semi-deciduous Shrubland). Three of the 14 mapping classes lacking vegetation plots were not directly visited and were only identified to the Virgin Islands Sub-formation (Gibney *et al.* 2000) with the aid of Kendall *et al.* (2005) and Thomas and Devine (2005) (Fresh Pond, Fringing Freshwater Grassland, and Thicket/scrub).

Polygons

A total of 247 polygons were digitized (Figure 5, page 23) based on interpretation of the imagery used. Ninety-two of the 247 polygons had one or more vegetation plots occurring in them (Figure 4, page 22). Eighty-two of the 155 polygons lacking vegetation plots were directly visited and confirmed (66 walked through and 16 kayaked past) although formal vegetation plot data collection did not occur. Of the remaining seventy-three polygons either lacking vegetation plots or which were not visited, twenty-three were felt to be obvious from aerial imagery. As another point of note, 39 of the total 247 polygons were smaller than the minimum mapping unit of 400 m². The final vegetation map showing all the map classes is provided in Figure 5 (page 23). Some polygons transitioned gently into one another and where to place the polygon boundary in the ecotone was difficult to determine and was made with the mapper’s best judgment. Based on Figure 3 (page 21), 28% of SARI lands are privately owned. As a result, 29 polygons comprising an area of 40 acres roughly in the center of the park were inaccessible to NPS personnel for the purpose of this vegetation map.

Accuracy Assessment

SFCN did not conduct a separate accuracy assessment of the classification accuracy. However, of the 247 polygons, 197 polygons (80%) either had plot data collected (92 polygons), were directly walked through (66 polygons), kayaked past (16 polygons), or were obvious from imagery. The latter included Beach (5 polygons), *Cocos nucifera* Coastal Evergreen Forest Alliance (1 polygon), Rock Cliff (1 polygon), Rocky Outcrop (2 polygons), Salt Pond (3 polygons), Seasonal Mudflat (3 polygons), and Developed Area (8 polygons). A total of 90% of the 218 accessible polygons (not privately owned), had plot data collected.

As mentioned above, 44 of the 58 map classes had 1 or more plots within them. Eleven of the 14 remaining map classes were directly visited or visually inspected via binoculars (Fringing Freshwater Grassland). When uncertainty existed, comparison was made to the Kendall *et al.* (2005) and Thomas and Devine (2005) maps to further confirm classification and/or polygons were only identified to the general Virgin Islands Sub-formation (Gibney *et al.* 2000). Thus for the accessible portions of the map, SFCN felt the combination of these factors is sufficient enough to meet the National Vegetation Inventory Program standard of 80% classification accuracy with 90% confidence.

As mentioned above the SFCN check of the horizontal accuracy indicated that positions of well defined points on the imagery were within 3.5 m of their true location. A separate positional accuracy of the vegetation map polygons was not possible, due to the scarcity of well-defined mappable objects. However, the accuracy of the imagery suggests that the map should be well within the 12.2 meters required by the NPS Vegetation Mapping Inventory Program.

Discussion

This NPS vegetation mapping product for Salt River Bay National Historical Park & Ecological Preserve was compared with the ecological characterization of the Salt River Bay area made by NOAA (Kendall *et al.* 2005), and with the collaborative ecological assessment of St. Croix as part of a larger mapping effort for the Virgin Islands made by the UVI (Thomas and Devine 2005). The NPS map has a total of 244 terrestrial polygons within the park boundary comprising 58 different community types, whereas the NOAA map has a total of 450 terrestrial polygons within the park boundary with only 26 community types, and the UVI map has a total of 111 terrestrial polygons within the park boundary with only 22 community types (Table 7, page 33).

The NPS map is more specific at describing vegetation structure (canopy height and canopy coverage) by utilizing categories such as forest, woodland, shrubland, grassland, and sparse vegetation. The NPS map also indicates dominant species in many areas with descriptions such as *Conocarpus erectus* Coastal Evergreen Shrubland Association or *Urochloa maxima* Coastal Grassland Alliance. In contrast, NOAA's map focuses mainly on canopy coverage while providing general descriptions of vegetation structure such as "Forest/Trees, Closed: >65% canopy coverage." The UVI map is the least detailed, classifying as Semi-deciduous forest or Thicket scrub with little reference to canopy or species characteristics. In order to demonstrate the differences in classification and detail among these maps, three areas were compared: the Northeast, Northwest, and South areas of the Salt River Bay area (Figure 6, page 24). A comparison of mangrove areas was also done. A comparison of the major mapping classes in each area can be seen in Table 8 (page 34).

The Northeast area (approximately 53.8 acres, 21.8 hectares) was divided into three sections (Figure 7, page 25). In section one (40.0 acres, 16.2 hectares) the UVI map indicates that the area was composed of Mixed grassland (35.3 acres, 14.3 hectares) with a small community of Coastal hedge (4.7 acres, 1.9 hectares). The NOAA map specifies this area as predominately Land Natural & Semi-Natural Areas Vegetated (21.9 acres, 8.9 hectares) with small communities of Shrubs/Bushes Sparse at 1%-15% canopy coverage (5.8 acres, 2.3 hectares), Shrubs/Bushes Open at 15%-65% canopy coverage (5.3 acres, 2.1 hectares), Shrubs/Bushes Closed at >65% canopy coverage (1.8 acres, 0.7 hectares), Land Bare Areas Soil (1.7 acres, 0.7 hectares), with seven additional communities each less than 0.8 acres. The NPS map agrees with the UVI map's classification of this area, however, it further identifies the dominant grass species present, *Urochloa maxima* Coastal Grassland Alliance (23.2 acres, 9.4 hectares). The NPS map also classifies this area with *Urochloa maxima-Cryptostegia madagascariensis* (5.8 acres, 2.3 hectares), *Coccoloba uvifera* Coastal Hedge Alliance (3.4 acres, 1.4 hectares), Mixed Dry Grassland (2.3 acres, 0.9 hectares), and *Leucaena leucocephala* Semi-deciduous Woodland Alliance (1.9 acres, 0.8 hectares), with 14 additional communities each less than 0.9 acres.

In section two of the Northeast area (7.8 acres, 3.2 hectares), the UVI map indicates that the area was composed of Thicket scrub (5.3 acres, 2.1 hectares), Semi-deciduous woodland (1.3 acres, 0.5 hectares), and Mixed dry shrubland (1.2 acres, 0.5 hectares). The NOAA map specifies this area as predominately Forest/Trees Closed at >65% canopy coverage (4.5 acres, 1.8 hectares) and Forest/Trees Open at 15%-65% canopy coverage (2.1 acres, 0.8 hectares), with 10 additional communities each less than 0.3 acres. The NPS map agrees with the NOAA map's classification

of structure in this area, however, it further identifies the dominant forest species present *Leucaena leucocephala* Semi-deciduous Forest Alliance (3.8 acres, 1.5 hectares) and *Coccoloba uvifera* Coastal Evergreen Forest Alliance (2.3 acres, 0.9 hectares), with six additional communities each less than 0.4 acres.

In section three of the Northeast area (6.0 acres, 2.4 hectares), the UVI map indicates that the area was comprised of Mixed dry shrubland (6.0 acres, 2.4 hectares). The NOAA map specifies this area as predominately Forest/Trees Open at 15%-65% canopy coverage (2.0 acres, 0.8 hectares) and Land Natural & Semi-Natural Areas Vegetated (1.1 acres, 0.4 hectares), with eight additional communities each less than 0.6 acres. The NPS map classifies this area with *Conocarpus erectus* Coastal Evergreen Shrubland Association (2.9 acres, 1.2 hectares) and *Acacia tortuosa* Semi-deciduous Shrubland Alliance (1.6 acres, 0.7 hectares), with seven additional communities each less than 0.3 acres.

The Northwest area (approximately 18.3 acres, 7.4 hectares) was divided into two sections (Figure 8, page 25). In section one (10.6 acres, 4.3 hectares) the UVI map indicates that the area was composed of Mixed grassland (9.1 acres, 3.7 hectares) with small communities of Mixed dry shrubland (1.1 acres, 0.4 hectares) and Thicket scrub (0.4 acres, 0.2 hectares). The NOAA map specifies this area as predominately Shrubs/Bushes Sparse at 1%-15% canopy coverage (3.2 acres, 1.3 hectares), Land Natural & Semi-Natural Areas Vegetated (2.2 acres, 0.9 hectares), and Forest/Trees Sparse at 1%-15% canopy coverage (2.0 acres, 0.8 hectares), with nine additional communities each less than 0.8 acres. This vegetation was not present during the recent field visitation to the area. The NPS map agrees with the UVI map's classification of this area, however, it further identifies the dominant grass species present, *Urochloa maxima* Coastal Grassland Alliance (5.7 acres, 2.3 hectares), with 11 additional communities each less than 0.7 acres.

In section two of the Northwest area (7.8 acres, 3.1 hectares), the UVI map indicates that the area was composed of Thicket scrub (7.8 acres, 3.1 hectares). The NOAA map specifies this area as predominately Forest/Trees Closed at >65% canopy coverage (5.7 acres, 2.3 hectares), with 14 additional communities each less than 0.5 acres. The NPS map classifies this area with Semi-deciduous Forests (5.1 acres, 2.1 hectares), with surrounding areas of *Leucaena leucocephala* Semi-deciduous Shrubland Alliance (1.1 acres, 0.4 hectares) and Semi-deciduous Shrubland (1.0 acres, 0.4 hectares), with 14 additional communities each less than 0.2 acres. The NPS map delineates the specific vegetation types present, mostly agreeing with the NOAA map attributes of structure.

The South area (approximately 104.4 acres, 42.3 hectares) was divided into two sections (Figure 9, page 25). In section one (24.4 acres, 9.9 hectares) the UVI map indicates that the area was composed of Thicket scrub (18.1 acres, 7.3 hectares) and Mixed dry shrubland (6.3 acres, 2.5 hectares). The NOAA map specifies this area as predominately Forest/Trees Closed at >65% canopy coverage (16.3 acres, 6.6 hectares) with small communities of Forest/Trees Open at 15%-65% canopy coverage (3.4 acres, 1.4 hectares) and Mangrove *Avicennia germinans* Closed at >65% canopy coverage (1.8 acres, 0.7 hectares), with 11 additional communities each less than 0.8 acres. The NPS map classifies this area with Semi-deciduous Forest (11.3 acres, 4.6 hectares) and Semi-deciduous Woodland (7.3 acres, 2.9 hectares) interspersed with Thicket/scrub (1.7

acres, 0.7 hectares), *Avicennia germinans* Mangrove Forest Alliance (1.6 acres, 0.6 hectares), and Mixed Dry Shrubland (1.0 acres, 0.4 hectares) with 9 additional communities each less than 0.6 acres.

In section two of the South area (80.1 acres, 32.4 hectares) the UVI map indicates that the area was composed of Semi-deciduous forest (72.9 acres, 29.5 hectares) with a thin strip of Gallery shrubland (7.1 acres, 2.9 hectares). The NOAA map specifies this area as predominately Forest/Trees Closed at >65% canopy coverage (72.0 acres, 29.1 hectares), with ten additional communities each less than 0.3 acres. The NPS map agrees with the UVI map's classification of this area, however, it further identifies the dominant grass species present, *Bourreria succulenta* Semi-deciduous Forest Alliance (42.9 acres, 17.4 hectares). The NPS map also classifies this area with communities of Semi-evergreen Forest (8.9 acres, 3.6 hectares), Semi-deciduous Forest (8.2 acres, 3.3 hectares), and *Melicoccus bijugatus* Semi-deciduous Forest Alliance (4.5 acres, 1.8 hectares), Semi-deciduous Woodland (1.5 acres, 0.6 hectares), Developed Area (1.4 acres, 0.5 hectares), and Basin Moist Forest (1.2 acres, 0.5 hectares), with ten additional communities each less than 0.5 acres. On the eastern side of this area, there is a strip dividing the *Bourreria succulenta* Semi-deciduous Forest Alliance that consists of a Gallery Semi-deciduous Forest (7.2 acres, 2.9 hectares) and a Gallery Semi-deciduous Woodland (2.8 acres, 1.1 hectares), indicating not only vegetation type but suggesting hydrological feature.

The most specific and consistent description for vegetation type shared by the three maps was for mangroves (Figure 10, page 26). We selected all of the living mangrove vegetation types from the three maps and compared them (Table 8, page 34). The mangrove area in the UVI map (44.9 acres, 18.2 hectares) is larger than that of the NOAA map (26.1 acres, 10.6 hectares); however, the UVI map considers area as Mangrove shrubland (28.0 acres, 11.3 hectares). This larger area seems suspicious as this area was heavily impacted by Hurricane Hugo (1989). It is possible that the map annotation of Mangrove shrubland had damaged mangrove areas lumped in with undamaged mangrove shrubland. The UVI map uses only four mangrove classifications, compared to the nine that the NOAA map uses to classify mangroves. The NPS map has the largest mangrove area (46.1 acres, 18.7 hectares), has more detail (11 mangrove classifications), and indicates that the areas in red actually contain Tidal Mud Flat or *Leucaena leucocephala* Semi-deciduous Forest Alliance, signifying post hurricane recovery (Figure 11, page 26). The NOAA map classifies much of the area as Mangrove Dead or Mangrove *Avicennia germinans* Closed at >65% canopy coverage. The NPS map shows that the mangroves are much further inland than what is represented on the NOAA map.

Overall, the comparison of the three areas and the mangrove vegetation types finds that there is a general progression from more general vegetation descriptions (UVI map) to more detailed vegetation structure (NOAA map) and then to more dominant species information (NPS map). The NPS map has built on more detailed vegetation information and expanded the information shown in the other two maps. It is recommended that the NPS map should be used as the primary resource for the SARI area based on it being the most recent product and also as a result of the greater detail of information on dominant species and structure.

Summary of final project specifications, products and files

The Salt River Bay vegetation map was made in UTM, NAD 83, zone 20N coordinates with a minimum mapping unit of 400 m². Aerial imagery used was a single U.S. Army Corps of Engineers natural color GeoTIFF orthophoto acquired as part of a larger collection in 2006-2007. SFCN tests showed the horizontal accuracy (RMSE) of the aerial image to be 3.5 m. The final vegetation map has a total of 58 mapping classes and 247 polygons. A vegetation key and classification are included in Appendix A. Thirty-two proposed new Alliances, and two new Associations are described in the vegetation classification. Photos of map classes are provided in Appendix B. A list of vegetation species observed in the field during this project is provided in Appendix C. Field data sheets are included in Appendix D. Data and photos were collected for 150 field plots as well as additional photos along trails or between plots. Eighty percent of the polygons either had vegetation data collection or were directly visited and confirmed; consequently SFCN feels the map meets the NPS VMP requirement of 80% accuracy with 90% confidence. The final product meets the FGDC metadata standard.

Table 9 (page 35) summarizes the products and filenames included in the Salt River Bay National Historical Park & Ecological Preserve vegetation mapping project products and files.

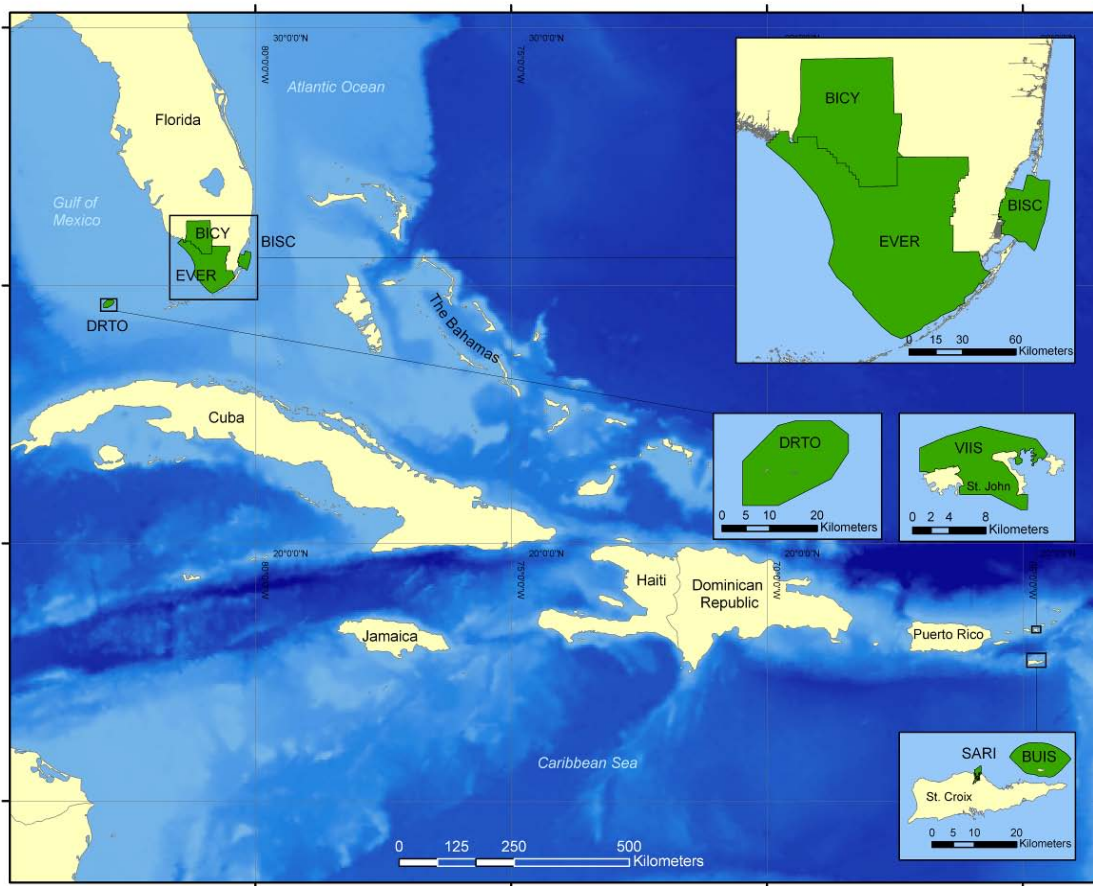


Figure 1. South Florida/Caribbean Network parks.

