USGS
science for a changing world

Tree Islands of the Florida Everglades - A Disappearing Resource

Tree islands are important centers of biodiversity in the Everglades, with two to three times the plant and animal diversity of the surrounding wetlands. This high diversity results from greater elevation relative to the wetlands (Fig. 1) with seasonally dry conditions providing refugia and nesting sites for animals and allowing establishment of various tree and shrub species. Since 1950, the number of tree islands in the Everglades has been halved, possibly due to changing water management practices. Restoration of these islands is an important component of the Comprehensive Everglades Restoration Plan (CERP), which requires solid scientific evidence on requirements for tree-island formation and development to maximize chances for successful tree-island restoration. This report summarizes results of USGS research designed to understand environmental requirements for tree-island formation and to assess the response of tree-island communities to hydrologic changes, particularly those of the 20th century. These analyses form the basis for prediction of tree-island response to different restoration schemes. In this report, we focus on results from research conducted in Loxahatchee National Wildlife Refuge (NWR), Water Conservation Area (WCA) 2A, and Everglades National Park (Fig. 2).

Until recently, the timing and cause of tree island formation have been poorly understood, with estimates of initial tree-island development as early as thousands of years ago to as recently as the last few decades. To increase our knowledge about the origins of these features, sediment cores were collected on and around tree islands. These cores were dated using radioisotopic techniques, including carbon-14 dating, which provides reliable dates from ~40,000 to ~300 years ago, and lead-210 dating, which provides age models for the last century. These age models were paired with vegetational reconstruction based on pollen analysis from cores to identify the timing of tree-island formation and assess past tree-island response to hydrologic changes in the 20th century.

Tree-Island Trends – Northern Everglades

The northeastern Everglades, including Loxahatchee NWR, contain the thickest and oldest peats of the Everglades, and wetlands are dominated by waterlily sloughs, which require the deepest water and longest flooding intervals of Everglades wetland communities. Within this landscape, there are a number of elongate tree islands called strand islands, which now are characterized by homogeneous vegetation and dominance of hollies (*Ilex*). Previous research indicates that these islands formed on shallow sites in a deeper marsh (Stone et al., 2002), and USGS research on sediment cores from strand islands indicates that tree-island taxa (characterized by abundant ferns in pollen and spore assemblages) were well-established more than 1,100 years ago (Fig. 2a). Although

Figure 1. Fixed tree island in central Everglades.

holly and wax myrtle (*Myrica*) abundance began increasing early in the 20th century, the greatest changes have occurred since 1960, when holly abundance increased more than fourfold. This trend suggests that total enclosure of Loxahatchee NWR by water-management structures in 1961 had substantial impacts on the composition of vegetation on the strand islands.

Tree-Island Trends – Central and Southern Everglades

Fixed tree islands are prominent features of the central and southern Everglades and contrast with Loxahatchee strand islands in their teardrop shape, concentration of trees and shrubs at the north end of the island, and development of a dense, shrubby tail south of the head. Analysis of numerous fixed tree islands shows that these features formed on topographic highs, which caused shallower water depths. Before trees and shrubs were present, these areas consisted of sawgrass marshes surrounded by waterlily sloughs. Tree island development began ~1,000-2,000 years ago, depending on location within the Greater Everglades ecosystem, and mature tree-island vegetation developed 600-1,200 years ago. After centuries of relative stability, hydrologic changes of the last 100 years have substantially altered fixed tree island size and vegetational composition.

In WCA 2A, water depths were kept too high for the first 13 years of its existence with no seasonal drawdowns. Wetlands converted to deep-water sloughs, and tree islands disappeared (Light and Dineen, 1994). A sediment core collected in the modern tail of such a tree island illustrates some of the paleovegetational patterns (Fig. 2b). Pollen assemblages indicate that the island developed at least 1,900 years ago; from then until the 20th century, taxa characteristic of relatively dry tree-island heads dominated the assemblages. After 1930, however, taxa associated with wetter conditions began to increase, reflecting altered hydrology associated with canal and levee construction. Increased abundance of waterlily (*Nymphaea*) pollen after 1960 reflects the impact of sustained high water. The incorporation of periodic drawdowns into the management scheme beginning in 1974 is mirrored in a shift toward more sawgrass (*Cladium*) pollen. These changes, and those in companion cores, reflect the decreases in size of the tree island in response to sustained high water levels.

In contrast to Water Conservation Area 2A, sites within Everglades National Park were affected by reduced fresh-water flow beginning in the 1930's. In a core collected in the tail of Manatee Hammock in Shark River slough (Fig. 2c), pollen assemblages indicate that mature tree-island vegetation was established ~700 years ago. Initial decreases in fresh water flow ~1930 resulted in loss of marsh and slough taxa; additional reductions after completion of the Water Conservation Areas in the early 1960's is correlated with two to sixfold increases in abundance of ferns, characteristic of drier conditions. This suggests that tree islands in this region, particularly the heads, expanded due to reduced flow in the past century.

