May 2019
Volume 19
Number 2

Grassroots

Newsletter of the Grassland Society of Southern Africa

South African wonder plant REMOVES MORE CO_2 THAN AMAZON

Bamboo the answer to SA's wood fuel crisis?

First commercial floating solar farm in Africa

Advancing Rangeland Ecology and Pasture Management in Southern Africa

ISSN: 10166122

In this issue

Fromoureditor

Welcome to Issue 2 of Grassroots for 2019!

In this full edition, we start with a feature article by Everson et al., where we are introduced to some new research on bamboo in South Africa. Bamboo has the potential to reduce deforestation of South Africa's natural forest by providing a source of fuelwood and building material. The water-use of this plant is not well understood under South African conditions and this DWS and WRC funded study aims to understand the effects of different bamboo species on water-use.

In our second feature article, Charné Viljoen presents recent research on nitrogen application rates on planted pastures. This study illustrated that, under current management practices, there is a major pool of leachable nitrate and suggests lower application rates for kikuyu pastures and kikuyu pastures over-sown with ryegrass compared to the conventional guidelines. Lower nitrogen rates will allow volunteer legumes to fix nitrogen as well as allow the pasture to use the mineralised nitrogen.

Finally, Costas Zachariades, from the PHP-ARC announces the introduction of the Tradescantia tip beetle into South Africa. This beetle has been bred as a biocontrol for *Tradescantia fluminensis* (Wandering Jew), an invasive alien plant that is affecting the recruitment of forest trees in the higher rainfall areas of SA.

Our news articles, as usual, cover a variety of topics, ranging from the use of technology in conservation, long-term monitoring of vegetation and floating solar panels to invasive alien plants and conservationists who share similar views.

In the previous issue, we introduced a photographic competition to get an idea of the interesting experiences and opportunities our readers have had in the field. Thank you to all who have supported this idea and all those who continue to support. The quality of your photos made judging a challenge. The winner for this issue's cover photo is Greg Martindale with his great photo of research in action – Congratulations!

We have also published the runners-up from each category in this issue for you to enjoy. Please keep submitting your pictures: your photo could be on the cover of the next issue of Grassroots.

A reminder that our GSSA Congress is now just around the corner. Please remember to register as soon as possible!

This year's congress will be held in Upington from 1 - 4 July and we look forward to seeing you there. More information on the congress is found in this issue.

Until next time, happy reading!

Janet

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

Cover Photo
Greg Martindale
Plant diversity assessment, Fort Nottingham Nature Reserve, KwaZulu-Natal.
Grassroots photo competition winner, May 2019.

@GrasslandSociety-ofSouthernAfrica

Is bamboo the answer to South Africa's wood fuel crisis?

Terry Everson, Colin Everson and Mxolisi Gumede

Current Address: University of KwaZulu-Natal, Pietermaritzburg
E-mail Address: EversonT@ukzn.ac.za

In South Africa, the traditional use of energy sources in the form of fuelwood has resulted in substantial negative environmental impacts. Removal of trees for timber and energy has caused degradation of large parts of South Africa, resulting in poor water infiltration, severe soil erosion and loss of biodiversity.

Biomass, particularly firewood, is the most widely used fuel in many rural areas of South Africa. However, timber is not readily available anymore due to heavy harvesting. One of the potential solutions to this is to convert degraded land into viable bamboo plantations which will provide timber and fuel to achieve sustainable development.

Bamboo is a grass which mainly reproduces vegetatively through the production of shoots (tillers) which mature into stems (culms). The function of the culms is to conduct water and nutrients from the soil to the leaves. Unlike the culms of most grasses, the culms of bamboo have extended woody internodes with intermittent, thickened nodes, which gives the bamboo its high tensile strength. In addition, bamboo has a fast growth rate and can reach a height of 30 m within four months (Awalluddin et al., 2017), depending on sufficient resources like sunlight, nutrients and adequate water.

Plate 1: Four-year old bamboo in KwaZulu-Natal

If managed correctly, multiple culms are produced annually which grow into clumps that reach maturity within six to seven years of planting (Plate 1). When harvesting takes place, not all the culms are removed. Generally, a selection of 5-6 culms from each plant is harvested each year. This ensures that the harvesting is sustainable as the remaining culms will continue to produce new shoots in subsequent years, a process that continues for many years.

With this very fast growth rate, high productivity and tensile strength, bamboo has the potential to reduce the deforestation of South Africa's natural forests. However, the bamboo species that have the most potential to solve South Africa's fuelwood crisis are not indigenous. Although not native to South Africa, it is accepted as a naturalized species since its introduction into South Africa during the 1600s (Claassens & Pretorius, 2004). Bamboo has gained popularity in this country because of its potential in the agricultural and forestry sector, its domestic value on farms and homesteads and more recently for its contribution to the green economy (Canavan et al. 2018).

Although there is a concern that it is an alien plant, it has to be acknowledged that some alien plants are an important contributor to the economy and there is a place for them in agricultural systems. However, Canavan et al. (2017) reported that globally there are few invasive species of bamboos (0.7% of taxa) in contrast with other taxa within the grass family (6 and 10%) as reported by Visser et al. (2016).

Bamboo species grow and spread in their habitat through two different growth forms, either sympodial growth, popularly known as clumping species, or monopodial growth through the production of rhizomes (running species). If the planting of bamboo is to be promoted in South Africa, clumping species should be selected rather than species that grow through monopodial rhizomes which may be invasive.

The Government, through the Departments of Trade and Industry (DTI) and Agriculture Forestry and Fisheries (DAFF), is promoting the planting of clumping bamboo species as part of rural agricultural development. According to the Bamboo Association of South Africa, about 40 000 ha are

Plate 2: Bamboo culms ready for market – Note absence of pith.

Plate 3: Installation of the heat pulse velocity technique

Plate 4: Dynamax collar installation

earmarked for bamboo plantations in both KwaZulu-Natal (KZN) and the Eastern Cape (EC).

However, the water-use of this crop is not well understood under the South African climatic conditions. Therefore, the amount of evapotranspiration by the relevant species of bamboo should be quantified in South Africa to provide a scientific basis to decide on the status of this crop as a streamflow reduction activity.

Knowledge of the water-use of bamboo species is also important for its water management to obtain optimum yields. Data must be obtained on the total and seasonal water-use to enable the judicious expansion of the bamboo industry. This is an important requirement to justify or substantiate applications for water-use licences, in order for production to be undertaken within official water-use authorisations.

To address this requirement, the Water Research Commission has funded a three-year project to determine the evapotranspiration and the stream flow reduction impact of bamboo species.

Determining the water-use of trees is a complex process that scientists have been researching for years. Both indirect and direct methods have been used to measure transpiration and the water–use of tree species. Indirect methods include the measurement of meteorological data which is then used to estimate the plant water-use. An alternative approach is the indirect estimation of water-use on the basis of soil moisture balance calculations.

A major limitation of these indirect methods is that the estimates of water-use may be influenced by various factors such as the structure of the soil, time of day and prevailing meteorological conditions. The setting up of an automatic weather station in any study on plant water-use is therefore necessary to assist with data interpretation. To avoid these problems plant water-use can be measured directly through measuring the sap flow in the stem.

One of the main challenges of the project is that technologies that have been successfully developed to measure the sap flow of dicotyledonous tree species, may not be suitable for bamboo species. Various technologies have been effective on dicotyledonous stems which have a pith at the centre of the stem surrounded by vascular bundles.

By contrast, bamboo is a monocotyledonous grass species which has stems with scattered vascular bundles near the outside edge of the stem with no pith region (Plate 2). Two different sap flow measuring techniques will be used to quantify the water-use of bamboo. These are: (i) the heat pulse velocity technique which quantifies sap flow with respect to depth of temperature probes in a stem (Plate 3), and (ii) the stem steady state technique that involves the application of continuous heat energy all around the stem through dynamax collars (Plate 4) which are used to quantify the total sap passing through a fixed area on a stem. The data will enable recommendations on which of the systems will be most suitable for determining the water-use of bamboo.

Since bamboo has not been grown extensively in South Africa, one of the challenges of the study was to find sites with adequate plantings of different species. An additional challenge was to locate a site with adequate security for the expensive equipment that will be used to monitor the water-use. In KwaZulu-Natal, Shooters Hill farm was identified which is located in Otto's Bluff in the Umgungundlovu District Municipality.

Approximately 10 ha on the farm has been planted with bamboo including at least 15 different species. The second site selected was Kowie farm near Bathurst in the Eastern Cape, where the EcoPlanet bamboo company started the first large-scale commercial bamboo cultivation in South Africa in 2012. On the 485 ha farm, 330 ha have been planted with bamboo. The species selected for the study are *Bambusa balcooa* Roth. (referred to as Balcooa) and *Bambusa balcooa* (variety Beema), referred to as Beema. Both are clumping species.

Understanding the effect of changing land-use on water requires knowledge of the natural 'baseline' vegetation. In order to compare the water-use of bamboo with other species, this study will also monitor the water-use of natural grassland, eucalyptus trees and wattle trees.

With all the instruments now currently collecting data, the project will be able to analyse the data and carry out a comparative water-use over the next 12 months.

This project is managed and funded by the Department of Water and Sanitation and the Water Research Commission (WRC project No. K5/2792).

References

1. Awalluddin, D., Ariffin, M.A.M., Osman, M.H., Hussin, M.W., Ismail, M.A., Lee, H.S. & Lim, N.H.A.S. 2017. Mechanical properties of different bamboo species. MATEC Web of Conferences, 2017. EDP Sciences, 01024. DOI: 10.1051/matecconf/201713801024.

2. Canavan, S., Richardson, D.M., Johannes, J., Le Roux, J.J. & Wilson, J.R.U. 2018. Alien Bamboos in South Africa: a Socio-Historical Perspective. Human Ecology doi.org/10.1007/s10745-018-0041-8

3. Canavan, S., Richardson, D.M., Visser, V., Le Roux, J.J., Vorontsova, M.S. & Wilson, J.R.U., 2017. The global distribution of bamboos: assessing correlates of introduction and invasion. *AoB Plants* 9: plw078; doi:10.1093/aobpla/plw078.

4. Claassens, H., & Pretorius, F. 2004. Die geskiedenis van Boerekos 1652-1806. *South African Journal of Cultural History* 18, 110–126.

5. Visser, V., Wilson, J.R.U., Fish, L., Brown, C., Cook, G.D. & Richardson, D.M. 2016. Much more give than take: South Africa as a major donor but infrequent recipient of invasive non-native grasses. *Global Ecology and Biogeography* 25, 679–692.

Are planted pastures receiving too much nitrogen?

Charné Viljoen

Current Address: PhD Student, Stellenbosch University
E-mail Address: cviljoen.su@gmail.com

A recent study on the Outeniqua Research Farm in George found that nitrogen application rates to dairy pastures might be too high and could be seasonally adjusted without compromising pasture production. The trial compared different nitrogen application rates to kikuyu and kikuyu over-sown with annual ryegrass pastures. An interesting result was the major pool of nitrogen in the soil that is vulnerable to potential losses through leaching. After two years of study, results showed that it is possible to lower the application rate, however, the long-term effects of the proposed changes have not been investigated and should thus be carefully considered.

Nitrogen fertiliser is an important management practise for pasture production on dairy farms. Dairy pastures in the southern Cape are mostly irrigated, minimum tillage systems that are being grazed. It has been reported that nitrogen application rates are often in the range of 500 kg N/ha per year. This equates to approximately 50 kg N/ha applied after every grazing. Historically, these guidelines were developed on small experimental sites that were being tilled and cut. This is not similar to current management practices which involve minimum tillage and nitrogen cycling through the excreta of grazing cows.