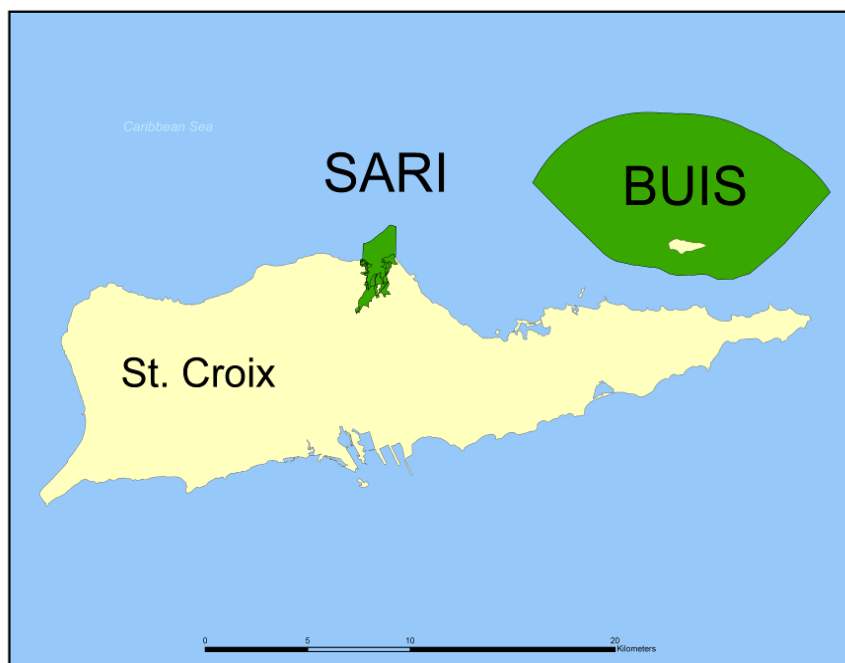


Figure 2. Salt River Bay National Historical Park & Ecological Preserve (SARI).

Salt River Bay National Historical Park & Ecological Preserve
Ownership Tracts as of March 2009

National Park Service
U.S. Department of the Interior

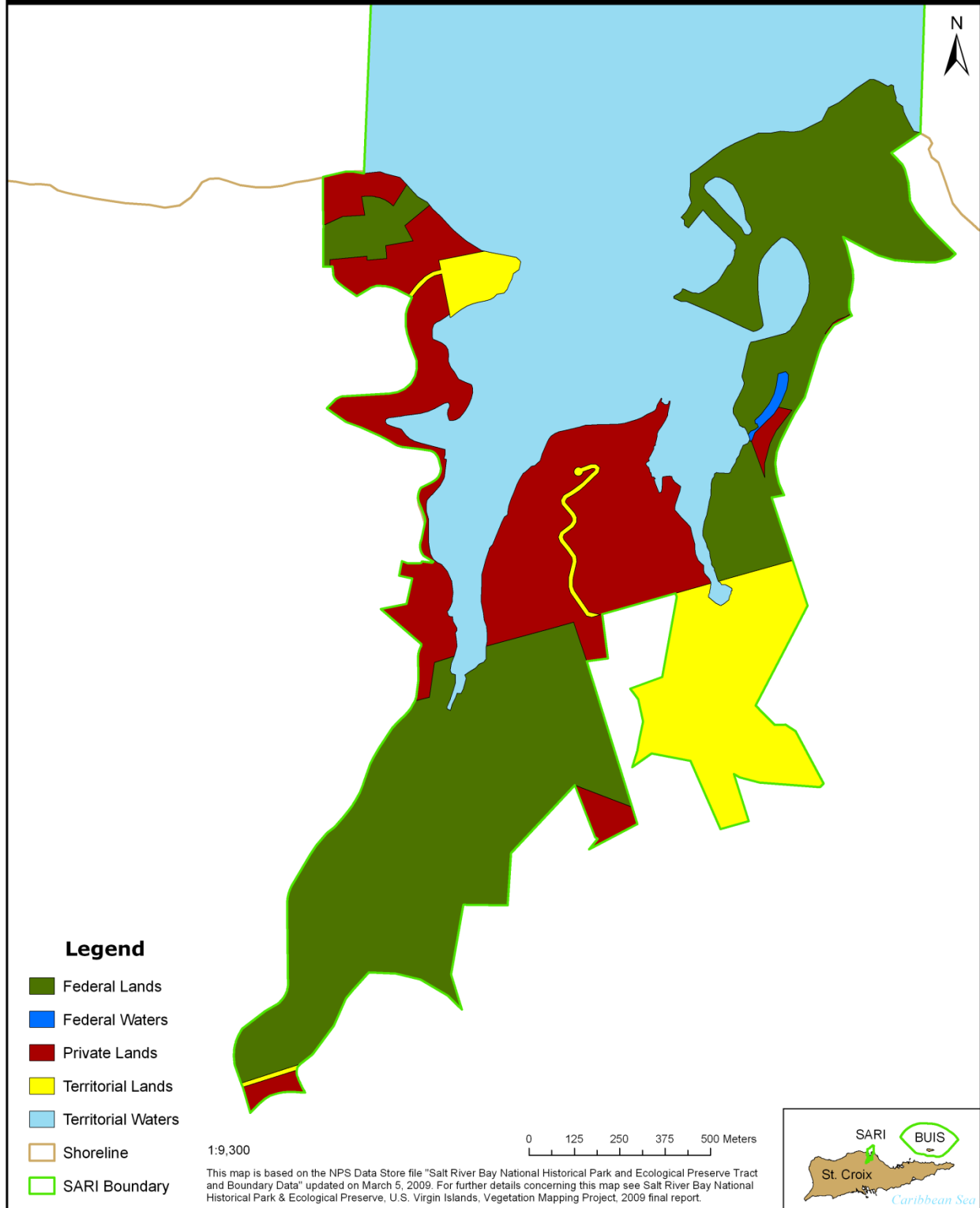


Figure 3. Salt River Bay National Historical Park & Ecological Preserve Ownership Tracts as of March 2009.



Figure 4. Map of vegetation polygons and field plots in Salt River Bay National Historical Park & Ecological Preserve.

Salt River Bay National Historical Park & Ecological Preserve Vegetation Map 2009

National Park Service
U.S. Department of the Interior

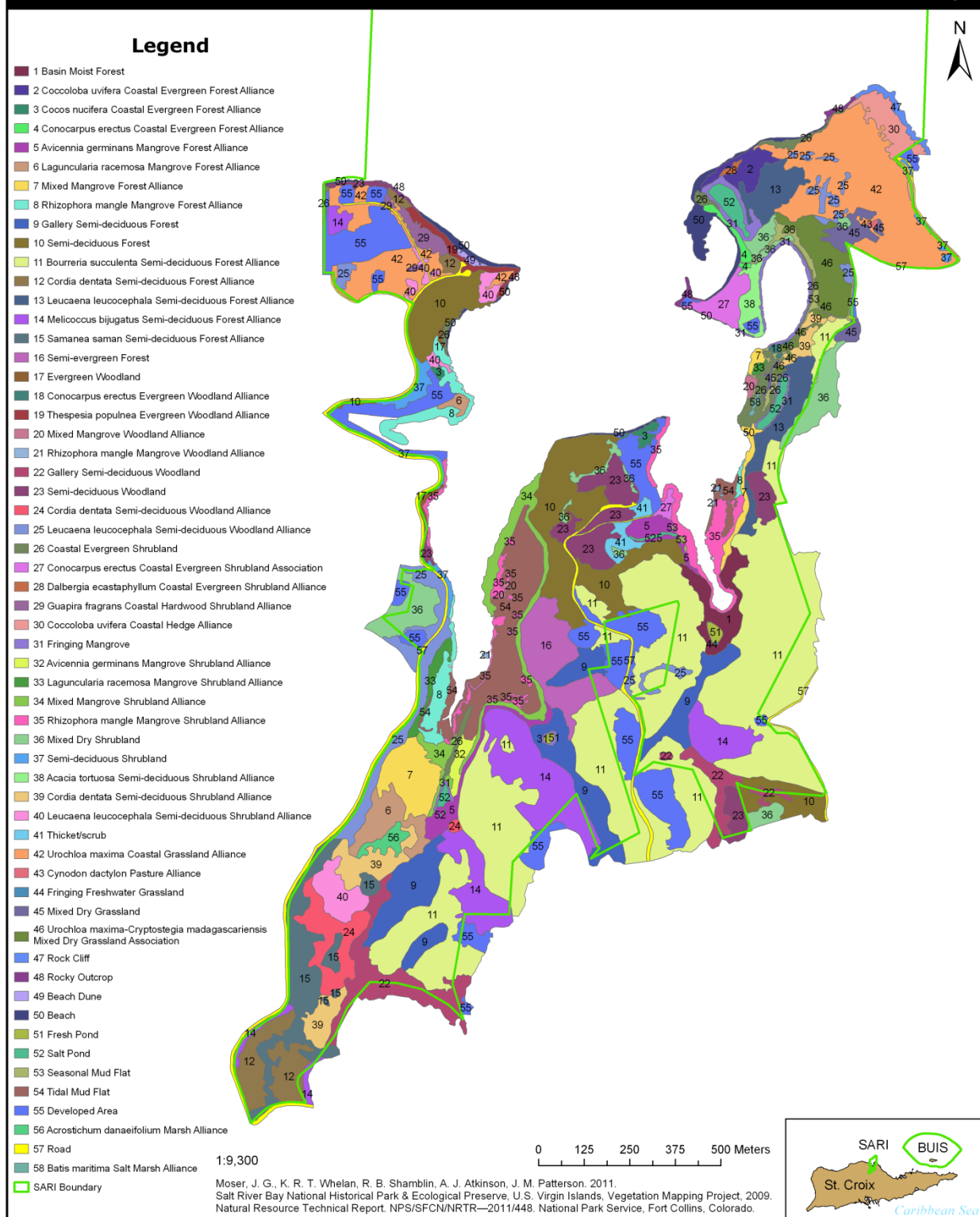


Figure 5. Map of classified vegetation polygons for Salt River Bay National Historical Park & Ecological Preserve.

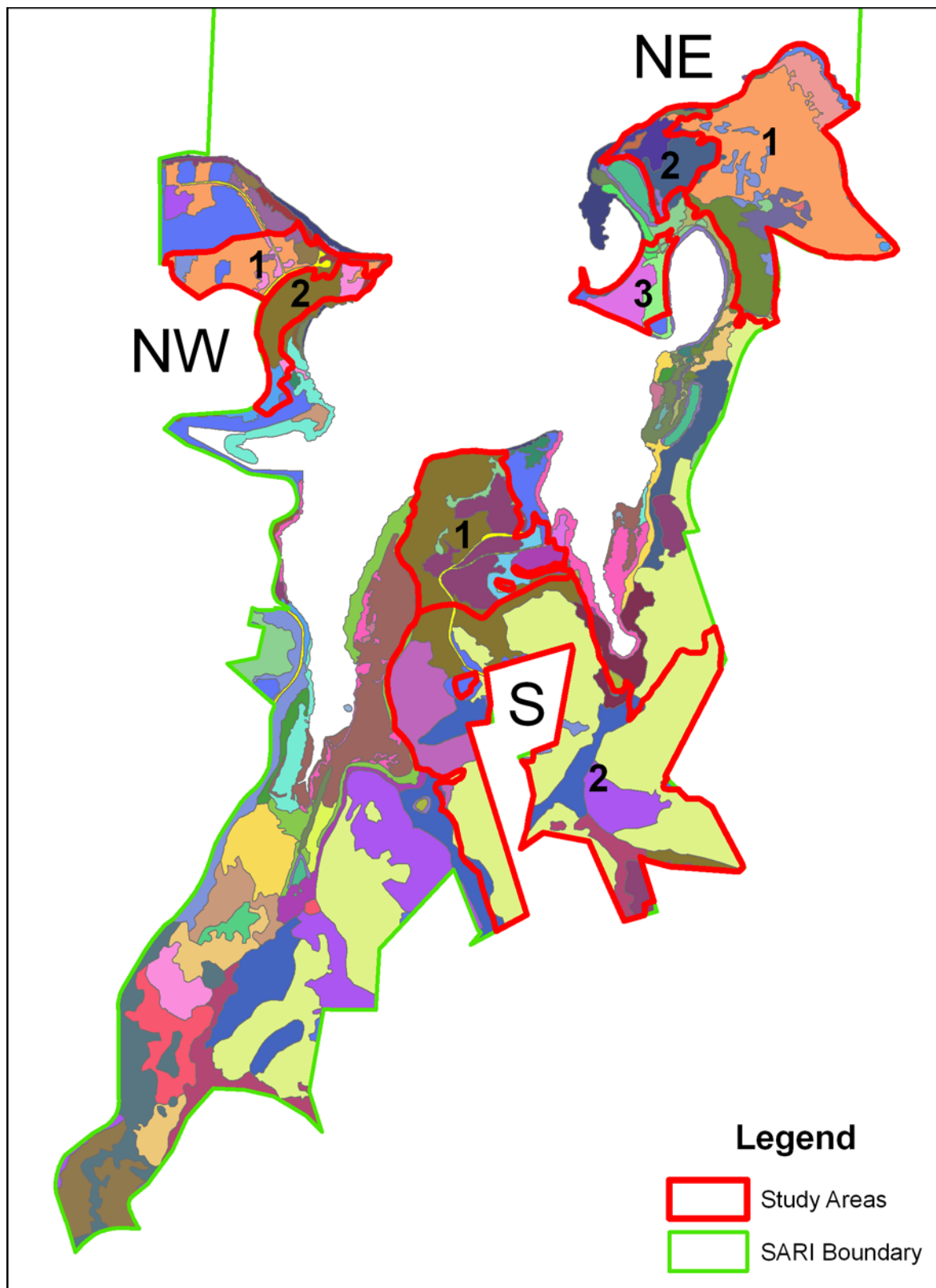


Figure 6. Northeast, Northwest, and South areas of the map chosen to compare vegetation classification among the UVI, NOAA, and NPS maps. The NPS map is shown above.

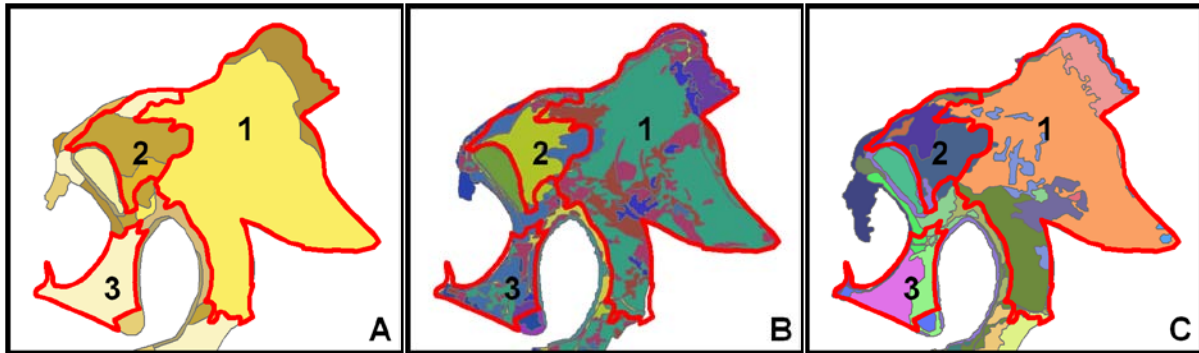


Figure 7. Northeast area of the UVI (A), NOAA (B), and NPS (C) maps. Sections 1-3 are shown.

