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Vegetation Cover Types of Shark River Slough, Everglades NP Derived from LANDSAT Thematic Mapper Data

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INTRODUCTION

Documentation of the vegetation resources of Everglades National Park is one tool used by the National Park Service to meet management objectives. Information from time-series analysis can be used to evaluate vegetation changes, and therefore determine success or failure of resource preservation. In addition, vegetation analyses may be used to test efficacy of wide-scale management actions, such as experimental water deliveries authorized by Congress (PL 98-181). The type of vegetation analysis examined during this study is the depiction of spatial patterns of vegetation cover types or plant associations using LANDSAT IV Thematic Mapper data.

Data from previous LANDSAT satellites have been used in the past to map various features of southern Florida wetlands and Everglades National Park. Higer et al. (1970) used Multi-Spectral Scanner (MSS) data to map hydrologic patterns of the Everglades. Rose and Rosendahl (1979, 1983) mapped the distribution of four "hydro-biologic" zones in the Shark River Slough of Everglades National Park. Capehart et al. (1977) found limited applications of the MSS data to map the distribution of an exotic tree, Melaleuca quinquenervia, throughout southern Florida.

The LANDSAT IV satellite is equipped with a Thematic Mapper Sensor (TM), which provides improvements in both spatial and spectral resolution over the older MSS sensor. The TM data represent scaled values of reflectance within seven bands in the electromagnetic spectrum. The resolution of these data is such that each picture element (pixel) on the earth is approximately 30m x 30m. Since the sensors scan wavelengths in the near, mid, and thermal infra-red region of the electromagnetic spectrum, environmental parameters such as soil moisture and temperature can be inferred during analysis of the data set. The increased spectral resolution of the TM may offer increased separability of wetland vegetation cover types (Dottavio and Dottavio 1984). Data from the TM sensor should produce an improved vegetation map of Everglades wetlands, because of the insensitivity of previous sensors to map the spatially variable features as well as the small size of some vegetation features such as tree islands or hammocks.

We present in this report the first application of Thematic Mapper data to map the vegetation of Everglades National Park. The intent of this report is to provide corollary information to the map, including how the map was derived, and a description of the cover types mapped.

METHODS

The LANDSAT data were collected on 20 December 1982, and cover the scene from row 15 pass 42. The data were partitioned to cover the area over Shark River Slough in Everglades National Park. The study area is bounded on the north by Tamiami Trail (US 41) or a parallel at approximately 25.45 degrees north latitude. The southern border of the study area is 25.20 degrees north. The western boundary is 80.57 degrees west longitude. The eastern boundary of the study site was drawn parallel to the main axis of the slough in order to exclude upland areas of the park and developed areas outside the park. The study area is predominantly freshwater wetlands, with small areas of mangroves included in the southern

portions. These mangrove areas are subject to very infrequent inundation by saline waters (generally only during extreme droughts or storm periods). The study area is named the Shark River Slough because the large freshwater drainage or slough supplies water to a myriad of rivers and creeks within the mangrove zone, the largest of which is the Shark River.

The data were analyzed at the NASA Earth Resources Laboratory, National Space Technology Laboratories, in Mississippi. Analysis was done on a Perkin-Elmer 3222 mini-computer system using the NASA Earth Resources Laboratory Applications Software (ELAS). The data were geographically rectified using known control points within the data set to develop a set of mapping equations which transformed internal x-y image coordinates into coordinates of the earth based on the Universal Transverse Mercator (UTM) Projection. Data from bands (3,4,5,7) were used to develop an unsupervised classification of 57 spectral classes. These classes were aggregated and assigned to various vegetation cover types based upon ground-truth information collected within the study area. The vegetation cover types chosen are primarily based on common associations of macrophytic species, but also include factors such as density of the vegetation, abundance of lower plant forms (such as periphyton) as well as substrate characteristics (type and moisture content).

RESULTS

Vegetation Cover Types

The accompanying map illustrates the spatial distribution of the vegetation cover types. These can be characterized as forested or graminoid associations. The forest types include the mangrove groups, freshwater swamp forest and tropical hardwood hammock. The grass-like associations are the sawgrass marshes, spikerush marshes, and muhly/sawgrass prairies. Some groups are combinations of vegetation associations, and are included with the dominant type.

We identified two forest types within the saline-water influenced zone of the map. Both types are dominated by red mangrove, Rhizophora mangle. The maroon color on the map depicts the distribution of red mangrove stands with relatively dense canopy cover. Other woody species such as buttonwood, Conocarpus erectus, may be found within this type. However, the pink color represents monospecific stands of red mangroves. These red mangroves have a stunted or dwarfed growth form and in some areas are scattered or form low density stands. The dwarf mangrove category has a signature (the combination of reflectance values in the various wavelength bands) which includes both water and the scattered mangrove vegetation. This category includes the mangrove fringe found along creeks which make up the upper reaches of the Shark River and the scattered dwarf mangroves found in the interface region between the freshwater marshes and mangrove zone.

The upland mixed hardwood forests are depicted by red on the map. These forests have a closed canopy and are dominated by tropical trees and locally referred to as tropical hardwood hammocks, although temperate genera are found in these associations. These forests are on elevated limestone outcrops, and are free from standing water under all but extreme

circumstances. Wild tamarind, Lysiloma latisiliquum, gumbo-limbo, Bursera simaruba, strangler fig, Ficus aurea, and cabbage palm, Sabal palmetto, are the tropical species which dominate many of these sites. Live oak, Quercus virginiana, is a common temperate species found in the overstory of these forests.