The study set out to determine how applicable the high nitrogen guidelines are under current management practices. A range of fixed nitrogen application rates and a variable rate applied after every grazing was investigated. The variable rate was determined by measuring a soil water sample for nitrate concentration. The soil water sample was collected from a wetting front detector that was installed in the pasture and the sample was measured with an electronic water quality nitrate meter. The nitrate concentration was mostly higher than the predetermined 75 mg/L nitrate and therefore, almost no nitrogen was applied in the variable application rate.

The study provided evidence that under current management practices, there is a major pool of leachable nitrate. Nitrate is water soluble, which makes it prone to leaching. When no nitrogen was applied during the study, the rates exceeded the allowable 50 mg/L nitrate in drinking water. A build-up of total mineral nitrogen was found in applications above 40 kg N/ha. Total mineral nitrogen is comprised of nitrate and ammonium which is plant available. This indicated that there is an abundance of nitrogen in the system. High nitrogen application rates also reduced the microbial activity measured in the form of urease activity. The urease activity became redundant when high mineral N was present.

The soil had a large potential to mineralise nitrogen; thereby supplying the pasture with significant amounts of nitrogen. On the kikuyu pasture, it was found that 50 to 170 kg N/ha could be mineralised within every grazing cycle, while the kikuyu oversown with annual ryegrass pasture had the potential to mineralise amounts of between 15 and 150 kg N/ha per grazing cycle. Future research could explore the potential of the soil to mineralise nitrogen further so that it would be possible to substitute a partial amount of the applied nitrogen in future fertilisation programs.

There were no treatment effects observed between high and low nitrogen

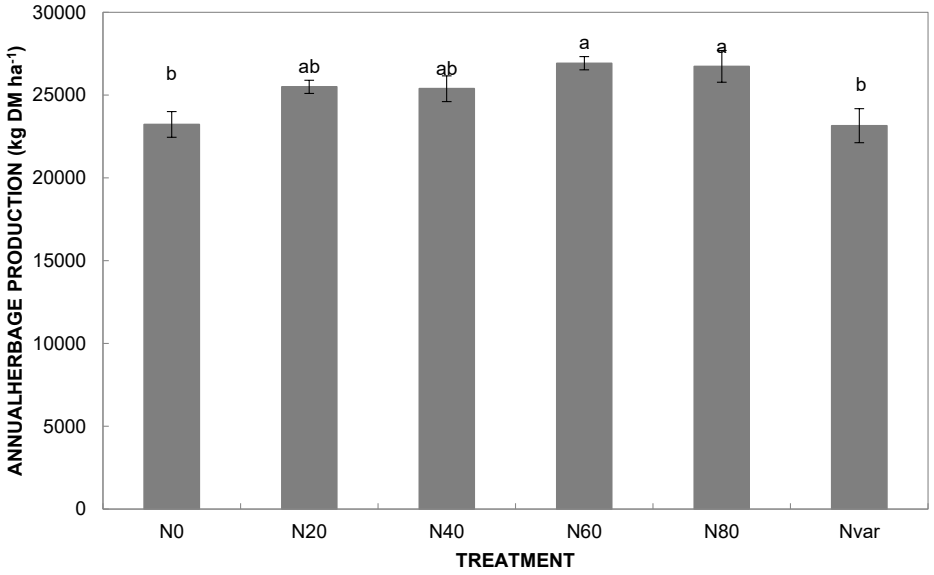


Figure 1: Annual herbage production (kg DM ha^{-1}) of the kikuyu site as affected by treatments N0, N20, N40, N60, N80 = 0, 20, 40, 60, 80 kg N ha^{-1} and Nvar = varying rate of N application according to soil water nitrate concentration applied after grazing. Error bars indicate standard error. No common letter above bars indicates significant difference at 5% level.

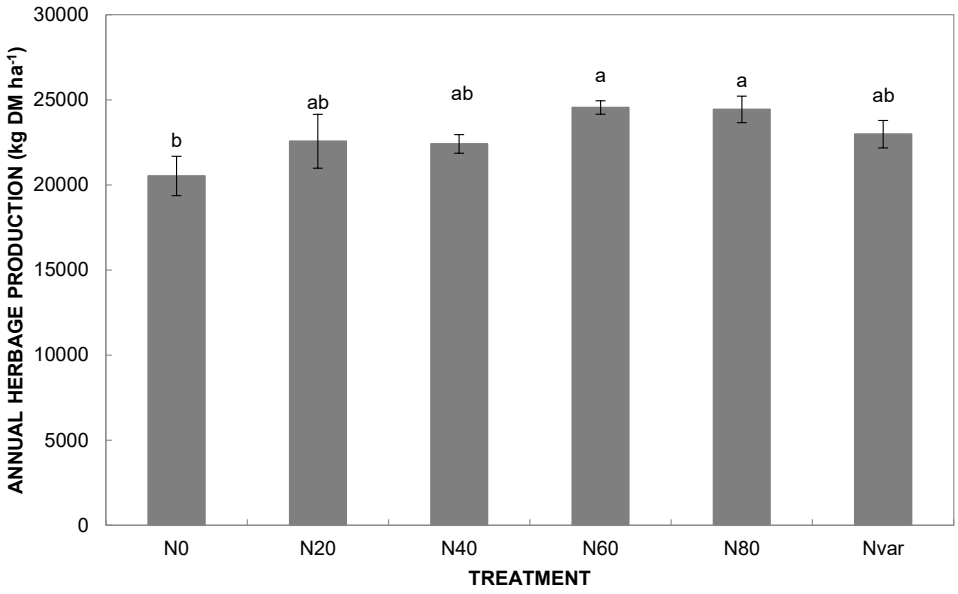


Figure 2: Annual herbage production (kg DM ha^{-1}) of the kikuyu-ryegrass site as affected by treatments N0, N20, N40, N60, N80 = 0, 20, 40, 60, 80 kg N ha-1 and Nvar = varying rate of N application according to soil water nitrate concentration applied after grazing. Error bars indicate standard error. No common letter above bars indicates significant difference at 5% level

application rates when agronomic nitrogen use efficiency was determined. It is an unusual occurrence, since applying low amounts of nitrogen usually result in higher nitrogen use efficiencies. This result could be seen as additional evidence that the soil is nitrogen saturated; the result of years of high nitrogen fertilisation and grazing inputs. Very few differences were observed in pasture production as a result of treatment. The main differences in production were found between seasons and this was due to the growing seasons of the different species.

Picture 1: Assembly of Fullstop™ Wetting Front Detector

Picture 2: Inserting Fullstop™ Wetting Front Detector into the soil at 15 and 30 cm depths

The differences that occurred due to treatments within seasons were when the highest nitrogen input was compared to the control (no nitrogen application). Annual production showed similar results (Figures 1 and 2). Applying as little as 20 kg N/ha per grazing cycle resulted in similar results compared to applying 80 kg N/ha per year. An economic evaluation was not done in this study; however, one must discern if applying twice as much fertiliser is worth the return on investment in terms of pasture production.

The crude protein content of the pasture and botanical composition were also considered. Crude protein increased with an increase in nitrogen application rate, while the botanical composition was mostly influenced by season rather than treatments. Volunteer legumes in the form of clover, however, was influenced by treatments and resulted in low clover contributions when large amounts of nitrogen were applied and vice versa.

The suggestion is that on pure kikuyu pastures, nitrogen application rates of 20 kg/ha per grazing cycle should be applied during summer, autumn and winter. No nitrogen should be applied during spring to allow legumes to fix nitrogen, but more importantly, to allow the pasture to utilise the mineralised nitrogen. On a kikuyu oversown with annual ryegrass, 20 kg N/ha per grazing cycle during winter and spring, and no nitrogen during summer and autumn should be sufficient.

The suggestion was based on the results of a 2-year study, applicable to producers that have long-term kikuyu-ryegrass pastures under minimum tillage practices (approximately 10 years) and long-term nitrogen application rates of 300 kg N/ha per year. Adopting the proposed guidelines should be carefully considered since the long-term effects of these guidelines have not been established.

This study was conducted by the Stellenbosch University and the Western Cape Department of Agriculture on the Outeniqua Research Farm near George. The study was undertaken under the supervision of Dr Pieter Swanepoel and Mrs Janke van der Colf.

Picture 3: Fullstop™ Wetting Front Detectors show with red and yellow float indicate that a water sample is ready to be collected

First release of the Tradescantia tip beetle as a biological control agent

13 March 2019, Iphithi Nature Reserve, Gillitts, eThekwini, KwaZulu-Natal

Costas Zachariades

Current Address: ARC-PHP, Cedara
E-mail Address: zachariadesc@arc.agric.za

Tradescantia fluminensis, commonly known as Wandering Jew, Wandering Willy or spiderwort, is a low-growing, herbaceous plant which is native to southern Brazil, but which has become invasive in several parts of the world, including Europe, Australia and New Zealand. The plant forms thick mats on the ground, particularly in wooded areas, preventing other herbaceous species from growing and impeding the recruitment of forest trees. In South Africa, spiderwort is not perceived as a major weed, although its inconspicuous habit has probably resulted in it being under-reported. It has a wide distribution, which includes most of the nine provinces, but it is limited by its requirement for water. It is thus mainly invasive in areas with high rainfall and riverine habitats in drier areas.

Spiderwort is highly invasive in New Zealand, and a successful biological control programme against the weed was implemented there several years ago. Three beetle species from Brazil were tested for their safety (they feed only on spiderwort) and released against the weed in New Zealand, as has a leaf fungus. These four biological control agents have decreased the density of the weed, allowing other plant species to return.

In 2013, the Agricultural Research Council (ARC) initiated a biological control programme against spiderwort in South Africa, with funding provided by the Department of Environmental Affairs' Natural Management Resource Programmes (DEA: NRMP). Although spiderwort in South Africa is not a high-profile weed, the programme was initiated because (i) there were already successful biological control agents available (shown to be safe and effective in New Zealand), thereby cutting costs and time for the programme; (ii) if a plant becomes a problematic invasive alien species in one country, the chances of it becoming a problem in other countries in which it is not native, are high. Introducing a biological control agent before the plant becomes very widespread can assist in slowing its spread, which can result in major cost savings.

The tradescantia tip beetle, *Neolema abbreviata*, was imported into the ARC-Plant Health and Protection quarantine facility at Cedara in 2014. A breeding population was established in quarantine, and the safety of the beetle was tested for, using standard international procedures. Indigenous plants which are closely related to spiderwort were exposed to the beetle, and its ability to survive on them was recorded. As had

Figure 1: Adult tradescantia tip beetle, *Neolema abbreviata*

been demonstrated in New Zealand, the beetle was only able to survive and form a population on the target weed, and is therefore safe for release in South Africa. An application for release of the beetle as a biological control agent against spiderwort, in the form of a report, was therefore submitted in 2017 to the Department of Agriculture, Forestry and Fisheries. The report was reviewed by international and local experts, and a permit for release was issued in March 2018. Unfortunately the size of the beetle culture in quarantine was small at that stage, and it has taken a year for the culture to be increased to a point at which a release can be made.

The adult beetles feed on the leaves of spiderwort, leaving characteristic elongated windows in the leaf. Eggs are laid singly or in small groups on the leaves, and the larvae are grey and slug-like in appearance.

They also feed on leaves, as well as in the shoot tips of the plant. The larvae pupate inside a white cocoon in the leaf litter, from which the next generation of adult emerges. In the laboratory, the life cycle takes about 10 weeks. At high numbers of beetles, plants become defoliated and die back.

