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Grassroots

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Myths about impact of

Elephants on big trees

Consequences of replacing wildlife with livestock

Introducing the Grass of the month

Advancing Rangeland Ecology and Pasture Management in Southern Africa

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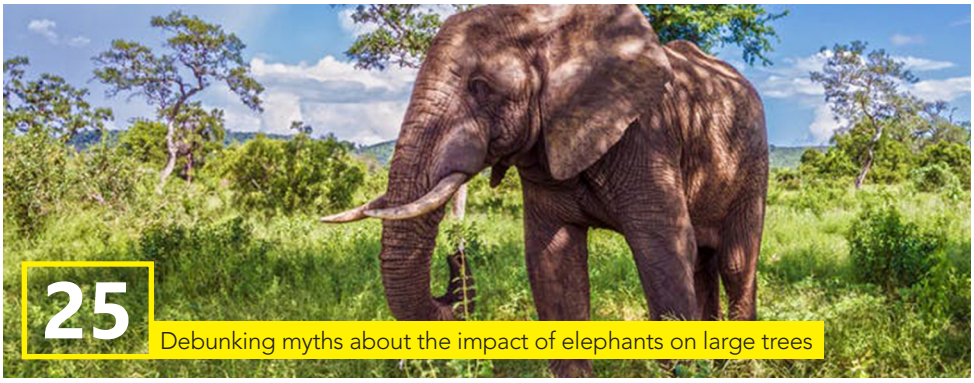

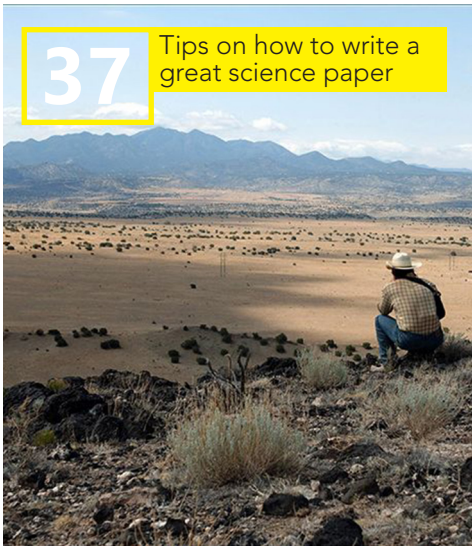

From our editor

The end of the year has arrived and so has Issue 4 of Grassroots!

Firstly, we congratulate those members who have recently achieved:

- Justin du Toit on receiving his PhD in Grassland Science. His research focused on the factors influencing the botanical composition and functioning of the eastern Karoo vegetation.
- Dave Goodenough on receiving a prestigious award for his lifelong commitment to the pasture seed industry: the Science For a Better Life Award from the South African National Seed Organisation (SANSOR) and Bayer.
- and Peter Scogings on the publication of a book titled *Savanna Woody Plants and Large Herbivores.*

Please let us know of other GSSA members who have achieved during the year and we will highlight them in our next issue.

The winner for this issue's photo competition is Michelle Keith. Her photo of an "Early morning start to vegetation survey on Ven Africa, Magudu, KZN", is printed on the cover page of Grassroots. Well done Michelle!

We have two feature articles in this issue: Craig Morris investigates how key forbs can indicate the condition of mesic grasslands and the team of Happy Msiza and Khuliso Ravhuhali from the North West University ask whether bush encroachment in the Ratlou Municipality in the North West province is creating a threat to livestock production.

We also have a variety of recent news articles ranging from biomass reducing erosion rates in the sandy areas to impacts of elephants on large trees and solar and wind energy. Finally, the latest consultation fees from SACNASP are also published in this issue.

This month we introduce something new to our publication: A grass of the month – here we provide a fact sheet of a pasture and rangeland grass species to get our readers more familiar with some of our country's grasses. We hope that you enjoy it!

For those who have not subscribed to Grassroots, please go onto the Grassroots webpage (https://grassland.org.za/publications/grassroots) and subscribe – you will then be notified, by email, when the next issue is out. This is a free subscription and a great opportunity to keep you up to date with Grassroots.

As this year draws to an end, the Grassroots editorial team wish you a happy festive season and a prosperous 2020. We have appreciated all the contributions readers have made to Grassroots and encourage you all to keep them coming in 2020 – remember you can now get a single SACNASP CPD point for any Grassroots article published!

Happy Holidays! *Janet*

Contact us
If you have any feedback, comments, or suggestions, feel free to contact us at:
info@grassland.org.za

Cover Photo
Michelle Keith
Early morning start to vegetation survey on Ven Africa, Magudu, KZN
Grassroots photo competition winner, November 2019.

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PhD Study Reveals a Grassier Eastern Karoo

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Reprinted From: http://bit.ly/37d5VK6

Research conducted by Dr Justin du Toit for his PhD in Grassland Science shows that as the climate changes, grassiness in the semi-arid Karoo is on the rise. His study investigated factors influencing the botanical composition of the eastern Karoo, including rainfall, grazing by livestock, and the impact of minimum temperatures on shifts in vegetation, while also examining the potential increased chances of fire.

Du Toit is based at the Department of Agriculture, Forestry and Fisheries' Grootfontein Agricultural Development Institute in Middelburg in the Eastern Cape, where he conducts and publishes research on vegetation-related aspects of the Karoo. His study was supervised by Professors Kevin Kirkman and Tim O'Connor, and will be relevant to researchers, managers, farmers and conservationists in the Karoo.

He said that the aim of his study was to gain a better understanding of how Karoo vegetation works and thereby contribute new knowledge on the consequences of management interventions such as livestock grazing, natural background drivers such as rainfall and drought, and emergent factors that can be controlled to a point, such as fires.

He explained that the increase in grassiness in the Karoo over the past few decades is generally seen as a positive development. He investigated a number of factors that contributed to this, beginning by using rainfall records dating from 1888 to establish that rainfall in recent decades has been notably higher, and droughts less common. He also found strong evidence of cyclical rainfall patterns, with the clearest cycle about 20 years long.

Combining the effects of livestock grazing with rainfall effects, du Toit used long-term data to reveal that increased rainfall had resulted in the eastern Karoo becoming much grassier and sometimes less shrubby, and boasting healthier veld from the 1960s to the 2010s. Periods of rainfall decline resulted in more pronounced grazing effects, with heavy summer grazing damaging the veld and increasing the amount of bare ground, as opposed to less damaging grazing spread out over the year. Winter grazing resulted in grasses thriving and shrubs becoming less common. Increased rainfall rendered the results of grazing less pronounced; even damaged veld recovered considerably and boasted good botanical diversity. Du Toit concluded that rainfall was the primary driver of vegetation condition, but that grazing has an important secondary effect that is especially pronounced during dry times.

Since rainfall increases the growth of flammable grasses and therefore the chance of fire (an important consideration as climate change is predicted to increase the incidence of wet periods as well as droughts), du Toit examined the influence of an accidental fire at Grootfontein. He found that while fire did not change the overall number of species, it caused major shifts in which species were dominant, noting that many shrubs took many years to regain their original size.

Du Toit also investigated whether minimum temperatures (and frost) correlated with shifts in vegetation, finding that despite background warming resulting in longer growing seasons and a general increase in temperatures, there was no correlation between the length of the growing season and changes in vegetation.

This research has resulted in 12 publications and presentations, including in the African Journal of Range and Forage Science, the South African Journal of Botany and at the Annual Congress of the Grassland Society of Southern Africa.

Du Toit extended special thanks to two people among the many that contributed to his research. Grootfontein's resident Karoo ecology expert Dr Piet Roux was instrumental in du Toit's research and in providing insight into the region, while he described co-supervisor O'Connor as providing amazing guidance, direction and insight, and said that it was an honour to work with him.

Figure 1: Dr Justin du Toit received a PhD in Grassland Science. Photo: supplied

Dave Goodenough making the GSSA proud

Ntuthuko Mkhize

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After 53 years of selfless service to the ARC, Dave Goodenough is still contributing immensely to the seed industry. Dave, who joined the GSSA in the mid-1979s, recently received the Science for a Better Life Award from the South African National Seed Organisation (SANSOR) and Bayer. This award is given annually to someone who has made a significant contribution and impact to the seed industry and who left a legacy for future generations in the seed industry. His research and forage breeding has made a massive contribution to seed and livestock industries.

Dave, who was born near Umkomaas on the KwaZulu-Natal South Coast, first joined the ARC-Cedara in January 1966 as a Forage Breeding Pupil Technician. Later in the years, Dave was promoted to Research Technician, Senior and then Chief Technician. In 1983 he was appointed Project Leader in Forage Crop Breeding, the post he held until his "retirement" at the end of April 2011. Dave never really retired because he was then reappointed at ARC-AP Cedara on contract basis to mentor and guide the forage breeding team until the end of June 2018. He comes to Cedara and advises the team.

Dave emphasises the major roles his mentors have played over the years in guiding and shaping his thinking and forage breeding strategies. He initially worked under the mentorship of Forage Plant Breeder Mr Jolyon Rhind, during which time Jolyon bred and released Midmar Westerwolds Ryegrass in 1975, with Dr Dieter Reusch and Dave being listed as co-breeders of Midmar. This was the first ryegrass to be bred at Cedara, and was vigorously marketed in South Africa for many years as well as in Australia. Later, under the mentorship of a geneticist, Dr Dieter Reusch, Dave bred Dargle, his first Italian ryegrass in 1993, which was also marketed in South Africa, Australia and New Zealand.

These ryegrasses were followed by many years of breeding and the release of 45 more varieties, most of which were, or are still being marketed in South Africa and internationally. "It has thus very definitely been a TEAM EFFORT", emphasises Dave. Receiving this award, Dave paid tribute to his co-operation with a biochemist Dr Johan Marais and his former colleague, Sigrun Amman.

Dave served on the council of the GSSA as Honorary Treasurer for 10 years, and then as President of the GSSA in 2001. In 1995, Dave received the Meritorious Award from the Grassland Society in recognition of outstanding service to Grassland Science. In addition to plant breeding, Dave also enjoys catching fish and, in his younger days, enjoyed playing league soccer and hockey. Valuable advice Dave received from his mentor, Dr Dieter Reusch, is that you need to have an "intimate" relationship with the plants that you evaluate- "that enables you to identify the most superior plants for inclusion in your forage breeding projects".

Figure 1: Dr Lukeshni Chetty (General Manager of SANSOR) and Dr Dave Goodenough, (ARC's retired Forage Breeder and GSSA's former council member)

Academic's contribution to new book enhances understanding of global savanna systems

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The publication of a book titled *Savanna Woody Plants and Large Herbivores* is the culmination of years' of work by Professor Peter Scogings of the School of Life Sciences, who was one of the editors of the work.

The book deals with the interactions between woody plants and browsing mammals in global savannas and discusses contemporary savanna management models and applications.

Throughout the 21 chapters, the focus is primarily on the C_4 grassy ecosystems with woody components that constitute the majority of global savannas. Savannas occur in tropical and sub-tropical climates as well as the warm, temperate regions of North America.

The comprehensive publication covers a range of topics, including the varying behaviour of browsing mammals, the response to browsing by woody species, and the factors that inhibit forage intake. Contributions came from active researchers and experts all over the world, and in the book they compare and contrast different savanna ecosystems, offering a global perspective on savanna functioning, the roles of soil and climate in resource availability and organism interaction, and the possible impacts of climate change across global savannas.

'This book represents a valuable contribution to current research, and provides new insights on this research and on recent developments in understanding global savanna systems,' said Scogings.

Scogings explained that the book's content filled a gap in literature on savanna management issues, including biodiversity conservation and animal production, and applies concepts developed in other biomes to future savanna research.

Scogings and his collaborators structured the publication to complement contemporary books on savanna or large herbivore ecology with the focus on the woody component of savanna ecosystems and large herbivore interactions in savannas. Tree-mammal systems of savannas and other eco-systems of temperate and boreal regions are compared, and the work provides numerous case studies of plant-mammal interactions from various savanna ecosystems.

The book will be of relevance to those working in ecology, wildlife and conservation biology, natural resource management, and environmental science, among other fields.

Scogings has been at UKZN since 2015 and it was during that year that he also began work on this publication with his collaborators, bringing to reality an idea conceived almost 20 years ago. Through his attendance at the annual Savanna Science Network meetings, Scogings was able to discuss the idea with many of the world's top savannah ecologists and elicited their eager co-operation on the publication.

Scogings, who holds a C-rating from the National Research Foundation and is Associate Professor of Terrestrial Ecology, was the Academic Leader of Biodiversity and Evolutionary Biology on the Westville campus in 2015 and on the Pietermaritzburg campus until the end of 2018.

This publication is an exploration of the areas of expertise he has dedicated his career to, including plant-herbivore interactions, secondary metabolites, savanna ecology, and rangeland management.

He completed his undergraduate degree in Environmental Biology and Geology at the former University of Natal (now UKZN) and went on to achieve his Masters in Wildlife Management from the University of Pretoria and a doctorate in Pasture Science from the University of Fort Hare. He spent 13 years at the University of Fort Hare and 12 years at the University of Zululand before joining UKZN.

Figure 1: Prof Peter Scogings with the newly-published book. Photo: supplied

Endangered Wildlife Trust wins prestigious international award

Endangered Wildlife Trust Press Release

Reprinted From: http://bit.ly/2qVrVZf

The Endangered Wildlife Trust (EWT) is extremely proud to announce that two of its programmes, the Wildlife and Energy and Wildlife and Transport programmes, were recipients last night of the International Conference on Ecology and Transportation (ICOET) International Stewardship Award for their innovative and holistic approach to tackling the impacts of linear infrastructure, such as roads and power lines, on wildlife in Africa.

The International Stewardship Award is presented to agencies or organisations that demonstrate, through the results of their actions, a cooperative effort to maintain or restore ecological function in the midst of transportation above the regulatory requirements. Lourens Leeuwner, EWT Wildlife and Energy Programme Manager, and Wendy Collinson, EWT Wildlife and Transport Programme Manager, won the prestigious award on behalf of the organisation.

African economies are currently among the fastest growing in the world, and this is reflected in expansion plans for road, rail and energy transmission lines, with high concentrations of such projects slated to occur in environmentally sensitive areas. The EWT's Wildlife and Transport and Wildlife and Energy programmes are working to address these environmental challenges, through putting plans in place to implement mitigation methodologies – one of the first African NGOs to do this.

The EWT believe in a less siloed approach that combines all forms of transportation and energy, since these necessary modes usually coexist and have multiple negative impacts on biodiversity. "It is an honour to be nominated, it is an outstanding achievement to reach the finals, and an exceptional milestone and celebration of excellence to win one of these awards," said Wendy Collinson.

The Wildlife and Transport Programme has improved our understanding of the impacts of transportation-linear infrastructure, namely rail and roads, on wildlife over the last nine years in South Africa, establishing partnerships with relevant stakeholders to provide measures to reduce the impacts on wildlife, whilst the Wildlife and Energy Programme has been working in partnership with Eskom for the last 23 years, developing solutions to wildlife and energy infrastructure impacts.

This partnership is internationally recognised as a leader in the implementation of innovative solutions to curb the impact of electrical infrastructure on wildlife.

"Our results are not limited to 'quick-fix temporary solutions' but demonstrate sustainable products," elaborated Lourens Leeuwner. "One of the EWT's mitigation success stories has demonstrated that bird mitigation on electrical infrastructure reduces collision mortality by approximately 90%."

ICOET is a biennial international event that addresses the broad range of ecological issues related to linear infrastructure systems, namely, roads, rail and power lines. Experts from these fields gather at ICOET to share current research, quality applications, and best practises that can enhance both the project development process and the ecological sustainability of all these modes. The ICOET gala dinner took place in California, USA on Monday, 23 September, and celebrated the most outstanding contributions to ecological stewardship.

