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Wetland Fire Remote Sensing Research: The Greater Everglades Example

Fire is a major factor in the Everglades ecosystem. For thousands of years, lightning-strike fires from summer thunderstorms have helped create and maintain a dynamic landscape suited both to withstand fire and recover quickly in the wake of frequent fires (Wade and others, 1980). Today, managers in the Everglades National Park are implementing controlled burns (fig. 1) to promote healthy, sustainable vegetation patterns and ecosystem functions (Xu and others, 2011). The U.S. Geological Survey (USGS) is using remote sensing (fig. 2) to improve fire-management databases in the Everglades, gain insights into post-fire land-cover dynamics, and develop spatially and temporally explicit fire-scar data for habitat and hydrologic modeling.

Figure 1. Coastal prairie burn in the Everglades National Park, May 2012. (Photograph by Jennifer Brown, National Park Service.)

Pilot Study Area

The Greater Everglades is a complex ecosystem composed of coastal mangrove swamps, salt marshes, and a variety of interior freshwater systems. Sawgrass dominates wet prairie plains and ridge and slough areas; marl prairies support a broader diversity of marsh species; and wooded areas include subtropical and hardwood hammocks, cypress swamps, and rockland pine forests (Welch and Madden, 1999). The Everglades ecosystem is bordered on the east by a heavily developed urban landscape, on the west by the Gulf of Mexico, and on the north by agricultural lands and Lake Okeechobee.

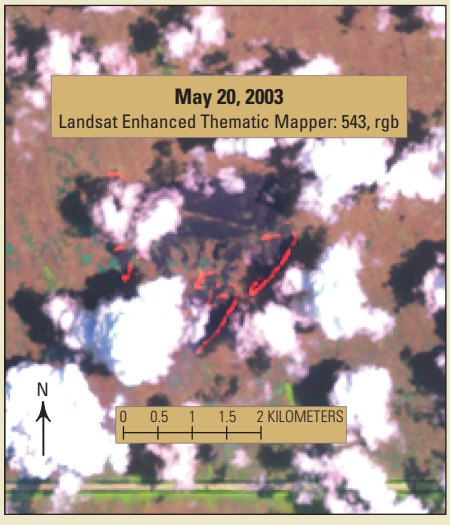

Figure 2. Landsat image showing an actively burning fire in Water Conservation Area 3AN south of Lake Okeechobee in southern Florida.

Part of the USGS Remote Sensing Fire Ecology Study Area (fig. 3) is within the Everglades National Park, where the National Park Service maintains extensive fire records. Because of the wealth of detailed fire information available for the park, it has served as the pilot area for USGS methods development. Remote sensing methods that work well inside the park may be applied in Water Conservation Areas, Big Cypress National Preserve, and other large wetland systems throughout the world.

Cataloging Fire Occurrence

Remotely sensed imagery can be used to locate fire scars on the landscape; however, metrics and algorithms that work well for fire detection in dry locations, such as the American West, have only limited use in Eastern wetlands. Problematic issues unique to eastern wetlands include limited cloud-free imagery, and wet terrain and rapid vegetation re-growth, which produce fire-scar reflectance properties that differ

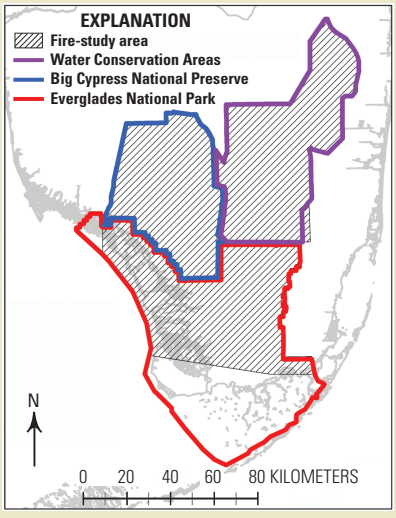

Figure 3. USGS Remote Sensing Fire Ecology Study area (shaded area) in relation to Park and Water Conservation Area boundaries. Florida 2004 coastline courtesy of Florida Fish and Wildlife Conservation Commission—Fish and Wildlife Institute.

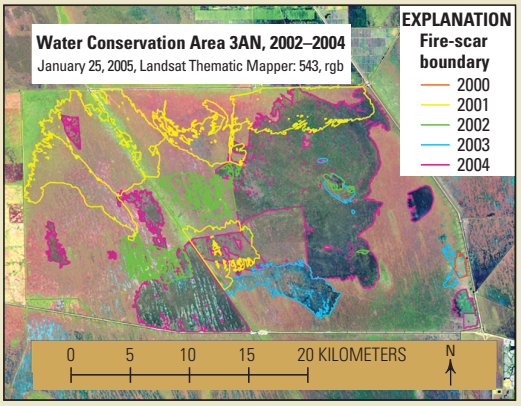

Figure 4. January 2005 Landsat Thematic Mapper image overlaid with GIS polygons delineating fire-scar boundaries in Water Conservation Area 3AN for 2000 to 2004.

from scars in dry locations (Godwin and Kobziar, 2011).