We will release the beetle at a number of sites with plenty of healthy spiderwort, in different habitats, and monitor it to determine whether it establishes a permanent population that is self-sustaining. If it does so, at some release sites at least, we will assess the effectiveness of the beetle in suppressing growth, density and spread of spiderwort, and the return of native biodiversity. Thereafter, we will also decide whether it is necessary to import other biological control agents from New Zealand.

Figure 2: First release of *Neolema abbreviata* beetle

Acknowledgements

- DEA: NRMP and ARC for funding to import the insect and conduct research on its host specificity, and for mass rearing.
- Manaaki Whenua – Landcare Research, New Zealand, and Dr Quentin Paynter, for the starter culture of *Neolema abbreviata*, for advice and for permission to use the photograph of the N. abbreviata adult.
- eThekwini Municipality for permission to release on land administered by them.
- Kloof Conservancy, Everton Conservancy and Iphithi Nature Reserve for providing the venue, logistics, release site and for sponsoring refreshments.
- Personnel at the ARC-PHP laboratory at Cedara for undertaking various aspects of the research and technical work over the years, and particular mention to Dr Andrew McConnachie, Dr Frank Chidawanyika, Ms Milly Gareeb, the late Ms Lynnet Khumalo, Mr Samora Mqolombeni and Ms Prudence Mabaso.

Figure 3: Dr Costas Zachariades (ARC-PHP), Mr Nceba Ngcobo (DEA: NRMP), Dr Frank Chidawanyika (UFS) and Prof Martin Hill (CBC, Rhodes University) with *Tradescantia fluminensis* and *Neolema abbreviata* at Iphithi Nature Reserve.

KEYNOTE Speakers

Yohay Carmel - The Technion – Israel Institute of Technology
Opening speaker: Myth in ecology

Ben Strohbach - Namibia University of Science and Technology
Long-term monitoring of vegetation dynamics in the arid savanna ecosystems of Namibia

Iain Paterson - Rhodes University
Biological control for the protection of water resources and rangelands

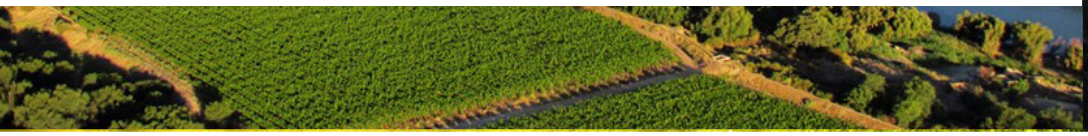
Jesse Nippert - Kansas State University
Bush encroachment alters grassland ecohydrology and requires novel solutions for rangeland management

Klaus Kellner - North-West University
Restoration and management of arid Kalahari rangelands: A 15 years review of research from the Mier area

Susi Vetter - Rhodes University
Plant-herbivore interactions in an arid, stochastic environment: insights from the Richtersveld

Timm Hoffman - University of Cape Town
Rangeland condition in Riemvasmaak 20 years after resettlement and what it means for conservation, communal areas and land reform in the drylands of South Africa

Registration Deadline: 17 June 2019



Grassland Society of Southern Africa
54th Annual Congress

For more information or to register or submit an abstract, go to: https://2019gssa.dryfta.com/en/

Normal payments due 4 June * Preliminary programme 28 May * Registration deadline 17 June * Cancellation deadline 17 June

Photocompetition

Cover Photo Winners

01

Greg Martindale
Sustainable grazing management, Fort Nottingham Nature Reserve, KwaZulu-Natal

02

Greg Martindale
Mooi River Highland Grassland, Fort Nottingham Nature Reserve, KwaZulu-Natal

03

Clinton Carbutt
Sea of Grass; Cathedral Peak Research Catchment, Maloti-Drakensberg Park WHS; November 2018

Photocompetition

Research in Action Winners

01 - Overall winner

Greg Martindale
Plant diversity assessment,
Fort Nottingham Nature Reserve,
KwaZulu-Nata

02

Donna Berjak
Planting a winter cereal evaluation trial on 28 March 2019 at Cedara Research Station, KwaZulu-Natal

03

Wayne Matthews
Soweto Highveld Grassland biodiversity Research;
Sasol Secunda

New technologies could help conservationists keep better track of Serengeti wildebeest herds

Sabrina Weiss

Current Address: University of Glasgow press release
Reprinted From: http://bit.ly/2JkvMpF

New methods of counting wildlife could provide conservationists with fast and accurate methods for estimating the abundance of natural populations.

In a new paper published today in the journal Methods in Ecology and Evolution, mathematicians and conservationists from the UK, Africa and the United States discuss how they have used both machine-learning and citizen science techniques to accurately count wildebeest in the Serengeti National Park in Tanzania more rapidly than is possible using traditional methods.

Evaluating wildebeest abundance is currently extremely costly and time-intensive, requiring manual counts of animals in thousands of aerial photographs of their habitats. From those counts, which can take months to complete, wildlife researchers use statistical estimates to determine the size of the population.

Detecting changes in the population helps wildlife managers make more informed decisions about how best to keep herds healthy and sustainable.

Figure 1: A wildebeest herd in the Serengeti. Photo: Daniel Rosengren

The team which produced the paper was comprised of researchers from the University of Glasgow, the University of Cape Town in South Africa, the Field Museum of Natural History in the USA and the Tanzania Wildlife Research Institute (TAWIRI).

Our approach gave us really good results, which I think shows the unique benefits of this type of cross-disciplinary collaboration.

They used a deep-learning algorithm to identify the wildebeest in images taken from the 2015 aerial survey of the Serengeti National Park. The system was 'trained' to recognise wildebeest using 500 high-resolution aerial images from the Serengeti, then fine-tuned for further accuracy, eventually being capable of processing 1,000 images in less than two hours and able to produce a total count of over 20,000 wildebeest within 1% of a count conducted by a human expert.

The team's second approach used the 'citizen science' website Zooniverse to publish a selection of the same images, with each large-resolution image split into 12 equal-sized tiles to make counting easier. Over three weeks in May 2017, more than 2,200 Zooniverse users looked at close to 10,000 of those images, offering their counts of the wildebeest in each image. To ensure an accurate count, every image was counted by 15 different volunteers.

Dr Colin Torney, senior lecturer in the University of Glasgow's School of Mathematics and Statistics, is one of the paper's lead authors. He said: "Wildlife managers need regular and accurate counts of animal populations to help them identify any changes and evaluate what's causing them. Without a good handle on population abundance, it's much harder for them to see the early warning signs of a decline caused by changing habitats or increased levels of poaching and start to take the proper steps to redress the imbalance.

Dr Edward Kohi, a co-author of the paper and Principal Research Officer at the Tanzania Wildlife Research Institute, said: "These emerging technologies will enable TAWIRI to have an annual wildebeest survey as the time consuming manual work will be taken care of. The success of the machine learning approach represents a major milestone for wildlife survey techniques in Tanzania and across Africa. TAWIRI and our partners take this improvement very seriously and we are planning to apply this advancement to other wildlife species."

Dr Grant Hopcraft of the University's Institute of Biodiversity Animal Health & Comparative Medicine, is the senior author on the paper. He added: "The major driving force in the Serengeti's ecosystem is the abundance of wildebeest. Currently, there are about 1.3 m wildebeest, which influence almost every variable in the ecosystem – everything from the return rate of fires, since they eat the grass, to the amount of insects that are available to migrating birds. Without wildebeest, the ecosystem would shift into a completely different state and therefore it's important to know how many there are.

"About 8.5 percent of that population is lost each year through illegal bushmeat trade, predation and natural causes. The fastest the population can grow through calving is about 10 percent each year, so the margin for maintaining the population is pretty slim.

"The work we've done with deep learning and citizen science is really encouraging, and we're keen to expand it further in the near future, perhaps for population surveys using satellite imagery. It's an exciting time for the field, and demonstrates the potential benefits that can be achieved from mathematicians and ecologists working more closely together."

Our research suggests deep learning algorithms could support traditional hand-counting methods or, potentially, even replace them entirely as the primary means of processing the aerial photographs.

The team's paper, titled 'A comparison of deep learning and citizen science techniques for counting wildlife in aerial survey images', is published in Methods in Ecology and Evolution. The research was funded by the British Ecological Society, the Friedkin Foundation, the European Union Horizon 2020 programme, and the James S. McDonnell Foundation.

Read the full article (free to read for a limited time): Torney CJ, Lloyd-Jones DJ, Chevallier M, et al. A comparison of deep learning and citizen science techniques for counting wildlife in aerial survey images. Methods Ecol Evol. 2019;00:1–9. DOI: 10.1111/2041-210X.13165

Media contact

Ross Barker, University of Glasgow Communications, Email: media@glasgow.ac.uk, Tel: +44 141 330 3535

South African wonder plant removes more CO_2 than the Amazon

Reprinted From: http://bit.ly/2H7nZu5

Spekboom, also known as pork bush or elephant's food, is our own indigenous South African wonder plant.

Besides being edible (and high in Vitamin C), the medium-sized shrub found predominantly in the Eastern Cape is resilient and an important 'weapon' in the fight against climate change.

This carbon sponge can sequester more than 4 tonnes of carbon dioxide per year per hectare planted, making it more effective than the Amazon rainforest at sucking carbon dioxide out of the atmosphere.

The unassuming-looking bush with its round, succulent leaves is especially good at photosynthesis (making plant food from sunlight), which produces a byproduct we desperately need: oxygen.

Kuzuko Lodge, a private game reserve in a concession next to Addo Elephant National Park, is able to sell carbon credits due to this miracle bush, which occurs naturally here and is also being planted as part of a landscape restoration project.

Parts of the reserve were previously owned by farmers and were overgrazed by livestock.

Governments in Europe and other parts of the world want to reduce industrial pollution, therefore businesses that produce high levels of greenhouse gas emissions, like transport companies, can buy carbon credits to offset their carbon footprint.

Here are some properties of this wondrous plant:

- It's easy to grow and can live for up to 200 years
- It grows to between 2 and 5m tall
- It's edible and high in Vitamin C
- Spekboom is very resilient and can survive frost, drought, and fire
- It's one of the most effective plants at sequestering carbon dioxide from the atmosphere as it is able to use two of the three types of photosynthesis, while most other plants only use one.

Figure 1: Spekboom at Kuzuko Lodge. Image credit: Elise Kirsten

Figure 2: Walking to the San rock art in Kuzuko Private Game Reserve. Image credit: Elise Kirsten

According to the The Spekboom Foundation, 'Spekboom has enormous carbon-storing capabilities.

Its capacity to offset harmful carbon emissions is compared to that of moist, subtropical forests.

This remarkable plant is unique in that it stores solar energy to perform photosynthesis at night.

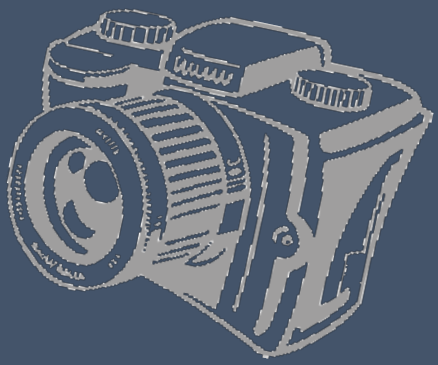
This makes a spekboom thicket 10 times more effective per hectare at carbon fixing than any tropical rainforest.

Each hectare of the South African wonder plant spekboom could capture 4.2 tonnes of carbon yearly.'