Fraser Shilling of the Road Ecology Center at UC Davis, and the main organisers of ICOET said, "The EWT unites industry and wildlife impacts in Africa, working towards shared objectives, expanding knowledge, and understanding how to ultimately minimise the threat to wildlife."

The core supporters of the EWT's Wildlife and Transport Programme are Bakwena Platinum Corridor Concessionaire, De Beers Group of Companies, Ford Wildlife Foundation, N3 Toll Concession, GreenMatter, and TRAC N4; the core project of the EWT's Wildlife and Energy Programme is the Eskom/EWT Strategic Partnership. Both programmes are dedicated to minimising the negative interactions between wildlife and linear infrastructure.

About the Endangered Wildlife Trust

The Endangered Wildlife Trust (EWT) has worked tirelessly for over 45 years to save wildlife and habitats, with our vision being a world in which both humans and wildlife prosper in harmony with nature. From the smallest frog, to the majestic rhino; from sweeping grasslands to arid drylands; from our shorelines to winding rivers: the EWT is working with you, to protect our world.

The EWT's team of field-based specialists works across southern and East Africa, where committed conservation action is needed the most. Working with our partners, including businesses and governments, the EWT is at the forefront of conducting applied research, supporting community conservation and livelihoods, training and building capacity, addressing human wildlife conflict, monitoring threatened species and establishing safe spaces for wildlife range expansion.

A beacon of hope for Africa's wildlife, landscapes and communities, the EWT is protecting forever, together. Find out more at www.ewt.org.za

Key forbs indicate the condition of mesic grassland

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After a burn in Spring, mesic grasslands are full of wildflowers. Bright yellow Hypoxis and Gazania flowers stand out vividly among the small everlastings, carpet beans, and pale yellow Hibiscus blooms. Fire lilies in scarlet red or lemon yellow intermingle with patches of white Gerberas, pink Asters and the occasional tiny white wild lettuce flowers. Purples and blues are harder to find – you have to search amongst the resprouting ash-black tufts of luminescent young grass for the few hidden Ipomoea, Commelina or Ruellia flowers. Myriad grassland forbs take this chance to emerge, flourish, flower, and set seed before the grass canopy closes in.

Many of the herbaceous forbs found in mesic grassland have evolved underground storage units (USOs) from which they resprout new stems and leaves each season. However, despite their protected USOs, forbs are not immune to disturbance (Chamane et al. 2017) and many species can be eliminated from grassland by relentless overgrazing (Scott-Shaw and Morris 2015). Depletion of forbs from grasslands can have important consequences. This is because a diversity of forb species stabilises grassland and forbs provide habitat and food for many creatures as well as crucial forage for livestock at certain times. The essential ecological roles forbs play in mesic and semi-arid grassland (Siebert and Dreber 2019) are not well understood and we are just beginning to document how disturbances like grazing, fire, drought, and medicinal plant collection affect forb populations. Recently published research has, however, shed some light on how forbs in two mesic grasslands respond to grazing (Morris and Scott-Shaw 2019). The main results of this study, elaborated further below, are:

- Some forbs increase while others decrease in abundance with increasing grazing intensity.
- A small number of indicator forbs have a consistent, predictable response to grazing.
- Grazing indicator forbs can speak for the rest, indexing the state of overgrazing and predicting total forb species diversity.

The study to identify grazing indicator forbs spanned 178 plots in Midlands Mistbelt Grassland, KwaZulu-Natal Sandstone Sourveld, and Ngongoni Veld (with these latter two grouped as 'Sandstone grassland') in KwaZulu-Natal, South Africa. Plots were deliberately placed across a range of grazing intensities from lightly or occasionally grazed grassland to areas that had been severely overgrazed. Such a grazing gradient allowed the pattern of change in overall forb species composition to be described and species with a directional response to grazing to be identified for each grassland. Examples of some species that declined markedly with in-

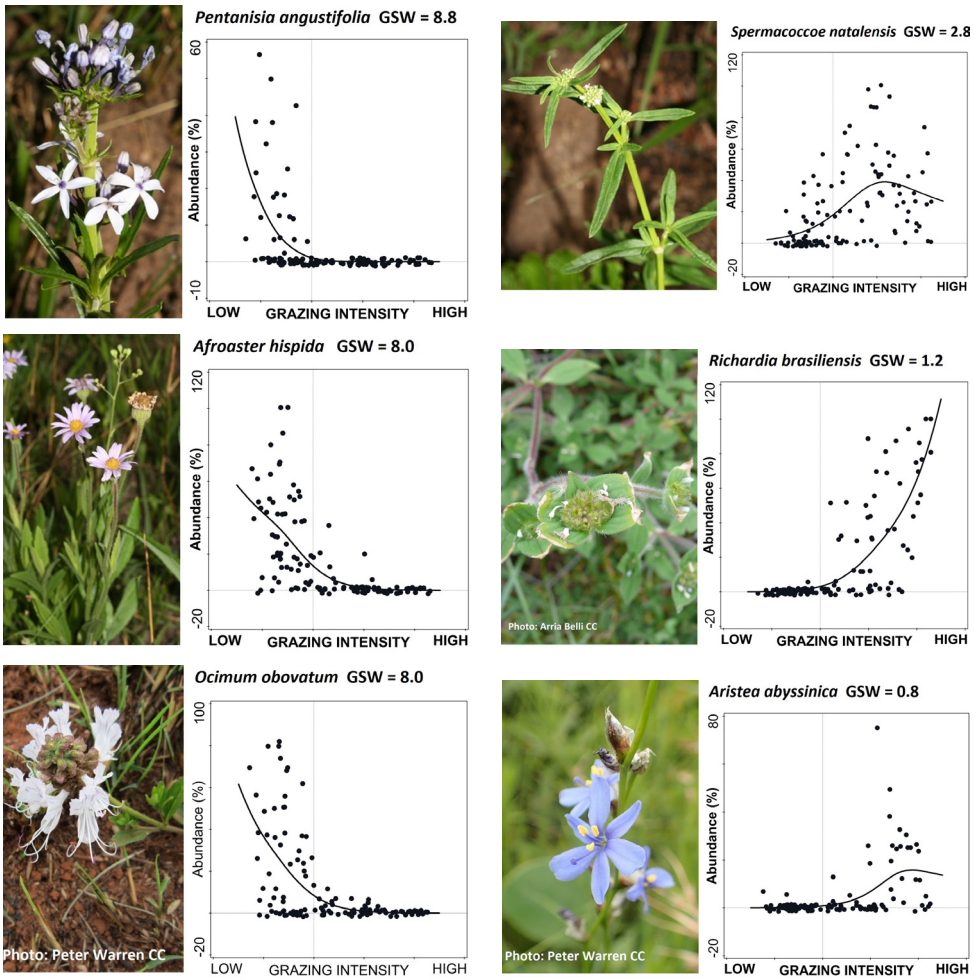

Figure 1: Examples of key grazing indicator forb species with a Decreaser or Increaser response along a grazing intensity gradient in Mistbelt grassland (photos by Rob Scott-Show, unless indicated). GSW = grazing sensitivity weight (0-10).

creased grazing intensity – Decreasers – as well as Increaser species that proliferated under chronic heavy grazing are shown in Figure 1.

We were also able to quantify the sensitivity of forbs to grazing based on the relative positions of their 'centres' of distribution along the grazing gradients. These grazing sensitivity weights (GSWs) were scaled from 0 to 10 to reflect an increasing negative response to increased grazing intensity. Forbs with a GSW of more than five were Decreasers, whereas those with a low GSW were Increasers. Forbs with low GSWs were generally prostrate or low-growing whereas the grazing-sensitive forbs with a high GSW tended to be taller, upright species with growing points vulnerable to defoliation.

The Decreaser/Increaser response categorisation has been commonly applied to grasses but not to forbs. Although all or most grasses in a grassland have been thus classified the response of many has not been determined and not all grasses are consistently influenced by grazing.

Our research showed that most (88-92%) forbs are similarly unaffected by grazing or too rare to precisely determine their grazing response pattern. Therefore, we reduced the list of around 370-400 forb species in each grassland to a small subset of the most responsive forbs: 24 and 32 species in Mistbelt and Sandstone grassland, respectively.

The pattern of distribution of just these indicator forbs closely matches the pattern of all forbs along the grazing gradient. In both grasslands there were more Decreaser than Increaser forbs, with the latter including alien species such as *Richardia brasiliensis* (Figure 1) and some native forbs (e.g. *Spermacoce natalensis*, *Aristea abyssinica*; Figure 1). The potential key grazing indicator forbs, plus a few somewhat less sensitive alternatives, were common and locally abundant enough to be potential key species for assessing and monitoring and assessing the ecological state and condition of mesic grassland. The two grasslands shared 13 indicator species but each had unique indicators, emphasising the need to conduct grazing impact studies in different grassland types.

Like the weighted grass species method developed as a quick means of monitoring important changes in the grass species composition of Highland Sourveld (Hurt and Hardy 1989), we propose that key indicator forbs could be used to more efficiently and effectively survey the diverse forb communities that are an integral part of mesic grassland.

A site score – which we call the forb condition score (FCS) - is simply the sum of the relative abundances of key indicator species found at a site weighted (multiplied) by their respective GSWs. The weighed sum is divided by 10 so the maximum FCS would tend to 100 if most of the key species present are Decreasers with high GSWs. A low FCS would indicate that heavy to severe grazing had reduced the abundance of or eradicated grazing-sensitive species and promoted more grazing-resistant forbs (Figure 2).

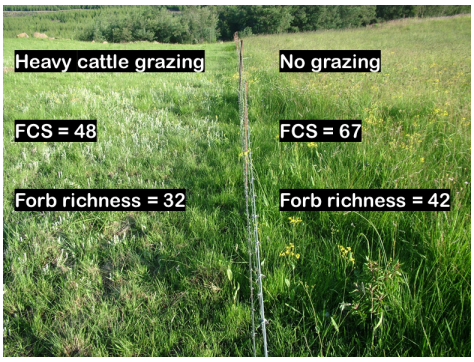

Figure 2: The weighted indicator grazing forb method applied to a fence-line contrast in mesic grassland (FCS = forb condition score).

When a survey of the abundance of all forbs present at a site is undertaken, or such data are already available, in Mistbelt or Sandstone grassland, the calculated FCS would contribute towards understanding the ecological condition at the site by indexing its state of overgrazing. A more rapid survey just looking for key indicator forbs would also provide a condition index for assessment and monitoring.

The FCS method could be used together with other important indicators such as basal cover, ratings of soil erosion, age and state of the grass sward, as well as standard veld condition assessment (VCA) methods to provide a deeper understanding of the integrity and health of mesic grassland.

Our previous research (Scott-Shaw and Morris 2015) showed that the VC score alone is not a good predictor of forb species richness (which is laborious to determine). In contrast, the FCS is significantly positively correlated with total indigenous forb species richness (Mistbelt: r = 0.793; Sandstone: r = 0.885) and can be used to adequately predict the number of indigenous forbs likely to be found at a site. Thus the few key species present at a site can tell a lot about the state and diversity of the whole grassland forb community.

We envisage that agricultural, botanical and conservation professionals and citizen scientist could include the FCS method in their current toolbox for routinely assessing and monitoring grassland sites. The method does need field testing to determine which key forb indicators could be confused with other species (which may or may not have the same grazing response) and the list of grazing indicators could be trimmed or augmented to ensure a practicable and precise rapid grassland appraisal method. Increased knowledge of forb dynamics would guide the management of grassland for multiple objectives and help sustain that fabulous flower show.

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Bush encroachment in North West province. Is it a threat?

Happy Msiza and Khuliso Ravhuhali

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Livestock production in the arid and semi-arid rangelands of the North West province faces challenges of inadequate forage supply due to the prevailing rainfall unreliability. This limits the productivity of livestock and the supply of low quality and quantity of feeds during the dry seasons. The rapid encroachment and invasion of plant species in arid areas have been widely reported as a common form of rangeland deterioration.

Most Farmers across the Ratlou municipality are battling with land degradation, that is thought to be commonly characterised by the invasion of *Vachellia*, and *Senegalia* together with *Dichrostahys cinerea* woody species (Figure 1 and 3), which greatly suppresses the production of herbaceous species as a result of increased bush cover especially in the Ratlou Municipality under Ngaka Modiri Molema district. The extent of bush encroachment has dominated large areas of the whole municipality. This makes livestock production no longer a profitable agricultural activity.

As a result, it has the potential to compromise rural livelihoods, as many depend on this natural resource base. Animals in these areas thus have to survive solely on rangeland vegetation (or herbaceous species) which is of low nutritive value such as *Aristida* spp. and semi palatable *Eragrostis* spp. throughout the dry season. Additionally, this lessens the sustainability of animal production, and increases the risk of food and feed scarcity.

Usefulness of the encroaching species

Through our observations in communal areas within the municipality: (Makgobistadt (25°46'41" S; 25°04'46" E, Luporung (25°47'34" S; 24°59'18" E), Makgori (25°50'20" S; 24°49'06" E, and Logagane (25°49'48" S; 24°53'20" E) villages, (Figure 2) *Senegalia mellifera*, *Vachellia erioloba* and *Dichrostachys cinerea* woody species were the most dominant in those areas. We noticed that most of the woody species available in the study areas were preferred by livestock especially goats and cattle and their potential as the forage provider for various livestock species in communal areas have also been recognized world-wide (Aganga et al., 2000; Mlambo et al., 2015; Revermann et al., 2018). From our wet chemistry proximate analysis, these browse species (*S. mellifera*, *V. erioloba* and *D. cinerea*) have higher concentrations of crude protein (CP) (above 10% DM) (Table 1). Failure to control this encroachment through disrupting the invasive woody plant community structure can lead to alteration of the environment, which many grazing livestock depend on.

Table 1. Average nutritional composition (g/kg DM, unless otherwise stated) values of three browse species found in the selected communal areas under Ratlou Municipality

Tree species	DM (g/kg)	OM	CP	NDF	ADF	ADL
V. erioloba	929.5	868.1	124.3	501.3	359	210.6
S. mellifera	913.3	825.4	150,2	452.6	253.7	109.1
D. cinerea	915.8	856.8	143.0	461.8	311.4	185.5
DM: dry matter; OM: organic matter; CP: crude protein; NDF: neutral detergent fiber; ADL: acid detergent lignin and ADF: acid detergent fibre. (Source: Ravhuhali 2018)						

Soil as a factor

In addition to climatic conditions (rainfall of 350-400 mm and the temperatures ranging from 2-39 °C (SAWS, 2019)), which are harsh in these areas, soil fertility is also known to contribute to the loss of grass species. Given the relative geology and prevailing semi-arid climatic conditions, the soils, which are sandy loam or continental red-brown shifting sand, tend to be relatively shallow, leached, and are highly weatherable. The soils in these areas are hence prone to being infertile (Frey, 2010). According to Ravhuhali (2018), the topsoil in these villages have lower concentrations of soil nutrients (Table 2). This is assumed to have led to the higher distribution of tree species density as observed in those communal areas. Depletion of soil nutrients can accelerate land degradation by gradually reducing the grass vegetation layer in many semi-arid areas (Mainuri & Owino, 2014; Ai et al., 2018). This provides an environment where competition for resources is limited and hence facilitates the increased germination of woody species seedlings that access topsoil nutrients.

