SOUTHERN Fire Exchange
Uniting Fire Science and Natural Resource Management

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Management Implications from the *Fire Ecology* Journal Special Issue on Fire in Wetlands

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Accessible fire science

In the spring of 2013, the journal *Fire Ecology* published a special open-access issue[1] on fire in wetland ecosystems that contained a significant emphasis on wetland environments in Florida. For readers intent on understanding research methodologies and analysis, the articles offer a wealth of detailed information. For those primarily interested in only the "take-home" messages, this research highlight presents a very brief summary of the focus of each study and the implications (in some cases preliminary) for management applications.

Fire effects on nitrogen cycling in native and restored calcareous wetlands

Liao, X., Inglett, P., and Inglett, K.
DOI: 10.4996/fireecology.0901006

In the Florida Everglades, much management effort has been exerted towards restoring ecosystems and natural fire regimes. Understanding nitrogen and phosphorus dynamics is an important element in restoration plans. The authors assessed wetland soil nitrogen cycling in burned and unburned sites in a section of the Everglades National Park that has been undergoing extensive restoration from the previous agriculture condition.

The effect of prescribed burning on soil nitrogen varied greatly but inconsistently by the stage of the nitrogen cycle and by the ecosystem condition (restored vs. natural reference, burn vs. control). One restoration goal in these ecosystems is to move sites from low nitrogen, high phosphorus availability to more natural phosphorus-limited conditions. The results of this study suggest that a high frequency burning cycle may work against this goal. Restoration activities and prescribed fire management programs in this region need to consider the differential impacts of fire frequency on N and P cycles.

Fire disturbance frequency and intensity can result in significant changes in wetland ecosystem structure, function, and composition. Photo by Larry Korhnak.

Impacts of fire on microbial carbon cycling in subtropical wetlands

Medvedeff, C., Inglett, K., Kobziar, L., and Inglett, P.
DOI: 10.4996/fireecology.0901021

Fire can substantially influence soil microbial processes, carbon cycling, and nutrient dynamics in wetland ecosystems. The authors assessed the influence of prescribed fire on soil carbon cycling one day, one month, and one year post fire on Everglades sites undergoing intense restoration efforts and on "native" sites that provided ideal reference.

Carbon responses to a single prescribed fire varied inconsistently between the native and restored sites with significant fluctuations observed in nearly all measured parameters. Initial stimulation of methane and carbon dioxide production in reference (low phosphorus) wetlands suggests fire may have a short-term adverse effect on carbon cycling, evidenced by augmented greenhouse gas production. This trend was not observed in restored sites. Wetland restoration programs need to recognize that fire effects on previous agriculture areas may not be the same as for natural site conditions. Differences in fire response may be driven by initial soil nutrient concentrations and associated fire derived nutrient inputs.

[1]This document summarizes numerous articles contained within the following journal issue:
Fire Ecology 9(1) DOI: 10.4996/fireecology.0901. To access the full article, visit http://fireecology.org/journal/issue/?journal=24.

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Tree island response to fire and flooding in the short hydroperiod marl prairie grasslands of the Florida Everglades, USA

Ruiz, P., Sah, J., Ross, M., and Spitzig, A.
DOI: 10.4996/fireecology.0901038

Tree islands are upland ecosystems within the Everglades that are generally surrounded by pyrogenic graminoid wetlands and prairies. These wetlands and prairie grasslands are dependent on frequent fire for maintaining species composition, structure, and function. Tree islands, on the other hand, can be severely damaged or destroyed by fire. This study investigated the interaction between fire and pre- and post-fire hydrologic conditions on tree island burn status and recovery.

The authors used remote sensing, GIS, and water table depth records to assess fire damage and recovery on 7400 tree islands following a 2008 wildfire in Everglades National Park. Results showed that 1) tree islands with a lower nearby water table were more likely to burn as a result of a wildfire than tree islands where the water table was closer to the surface; 2) tree islands with short hydroperiods after the fire and larger tree islands had greater vegetation recovery; and 3) tree island size, pre-fire marsh water levels, and post-fire hydroperiods appear to be indicators of tree island fire effects and post-fire recovery. The authors caution, however, that intentionally raising the water table to protect tree islands during a fire may also result in post-burn tree island flooding that can hinder tree island vegetative recovery.

Multi-year salutary effects of windstorm and fire on river cane

Gagnon, P., Passmore, H., and Platt, W.
DOI: 10.4996/fireecology.0901055

River cane (*Arundinaria gigantea*, also called giant cane) was once found in floodplain forests throughout the Southeast, growing in expansive, disturbance-dependent stands, called canebrakes. Restoration projects that seek to increase or maintain canebrake areas may benefit from recent research on the role of fire and wind disturbance in canebrake ecology. Plots were assessed four years after several prescribed fires and seven years after tornado blowdown.

Each disturbance had positive effects on cane growth. Plots disturbed by either fire or windthrow contained approximately twice as many stems as plots not subjected to disturbance. Plots impacted by both windstorm and fire had the highest density of all the sample plots—implying that fire and windstorms worked multiplicatively to produce denser, healthier canebrakes. Disturbances play a key role in "resetting" cane stands and the authors recommended burning both open-grown and forest-grown canebrakes every three to eight years to maximize density and to protect stands from local disease-related mortality as well as natural senescence.

Dynamics of mangrove-marsh ecotones in subtropical coastal wetlands: fire, sea-level rise, and water levels

Smith, T., Foster, A., Tiling-Range, G., and Jones, J.
DOI: 10.4996/fireecology.0901066

Ecotones are boundaries between ecosystems and vegetation types. In South Florida, the boundary between coastal mangroves and coastal marshes represents a common ecotone between two ecologically important ecosystems. This study took a long term view on how fire, sea level and water levels influence the location of mangrove and marsh ecotones.