The swamp forests of Shark River Slough are locally referred to as tree islands, a name descriptive of these forests which are surrounded by marsh vegetation. The swamp forests are represented on the map by brown and are comprised of a diverse association of hydrophytic hardwoods. Common overstory species include: swamp bay, Magnolia virginiana; dahoon holly, Ilex cassine; willow, Salix caroliniana; pond apple, Annona glabra; and wax myrtle, Myrica cerifera. These species form a relatively closed canopy over hardwoods such as cocoplum, Chrysobalanus icaco, and buttonbush, Cephalanthus occidentalis, as well as fern species such as the large leather fern, Acrostichum danaeifolium.

Two of the mapped vegetation categories are composite categories consisting of a mixture of forested and non-forested areas. One type is a combination of wet prairie and some swamp tree species. The other category is characterized as tall, dense sawgrass with a component of swamp trees.

The gold color on the map shows the distribution of the wet prairie and swamp tree category. Stunted or dwarf cypress forests are included in this category. The cypress, Taxodium ascendens, has a stunted growth form due to poor growth conditions. The trees are scattered and form a sparse canopy cover (less than 20%) in a savannah-like setting. These type cypress forests are difficult to detect from these data, because of their scattered, sparse distribution and that the trees were leafless during the time of scanning (December). The understory is an association of sedges and grasses dominated by sawgrass, Cladium jamaicense, and grasses such as muhly, Muhlenbergia filipes, Schizachyrium rhizomatum. This category also includes small (less than $50m^2$) tree islands scattered through the prairie areas. The species found within these tree islands are the same ones listed above for the swamp forest communities. The small tree islands are included in this category because the signature within each pixel is dominated by the prairie association characteristics yet has a component of the mixed hardwood islands.

The green color on the map represents areas of tall, dense sawgrass, Cladium jamaicense. These sites may also support scattered hardwood tree species such as pond apple, Annona glabra, and willow, Salix caroliniana, which emerge above the sawgrass. Sawgrass attains heights of 3 m and forms such dense, impenetrable stands. The tall sawgrass cover type is typically found at the downstream end or tail of the teardrop-shaped tree islands.

The brown and yellow colors depict phases of wet prairie-type vegetation found growing on marl substrate. Short-stature sawgrass grows in these associations along with other grasses, sedges and forbs, with varying degrees of cover. Dominant species include muhly, Muhlenbergia filipes, black top sedge, Schoenus nigricans, and sawgrass. Sawgrass appears to have a higher density and cover within the brown class. The yellow areas

had deeper water depths at the time of data collection than the brown areas, and the signature reflects more of water component than in the brown grouping. The yellow color group also has a component of periphyton which influenced the reflectance classification.

The white color portrays areas of very high reflectance. The high reflectance is due to an almost complete coverage of the ground surface by a dense mat of periphyton. The periphyton mat is comprised of various species of blue-green, green and brown algae. The blue-green algae precipitate calcium carbonate, which may contribute to the high reflectance. The mat floats at the water surface, precluding the influence of water on the reflectance. The white areas in the northern part of the map have a component of sawgrass and muhly type macrophytic vegetation, whereas the white areas in the south have very sparse scattering of sawgrass.

The medium blue color represents areas of short-stature (heights less than 1 m) sawgrass. Sawgrass in these areas forms typically monospecific stands. The sawgrass forms a dense ground cover. These areas have not been burned in a number of years, and the accumulation of standing dead leaves increases the apparent density of cover. These areas of sawgrass are also found on peat soils, indicative of longer periods of inundation. The blue category also includes some standing water, as water depths were approximately 6-10 inches during the time of data collection.

The darkest blue color covers areas of relatively open water. This group includes areas of open water, with no emergent vegetation, as well as slough areas with sparse, emergent plant cover. The dominant plant in the slough category is spikerush, Eleocharis cellulosa. Maidencane, Panicum hemitomon, may be locally dominant within the slough type. The majority of the area within the slough-type is covered by submerged plants of the genera Utricularia. A submerged periphyton mat is found on and around the matrix of Utricularia stems. This mat is much darker in color and appears brownish to the eye, hence is not highly reflective like the other type of periphyton.

The lightest blue color depicts a class which is primarily sparsely vegetated spikerush and open water over marl-type substrate.

Other Features

Other features are depicted on the map, some of which are natural whereas others were created by human activity. The natural features apparent on the map include the margins or borders of the central part of Shark River Slough. The eastern border is a fairly well-defined transition between marl and peat substrates, and is shown between the yellow and blue colors. The western border of the central slough is not as marked a transition, as shown by the zone of mottled yellow, blue and white, indicative of the spatial heterogeneity in the topography, hydrology and vegetation. Other notable features are the rock reefs, or bedrock outcrops. These elevated ridges are colonized by hardwood vegetation, and appear as thin lines oriented northwest to southeast and located in the upper and lower central segments along the eastern border of the map.

The anthropogenic features on the map include roads, canals and off-road vehicle trails. The Shark Valley Loop Road in the northern central area of the map is visible, as is the main park road of Everglades National Park (southeastern corner). Canals such as the L-67 extension and Blue Shanty Canal are also apparent. Swamp hardwoods line the Blue Shanty Canal, which resulted in the canal being outlined in reddish brown (the swamp hardwood category). Airboat trails are visible in northeast Shark River Slough. These areas have a signature of open water, due to removal of standing vegetation by repeated passes with an airboat. Vehicle trails, caused by airboats and swamp-buggies, appear as white in the northwest corner of the map.

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