Table 2. Summary of nutrients concentration (mg/kg unless otherwise stated) of soil found in the selected communal areas under Ratlou Municipality.

pH	N (%)	C (%)	P	K	Ca	Mg	Na	Fe	Cu	Zn	Mn
5.02	0.011	0.27	2.5	65.3	1034.3	72.2	5.2	3.89	0.23	0.30	30.41
N: nitrogen; C: carbon; P: Phosphorus; K: potassium; Ca: calcium; Mg: magnesium; Na: sodium; Fe: iron; Cu: copper; Zn: zinc; Mn: manganese (Ravhuhali 2018)											

Figure 1: *Vachellia spp.* and *Dichrostachys cinerea* are some the of the most dominant woody plant species in the areas

Control measures

Though these areas have small livestock which can assist in reducing bush encroachment, browsing is often only effective within the 1.5 m height class. Furthermore, chemical control is limited due to financial constraints in communal areas.

Controlling encroaching plants through integration effects of fire, browsing and cutting can hinder the succession of woody species, and forage production of herbaceous vegetation can increase with reduction of woody species.

Taking into consideration the National Environmental Management Biodiversity Act (Act 10 of 2004) for certain plants that have been listed as endangered species (e.g. *Vachellia erioloba* (Tietema et al., 1990; Barnes et al 1997; Orwa et al., 2009; Hauwanga et al., 2018), reduction of these species should be done in consultation with the state's authorities.

Considering the height of the woody trees, biological treatment (browsing goats and sheep) can be used to reduce or control bush encroachment. Additionally, good veld management principles such as stocking rate and ratio of grazers to browsers can be considered too.

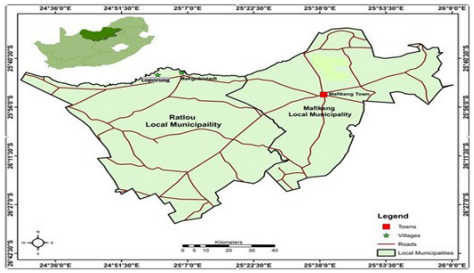

Figure 2: A map showing the Makgobistadt and Luporung villages in the North West province (Ravhuhali, 2018).

Way forward

Though density of woody vegetation cover might be low in these villages, the encroachment of woody species is in a swift change from the open savanna to a shrubland state. Through observation, is it evident that this area is heavily encroached with a high density of woody species.

This safely answers the question that bush encroachment is a threat in the North West province. Above all, research might need to look into the perception of farmers on bush encroachment. Furthermore, a scientific study can be done to look at the canopy layer and species diversity.

And again, we might as well look at the veld condition assessment to determine the grazing/carrying capacity of these areas.

There can be also an introduction of programmes (such as farmer's day, information days and some training workshops) where the local farmers rearing livestock and the relevant authorities can participate so that there will be a unified method for bush control.

Figure 3a and 3b: Bush encroachment (*Senegalia mellifera*, *Vachellia erioloba* and *Dichrostachys cinerea*) has challenged livestock production in communal grazing areas hence, farmers have not managed to maximise production and have made financial losses.

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Photo competition

Cover Photo Winners

01 - Overall winner

Michelle Keith
Early morning start to vegetation survey on Ven Africa, Magudu, KZN

02

Heleen Els
Photo 1: Namaqua tranquility.
Photo 2: Alone in a bed of daisies, Nieuwoudsville.

03

Wayne Matthews
Mountain sourveld Grassland; Wolkberg Wilderness

Photo competition

Research in Action Winners

01

Michelle Keith
The risky business of deep soil augering for vegetation survey on Bhekhula Community Conservation area, Zululand, KZN

02

Michelle Keith
Early morning mist on Glenara farm, Hogsback, Eastern Cape – First site of the day's vegetation assessment

03

Sachin Doarsamy
Blue Crane Courtship Dance – Naude's Neck Pass, Eastern Cape

Grass of the month

Hyparrhenia hirta: Common thatching grass

This perennial tufted grass is the most widespread (and popular) of all the *Hyparrhenia* species and can easily be confused with *H. filipendula* and *H. anamesa*.

***H. hirta*:**

- Is an iconic grassland species for South Africa
- Grows 300-800 mm tall
- Is an Increaser I species with an average grazing value
- Is a fairly tough grass when mature and hence mostly grazed early in the growing season
- Is an indicator of climax vegetation
- Is drought resistant and protects soil from erosion
- Is very competitive species in infertile soils and is difficult to control
- Is a popular thatching grass (for roofs) and is used for weaving mats and baskets
- Preferred habitat is stony slopes and disturbed soils often found along the roadside on the Highveld.
- Prefer stony soils, and also damp or disturbed soils
- Indicator of stable ungrazed veld or disturbed veld.
- Drought resistant and valuable for stabilizing hard, gravelly soil.

Information taken from van Oudtshoorn (2002) and Fish et al. (2015).

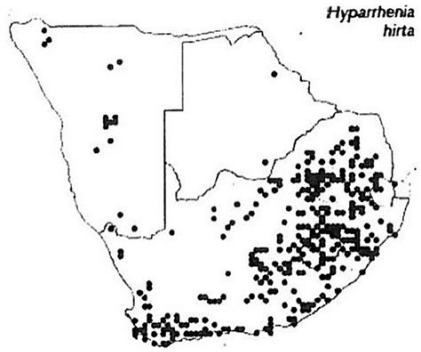


Figure 1: *H. hirta* distribution. (From Fish et al. 2015)

Figure 2: A tuft of *H. hirta* in the veld. ©SANBI

Figure 3: *H. hirta* is often used for thatching. © Thatchgalore.co.za

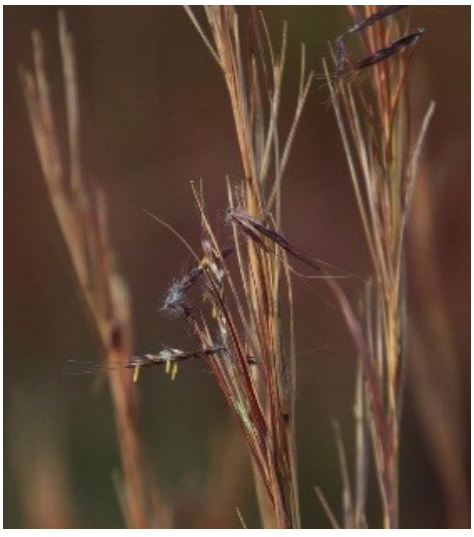
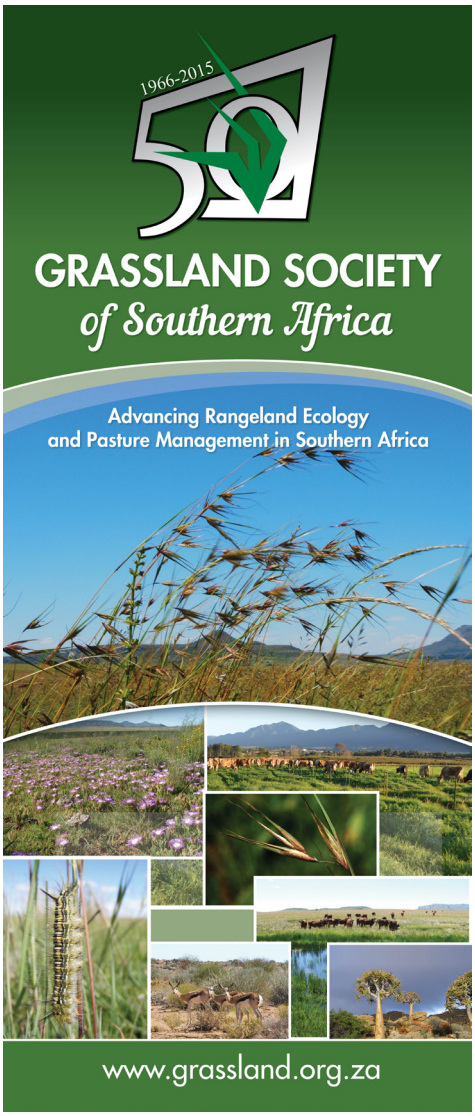


Figure 4: *H. hirta* inflorescence. Photo: T Rebelo at https://www.inaturalist.org/observations/26934295



Lolium multiflorum: Annual Ryegrass (Italian Ryegrass or Westerwolds Ryegrass)

This annual grass is highly nutritional and a popular winter planted pasture for mainly the diary industry of South Africa

L. multiflorum:

- Can be planted as pure swards, mixtures or over-sown into perennial pastures
- Is a dense, soft tufted grass
- Leaf blades are green to dark green, hairless and shiny
- It can grow up to 400 mm tall
- It is best adapted to areas with long seasons of cool, moist weather, and well drained soils but can be tolerant to a wide range of soils and climates.
- It is easily confused with *Lolium perenne* but can be distinguished by its long awns (up to 10 mm long)
- There are a number of different cultivars available in South Africa
- Herbicide-resistant ryegrass is a serious problem in Western Cape grain-producing areas. A study by Ferreira et al. (2015) found that 48% of this problematic ryegrass were *L. multiflorum* x *L. perenne*.

Information taken from van Oudtshoorn (2002), Abraha (2015), Ferreira et al. (2015), and Van der Colf et al. (2016).

Figure 1 & 2: *Lolium multiflorum* (Source: keyserver.lucidcentral.org)

Figure 3 & 4: Kikuyu-ryegrass pastures on the Outeniqua Research Farm (Source: M. Murphy)

7 Consequences of replacing wildlife with livestock

Reprinted From: http://bit.ly/32Mp2qM

Africa Geographic Editorial

Africa has the largest remaining area of untransformed (uncultivated) land on Earth, but research suggests that the combined impact of increasing human populations and the decimation of native species over the last few centuries by colonial hunters, means that livestock populations now vastly outnumber wildlife.

Do livestock species restore ecological processes, by serving as comparable replacements for native herbivores?

A fascinating study has been published about the impact on ecological processes and ecosystems of the ongoing extinction of native African herbivore species and the increase in livestock populations. This report compares current data with estimates of herbivore biomass since the Pleistocene period (11,700 years ago).

Here are 7 interesting findings:

1. Herbivore biomass change

Total herbivore biomass has decreased across Africa, mainly due to the removal of elephants by hunters. Only arid regions have experienced increases, largely due to the use of artificial water points and forage for livestock.

Relatively speaking, livestock biomass now surpasses native herbivore species biomass.

2. Herbivore functional diversity

African rangelands are now dominated by three species – cattle, goats and sheep – which account for 90% of current herbivore biomass. In other words, Africa has undergone a vast contraction in herbivore diversity. The removal of elephants has had a particularly pronounced impact, due to their beneficial impact on density and diversity of forest saplings and on seed dispersal – but the removal of other specialist browsers and frugivores has also been felt. The result has been an increase in bush encroachment and reduction in seed dispersal.

Figure 1: Cattle and herder in a drought-stricken region in Africa

3. Fires versus grazers

Fire is a significant alternative consumer of vegetation to herbivores and the balance between the two shapes ecosystems. Conceptually, grazers can suppress fires when they consume so much grassy material in the wet season that there is insufficient fuel to carry fires in the dry season. Fewer grazers therefore means more fire, and vice versa – all of which is subject to rainfall levels.

4. Woody cover

Herbivores directly and indirectly affect woody cover. The report predicts that the increasing dominance of livestock over native herbivore species will enhance woody cover in African savannas, in addition to other factors such as carbon dioxide levels.

The substantial contraction of elephant distribution ranges and populations has and will result in more woody cover as fewer trees are toppled. Moreover, the increase in grazer densities (livestock) has reduced fire across much of the continent, thereby also increasing woody cover. However, mitigating this to a degree is the increase in smallstock browser farming and subsequent increase in consumption of woody cover.

5. Greenhouse gas emissions

Carbon is stored above and below ground. The increase of woody cover increases the above-ground carbon stocks and therefore influences the carbon cycle – but the exact extent is not known. More easily measured is the methane emissions of herbivores. Methane has 28 times the warming potential of carbon dioxide. Ruminants (mammals that first partly digest food in one stomach, then regurgitate it and chew it further before re-ingesting it) such as

cattle, sheep, antelope and giraffes produce considerably more methane than non-ruminants such as elephants, hippos and zebras. In addition, larger animals produce more methane per body mass. The dominance of livestock in Africa has resulted in a significant increase in methane emissions – up to 15% of the global emission levels.

6. Movement of nutrients

Animals move nutrients from nutrient hotspots across ecosystems, thereby increasing overall fertility. The dominance of livestock has resulted in widespread loss of nutrient dispersal – with current levels estimated at being less than five percent of previous levels.

7. Ecosystem susceptibility

Mesic habitats (those with a balanced supply of moisture) have experienced biomass losses while arid habitats have experienced biomass increases.

The imposition on arid habitats of increased livestock biomass (mostly sedentary), is causing disturbance to vegetation that usually has a seasonal dynamic. For example, year-round trampling and grazing may increase grass tuft mortality and thereby increased soil erosion by wind and water, and reduced water infiltration due to soil compaction and greater run-off.

The removal of elephants from mesic habitats holds more substantial ecological implications, by increasing woody growth and reducing movement of nutrients in these typically highly leached, nutrient poor ecosystems.

Humans are replacing some of this elephant functionality by harvesting fuelwood, and currently woody biomass is reducing over much of the continent, despite the ongoing encroachment of woody vegetation.

Human hunting is likely to remain the greatest threat to large mammal herbivores in Africa's tropical forest ecosystems, exacerbating current effects on seed dispersal, recruitment and vegetation structure in the forest understory.

The general shift from migratory native to resident livestock herbivore populations represents a ubiquitous distortion of large mammal herbivore ecology. Only a handful of ecosystems now retain the diversity of functional seasonal resources necessary to support large, migratory herbivore populations that can adapt to inherently variable ecosystems.

Populations that cannot migrate are more susceptible to drought and are subject to considerable natural fluctuation in herbivore densities.

The full report: Nature.com, Gareth P. Hempson, Sally Archibald, William J. Bond: "The consequences of replacing wildlife with livestock in Africa"

Photo Competition Entry: Research in Action
Soweto Highveld Grassland biodiversity Research; Sasol/Secunda Photo: Wayne Matthews

Belowground biomass reduces erosion rates in sand dunes

New research shows that it's the parts of the plants you don't see that help preserve dunes from erosion.

Website: http://alunsalt.com
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Alun Salt

Sand dunes are one of the coastal features that help protect shorelines from storms, but they're under constant attack from the sea. Why doesn't the sand wash away? New research from De Battisti and Griffin investigates how three plants help fight the erosion of the shore.

The big problem is swash. It's a word I only know as half of -buckler. De Battisti explained that the problem isn't piracy; it's frequency. "Basically, the swash is the amount of water that runs up the shore after a wave breaks on the beach. The swash hits the dune toe, partially eroding the sediment, and then comes back taking away the sediment. So, generally, the swash has less power than its corresponding wave (i.e. the wave that broke and created the swash) because part of the energy wave has been dissipated in the breaking process and along the beach slope before reaching the dune."

"However, waves can directly hit the dunes only during a big storm surge. In contrast, the swash can attack and erode dunes more frequently, exactly because it expand further away from the waves breaking points. Thus, the swash has a strong role in sand dune erosion."

To see how vegetation influenced erosion, De Battisti and Griffin collected cores of dunes and tested them in a flume. Careful analysis showed how the roots, rhizomes and buried shoots contributed to erosion resistance. A core, in this case, is a block of dune 25 cm × 25 cm × 25 cm. In the paper the process of gathering the cores is covered by "Cores were collected…" but De Battisti said that getting the cores right was not simple.

