



Session 2: Vegetation change

Chair: Tony Palmer

Systematic land-cover change in KwaZulu-Natal, South Africa

Debbie Jewitt^{1}, Peter Goodman², Barend Erasmus³, Tim O'Connor⁴ and Ed Witkowski³*

¹Ezemvelo KZN Wildlife, South Africa; ²Wildlife Conservation Solutions, South Africa; ³University of the Witwatersrand, South Africa; ⁴South African Environmental Observation Network, South Africa. Email: debbie.jewitt@kznwildlife.com

Habitat loss is recognised as one of the major drivers of biodiversity loss in the world. KwaZulu-Natal (KZN) contains high levels of biodiversity but is experiencing a rapid loss of natural habitat. The patterns, processes and rates of land-cover change in the province were investigated in order to effectively plan for biodiversity conservation. The Intensity Analysis Framework was used to investigate the systematic land-cover changes occurring in the province using three land-cover maps (2005, 2008 and 2011) developed by Ezemvelo KZN Wildlife. Using the national 1994 and 2000 land-cover maps, the rates of habitat loss between 1994 and 2011 were determined. Between 2005 and 2011, 7.6% of the natural habitat of the province was converted to anthropogenic land-uses. Habitat loss was driven by agriculture, timber plantations, the built environment, dams and mines. The swapping of anthropogenic categories back to secondary vegetation was tracked. The rate of habitat loss since 1994 was 1.2% per annum. The biodiversity conservation implications of these landscape changes are discussed and recommendations for fulfilling legislative requirements, such as fulfilling criteria B (rate of loss of natural habitat) of the national list of threatened ecosystems in need of protection, are made. The loss of natural habitat in KZN is significant, posing challenges for biodiversity conservation. Bolder thinking on the part of conservation professionals is required if this biodiversity is to be safeguarded for future generations to enjoy and benefit from.

Keywords: biodiversity, conservation, habitat loss, Intensity Analysis Framework, legislation



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Using *Acacia tortilis* demography to predict vegetation shift in the gravel plains of Sharjah, United Arab Emirates

Lisa Hebbelmann

Environment and Protected Areas Authority, Sharjah, United Arab Emirates. Email: lisahebbelmann@gmail.com

Elebredi protected area presently conserves a small area of the last remaining *Acacia tortilis* woodland in the Emirate of Sharjah, UAE. Protection for the last three years has provided a platform to examine *A. tortilis* recruitment, seedling, and small tree survivability through harsh summers in the absence of heavy browsing pressure and harvesting in surrounding areas. Inland gravel plains characterized by tall *A. tortilis* trees are experiencing a vegetation shift from *A. tortilis* tree-dominated vegetation to a shrub-dominated state. With this change there is a decrease in plant biomass causing rain water infiltration to decrease. This results in a higher water runoff and subsequent loss of fertile topsoil to erosion by wind, leading ultimately to decreased perennial plant diversity. An analysis of aerial imagery has revealed that between 2005 and 2015 a 15% decrease in *A. tortilis* trees in some areas. Recruitment is low, when present, with seed germinability reduced by high bruchid beetle infestations (70±16%). Since heavy grazing by camels has been described as the greatest threat to biodiversity in the UAE, this study aimed to examine whether an *A. tortilis* population would be able to successfully recruit in the absence of these large herbivores. The inland region of the UAE received a comparably high rainfall during the 2014 rainy season (approximately 80 mm) and extremely low rainfall in the 2015 rainfall season (10 mm). The high 2014 rainfall resulted in high *A. tortilis* germination rates both in and outside of the Elebredi Protected Area where up to 4±2.7 seedlings/m² were measured within the protected area and 1.4±1.6 seedlings/m² outside the protected area. This provided an opportunity to examine seedling and small tree survival over the harsh summer months in the absence and presence of herbivores. Mortality of seedlings was 69.8% within the protected area and 100% outside the protected area resulting in a significantly lower seedling density of 1.6±2.9 seedlings/m² ($t_9=2.2$, $p<.001$) in the protected area. In the protected area seedlings that were able to survive the harsh summer months grew 1.9 ±6.9 cm in height with an average increase in the number of branches or stems from 1.2±0.6 in 2014 to 1.9±1 in 2015. A simple model using a 10-year rainfall cycle estimation for the Emirate of Sharjah predicts that although seedling survival in the protected area is extremely low, current recruitment success over time should result in an increase in seedling and small tree densities over the next 20 years, providing seed germination can occur during years with high rainfall. This would agree with similar studies where tree biomass production increased when camels were excluded from rangeland areas. Unfortunately it appears that the complete absence of recruitment outside the protected area will result in a vegetation shift from *A. tortilis* dominated gravel plains to shrub dominated gravel plains affecting the biodiversity, carrying capacity and the provision of ecosystem services.

