

Public Abstract

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Graduation Term:FS 2015

Department:Biological Sciences

Degree:PhD

Title:The Spatial Dimensions of Savanna Fire Ecology in Kruger National Park, South Africa

Savannas are thought to be bistable with forests potentially occurring above ~650 mm / yr of Mean Annual Precipitation (MAP) due to the limiting effects of fire on tree cover. This is predicated on two assumptions: 1) fires increasingly limit woody cover in more mesic (> 650 MAP) savannas and 2) increasing tree cover produces feedbacks that reduce fire intensity. These assumptions are investigated in a spatially explicit framework. We use Kruger National Park (KNP), South Africa as our study system, in part due to the wide range of frequency of fires, the large variation in natural communities and rainfall, and the large body of previous research for comparisons and modeling efforts. To investigate whether tree cover produces feedbacks on fire intensity, we measured fire behavior as a function of grass fuel load and woody cover in experimental burns within KNP. We found weak but positive relationships (not negative, as assumed) between woody cover and fire intensity, independent of grass fuel load, and no relationship between tree cover and grass fuel load. At a landscape scale, we modeled the factors predicted to drive fire severity in KNP. We observed that fireline intensity is a strong predictor of many estimations of fire severity in small fires, but across larger fires, rainfall and woody cover likewise can predict impacts on herbaceous consumption and woody cover, respectively. Lastly, to investigate whether trees escape fire less often in more mesic savannas, we used a stochastic model parameterized with real data. After a review of published growth rates, we modeled fire escape probability using mean annual precipitation, fire frequency, and fireline intensity values across KNP. When accounting for species turnover across rainfall gradients, we found a nearly flat relationship between the probability of individuals escaping fire and rainfall. Our research challenges two key assumptions for fire-mediated bistability of mesic savannas.