"The cores extraction required a lot of work. For inserting the core, I needed to hammer the core inside the sediment, which was not easy because of the compactness of sand. I used a wood plank that I placed on top of the core, and I hammered the wood to avoid hitting the core directly and damaging it. I had to be careful when striking because I didn't want to disrupt the sediment, although it was something that was not possible to avoid altogether."

"After the core was inserted at the required depth, I inserted the metal plate in the front part of the core (the core was designed with one side open to facilitate the extraction of the sample in the laboratory for the flume test). Then, I dug a hole in front of the core and inserted another metal plate at the bottom of the core. This closed the core itself and avoided losing sediment during transport to the laboratory. For Ammophila arenaria, I inserted the spade in each side of the core and hit the spade few time to cut possible rhizomes connection with other plant clones."

"At this point it was possible to extract and lift, by hand, the core and bring it to the vehicle. In total, it took me about 30 minutes for extracting each core. Also, there were times that I had to extract the cores during bad weather, which increased the time and effort to extract each core."

One of the surprises in the paper is that annual plants can contribute to the fight against erosion. De Battisti said that the experiment had changed his ideas of how dune erosion works. "I had the first clue that buried shoots were important for sediment stabilisation during the flume experiment. During the experiment, I started to recognise that cores with annual plants were eroding less than the bare cores, although at that point it was more an intuition. Then, when I was cleaning the plants from the sediment, I clearly saw that annual plants had few roots but abundant shoots buried under the sediment."

"At that point it was clear that, if the erosion reduction would have been significant in annual plants, then buried shoots should have had a strong role for sediment stability. Yet, at that time, I was still convinced that roots would have been the most important organ for sediment stabilisation."The results have relevance for dune restoration, De Battisti said. "I believe that this paper indicates the potential importance that annual plants can have for sediment stabilisation in sand dunes. In particular, our findings could lead managers to integrate the use of annual plants into management schemes."

"Furthermore, this paper shows the importance in considering the context of the study. In terrestrial systems, sedimentation is (generally speaking) a negligible factor and therefore roots are the main plant organs presents in the sediment. Clearly, in erosion studies researchers have focused on the role of roots for sediment stabilisation. In contrast, in systems where sedimentation is high, such as sand dunes, researchers need to take this into account and thus incorporate each plant part that is found under the sediment."

De Battisti and Griffin's conclusions point to the importance of adding annual plants into dune restoration, and that variety helps promote sedimentation of sites.

Figure 1: Dune cores. Photo: Davide De Battisti.

Crop leftovers can store huge amounts of carbon: insights from Uganda

Reprinted From: http://bit.ly/37c3ZkM

Dries Roobroeck

Farmers in countries like Uganda could help fight climate change – and improve their crop yields – by adding agricultural waste to their fields. The process removes carbon from the atmosphere and stores it in the soil.

It's a strategy proposed under the United Nations Framework Convention on Climate Change and shown to have strong potential, especially in sub-Saharan Africa, in recent research done by myself and colleagues from Makerere University in Uganda and the University of Natural Resources and Life Sciences in Austria.

Soils can absorb carbon dioxide from the air through a process called carbon sequestration. This is when more carbon is added to the soil than it loses. Carbon dioxide is lost from soils to the atmosphere when plant material, manure and other organic matter decomposes.

Biochar – plant matter that's been burned using only a little oxygen – is an excellent way to add carbon to soil. Many of the world's soils already hold charred organic matter which originates from natural and human-made vegetation fires. Biochar is good at storing carbon in soils because its natural breakdown happens very slowly, unlike raw residues or manure. This means it can remove carbon from the atmosphere over a long period of time.

A number of carbon sequestration projects using biochar are already taking place in North and South America, Asia and Europe. For instance by 2020, using biochar from the natural waste of home gardens and public parks, Sweden's capital city will remove as much carbon dioxide as 3,500 cars emit in a year.

In sub-Saharan Africa, biochar from farming residues – like husks, hulls, leaves, branches and straw – could be used for the same purpose. But few studies have assessed how much of this material is available for biochar and how much carbon it could store in soils.

Figure 1: A sample of biochar NCAT (Photo credit:CAES/Flickr)

In our paper we shed more light on this. We looked at how much residue was left over from maize, sorghum, rice, millet and groundnut crops on eastern Ugandan farms.

We found that, when converted into biochar, these "leftovers" have significant potential for storing carbon in soils. Adding biochar from crop residues to soil on one hectare (2.5 acres) of land could offset between 16% and 80% of the 4.6 tons of carbon dioxide emitted by one vehicle in the US each year.

Biochar has the added benefit of improving soil fertility and crop production in tropical climates. So this strategy – to use biochar to remove warming gases from the atmosphere – will benefit farmers.

Making biochar

When crops grow and are harvested, they leave behind large amounts of residue which has many valuable uses: it can be added to soil to make it more fertile, or used in animal feed, for construction, or to generate heat and power.

Despite its uses, farmers in sub-Saharan Africa burn a lot of crop residues in fields because recycling the waste in-

volves time, labour and machinery that they can't afford.

But it only takes hours or a few days to collect residues and make biochar. And it doesn't have to involve expensive technology.

When biomass is exposed to temperatures between 300°C and 800°C with little, or no, oxygen present it is converted into combustible gases, oils and biochar. There is a broad range of systems that can carry out this process. Some are basic, such as domestic cook stoves that have a chamber with a natural or forced air draft. Other systems may be larger and more complex, generating heat and electricity through highly controlled processes. These can serve whole communities.

Using these systems, biochar can be generated from crop residues and mixed directly into agricultural soils, if done cautiously.

Potential of biomass waste

In our study, we measured the residues produced by five crops over two growing seasons. These five crops form the major food staples across our study area and other parts of Uganda. For maize and sorghum we sampled two quadrants of 4m² in 14 fields. For rice, millet and groundnut we studied four quadrants of 1m² in 25 fields.

We interviewed 60 farmers and recorded how many of them use specific crop residues for animal fodder, as cooking fuel, to put on soil and for construction. This revealed between 39% and 60% of cereal straw is potentially available for biochar, as is 88% to 100% of non-straw residues like shanks, chaff and hulls. Nearly all respondents said they burned crop residue to get rid of it.

We then worked out how much carbon could be stored in the soil of smallholder farms using the available biochar. This analysis showed there is a lot of potential to absorb carbon dioxide from the air under a wide range of farming scenarios.

We found that biochar derived from residues of the studied crops could compensate for 19% to 77% of all greenhouse gas emissions from Uganda each year, depending on how much residue is left unused by farmers.

From potential to action

Sub-Saharan African countries have the ability to remove large amounts of carbon from the atmosphere with biochar from crop residues. But there's a long way to go before farmers start using this technique.

First, more awareness must be created about its benefits for climate, agriculture and energy.

It will also take a great effort to adapt biomass transport models, gasifier energy appliances and biochar farming practices to suit different agricultural, ecological and socioeconomic contexts.

The economic viability of sequestering carbon in soils through biochar has proved to be limited in parts of the world where benefits for agriculture and energy are less pronounced.

Insights like those from our study point to a bigger role for sub-Saharan Africa in adopting the practice. The debate and research on biochar needs to take this into account.

Photo Competition Entry: Research in Action
Early morning start to *Phymaspermum acerosum* herbicide control trial Photo: Michelle Keith

Solar and wind energy could set South Africa on track for the world's cheapest electricity

Reprinted From: http://bit.ly/2KurjRg

Dom Wills

It's a no-brainer — a move to renewable energy will not only boost the economy and create jobs, it is also the path to providing South Africa with potentially the cheapest electricity in the world given our natural wind and solar resources.

Energy was never this difficult. Energy came from coal in the ground, burnt somewhere, put in a turbine, wires were connected, and cheap energy flowed for many years. However, this was never going to last long, because the amount of coal that forms in a year was being burnt in a minute. The world has now realised that this is unsustainable behaviour, and we're faced with a set of future alternatives: hydro, nuclear, wind, solar, biomass, coal — each with a sidecar of complexity, and we need to make some decisions.

Ten years ago, the general public didn't know what a kilowatt-hour (kWh) was, what it cost, where it came from; they didn't know how many litres of water were spent in a flush or shower, how many dams we had or how many megalitres we use per day.

That's changed. We're more knowledgeable now. Why? Because we've felt the effects. Electricity is expensive and we've even run out of it (many times). We've been on water restrictions for years, and Cape Town came close to being the first major city in the world to run out. Authorities are having to find alternative methods to abstract water, domestically and regionally. Unemployment is a major contributor to poverty and addiction, and we witness frequent protests against injustice.

Knowledge, however, can help us to solve problems. If the problem at hand is to solve the electricity crisis, we need deep understanding to find the least cost kWh and invest in the technologies that will deliver that. The "least cost" does not only refer to the financial cost, but also the environmental and social cost. The industry has been poor at recognising the entrenchment of communities reliant on the electricity sector and ensuring that reform is done fairly.

In the long wait for the IRP 2019 to be gazetted, many people have missed a recent study published in the international journal, *ScienceDirect*, which took a bold step forward in modelling a best electricity policy scenario based on cost, water and employment. The strength of this peer-reviewed article is that it is founded on solid scientific data. And while a cold approach to kWhs might not reflect every sensitivity in our country, the study did pay attention to the largest social item on our agenda: jobs.

The paper, titled *Pathway towards achieving 100% renewable electricity by 2050 for South Africa*, modelled the costs of renewable and non-renewable electricity generation pathways in South Africa, taking into consideration South Africa's current energy requirements, the expected population growth, and costs of electricity. The paper highlighted the possible scenarios for South Africa's electricity future — whether we stay on the Current Policy Scenario, highly reliant on coal — or go aggressively into renewable energy (what the authors term the "Best Policy Scenario").

Their suggested "Best Policy Scenario" (BPS) includes 71% of overall electricity production coming from solar PV and 22% by wind by 2050. In addition to this, storage technologies, transmission grids and gas power plants would be utilised to provide the elements of consistency for a stable electricity supply.

The BPS is 25% cheaper than the current policy scenario, and this doesn't take into account the additional benefits of electricity being virtually 100% renewable, such as the reduction in the detrimental effects of carbon and other poisonous gases in Earth's atmosphere, the distributed nature of the employment, and the lower risk in the technologies.

If you put a cost saving to these benefits, particularly the greenhouse gas emissions, then the 100% renewables case becomes more than 50% cheaper than the Current Policy Scenario. In addition, the cost reductions in Levelised Cost of Electricity (LCOE) are not the only benefit of this pathway. In addition to their findings on LCOE, the authors assert that the low-carbon pathway will also decrease water consumption by 87% by 2030, and by 99% by 2050, compared to the baseline — which would remain in the Current Policy Scenario.

From an employment perspective, the renewables-rich BPS will grow the jobs created by the energy sector dramatically, almost doubling to 408,000 by 2035 and tapering off to 278,000 by 2050 as construction jobs stabilise. In the Current Policy Scenario, fewer jobs are created, never rising higher than the 200,000 mark, and decreasing to 184,000 jobs in 2050.

What about coal and nuclear?

The arguments to retain a coal-heavy electricity supply are becoming thinner, particularly given the overwhelming evidence toward coal's contribution to greenhouse gas emissions that cause climate change and the fact that South Africa is one of the world's worst emitters of CO_2, clocking in just behind huge economies like China and the US. The authors assert that coal and nuclear should be phased out in the BPS, adding that new investments in coal and nuclear could be at risk of becoming stranded assets as more banks tend to opt out of investing in non-renewable technologies.

On nuclear energy, the authors assert that, "results for the fully renewable end-point scenarios indicate that there is no need for high cost and high-risk nuclear energy in the future South African electricity mix".

From the study, it is clear that South Africa has an important policy decision to make: one that will steer its future toward low-cost, low-carbon electricity that will create jobs and reduce freshwater consumption. It is an option that would be to the benefit of all South Africans — and the world at large. The "side" benefit is that in this scenario, due to our significant wind and solar resources, we'd probably have the cheapest electricity in the world, adding a strong element of competitiveness to our economy, which we're also trying to grow. Now more than ever, we need to do the right thing. It's clear as day.

Wills writes in his personal capacity, but as the CEO of solar PV company SOLA, it should be acknowledged that the journal in which the study appeared was titled Solar Energy. The scientific models used were not biased towards solar and included various other possible scenarios and forms of energy.

In a flood (of tears) for the lost riparian woodlands of the Lowveld

Current Address: SAEON Ndlovu Node
Reprinted From: http://bit.ly/32Qt55v

Joshua Weiss and Dave Thompson

The rivers of the Lowveld are the lifeblood of the landscape, transporting water, sediments and nutrients from the escarpment and surrounding landscape, which become the important resources that sustain critical aquatic and riparian habitats.

Riparian vegetation differs markedly from upland areas, particularly in winter, with brown savanna giving way to lush, year-round greenery.

Magnificent jackalberry (*Diospyros mispeliformis*), sycamore fig (*Ficus sycamorus*) and nyala tree (*Xanthacercus zambeziaca*) specimens, to name a few, are supported in this transition zone between aquatic and savanna realms. Plants here are able to withstand the high water table and accumulation of nutrients associated with riverbanks. Indeed, many of the Lowveld's riparian woodlands are so unique that they are classified as distinct vegetation units (i.e. Subtropical Alluvial Forest and Lowveld Riverine Forest).

These riparian zones range from as little as 10 m in width to over 250 m wide along some parts of the Sabie and Luvuvhu Rivers in the Kruger National Park (KNP). This riparian vegetation fulfils important ecological functions such as the trapping of pollutants, regulating river flow and buffering against floods, and providing habitat, shade and forage. Riparian ecosystems are also culturally and recreationally (and so financially) important.

Riparian woodlands are decreasing

Verbal accounts supported by limited ground-based and satellite images, reveal decreasing riparian woodland and a loss of large trees along the rivers of KNP, and elsewhere, over the last century (Figure 1). An earlier SAEON study also showed dramatic reduction in Greefswald (riparian) Forest in Mapungubwe National Park .

Figure 1: Satellite imagery from Google Earth showing the loss of riparian woodland along a stretch of the Olifants River in the Kruger National Park between March 2009 (top) and July 2013 (bottom). Areas where mature woodland existed have been replaced by sand banks sparsely vegetated by *Croton megalabotrys* (Lavender fever-berry) and other pioneer shrubs.

Studies conducted on rivers elsewhere in the country have revealed riparian woodland losses driven by water abstraction, removal of vegetation to make way for cultivation, and elephant damage. Little research has focused on riparian woodland dynamics either in or out of protected areas, perhaps because these habitats represent only a

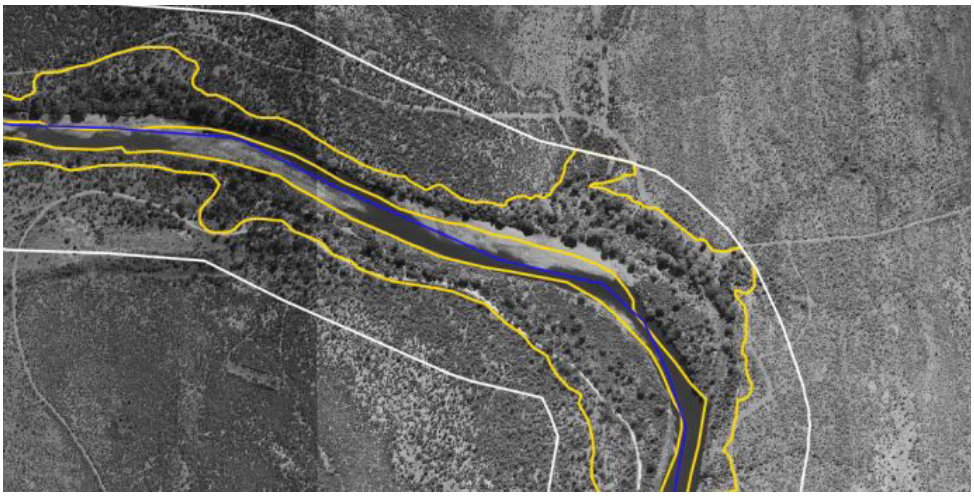

Figure 2: Riparian areas were delineated within 300 m buffer polygons (white boundary) of several rivers (blue line) in KNP. The riparian woodland extent was manually drawn at each site (yellow boundary) and analysis was in these areas. This image shows a bend in the Shingwedzi River in the 1950s.

tiny fraction of the land surface area.