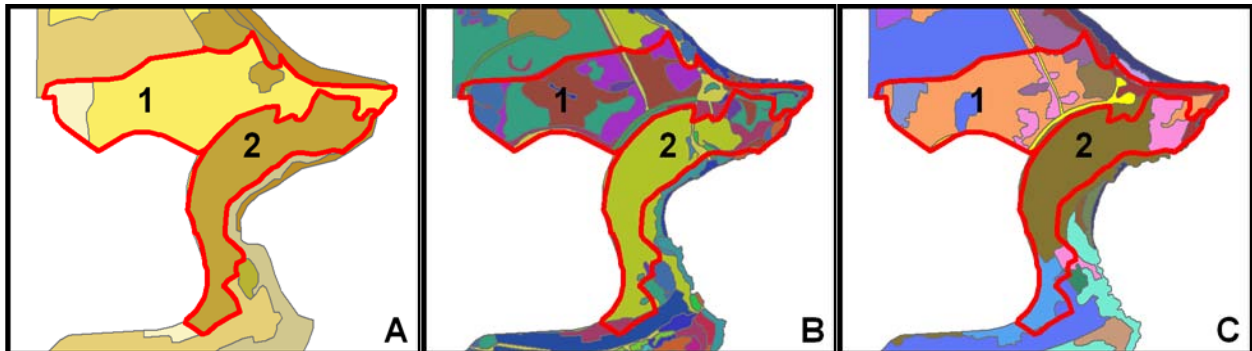


Figure 8. Northwest area of the UVI (A), NOAA (B), and NPS (C) maps. Sections 1 and 2 are shown.

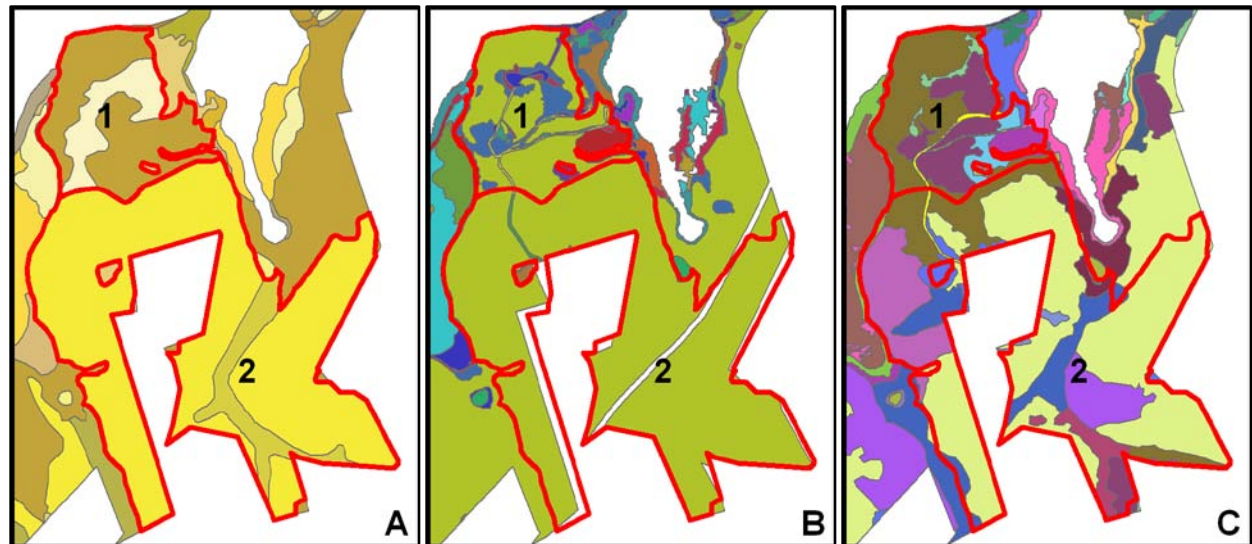


Figure 9. South area of the UVI (A), NOAA (B), and NPS (C) maps. Sections 1 and 2 are shown.

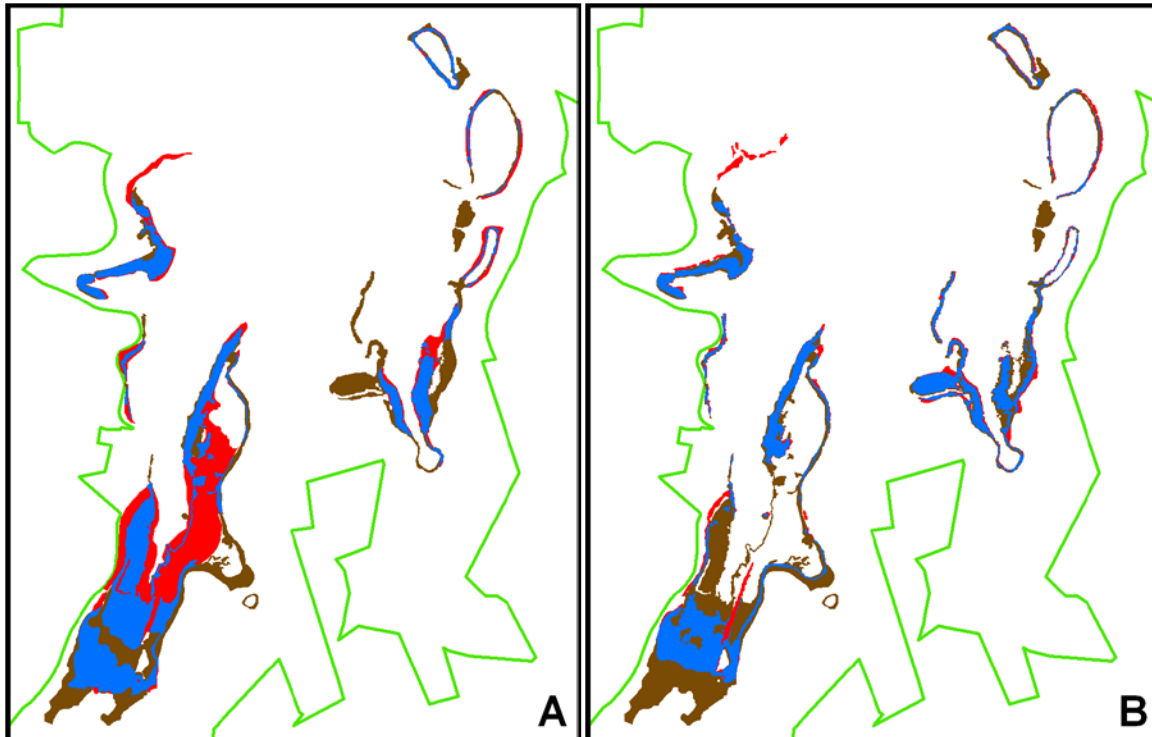


Figure 10. Comparison of mangrove areas in the NPS map to mangrove areas in the UVI map (A) and the NOAA map (B). Brown represents areas where only the NPS map classifies mangroves. Blue represents areas where both maps classify mangroves. Red represents areas where only the UVI (A) or NOAA (B) maps classify mangroves.

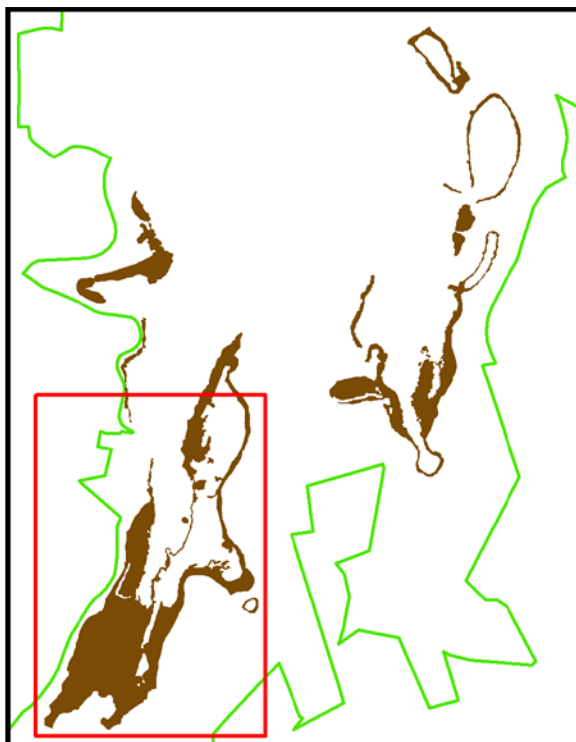


Figure 11. Majority of differences between the NPS map and the UVI and NOAA maps. Outlined in red is where most differences occurred. Mangrove areas from the NPS map are brown.

Table 1. Descriptions of Fields for Vegetation Field Plots.

Field Name	Description
IDENT	GPS mark number (ID)
Site_ID	Unique site ID
LAT	Latitude
LONG	Longitude
COMMENT	Date collected
ALTITUDE	Altitude in meters
MODEL	GPS unit model
GPS_Unit	GPS unit number
Field_Date	Date in Field; date data was collected in the field (year, month, day)
Xcoord	UTM easting
Ycoord	UTM northing
Site	NPS park acronym
Site_Description	Site Description; description of general area around GPS mark
Remarks	Main observer, general remarks, and interesting observations
Height	Average Height of Canopy; this is the average visual estimate of canopy height (in meters) at the site
Cover	Canopy Cover; percent (%); visual estimate; with overlap
Level_3	Community Type, Virgin Islands Sub-formations. See additional description. Forest: >5m in height, and >60% canopy cover Woodland: >5m in height, 25-50% canopy cover Shrubland: <5m in height, >25% canopy cover, <25% canopy cover of trees
Spp_1	Dominant species code in upper canopy of field plot or point. Note; six letter species codes were created using the first three letters of the genus and first three letters of the species name, and do not necessarily match ITIS species codes.
Spp_2	Dominant species code in upper canopy; if filled out is co-dominant
Spp_Additional	Additional species code found at site
Observer	Primary field observer
Num_Photos	Number of vegetation photos indicated on the data sheet
Num_Thumbsplus	Number of vegetation photos actually relating to the ThumbsPlus 7 [®] database
Hurr_Cover_B4	Canopy Cover Before Hurricane Omar; visual estimate of site canopy cover (%) as it may have been before Hurricane Omar
Hurr_Damage	Hurricane Omar Damage: See additional description; see Table 3
Height_Und	Average Height of Understory; this is the average visual estimate of understory height (in meters) at the site
Cover_Und	Understory Cover; percent (%); visual estimate; with overlap
Spp_1_Und	Dominant species code in understory of field plot or point
Spp_2_Und	Dominant species code in understory; if filled out is co-dominant
Strata	Area Description/Sub Strata; description of vegetation structure
Stage	Successional Stage; Early, Secondary, Late (climax)
Disturbance	Disturbance; recent; notes any detection of disturbance at site
Slope	Flat, moderate, or steep
Tree_Height	Canopy height of tree layer in meters
Tree_Cover	Canopy cover of tree layer in meters
Shrub_Height	Canopy height of shrub layer in meters
Shrub_Cover	Canopy cover of shrub layer in meters
Herb_Height	Canopy height of herb layer in meters
Herb_Cover	Canopy cover of herb layer in meters

Table 2. Additional Description of Community Type - Virgin Islands Sub-formations (Level_3).

Vegetation Physiognomic Class	Virgin Islands Sub-formation
Forest	Basin Moist Forest Coastal Evergreen Forest Mangrove Forest Gallery Semi-deciduous Forest Semi-deciduous Forest Semi-evergreen Forest
Woodland	Evergreen Woodland Mangrove Woodland Gallery Semi-deciduous Woodland Semi-deciduous Woodland
Shrubland	Coastal Evergreen Shrubland Coastal Hardwood Shrubland Coastal Hedge Fringing Mangrove Mangrove Shrubland Mixed Dry Shrubland Semi-deciduous Shrubland
Grassland	Thicket/scrub Coastal Grassland Pasture Fringing Freshwater Grassland Mixed Dry Grassland
Sparse Vegetation	Rock Cliff Rocky Outcrop Beach Dune Beach Fresh Pond Salt Pond Seasonal Mud Flat Tidal Mud Flat
Hierarchy Placement Undetermined	Developed Area Marsh Road Salt Marsh

Table 3. Additional Description of Hurricane Omar Damage.

Damage	Description
None	no obvious damage
Minor	leaf loss and small branches broken off
Moderate	about 50% of plants have major branch breaks
Severe	majority of plants have tip ups and major branch breaks*
Total Loss	extensive damage with most plants showing major branch breaks, tip ups, or trunk snaps**
*This category was only recorded once **This category was not observed	

Table 4. Descriptions of Fields for Polygons.

Field Name	Description
Level_1	Vegetation Physiognomic Class - most basic vegetation community description
Level_2	Caribbean Formation - further description built on Level_1 found in <i>A guide to Caribbean vegetation types: preliminary classification system and descriptions</i> by Areces-Mallea et al. (1999)
Level_3	Virgin Islands Sub-formation - further description built on Level_2 found in <i>U.S. Virgin Islands vegetation community classification: basic community descriptions – habitat mapping in support of land use and biodiversity planning in the Virgin Islands</i> by Gibney et al. (2000) with additions by SFCN
Level_4	Alliance/Association - further description built on Level_3, species Alliance/Association which include dominant species if applicable (using species codes) by SFCN
Level_4_L	Alliance/Association - further description built on Level_3, species Alliance/Association which include dominant species if applicable (using species scientific name) by SFCN
Acres	Area of polygon in acres
Num	Polygon number label
Num_L4	Polygon number label and Alliance/Association
Perim_mile	Perimeter of polygon in miles
Shape_Area	Area of polygon in square meters
Shape_Length	Perimeter of polygon in meters

Table 5. Vegetation Classification.

Vegetation Physiognomic Class

Caribbean Formation

Virgin Islands Sub-formation

Alliance/Association

I. FOREST

I.A.3.N.a. Lowland tropical/subtropical seasonal evergreen forest (Caribbean Formation)

1. Basin Moist Forest (Virgin Islands Sub-formation)
2. Coastal Evergreen Forest (Virgin Islands Sub-formation)
 - Coccoloba uvifera* Coastal Evergreen Forest Alliance
 - Cocos nucifera* Coastal Evergreen Forest Alliance
 - Conocarpus erectus* Coastal Evergreen Forest Alliance

I.A.5.N.e. Tidally flooded tropical/subtropical broad-leaved evergreen sclerophyllous forest (Caribbean Formation)

1. Mangrove Forest (Virgin Islands Sub-formation)
 - Avicennia germinans* Mangrove Forest Alliance
 - Laguncularia racemosa* Mangrove Forest Alliance
 - Mixed Mangrove Forest Alliance
 - Rhizophora mangle* Mangrove Forest Alliance

I.C.1.N.a. Lowland tropical/subtropical semi-deciduous forest (Caribbean Formation)

1. Gallery Semi-deciduous Forest (Virgin Islands Sub-formation)
2. Semi-deciduous Forest (Virgin Islands Sub-formation)
 - Bourreria succulenta* Semi-deciduous Forest Alliance
 - Cordia dentata* Semi-deciduous Forest Alliance
 - Leucaena leucocephala* Semi-deciduous Forest Alliance
 - Melicoccus bijugatus* Semi-deciduous Forest Alliance
 - Samanea saman* Semi-deciduous Forest Alliance
3. Semi-evergreen Forest (Virgin Islands Sub-formation)

II. WOODLAND

II.A.1.N.a. Tropical/subtropical broad-leaved evergreen woodland (Caribbean Formation)

1. Evergreen Woodland (Virgin Islands Sub-formation)
 - Conocarpus erectus* Evergreen Woodland Alliance
 - Thespesia populnea* Evergreen Woodland Alliance

II.A.1.N.e. Tidally flooded tropical/subtropical broad-leaved evergreen woodland (Caribbean Formation)

1. Mangrove Woodland (Virgin Islands Sub-formation)
 - Mixed Mangrove Woodland Alliance
 - Rhizophora mangle* Mangrove Woodland Alliance

II.C.1.N.a. Tropical/subtropical semi-deciduous woodland (Caribbean Formation)

1. Gallery Semi-deciduous Woodland (Virgin Islands Sub-formation)
2. Semi-deciduous Woodland (Virgin Islands Sub-formation)
 - Cordia dentata* Semi-deciduous Woodland Alliance
 - Leucaena leucocephala* Semi-deciduous Woodland Alliance

III. SHRUBLAND

III.A.1.N.b. Tropical/subtropical broad-leaved evergreen shrubland (Caribbean Formation)

1. Coastal Evergreen Shrubland (Virgin Islands Sub-formation)
 - Conocarpus erectus* Coastal Evergreen Shrubland Association
 - Dalbergia ecastaphyllum* Coastal Evergreen Shrubland Alliance
2. Coastal Hardwood Shrubland (Virgin Islands Sub-formation)
 - Guapira fragrans* Coastal Hardwood Shrubland Alliance
3. Coastal Hedge (Virgin Islands Sub-formation)
 - Coccoloba uvifera* Coastal Hedge Alliance

III.A.1.N.g. Semi-permanently flooded tropical or subtropical broad-leaved evergreen shrubland (Caribbean Formation)

1. Fringing Mangrove (Virgin Islands Sub-formation)

III.A.1.N.h. Tidally flooded tropical or subtropical broad-leaved evergreen shrubland (Caribbean Formation)

1. Mangrove Shrubland (Virgin Islands Sub-formation)
 - Avicennia germinans* Mangrove Shrubland Alliance
 - Laguncularia racemosa* Mangrove Shrubland Alliance