Grassroots
Newsletter of the Grassland Society of Southern Africa

Photo competition

Are you a keen photographer? Have you recently taken unique photos while doing field work?
Enter them into any of the following two categories and your photo can be our next ***Grassroots*** **cover**!



"Cover" photos

Any high quality photos that are related to rangeland ecology and pasture management in southern Africa

"Research in Action" photos

Any interesting photos taken while collecting data or doing field work that are related to rangeland ecology and pasture management in southern Africa

Winning photos will feature in the next *Grassroots* and the overall winning photo will be on the cover!

Competition runs for the next 3 Grassroots editions of 2019!

How to enter:.

- Choose one of the above categories.
- Photos must be in jpg format and not exceed 10 MB.
- Email your entries with your name and contact details to **photos.grassroots@gmail.com.**
- Include a title and information on where and when the image was taken.
- Email your photos before 17h00 on the following dates:
  - 10 April 2019 (*May edition*)
  - 1 July 2019 (*August edition*)
  - 1 October 2019 (*November edition)*
- You will receive a confirmation email upon entrance.

For additional information, send an email to **info@grassland.org.za**

***Terms & Conditions:**

- Anyone is welcome to enter, except the *Grassroots'* publication team and their immediate family. Photos will be judged by the publications team.
- More than one entry is allowed.
- A participant who is announced as a winner may not enter the competition for the following editions.
- *Grassroots* holds the right to use entered photos elsewhere in *Grassroots*, the GSSA website, or for future marketing purposes without compensation to the photographer.
- A photographer will receive the necessary recognition if any of his/her photos are published by *Grassroots.*
- Winners will be notified a week before publication.

Little dragons with a sweet tooth pollinate the mysterious "Hidden Flower"

High up in the Maloti-Drakensberg World Heritage Site in South Africa, and unexpected visitor is changing ideas of what animals can be pollinators.

Current Address: School of Life Sciences, University of KwaZulu-Natal, Pietermaritzburg, South Africa
E-mail Address: RuthCozien@gmail.com
Reprinted From: http://bit.ly/2YhrIuN

Ruth Cozien and Alex Assiry

How do you attract pollinators, like bees and butterflies, if you have flowers? Almost 90% of flowering plants use bright colourful floral displays to attract their pollinators. The flowers of *Guthriea capensis* are different. *G. capensis* is the "Hidden Flower". Just as their common name implies, the flowers are hidden at ground level, beneath the leaves of the plant. Also like the leaves, they are green. The flowers are, however, filled with nectar and strongly scented, which suggests that some animal does manage to find and pollinate the "Hidden Flowers"- but what is it?

Researchers from South Africa and the Netherlands, based at the Pollination Ecology Research Lab at the University of KwaZulu-Natal and the Afromontane Research Unit at the University of the Free State, think they have the answer. They have published their discovery in the journal *Ecology*. The team found staked out a group of "Hidden Flowers" in the Maloti-Drakensberg World Heritage Site in South Africa. After many fruitless hours of human observations, cameras triggered by motion-detectors finally revealed the identity of a shy and highly surprising pollinator. Drakensberg Crag Lizards pick up pollen on their snouts when they visit the flowers to lap nectar.

"'Gobsmacked'" is probably the most appropriate word to describe us when we saw the first footage," said Ruth Cozien, first author of the paper. We were aware lizards occasionally visit flowers on islands, and we knew that lizards are very abundant where *Guthriea* occurs. They both have a preference for rocky, high elevation habitats. We never put two and two together because it simply never occurred to us that a plant in continental Africa would be pollinated by lizards."

Flowers like the "Hidden Flower" look like other flowers that use rodents and shrews as pollinators. Ruth Cozien said: "We had strong, preconceived ideas about what we were going to find, to the extent that, based on the expectation that most pollinator activity would be between dusk and dawn (when rodents and shrews are most active), we even initially set most of the motion-trigger cameras to record only during the night, to save battery power and storage space on memory cards which are often major limitations on data collection when working with motion trigger cameras in inaccessible sites. We won't do that again!"

Lizards are not on the list of suspects, when botanists search for pollinators. Ruth Cozien explained: "Although it has been known for more than fifty years that some lizards do feed on flowers, they are still rarely considered as potential pollinators. Firstly, because they really are unlikely to be visiting flowers, and secondly because they are unlikely to be observed if they do visit! Lizards (like mice and shrews) may even actively avoid humans, so these interactions are really difficult to document. That the lizards have been found now, is down to affordable motion-sensitive cameras.

But using them still isn't a simple task. Ruth Cozien said: "The first challenge with filming "hidden flowers" is pointing a camera at any flower at all. The flowers lie on the ground, and the line of sight is almost inevitably obscured by the leaves under which the flowers are hidden. To get an angle where flowers were visible, we had to position cameras below the plants. One way was to either by angle them upwards on very steep ground. This involved a lot of repositioning of rocks at 2700m! Another way was by partly sinking the cameras into the ground.

"In theory that works to get the flowers in view. But you can't be sure because both tricks make the viewfinder impossible to reach as it's on the underside of the camera. Worse, you may obscure the motion sensor, which is critical to operate the camera!

"It turns out that to record activity at ground level, it is best to position your motion-trigger camera upside-down for recording in the field, and then use software afterwards to flip the footage back to right-side-up. But this advice does not come with the standard operating instructions!"

Once the team saw the lizards carrying off pollen, they made sure that the lizards really were pollinators. When lizards were experimentally excluded from plants, the number of seeds produced dropped dramatically, by almost 95% percent. Although flower visitation by lizards is not unknown, it occurs almost exclusively on oceanic islands, and the critical role of lizards for reproduction in *G. capensis* is virtually unprecedented.

Just how lizards find the "Hidden Flowers" is the next riddle to be solved. Most lizards are insectivorous. In the harsh environments of islands, deserts, and high mountains, they may develop a sweet tooth and supplement their insect diets with sips of nectar. Lizards can locate food using only odour, and

chemical analysis of the scent produced by the "Hidden Flowers" identified compounds which are almost unique in the plant kingdom. It seems likely that these extraordinary scent chemicals are key to attracting the lizard pollinators.

Intriguingly, at close range, small orange glands are visible at the base of the inside of the flowers, and these glands bear a striking resemblance to the orange colour that male lizards develop in mating season to attract females. This similarity suggests that flowers may be using a colour that the reptiles recognise to enable them to locate the nectar.

The unique combination of specialized lizard pollination in a continental setting provides exceptional opportunities for gaining insight into both the ecology of lizards and the function of unusual flower features.

This study shows while insects such as honey bees are for pollination, there are still many unknown and surprising interactions that also need to be conserved. If we want to ensure that plants like the mysterious "Hidden Flower" persist then we will need to make sure that visits continue from the little dragons with a sweet tooth.

Further reading

Cozien, R. J., Niet, T., Johnson, S. D., & Steenhuisen, S. (2019). Saurian surprise: lizards pollinate South Africa's enigmatic hidden flower. Ecology, e02670. https://doi.org/10.1002/ecy.2670

Figure 1: A Drakensberg Crag Lizard (*Pseudocordylis subviridis*) licking nectar from the "Hidden Flowers" of *Guthriea capensis* in a terrarium (photo credit: Ruth Cozien & Steve Johnson)

Measuring total evaporation in SAEON's Cathedral Peak research catchments

Current Address: SAEON Grasslands-Forests-Wetlands Node
E-mail Address: michele@saeon.ac.za
Reprinted From: http://bit.ly/2PUrlDh

Michele Toucher, Byron Gray and Sue Janse Van Rensburg

Given the growing pressures on South Africa's water resources, the protection and good management of our key water source areas is becoming increasingly important.

The uKhahlamba Drakensberg in KwaZulu-Natal is one of those key water source areas which need to be protected and managed to ensure sustainable water supply to Gauteng and KwaZulu-Natal.

These high-altitude mountainous regions are facing several threats, one of which is vegetation change. How and why vegetation change is occurring in grasslands is one of the key research themes of the SAEON Grasslands Node.

There are both local drivers of vegetation change, such as historical or current land use and fire management practices, and global drivers of vegetation change such as carbon fertilisation, nitrogen deposition and climatic shifts.

Understanding the impacts of vegetation change on water dynamics

The vegetation of an area and the hydrological response of that area are closely interlinked. When the vegetation changes, the way in which precipitation is divided into infiltration and runoff is altered, and therefore the streamflow generated is changed.

Understanding the impacts of vegetation change on localised water dynamics is thus vital for informing water resources planning. Vegetation can be managed to some extent at local scales, unlike the threat of climate change where little can be done locally about the temperature and rainfall.

With a better understanding of interaction between vegetation and water resources, under different land use or land management regimes, appropriate management opportunities can be identified that can be used to mitigate the potential negative impacts of changes in climate on our water resources.

To date, research on the impacts of vegetation on water has focused on commercial forestry and agricultural crops. The SAEON Cathedral Peak research catchments, where different land use and land management treatments have been applied, provide a unique experimental opportunity to study the catchment scale impacts of woody encroachment and degraded grassland on water resources in comparison with the hydrological response under pristine grassland.

To be able to understand the impacts of vegetation on water, the components of the hydrological cycle that need to be measured are climate variables (radiation, wind speed and direction, air temperature, humidity and rainfall), total evaporation, soil water, interception and river flow. SAEON has monitored climate variables and river flows of the Cathedral Peak research catchments since 2012, as well as the total evaporation and soil water of the pristine grassland catchment.

However, until recently no total evaporation or soil water measurements were being made in the catchments showing vegetation change, namely Catchment III, which is degraded, and woody encroachment in Catchment IX.

Measuring total evaporation

Measurement of total evaporation is very challenging, especially in mountainous, steep sites with varying vegetation structure.

The total evaporation of the pristine grassland is being measured using an open path eddy covariance (EC) system. However, there were concerns about using these systems in the de-

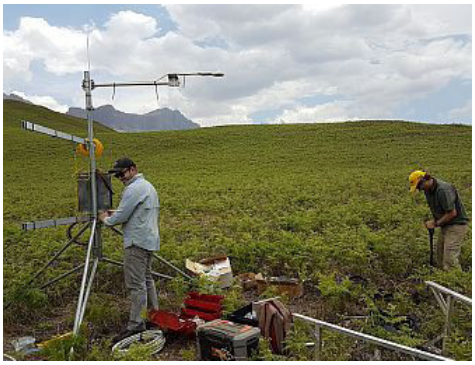


Figure 1: Byron Gray and Kent Lawrence install the Surface Renewal system in Catchment III, Cathedral Peak

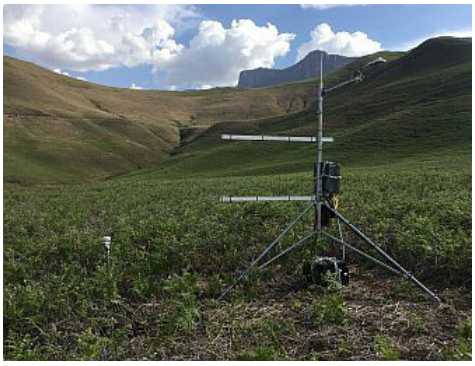


Figure 2: The fully installed Surface Renewal system in the degraded Catchment III measuring over bracken fern (*Pteridium aquilinum*)

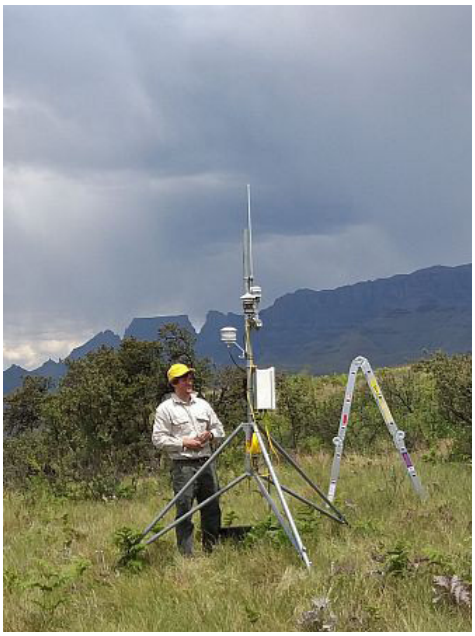


Figure 3: Byron Gray installs the Automatic Weather Station to support the Surface Renewal measurements in Catchment IX, Cathedral Peak

Figure 4: The fully installed Surface Renewal system in the woody encroached Catchment IX

graded and woody encroached catchment. Thus, after much discussion, the SAEON Grasslands Node team decided to test the Surface Renewal method in these catchments.