Study determines trends in riparian woodland cover

A recent MSc project completed by Joshua Weiss under the supervision of Prof Mike Cramer (University of Cape Town) and Dr Dave Thompson (SAEON) aimed to determine trends in riparian woodland cover within KNP on a temporal scale not done previously. Possible drivers of change were identified by comparing long-term environmental data to woodland extent over time.

Eighteen sites along 14 of the park's rivers (nine perennial, five non-perennial) were selected for the study. A multi-decadal time-series analysis of riparian woodland extent was conducted using aerial and satellite imagery, with the oldest photograph used dating back to 1936. Riparian areas were delineated along a 10 km stretch of river at each site and then the tree cover proportion was estimated using random point plots using GIS tools (Figure 2).

The time-series of tree cover at each site was compared to river flow data sourced from Department of Water and Sanitation gauging stations (Figure 3) located at the centre of each site. Rainfall data from the nearest South African Weather Service station to each site was also compared to the tree cover.

Particular attention was paid to cumulative flow effects, as well as the frequency and magnitude of large infrequent disturbances (LIDs) such as droughts and floods, which regulate the depth of the water table and may cause physical disturbance.

Tree cover typically fluctuated over the time period, with the trajectory of change being variable between sites. Most (14 of 18) sites experienced decreasing overall tree cover between the first and last observation, with these decreases being significant at six sites (red and deep orange arrows, Figure 4).

Several sites were sparsely covered in the 1940s to 1960s, before experiencing increases in woody cover, which has subsequently declined over the last three decades. Tree cover increased only at three sites (green arrows, Figure 4) over time, with these increases being significant in one instance.

Increased riparian woodland cover was associated with non-perennial rivers which have transient surface water only after large flood events. Further, increased tree cover was only seen in rivers where the catchments fall at least 90% within the protected area, highlighting a possible positive link to a lack of anthropogenic disturbance.

Peak flow and maximum rainfall events, however, were the strongest significant association with decreases in riparian tree cover, indicating that floods are potentially the biggest drivers of tree loss. Indeed, tree cover decreased substantially at several sites following the mega-flood event of early 2000 (one of the largest on record) and subsequent large floods over the last decade, such as those in 2012 and 2013.

A bleak future for these woodlands?

With predictions of increasing climate variability and extreme climate events into the future, and increasing anthropogenic disturbance, particularly through water abstraction outside of but impacting protected areas, the future of the riparian woodlands of the Lowveld, and of their associated biota, looks bleak.

The findings from this study should prompt increased attention to riparian habitats and fine-scale, detailed work aimed at further understanding the dynamics of these systems. This will go some way in determining thresholds for conservation concern in an attempt to ensure persistence of these important ecosystems, in not only KNP, but other subtropical savannas.

Figure 3: One of the Department of Water and Sanitation hydrological gauging stations on the Olifants River, KNP

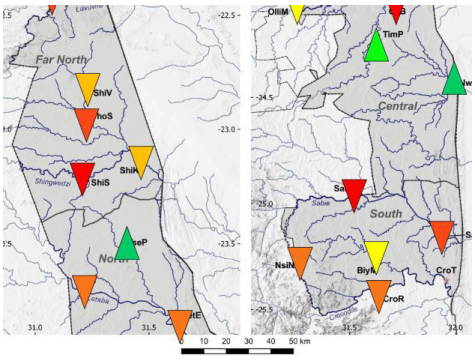

Figure 4: Study sites with respective arrows indicating riparian tree cover losses/gains. Arrows pointing down indicate a decrease in riparian tree cover and vice versa, while the colour scale is graded from red (greatest loss in tree cover), through yellow (moderate gain/loss in tree cover) to dark green (greatest gain in tree cover). One site had a net zero change.

Debunking myths about the impact of elephants on large trees

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Ross Harvey

Elephants are often accused of being responsible for the unsustainable loss of large trees in protected areas. This is because they strip bark and break branches. They can also have a heavier impact through uprooting trees or snapping stems. They have forage preferences too. Marula, knobthorn and red bushwillow are among their favourites.

This type of behaviour has raised concerns over the effects of elephants on large trees in protected areas such as South Africa's Kruger National Park. As a result, elephant populations have been managed to preserve trees and the environment in a static state.

Researchers Dr Michelle Henley and Robin Cook recently set out to establish whether elephants are in fact responsible for large tree mortality.

They did this by reviewing the science and evaluating how effective past strategies have been at mitigating large tree loss, given that such loss was typically attributed to high elephant densities. These strategies usually focused on controlling elephant numbers lethally, through either culling or hunting.

Their review shows that in African savannas:

> *maintaining elephant numbers at a pre-determined carrying capacity level did not prevent the loss of large trees.*

The researchers conclude that the relationship between elephant populations and large trees is complex. In large ecosystems, managing elephant populations so they don't exceed a certain threshold number is arbitrary.

What causes large tree mortality?

Large tree survival is a function of numerous historical and interacting variables.

For instance, aesthetically appealing landscapes with extensive large tree cover are probably historical anomalies. Colonially imported diseases such as rinderpest – throughout the late 19th and early 20th centuries – decimated herbivore populations. Combined with excessive recreational elephant hunting, trees of specific aged cohorts could proliferate.

The factors determining large tree mortality and distribution are complex. For example, the decline in large tree species within Botswana's Chobe National Park has been attributed to high impala densities rather than elephants.

The authors argue that elephant management strategies should abandon the notion of carrying capacity – that landscapes can only sustain a certain threshold number of elephants per square km. Rather, managers should ensure that migratory corridors remain as open as possible.

Managers should also reduce the density of artificial water points so that elephant impact is not spread more evenly across the landscape. Intermittent natural water sources encourage seasonal movement patterns among megaherbivores. This provides important plant refugia within large, open systems, which increases overall biodiversity.

In smaller reserves, where elephant densities may be problematic for large tree survival prospects, non-lethal interventions are – from an ethical and tourism safety perspective – more desirable than culling or hunting. Contraceptive methods, pioneered by Audrey Delsink and others, lower growth rates successfully. Translocation also works, though it is traumatic and depends on space being available elsewhere.

The history and the science

The researchers reviewed the science on the interaction between elephants and large trees.

While some studies have found that elephants can have a negative influence on biodiversity, others show that they play a critical role in the propagation of large trees. For instance, mature bulls can transport seeds to a maximum distance of 65 km away from their source.

Elephants modify their landscapes as ecosystem engineers, often increasing biological diversity in the process.

Large trees do have important ecosystem functions, including providing nesting sites for vultures and raptors. But the addition or reduction of large trees is not necessarily positive or negative. A reduction in large tree cover may, for instance, reveal that a degraded environment is in the process of restoration from past management practices.

Past management strategies

The second part of the paper evaluates past methods to manage elephants.

The precautionary principle is highly contested in conservation. It suggests that an action should be avoided if it is not yet scientifically established that it can prevent an undesirable outcome. Henley and Cook found that this principle had been interpreted differently in past elephant management strategies.

For instance, culling was implemented before the relationship between elephant density and large tree cover had been scientifically established. The

irony is that elephants start to disperse once they reach a certain density and the population growth rate naturally starts to slow down. Culling prevents that threshold density being reached. As the paper states:

The safety margins provided by the precautionary principle favour a static environmental state within thresholds of potential concern, which may not always be applicable in a dynamic ecosystem.

Culling programmes in the Kruger Park between 1967 and 1994 focused on maintaining the elephant population at one elephant per square mile – roughly 7 000 in total. The current population is over 20 000, about 3 per square mile.

The idea, embedded in the public mind, that the Kruger can only sustain 7 000 elephants, ignores the fact that, as research has pointed out, a carrying capacity of a static nature does not hold true in a complex ecological system.

The authors also stress that hunting cannot be used as a viable elephant management tool:

Hunting is a highly selective activity, as bulls of particular age categories and with sought-after physical traits are targeted.

They have therefore not proposed it as a population reduction method as it "could result in undesirable skewed sex ratios and age structures within populations".

Key takeaways

The key is to keep migratory corridors open – in conjunction with the natural expansion of elephants' range in the wet season and contraction in the dry season – so that natural ecological functions occur.

Minimal – and non-lethal – intervention is the optimal management strategy to maintain biological diversity in large, dynamic ecosystems.

Figure 1: African elephant in Kruger national park, South Africa. PACO COMO/Shutterstock

New maps show where giraffes live - mostly outside protected areas

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Shreya Dasgupta

- *By combining the latest data from on ground and aerial surveys, following movements of GPS-tagged animals, consultation with experts, and reviewing the scientific literature, researchers have produced a series of maps that they say represent the most comprehensive and accurate picture of where giraffes live in Africa.*
- *While the IUCN recognizes only one species of giraffe and nine subspecies, the study's authors decided to use the taxonomy suggested by recent studies that recognize the giraffe as not one but four distinct species — northern, southern, reticulated, and Masai giraffe — and five subspecies.*
- *The new range maps will serve as a baseline from which conservationists can now start monitoring changes in giraffe distribution in the future, the researchers say.*
- *The range maps show that around 70 percent of the giraffe's range occurs outside government-managed protected areas.*

You know a giraffe when you see one. But where in Africa *can you* see one?

Unlike lions and rhinos, the world's tallest animal is grossly understudied, with very little known about it, including its distribution in Africa. Until recently, maps of where giraffes occurred had been based largely on crude estimates and some guesswork.

Now, by combining the latest data from on-the-ground and aerial surveys, following movements of GPS-tagged animals, consultation with experts, and reviewing the scientific literature, researchers have produced a series of giraffe distribution maps in a new study, which they say presents a more accurate picture of where the giraffe lives. As it turns out, around 70 percent of the giraffe's range occurs outside government-managed protected areas, the study found.

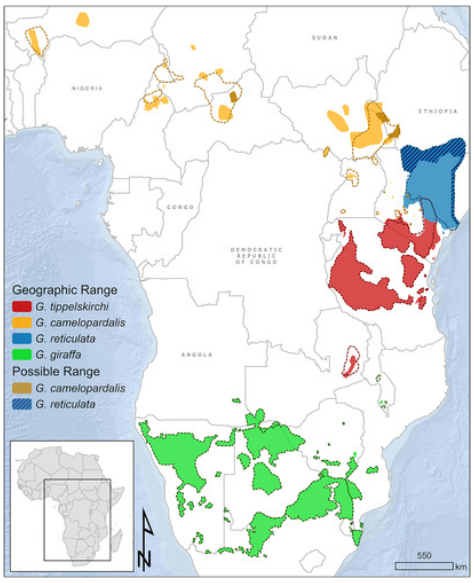

Figure 1: Updated geographic range maps for giraffe in sub-Saharan Africa. Image courtesy of O'connor et al. (2019).

The previous giraffe range maps were published by the International Union for Conservation of Nature (IUCN) in 2016. Although recent, those maps weren't based on the most up-to-date and accurate data on the animals, Jenna Stacey-Dawes, a co-author of the study and researcher at San Diego Zoo Global, told Mongabay.

"Just looking at the range maps that existed for reticulated giraffe, which is the species that our project focuses on in northern Kenya, we realized that the IUCN maps weren't showing exactly where giraffes are occurring in northern Kenya," Stacey-Dawes said. "Historic maps for giraffe vary wildly from source; they're just really inconsistent. So as a group, we decided that for giraffe conservation to move forward, it's really critical to have these updated and accurate range maps to understand where giraffes are occurring, and if their range is decreasing in the future, or if they're moving into new areas."

Formally, the IUCN recognizes only one species of giraffe, *Giraffa camelopardalis*, and nine subspecies. But recent studies have suggested that the giraffe is not one but four distinct species — northern giraffe (*Giraffa camelopardalis*), southern giraffe (*G. giraffa*), reticulated giraffe (*G. reticulata*), and Masai giraffe (*G. tippelskirchi*) — and five subspecies. To make the updated giraffe distribution maps, the researchers decided to use the latter taxonomy.

"Why the taxonomy hasn't been accepted by IUCN has more to do with people and politics than it has to do with science," Julian Fennessy, co-author of the study and co-founder of the Giraffe Conservation Foundation, who also co-authored the studies revising giraffe taxonomy, told Mongabay. "We look at the best science to support our conservation actions on the ground and we're pretty confident that the science says it all."

Considering the giraffe as four separate species matters for conservation.

"Conservation is done at a species level, so by identifying the different species, we can escalate them to the proper conservation level that they deserve," Fennessy said. "If we or the IUCN was to undertake a new assessment, looking at four species, three of the four species [northern, reticulated and Masai] would be listed as endangered or critically endangered."

The researchers used a variety of data, including those from large-scale aerial surveys such as the Great Elephant Census (GEC) designed to count African savanna elephants (*Loxodonta africana*) and other large mammals, including giraffe. By doing so, they produced what they call the "most comprehensive and accurate" maps for where giraffe populations live in sub-Saharan Africa to date.

Since the new maps depend on more reliable and rigorously collected data,

they cannot be compared with previous known distributions. The updated maps will, however, serve as a baseline from which conservationists can now start monitoring changes in giraffe distribution in the future, the researchers say.

The latest maps, for example, show that the northern giraffe's populations occur in small, fragmented populations. Their decline, the researchers say, has been driven largely by the loss of habitat. The maps also show an expansion in the distribution of the reticulated giraffe than previously thought, but this is probably because of improved monitoring and data collection.

The maps also reveal that, on average, around 70 percent of giraffe distribution occurs outside of what the researchers term as "government managed protected areas," or formally protected areas like national parks. This means that most giraffe populations live on community lands, sharing space with livestock and people.

"Government managed protected areas setting aside pieces of land for wildlife is critical, and that's really helpful for preserving habitat, but to really conserve giraffe we will have to work directly with the people that are living alongside these animals," Stacey-Dawes said. "That's kind of the model that we're working with in northern Kenya with reticulated giraffe where over 95 percent of their distribution occurs outside these formerly protected areas."

For four countries, including eSwatini (formerly Swaziland), Namibia, Somalia and South Africa, the researchers weren't able to get sufficient data. In Somalia, this is because there hasn't been any systematic survey on giraffes due to ongoing conflict and insecurity, Fennessy said. In Namibia and South Africa, which have some of the largest populations of giraffe, there is another challenge: most giraffes live outside protected areas on private land, from where getting an accurate count is especially hard.

"There is a whole bunch of reasons behind that," Fennessy said. "In these countries, giraffe is physically owned by owners of those private land and they don't want to expose all of their assets. Some people feel there is a sense of spying on them, there are tax implications … they just don't want to share all that information. We've been trying to slowly get a little bit of information and extrapolate but it is definitely challenging."

There is greater attention on the giraffe today, and the researchers hope that through more monitoring and collaborative efforts, they will be able to better understand the tall mammal and help conserve it.

"It almost feels like you're building from zero," Stacey-Dawes said. "There's not much existing literature on giraffe, so a lot of the research that's being done right now is just to answer those basic ecological questions about giraffe social structure, habitat preference. There are things that we still just don't know about some giraffe populations."