- Mixed Mangrove Shrubland Alliance
 - Rhizophora mangle* Mangrove Shrubland Alliance
 - III.B.1.N.a. Lowland drought deciduous shrubland (Caribbean Formation)
 - 1. Mixed Dry Shrubland (Virgin Islands Sub-formation)
 - 2. Semi-deciduous Shrubland (Virgin Islands Sub-formation)
 - Acacia tortuosa* Semi-deciduous Shrubland Alliance
 - Cordia dentata* Semi-deciduous Shrubland Alliance
 - Leucaena leucocephala* Semi-deciduous Shrubland Alliance
 - 3. Thicket/scrub (Virgin Islands Sub-formation)
- V. GRASSLAND
 - V.A.1.N.a. Tall tropical/subtropical grassland (Caribbean Formation)
 - 1. Coastal Grassland (Virgin Islands Sub-formation)
 - Urochloa maxima* Coastal Grassland Alliance
 - V.A.1.N.d. Short sod tropical/subtropical grassland (Caribbean Formation)
 - 1. Pasture (Virgin Islands Sub-formation)
 - Cynodon dactylon* Coastal Grassland Alliance
 - V.A.1.N.h. Semi-permanently flooded tropical/subtropical grassland (Caribbean Formation)
 - 1. Fringing Freshwater Grassland (Virgin Islands Sub-formation)
 - V.A.2.N.a. Tall tropical/subtropical grassland with mainly broad-leaved evergreen trees (Caribbean Formation)
 - 1. Mixed Dry Grassland (Virgin Islands Sub-formation)
 - Urochloa maxima*-*Cryptostegia madagascariensis* Mixed Dry Grassland Association
- VII. SPARSE VEGETATION
 - VII.A.1.N.a. Cliffs with sparse vascular vegetation (Caribbean Formation)
 - 1. Rock Cliff (Virgin Islands Sub-formation)
 - VII.B.2.N.a. Boulder field vegetation (Caribbean Formation)
 - 1. Rocky Outcrop (Virgin Islands Sub-formation)
 - VII.C.1.N.a. Dunes with sparse herbaceous vegetation (Caribbean Formation)
 - 1. Beach Dune (Virgin Islands Sub-formation)
 - VII.C.2.N.b. Intermittently flooded sand beaches and shores (Caribbean Formation)
 - 1. Beach (Virgin Islands Sub-formation)
 - VII.C.4.N.b. Intermittently flooded mud flat (Caribbean Formation)
 - 1. Fresh Pond (Virgin Islands Sub-formation)
 - 2. Salt Pond (Virgin Islands Sub-formation)
 - VII.C.4.N.c. Seasonally/temporarily flooded mud flat (Caribbean Formation)
 - 1. Seasonal Mud Flat (Virgin Islands Sub-formation)
 - VII.C.4.N.d. Tidally flooded mud flat (Caribbean Formation)
 - 1. Tidal Mud Flat (Virgin Islands Sub-formation)
- XX. HIERARCHY PLACEMENT UNDETERMINED
 - XX. Hierarchy Placement Undetermined
 - 1. Developed Area (Virgin Islands Sub-formation)
 - 2. Marsh (Virgin Islands Sub-formation)
 - Acrostichum danaeifolium* Marsh Alliance
 - 3. Road (Virgin Islands Sub-formation)
 - 4. Salt Marsh (Virgin Islands Sub-formation)
 - Batis maritima* Salt Marsh Alliance

Table 6. Vegetation mapping class statistics.

Vegetation Class	Number of Polygons	Total Area (acres)	Number of Plots Sampled	Average Area (acres)	Minimum Area (acres)	Maximum Area (acres)
1 Basin Moist Forest	1	4.7	1	4.7	4.7	4.7
2 <i>Coccoloba uvifera</i> Coastal Evergreen Forest Alliance	1	2.6	2	2.6	2.6	2.6
3 <i>Cocos nucifera</i> Coastal Evergreen Forest Alliance	2	0.9	0	0.4	0.2	0.7
4 <i>Conocarpus erectus</i> Coastal Evergreen Forest Alliance	2	0.9	1	0.5	0.11	0.8
5 <i>Avicennia germinans</i> Mangrove Forest Alliance	4	4.7	3	1.2	0.2	2.7
6 <i>Laguncularia racemosa</i> Mangrove Forest Alliance	2	5.1	2	2.5	0.6	4.4
7 Mixed Mangrove Forest Alliance	3	7.9	4	2.6	0.4	6.0
8 <i>Rhizophora mangle</i> Mangrove Forest Alliance	3	6.5	6	2.2	0.2	3.3
9 Gallery Semi-deciduous Forest	5	21.1	5	4.2	1.6	6.5
10 Semi-deciduous Forest	5	29.4	5	5.9	0.3	13.4
11 <i>Bourreria succulenta</i> Semi-deciduous Forest Alliance	11	103.6	23	9.4	0.3	35.7
12 <i>Cordia dentata</i> Semi-deciduous Forest Alliance	4	8.5	2	2.1	0.4	4.0
13 <i>Leucaena leucocephala</i> Semi-deciduous Forest Alliance	2	9.5	6	4.8	4.3	5.2
14 <i>Melicoccus bijugatus</i> Semi-deciduous Forest Alliance	6	24.8	5	4.1	0.5	12.0
15 <i>Samanea saman</i> Semi-deciduous Forest Alliance	5	12.1	4	2.4	0.09	10.5
16 Semi-evergreen Forest	1	9.7	3	9.7	9.7	9.7
17 Evergreen Woodland	2	0.6	0	0.3	0.13	0.5
18 <i>Conocarpus erectus</i> Evergreen Woodland Alliance	2	0.3	1	0.13	0.05	0.2
19 <i>Thespesia populnea</i> Evergreen Woodland Alliance	1	1.8	1	1.8	1.8	1.8
20 Mixed Mangrove Woodland Alliance	3	0.5	1	0.2	0.07	0.3
21 <i>Rhizophora mangle</i> Mangrove Woodland Alliance	4	0.2	0	0.04	0.01	0.06
22 Gallery Semi-deciduous Woodland	4	12.8	1	3.2	0.2	9.1
23 Semi-deciduous Woodland	8	12.1	1	1.5	0.4	2.8
24 <i>Cordia dentata</i> Semi-deciduous Woodland Alliance	2	6.3	1	3.1	0.3	6.0
25 <i>Leucaena leucocephala</i> Semi-deciduous Woodland Alliance	13	11.2	8	0.9	0.08	4.8
26 Coastal Evergreen Shrubland	12	4.5	7	0.4	0.02	1.7
27 <i>Conocarpus erectus</i> Coastal Evergreen Shrubland Association	2	3.5	3	1.8	0.6	2.9
28 <i>Dalbergia ecastaphyllum</i> Coastal Evergreen Shrubland Alliance	1	0.3	1	0.3	0.3	0.3
29 <i>Guapira fragrans</i> Coastal Hardwood Shrubland Alliance	3	1.8	2	0.6	0.13	1.5
30 <i>Coccoloba uvifera</i> Coastal Hedge Alliance	1	3.8	1	3.8	3.8	3.8
31 Fringing Mangrove	6	3.5	3	0.6	0.1	1.5
32 <i>Avicennia germinans</i> Mangrove Shrubland Alliance	1	1.1	1	1.1	1.1	1.1

Vegetation Class	Number of Polygons	Total Area (acres)	Number of Plots Sampled	Average Area (acres)	Minimum Area (acres)	Maximum Area (acres)
33 <i>Laguncularia racemosa</i> Mangrove Shrubland Alliance	2	1.6	3	0.8	0.2	1.4
34 Mixed Mangrove Shrubland Alliance	2	7.4	6	3.7	1.6	5.8
35 <i>Rhizophora mangle</i> Mangrove Shrubland Alliance	14	7.6	4	0.5	0.04	4.3
36 Mixed Dry Shrubland	12	12.5	1	1.0	0.05	4.3
37 Semi-deciduous Shrubland	7	3.3	0	0.5	0.06	1.6
38 <i>Acacia tortuosa</i> Semi-deciduous Shrubland Alliance	1	2.0	1	2.0	2.0	2.0
39 <i>Cordia dentata</i> Semi-deciduous Shrubland Alliance	5	7.8	4	1.6	0.04	3.9
40 <i>Leucaena leucocephala</i> Semi-deciduous Shrubland Alliance	7	5.5	4	0.8	0.03	3.5
41 Thicket/scrub	2	1.8	0	0.9	0.5	1.3
42 <i>Urochloa maxima</i> Coastal Grassland Alliance	5	32.1	9	6.4	0.4	23.7
43 <i>Cynodon dactylon</i> Pasture Alliance	1	0.11	1	0.11	0.11	0.11
44 Fringing Freshwater Grassland	1	0.04	0	0.04	0.04	0.04
45 Mixed Dry Grassland	4	3.3	3	0.8	0.17	2.1
46 <i>Urochloa maxima</i> - <i>Cryptostegia madagascariensis</i> Mixed Dry Grassland Association	6	7.0	1	1.2	0.08	6.1
47 Rock Cliff	1	1.2	0	1.2	1.2	1.2
48 Rocky Outcrop	4	0.9	0	0.2	0.05	0.3
49 Beach Dune	1	0.3	0	0.3	0.3	0.3
50 Beach	8	4.8	0	0.6	0.02	3.1
51 Fresh Pond	2	0.6	0	0.3	0.15	0.4
52 Salt Pond	5	3.0	0	0.6	0.01	1.5
53 Seasonal Mud Flat	4	2.1	0	0.5	0.03	2.0
54 Tidal Mud Flat	4	15.3	5	3.8	0.2	12.3
55 Developed Area	21	33.6	1	1.6	0.16	6.0
56 <i>Acrostichum danaeifolium</i> Marsh Alliance	1	1.4	2	1.4	1.4	1.4
57 Road	4	10.1	0	2.5	0.6	6.5
58 <i>Batis maritima</i> Salt Marsh Alliance	1	0.2	1	0.2	0.2	0.2
Total	247	481.9	150			

Table 7. Comparison among NPS, NOAA, and UVI Salt River Bay National Historical Park & Ecological Preserve maps.

	NPS map	NOAA map	UVI map
Year of imagery	2006-2007	2000	1994
Terrestrial polygons within park boundary	244	450	111
Mapping classes	58	26	22

Table 8. Comparison of major mapping classes among NPS, NOAA, and UVI Salt River Bay National Historical Park & Ecological Preserve maps for dominant vegetation type.

Area	Section	NPS	NOAA	UVI
Northeast	1	<i>Urochloa maxima</i> Coastal Grassland Alliance	Land Natural & Semi-Natural Areas Vegetated	Mixed grassland
	2	<i>Leucaena leucocephala</i> Semi-deciduous Forest Alliance <i>Coccoloba uvifera</i> Coastal Evergreen Forest Alliance	Forest/Trees, Closed: >65% canopy coverage Forest/Trees, Open: 15%-65% canopy coverage	Thicket scrub Semi-deciduous woodland Mixed dry shrubland
	3	<i>Conocarpus erectus</i> Coastal Evergreen Shrubland Association <i>Acacia tortuosa</i> Semi-deciduous Shrubland Alliance	Forest/Trees, Open: 15%-65% canopy coverage Land Natural & Semi-Natural Areas Vegetated	Mixed dry shrubland
Northwest	1	<i>Urochloa maxima</i> Coastal Grassland Alliance	Shrubs/Bushes Sparse: 1%-15% canopy coverage Land Natural & Semi-Natural Areas Vegetated Forest/Trees, Sparse: 1%-15% canopy coverage	Mixed grassland Mixed dry shrubland
	2	Semi-deciduous Forest	Forest/Trees, Closed: >65% canopy coverage	Thicket scrub
South	1	Semi-deciduous Forest Semi-deciduous Woodland	Forest/Trees, Closed: >65% canopy coverage Forest/Trees, Open: 15%-65% canopy coverage	Thicket scrub Mixed dry shrubland
	2	<i>Bourreria succulenta</i> Semi-deciduous Forest Alliance	Forest/Trees, Closed: >65% canopy coverage	Semi-deciduous forest
Mangrove Areas		Mixed Mangrove Forest Alliance <i>Rhizophora mangle</i> Mangrove Shrubland Alliance Mixed Mangrove Shrubland Alliance <i>Rhizophora mangle</i> Mangrove Forest Alliance <i>Laguncularia racemosa</i> Mangrove Forest Alliance <i>Avicennia germinans</i> Mangrove Forest Alliance Fringing Mangrove <i>Laguncularia racemosa</i> Mangrove Shrubland Alliance <i>Avicennia germinans</i> Mangrove Shrubland Alliance Mixed Mangrove Woodland Alliance <i>Rhizophora mangle</i> Mangrove Woodland Alliance	Mangrove <i>Avicennia germinans</i> , Closed: >65% canopy cover Mangrove <i>Rhizophora mangle</i> , Closed: >65% canopy cover Mangrove <i>Avicennia germinans</i> , Open: 15%-65% canopy coverage Mangrove <i>Rhizophora mangle</i> , Open: 15%-65% canopy coverage Mangrove <i>Avicennia germinans</i> , Sparse: 1%-15% canopy coverage Mangrove <i>Laguncularia racemosa</i> , Open: 15%-65% canopy coverage Mangrove Mixed, Open: 15%-65% canopy coverage Mangrove <i>Rhizophora mangle</i> , Sparse: 1%-15% canopy coverage Mangrove Mixed, Closed: >65% canopy cover	Mangrove shrubland Mangrove forest Fringing mangrove Mangrove woodland

Table 9. Salt River Bay National Historical Park & Ecological Preserve vegetation mapping projects products, file descriptions, and filenames. Naming conventions and required files follow guidelines from the NPS Vegetation Mapping Inventory Program.

Category	Product or File Description	Filename
Aerial Photography	Orthophoto graphic Self extracting file containing spatial orthophoto data	sariortho.pdf sariortho.zip
Vegetation Information	Project report (contains full report about the vegetation map including funding source, background information, methods and results, final product specifications, brief description of products and files, vegetation classification and key, photos of map classes, species list from plots, and example field data sheets)	sarirpt.pdf sarirpt_pressquality.pdf
Field Data	Graphic showing location of field sites MS Excel format of Plot data MS Excel format of Species List Data for Plots Field plot photos (photos named using Site_ID, GPS_Unit, and Field_Date fields in plots.xls, i.e., <u>Site ID GPS Unit Field Date Photo Number...</u>)	sariplots.pdf plots.xls sp_cov.xls field_photos.zip
Geospatial Vegetation Information	Zip folder containing geodatabase (sari.mdb) of spatial data (includes data for vegetation polygons, field plot points and data, park boundary, and shoreline) ESRI ArcMap Project file – displays geodatabase (MDB) files Graphic of vegetation communities (low resolution) Graphic of vegetation communities (high resolution) Although use of the geodatabase and ArcMap Project File is recommended, individual shapefiles are also included as zip files: Vegetation polygons Vegetation plots Park boundary Shoreline	sari.zip sari_veg_project.mxd sari.pdf sari_large.pdf sari_vegetation_polygons.zip sari_vegetation_plots.zip sari_boundary.zip sari_shoreline.zip
Accuracy Assessment Information	<i>(Not applicable)</i>	
Project Metadata	Aerial photo metadata Field plots metadata Spatial vegetation metadata Park boundary metadata Shoreline metadata	metasariortho.txt metasarifield.txt metasarispatial.txt metasaribdy.txt metasarishl.txt

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Appendix A: Vegetation Classification (includes Vegetation Key and Class Descriptions)

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Disclaimer

Vegetation species listed were observed while surveying vegetation plots in the Salt River Bay area. The listed species represent only a subset of the common species found on Salt River Bay National Historical Park & Ecological Preserve, and do not represent a complete inventory for a polygon or community.

I. FOREST

Forest types are characterized by a closed tree canopy and canopy cover that is greater than 60%. Trees are greater than 5m in height.

I.A.3.N.a. Lowland tropical/subtropical seasonal evergreen forest (Caribbean Formation)

1. Basin Moist Forest (Virgin Islands Sub-formation) – “These forests are found in basins and lowland areas, generally along the coast, where runoff from large upland watersheds collects. These forest types are well represented on all the Virgin Islands. The basin forest emergent species may reach 25m or more and the forest is normally comprised of 3 synusia. A continuous canopy is formed at 15-18m and a lower layer at 5-10m. A lower shrub layer may be common or moderately well developed. Herbs and vines are found in significant numbers in a well-developed community. Epiphytes and ferns are rare” (Gibney *et al.* 2000).

2. Coastal Evergreen Forest (Virgin Islands Sub-formation) – This vegetation cover type occurs as very small patches on steep northern slopes at low elevations. It is found on all three islands and on some of the offshore cays where landscape modifications have taken place. In a number of locations it may occur as a coconut palm woodland in basin or coastal areas.

***Coccoloba uvifera* Coastal Evergreen Forest Alliance**

Name, translated: Sea Grape Evergreen Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Evergreen forest found near the coast and dominated by the evergreen tree *Coccoloba uvifera* (Sea Grape). Other species associated with habitat include *Conocarpus erectus*, *Acacia tortuosa*, *Croton rigidus*, *Corchorus hirsutus*, and the exotic trees *Leucaena leucocephala* and *Terminalia cattapa*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

This habitat is found in coastal communities along the shore or behind beaches.