The authors utilized fire perimeter GIS records, Everglades Park hydrologic records, NOAA sea level records, and a digitized series of historical aerial photos at three locations within the park to evaluate changes between 1928 and 2004 in the observed boundaries between mangroves and marshes. At two of the sites overall increases in mangroves and decreases in the marshes were not correlated with sea level or water depth records, but at least one site suggested that more frequent fire was associated with an expansion of the mangroves. Managers interested in promoting either of these vegetation types may want to establish monitoring plots to assess the long-term results of their fire management programs.

Foraging wading bird (*Ciconiiformes*) attraction to prescribed burns in an oligotrophic wetland

Venne, L., and Frederick, P.
DOI: 10.4996/fireecology.0901078

Despite decades of active fire management in many South Florida wetlands relatively little is known about the effects of fire on wetland-dependent wildlife species such as the long-legged wading birds (herons, egrets, ibises, storks, and spoonbills). Venne and Frederick conducted weekly aerial surveys of six units that were burned with prescribed fire in the central Everglades between the months of February and April. They also conducted focal sampling of individual wading birds and sampled post-burn prey populations.

The authors determined that great egrets and white ibis preferred to feed in flooded sawgrass sites that were recently burned and abandoned those burned sites when water levels dropped below the surface of the ground. Great egrets were more efficient capturing prey in flooded sawgrass sites that were recently burned than in the adjacent sloughs, likely due to increased prey availability. The authors suggest that burns may provide short-term wetland habitats for predators such as wading birds to forage.

Evaluating methods to restore amphibian habitat in fire suppressed pine flatwoods wetlands

Gorman, T., Haas, C., and Himes, J.
DOI: 10.4996/fireecology.0901096

In the isolated wetlands embedded within the longleaf pine flatwoods, the ecological role of fire and the implications of

prolonged fire exclusion are not well understood, particularly with regards to the amphibian species that depend on those wetlands, including the reticulated flatwoods salamander, a federally endangered species. Previous research suggests that for some amphibians, such as the reticulated flatwoods salamander, frequent fire may be beneficial for maintaining relatively open canopies and herbaceous groundcover around breeding wetlands. If fire has been excluded, mechanical opening of the canopy (felling smaller stems), herbicides, and/or prescribed fire may be necessary to create those conditions.

This study looked at these treatments in the Florida Panhandle. While only first year results were presented, preliminary results do suggest that fire, especially in combination with mechanical and herbicide removal of hardwood and shrub stems, can transition fire-suppressed wetlands toward conditions with a more open canopy and herbaceous ground cover is more suitable for a diverse amphibian community.

Successional and transitional models for restoration and management of natural South Florida, USA, plant communities

Duever, M. and Roberts, R.
DOI: 10.4996/fireecology.0901110

South Florida contains a unique variety of ecosystems, many of which are distinct from those found in North and Central Florida. Duever and Roberts developed graphical models that describe the relationships among 21 plant communities in terms of the regions two major natural and management-influenced environmental processes: hydrology and fire.

Two of the models for mineral and organic soils describe likely transitions among the plant communities in terms of hydrology and fire characteristics (return interval, intensity, growing or dormant season and severity). In addition, the authors provide an excellent discussion of how rates of change across transitions to earlier or later successional stages may vary significantly depending on direction of change and a number of ecological factors. Land managers can use the successional and transition models to understand long-term implications of their management decisions relative to their goals for maintaining or restoring specific plant communities. In addition, the models can help managers anticipate the implications of human activities on surrounding lands and improve their ability to maintain desirable plant communities on their own management areas.

Smoldering combustion and ground fires: ecological effects and multi-scale significance

Watts, A., and Kobziar, L.
DOI: 10.4996/fireecology.0901124

Typically burning slowly over long periods of time, ground fires burn in a relatively low-temperature (500° to 700° C), flameless, low-oxygen process known as smoldering combustion. This literature review of smoldering combustion in organic soils focused on the effects on human health and ecological conditions. Most of the negative effects are well known: impacts on roadway visibility and inhalation of $PM_{2.5}$ and other pollutants; releases of large amounts of carbon into the atmosphere; mortality in vegetation communities as the organic soil is consumed; and changes in local water storage due to changes in microtopography. The authors propose that some of the microtopographic changes may benefit animal species that are dependent on isolated depressions that retain water during dry periods. Thus, ground fires may play an important role in wetland ecosystems by maintaining open water in isolated wetlands. Currently these implications are generally not considered when planning the management of landscapes with fire and the authors suggest that future management strategies should incorporate them when possible.

Wetland fire scar monitoring and analysis using archival Landsat data for the Everglades

Jones, J., Annette, H., Foster, A., Smith, T.
DOI: 10.4996/fireecology.0901133

Mapping of landscape level fire scars can provide valuable information for researchers and management personnel. Using the Landsat archive, the authors delineated 11 years of fire scars in the Everglades to assess vegetation changes as functions of water depth and fire type (prescribed/wild). Fire scars where the maximum water depth during the year of the fire was less than 6 inches returned to pre-burn conditions most rapidly (2.9 years on average), suggesting that these conditions support a two to three-year burn interval. Fire scars in wetter locations where water depths during green-up exceed 10 to 11 inches, and fires in drier locations that typically experience large fluctuations in water depth (>11”), take longer to regrow and may support less frequent burning (~ three to five years). As Landsat images are available at no cost similar methods could be used in other wetlands to assess fire impacts on vegetation dynamics.

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For more information on the Southern Fire Exchange visit www.southernfireexhchange.org or email contactus@southernfireexchange.org.

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