Keywords: *Acacia tortilis*, recruitment, seedling survival, vegetation shift, herbivory



The effects of gut passage and dung fertilization on seedling establishment of
Dichrostachys cinerea and *Acacia nilotica*

Julius T Tjelele^{*1,2}, David Ward² and Luthando Dziba³

¹Agricultural Research Council, Animal Production Institute, South Africa; ^{*2}College of Agriculture, Engineering and Science, University of KwaZulu-Natal, South Africa; ³CSIR, Natural Resources and the Environment, South Africa.
Email: jtjelele@arc.agric.za

Dichrostachys cinerea and *Acacia* species pods have higher nutritive value than grasses and other browse plants during the dry season and form an important part of the diet of livestock. Ingested seeds of these species pass through the digestive tract of livestock and usually remain viable even after mechanical (chewing) and chemical (digestive) scarification. We studied seedling emergence, seedling establishment and recruitment of *D. cinerea* and *A. nilotica* seeds dispersed by cattle and goats under natural conditions. Significantly more *A. nilotica* and *D. cinerea* seeds were retrieved from cattle (40.0±3.6% and 25.7±3.9%, respectively), than goats (11.7±3.1% and 13.2±3.8%, respectively). However, there was a significant interaction between animal species (goats, cattle) and other factors such as seed recovery day, seed germination treatment (seeds placed on top of the soil with no dung, seeds buried 2 cm under the soil with no dung, seeds buried 2 cm under the soil with dung) and season (dry, wet) on percentage seedling recruitment. Most importantly, seeds retrieved from goats (11.96±0.06%) recruited significantly better than seeds retrieved from cattle (7.62% ± 0.05) and control seeds (i.e. no passage through the gut) (4.12±0.02%). More seeds can potentially germinate and recruit following seed ingestion by goats than cattle and untreated seeds. Goats may facilitate woody plant encroachment by enhancing seedling emergence.

Keywords: dung nutrients, recruitment, scarification, seedling emergence, woody plant encroachment



Regular fire maintains stable grasslands in the KwaZulu-Natal Drakensberg: Evidence from a long-term burning trial

Colin S Everson^{1*}, Terry M Everson² and Craig D Morris³

¹South African Environmental Observation Network (SAEON), South Africa; ²University of KwaZulu-Natal, South Africa; ³Agricultural Research Council, South Africa. Email: colin@saeon.ac.za

Extensive component and long-term research in southern Africa has been devoted to understanding the effects and potential role of fire on mesic grasslands. The replicated (n = 3) Brotherton burning experiment in the important catchments of the KwaZulu-Natal Drakensberg is particularly valuable because 11 different combinations of different frequencies and seasons of burn have been applied since 1982. Botanical composition has been consistently sampled by the same team (C & T Everson) every second year during the first 10 years of the trial, and in 2004 and 2015. Some treatments were terminated in 2000, but seven have been maintained. Distance-based multivariate control charts indicated that annual or biennial burning, irrespective of dormant season (autumn, winter, spring) and intensity, maintained temporal fluctuations in grassland composition within the bounds of expected random deviations from the original composition. In contrast, a summer burn rapidly and markedly depleted grasses and overall cover, and increased herbaceous forbs. Fire protected plots and, to a lesser extent those burned every 5 years, moved steadily and predictably away from their initial state. The key changes induced by eliminating regular fire was an initial shift from dominance by the pyrophilous grass, *Themeda triandra* to a greater abundance of fire-sensitive species such as *Tristachya leucothrix* and *Stiburus alopecuroides*. This was followed by an increase in *Harpochloa falx* and a proliferation of herbaceous forbs as well as native and exotic shrubs. It is concluded that regular controlled burning during the dormant season is required to maintain the composition of mesic grassland in a stable state, and that untimely burning and fire suppression constitutes an important undesirable disturbance to the stability and structure of the montane grassland ecosystem.