Citation:

O'connor, D., Stacy-Dawes, J., Muneza, A., Fennessy, J., Gobush, K., Chase, M. J., Mueller, T. (2019). Updated geographic range maps for giraffe, *Giraffa* spp., throughout sub-Saharan Africa, and implications of changing distributions for conservation. *Mammal Review*, 49(4), 285-299. doi: 10.1111/mam.12165

Figure 2: Giraffe in Tanzania's Serengeti National Park. Image by Udayan Dasgupta.

Buffelgrass: Broadening the frontier of genetic resources conservation, research & utilization

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Ricardo A. Sánchez Gutiérrez & Alemayehu Teressa Negawo

Buffelgrass (*Cenchrus ciliaris L.*) is an important forage grass particularly in the semi-arid areas of the subtropics and tropics. Originating in Africa, Arabia, the Middle-East and India, it is also widely cultivated in Australia, and the Americas. The International Livestock Research institute (ILRI) maintains over 200 accessions, collected from 19 African countries, in its forage genebank. The collection offers a valuable resource for the selection and development of new varieties and, with this in mind, ILRI and the Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) in Mexico have been working together to evaluate the performance of these materials. This project 'Conservation, Characterization and use of forage genetic resources for priority grazing land ecosystems of Mexico' (2013-2016) was also about capacity building.

Characterization in Ethiopia

The first study was carried out at ILRI's experimental station in Bishoftu, Ethiopia on a vertisol soil, at 1850 metres above sea level (asl.), with average annual maximum and minimum temperatures (Tmax/Tmin) of 25 and 11°C, respectively, and an average annual rainfall of 850 mm. Significant diversity in agronomic, morphological and nutritional characteristics was identified in the collection with one group consisting of eight accessions being more productive than all others. This group included 11 commercial cultivars, with which they were compared. In a second study performed at ILRI's Zwai Experimental Station (loamy sand at 1,640 m asl., Tmax/Tmin 26/20°C, and with 600 mm annual rainfall), which included 10 commercial cultivars, four clusters of accessions were identified with one group, consisting of six accessions, having exceptional characteristics in both forage and seed production.

Genotyping

More recently, ILRI has started a genotyping-by-sequencing initiative on its collection to complement the agro-morphological data and investigate the possibility of initiating marker-assisted selection in this species. So far, we have genotyped 185 accessions collected from across the origin countries and identified over 200,000 molecular markers, which were mapped to the genome of Foxtail millet (*Setaria italica*), a closely related species. Using a subset of 1,000 of these markers distributed across the *S. italica* genome, we have sorted the accessions into two main groups with up to 8 sub-groups in the collection at ILRI, none of which align with the geographic origin or cluster based on agronomic traits so far.

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Sánchez-Gutiérrez R, Hanson J, Jones C, Jurado-Guerra P, Santellano-Estrada E, Melgoza-Castillo A, Morales-Nieto C. n.d. Phenotypic variation of Buffelgrass [*Pennisetum ciliare* (L.) Link] and accessions with potential for forage and seed production. Revista Fitotecnia Mexicana (submitted in 2018)

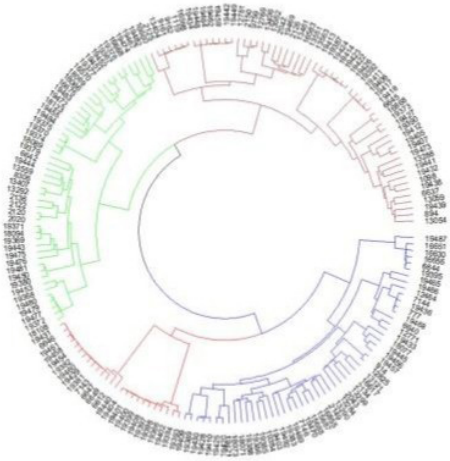

Figure 1: Cluster analysis of 185 Buffelgrass accessions based on 1000 SNP markers. Photo: R Sánchez-Gutiérrez

Figure 2: Contrasting accessions from the experiment in Bishoftu, Ethiopia. Photo: R Sánchez-Gutiérrez

Figure 3: Harvesting the Buffelgrass trial in Bishoftu, Ethiopia. Photo: R Sánchez-Gutiérrez

How our plants have turned into thieves to survive

University of Sheffield

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Scientists have discovered that grasses are able to short cut evolution by taking genes from their neighbours. The findings suggest wild grasses are naturally genetically modifying themselves to gain a competitive advantage.

Understanding how this is happening may also help scientists reduce the risk of genes escaping from GM crops and creating so called "super-weeds—which can happen when genes from GM crops transfer into local wild plants, making them herbicide resistant.

Since Darwin, much of the theory of evolution has been based on common descent, where natural selection acts on the genes passed from parent to offspring. However, researchers from the Department of Animal and Plant Sciences at the University of Sheffield have found that grasses are breaking these rules. Lateral gene transfer allows organisms to bypass evolution and skip to the front of the queue by using genes that they acquire from distantly related species.

"Grasses are simply stealing genes and taking an evolutionary shortcut," said Dr. Luke Dunning.

"They are acting as a sponge, absorbing useful genetic information from their neighbours to out compete their relatives and survive in hostile habitats without putting in the millions of years it usually takes to evolve these adaptations."

Scientists looked at grasses—some of the most economically and ecologically important plants on Earth including many of the most cultivated crops worldwide such as: wheat, maize, rice, barley, sorghum and sugar cane.

The paper, published in the journal Proceedings of the National Academy of Sciences, explains how scientists sequenced and assembled the genome of the grass *Alloteropsis semialata*.

Studying the genome of the grass *Alloteropsis semialata* - which is found across Africa, Asia and Australia - researchers were able to compare it with approximately 150 other grasses (including rice, maize, millets, barley, bamboo etc.). They identified genes in *Alloteropsis semialata* that were laterally acquired by comparing the similarity of the DNA sequences that make up the genes.

"We also collected samples of *Alloteropsis semialata* from tropical and subtropical places in Asia, Africa and Australia so that we could track down when and where the transfers happened," said Dr. Dunning.

"Counterfeiting genes is giving the grasses huge advantages and helping them to adapt to their surrounding environment and survive - and this research also shows that it is not just restricted to *Alloteropsis semialata* as we detected it in a wide range of other grass species"

"This research may make us as a society reconsider how we view GM technology as grasses have naturally exploited a similar process.

"Eventually, this research may also help us to understand how genes can escape from GM crops to wild species or other non-GM crops, and provide solutions to reduce the likelihood of this happening."

"The next step is to understand the biological mechanism behind this phenomenon and we will carry out further studies to answer this."

More information

Luke T. Dunning el al., "Lateral transfers of large DNA fragments spread functional genes among grasses," *PNAS* (2019). www.pnas.org/cgi/doi/10.1073/pnas.1810031116 Journal information: Proceedings of the National Academy of Sciences

Putting deniers on ice: Inside the mind of a climate geek (Part One)

Current Address: Independent Economist PhD Candidate, University of Cape Town
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Tiara Walters

New findings released this month by the journal Nature Communications reveal that English-language digital and print media give 49% more coverage to bush-league climate contrarians than top scientists. We asked Professor Guy Midgley, a Stellenbosch University expert on how biodiversity responds to the climate crisis. With the odds in favour of 'at scale climate change disinformation', as the study puts it, what's the best way for ordinary people to make sense of this wilderness?

Q: Climate modelling is full of uncertainties — how do these affect the science community's ability to nail its projections to the mast?

A: The temperature projections made back in the early '90s were done with somewhat rudimentary models. Now it seems those early projections were more extreme because they didn't include all the necessary processes. That means projections dating to the early '90s — such as a likely 2°C increase for the planet by 2050 — are now more likely to materialise towards the latter half of this century, if no action is taken to reduce emissions. There's a lot of empirical support for what these models do and they've been quite extensively reviewed, including by the United Nations Intergovernmental Panel on Climate Change (IPCC).

More recently even, the latest set of models from the IPCC have included new work on improving estimates of climate sensitivity. Early results suggest that they're projecting a warmer future sooner than the previous round five or six years ago.

Q: So what's making the latest batch of models more climate-sensitive, and therefore, more useful?

A: As I understand it, the new models incorporate energy feedback from clouds more efficiently and more realistically. The net effect is that a more responsive warming to rising CO_2 is being projected than before. In fact, we have a good idea from hundreds of thousands of years of ice core data that there's a good correlation between CO_2 concentration and atmospheric temperature.

So, that's not very good news for us, but it's a moving target and climate science is evolving. For instance, I think it's fair to say that we don't fully understand yet how responsive the atmosphere is to CO_2, but we do know with virtual certainty that rising CO_2 is causing warming.

Q: But surely all this is grist to the denier's mill — extreme projections in the early '90s, cooler projections around 2013/14 and now we're looking at a warmer future again. And yet, scientific credibility is the key to whether or not people acknowledge that nature is dangerously close to ejecting Homo sapiens from the mothership.

A: I don't think any modeller would claim their model is 100% spot-on. Models try to simplify and synthesise complex processes so that they can come up with useful predictions. Models are either useful or not useful, but they're never perfect — the complexity of nature is beyond what models can capture in all details.

In the physics of climate, it's understood that we cannot precisely predict the future because climate has a characteristic called "deterministic chaos". To get a perfect prediction, you must measure everything with absolute precision and, even if you're out by, say, 0.000001% in the measurement of so-called "initial conditions", the model will deviate from reality after a certain amount of time.

Therefore, it's not possible to model the weather precisely over long periods — modelling hurricane tracks is a lovely, real-world example. That's why we need to consider the issues very carefully and take lessons from the results. Models are getting better, though. We've all experienced more accurate predictions of weather over the timescale of days and even weeks — and that's part of research to reduce the uncertainties.

Q: How well are the models serving us on the long-term outlooks?

A: Pretty well. Take the simple '80s models of, say, the former director of Nasa's space studies institute Jim Hansen [today Columbia University climate programme director]. He came up with three scenarios — high, middle and low — and here's an example of how iniquitous the denialist fraternity are, because they always highlight and cite his high scenario and say, "Well, he completely overestimated climate warming."

But his mid-level scenario has been really useful. Hansen even included the assumption of an El Chichon-sized volcanic eruption in the mid-'90s. He wasn't predicting a volcanic eruption, he was simulating an uncertainty: What if there was a significant eruption? How would it affect the projections? How much time might it buy us? After all, big volcanic eruptions can cause hemispherical or even global cooling for a few years, because volcanoes emit sulphate aerosols, which create a "sunscreen effect" that reflects radiation back into the atmosphere.

In fact, we did have an eruption — Mount Pinatubo in the Philippines in

June 1991. You don't often get volcanoes of a size big enough to cause such a substantial sunscreen effect. They only occur every few decades at best. So it was quite an extraordinary projection by Hansen. Certainly the newer models have done a very good job of predicting the warming we would have expected back in the '90s, so that denialist talking point doesn't hold any water.

Q: So if denialism were my side-hustle — which seems to be the case with many of the deniers — how could I go about poking holes in the trends?

A: Fluctuations caused by the energy fluxes between atmosphere and ocean are popularly used by the denialist fraternity to cherry-pick and cast doubt. When we get an El Niño event, which changes the circulation of water in the Pacific, it releases a lot of that energy back into the atmosphere. During El Niño years you tend to get above-average warm temperatures; during La Niña years the ocean tends to absorb energy out of the atmosphere.

In 1998 we had a strong El Niño, which made it a very significant El Niño year — and that was the hottest year on record at that time. Even without factoring in El Niño, we've repeated the temperature record many times since then. But that's where this idea of a "warming hiatus" between the end of the '90s and 2012 came from. To even have a snowball's hope of showing that, you have to start your record in extremely hot 1998 and trace it through to 2012, where you had a bit of a La Niña. Temperatures didn't cool, they simply plateaued for a while, but this "hiatus" was still the warmest period since records began.

Q: Right, but that's just one period. Why fixate on that?

A: Looking at the long-term warming trends by drawing a line through a 40- or 50-year period, and considering the trends since 2012 where we still have most of the hottest years on record since 1998, you can see the denialist-supporting wiggle in all this, and that's not entirely surprising. Earth-system science is such a complex and multi-faceted area and there are all sorts of tricks you can use to confuse people — fossil fuel emission uncertainties and clouds and ocean circulation and model sensitivity.

But none of the sceptics will take the record from 1991 to 1998 and say, "Ooh, global warming's accelerated." They'd rather take the period from 1998 to 2012 and say, "Ah! Global warming has gone away!" We call that "cherry-picking". If somebody makes that argument, either the person genuinely doesn't understand the science, or they do understand the science and they're trying to fool you. For both of those eventualities that person is not worth listening to as an expert. Discount it. It's just junk. Mendacious. Completely false. Puerile.

Q: Climate projections seem to do fairly well when considering large swathes of the planet, but struggle on a granular level. Why the gap?

A: On a broader scale it's certainly more feasible to come up with general conclusions about climate change risks. For example, in the northern hemisphere the preponderance of evidence shows that wild species have been shifting their geographic ranges — the areas where they naturally occur — towards the pole and upwards in elevation when that's available to them, because they're tracking their preferred "climate space"; and that the quantum of those range shifts matches the predictions from the climate models.

There are people who say the temperature records have been fiddled with to show global warming and to argue that point you have to argue that the wild species in the northern hemisphere have also been duped by that fraud because they're all responding in the way they should [laughs].

Q: What happens when you get more specific and local?

A: Then the uncertainties pile up so much that it becomes hard to say anything specific. To predict impacts at a particular point climatically starts to make little sense because there are all sorts of things that could push that pre-

Figure 3: Climate scientist Professor Guy Midgley of Stellenbosch University. (Photo: Kerry Grey)

diction out of whack.

For instance, you could say that the species *Protea Magnifica* occurs with a 100% likelihood in the fynbos biome, but it becomes impossible to pinpoint the certainty of its occurrence within a 10 m^2 range. With respect to rainfall projections, however, one of the few exceptions at the regional scale is the Western Cape, where the models predict the entire westerly frontal systems are likely to start moving south, thus creating conditions of a greater frequency of drought in this part of the world.

This also holds for other Mediterranean-climate areas of the world like Western Australia, South America, California and the Mediterranean itself. This is one of the most consistent and well agreed weather-system shifts that occurs. The circulation from the poles to the tropics is strengthened and it pushes the fronts more towards the south.

Q: To what extent do these extreme individual events create honest signals of larger climate breakdown?

A: There's no question that the trends we're seeing in rainfall indicate much more intense events, but, interestingly, also longer dry spells between them. So, even where you don't get a change in rainfall, you're seeing a concentration of rain into shorter, sharper events with flooding — and then the dry spells in between can seal off the soils, so you get this increased run-off effect.

We've seen flooding in Joburg, more broadly in Gauteng, and KwaZulu-Natal, for example. This terrible recent sequence of cyclones that hit Mozambique has also brought home the reality of these risks. And we're only in 2019. Let's say this doesn't bode well. If extreme weather does occur over the next few decades, we're going to have to be ready.

Look at the drought in Makhanda. Cape Town nearly ran out of water. The likelihood of a Cape Town drought was something we identified in 2000 when we were doing some work for local government and looked at rainfall records going back to the 1920s.

We saw this very significant natural drought in the 1920s and 1930s and it was obvious that, with warmer temperatures and more people, Cape Town could run into problems.

We're now seeing these extremes starting to bite. Elsewhere in the world, we've seen hectic heatwaves in Australia leading, for example, to mass mortality of fruit bats. Europe's heatwaves have been extraordinary.

