Grassroots

Newsletter of the Grassland Society of Southern Africa
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More on the 53rd GSSA Congress

Facing a mass extinction

Tiny beatle & deadly fungus:
Threatening South Africa's trees

How EATING SEAWEED *can help cows belch less methane*

Advancing Rangeland Ecology and Pasture Management in Southern Africa

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FROM THE EDITOR

Welcome to the third edition of Grassroots! This edition comes with a change. With Josef's term as editor having come to an end, I have been elected into this position now. The rest of the editorial committee remains the same. Hopefully my transition into editor position will be a smooth one. Thank you, Josef, for all you have done for Grassroots!

After a successful GSSA congress held at the ARC Training Centre at Roodeplaat in July, we share some memories through photographs, a summary of the conference and the presidential address.

In this edition we also have 2 feature articles; the first one looks at a way to be resourceful with some field equipment. Russell et al. have worked with developing a homemade radiation shield and discuss the complexities and uncertainties for measuring ambient temperature in the field. The second feature article presents the research of Mwendia et al. who has looked into the challenges and opportunities for forage feed systems in East Africa.

As usual, we have a wide range of news articles ranging from the good news of the newly enacted Indalo Game Reserves Protected Environment, a 68 075 ha conservation area in the Eastern Cape and getting to know more about SAEON's Lower Orange River Riparian Project to some more concerning news on bush encroachment and the impact of shothole borer on our trees.

We have included an "upcoming events page". Please, if you are organising or know of any event of interest, and would like the Grassroots community to hear about it, contact us with the details and we will include it in the next issue.

Thank you to those who contributed to this issue – we would love to hear from more of you, please keep those articles coming.

Happy reading!

Janet

6 things to look forward to in this issue:

- Looking back at the 53rd GSSA Congress
- How eating seaweed can help cows to belch less methane
- Facing a 6th mass extinction event
- A tiny beetle and deadly fungus threatening South Africa's trees
- Positive effect of community-based conservation on wildlife
- Biological control of invasive tree species in South Africa

Presidential address GSSA Congress 53 at ARC Roodeplaat, 23 July 2018

GSSA President 2017/18

Sigrun Ammann

Dear delegates, members and guests, of the 53rd Congress of the Grassland Society of Southern Africa (GSSA). It has been a privilege to serve as the president of the Society for the past year. I would like to share some impressions and thoughts with you.

The first time I was voted onto council was in 2000 at the congress that took place in Triangle, Zimbabwe. That is almost two decades ago. Since then many things have changed in the world and also in our Society, the GSSA, yet some things have also stayed the same. So, what are those things that have stayed the same? They are things such as the collegial nature in our Society, a welcoming nature, a welcoming atmosphere where scientists and students can present their work, discuss their work and build valuable contacts. A Society where young scientists are given a chance, not only to present and share their work but they are also often given a chance to be part of the leadership within various aspects of the Society, be it in council, be it as part of the various editing and publication teams, Grassroots and the website, committees etc. Having a diverse membership in terms of fields of expertise has always been part of the GSSA. These are amongst the positive things that have stayed the same and are the positive attributes of our Society, the ones amongst others that are part of our essence and hopefully also the ones that contribute to the continued existence of our Society. Some of the challenges the GSSA faces have also stayed the same over time. For example, the financial challenges. I looked back at AGM minutes going back to the 1980's. It was astonishing; in terms of finances the very same things were talked about as we do now more than 30 years later. In a way this seemed both surprising and frustrating that it is clearly a problem that cannot be solved or overcome very easily. On the other hand, it also says something about the resilience of the Society. Despite finances being a perpetual problem literally for decades, we are still in existence. This should, however, not at all be a reason for complacency. It is very concerning that a large number of potential delegates could not attend due to funding challenges they face and this of course impacts our congress. This is also of concern for those of us

who are required to be registered with the South African Council for Natural Scientific Professions (SACNASP) and thus need to earn Continuing Professional Development (CPD) points. We do need to find innovative solutions to secure the future financial viability of the Society. We need to be open to linkages with like-minded Societies or interest groups. Our congress needs to be seen as an important and worthwhile event for scientists and students.

There are some things that really make the GSSA very unique. We encompass very diverse fields of study and expertise. Yet in essence we also have a lot of commonality, we work with grass, with trees, their interactions with each other, with grazing animals. We conduct research on ecosystems, be it natural ecosystems, or agro-ecosystems or pasture systems. We try and quantify and monitor interactions, diversity, change and efficiency amongst others. Whether we work with natural ecosystems or agro-ecosystems, or pasture systems we are faced with the realities of climate change, droughts and other extreme events that impact our systems and the way we do things, and dare I say impact our existence in various ways. We try and understand how plants function, how they respond, what gives resilience and how we can mitigate impacts.

To me it is very clear that whether we work with rangelands or pastures, we have a lot of commonality in many ways. I believe that in our search for solutions we can learn from other disciplines, learn from each other irrespective of our field of expertise or speciality. Where disciplines overlap, there is a greater chance of something new growing or being discovered, or innovative solutions being found. In modern terminology we have the concept or term disruptive technology. I would like to encourage, especially our young scientists, to read widely, read up about different things, not only what you may need in your literature review or project proposals.