The Surface Renewal method estimates sensible heat in a simple and cost-effective way. The method is similar to the EC system in principle but uses high-frequency measurements of air temperature at two different heights above the canopy, measured by two exposed fine wire thermocouples as the basis for sensible heat flux measurements, as opposed to infrared gas analysis of water vapour in the EC system.

It was with great excitement that the Grasslands Node team installed the Surface Renewal systems in Catchments III and IX during November 2018. These systems will be monitored for the next two years to allow for total evaporation to be determined over different seasons.

The total evaporation data, together with the climate variables and streamflow, will allow us to better understand the impacts of these vegetation covers on the hydrological response. This study will form a component of SAEON student Byron Gray's PhD.

Driest December on record for the Cathedral Peak research catchments

2018 ended on a low for the Cathedral Peak research catchments, with only 73 mm of rainfall recorded at the Mike's Pass meteorological station for December 2018. This was well below the long-term historical (1949–1992) December mean rainfall of 202 mm, and below the previous December minimum rainfall recorded in 1970 of 83 mm.

Scientists split on SA's winter and summer rainfall zones

Current Address: University of the Witwatersrand
E-mail Address: Jennifer.Fitchett@wits.ac.za
Reprinted From: http://bit.ly/2vZfNFG

Jennifer Fitchett, Chris Curtis and Sarah Roffe

South Africa is among a handful of countries that experience winter rainfall in some areas and summer rainfall in others, but scientists are split on SA's winter and summer rainfall zones. The southwestern tip of the country has a Mediterranean climate, with hot dry summers and cool wet winters. This is because midlatitude cyclones migrate further north during winter, allowing the edge of the cold front arm to sweep across the southern most part of the country.

The interior is dry and cold in winter, with subsiding air from strong high-pressure systems. In summer, this high pressure moves south, causing the dry conditions in the Western Cape and allowing convective storms in the interior.

All this is well documented. What is unclear is where exactly the boundary between the winter and summer rainfall zones exists. There is consensus that Cape Town is in the winter rainfall zone, and Johannesburg is in the summer rainfall zone, but these cities are separated by a 1,400km distance. What about the zone in between?

As it turns out, not even climate scientists are sure. We discovered this in research we did to try and pin down where the line might be drawn. We geo-referenced all the existing rainfall seasonality maps, using Geographic Information System software to determine the areas of overlap between the maps. We found that there was no agreement in the position of this line. This is a problem for farmers, tourists, and even high school geography students who need to accurately classify the rainfall seasonality of a particular town.

Interrogating historical maps

We explored 60 South African rainfall seasonality maps that were published between 1938 to present. Although some of these maps are direct republishing of an original map, each unique map has used a different climatological or statistical approach, and each has a slightly different location of the boundary of the winter rainfall zone.

A large area of the country has an agreement in rainfall zone classification of 75% or more. However, the region between the winter and summer rainfall zones is highly contested. A large band is classified by half of the scientists as winter rainfall zone, and half as summer rainfall zone. A smaller area, including the town of Sutherland, is completely disputed with researchers classifying it as summer, winter and year-round rainfall zones.

This problem is largely unique to South Africa. Much of the Mediterranean, which experiences a similar climatic transition, comprises small countries and thus each has a relatively coherent rainfall regime. Other countries that have changes in rainfall zone have a density of rainfall stations, which means they do not face the same problem. That said, this is one of the first papers to explore disagreements in rainfall zone mapping. To complicate matters, boundaries appear to be shifting under climate change. In South Africa, the winter rainfall zone extended as far north as Lesotho and the Free State during the Last Glacial Maximum, 24,000 years ago. It has progressively migrated south over the past 20,000 years.

Recent research suggests that a continued southward migration under climate change may have been responsible for the severe 2015-2017 drought in Cape Town. This southward migration in the westerlies (winds blowing from the west toward the east) has been reported for the entire southern hemisphere. Similar impacts of a weakened westerly system has also been implicated in the California drought of 2013-2014.

Why it matters

The classification of rainfall seasonality is important beyond academic debate. Tourism marketing relies heavily on providing potential visitors with an accurate picture of the weather that they can expect so that they can choose their destination to visit, plan the timing of their vacation and pack appropriate clothing. Agriculture also relies on accurate and well-documented climate information allowing farmers to sow their crops at the correct time of the year, select appropriate crops for the area, and manage pest and plant invasions effectively.

Even sectors such as transport and shipping and manufacturing benefit from accurate climate information. Pilots, for example, need accurate climate information to determine flight paths.

Better measures needed

Our study highlights that there needs to be a more systematic approach to classifying rainfall seasonality in South Africa.

The country needs to decide on the most appropriate measure of seasonality and apply it to all the available rainfall stations in the country.

Farmers, tourists and climatologists will all need to keep a particularly close eye on these shifting zones over the next few years.

Acknowledgement

Jennifer Fitchett, Senior Lecturer in Physical Geography, University of the Witwatersrand; Chris Curtis, Professor of Geography, University of the Witwatersrand; Sarah Roffe, PhD student, Climatology, University of the Witwatersrand.

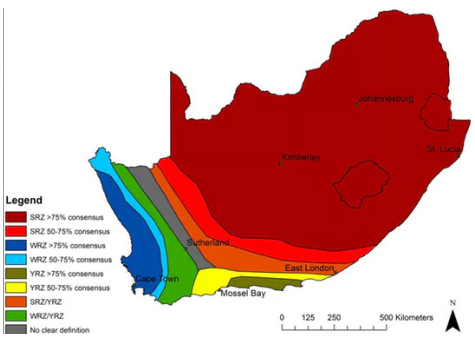


Figure 1: South Africa's rainfall zone (Provided by authors)

Long-term monitoring expands our knowledge of the Succulent Karoo

Current Address: SAEON Arid Lands Node
E-mail Address: helga@saeon.ac.za
Reprinted From: http://bit.ly/2HaJXfP

Helga van der Merwe

The recent publication of a Special Issue on the Karoo in the *African Journal of Range and Forage Science* highlighted findings from scientific studies across the Karoo.

Papers were diverse and not limited to only the Nama Karoo Biome but included papers on the Succulent Karoo Biome, an arid hotspot of diversity.

The Karoo Special Issue featured three long-term vegetation monitoring projects in the Succulent Karoo with survey data generated over 15 to 26 years. In all three cases, the researchers that initiated the studies at these sites are still involved with the projects.

These researchers re-survey the sites at yearly (for two projects) and five-yearly (for one project) intervals. This is rare and adds crucial continuity in field survey methodology and species identification.

The researchers' expertise and experience over a decade or two at the same sites also aids interpretation of the findings, thereby adding value to these lengthy studies.

Diverse study locations

The three Succulent Karoo study locations were diverse: (1) *Leliefontein* communal area and adjacent privately-owned farmland, (2) *Goegap Nature Reserve*, and (3) *Soebatsfontein* communal farmland. Each project used different research methodologies to investigate vegetation change over time.

One study comparing a fence-line contrast between the continually grazed *Leliefontein* communal area with adjacent rotationally grazed private farmland found a decline in total vegetation cover on both communal and privately-owned farmland in the later monitoring period. This decline was attributed to the low rainfall and the large reduction in the annual plant component.

In another study in which SAEON is involved, the effect of high grazing pressure by wildlife on the plains of *Goegap Nature Reserve* was found to decrease total plant cover and reduce grazing-sensitive species. Additionally, perennial species composition had changed over the >20-year period, while annual species changes that occurred were dependent on timing and amount of rainfall.

Overall, on the *Soebatsfontein* communal farmland, with stocking rates currently much lower than when privately farmed, vegetation cover of shrubs and annuals decreased and a strong dependence of vegetation on rainfall and temperature, or just rainfall, was found.

Research findings

Findings were similar across these locations exhibiting diverse land uses, historical and current management practices as well as different research methodologies. All three studies confirmed that rainfall had an important effect on total annual plant cover.

Historical and current grazing regimes were found to slowly affect perennial plant cover and composition under livestock and wildlife utilisation. All three projects confirmed that long-term studies are essential to gain an understanding of vegetation change in the Succulent Karoo as vegetation change occurs slowly under the arid conditions that prevail in this biome.

Figure 1: A line transect on the plains of *Goegap Nature Reserve* (Photo: Helga van der Merwe)

Figure 2: The *Leliefontein* communal area (Photo: Joh Henschel)

Figure 3: The *Soebatsfontein* Observatory in Namaqualand (Photo: Helga van der Merwe)

Whether herbivores increase or decrease plant diversity depends on what's on the menu

Current Address: University of California - Santa Barbara
Reprinted From: http://bit.ly/2H98pOE

Harrison Tasoff

Cows eat grass. It seems simple enough. But just which kind of grass cows and their vegetarian comrades munch on can influence the entire ecosystem.

Scientists have long known that herbivores affect the plant diversity around them. The thought was that in highly productive ecosystems—like jungles and tropical savannas—animals would favor dominant, fast-growing plants. This would free up nutrients and space, allowing for a greater variety of plants to thrive in the ecosystem overall. In contrast, herbivores in regions with low plant biomass—such as tundras and deserts—would eat whatever they could find, driving down plant diversity in the nutrient-strapped ecosystems.

Now, a team of scientists including UC Santa Barbara's Deron Burkepile has tested this hypothesis by conducting a meta-analysis of studies that investigated the effects of herbivory on the plant diversity in different kinds of grasslands around the world. Burkepile, an associate professor of ecology, helped lead the 82-person team of biologists as they reviewed 252 different studies comparing plant diversity in areas where herbivores were and were not excluded. Their findings appear in the journal *Nature Ecology and Evolution*.

When the dust settled, the correlation between herbivory and diversity wasn't nearly as clear as everyone had expected. "The data was kind of like a shotgun blast," Burkepile said. "So we wanted to tease apart why you'd see this highly variable relationship around this fairly well-accepted idea in ecology."

Although the connection was small between the productivity of the ecosystem and the effects of herbivory on plant diversity, the team noticed another, much stronger association. When the ecosystem hosted a particularly vigorous species of plant, herbivory seemed to be crucial in maintaining biodiversity.

For instance, grasslands in the tallgrass prairie in the American Midwest tend to be dominated by fast-growing grasses, such as big bluestem, that give that area its iconic name. The team discovered that herbivores had an outsized effect on maintaining biodiversity by keeping big bluestem from taking over and outcompeting dozens of smaller, slower growing plant species.

However not all herbivores are on an equal foot, or hoof. The team found that the connection between herbivory and diversity was particularly strong in grasslands where more animals graze on grass than on herbs and shrubs. This seems reasonable, since grasses tend to be the dominant species in grasslands, as the name suggests.

