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Long-term effects of fire frequency and season on herbaceous vegetation in savannas of the Kruger National Park, South Africa

Melinda D. Smith [1,*], Brian W. van Wilgen[2], Catherine E. Burns[3], Navashni Govender[4], Andre L. F. Potgieter[4], Sandy Andelman[5], Harry C. Biggs[4], Judith Botha[4] and Winston S. W. Trollope[6]

[1] Department of Ecology and Evolutionary Biology, Yale University, PO Box 208106, New Haven, CT 06520, USA
[2] Centre for Invasion Biology, Council for Scientific and Industrial Research Natural Resources and the Environment, PO Box 320, Stellenbosch 7600, South Africa
[3] North Carolina Chapter Office, The Nature Conservancy, 4705 University Drive, Suite 290, Durham, NC 27707, USA
[4] Scientific Services, South African National Parks, Private Bag X402, Skukuza 1350, South Africa
[5] Tropical Ecology, Assessment and Monitoring (TEAM) Network, Conservation International, 2011 Crystal Drive, Suite 500, Arlington, VA 22202, USA
[6] Department of Livestock and Pasture Science, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa
[*]Correspondence address. Department of Ecology and Evolutionary Biology, Yale University, PO Box 208106, New Haven, CT 06520, USA. Tel: 203-432-9422; Fax: 203-432-5176; E-mail: melinda.smith@yale.edu

ABSTRACT

Aims: The long-term effects of changing fire regimes on the herbaceous component of savannas are poorly understood but essential for understanding savanna dynamics. We present results from one of the longest running (>44 years) fire experiments in savannas, the experimental burn plots (EBPs), which is located in the Kruger National Park (South Africa) and encompasses four major savanna vegetation types that span broad spatial gradients of rainfall (450–700mm) and soil fertility. Methods: Herbaceous vegetation was sampled twice in the EBPs using a modified step-point method, once prior to initiation of the experiment (1954) and again after 44–47 years. Different combinations of three fire frequency (1-, 2- and 3-year return intervals) and five season (before the first spring rains, after the first spring rains, mid-summer, late summer and autumn) treatments, as well as a fire exclusion treatment, were applied at the plot level (;7 ha each), with each treatment (n = 12 total) replicated four times at each of the four sites (n = 192 plots total). The effects of long-term alterations to the fire regime on grass community structure and composition were analyzed separately for each site.
Important Findings: Over the 44+ years duration of the experiment, fires were consistently more intense on sites with higher mean annual rainfall (>570 mm), whereas fires were not as intense or consistent for sites with lower and more variable rainfall (<510 mm) and potentially higher herbivory due to greater soil fertility. Because the plots were open to grazing, the impacts of herbivory along with more variable rainfall regimes likely minimized the effects of fire for the more arid sites. As a consequence, fire effects on grass community structure and composition were most marked for the higher rainfall sites and generally not significant for the more arid sites. For the high-rainfall sites, frequent dry season fires (1- to 3-year return intervals) resulted in high grass richness, evenness and diversity, whereas fire exclusion and growing season fires had the lowest of these measures and diverged the most in composition as the result of increased abundance of a few key grasses. Overall, the long-term cumulative impacts of altered fire regimes varied across broad climatic and fertility gradients, with fire effects on the grass community decreasing in importance and herbivory and climatic variability likely having a greater influence on community structure and composition with increasing aridity and soil fertility.