



Session 7: Bush encroachment I

Chair: Ntuthuko Mkhize

Effects and use of multiple ignitions for controlling encroaching shrub species in north-eastern KwaZulu Natal

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Bush encroachment in natural grasslands and savannas has become a serious problem for domestic livestock ranchers and wildlife managers in South Africa. In this regard a major problem is the alien invasive shrub species chromolaena (*Chromolaena odorata*) and the indigenous shrub species sickle bush (*Dichrostachys cinerea*) which have and continues to invade extensive coastal forest and thornveld areas in Zululand in north eastern KwaZulu Natal. Chemical and mechanical means of controlling these encroaching species are very costly and fire is an alternative and economically attractive method. However, burning requires extreme weather conditions for generating high intensity fires required to have a significant effect in reducing the extent and degree of this bush encroachment. This translates into applying prescribed burns under dangerous conditions with a high fire risk. As a possible solution to this problem experience gained with prescribed burning in the Kruger National Park during 2010 led to the conclusion that high intensity fires may be achieved under less extreme weather conditions by using multiple ignitions. This hypothesis was tested in field trials during 2012 using multiple aerial ignitions applied as Spiral and Race Course ignitions versus Perimeter ignitions to four hectare plots with a helicopter. The trials showed that the multiple ignitions resulted in fire intensities measured with an infrared camera were approximately three times more intense than perimeter ignitions which is currently the standard ignition procedure for applying prescribed burns. These results were tested on a field scale using 30 hectare plots in Zululand in KwaZulu Natal in areas severely encroached by chromolaena and sickle bush. The effects of the multiple and perimeter ignitions were assessed in terms of percentage kill of the two encroaching species and the reduction in phytomass of the shrubs expressed in tree equivalents per hectare. These initial results have shown that the multiple ignitions have caused a significant reduction in the phytomass of both encroaching shrub species but in terms of mortality only the chromolaena was highly susceptible to fire in contrast to the low percentage kill of sickle bush similar to results found in burning trials in the Kruger National Park. These results are providing practical guidelines for using integrated fire management for assisting with the control of chromolaena using fire alone and/or in combination with spraying with herbicides.

Keywords: bush encroachment, alien plant, fire



Local vs. landscape effects of bush encroachment on abiotic conditions and herbaceous composition and productivity

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Bush encroachment is a global phenomenon that has important impacts on grassy ecosystems, causing potentially rapid shifts to functionally distinct forest or thicket. Key to the regime shift between grassland and forest appears to be the loss of a flammable C₄ grass layer, as C₄ savanna grasses generally have low shade tolerance. As the canopy cover of woody plants increases in grasslands and savannas, abiotic conditions including light, soil moisture and nutrient availability change, resulting in altered grass species composition and productivity. These changes have important ecological and economic consequences. Individual large trees often have a net positive effect on herbaceous productivity and quality at the local (i.e. subcanopy vs intercanopy) scale. Bush encroachment, on the other hand, has generally been found to have a negative effect on herbaceous productivity at the landscape scale. Despite this apparent contradiction, research at the two scales has had surprisingly little integration. We quantified light availability, soil moisture, frost occurrence and herbaceous basal cover (total and by species) at 800 transect points representing sub- and intercanopy microhabitats at four sites (open, and approximately 25, 50 and 75 % canopy cover), and determined how the local “tree” effect (i.e. differences in the inter- vs. subcanopy) scaled up to the landscape scale with increasing tree cover. Herbaceous productivity was measured in paired exclosures in the sub- and intercanopy microhabitats at the sites with 25, 50 and 75 % tree cover. Compared to the open, the subcanopy habitat had lower light availability, but increased shading of the intercanopy at higher tree density resulted in a greater than expected overall light availability at encroached sites. Tree canopies reduced soil moisture, though this effect was not consistent and appeared primarily after lighter rainfall events. Frost was significantly reduced under tree canopies and at higher tree density. Herbaceous basal cover and productivity was lower in the subcanopy microhabitat, which was dominated by the C₃ species *Panicum aequinerve*. The four most common C₄ species became less dominant in the subcanopy, and the abundance of *Themeda triandra* in the inter-canopy decreased significantly with increasing tree cover, but the dominant C₄ grass species were still commonly encountered under the lowest light conditions (< 20 % transmittance). There was thus no evidence for the exclusion of flammable C₄ grass species under bush encroachment in this study site, although their basal cover and biomass did decrease under dense tree cover. Overall, we found that the local tree effects were generally negative (reduced light, equal or lower soil moisture, lower ANPP) and that this scaled up to the landscape scale, though in some cases to a greater degree than would have been predicted based on the subcanopy/inter-canopy differences alone. We attribute the greater than expected persistence of sun-loving C₄ grasses under even fairly dense bush encroachment to the very low stocking rates at our study site. If further research confirms this, it has important implications for managing areas that have become encroached by savanna trees.



Is there an ecological and cost-effective answer to controlling bush encroachment?

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The problem of bush encroachment is widespread throughout southern Africa and affects not only the livestock industry but also the game industry resulting in extensive areas becoming less productive and therefore economically less viable. The conventional and more popular methods of controlling bush encroachment are the use of herbicides and/or mechanical clearing of the bush, both of which are costly. Fire is a natural factor of the environment and has fewer long term negative effects on ecosystem functioning so is more ecologically acceptable. Since the income from the Game Industry alone in South Africa is estimated to be R16 billion per year, cost effective, environmentally sensitive, effective prescribed burning programmes for controlling bush encroachment can be of benefit not only to the game sectors but the same technology can benefit the agricultural sector too. Two very simple and repeatable vegetation survey techniques used to assess the condition of the herbaceous and woody vegetation, quantifies the condition of the veld using ecological criteria to assess whether the vegetation qualifies to withstand the disturbance of a prescribed burn. Similarly the assessment techniques, a step-point full species grass survey technique to assess the condition of the grass sward, as well as an adaptive point centred quarter technique to assess woody vegetation, quantitatively assess the ecological status and response of both the herbaceous and woody vegetation pre and post burn. The veld condition assessment data on Phinda Private/Mun-ya-wana Game Reserve and adjacent wildlife areas, provides scientific evidence that prescribed burning programmes can in fact cause a shift in vegetation from a bush encroached scenario to open grassland. This data also provides evidence that ecologically based burning programmes change the ecological status of the grassland from less palatable Increaser dominated sward to a more palatable Decreaser dominated sward. The Phinda Private/Mun-ya-wana Game Reserve has been applying ecologically based prescribed burns since 2001 resulting in a significant improvement in veld condition, and a 114% increase in numbers of game animals as reflected in the trends in the annual game census conducted from 2004 to 2010. The data also clearly shows a significant reduction in density and phytomass of woody species.

Keywords: bush encroachment, veld condition assessments, prescribed burning