Plots: 011-O_3_20090112, 010_3_20090112

***Cocos nucifera* Coastal Evergreen Forest Alliance**

Name, translated: Coconut Palm Evergreen Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Evergreen forest dominated by the exotic tree species *Cocos nucifera* (Coconut Palm). These trees are usually planted as ornamentals and fruit trees and may form dense monospecific stands.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

This habitat is found inland from the mangrove zone near the marina.

Plots: None

***Conocarpus erectus* Coastal Evergreen Forest Alliance**

Name, translated: Buttonwood Coastal Evergreen Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Coastal Evergreen Forest dominated by *Conocarpus erectus*. This community has a closed tree canopy cover with very little understory herbaceous cover. Other woody species include *Hippomane mancinella*, *Thespesia populnea*, *Pithecellobium unguis-cati*, and the introduced *Leucaena leucocephala*, and *Yucca aloifolia*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found along the coast in the northern areas of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 123_3_20090720

I.A.5.N.e. Tidally flooded tropical/subtropical broad-leaved evergreen sclerophyllous forest (Caribbean Formation)

1. Mangrove Forest (Virgin Islands Sub-formation) – “Mangrove forests dominated by *Rhizophora mangle* and other mangrove species exhibiting a closed tree canopy” (Gibney *et al.* 2000).

***Avicennia germinans* Mangrove Forest Alliance**

Name, translated: Black Mangrove Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Mangrove forest community dominated by *Avicennia germinans* (Black Mangrove). Other overstory species associated with this community include *Laguncularia racemosa*, *Conocarpus erectus*, *Rhizophora mangle*, *Cordia dentata*, *Acacia macracantha* and the exotic tree *Thespesia populnea*. This community may exhibit an understory component consisting of *Acrostichum danaeifolium*, *Sesuvium portulacastrum*, and the exotic *Cyperus involucratus*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in low lying coastal areas affected by tidal inundation. Usually found behind the Red mangrove communities.

Plots: 140_3_20090721, 143_3_20090721, 145_3_20090721

***Laguncularia racemosa* Mangrove Forest Alliance**

Name, translated: White Mangrove Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

A generally species poor Mangrove Forest habitat dominated by *Laguncularia racemosa*. Other characteristic species include *Rhizophora mangle*, and *Acrostichum danaeifolium*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in low lying coastal areas with periodic tidal inundation.

Plots: 058_3_20090115, 343_1_20090722

Mixed Mangrove Forest Alliance

Name, translated: Mixed Mangrove Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Mixed mangrove forest could be comprised of *Avicennia germinans*, *Laguncularia racemosa*, and *Rhizophora mangle* with no single dominant species, but does not need all three species to be present. Other characteristic species may include *Conocarpus erectus*, *Sesuvium portulacastrum*, and the exotic tree *Thespesia populnea*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in low lying coastal areas with periodic tidal inundation.

Plots: 104_3_20090720, 112_3_20090720, 146_3_20090721, 147_3_20090721

***Rhizophora mangle* Mangrove Forest Alliance**

Name, translated: Red Mangrove Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Mangrove forest dominated by *Rhizophora mangle*. This community may appear as a monoculture, or have a minor component consisting of *Laguncularia racemosa*, *Avicennia germinans*, and/or the exotic tree *Thespesia populnea*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in low lying coastal areas with periodic tidal inundation.

Plots: 057_3_20090115, 202-P15_20090115, 323_1_20090721, 324_1_20090721, 326_1_20090721, 329_1_20090721

I.C.1.N.a. Lowland tropical/subtropical semi-deciduous forest (Caribbean Formation)

1. Gallery Semi-deciduous Forest (Virgin Islands Sub-formation) – “This vegetation type is limited to the smaller riparian corridors such as ravines, guts and intermittent streams found within dry forest watersheds. Additional moisture is available to the vegetation as a result of runoff. The taller dry forest species find their maximum height in these locations. Shrub and herb community development are variable” (Gibney *et al.* 2000).

2. Semi-deciduous Forest (Virgin Islands Sub-formation) – “Throughout the Virgin Islands, this is the dominant forest cover. On St. John, well over 50% of the island is vegetated with this cover type. A large percentage of the remaining undeveloped land on St. Thomas and a majority of the small quantity of remaining forest on northwestern hill slopes on St. Croix are classified as this forest type. This forest group contains a number of fairly distinct forest types, which vary in physiognomy, composition and in degree of human modification. In most cases these forests may be found on north facing hillsides of all main islands, upper southern facing elevations below 250m, in basins without large watersheds, along smaller guts and ravines and mixed with dry deciduous forests on lower south facing slopes” (Gibney *et al.* 2000).

***Bourreria succulenta* Semi-deciduous Forest Alliance**

Name, translated: Pigeonberry Semi-deciduous Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

A diverse semi-deciduous forest community dominated by *Bourreria succulenta*.

Other characteristic species include *Capparis flexuosa*, *Capparis indica*, *Erythroxylum brevipes*, *Eugenia biflora*, *Bursera simaruba*, *Comocladia dodonaea*, and *Acacia tortuosa*. This habitat may also include exotic species such as *Leucaena leucocephala*, *Triphasia trifoliata*, and *Melicoccus bijugatus*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found primarily on northwestern hillsides, but may also be found on coastal uplands. These coastal upland communities are generally disturbed and exhibit higher concentrations of exotic species.

Plots: 066_3_20090116, 101_1_20081024, 102_1_20081024, 102-O_1_20081024, 107_1_20081024, 108_1_20081024, 112_1_20081024, 114_1_20081024, 124_3_20090721, 129_3_20090721, 130_3_20090721, 131_3_20090721, 132_3_20090721, 156_3_20090723, 302_1_20090720, 303_1_20090720, 306_1_20090720, 307_1_20090720, 309_1_20090720, 310_1_20090720, 311_1_20090720, 312_1_20090720, 313-O_1_20090720

***Cordia dentata* Semi-deciduous Forest Alliance**

Name, translated: White Manjack Semi-deciduous Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

A usually dense, disturbed, and almost impenetrable forest dominated by *Cordia dentata*. Due to the disturbed nature of this habitat, there is a high concentration of exotic species such as *Melicoccus bijugatus*, *Leucaena leucocephala*, *Tecoma stans*, and *Sansevieria hyacinthoides*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in low lying, usually coastal areas.

Plots: 047_3_20090115, 150_3_20090722

***Leucaena leucocephala* Semi-deciduous Forest Alliance**

Name, translated: Tan Tan Semi-deciduous Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

A disturbed habitat dominated by the exotic tree *Leucaena leucocephala*. Due to the disturbed nature of this habitat, there is a high concentration of exotic species such as *Terminalia cattapa*, *Cocos nucifera*, *Triphasia trifoliata*, and *Yucca aloifolia*. At the northern areas of Salt River Bay National Historical Park & Ecological Preserve this community may have a dense understory of *Urochloa maxima*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in disturbed areas along roadsides and in open fields of guinea grass at the northern areas of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 007_1_20090112, 013_3_20090112, 109_3_20090720, 113_1_20081024, 113_3_20090720, 349_1_20090723

***Melicoccus bijugatus* Semi-deciduous Forest Alliance**

Name, translated: Genip Semi-deciduous Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

A sometimes diverse semi-deciduous forest dominated by *Melicoccus bijugatus*.

Other species found in this community include *Bourreria succulenta*, *Guapira fragrans*, *Cordia dentata*, *Capparis indica*, *Eugenia biflora*, *Randia aculeata*, and exotic species such as *Leucaena leucocephala*, *Triphasia trifoliata*, and *Urochloa maxima*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found usually on northwest facing hillsides and in valleys between hills of central Salt River Bay National Historical Park & Ecological Preserve.

Plots: 052_3_20090115, 128_3_20090721, 144_3_20090721, 151_3_20090722, 305_1_20090720

***Samanea saman* Semi-deciduous Forest Alliance**

Name, translated: Licorice or Rain Tree Semi-deciduous Forest Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Semi-deciduous Forest dominated by the large exotic tree *Samanea saman*. A community dominated by these large trees with wide spreading branches, and usually exhibiting an open understory. Characteristic understory species include *Leucaena leucocephala*, *Cordia dentata*, and *Urochloa maxima*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found along the roadside in the southwestern region of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 153_3_20090722, 154_3_20090722, 341_1_20090722, 347_1_20090722

3. Semi-evergreen Forest (Virgin Islands Sub-formation) – “This forest cover type is very similar in distribution to the semi deciduous type and in many locations grades into it. It is generally found above 250m in elevation, on northwest facing slopes below moist forest levels. Species composition changes to include a shift toward a greater majority of evergreen species. This type is found on all three main islands, but to a greater degree on St. Thomas west end” (Gibney *et al.* 2000).

II. WOODLAND

Woodland types have low density stands of trees characterized by an open tree canopy and canopy cover is ~10-60%. Tree heights are greater than 5m.

II.A.1.N.a. Tropical/subtropical broad-leaved evergreen woodland (Caribbean Formation)

1. Evergreen Woodland (Virgin Islands Sub-formation) – “This vegetation cover type occurs as very small patches on steep northern slopes at low elevations. It is found on all three islands and on some of the offshore cays where landscape modifications have taken place. In a number of locations it may occur as a coconut palm woodland in basin or coastal areas” (Gibney *et al.* 2000).

***Conocarpus erectus* Evergreen Woodland Alliance**

Name, translated: Buttonwood Evergreen Woodland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Coastal woodland community dominated by *Conocarpus erectus*. Other species found in this community include *Laguncularia racemosa* and small percentages of the exotic shrub *Cryptostegia madagascariensis*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in coastal areas in the northeastern portion of Salt River Bay National Historical Park & Ecological Preserve. A transitional habitat from the mangrove community to a more upland community.

Plots: 103_3_20090720

***Thespesia populnea* Evergreen Woodland Alliance**

Name, translated: Seaside Mahoe Evergreen Woodland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Coastal woodland community dominated by the tree *Thespesia populnea*. Other characteristic species include *Coccoloba uvifera*. This community may have an understory of exotic grasses such as *Urochloa maxima* and *Botriochloa pertusa*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found along the coast in the northeastern portion of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 049_3_20090115

II.A.1.N.e. Tidally flooded tropical/subtropical broad-leaved evergreen woodland (Caribbean Formation)

1. Mangrove Woodland (Virgin Islands Sub-formation) – “Similar to a mangrove forest with a less dense association where the tree canopy is not closed. This woodland type lies at the shoreward extreme of the tidally flooded areas and may be dominated by *Avicennia germinans*, *Laguncularia racemosa*, *Rhizophora mangle*, and *Conocarpus erectus*.” (Gibney *et al.* 2000).

Mixed Mangrove Woodland Alliance

Name, translated: Mixed Mangrove Woodland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Mixed mangrove woodland could be comprised of *Avicennia germinans*, *Laguncularia racemosa*, and *Rhizophora mangle* with no single dominant species, but does not need all three species to be present.

Environment (Salt River Bay National Historical Park & Ecological Preserve): Found in coastal mangrove communities throughout Salt River Bay National Historical Park & Ecological Preserve.

Plots: 317_1_20090721

***Rhizophora mangle* Mangrove Woodland Alliance**

Name, translated: Red Mangrove Woodland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Mangrove woodland community dominated by *Rhizophora mangle*. May have a minor component of *Avicennia germinans*, *Laguncularia racemosa*, and *Thespesia populnea*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in coastal mangrove communities throughout Salt River Bay National Historical Park & Ecological Preserve.

Plots: None

II.C.1.N.a. Tropical/subtropical semi-deciduous woodland (Caribbean Formation)

1. Gallery Semi-deciduous Woodland (Virgin Islands Sub-formation) – St. Croix, as a result of extensive land clearing, may be the only island, which exhibits this cover type. It is primarily found in guts and ravines at low elevation and appears as strips of open canopy woodland where the guts pass through cleared areas (Gibney *et al.* 2000).

2. Semi-deciduous Woodland (Virgin Islands Sub-formation) – “Found primarily on abandoned agricultural land on St. Croix and also in central and eastern St. Thomas. The species composition is comprised mainly of common native and naturalized exotics. The size range varies considerably with past land use history and may range from 5-25 meters. Canopy cover is open, from 25 - 60% commonly. These areas are typically influenced by hurricane winds which reduce canopy cover temporarily” (Gibney *et al.* 2000).

***Cordia dentata* Semi-deciduous Woodland Alliance**

Name, translated: White Manjack Semi-deciduous Woodland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Coastal woodland community dominated by *Cordia dentata*. Other characteristic species include *Acacia macracantha*, *Capparis flexuosa*, *Tabebuia heterophylla*, *Tournefortia volubilis*, and the exotic tree *Leucaena leucocephala*. This community may develop a thick almost impenetrable understory of exotics consisting of *Cryptostegia madagascariensis*, and *Yucca aloifolia*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in coastal areas just upland of the mangrove communities of central and northeastern Salt River Bay National Historical Park & Ecological Preserve.
Plots: 133_3_20090721

***Leucaena leucocephala* Semi-deciduous Woodland Alliance**

Name, translated: Tan Tan Semi-deciduous Woodland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Woodland community dominated by the exotic tree *Leucaena leucocephala*. This is a widespread community generally found in areas of high disturbance. Due to the disturbed nature of this community, many species may be found within it.

Typical overstory species include *Capparis indica*, *Capparis flexuosa*, *Cordia dentata*, *Eugenia biflora*, *Piscidia carthagenensis*, and *Melicoccus bijugatus*.

Typical understory species include *Acacia tortuosa*, and the exotics *Yucca aloifolia*, *Sansaeveeria hyacinthoides*, and *Urochloa maxima*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found throughout Salt River Bay National Historical Park & Ecological Preserve.

Plots: 005_3_20090112, 054_3_20090115, 060_3_20090115, 115-O_3_20090720, 119_3_20090720, 148_3_20090721, 149-O_3_20090721, 301_1_20090720

III. SHRUBLAND

Shrubland types are usually characterized by a high density of small trees or shrubs with heights ranging from 0.5-5m.

III.A.1.N.b. Tropical/subtropical broad-leaved evergreen shrubland (Caribbean Formation)

1. Coastal Evergreen Shrubland (Virgin Islands Sub-formation) – Shrubland dominated by evergreen tree and shrub species located near the coast. This community may exhibit more than one stratum with the overstory consisting of salt adapted species such as *Coccoloba uvifera*, *Conocarpus erectus*, *Sideroxylon obovatum*, and *Pithecellobium unguis-cati*. Understory species include *Acacia tortuosa* and *Oplonia spinosa*.

***Conocarpus erectus* Coastal Evergreen Shrubland Association**

Name, translated: Buttonwood Shrubland Association

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Shrubland dominated by *Conocarpus erectus* (Buttonwood). Other characteristic shrub species include *Tabebuia heterophylla*, *Pithecellobium unguis-cati*, *Acacia tortuosa*, and *Jacquinia armillaris*. This community generally has an herbaceous ground cover component consisting of *Fimbristylis spathacea*, *Sporobolus indicus*, and *Sporobolus virginicus*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in coastal areas especially in the northeastern area of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 010_1_20090112, 014_3_20090112, 017_3_20090112

***Dalbergia ecastaphyllum* Coastal Evergreen Shrubland Alliance**

Name, translated: Coin Vine Coastal Evergreen Shrubland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Coastal Shrubland dominated by *Dalbergia ecastaphyllum*. This is a generally species poor habitat due to the thicket forming nature of the Coin vine. In some cases, low densities of shrubs such as *Acacia tortuosa* and *Coccoloba uvifera* may be present.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in coastal areas especially in the northeastern area of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 011_3_20090112

2. Coastal Hardwood Shrubland (Virgin Islands Sub-formation) – Shrublands dominated by tropical hardwood tree and shrub species which are in a shrub-like state due to proximity to coast. Harsh conditions of the coastal area such as salt spray and windy conditions prevent these species from reaching tree size.

***Guapira fragrans* Coastal Hardwood Shrubland Alliance**

Name, translated: Black Mampoo Coastal Hardwood Shrubland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Coastal hardwood Shrubland dominated by *Guapira fragrans*. Other characteristic hardwoods found in this community include *Bourreria succulenta*, *Capparis flexuosa*, *Cordia dentata*, *Croton rigidus*, *Eugenia biflora*, *Randia aculeata*, and the exotic tree *Leucaena leucocephala*. This community may have an herbaceous understory component consisting of *Urochloa maxima*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in coastal upland areas of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 337_1_20090722, 339_1_20090722

3. Coastal Hedge (Virgin Islands Sub-formation) – “Shaped by wind shear and salt spray, these dense patch communities can be very low growing (less than 1 meter) or as tall as 3 meters. They are generally found on east, southeast or northeast coastal areas with exposure to prevailing winds. The limited species are generally wind and salt adapted. The formation may occur on the berms of beaches, seaward of salt ponds and flats or above rocky coasts or pavement. Hedge effect from wind is the prevailing structural architect for the environment as almost all of the species found here are capable of greater height in less hostile environments. The severe environment causes plants to produce small, succulent leaves which can be highly cutinized” (Gibney *et al.* 2000).

