

## Fire Effects on Flow in Vegetated Wetlands of the Everglades

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Fires are a critical, but not well-understood, dynamic occurrence that randomly and variously affect the Everglades ecosystem. However, fire impacts on subsequent surface-water (sheet) flow conditions have never been investigated. The nature of sheet flow in burned areas has not been documented and compared to adjacent unburned areas and any residual effects of fire on sheet flow behavior during vegetation recovery have not been assessed. The potential impacts of fire disturbances on vegetation and sheet flow behavior should be recognized and considered in the analyses of restoration scenarios being evaluated for the greater Everglades ecosystem.

In the late afternoon of June 2, 2001, lightning ignited a fire about 10 km west of Pa-hay-okee Lookout Tower in Everglades National Park (ENP). The fire was centered in a dense stand of sawgrass (*Cladium jamaicense*) at the headwaters of Squawk Creek, a narrow tributary of Tarpon Bay, approximately 5 km south of the ENP P35 water-level gage (fig. 1). On the afternoon of June 3, a rainstorm extinguished the fire but not before it burned approximately 202 hectares. Residual sawgrass plant stems, about 10 to 15 cm in length, remained above the top of the root zone. The location of the burn area afforded the opportunity to quantify the effects of fire on sheet flow conditions and to investigate flow behavior during vegetation recovery.

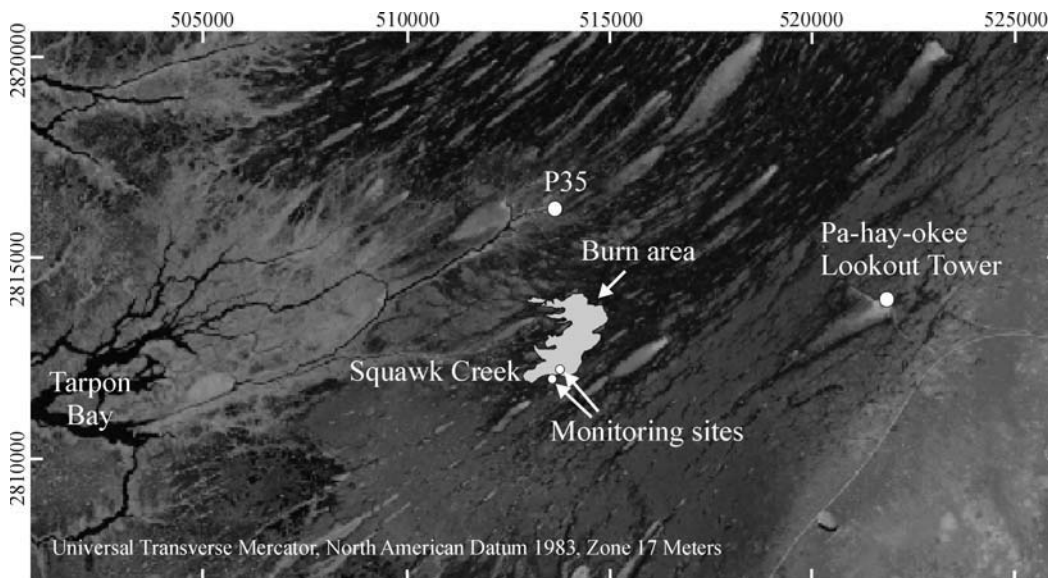


Figure 1. Satellite image of Squawk Creek burn area.

In August 2001, two flow-monitoring stations were established at the southern extent of the Squawk Creek burn area (fig.1). Located in burned and unburned vegetation approximately 280 m apart, each station consisted of a self-recording, point-sampling, acoustic Doppler velocity (ADV) meter. The ADV meters were set to record mean flow velocities simultaneously over two-minute sample intervals every 15 minutes. Analyses of initial continuous ADV data revealed periods during which flow velocities in the burn area were on the order of two times faster than in the unburned vegetation. During intermittent site visits, vertical velocity profiling was conducted at 3-cm depth intervals to document the water-column flow structure (fig. 2a) in conjunction with 10-cm incremental determination of vegetation volume (fig. 2b). Data from eight sets of vertical velocity profiles covering a depth range of 22 to 42 cm revealed similar

two-fold velocity magnitude differences between the sites, particularly in the upper part of the water column (fig. 2a).