Summary and Implications

Everglades tree islands are geologically old features that first developed in response to natural climatic and topographic controls 1,000-2,000 years ago. The original distribution of both strand and fixed tree islands was determined by local topographic highs where water depths were shallower than average, ultimately undergoing sufficient seasonal drying for trees and shrubs to become established. These features have been a distinctive component of the Everglades ecosystem for centuries, but altered water management practices of the past century have changed their vegetational composition and size to varying degrees.

For successful restoration of extremely degraded tree islands, it is necessary to establish both appropriate water depths and seasonality of flow. Restoration efforts should focus on sites of drowned tree islands, because the requisite geologic and topographic parameters exist there. Even with optimal hydrologic conditions, restoration of these features will not be rapid; their development took centuries, so restoration goals should be set accordingly.

While tree islands in some parts of the Everglades have disappeared due to overly long hydroperiods and deep water, those in other regions have become larger due to reduced water supplies. Therefore, restoration plans designed to improve Everglades tree-island health should develop regionally-based performance measures; this would incorporate differences in both hydrology (past, present, and future) and inherent differences in species composition based on latitude within the Everglades.

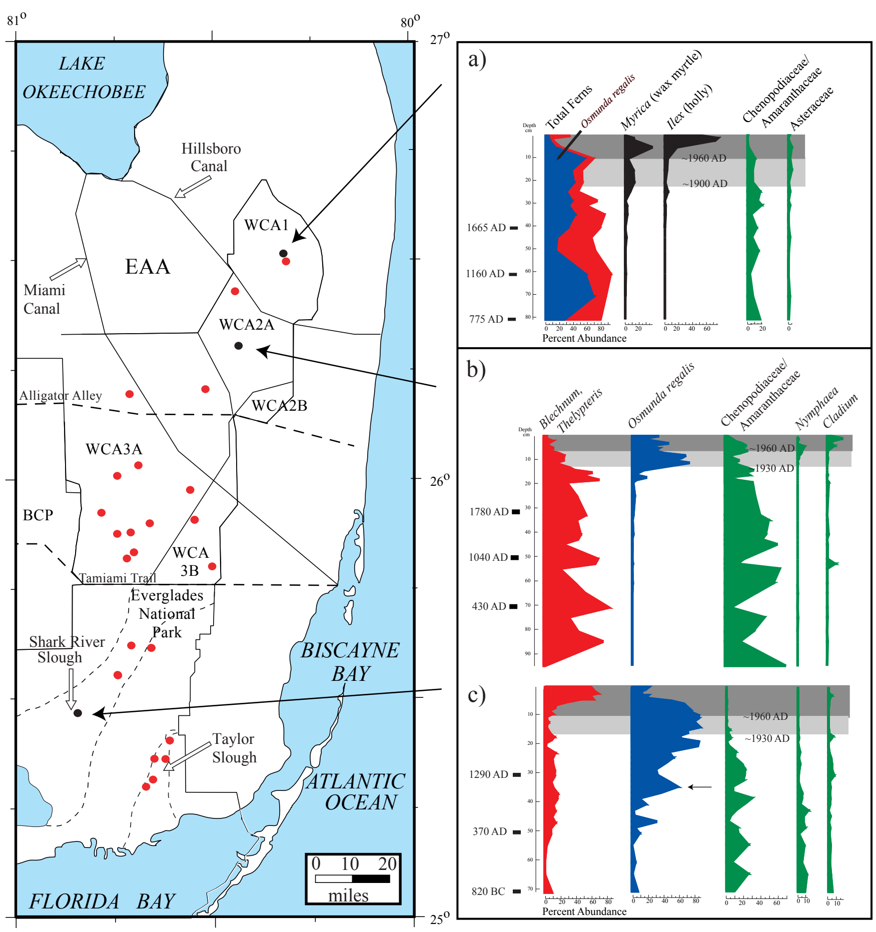

Figure 2. Locality of tree islands sampled in Everglades between 1998-2002; a-c indicate percent abundance of pollen at three sites. a) Strand island, Loxahatchee NWR; b) Treece's Island, Water Conservation Area 2A; c) Manatee Hammock, Everglades National Park. Arrow indicates establishment of mature tree island community. Color coding: blue = taxa indicating wetter tree-island conditions; red = taxa indicating drier tree-island conditions; green = marsh taxa.

Contact Information:

Debra Willard
U.S. Geological Survey
926A National Center
Reston, VA 20192
Telephone: 703-648-5320
Fax: 703-648-6953
Email: dwillard@usgs.gov

Learn more on the Web:
http://sofia.usgs.gov/projects/tree_islands/

References:

Light, S.S. and Dineen, J.W., 1994. Water control in the Everglades: a historical perspective. In: S.M. Davis and J.C. Ogden (Editors), Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, FL, pp. 47-84.

Stone, P.A., Gleason, P.J., and Chmura, G.L., 2002. Bayhead tree islands on deep peats of the northeastern Everglades. In: F. Sklar and A. van der Valk (Editors), Tree Islands of the Everglades, Kluwer Academic Press, Dordrecht.