***Coccoloba uvifera* Coastal Hedge Alliance**

Name, translated: Sea Grape Coastal Hedge Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Coastal hedge Shrubland dominated by dwarf *Coccoloba uvifera*. Other characteristic species include *Croton rigidus* and *Oplonia spinosa*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in northeast Salt River Bay National Historical Park & Ecological Preserve on rocky coastal berms.

Plots: 008_3_20090112

III.A.1.N.g. Semi-permanently flooded tropical or subtropical broad-leaved evergreen shrubland (Caribbean Formation)

1. Fringing Mangrove (Virgin Islands Sub-formation) – “Shoreline and salt pond vegetation which is semi-permanently and tidally flooded. These areas are quite common to all islands” (Gibney *et al.* 2000).

III.A.1.N.h. Tidally flooded tropical or subtropical broad-leaved evergreen shrubland (Caribbean Formation)

1. Mangrove Shrubland (Virgin Islands Sub-formation) – “Nontidal shrublands or scrub mangrove thickets dominated by *Rhizophora mangle*. Occurs in more stressed sites than mangrove forests and has shorter individuals (less than 5 meters and usually only one-half to two meters tall) and often sparser as well” (Gibney *et al.* 2000).

***Avicennia germinans* Mangrove Shrubland Alliance**

Name, translated: Black Mangrove Shrubland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Mangrove Shrubland dominated by *Avicennia germinans*. Due to the saline nature of this community, it is generally species poor. Other characteristic species include low densities of *Laguncularia racemosa*, *Thespesia populnea*, *Conocarpus erectus*, and *Acacia tortuosa*. This community may have an herbaceous understory component consisting of *Sesuvium portulacastrum*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in low lying coastal areas of central Salt River Bay National Historical Park & Ecological Preserve.

Plots: 142_3_20090721

***Laguncularia racemosa* Mangrove Shrubland Alliance**

Name, translated: White Mangrove Shrubland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Mangrove Shrubland dominated by *Laguncularia racemosa*. Other characteristic species include low densities of *Avicennia germinans*, *Rhizophora mangle*, *Thespesia populnea*, *Conocarpus erectus*, and *Coccoloba uvifera*. May have a sparse herbaceous understory of *Chloris barbata*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in low lying coastal areas of central Salt River Bay National Historical Park & Ecological Preserve.

Plots: 059_3_20090115, 061_3_20090115, 105_3_20090720

Mixed Mangrove Shrubland Alliance

Name, translated: Mixed Mangrove Shrubland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Mixed mangrove shrubland could be comprised of *Avicennia germinans*, *Laguncularia racemosa*, and *Rhizophora mangle* with no single dominant species, but does not need all three species to be present. Other characteristic species may include low densities of *Conocarpus erectus*, and the exotic tree *Thespesia populnea*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in low lying coastal areas with periodic tidal inundation.

Plots: 136_3_20090721, 141_3_20090721, 314_1_20090721, 315_1_20090721, 316_1_20090721, 319_1_20090721

***Rhizophora mangle* Mangrove Shrubland Alliance**

Name, translated: Red Mangrove Shrubland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Mangrove Shrubland dominated by *Rhizophora mangle*. This community usually appears in monospecific stands, but may have low density shrubs such as *Laguncularia racemosa*, *Conocarpus erectus*, and a ground cover of *Sesuvium portulacastrum*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in low lying coastal areas with periodic tidal inundation.

Plots: 318_1_20090721, 328_1_20090721, 332_1_20090721, 333_1_20090721

III.B.1.N.a. Lowland drought deciduous shrubland (Caribbean Formation)

1. Mixed Dry Shrubland (Virgin Islands Sub-formation) – “This vegetation cover is common to the drier parts of all three islands; east and south shores and low elevation locations. It may in some places extend as far up as 275 meters on south facing slopes. An extremely diverse community, Cacti and Agave are common though scattered, while vegetation height can range from 1-10 meters. The taller forms may consist of a canopy layer of larger individuals under slightly more moist conditions. The shorter forms are common to very exposed locations such as the east sides of headlands on the south shores” (Gibney *et al.* 2000).

2. Semi-deciduous Shrubland (Virgin Islands Sub-formation) – Similar to Semi-deciduous forests but not as tall. These communities are generally less than 5 meters in height and have a canopy cover greater than 50%. A majority of the shrubs present are deciduous, with *Acacia tortuosa*, *Cordia dentata*, and the exotic tree *Leucaena leucocephala* making up a large portion of the canopy cover.

***Acacia tortuosa* Semi-deciduous Shrubland Alliance**

Name, translated: Casha Semi-deciduous Shrubland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Semi-deciduous Shrubland dominated by *Acacia tortuosa*. Other characteristic species include *Cordia dentata*, *Pithecellobium unguis-cati*, and the exotic tree *Leucaena leucocephala*. May have an herbaceous understory of *Urochloa maxima*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in the northern upland areas of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 122_3_20090720

***Cordia dentata* Semi-deciduous Shrubland Alliance**

Name, translated: White Manjack Semi-deciduous Shrubland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Semi-deciduous Shrubland dominated by *Cordia dentata*. Other characteristic species include *Pithecellobium unguis-cati*, *Serjania lucida*, and exotic trees and shrubs such as *Leucaena leucocephala*, *Cryptostegia madagascariensis*, and *Yucca aloifolia*. May have an herbaceous understory component consisting of *Urochloa maxima* or *Acrostichum danaeifolium*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in generally disturbed areas throughout Salt River Bay National Historical Park & Ecological Preserve.

Plots: 101-O_3_20090720, 107_3_20090720, 152_3_20090722, 345_1_20090722

***Leucaena leucocephala* Semi-deciduous Shrubland Alliance**

Name, translated: Tan Tan Semi-deciduous Shrubland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Semi-deciduous Shrubland dominated by the exotic tree *Leucaena leucocephala*. Other characteristic shrub species include *Cordia dentata*, *Acacia tortuosa*, *Capparis flexuosa*, and *Guapira fragrans*. Vine cover may include *Caesalpinia bonduc* and *Serjania lucida*. May have an herbaceous understory of *Urochloa maxima*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found throughout upland areas of Salt River Bay National Historical Park & Ecological Preserve, especially in disturbed areas along roadsides.

Plots: 045_3_20090115, 336_1_20090722, 338_1_20090722, 346_1_20090722

3. Thicket/scrub (Virgin Islands Sub-formation) –“This deciduous formation is quite common on all three islands and cays. It is characterized by thorny scrub communities which generally form a very dense, closed cover community. The height of the vegetation averages approximately 3-4 meters with occasional emergent trees. These communities may have uniform height as mono-specific stands or structural variety as a mixture of two species. This community type may also exist in many locations as a transitional seral stage to taller woodland or dry forest types. Land use history has great influence in the distribution of this cover” (Gibney *et al.* 2000).

V. GRASSLAND

V.A.1.N.a. Tall tropical/subtropical grassland (Caribbean Formation)

1. Coastal Grassland (Virgin Islands Sub-formation) – “Extremes of wind, salt spray and low moisture sometimes combine to form communities of grasses adapted to these harsh conditions” (Gibney *et al.* 2000).

***Urochloa maxima* Coastal Grassland Alliance**

Name, translated: Guinea Grass Coastal Grassland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Grassland community dominated by *Urochloa maxima*. This community is generally found in large monotypic grass patches, however, there may also be a shrub or small tree component. The shrub component may consist of *Leucaena leucocephala*, *Acacia tortuosa*, *Coccoloba uvifera*, *Croton rigidus*, and *Lantana involucrata*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

A widespread community dominating the northeastern and northwestern area of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 002_1_20090112, 004_3_20090112, 007_3_20090112, 009_3_20090112, 044_3_20090115, 048_3_20090115, 050_3_20090115, 051_3_20090115, 348_1_20090723

V.A.1.N.d. Short sod tropical/subtropical grassland (Caribbean Formation)

1. Pasture (Virgin Islands Sub-formation) – “These are primarily grasslands with a very low (less than 10%) incidence of shrub and tree species occurring as part of the community. These can generally be classified as planted and cultivated areas subject to maintenance by grazing and fire” (Gibney *et al.* 2000).

***Cynodon dactylon* Coastal Grassland Alliance**

Name, translated: Bermuda Grass Coastal Grassland Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Grassland habitat dominated by *Cynodon dactylon*. This community was found in one place as a small patch in which this grass was the only species present.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found as a single small patch in the northeast area of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 117_3_20090720

V.A.1.N.h. Semi-permanently flooded tropical/subtropical grassland (Caribbean Formation)

1. Fringing Freshwater Grassland (Virgin Islands Sub-formation) – Grassland community found in a fringing pattern around freshwater lakes or ponds.

V.A.2.N.a. Tall tropical/subtropical grassland with mainly broad-leaved evergreen trees (Caribbean Formation)

1. Mixed Dry Grassland (Virgin Islands Sub-formation) – “Grassland dominated communities with greater than 25% shrub, tree and herbaceous species usually formed by selective grazing of livestock that shun spiny and/or poisonous plants” (Gibney *et al.* 2000).

***Urochloa maxima*-*Cryptostegia madagascariensis* Mixed Dry Grassland Association**

Name, translated: Guinea Grass-Purple Allamanda Mixed Dry Grassland Association

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Grassland and shrub community dominated by the grass *Urochloa maxima* and the shrub *Cryptostegia madagascariensis*. Other forbs found in this community include *Chloris barbata*, *Fimbristylis cymosa*, *Sesuvium portulacastrum*, and *Sansevieria hyacinthoides*. Other shrub species include *Acacia tortuosa*, *Gossypium barbadense*, *Cordia dentata*, *Lantana involucrata*, and the introduced *Yucca aloifolia* and *Leucaena leucocephala*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

This community is found in disturbed areas in the northeastern portion of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 019_3_20090112

VII. SPARSE VEGETATION

VII.A.1.N.a. Cliffs with sparse vascular vegetation (Caribbean Formation)

1. Rock Cliff (Virgin Islands Sub-formation) – Coastal cliffs, rocky outcrops, boulder fields and landslide areas with less than 10% vegetative cover.

VII.B.2.N.a. Boulder field vegetation (Caribbean Formation)

1. Rocky Outcrop (Virgin Islands Sub-formation) – Outcrops of rock with sparse vegetative cover (generally 10% cover or less).

VII.C.1.N.a. Dunes with sparse herbaceous vegetation (Caribbean Formation)

1. Beach Dune (Virgin Islands Sub-formation) – “Shoreline beaches of sand, cobble or gravel that exhibit less than 10% vegetative cover” (Gibney *et al.* 2000). Usually found behind the intermittently flooded sand beaches.

VII.C.2.N.b. Intermittently flooded sand beaches and shores (Caribbean Formation)

1. Beach (Virgin Islands Sub-formation) – “Shoreline beaches of sand, cobble or gravel that exhibit less than 10% vegetative cover” (Gibney *et al.* 2000).

VII.C.4.N.b. Intermittently flooded mud flat (Caribbean Formation)

1. Fresh Pond (Virgin Islands Sub-formation) – “Permanent catchment and drainage areas of fresh water” (Gibney *et al.* 2000).

2. Salt Pond (Virgin Islands Sub-formation) – “Permanently flooded coastal ponds” (Gibney *et al.* 2000).

VII.C.4.N.c. Seasonally/temporarily flooded mud flat (Caribbean Formation)

1. Seasonal Mud Flat (Virgin Islands Sub-formation) – Coastal pond areas, sand and mud flats behind barrier beaches that are seasonally flooded, usually during months of high rainfall.

VII.C.4.N.d. Tidally flooded mud flat (Caribbean Formation)

1. Tidal Mud Flat (Virgin Islands Sub-formation) – Coastal pond areas, sand and mud flats behind barrier beaches that are periodically flooded during high tides.

XX. HIERARCHY PLACEMENT UNDETERMINED

XX. Hierarchy Placement Undetermined

1. Developed Area (Virgin Islands Sub-formation) – “Areas permanently altered for the purpose of residential, commercial and industrial uses” (Gibney *et al.* 2000).

2. Marsh (Virgin Islands Sub-formation) – Low lying fresh or brackish water wetland areas dominated by herbaceous forbs and ferns. There is very little, if any, tree canopy cover.

***Acrostichum danaeifolium* Marsh Alliance**

Name, translated: Leather Fern Marsh Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Dense freshwater to brackish marsh community dominated by *Acrostichum danaeifolium*. This community forms dense thickets with sparse tree canopy cover. Other species include *Typha domingensis* and the vine *Serjania lucida*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in central Salt River Bay National Historical Park & Ecological Preserve in large patches where the Salt River transitions into the Mangrove communities.

Plots: 062_3_20090116, 198-P_20090721

3. Road (Virgin Islands Sub-formation) – Paved roads.

4. Salt Marsh (Virgin Islands Sub-formation) – Low lying saltwater wetlands periodically inundated by tidal action or storm surges. May also have low densities of shrubs or trees.

***Batis maritima* Salt Marsh Alliance**

Name, translated: Saltwort Salt Marsh Alliance

Vegetation (Salt River Bay National Historical Park & Ecological Preserve):

Salt Marsh community dominated by *Batis maritima*. Other herbaceous species include *Sesuvium portulacastrum*, and *Sporobolus indicus*. This community may have low densities of trees or shrubs. Woody species commonly found in this community include *Conocarpus erectus*, *Thespesia populnea*, and the introduced *Cryptostegia madagascariensis*.

Environment (Salt River Bay National Historical Park & Ecological Preserve):

Found in small patches behind the coastal Mangrove zone in the northeastern area of Salt River Bay National Historical Park & Ecological Preserve.

Plots: 114_3_20090720

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Basin Moist Forest Virgin Islands Sub-formation

Basin Moist Forest Virgin Islands Sub-formation

NPS SECN



Coastal Evergreen Forest Virgin Islands Sub-formation

Coccoloba uvifera Coastal Evergreen Forest Alliance
Sea Grape Evergreen Forest Alliance



Coastal Evergreen Forest Virgin Islands Sub-formation

***Cocos nucifera* Coastal Evergreen Forest Alliance**
Coconut Palm Evergreen Forest Alliance

No Photo Available

Coastal Evergreen Forest Virgin Islands Sub-formation

Conocarpus erectus Coastal Evergreen Forest Alliance
Buttonwood Coastal Evergreen Forest Alliance



Mangrove Forest Virgin Islands Sub-formation

Avicennia germinans Mangrove Forest Alliance
Black Mangrove Forest Alliance



Mangrove Forest Virgin Islands Sub-formation

Laguncularia racemosa Mangrove Forest Alliance
White Mangrove Forest Alliance



Mangrove Forest Virgin Islands Sub-formation

Mixed Mangrove Forest Alliance

NPS SFCN



Mangrove Forest Virgin Islands Sub-formation

Rhizophora mangle Mangrove Forest Alliance
Red Mangrove Forest Alliance

NPS SFCN



Gallery Semi-deciduous Forest Virgin Islands Sub-formation

Gallery Semi-deciduous Forest Virgin Islands Sub-formation



Semi-deciduous Forest Virgin Islands Sub-formation

Semi-deciduous Forest Virgin Islands Sub-formation



Semi-deciduous Forest Virgin Islands Sub-formation

Bourreria succulenta Semi-deciduous Forest Alliance

Pigeonberry Semi-deciduous Forest Alliance



Semi-deciduous Forest Virgin Islands Sub-formation

Cordia dentata Semi-deciduous Forest Alliance
White Manjack Semi-deciduous Forest Alliance



Semi-deciduous Forest Virgin Islands Sub-formation

Leucaena leucocephala Semi-deciduous Forest Alliance
Tan Tan Semi-deciduous Forest Alliance



Semi-deciduous Forest Virgin Islands Sub-formation

Melicoccus bijugatus Semi-deciduous Forest Alliance
Genip Semi-deciduous Forest Alliance



Semi-deciduous Forest Virgin Islands Sub-formation

Samanea saman Semi-deciduous Forest Alliance

Licorice or Rain Tree Semi-deciduous Forest Alliance



Semi-evergreen Forest Virgin Islands Sub-formation

Semi-evergreen Forest Virgin Islands Sub-formation



Evergreen Woodland Virgin Islands Sub-formation

Evergreen Woodland Virgin Islands Sub-formation

No Photo Available

Evergreen Woodland Virgin Islands Sub-formation

Conocarpus erectus Evergreen Woodland Alliance

Buttonwood Evergreen Woodland Alliance



Evergreen Woodland Virgin Islands Sub-formation

Thespesia populnea Evergreen Woodland Alliance
Seaside Mahoe Evergreen Woodland Alliance