What's more, Burkepile previously discovered that invasive animals tend to promote the spread of invasive plants, and vice versa for native animals and plants. Native plants are particularly vulnerable to invasive herbivores because they never evolved defenses against these foreigners. Not only do invasive animals reduce the abundance of native plants, they also open land and resources for invasive plants to spread.

For example, cattle introduced into American grasslands often suppress native grasses and facilitate the spread of unpalatable invasive species, like cheatgrass, Burkepile said. Scientists call this an invasional meltdown, and the team hopes to suss out more details about this phenomenon in future work.

These findings are more than academic. "We've seen three decades of really important papers saying that ecosystems work better when you have more species in them," Burkepile said. "What our data suggests is that herbivores are especially important for maintaining this biodiversity in places where you have a plant species that is potentially really dominant."

As biodiversity continues to decline worldwide, conservationists are looking for ways to prevent catastrophic losses."This suggests that one potential method to managing ecosystems and biodiversity is to use herbivores to manage these dominant species," Burkepile said.

More information: Sally E. Koerner et al. Change in dominance determines herbivore effects on plant biodiversity, *Nature Ecology & Evolution* (2018). DOI: 10.1038/s41559-018-0696-y

Figure 1: An impala browses upon a shrub in Kruger National Park, South Africa. Credit: John Parker/University of California - Santa Barbara

Utilising invasive cacti as processed livestock feed and as a means of control

Current Address: Professional Animal Scientist, University of the Free State, Bloemfontein
E-mail Address: dewaalho@ufs.ac.za / dewaalho0@gmail.com
Reprinted From: SAPIA News No. 51

HO de Waal

Scientists at the University of the Free State have made major advances in utilising spineless cactus pears (*Opuntia ficus-indica and O. robusta*) as multi-use crops for humans and livestock. In addition to the conventional uses of the fruits, cladodes and fruits have been processed as livestock feed (De Waal 2015).

Construction of a wind turbine farm was started by an Independent Power Producer (IPP) near Bedford in the Eastern Cape Province. However, the construction footprint was heavily invaded by spiny cactus pears, notably the spiny form of *O. ficus-indica* and the spiny *O. engelmannii*. Acting on good advice the IPP called on the local expertise and knowledge in dealing with cactus pears, albeit the spineless forms.

The origin and extent of spiny cactus pear invasions

Invasive alien plants (IAPs) pose a direct threat to South Africa's biological diversity, as well as to water security, the ecological functioning of natural systems and productive use of land. A range of methods are used to control IAP's, namely mechanical, chemical, biological and integrated control methods (Anonymous 2009). In this initiative, the focus is on mechanical control. The invading alien spiny cactus pears are well-known in South Africa (NEMBA 2014a,b). Indications are that they were introduced by seafarers to the Cape of Good Hope about 300 years ago and later transported to the interior of the subcontinent (Kiesling & Metzing 2017).

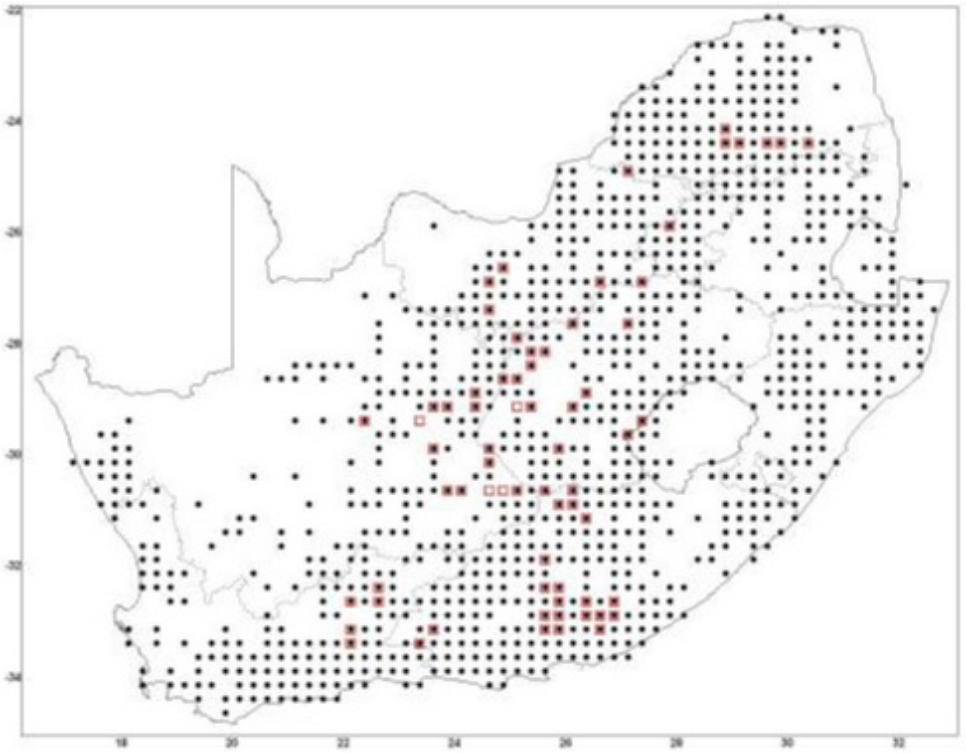
Spiny cactus pears resulted in dense, impenetrable thickets in some regions, especially the Eastern Cape Province (see map). By the 1950's, about 1 million ha of South Africa had been invaded by the alien cacti (Annecke & Moran 1978 cited by Moran et al. 2013). Infestations of the spiny form of *O. ficus-indica*, so-called sweet prickly pear, severely impacted on agriculture (Moran *et al.* 2013), despite it being utilised by people and livestock.

In the early 1900's, spineless cactus pear cultivars (*O. ficus-indica* and *O. robusta*) were imported from the Burbank collection in California to the Grootfontein Agricultural College in the Eastern Cape Province (De Kock 2001; Mondragón-Jacobo & Peréz-González 2001). During the past few decades, fruit production by spineless cactus pear cultivars (*O. ficus-indica*) for local markets and export has gained momentum. The plants are pruned annually to stimulate production of quality fruit and most of the fresh cladodes are used as livestock feed (De Waal 2015).

South Africa has a long history of living with and combating invasive alien plant species, including alien spiny cactus pear species (Moran *et al.* 2013). Spiny cactus pears have invaded large parts of the Eastern Cape Province and the spiny form of *O. ficus-indica* and another spiny cactus pear species *O. engelmannii* are of particular interest in this initiative. Although biological control agents have been introduced (photo 1), the success in controlling the invading alien cactus pear species varies (Zimmermann 2009).

Harvesting and processing spiny cactus pears

In addition to the continued actions of two biological control agents, mechanical control is used to harvest alien spiny cactus pears and the large volume of material



Map 1: The distributions of sweet prickly pear (*Opuntia ficus-indica*) (black dots) and small round-leaved prickly pear (*O. engelmannii*) (red squares). Source: SAPIA database, ARC-PPRI.

is processed as livestock feed. Infestations will be opened, reclaimed, rehabilitated and the natural pastures (veld) allowed to revert back to grazing for livestock.

The harvesting and processing of the spiny cactus pears is fairly simple, although it requires a good measure of physical strength, perseverance and the necessary protective clothing. There are three successive stages, namely:

- harvesting of plants (photo 2),
- shredding through a cladode cutter (photo 3a) and drying in the sun (photo 3b),
- grinding in a hammer mill (photo 4).

The long spines are degraded mechanically by grinding the sun-dried cladode strips in a hammer mill before including it in balanced livestock diets.

Recommendations and the way forward

Cactus pears propagate vegetatively by means of cladodes sprouting roots and sexually through seed production. Over many centuries the spiny cactus pear fruits have been eaten by avian and mammal species, including people (without appropriate toilet facilities to contain the seeds); hence a vast seedbed has been created, just waiting for the right conditions to germinate.

During the cactus pear fruit ripening period, ripe fruits with mature seeds must be separated before harvesting and processing the cladodes. Although cladodes sprout roots and propagate vegetatively, dispersion of spiny cactus pear seeds in the faeces of animals (photo 5) and humans is a major means of spreading these invaders.

Mechanical control of alien spiny cactus pears is viewed as a long-term management activity, spanning a period of at least 20 years or more (Zimmermann *et al.* 2004). A range of methods is used to control IAP's, including mechanical, chemical, biological and integrated control methods. A control programme must include the following three phases:

- Initial control to drastically reduce the existing population.
- Follow-up control of seedlings, root suckers and coppice growth.
- Maintenance control on an annual basis to sustain low alien plant numbers.

The logistical challenges of rough terrain and the distances from the cacti harvesting sites to a processing facility are impacting conventional norms for profitable business planning.

Photo 1: Biological control of *O. engelmannii* using cochineal insects (Photo: HO de Waal)

Photo 2: Harvesting of plants (photo: F Havenga)

Photo 3a: Shredding plants through a cladode cutter (photo: F Havenga)

Photo 3b: Drying cactus pear in the sun (photo: F Havenga)

Photo 4: Grinding plant material in a hammer mill (photo: F Havenga)

Photo 5: Dispersion of spiny cactus pear seed in animal faeces (photo: HO de Waal)

The National Resource Management Programme (NRMP) will be approached for official support in clearing and rehabilitating massive areas of infestations by alien spiny cactus pears in the Eastern Cape Province.

It is envisaged that such financial support may be provided similar to that for the Working for Water (WfW) Programme (Zimmermann *et al.* 2004; Anonymous 2009; Moran *et al.* 2013) and will be an investment in reducing the infestations by invaders and the rehabilitation and sustainable use of natural resources in South Africa.

The benefits

This initiative (starting in the Eastern Cape Province) is setting a baseline standard and creates an opportunity to manage the massive infestations of alien spiny cactus pears with mechanical control and to revert valuable underutilised farm land back to natural grazing for livestock.

A primary objective of this baseline standard is to apply appropriate processing technology and transform the spiny plant material (through shredding, sun-drying and coarsely grinding in a hammer mill) into livestock feed which greatly limits the possibility of vegetative propagation.

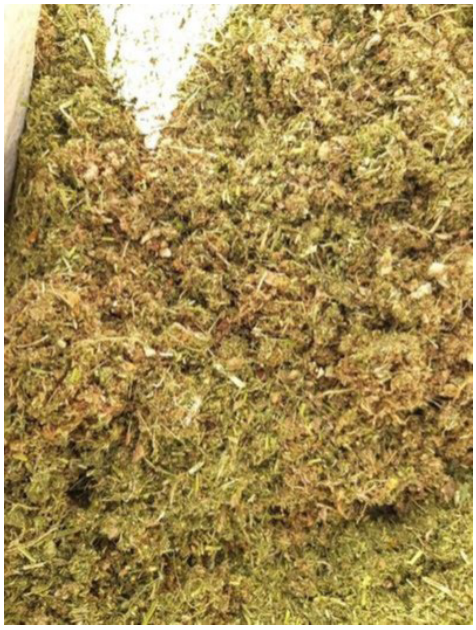


Photo 6: Shredded, sun-dried and coarsely ground spiny cactus pears (*Opuntia ficus-indica* and *O. engelmannii*), ready to be included in balanced diets for ruminant livestock (cattle, sheep and goats) and wild antelopes (photo: HO de Waal)

An important spin-off and long-term benefit will also be gained from the large but untapped resource, namely converting invaders into useful processed livestock feed. Another important benefit is the range of employment opportunities, which will be created for unemployed local people to engage in harvesting and processing the alien spiny cactus pears.