The melting of Greenland ice is unprecedented. You're looking beyond South Africa's shores. And there are all sorts of signs that the system is starting to show all the signs of this shift into a much warmer world. DM

Professor Midgley is also co-author of leading South African climate change studies dating back to the year 2000, and was awarded Germany's Humboldt Research Award in June. According to Stellenbosch University, "the award is granted in recognition of a researcher's entire achievements to date and to academics whose fundamental discoveries, new theories or insights have had a significant impact on their own discipline and who are expected to continue producing cutting-edge achievements in the future."

Photo Competition Entry: Cover Photos
A stand of *Kniphofia* reach for the sky. Photo: Heleen Els

Wetlands do the job of expensive technology, if we let them

Current Address: Deputy Dean Faculty of Science, Nelson Mandela University
Reprinted From: http://bit.ly/2qVJRCW

Gaathier Mahed

The world's freshwater supplies are at risk. This is a threat to all life on the planet. It is therefore no surprise that water purification has turned into a multibillion-dollar global business.

The World Bank estimates that at least $150 billion a year will be required to give the entire global population access to clean drinking water by 2030.

There is no silver bullet when it comes to the technology available to tackle severe water shortages. Several options therefore need to be explored.

One purification option can be found in nature – wetlands. Research shows that wetlands are able to act as filters of water in numerous ways. This includes the uptake of pollutants by plants, soils and even microbes present in the wetlands.

They are also able to mitigate the effects of floods and store carbon dioxide, while aiding in providing livelihoods and holding cultural importance.

We conducted an analysis of the Rietvlei freshwater wetland on the outskirts of the coastal city of Cape Town, in South Africa's Western Cape Province, to understand the soil, surface and groundwater, because of the intricate interplay between water bodies in the area as well as the reliance of the entire ecosystem on water flow between them.

We found that the wetland had been impacted due to water being drained from it as well as from contamination. This, in turn, is affecting the well-being of people, animals and plants that depend on the wetland. Our research underscores the fact that wetlands are important for the functioning of ecosystems and need better care.

This will help protect the environment and the earth's already strained water resources.

What we found

A number of factors have affected the Rietvlei body in the past.

One is that it is near residential areas, a wastewater treatment plant and a petroleum refinery. This has implications for water in the wetland, due to the discharge from industry and households as well as consumption upstream.

In addition, the natural water flow in Rietvlei's immediate vicinity has been altered. This is due to the canalisation, which is the lining of the riverbed and banks with concrete to form a channel, of the Diep River as well as the use of water by farmers in the area.

The amount of water in the river has been drastically reduced and its quality has been affected, which has an impact on plants and animals as well as human health.

Then there is the issue of contamination: we found that flooding water from the river and on the surface in the rainy season filled the cracks in the soil formed during the dry season.

The floodwaters flushed salts into the groundwater through cracks. Water quality and plant survival are threatened by the salinity.

Other factors have also increased the amount of salt in the groundwater. One of them is over-pumping during a recent drought. Cape Town drew large volumes of groundwater daily and seawater may have moved into the wells to replace it.

Another possibility is that the local geological formation contains a salt deposit, which is being dissolved in the groundwater.

These findings shed light on the water quality in the wetland and show what is needed to better understand the functioning of wetlands in order to improve their management.

Protecting a precious resource

A report, which examined the state and trends of wetlands around the world, the Global Wetland Outlook, recently examined the status of wetlands in line with the Ramsar Convention – the only international treaty focused on wetlands.

It found that wetland quality and quantity are declining and this has immediate and long-term effects on biodiversity and human livelihoods.

These include declining food and water security.

As a result, many countries are now employing policy and legislation to strengthen the application of the Ramsar Convention and the United Nations' Sustainable Development Goals.

Wetlands are sensitive systems that are affected by human activity. They need to be protected because they play a critical role in the ecosystem.

Streets and rivers must be kept clean to stop pollutants from migrating into rivers and ultimately into wetlands. Industry should be more responsible when emitting discharge into rivers.

This means stricter rules regarding the quality of water that is pumped from industrial processes into the environment.

The problem with trees-for-carbon

Programmes to encourage tree-planting have been hailed as a solution in the fight to reduce greenhouse gases and global warming. But new research casts doubt on the likely success of trading trees for carbon.*

Current Address: SAEON
Reprinted From: http://bit.ly/37aBMej

Staff Writer

Africa is the grassiest continent. These grasses support birds, reptiles, plants, insects and the last remaining herds of large animals that lived during the Pleistocene epoch – an invaluable asset for the continent and the world.

Africa's grasslands were the cradle of our ancestors and today are home to more than 300 million people. But these open landscapes could be transformed if trees-for-carbon projects inappropriately target them for 'restoration', according to University of Cape Town (UCT) Emeritus Professor William Bond, research associate of SAEON and lead author of new research on the topic.

"We challenge the popular view that planting trees is a credible way of slowing global warming," says Bond.

The suggestion that Africa's grasslands might be transformed to forestry plantations is not theoretical: the Bonn Challenge is an example project that proposes to 'restore' forest across 3.5 million square kilometres – an area covered by Europe's 10 largest countries – by 2030. Much of the land it's targeting lies in Africa.

Bond collaborated with Dr Nicola Stevens and Professor Guy Midgley from Stellenbosch University, and Dr Caroline Lehmann of the Royal Botanic Garden Edinburgh to look critically at such trees-for-carbon projects that propose to forest landscapes to capture carbon dioxide from the atmosphere.

"We found that the benefits of afforestation for reducing atmospheric carbon are paltry," he says, "while the costs to Africa in lost land for agriculture, livestock, conservation, and in managing vast plantations will have to be borne for the foreseeable future."

Restoration or distraction?

The researchers' focus was the ambitious AFR100 plan to plant 100 million hectares of trees in Africa by 2030, an offshoot of the Bonn Challenge. That vast area – more than four times the size of Britain – is the subject of a pledge by 28 African countries.

Mozambique, for example, has committed to planting one million hectares, South Africa to 3.6 million hectares. Cameroon's pledge requires converting a quarter of the country to plantations, and Nigeria's requires almost one-third.

To assess the impact of AFR100, the researchers looked at how much it would cost to plant enough trees to balance out one year's growth in atmospheric carbon dioxide at current rates of emissions.

Their results suggest that far from offering hope, such trees-for-carbon projects may be detrimental for grasslands in Africa and distract attention from the more urgent problem: lessening emissions from fossil fuels.

Trees for carbon

We know that the amount of carbon dioxide in the atmosphere is increasing by about 4.7 gigatonnes per year (1 gigatonne = 1 000 000 000 tonnes).

Assuming it would cost USD10 to se-

Figure 1: Africa's grasslands could be transformed if trees-for-carbon projects inappropriately target them for 'restoration' (Photo: Shutterstock)

Figure 2: The researchers found that the benefits of afforestation for reducing atmospheric carbon are paltry, while the costs to Africa in lost land for agriculture, livestock, conservation, and in managing vast plantations will have to be borne for the foreseeable future

quester a tonne of carbon – a "very conservative" rate according to Bond – the total amount required to balance out this yearly increase would be USD47 billion.

"The World Bank's contribution of a billion dollars [to the Bonn Challenge] is less than 0.5% of what would be needed over the next 10 years," explains Bond. "And that billion dollars, spread over 100 million hectares of Africa, works out at USD10 per hectare – a bargain for the industrial countries of the world."

The researchers' calculations show that should Africa reach its target of foresting 100 million hectares, only 2.7% less carbon dioxide would enter the atmosphere each year.

"If that seems small, consider that the coal used in the industrial revolution took 400 million years to accumulate,"

Figure 3: Emeritus Professor William Bond, former Chief Scientist of SAEON and lead author of the new research

adds Stevens, a co-author on the study. "Can you really expect to stuff it all back again in the next few decades?"

The team concludes that converting Africa's grassy landscapes to tree plantations will not only do little to reduce greenhouse gases, but that the funding for the programme is a small fraction of what is needed. African countries could also be locking themselves into plantation forestry for decades at the expense of other industries, such as food crops, livestock farming and conservation.

Furthermore, the amount of carbon that tree plantations store depends on intensive management: suppressing fires, felling trees and then storing the carbon, and replanting every decade or two for the foreseeable future. This is something African countries would need to deliver on.

Exporting emission problems

The researchers also raise the point that there isn't even scientific agreement on whether such tree plantations will warm or cool the planet. Overall, tree canopies are darker than grassy vegetation, and thus absorb more sunlight and heat – this could lead to warming.

Advocates of trees-for-carbon projects have not taken this into account.

"What concerns us is that the trees-for-carbon projects distract us from the real issue: the urgent and immediate need to reduce carbon emissions, especially by reducing fossil fuel use," adds Bond.

Indeed, trees-for-carbon projects can be seen as a way for industrialised countries – the major sources of greenhouse gases – to export fossil-fuel emission problems to Africa.

The researchers highlight that they strongly endorse planting trees to restore destroyed forests and in urban areas for shade and enjoyment. They also support retaining the intact forests that remain. But that trees-for-carbon projects are based on wrong assumptions. "For tree planting to be positive, it needs to be the right trees in the right places," says Lehmann.

A better way of supporting Africa's transition to a warmer future might be to promote energy-efficient cities in this rapidly urbanising continent so that Africa follows a less carbon-intensive trajectory without destroying its grassy landscapes.

* Bond WJ et al. (2019) The Trouble with Trees: Afforestation Plans for Africa, Trends in Ecology and Evolution. https://doi.org/10.1016/j.tree.2019.08.003

LISTEN to Professor Bond being interviewed on the Afternoon Drive with John Maytham here: http://bit.ly/2QpTiVK

Figure 4: The researchers support retaining the intact forests that remain and strongly endorse planting trees to restore destroyed forests (Photo: Shutterstock)

Novelist Cormac McCarthy's tips on how to write a great science paper

The Pulitzer prizewinner shares his advice for pleasing readers, editors and yourself.

Current Address: [1]University of California, Los Angeles and [2]Santa Fe Institute, New Mexico
Reprinted From: https://go.nature.com/2QzTh1V

Van Savage[1,2] & Pamela Yeh[1,2]

For the past two decades, Cormac McCarthy — whose ten novels include *The Road, No Country for Old Men and Blood Meridian* — has provided extensive editing to numerous faculty members and postdocs at the Santa Fe Institute (SFI) in New Mexico. He has helped to edit works by scientists such as Harvard University's first tenured female theoretical physicist, Lisa Randall, and physicist Geoffrey West, who authored the popular-science book Scale.

Van Savage, a theoretical biologist and ecologist, first met McCarthy in 2000, and they overlapped at the SFI for about four years while Savage was a graduate student and then a postdoc. Savage has received invaluable editing advice from McCarthy on several science papers published over the past 20 years. While on sabbatical at the SFI during the winter of 2018, Savage had lively weekly lunches with McCarthy. They worked to condense McCarthy's advice to its most essential points so that it could be shared with everyone. These pieces of advice were combined with thoughts from evolutionary biologist Pamela Yeh and are presented here. McCarthy's most important tip is to keep it simple while telling a coherent, compelling story. The following are more of McCarthy's words of wisdom, as told by Savage and Yeh.

- Use minimalism to achieve clarity. While you are writing, ask yourself: is it possible to preserve my original message without that punctuation mark, that word, that sentence, that paragraph or that section? Remove extra words or commas whenever you can.

- Decide on your paper's theme and two or three points you want every reader to remember. This theme and these points form the single thread that runs through your piece. The words, sentences, paragraphs and sections are the needlework that holds it together. If something isn't needed to help the reader to understand the main theme, omit it.

- Limit each paragraph to a single message. A single sentence can be a paragraph. Each paragraph should explore that message by first asking a question and then progressing to an idea, and sometimes to an answer. It's also perfectly fine to raise questions in a paragraph and leave them unanswered.

- Keep sentences short, simply constructed and direct. Concise, clear sentences work well for scientific explanations. Minimize clauses, compound sentences and transition words — such as 'however' or 'thus' — so that the reader can focus on the main message.

- Don't slow the reader down. Avoid footnotes because they break the flow of thoughts and send your eyes darting back and forth while your hands are turning pages or clicking on links. Try to avoid jargon, buzzwords or overly technical language. And don't use the same word repeatedly — it's boring.

- Don't over-elaborate. Only use an adjective if it's relevant. Your paper is not a dialogue with the readers' potential questions, so don't go overboard anticipating them. Don't say the same thing in three different ways in any single section. Don't say both 'elucidate' and 'elaborate'. Just choose one, or you risk that your readers will give up.

- And don't worry too much about readers who want to find a way to argue about every tangential point and list all possible qualifications for every statement. Just enjoy writing.

- With regard to grammar, spoken language and common sense are generally better guides for a first draft than rule books. It's more important to be understood than it is to form a grammatically perfect sentence.

- Commas denote a pause in speaking. The phrase "In contrast" at the start of a sentence needs a comma to emphasize that the sentence is distinguished from the previous one, not to distinguish the first two words of the sentence from the rest of the sentence. Speak the sentence aloud to find pauses.

- Dashes should emphasize the clauses you consider most important — without using bold or italics — and not only for defining terms. (Parentheses can present clauses more quietly and gently than commas.) Don't lean on semicolons as a crutch to join loosely linked ideas. This only encourages bad writing. You can occasionally use contractions such as isn't, don't, it's and shouldn't. Don't be overly formal. And don't use exclamation marks to call attention to the significance of a point. You could say 'surprisingly' or 'intriguingly' instead, but don't overdo it. Use these words only once or twice per paper.

- Inject questions and less-formal language to break up tone and maintain a friendly feeling. Colloquial expressions can be good for this, but they shouldn't be too narrowly tied to a region. Similarly, use a personal tone because it can help to engage a reader. Impersonal, passive text doesn't fool anyone into thinking you're being

objective: "Earth is the centre of this Solar System" isn't any more objective or factual than "We are at the centre of our Solar System."

- Choose concrete language and examples. If you must talk about arbitrary colours of an abstract sphere, it's more gripping to speak of this sphere as a red balloon or a blue billiard ball.

- Avoid placing equations in the middle of sentences. Mathematics is not the same as English, and we shouldn't pretend it is. To separate equations from text, you can use line breaks, white space, supplementary sections, intuitive notation and clear explanations of how to translate from assumptions to equations and back to results.

- When you think you're done, read your work aloud to yourself or a friend. Find a good editor you can trust and who will spend real time and thought on your work. Try to make life as easy as possible for your editing friends. Number pages and double space.

- After all this, send your work to the journal editors. Try not to think about the paper until the reviewers and editors come back with their own perspectives. When this happens, it's often useful to heed Rudyard Kipling's advice: "Trust yourself when all men doubt you, but make allowance for their doubting too." Change text where useful, and where not, politely explain why you're keeping your original formulation.

- And don't rant to editors about the Oxford comma, the correct usage of 'significantly' or the choice of 'that' versus 'which'. Journals set their own rules for style and sections. You won't get exceptions.

- Finally, try to write the best version of your paper: the one that you like. You can't please an anonymous reader, but you should be able to please yourself. Your paper — you hope — is for posterity. Remember how you first read the papers that inspired you while you enjoy the process of writing your own.

When you make your writing more lively and easier to understand, people will want to invest their time in reading your work.

And whether we are junior scientists or world-famous novelists, that's what we all want, isn't it?