NPS SFCN



Mangrove Woodland Virgin Islands Sub-formation

Mixed Mangrove Woodland Alliance



Mangrove Woodland Virgin Islands Sub-formation

***Rhizophora mangle* Mangrove Woodland Alliance**
Red Mangrove Woodland Alliance

No Photo Available

Gallery Semi-deciduous Woodland Virgin Islands Sub-formation

Gallery Semi-deciduous Woodland Virgin Islands Sub-formation



Semi-deciduous Woodland Virgin Islands Sub-formation

Semi-deciduous Woodland Virgin Islands Sub-formation



Semi-deciduous Woodland Virgin Islands Sub-formation

Cordia dentata Semi-deciduous Woodland Alliance

White Manjack Semi-deciduous Woodland Alliance



Semi-deciduous Woodland Virgin Islands Sub-formation

Leucaena leucocephala Semi-deciduous Woodland Alliance
Tan Tan Semi-deciduous Woodland Alliance



Coastal Evergreen Shrubland Virgin Islands Sub-formation

Coastal Evergreen Shrubland Virgin Islands Sub-formation



Coastal Evergreen Shrubland Virgin Islands Sub-formation

Conocarpus erectus Coastal Evergreen Shrubland Association
Buttonwood Shrubland Association



Coastal Evergreen Shrubland Virgin Islands Sub-formation

Dalbergia ecastaphyllum Coastal Evergreen Shrubland Alliance
Coin Vine Coastal Evergreen Shrubland Alliance



Coastal Hardwood Shrubland Virgin Islands Sub-formation

Guapira fragrans Coastal Hardwood Shrubland Alliance

Black Mampoo Coastal Hardwood Shrubland Alliance

NPS SFCN



Coastal Hedge Virgin Islands Sub-formation

Coccoloba uvifera Coastal Hedge Alliance
Sea Grape Coastal Hedge Alliance



Fringing Mangrove Virgin Islands Sub-formation

Fringing Mangrove Virgin Islands Sub-formation

NPS SFCN



Mangrove Shrubland Virgin Islands Sub-formation

Avicennia germinans Mangrove Shrubland Alliance
Black Mangrove Shrubland Alliance



Mangrove Shrubland Virgin Islands Sub-formation

Laguncularia racemosa Mangrove Shrubland Alliance
White Mangrove Shrubland Alliance



Mangrove Shrubland Virgin Islands Sub-formation

Mixed Mangrove Shrubland Alliance



Mangrove Shrubland Virgin Islands Sub-formation

Rhizophora mangle Mangrove Shrubland Alliance
Red Mangrove Shrubland Alliance

NPS SFCN



Mixed Dry Shrubland Virgin Islands Sub-formation

Mixed Dry Shrubland Virgin Islands Sub-formation

NPS SFCN



Semi-deciduous Shrubland Virgin Islands Sub-formation

Semi-deciduous Shrubland Virgin Islands Sub-formation

No Photo Available

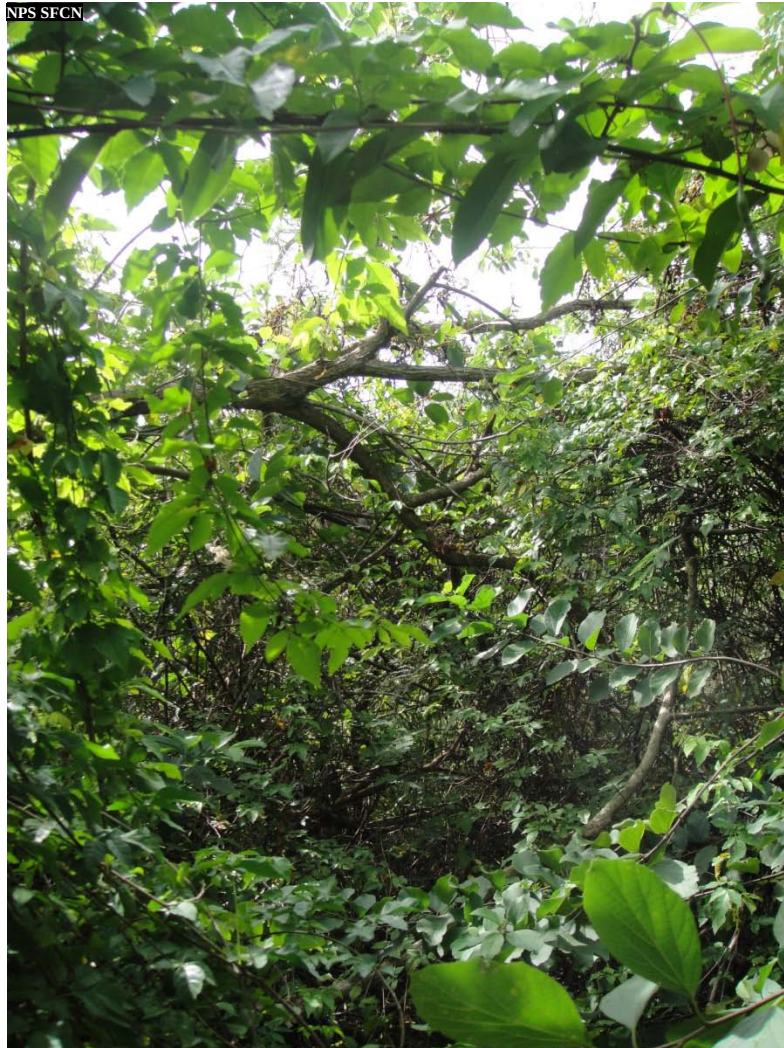
Semi-deciduous Shrubland Virgin Islands Sub-formation

Acacia tortuosa Semi-deciduous Shrubland Alliance
Casha Semi-deciduous Shrubland Alliance



Semi-deciduous Shrubland Virgin Islands Sub-formation

Cordia dentata Semi-deciduous Shrubland Alliance
White Manjack Semi-deciduous Shrubland Alliance



Semi-deciduous Shrubland Virgin Islands Sub-formation

Leucaena leucocephala Semi-deciduous Shrubland Alliance
Tan Tan Semi-deciduous Shrubland Alliance

NPS SFCN



Thicket/scrub Virgin Islands Sub-formation

Thicket/scrub Virgin Islands Sub-formation

No Photo Available

Coastal Grassland Virgin Islands Sub-formation

Urochloa maxima Coastal Grassland Alliance
Guinea Grass Coastal Grassland Alliance



Pasture Virgin Islands Sub-formation

Cynodon dactylon Coastal Grassland Alliance
Bermuda Grass Coastal Grassland Alliance

NPS SFCN



Fringing Freshwater Grassland Virgin Islands Sub-formation

Fringing Freshwater Grassland Virgin Islands Sub-formation

No Photo Available

Mixed Dry Grassland Virgin Islands Sub-formation

Mixed Dry Grassland Virgin Islands Sub-formation

NPS SFCN



Mixed Dry Grassland Virgin Islands Sub-formation

Urochloa maxima-*Cryptostegia madagascariensis* Mixed Dry Grassland Association

Guinea Grass-Purple Allamanda Mixed Dry Grassland Association

NPS SECN



Rock Cliff Virgin Islands Sub-formation

Rock Cliff Virgin Islands Sub-formation

No Photo Available

Rocky Outcrop Virgin Islands Sub-formation

Rocky Outcrop Virgin Islands Sub-formation

No Photo Available

Beach Dune Virgin Islands Sub-formation

Beach Dune Virgin Islands Sub-formation

No Photo Available

Beach Virgin Islands Sub-formation

Beach Virgin Islands Sub-formation

No Photo Available

Fresh Pond Virgin Islands Sub-formation

Fresh Pond Virgin Islands Sub-formation

No Photo Available

Salt Pond Virgin Islands Sub-formation

Salt Pond Virgin Islands Sub-formation

No Photo Available

Seasonal Mud Flat Virgin Islands Sub-formation

Seasonal Mud Flat Virgin Islands Sub-formation

No Photo Available

Tidal Mud Flat Virgin Islands Sub-formation

Tidal Mud Flat Virgin Islands Sub-formation

NPS SFCN



Developed Area Virgin Islands Sub-formation

Developed Area Virgin Islands Sub-formation

No Photo Available

Marsh Virgin Islands Sub-formation

Acrostichum danaeifolium Marsh Alliance
Leather Fern Marsh Alliance



Road Virgin Islands Sub-formation

Road Virgin Islands Sub-formation

No Photo Available

Salt Marsh Virgin Islands Sub-formation

Batis maritima Salt Marsh Alliance
Saltwort Salt Marsh Alliance



Appendix C: List of Species Observed during Vegetation Mapping*

Family	Scientific Name	Common Name	Code
Acanthaceae	<i>Oplonia microphylla</i> (Lam.) Stearn	Thicketwort	oplmic
	<i>Oplonia spinosa</i> (Jacq.) Raf.	Pricklybush	oplspi
Agavaceae	<i>Yucca aloifolia</i> L.	Spanish bayonet	yucalo
Aizoaceae	<i>Sesuvium portulacastrum</i> (L.) L.	Bay flower	sespor
Anacardiaceae	<i>Comocladia dodonaea</i> (L.) Urban	Christmas bush	comdod
Arecaceae	<i>Cocos nucifera</i> L.	Coconut palm	cocnuc
Asclepiadaceae	<i>Cryptostegia madagascariensis</i> Bojer ex Dcne.	Rubber vine	crymad
Bataceae	<i>Batis maritima</i> L.	Saltwort	batmar
Bignoniaceae	<i>Macfadyena unguis-cati</i> (L.) A.H. Gentry	Cat claw	macung
	<i>Tabebuia heterophylla</i> (DC.) Britt.	Black cedar	tabhet
	<i>Tecoma stans</i> (L.) Juss. ex Kunth	Catapult tree	tecsta
	<i>Bourreria succulenta</i> Jacq.	Pigeon berry	bousuc
Boraginaceae	<i>Cordia dentata</i> Poir.	Flute boom	corden
	<i>Tournefortia volubilis</i> L.	Twining soldierbush	touvol
	<i>Bursera simaruba</i> (L.) Sarg.	Gumbo limbo	bursim
Cactaceae	<i>Melocactus intortus</i> (P. Mill.) Urban	Turk's cap	melint
Capparaceae	<i>Capparis cynophallophora</i> L.	Jamaican caper	capcyn
	<i>Capparis flexuosa</i> (L.) L.	Limber caper	capfle
Combretaceae	<i>Conocarpus erectus</i> L.	Buttonwood	conere
	<i>Laguncularia racemosa</i> (L.) Gaertn. f.	White mangrove	lagrac
	<i>Terminalia catappa</i> L.	Indian almond	tercat
Commelinaceae	<i>Commelina erecta</i> L.	French grass	comere
	<i>Tradescantia spathacea</i> Sw.	Oyster plant	traspa
Cyperaceae	<i>Cyperus involucratus</i> Rottb.	Umbrella plant	cypinv
	<i>Fimbristylis spathacea</i> Roth	Hurricane grass	fimspa
Erythroxylaceae	<i>Erythroxylum brevipes</i> DC.	Brizzlet	erybre
Euphorbiaceae	<i>Croton rigidus</i> (Muell.-Arg.) Britt.	Yellow maran	crorig
	<i>Euphorbia tirucalli</i> L.	Milk bush	euptir
	<i>Gymnanthes lucida</i> SW.	Crab wood	gymluc
	<i>Hippomane mancinella</i> L.	Manchineel	hipman
Fabaceae	<i>Acacia macracantha</i> Humb. & Bonpl. ex Willd.	Long-spine acacia	acamac
	<i>Acacia tortuosa</i> (L.) Willd.	Poponax	acator
	<i>Caesalpinia bonduc</i> (L.) Roxb.	Gray nicker	caebon
	<i>Caesalpinia ciliata</i> (Bergius ex Wikstr.) Urban	Yellow nicker	caecil
	<i>Crotalaria retusa</i> L.	Rattle box	croret
	<i>Dalbergia ecastaphyllum</i> (L.) Taubert	Coinvine	daleca
	<i>Desmanthus virgatus</i> (L.) Willd.	Wild tantan	desvir
	<i>Leucaena leucocephala</i> (Lam.) de Wit	Tan tan	leuleu
	<i>Piscidia carthagenensis</i> Jacq.	Dogwood	piscar
	<i>Pithecellobium unguis-cati</i> (L.) Benth.	Blackbead	pitung
	<i>Samanea saman</i> (Jacq.) Merr.	Raintree	samsam
	<i>Sesbania sericea</i> (Willd.) Link	Papagayo	sesser
	<i>Sansevieria hyacinthoides</i> (L.) Druce	Iguanatail	sanhya
	<i>Gossypium barbadense</i> L.	Creole cotton	gosbar
Malvaceae	<i>Thespesia populnea</i> (L.) Soland. ex Correa	Seaside mahoe	thepop
	<i>Swietenia mahagoni</i> (L.) Jacq.	Mahogany	swimah
Myrtaceae	<i>Eugenia biflora</i> (L.) DC.	Blackrodwood	eugbif
	<i>Eugenia cordata</i> (Sw.) DC.	Lathberry	eugcor
Nyctaginaceae	<i>Guapira fragrans</i> (Dum.-Cours.) Little	Wild mampoo	guafra
	<i>Pisonia subcordata</i> Sw.	Water mampoo	pissub
Poaceae	<i>Bothriochloa pertusa</i> (L.) A. Camus	Pitted beardgrass	botper
	<i>Cynodon dactylon</i> (L.) Pers.	Bermudagrass	cyndac
	<i>Sporobolus indicus</i> (L.) R. Br.	Smut grass	spoin
	<i>Sporobolus virginicus</i> (L.) Kunth	Seashore dropseed	spovir
	<i>Urochloa maxima</i> (Jacq.) R. Webster	Guinea grass	uromax
Polygonaceae	<i>Antigonon leptopus</i> Hook. & Arn.	Coral vine	antlep

Family	Scientific Name	Common Name	Code
	<i>Coccoloba uvifera</i> (L.) L.	Seagrape	cocuvi
	<i>Coccoloba venosa</i> L.	Cherry grape	cocven
Pteridaceae	<i>Acrostichum danaeifolium</i> Langsd. & Fisch.	Inland leatherfern	acrdan
Rhamnaceae	<i>Gouania lupuloides</i> (L.) Urban	Whiteroot	goulup
	<i>Krugiodendron ferreum</i> (Vahl) Urban	Ironwood	krufer
Rhizophoraceae	<i>Rhizophora mangle</i> L.	Red mangrove	rhiman
Rubiaceae	<i>Randia aculeate</i> L.	Christmas tree	ranacu
Rutaceae	<i>Triphasia trifolia</i> (Burm. f.) P. Wilson	Lime berry	tritri
Sapindaceae	<i>Melicoccus bijugatus</i> Jacq.	Genip	melbij
	<i>Serjania lucida</i> Schum.	Basket wood	serluc
Sapotaceae	<i>Sideroxylon obovatum</i> Lam.	Mastic	sidobo
Theophrastaceae	<i>Jacquinia armillaris</i> Jacq.	NA	jacarm
Tiliaceae	<i>Corchorus hirsutus</i> L.	Jackswitch	corhir
Typhaceae	<i>Typha domingensis</i> Pers.	Southern cattail	typdom
Verbenaceae	<i>Avicennia germinans</i> (L.) L.	Black mangrove	aviger
	<i>Citharexylum fruticosum</i> L.	Fiddlewood	citfru
	<i>Lantana involucrate</i> L.	Sage	laninv
Vitaceae	<i>Cissus trifoliata</i> (L.) L.	Sorrel vine	cistri
	<i>Cissus verticillata</i> (L.) D.H. Nicols. & Jarvis	Pudding vine	cisver

Disclaimer

* This is a list of vegetation species observed in the field during this project, and represents only a subset of the common species found in the Salt River Bay area. For a complete list of vegetation species potentially occurring at Salt River Bay National Historical Park & Ecological Preserve, see Ray's (2003) Vascular plant inventory and mapping of Buck Island Buck Island Reef National Monument St. Croix, U.S. Virgin Islands and the "Flora of St. John, U.S. Virgin Islands" (Acevedo-Rodriguez 1996).

Appendix D: Field Data Sheets

October 2008 Field Data Sheet

Date: _____ **Observers:** _____

Mark #: _____ **Unit:** ____ **# of Photos:** ____

Community Type: _____

Dominant Vegetation Type in Cell

Canopy Height: _____m

Canopy Cover: _____%

Species (D = dominant species)

- | | |
|----|-----|
| 1) | 6) |
| 2) | 7) |
| 3) | 8) |
| 4) | 9) |
| 5) | 10) |

Remarks

Hurricane Omar (October 2008)

Hurricane Damage: _____

Canopy Before Hurricane: _____

January 2009 Field Data Sheet

SARI TRAINING POINTS FOR VEGETATION MAPPING

Park:

Date:

GPS Mark #:

of Pictures taken/Description:

Polygon #:

Training Point #:

Observers:

Avg. Canopy Height:

Primary -

Assistant -

Canopy Cover %:

Dominant Species present:

Community Type:

Forest: height > 5m & > 60% canopy cover- Gallery Semi-deciduous Forest - Dry Semi-deciduous Forest

Woodland: height > 5m & 25-50% canopy cover - Gallery Semi-deciduous Woodland - Semi-deciduous Woodland

Shrubland: height < 5m & > 25% shrub canopy cover & < 25% tree canopy cover

Mixed Dry Shrubland- diverse, with Cacti and Agave

Thicket Scrub- thorny, dense, closed cover, 3-4m tall with occasional emergent tree

Gallery Shrubland - found in small guts and ravines

Wetlands: Mangrove (forest, woodland, shrubland), Salt Pond, Salt flat

Herbaceous: (coastal grassland)

Beach

Coastal Hedge

(Gibney *et al.* 2000)

1

SARI TRAINING POINTS FOR VEGETATION MAPPING

Area Description/Sub Strata:

Disturbance?