Literature consulted

Annecke, D.P. & Moran, V.C. 1978. Critical reviews of botanical pest control in South Africa 2: The prickly pear, *Opuntia ficus-indica* (L.) Miller. *J. Entomol. Soc. S. Afr.* 41, 161–188.

Anonymous. 2009. The war on invasive plants. *Wildlife Ranching* Winter 2009. Vol 2(3), 58–59.

De Kock, G.C. 2001. The use of Opuntia as a fodder source in arid areas of southern Africa. In: *FAO Plant Production and Protection Paper* 169. (eds.) Mondragón-Jacobo, C. & Peréz-González, S. Food and Agriculture Organization of the United Nations, Rome. pp 101-105.

De Waal, H.O. 2015. Spineless cactus pear as livestock feed in South Africa. In: Development of a cactus pear agro-industry for the sub-Sahara Africa Region. Proceedings of International Workshop. 27–28 January 2015. University of the Free State, Bloemfontein, South Africa. pp 30–39. *Cactusnet Newsletter*, 14 [Special Issue]. 94 pp.

Kiesling, R. & Metzing, D. 2017. Origin and taxonomy of *Opuntia ficus-indica*. In: Inglese P., Mondragon, C., Nefzaoui, A. & Saenz, C. (eds). *Crop ecology, cultivation and uses of cactus pear*. Advance draft prepared for the IX International Congress on Cactus Pear and Cochineal CAM crops for a hotter and drier world. Coquimbo, Chile, 26-30 March 2017. pp 29-35.

Mondragón-Jacobo, C. & Peréz-González, S. 2001. Germplasm resources and breeding Opuntia for fodder production. In: *FAO Plant Production and Protection Paper* 169. (eds.) Mondragón-Jacobo, C. & Peréz-González, S. Food and Agriculture Organization of the United Nations, Rome. pp 21-27.

Moran, V.C., Hoffmann, J.H. & Zimmermann, H.G. 2013. 100 years of biological control of invasive alien plants in South Africa: History, practice and achievements. *S. Afr. J. Sci.* 2013;109(9/10), Art. #a0022, 6 pages. http://dx.doi.org/10.1590/sajs.2013/a0022

NEMBA, 2014a. No. 598. National Environmental Management: Biodiversity Act 2004 (Act No. 10 of 2004): Alien and invasive Species Regulations, 2014. *Government Gazette*, 1 August 2014.

NEMBA, 2014b. No. 599. National Environmental Management: Biodiversity Act 2004 (Act No. 10 of 2004): Alien and invasive Species Lists, 2014. *Government Gazette*, 1 August 2014.

Zimmermann, H.G. 2009. Managing prickly pear invasions in South Africa. In: Nefzaoui, A., Inglese, P., Belay, T. (Eds.). *Improved utilization of cactus pear for food, feed, oil and water conservation and other products in Africa*. Proceedings of International Workshop, Mekelle (Ethiopia), 19–21 October, 2009, pp 157–166. Cactusnet Newsletter, 12 [Special Issue]. 224 pp.

Zimmermann, H.G., Moran, V.C. & Hoffmann, J.H. 2004. Biological control in the management of invasive alien plants in South Africa, and the role of the Working for Water programme. *S. Afr. J. Sci.* 100, 34-40.

Conservationists share 'core aims' but clash over ways forward, study finds

Research reveals rifts within global movement – from economic approaches to protected areas – while confirming support for aims underpinning it.

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

University of Cambridge Media Release

The first large-scale study of the views held by those working to protect the natural world has found agreement on the goals of conservation – but substantial disagreement on how to move towards them.

Latest research reveals a sizable consensus among conservationists for many core aims: maintaining ecosystems, securing public support, and reducing environmental impact of the world's richest.

However, the study also shows the global community is deeply split on whether to place economic value on nature. The necessity of protected areas – and whether people should be moved to create them – is highly disputed, as is the worth of "non-native" species.

Conducted by Cambridge University's Dr Chris Sandbrook with colleagues from Edinburgh and Leeds universities, the new study collected opinions of over 9,200 conservationists in over 140 countries. It is published today in the journal *Nature Sustainability*.

Figure 1: A conservationist and a farmer in Rosebud County, Montana. Credit: Photo courtesy of USDA Natural Resources Conservation Service

The research uncovers some demographic variation. For example, women and those from Africa and South America lean more toward "people-centered" conservation, which aims to benefit communities and give them a say in conservation decisions.

Men and those from North America tend to favour a "science-led" approach associated with protecting nature for its own sake.

'...like a political party'

Next year's Convention on Biological Diversity meeting will see UN member states gather in Beijing to set global conservation goals for the following decade. The research team says their findings "raise important questions about whose voices get heard in conservation debates".

"A core set of aims must form the bedrock of any social movement," said lead author Sandbrook, from the Cambridge Conservation Initiative.

"Our study shows that conservation is a diverse movement, both in people and ideas"
- Chris Sandbrook

"We can see that the world's conservation community is in general agreement on many fundamental beliefs and objectives."

"When it comes to the mechanisms for delivering conservation, we find significant rifts emerge. In some ways the conservation movement is like a political party, where some underlying beliefs bind together people who don't agree on absolutely everything. When big decisions need to be taken these splits come to the surface."

Researchers took great pains to reach as many conservationists around the world as possible. However, they say their sample is still skewed towards Europe and North America.

Sandbrook cautions that the diversity of opinion the study is helping to reveal is often underrepresented. "There will be huge decisions taken about the future of conservation in the next 18 months. Let's make sure we ask the whole global community, so we can build an inclusive and effective movement."

Fault lines

While the study's authors say conservation is facing "bitter internal disputes" over its future, their research confirms some key ideas around which the majority of conservationists coalesce.

The study finds 90% agreement for science-based conservation goals, as well as for giving a voice to people affected by those goals. Some 88% agree that the environmental impact of the rich must be curtailed, and only 8% think global trade is fine as it is.

Some 77% believe human population growth should be reduced, and only 6% think humans are separate from nature.

The fault lines in the global movement are also revealed. For example, only 57% think strict protected areas are required, and almost half (49%) believe it's wrong to displace humans in the process. Reports of 'eco-guards' suppressing local people in Africa's protected areas have recently brought these debates into sharp focus.

So-called invasive species also prove divisive. Some 35% think they offer little value to conservation, while 50% disagree. Sandbrook says that some examples of non-native species can help engage the public, but they are often bad news for local species.

"In the UK, many people love Ring-Necked Parakeets because they look beautiful and tropical. But these animals can threaten native wildlife and some argue they should be culled," he said.

'Conservation through capitalism'

The study shows the application of economics to nature is one of conservation's most contentious issues. "Some think assigning monetary value to nature is a pragmatic way to assist policy-making.

Others believe it reprehensible to put a price tag on things that are priceless," said Sandbrook.

Only around half (52%) of conservationists think their movement "should work with capitalism". Some 61% believe "economic arguments for conservation are risky", and 73% think economic rationales risk displacing other motivations for protecting species.

However, a high number – some 84% – believe corporations "can be a positive force for conservation" and 62% say the movement needs the support of corporations, suggesting many conservationists see both the pros and cons of economic approaches.

This "conservation through capitalism" is viewed more favorably by younger conservationists and those from Africa, but also among those in more senior jobs.

"Our study shows that conservation is a diverse movement, both in people and ideas," added Sandbrook. "As the Convention on Biological Diversity 2020 meeting approaches, we need to improve the representation of this diversity when debating how best to preserve life on Earth."

First commercial floating solar farm in Africa

Website: www.agriabout.com
Reprinted From: AgriAbout March 2019, No. 71

From the ongoing issues at Eskom to the chemicals being sprayed and the high energy needs of farms, the agricultural sector is looking to become more financially and environmentally sustainable through green energy solutions like the first commercial floating solar farm in Africa.

On 1 March 2019, media personnel as well as individuals from trade and industry joined together at Marlenique farm to hear from Minister of Economic Opportunities Beverley Schafer, CEO of New South Energy (NSE) David Masureik, and Financial Director of Boplaas 1743 Carl van der Merwe.

NSE recently installed a state of the art microgrid solution at Marlenique, a farm located just outside Franschoek on the famous R45 (Drakenstein Municipality). The farm produces export quality fruit as well as runs an award-winning wedding and function venue.

Due to rising energy prices and a high energy demand from its cold storage, irrigation and venue facilities, a microgrid system provided the best long-term solution for the farm. This decision was also made from taking in to consideration the input costs, power reliability and sustainability as key contributing factors towards the success of the business.

Africa's First Commercial Floating Solar Farm

The floating solar system is the first commercially operational system to be installed in Africa and, at 60 kWp, it is by far the largest.

The solution includes:

- An internal AC reticulation upgrade and consolidation of connection points
- The installation of a backup generator to run the internal grid in the event of power outages
- a 534 kWp ground mounted solar system to supply renewable energy through the day
- a 60 kWp floating solar system for the farms dam to supply renewable energy through the day as well as minimize land usage and reduce evaporation on the dam
- Provision for infrastructure to allow for battery system to be included during phase two to take the site completely off-grid

Figure 1: Africa's first commercial floating solar farm is located just outside Franschoek on the R45

The Floating Solar Pioneer

Ciel & Terre have been developing large scale solar power plants for commercial, government and non-profit institutions since 2006. With a recognized know-how in the integration of photo-voltaic power plants in buildings on the ground, as well as sustained efforts in research and development, Ciel & Terre provides, since 2011, innovative floating solar solutions with the Hydrello system, a market to which they have been completely devoted since 2013.

Of their contribution to the state-of-the-art system, Jack Setton, Ciel & Terre's EMEA Business Developer, said "we're delighted to have delivered South Africa's first commercial floating PV installation, in collaboration with Floating Solar PTY and New Southern Energy. Irrigation reservoirs like this one are perfect for solar projects, and we see great opportunities on the Western Cape's countless dams, particularly for clients such as wineries or fruit growers."

He explains, "upgrading a reservoir with FPV saves space, limits evaporation and allows on-site energy generation, which makes floating solar a perfect solution to the region's high land usage, water stress and unstable electrical supply. South Africa is a forerunner country in the continent. Our technology has great potential there, and we hope this initiative will pave the way to future FPV projects across the country and Africa."

Floating Solar (Pty) Ltd, the distributors for the Ciel & Terre floating solar system in South Africa, was established in 2017 as a Floating Solar PV equipment provider and project developer.

On the completion of the system, their representative Peter Varndell says,

Figure 2: Solar panels reduce carbon footprints of a farming enterprise hugely

Figure 3: Part of the floating solar farm

Figure 4: Having a state-of-the-art solar system has guaranteed the farm fixed energy costs for the next 25 plus years

"congratulations to New Southern Energy for completing this first commercial scale Floating Solar plant in Africa. There is significant potential to replicate this technology in the African market where it can be used to provide clean energy for mining, industrial, agricultural, water treatment works, hydropower and reservoir sites.

The additional benefit of reducing evaporation will prove to be an attractive prospect in this waterstressed region and we look forward too many more successful projects with New Southern Energy." The Initial Drivers for the System As the oldest family business in South Africa, sustainability is key to survive rising costs and high energy needs. The question Boplaas asked themselves was "how can we keep the business running for another 10+ generations?"

One of the factors is to farm greener and to secure their power supply for future farming. Increasing needs for water and irrigation as well as packhouses for rising export demands has inevitably led to their production cost escalating more than their sales revenue per annum.

In order to be sustainable both financially and environmentally, the company realised they had to push their running costs.

Having a state-of-the-art solar system has guaranteed them fixed energy costs for the next 25 plus years. Van der Merwe says of the investment, "it was a better decision than planting a new orchard!"