Keywords: burning, fire frequency, long-term trial, season, species composition



Fire in the Nama-Karoo – a shift from dwarf-shrubland to sparse grassland

*Justin C O du Toit*¹, Loraine van den Berg¹ and Tim O'Connor²*

¹Department of Forestry and Fisheries, Grootfontein Agricultural Development Institute, South Africa. ²South African Environmental Observation Network, South Africa. Email: justindutoit@gmail.com

The Nama-Karoo biome in South Africa is dominated by dwarf shrubs with grasses, shrubs, geophytes and herbs at varying levels of abundance. The position of the Nama-Karoo/grassland boundary is determined in part by rainfall amount, and in recent years there has been an increase in grassiness, correlated with good rains. This has allowed wildfires, an unusual occurrence, to burn at several sites in the central and eastern regions of the biome. The general effect of fire has been to convert dwarf shrublands to grassland with the extirpation of several nonsprouter species. It is anticipated that these non-sprouters will recolonise by seed over time, but could be eliminated if fire frequency is high enough to eliminate their seedbank. It is predicted that if grassy conditions persist in the Nama-Karoo, then fire will be an important factor that shapes the Nama-Karoo rangeland boundary.

Keywords: biome shift, non-sprouter, resprouter

The effects of fire on species and growth form diversity in Namaqualand Granite Renosterveld

Megan B Simons^{1,2}, M Igshaan Samuels^{1,2}, Clement F Cupido^{1,2}, Richard S Knight¹,
Melvin B V Swarts²*

¹University of the Western Cape, South Africa; ²Agricultural Research Council, Animal Production Institute, South Africa. Email: SimonsM@arc.agric.za

Renosterveld is one of the richest vegetation types in terms of plant diversity in South Africa. However, this vegetation type is severely fragmented and transformed. Presently, less than 9% of the original extent of Renosterveld remains in South Africa, of which less than 2% is formally conserved. Namaqualand Granite Renosterveld is a near-endemic and highly threatened vegetation type in Namaqualand and has been severely transformed by cropping and grazing. In addition, renosterveld is under threat from frequent unplanned fires. Over the last 15 years, more than 20 fire incidences have occurred in the Kamiesberg Uplands where renosterveld is present. The aim of this study is to assess the post-fire plant recovery mechanisms adopted by plants and the effects fires have on the plant diversity of renosterveld over time. This study was conducted in the Leliefontein communal area in Namaqualand. Historical data from NASA fire archive <http://rapidfire.sci.gsfc.nasa.gov/> was used to study the occurrences of fires and determine the fire regime for the Kamiesberg Uplands. Vegetation sampling commenced from April to September 2014. Ten burned and 10 adjacent unburned sites were selected for the study. The effects of fire on plant diversity and post-fire vegetation recovery were assessed using 10 x 10 m quadrats in each site. The Shannon-Weiner diversity index was used to determine alpha diversity at each site and within each growth form. Preliminary results show that there was no statistically significant difference ($p > 0.05$) in alpha diversity of the burned and its adjacent unburned site. Growth forms responded differently to fire, being that their diversity did not change significantly ($p > 0.05$). However, herbs and succulents showed a significant decrease ($p < 0.05$) in alpha diversity in the burned areas. Over time the species and growth form diversities did not change, except for non-succulent shrubs that showed a significant positive increase over time ($p < 0.05$), as fire presumably promoted their growth. In general, the data point to the fact that plant diversity is not solely affected by fire alone but possibly by livestock grazing and biophysical factors as well.

Keywords: fire, diversity, Namaqualand Granite Renosterveld, semi-arid rangeland, Kamiesberg Uplands