Successional stage?

Representative of Polygon?

Remarks/Point changed? :

July 2009 Field Data Sheet

Point #: _____

Date/Time: _____

Observers: _____

Mark #: _____

of Photos: _____

Unit: _____

Slope: _____

Moved Point?: Y / N

Why: _____

Description of Cell and Veg. Type + Comments

(Structures, roads, hurricane damage, water cover, soil cover, etc.)

Community Type: _____

Dominant Vegetation Type in Cell

Overall Canopy Cover (if present) _____%

Canopy Height (if present) _____m

Relative Cover of Dominant Species in Tallest Stratum

(generally should add to ca. 100%)

Note: D = dominant sp. % cover only estimated for dominant

Tree _____ % cover

1)

2)

3)

Tree _____ % cover

4)

5)

6)

Shrub _____ % cover

1)

2)

3)

Shrub _____ % cover

4)

5)

6)

Herb _____ % cover

1)

2)

3)

Herb _____ % cover

4)

5)

6)

Canopy (m) Tree: _____ Shrub: _____ Herb: _____

Appendix E:

U.S. Virgin Islands vegetation community classification: basic community descriptions – habitat mapping in support of land use and biodiversity planning in the Virgin Islands

Gibney, E., T. Thomas, R. O'Reilly, B. Devine. 2000. U.S. Virgin Islands vegetation community classification: basic community descriptions – habitat mapping in support of land use and biodiversity planning in the Virgin Islands. Eastern Caribbean Data Center.

**U.S. Virgin Islands
Vegetation Community Classification
January 2000**

Basic Community Descriptions

*Habitat Mapping in Support of
Land Use and Biodiversity Planning
in the Virgin Islands*

**Prepared by: E. Gibney, Consultant
T. Thomas, Cooperative Extension Service, UVI.
R. O'Reilly, USDA.
B. Devine, Ph.D., Conservation Data Center, UVI.**

U.S.V.I. Vegetation Community Classification Basic Community Descriptions

Gibney, E., Thomas, T., O'Reilly, R. and Devine, B.
January 2000

Moist Forest

I.A.3.N.a. - Lowland tropical or subtropical seasonal evergreen forest.

Tropical and subtropical seasonal evergreen forests with mainly broad-leaved evergreen trees and some foliage reduction in the dry season. The moist forests develop in watershed basins along the coast, in riparian habitats associated with drainage guts and swales which carry runoff from upper elevations and on suitably elevated upland locations where the elevations are high enough to experience rainfall totals above 1200mm per year. A dry period of 2-4 months is common. These are the true forests of the islands where more than 100 species of trees may grow to heights of 10-30m. The taller formations of this type generally have 3 synusiae or canopy strata, while the shorter formations exhibit only two layers. Generally, 70% or more of the tree species are evergreen.

Upland Moist Forest (umf) - These forests are confined to the summits and upper north aspects of the taller mountains. Emergent trees may be 25m tall, although at present, they are often less. The continuous canopy forms at about 15m, with a small tree/tall shrub layer often found at 5-10m. Low shrubs, herbs and epiphytes may be very abundant to absent. Recent hurricane disturbance has temporarily increased vine, herb and small shrub growth.

Gallery Moist Forest (gmf) - These are riparian communities found in ravines and guts draining large upland watersheds. The moist ravines and guts with the gentlest slopes support the tallest trees on the islands, some over 30m. Although several emergent species are deciduous, the dominant species are generally evergreen. As a result of flash floods, more young trees are found and stratification is less pronounced than in the upland type. The shrub layer is extremely variable and fewer herbs, shrubs, epiphytes and vines persist. In many locations, the introduced, deciduous fruit tree Melicoccus bijugatus (Genip) may dominate.

Basin Moist Forest (bmf) - These forests are found in basins and lowland areas, generally along the coast, where runoff from large upland watersheds collects. These forest types are well represented on all the Virgin Islands. The basin forest emergent species may reach 25m or more and the forest is normally comprised of 3 synusiae. A continuous canopy is formed at 15-18m and a lower layer at 5-10m. A lower shrub layer may be common or moderately well developed. Herbs and vines are found in significant numbers in a well-developed community. Epiphytes and ferns are rare.

Dry Forest

I.C.1.N.a. Lowland tropical/subtropical semi-deciduous forest.

I.B.1.N.a. Lowland or submontane tropical/subtropical drought deciduous forest.

Vegetation communities of the dry forest are influenced by a number of factors. Prevailing wind patterns, wind velocity, length of the dry season or number of months with less than 50mm of rainfall, aspect and slope can all influence vegetation composition. These formations are found at lower elevations, generally below 300m with rainfall accumulation of 850 - 1100mm per year. Steep slopes and strong winds in the presence of heavy salt spray may reduce the height of the climax vegetation, altering the composition and diversity of the forest. Tree strata are generally limited to 2 layers with a maximum height of 15-20m. Following a gradient of increasing aridity, seasonal vegetation may exhibit leaf specialization, leaning toward deciduousness, while dry evergreen vegetation may exhibit greater degrees of sclerophylly. Forests of this type grade and mix with one another and may be difficult to distinguish, other than by quantitative sampling measures.

Gallery Semi-deciduous Forest (gsf) - This vegetation type is limited to the smaller riparian corridors such as ravines, guts and intermittent streams found within dry forest watersheds. Additional moisture is available to the vegetation as a result of runoff. The taller dry forest species find their maximum height in these locations. Shrub and herb community development are variable.

Semi-deciduous Forest (sdf) - Throughout the Virgin Islands, this is the dominant forest cover. On St. John, well over 50% of the island is vegetated with this cover type. A large percentage of the remaining undeveloped land on St. Thomas and a majority of the small quantity of remaining forest on northwestern hill slopes on St. Croix are classified as this forest type. This forest group contains a number of fairly distinct forest types, which vary in physiognomy, composition and in degree of human modification. In most cases these forests may be found on north facing hillsides of all main islands, upper southern facing elevations below 250 meters, in basins without large watersheds, along smaller guts and ravines and mixed with dry deciduous forests on lower south facing slopes.

Semi-evergreen Forest (sef) - This forest cover type is very similar in distribution to the semi deciduous type and in many locations grades into it. It is generally found above 250 meters in elevation, on northwest facing slopes below moist forest levels. Species composition changes to include a shift toward a greater majority of evergreen species. This type is found on all three main islands, but to a greater degree on St. Thomas west end.

Drought-deciduous Forest (ddf) - The drought deciduous forests are found on all three islands, but may be difficult to delineate other than during the annual dry season from January - May. Structure and species composition is much the same as semi-deciduous forests, but this type is characterized by greater than 75% deciduous species. Species may have differing leaf phenology under varying climatic conditions, being evergreen in one location and deciduous in another. The formation is found mainly at lower elevations below 250 meters, on south and southwest facing slopes toward the drier east end locations and in south and west aspects along the north shores. The forest is low in stature with emergent trees at 15 meters. The main canopy rises to 7-10 meters. Shrubs are moderately sparse to abundant while the herb layer is ephemeral, regularly dying back in drier weather.

Woodlands

II.A.1.N.a. Lowland tropical/subtropical broad-leaved evergreen woodland.

II.B.1.N.a. Lowland or submontane broad-leaved drought deciduous woodland.

II.C.1.N.a. Tropical or subtropical semi-deciduous woodland.

These forest types are characterized by an open tree canopy where the crowns are generally separated and cover is approximately 25-60 %. Many of these woodland areas throughout the islands are of anthropogenic origin. They are more common to St. Croix than to St. Thomas and St. John as a result of human activities a previous land use history. A substantial number of the same species found in the dry forests are also found here. Height of the canopy varies greatly depending on human modifications, effects of hurricanes and available soil moisture but may be from 8 - 20 meters. The cover types in this category grade into one another and are difficult to distinguish except by sampling and critical observation.

Evergreen Woodland (ew) - This vegetation cover type occurs as very small patches on steep northern slopes at low elevations. It is found on all three islands and on some of the offshore cays where landscape modifications have taken place. In a number of locations it may occur as a coconut palm woodland in basin or coastal areas.

Gallery Semi-deciduous Woodland (gsw) - St. Croix, as a result of extensive land clearing, may be the only island, which exhibits this cover type. It is primarily found in guts and ravines at low elevation and appears as strips of open canopy woodland where the guts pass through cleared areas.

Semi-deciduous Woodland (sdw) - Found primarily on abandoned agricultural land on St. Croix and also in central and eastern St. Thomas. The species composition is comprised mainly of common native and naturalized exotics. The size range varies considerably with past land use history and may range from 5-25 meters. Canopy cover is open, from 25 - 60% commonly. These areas are typically influenced by hurricane winds which reduce canopy cover temporarily.

Drought Deciduous Woodland (ddw) -This type occurs most commonly on St. Croix on the drier eastern hills and in patchy areas across the island. Species composition and community structure are very similar to other woodland types. Delineation is difficult.

Shrublands

- III.A.1.N.b. Tropical/subtropical broad-leaved evergreen shrubland.**
- III.A.1.N.c. Sclerophyllous tropical/subtropical broad-leaved evergreen.**
- III.A.5.N.a. Broad-leaved microphyllous evergreen extremely xeromorphic sub-desert shrubland.**
- III.A.5.N.c. Succulent extremely xeromorphic evergreen shrubland.**
- III.B.1.N.a. Lowland drought deciduous shrubland.**
- III.B.3.N.a. Extremely xeromorphic deciduous sub-desert shrubland.**
- III.C.1.N.a. Mixed evergreen drought deciduous shrubland with succulents.**
- III.C.3.N.a. Extremely xeromorphic deciduous sub-desert shrubland with Succulents.**
- IV.C.1.N.b. Mixed evergreen drought deciduous dwarf shrubland.**

Shrublands occur in dry locations at low elevations on all islands and offshore cays. These communities are at least 0.5 meters to 5 meters in height with 3 meter height typical. Shrubs are generally defined as multiple stemmed, bushy and interlocking in structure. Thorny shrubs and cactus species are common along with succulents in some locations. These vegetation types are quite difficult to distinguish between categories and vary in height, structure and species composition. Aspect, elevation and past land use history can have a profound effect. Due to severe environmental constraints of thin soils, strong winds and little moisture, vegetation height is limited. Land use history may impact many of these transitional communities where succession will create different cover types in the future.

Gallery Shrubland (gs) - These cover types are found most commonly in small gullies and ravines where additional catchment and soil moisture prevail. Many evergreen species are common to these locations and height of the vegetation is typically at the taller end of the spectrum. They may form very dense communities in these areas and may remain as a result of land use history, being transitional stages to other community types.

Thicket/scrub (t/s) - This deciduous formation is quite common on all three islands and cays. It is characterized by thorny scrub communities which generally form a very dense, closed cover community. The height of the vegetation averages approximately 3-4 meters with occasional emergent trees. These communities may have uniform height as mono-specific stands or structural variety as a mixture of two species. This community type may also exist in many locations as a transitional seral stage to taller woodland or dry forest types. Land use history has great influence in the distribution of this cover.

Mixed Dry Shrubland (mds) - This vegetation cover is common to the drier parts of all three islands; east and south shores and low elevation locations. It may in some places extend as far up as 275 meters on south facing slopes. An extremely diverse community, Cacti and Agave are common though scattered, while vegetation height can range from 1-10 meters. The taller forms may consist of a canopy layer of larger individuals under slightly more moist conditions. The shorter forms are common to very exposed locations such as the east sides of headlands on the south shores.

Sclerophyllous Evergreen Shrubland (ses) - This formation type is less common than that described above and occurs mainly on St. Thomas and in certain east end locations on St. John. Slight changes in moisture regime and aspect, along with thin soils create conditions where other shrublands grade into this. Plants exhibit a strong degree of sclerophylly and evergreen species become somewhat more numerous. The distinction between this formation and coastal hedge can be extremely difficult to discern.

Coastal Hedge (ch) - shaped by wind shear and salt spray, these dense patch communities can be very low growing (less than 1 meter) or as tall as 3 meters. They are generally found on east, southeast or northeast coastal areas with exposure to prevailing winds. The limited species are generally wind and salt adapted. The formation may occur on the berms of beaches, seaward of salt ponds and flats or above rocky coasts or pavement. Hedge effect from wind is the prevailing structural architect for the environment as almost all of the species found here are capable of greater height in less hostile environments. The severe environment causes plants to produce small, succulent leaves which can be highly cutinized.

Herbaceous

- V.A.1.N.a. Tall tropical/subtropical grassland.**
- V.A.1.N.b. Medium tall sod tropical/subtropical grassland.**
- V.A.1.N.c. Medium tall bunch tropical/subtropical grassland.**
- V.A.1.N.d. Short sod tropical/subtropical grassland.**
- V.A.2.N.b. Tall tropical/subtropical grassland with mainly broad-leaved Evergreen drought deciduous trees.**
- V.A.2.N.d. Medium tall tropical/subtropical grassland with broad-leaved Drought deciduous trees.**
- V.A.3.N. Tropical/Subtropical grassland with a shrub layer, natural or semi-natural.**
- V.A.4.N. Tropical or subtropical grassland with a dwarf shrub layer, natural or semi-natural.**

Herbaceous communities occur in areas of very low rainfall, along the coast or in areas which have been subject to disturbance by human activities associated with agriculture and grazing of livestock. Many herbaceous communities may have

a small percentage of shrub species and broad-leaved evergreen and semi-deciduous trees as a component. These ecosystems are dominated by grasses and maintained by grazing and fire and are generally located on nearly flat or moderate slopes.

Pasture (p) - These are primarily grasslands with a very low (less than 10%) incidence of shrub and tree species occurring as part of the community. These can generally be classified as planted and cultivated areas subject to maintenance by grazing and fire.

Pasture mixed scrub (pms) - Grassland dominated communities with greater than 10 - 25% thorn/scrub vegetation. This community type results when grazing and fire maintenance have been discontinued and successional changes occur within the community.

Mixed Dry Grassland (mg) - Grassland dominated communities with greater than 25% shrub, tree and herbaceous species usually formed by selective grazing of livestock that shun spiny and/or poisonous plants.

Coastal Grassland (cg) - Extremes of wind, salt spray and low moisture sometimes combine to form communities of grasses adapted to these harsh conditions

Sparse Vegetation

VII.A.1.N.a. Cliffs with sparse vascular vegetation

VII.C.2.N.b. Intermittently flooded sand, gravel, cobble beaches

Rock Pavement (rp) - Coastal cliffs, rocky outcrops, boulder fields and landslide areas with less than 10% vegetative cover.

Beach (sand, cobble or gravel) (b) - Shoreline beaches of sand, cobble or gravel that exhibit less than 10% vegetative cover.

Wetlands

I.A.5.N.f. Tidally flooded tropical or subtropical broad-leaved evergreen Sclerophyllous closed tree canopy.

III.A.1.N.e. Seasonally flooded/saturated tropical/subtropical broad-leaved evergreen shrubland.

III.A.1.N.g. Semi-permanently flooded tropical or subtropical broad-leaved evergreen shrubland.

VII.C.4.N.b. Intermittently flooded mud flats.

Mangrove Forest (mf) - Mangrove forests dominated by Rhizophora mangle and other mangrove species exhibiting a closed tree canopy.

Mangrove Woodland (mw) - Similar to the above with a less dense association where the tree canopy is not closed. This woodland type lies at the shoreward extreme of the tidally flooded areas and may be dominated by Avicennia germinans, Laguncularia racemosa and Conocarpus erectus.

Mangrove Shrubland (ms) - Nontidal shrublands or scrub mangrove thickets dominated by Rhizophora mangle. Occurs in more stressed sites than mangrove forests and has shorter individuals (less than 5 meters and usually only one-half to two meters tall) and often sparser as well.

Fringing Mangrove (fm) - Shoreline and salt pond vegetation which is semi-permanently and tidally flooded. These areas are quite common to all islands

Mixed Swamp (msp) - Semi-permanently and tidally flooded communities composed of a mixture of mangrove and wetland tree and shrub species.

Salt Flat (sf) - Coastal pond areas, sand and mud flats behind barrier beaches.

Salt Pond (sp) - Permanently flooded coastal ponds.

Fresh pond (fp) - Permanent catchment and drainage areas of fresh water.

Cropland (c) - Agricultural areas and farm plots.

Developed Areas (d) - Areas permanently altered for the purpose of residential, commercial and industrial uses.

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.

NPS 141/107552, April 2011

National Park Service
U.S. Department of the Interior



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