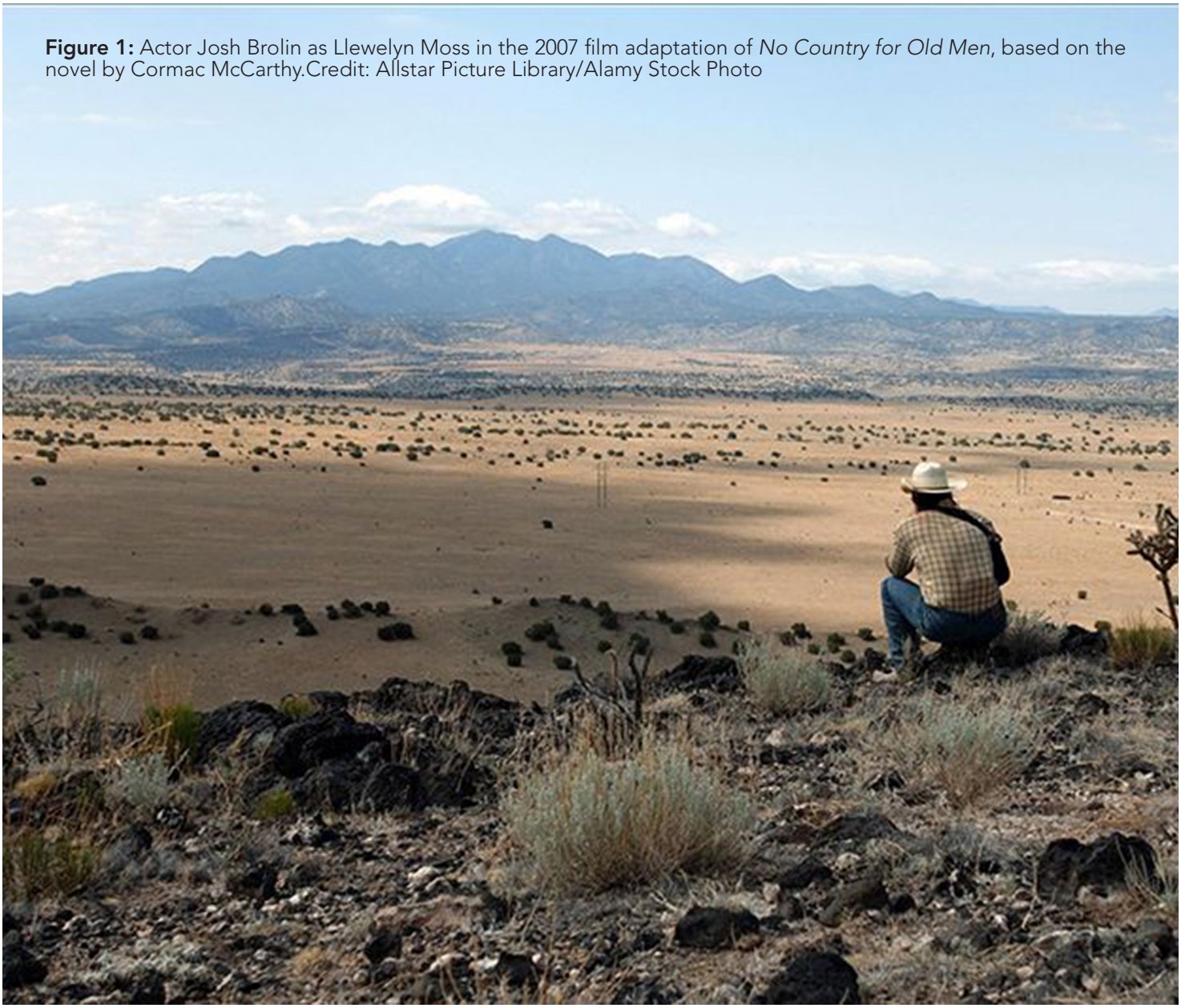

Figure 1: Actor Josh Brolin as Llewelyn Moss in the 2007 film adaptation of *No Country for Old Men*, based on the novel by Cormac McCarthy.Credit: Allstar Picture Library/Alamy Stock Photo

SACNASP FEES 2019

STAATSKOERANT, 12 JULIE 2019 **No. 42576 151**

BOARD NOTICE 111 of 2019

SOUTH AFRICAN COUNCIL FOR NATURAL SCIENTIFIC PROFESSIONS

RECOMMENDED CONSULTATION FEES

The South African Council for Natural Scientific Professions herewith retract Board Notice 15 of 2017 as published on 13 March 2017 in Government Gazette No. 40660.

The South African Council for Natural Scientific Professions has under article 35 (1) of the Natural Scientific Professions Act, 2003 (Act 27 of 2003), determined the amended tariff of recommended fees in this Schedule, which has been approved.

SCHEDULE

Definitions

1. In this Schedule the definitions are as follows:

"Category A", in respect of a private consulting practice in natural sciences, shall mean a top practitioner whose expertise is nationally or internationally recognized and who provides advice at a level of specialization where such advice is recognized as that of an expert:

"Category B", in respect of private consulting practice in natural sciences, shall mean a partner, a sole proprietor, a director, or a member who, jointly or severally with his other partners, co-directors or co-members, bears the risk of the business, takes full responsibility for the liabilities of such practice, performs work of a conceptual nature in natural sciences and development, provides strategy guidance in planning and executing a project and/or carries responsibility for quality management pertaining to a project;

"Category C", in respect of a private practice in natural sciences, shall mean all salaried professional and technical staff performing work of a natural scientific nature and who carry the direct technical responsibility for one or more specific activities related to a project. A person referred to in Category B may also fall in this category if such person performs work of a natural scientific nature at this level;

"Category D", in respect of a private consulting practice in natural sciences, shall mean all other salaried technical staff with adequate expertise and relevant experience performing work of a natural scientific nature with direction and control provided by any person contemplated in Categories A or B or C.

RECOMMENDED RATES

CATEGORY OF STAFF	Indicative Rates per hour in Rands (2019)
A	R2 415.00
B	R2 065.00
C	R1 225.00
D	R880.00

NEW BOOK

Flowering plants of the Southern Kalahari

Noel & Gretel van Rooyen

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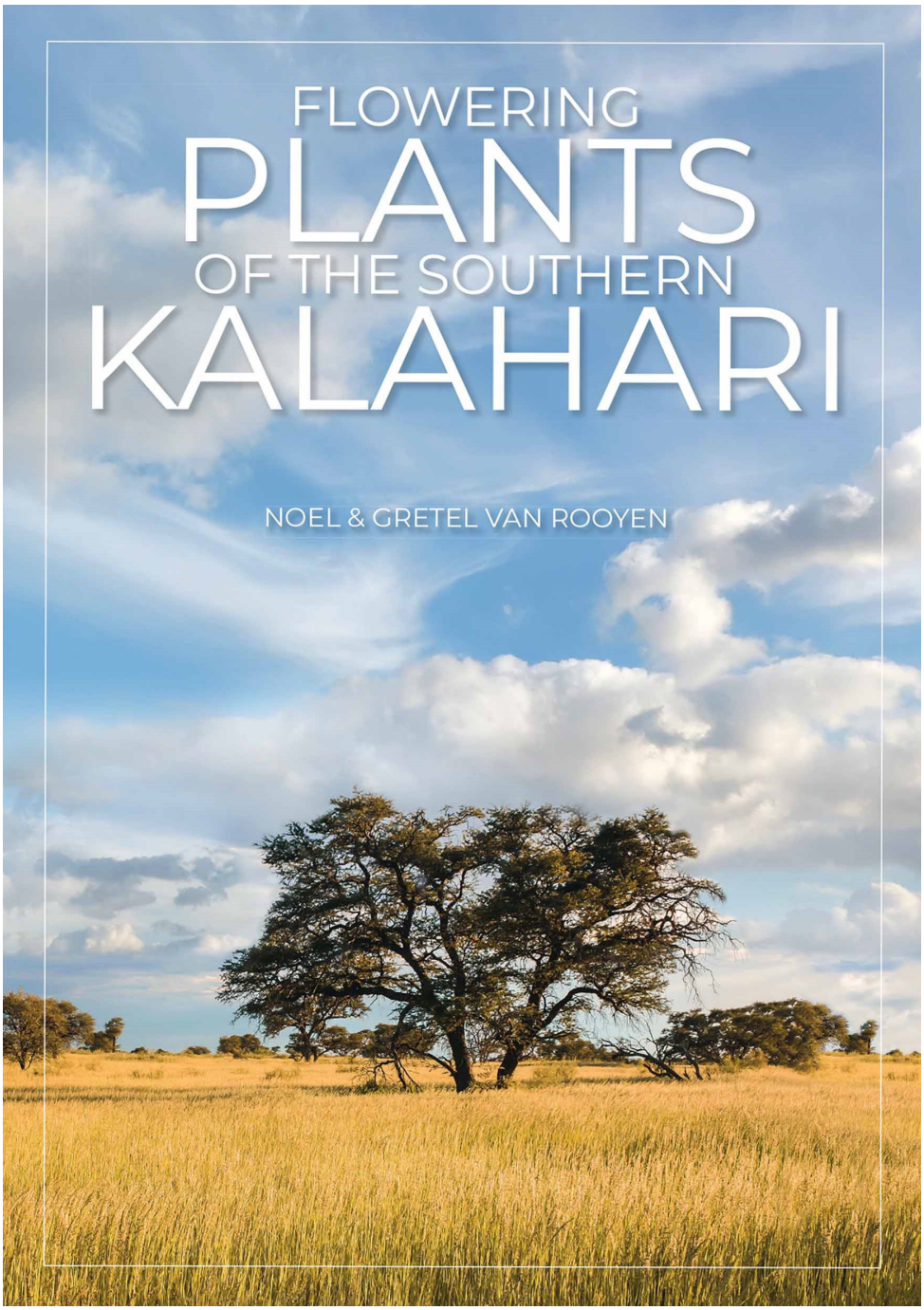
email: noel@ekotrust.co.za
gretel@ekotrust.co.za

ISBN: 978-0-620-084493-2



Grassland Society of Southern Africa (GSSA) Congress

We are now beginning preparations for a scientifically exciting Congress 55, to be held in the wonderful Eastern Cape Province from 29 June to 2 July 2020.

In this regards, the Scientific Committee welcomes proposals for Special Sessions.

Proposals for Special Sessions can be submitted on a form available from the GSSA Administrator (a full list of presentations is not mandatory at this point).

Submissions need to be made to the Administrator (email to info@grassland.org.za) by 30 November 2019, to receive consideration.

We look forward to reading your suggestions!

Kind regards
Ralph Clark
Scientific Committee Chair

PS: For enquiries contact the Administrator via email, info@grassland.org.za.
Thank you!

Joint XXIV International Grassland (IGC) and XI International Rangeland (IRC) congresses

Due to public demand, the deadline for submission of abstacts has been extended to 23rd December 2019.

Please visit the congress website for more info:
http://2020kenya-igc-irc.rangelandcongress.org/

Financial support through the Trust of the Grassland Society of Southern Africa

Background
The Trust of the Grassland Society of Southern Africa offers financial support to members of the Society for a range of activities.

What can be covered?
Any application must be of relevance to the interests of the Grassland Society of Southern Africa, for example:

- Attendance of GSSA Congress
- Attendance of local conferences
- Attendance of international conferences
- Small research grants
- Attendance of short educational courses (including online)
- Attendance of field educational courses

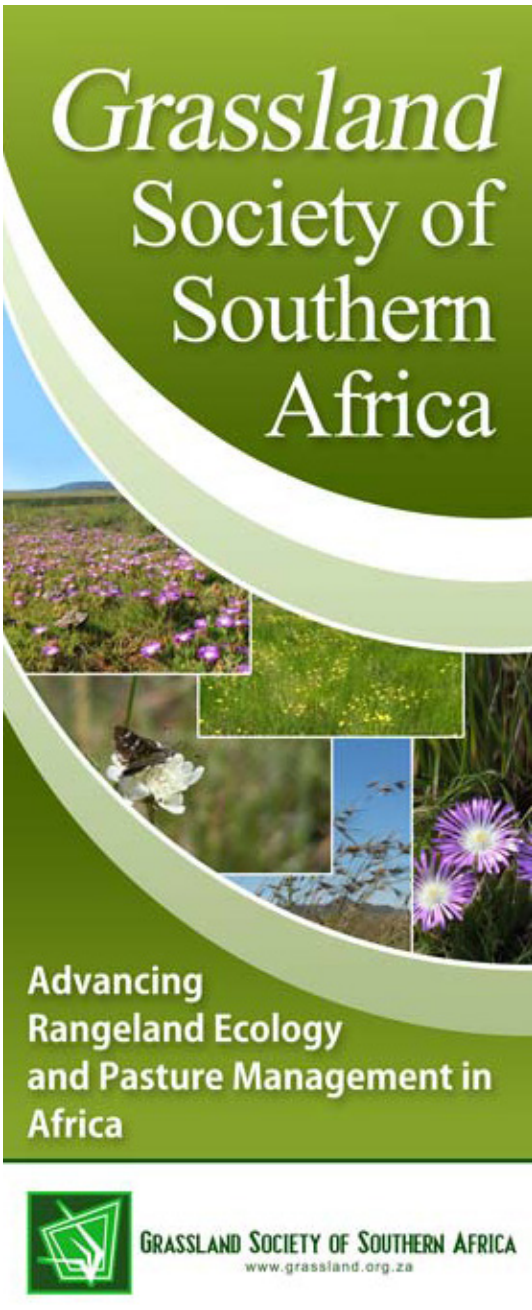
Who can apply?
- Members of the Grassland Society of Southern Africa
- Non-members if special motivation is made but they are encouraged to first join
- Students and early career professionals will be given priority

How much can be requested?
Applications up to R30,000 will be considered, but allocation may be less at the discretion of the Trustees.

When must applications be in?
Applications must be in by the last day of January 2020 for this call

How can I apply?
Applications are done via http://bit.ly/2pVfYT2

Nota bene
The decision of the Trustees of the Grassland Society of Southern Africa's Trust is final.



Upcoming events

20 - 23 Jan 2020

Combined Congress: University of the Free State, Bloemfontein. For more info and registration visit https://combinedcongress.org.za/ or contact Ms Nancy Nortjé at 083 389 0543 or email nancynortje@icloud.com

18 - 20 Feb 2020

Africa Agri Tech 2020 will showcase and host leading representatives in the field of Agri Technology from across the globe and specifically Africa. Maslow Hotel & Conference Centere, Pretoria. For more info contact enquiries@africa-agri.co.za.

1 - 5 March 2020

International Savanna Science Network Meeting. Visit the website www.savannascience.com for more information and registration.

29 June - 2 July 2020

55th Annual Congress of the Grassland Society of Southern Africa. Watch this space as venue in the Eastern Cape of South Africa will be confirmed! For enquiries contact info@grassland.org.za.

6 - 9 July 2020

54th Conference of the SA Society for Agricultural Extension. Ashanti Estate, Sonstraal Road, Paarl, Western Cape. Theme conference is "Facilitation for Development in Agricultural Extension". Abstracts due 16 Dec 2019. For more info contact the SASAE Secretary on 051 401 2781 or email on secretariat@sasae.co.za or Dr. J A van Niekerk at 083 231 7380 or email vNiekerkJA@ufs.ac.za

7 - 11 September 2020

MEDECOS will be held at Club Mykonos, Langebaan, Western Cape are now inviting proposals for symposia and workshops for the 15th Conference on Mediterranean-type ecosystems. You can direct any questions on symposia and workshops to Karen Esler (kje@sun.ac.za) and Nicky Allsopp (allsopp@saeon.ac.za). See http://medecos2020.org/ for more details.

25 - 30 October 2020

Joint XXIV International Grassland (IGC) and XI International Rangeland (IRC) congresses to be held in Nairobi, Kenya. The theme is 'Sustainable Use of Grassland/Rangeland Resources for Improved Livelihoods'. Information is available here: http://bit.ly/Kenya2020

If you would like to advertise your upcoming event, please contact us and we will include it in our next edition.