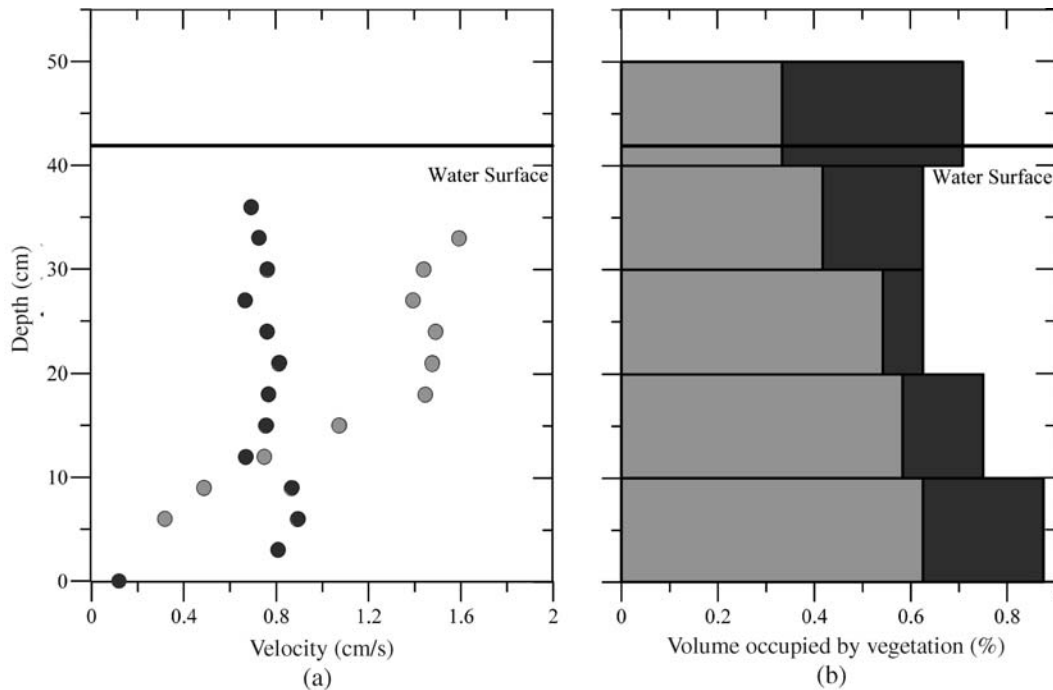


Figure 2. Velocity (a) and vegetation volume (b) measured at the burned (light gray) and unburned (dark gray) sites in June 2002.

During site visits, vegetation types and densities immediately upstream and within the flow paths to the ADV meters were assessed by measuring vegetation properties in selected areas of similar composition in the local vicinity of, but removed from interference with, the ADV probes. Initial vegetation differences, observed in August 2001, included lower plant heights and less biomass in the burn area as implied by the smaller number of leaves per sawgrass culm than in the unburned vegetation. During June and October 2002, emergent stem densities and vegetation volumes (expressed as a percentage of the water column volume) were measured at 10-cm depth intervals in three 0.04 m<sup>2</sup> quadrats at each site. Additionally, the diameters of all plant stems in the top 10 cm of the water column were measured to calculate stem spacing near the water surface. Plant heights were measured and qualitative observations of vegetation type and density also were recorded. In June 2002, the dominant plant species was sawgrass at both sites with lower plant heights measured in the quadrats and observed throughout the burn area. Vegetation volume within the 41-cm water column was less at the burn site (0.54 vs. 0.69 %) (fig. 2b) and stem spacing near the water surface was greater (3.4 vs. 2.5 cm). In October 2002, sawgrass remained the dominant plant species at both sites with lower plant heights again measured in the quadrats and observed throughout the burn area. However, significant quantities of periphyton and muskgrass (*Chara* sp.) also were found in the burn area. Both vegetation volume within the 32-cm water column, which included the periphyton and chara, (1.28 vs. 1.14 %) and stem spacing near the water surface (5.9 vs. 3.6 cm) were greater at the burn site.

Implications from measured, vertical velocity profiles (fig. 2a) are that remnant dead plant stems continue to impart equivalent, pre-fire shear-resistance effects on flow in the lower part of the water column. Although flow depths at the two monitoring stations were similar during all site visits, unit mass flux through the upper part of the water column at the burn site was computed to

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be equivalently greater than at the unburned site due to the greater flow velocities near the water surface. Reduced plant heights above the water surface as well as greater stem spacing just below the water surface appear to yield diminished sheltering effects from wind and reduced shear-resistance effects from vegetation thus contributing to the greater flow velocities in the upper part of the water column at the burn site.

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