On his expectations of the solar system van der Merwe says, "it will reduce our carbon footprint by more than 50%". He adds, "Marlenique farm is the highest energy user in our portfolio.

We are aiming to be 100% green through solar energy solutions across our entire portfolio in the near future. Anyone is welcome to try to take us to any solar plant better built than the one on Marlenique. I don't think it is possible because this one is world class standard."

Minister of Economic Opportunities also spoke today saying, "it is incredibly exciting for me, as the Minister of Economic Opportunities, responsible for economic development and tourism, and agriculture, to see a business like Marlenique, which creates jobs in the rural economy, investing in the kind of technology that they have, creating a reliable, clean energy source.

As the Western Cape Government, we have been encouraging businesses to invest in solar PV and alternative energy sources to build resilience and protect the economy against shocks like power outages and water shortages. We thank Marlenique for seeing the bigger picture, for answering the Western Cape government's call to invest in resilience, and for finding ways to make their business more sustainable and more profitable."

In addition, NSE CEO David Masureik commended Boplaas for being innovators in the agricultural sector, adding, "I would also like to thank governments interest in solutions that will inevitably encourage the sector to thrive."

Without the support and encouragement from national and local government for industry to become more sustainable and independent in terms of power solutions, our business would not exist. We are honoured to take part in positive change happening across the public and private sector."

The project was financed through Nedbank Agriculture with the savings from the system allowing the farm to operate cash-flow positive from day one, while paying the asset off over 10 years. With a long-lasting life-space the benefits of the system will be passed on for generations to come.

About NSE

New Southern Energy is a leading South African-based, full-service renewable energy provider for distributed energy projects throughout Africa. With extensive experience in the renewable energy sector, NSE has the technical and professional skills required to implement energy projects across Africa.

Established in 1743, Boplaas is home to more than quality export fruit and old-fashioned values. As the oldest family business in South Africa, they have stood the test of time and offer the knowledge and dedication of an unbroken lineage of 10 generations of farmers on beautiful, fertile, South African land.

Grassland restoration – rethinking planting methods and seed mix selection

Seed mix type but not planting method or seed priming affect grassland restoration outcomes: a greenhouse trial - African Journal of Range and Forage Science, published online 15 April 2019

Current Address: [1]School of Life Sciences, University of KwaZulu-Natal, Pietermaritzburg, South Africa
E-mail Address: 214518784@stu.ukzn.ac.za

Stuart Demmer[1], Michelle Tedder[1] and Kevin Kirkman[1]

Grassland restoration is a growing industry in South Africa. Construction, mining, and agricultural industries are often contractually obliged to restore areas which they might have damaged but restoration outcomes are often unsuccessful or very short-lived. We think this has a lot to do with the way seeds are planted and seed mixes used in restoration. Because grass seeds come in a range of sizes, air powered agricultural planters do not work very well and so seed is simply cast over the soil. When this happens seeds seldom germinate and those that do roast alive under the sun. To help fix this we tested whether seed could be injected into the soil (a more ideal place for seeds to germinate) using a gel-like carrier medium made from cellulose. Using a simple greenhouse trial we compared different planting methods and found that planting seed in the gel medium did not negatively affect the seed – trying this method out in the field would be the next step.

Mayford has released a Biomosome™ seed mix series with branding suggesting that these mixes have been selected to match particular biomes. We wanted to test how this compares to seed collected from undisturbed grasslands in the targeted site. The Biomosome™ seed mix germinated well whilst our harvested seed mix produced more biomass, both good grassland restoration characteristics. But when we looked at the species themselves we found big differences. The harvested seed mix had a very variable composition and contained more flower species whilst the same species occurred over and over in the commercial seed mix; many of these were common tropical pasture species such as *Eragrostis tef, Panicum maximum, and Chloris gayana*. We hope our findings will make practioners and the public more aware of how important it is to carefully select a seed source when restoring degraded areas.

Figure 1: Seed collected from undisturbed grasslands around Pietermaritzburg using a seed harvester.

Figure 2: Retail restoration seed mix manufactured by Mayford. This seed mix has been designed to match the "grassveld" biome.

Figure 3: A sample of the harvested seed suspended in the gel matrix which allows for a very heterogeneous distribution.

Grass patch heights supporting herbivores

Reprinted From: http://bit.ly/2YfTMP7

Rina Grant drove around the Kruger National Park and found it curious that one seems to always find animals on the short grass areas rather than areas where there is lots of grass. In her post-doctoral study, Grant looked at possible reasons, and found that the grasses on these sites were indeed more nutritious.

As an expansion of this, published in the *African Journal of Range & Forage Science, Volume 36, Issue 1*, 2019 "When less is more: heterogeneity in grass patch height supports herbivores in counter-intuitive ways" looks at whether animals really selected the short grass patches or whether it was easier to see them there.

The study observes which patches were frequently utilised, by doing regular monthly road counts, grass height observations and dung counts on selected short grass patches in the Kruger National Park. Grant thought that one may find different patterns of utilization in the different areas of Kruger.

"Because it is interesting and exciting driving in Kruger and especially looking at where animals are, I had the opportunity to get inputs from many scientists on the design of the project and the interpretation of the results," Grant said.

Herbivores are an integral part of the African landscape and have evolved with the vegetation to create the savanna landscape. Managers of these landscapes can benefit from a better understanding of how indigenous herbivores use the landscape to which they are adapted.

Smaller-framed impala and blue wildebeest (meso-herbivores) were most regularly seen on these nutritious patches, while from dung deposits it was clear that the even larger-framed buffalo (mega-herbivores) spent time there.

This preference can be explained by considering the nutritional needs and food intake of the herbivores. Smaller-framed herbivores seem to be able to satisfy their dietary requirements on the high-quality forage patches, while larger-framed herbivores seem to supplement the quality forage by also spending foraging time on areas of higher grass biomass.

From this insight, Grant and her co-authors propose that range management should take herbivore preferences into account and allow herbivores to select and concentrate their foraging on the most nutritious forage. This approach, according to the paper, is likely to decrease inputs while allowing animals to maintain or increase production.

Grant's co-authors

Judith Botha: Grant has worked with Botha for about 20 years. They started by looking at the use of dung analysis to evaluate the nutritional status of herbivores, but later she specialized in statistics and she did the sophisticated statistical analysis for this paper.

Thelani Grant: Thelani Grant was very keen to do a MSc related to this project and joined Grant on all the field trips. She used some of the data collected for her MSc thesis.

Mike J S Peel: Peel is the head of the wildlife research group of the Agricultural Research Council in Nelspruit. He provided important input to the project and offered the opportunity to look at systems on private reserves.

Izak P J Smit: A project on the effect of waterholes on the surrounding vegetation developed into a PhD and later to Smit joining SANParks as the program manager responsible for remote sensing. Apart from joining Grant on some field trips, he gave advice on the design of the project. His thinking helped to make the manuscript understandable.

Figure 1: Rina Grant on one of her many expeditions.

James Calder, a BSc Agric student at the University of the Free State, recently received the GSSA merit award for the Best BSc Agric student in Grassland Science with a minimum of 70% in his final year. Congratulations James on your achievement!

Figure 1: James Calder receives the GSSA award from the University of the Free State's lecturer, (and GSSA Member) Paul Malan.

Mr Lindo Dlamini recently received the UKZN GSSA Award for Outstanding Academic Achievement. This was presented to him for his MSc in Grassland Science through the University of KwaZulu-Natal. The title of his project was "The competitive effect of vetiver grass on native grasses and implications for grassland rehabilitation in South Africa" and was completed under the supervision of Prof Kevin Kirkman and Dr Michelle Tedder. Well done Lindo! Lindo has plans to start his PhD in 2019.

Figure 2: Mr Lindo Dlamini receives his award from Prof Kevin Kirkman.

Figure 3: Mr Dlamini with the GSSA Award for Outstanding Academic Achievement.

GSSA Congress 54 sponsor

National Science and Technology Forum

proSET
A sector of the NSTF representing professional bodies

Upcoming events

3 - 5 June 2019

11th SA Large Herds Conference. The Boardwalk, Port Elizabeth. See www.largeherds.co.za or contact Julie McLachlan, the MPO Events Manager, on 083 740 2720 / 012 843 5638 or julie@mpo.co.za for more.

7 - 10 July 2019

39th Congress of the Zological Society of Southern Africa (ZSSA). Skukuza, Kruger National Park. Contact Dan Parker: Daniel.Parker@ump.ac.za or web for more: https://zssa.co.za/zssa-2019/

1 - 4 July 2019

Grassland Society of Southern Africa 54th Annual Congress in Upington. Abstract submissions now open! See the website for more: https://2019gssa.dryfta.com/en/

1 - 5 Sept 2019

South African Wildlife Management Association (SAWMA) Conference. Wilderness Hotel, Southern Cape. See website for more: http://sawma.co.za/conference-2019/

2 - 7 Sept 2019

International Long Term Ecological Research Network 2nd Open Science Meeting. Hosted by Helmholtz Center for Environmental Research, UFZ. In Leipzig Germany. For more visit: http://ilter-2019-leipzig.de

22 - 27 Sept 2019

8th World Conference on Ecological Restoration to be held in Cape Town, SA. Visit https://ser2019.org/ for more.

15 - 19 Oct 2019

Veld Management Course by Africa Land-Use Training. Cost: R4,950. For more, contact Frits van Oudtshoorn at 078 228 0008 or courses@alut.co.za.

Looking further ahead: 25 - 30 Oct 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.

Grassroots
Newsletter of the Grassland Society of Southern Africa

Photo competition

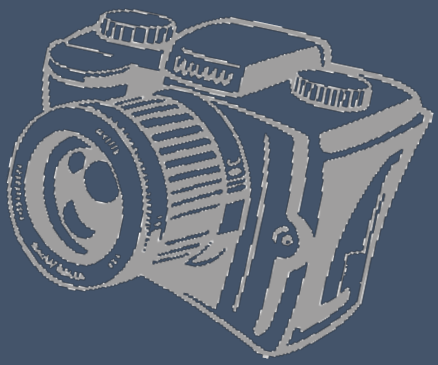
Are you a keen photographer? Have you recently taken unique photos while doing field work?
Enter them into any of the following two categories and your photo can be our next ***Grassroots*** **cover**!

"Cover" photos

Any high quality photos that are related to rangeland ecology and pasture management in southern Africa

"Research in Action" photos

Any interesting photos taken while collecting data or doing field work that are related to rangeland ecology and pasture management in southern Africa



Winning photos will feature in the next *Grassroots* and the overall winning photo will be on the cover!

Competition runs for the next 3 Grassroots editions of 2019!

How to enter:.

- Choose one of the above categories.
- Photos must be in jpg format and not exceed 10 MB.
- Email your entries with your name and contact details to **photos.grassroots@gmail.com.**
- Include a title and information on where and when the image was taken.
- Email your photos before 17h00 on the following dates:
  - 10 April 2019 (*May edition*)
  - 1 July 2019 (*August edition*)
  - 1 October 2019 (*November edition)*
- You will receive a confirmation email upon entrance.

For additional information, send an email to **info@grassland.org.za**

***Terms & Conditions:**

- Anyone is welcome to enter, except the *Grassroots'* publication team and their immediate family. Photos will be judged by the publications team.
- More than one entry is allowed.
- A participant who is announced as a winner may not enter the competition for the following editions.
- *Grassroots* holds the right to use entered photos elsewhere in *Grassroots*, the GSSA website, or for future marketing purposes without compensation to the photographer.
- A photographer will receive the necessary recognition if any of his/her photos are published by *Grassroots.*
- Winners will be notified a week before publication.