Visual interpretation of high temporal frequency Landsat imagery is a cost-effective alternative with more than 30 years of record available from the USGS at no charge to the user. Visual interpretation is an effective method for locating and mapping fire scars in the Everglades, and it is helping refine fire-scar perimeters in Everglades National Park and other areas of the Greater Everglades (fig. 4).

Tracking Post-Fire Land-Cover Changes

In addition to cataloging fire occurrence in the Everglades, the USGS is developing remote-sensing methods to monitor post-fire land-cover changes (fig. 5). Research is currently directed at quantifying variable vegetation recovery rates both within scars and among scars located in different habitats as well as tracking the return of green vegetation and fuel loads over time. Once this tracking information is calibrated with measurements collected in the field (fig. 6), the information can be used to contribute to both habitat and water modeling efforts in the Greater Everglades ecosystem.

Figure 6. Western coastal prairie monitoring plot before (March 27) and after (September 24) a prescribed burn in 2000. (Photographs from National Park Service.)

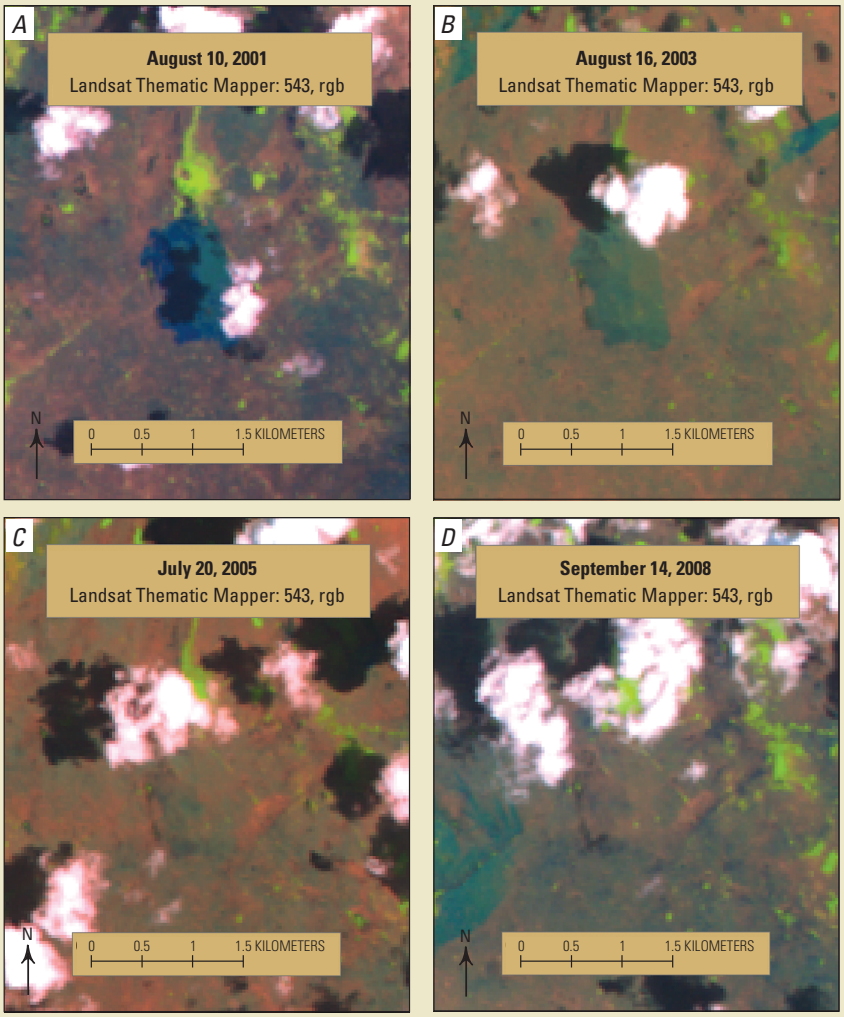

Figure 5. Post-burn progression for a scar in Everglades National Park: (*A*) freshly burned scar, (*B*) scar containing green vegetation and little dead or dry vegetation (fuel), (*C*) increased dry fuel, and (*D*) return of fuel levels similar to pre-burn conditions.

References

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