Allow yourself the freedom to read about things that might seem unrelated to what you do. I think you will be surprised but also be rewarded and it will hopefully lead to greater innovation. In terms of the concept of a broader scope, we have now also expanded the scope of our journal. The African Journal of Range and Forage Science can in future also publish relevant research from outside of Africa. I see this as a very positive development.

We need to strive for excellence in our research. This is a really important. We are a group of relatively few people who work in the field of Grassland Science in the broadest sense of the word. We should really strive for excellence in our research, the research we present at our congresses, and what we publish. We also need to assist each other. We need to contribute to our Society, the GSSA. Serving on council or any committee of a Society, like the GSSA, is about making a contribution to our discipline, our field of expertise. It is in some ways quite contrary to what the norm in our modern world is where so much is about the individual and what one gets out of it. Being part of something like the GSSA where you give your time, your inputs for free, but it is an important contribution to our discipline.

I want to encourage each of us to think new and differently about our research. We need to look critically at what we do and how we do it, in a positive way. What should change in the way we do research, what we research and the answers we seek? Everything around us is changing with increasing pace, be it the climate, be it technology, be it how we communicate, or how we live etc.

So, my challenge and question to each of us is:

What do I need to do differently?

53rd Annual Congress of the Grassland Society of Southern Africa: Roodeplaat

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When the Gauteng province hosted the 44th GSSA congress in 2009, the urgency to reduce carbon footprint was far less than it is today. Nine years later, the GSSA has advanced its efforts so much that the success of the recent congress was largely dependent on continuous Internet access by all delegates and their ability to download and use a cloud-based, all-in-one event management platform called Dryfta. The 53rd congress of this society took place between 22 and 27 July 2018 at the Agricultural Research Council's Training Centre, Roodeplaat in Pretoria bringing together 186 delegates. While 172 of all delegates came from all the nine provinces of the country (Figure 1), the rest of the attendees hailed from six countries, viz Zimbabwe, Kenya, Lesotho, Namibia, Uganda and Colombia. Gender-wise, 122 males versus 64 females attended. Importantly, the 53rd GSSA congress provided 62 GSSA members and 124 non-members with a valuable opportunity to network.

The overall theme of the congress was "Advancing Rangeland Ecology and Pasture Management in Africa" and 91 delegates presented their platform presentations, standard posters and research proposal posters. These presentations addressed a variety of topics relevant to the main theme, including Climate Change, Rangeland Ecology & Management, Planted Pastures, Land Transformation & Rehabilitation, and many other topical themes. Prior to the official opening of the main congress, a 2-day 9th Research Skills Workshop (RSW) was held. This was attended by 41 delegates including postgraduate students, earlier career scientists, government officials and a number of experienced scientists who wanted to refresh their skills. This workshop provided a friendly and supportive environment especially for the students to learn and gain confidence.

The RSW was followed by the opening "meet and greet" function during which Sigrun Amman delivered a well-structured presidential address. Jaco Fouché of Corteve AgriScience gave insightful remarks on the chemical solutions for bush encroachment. The official opening address was delivered by Paul Avenant of DAFF who launched a newly developed long-term grazing map for South Africa. In a very thought-provoking style, Paul highlighted a number of ways in which this long-term grazing map can be used, misused and even be abused by especially the "office researchers" who might replace the need for going out in the field and conducting veld condition assessments with this map.

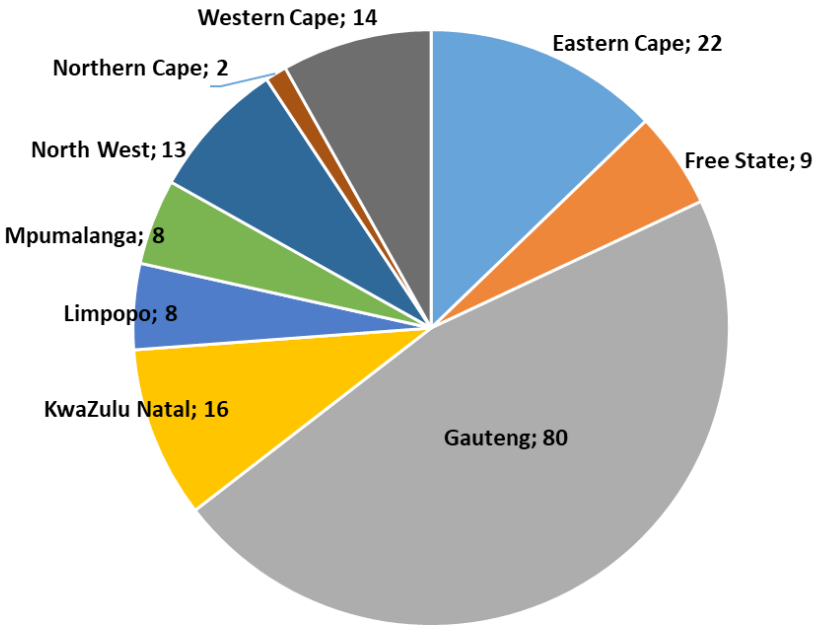

Figure 1: Number of the people who attended the 2018 GSSA congress as per province

The following morning kick-started with five keynote addresses. Dr Barney Kgope of the Department of Environmental Affairs got the delegates seriously thinking about whether bush encroachment on South Africa's grasslands is any form of land degradation. Prof Stephanie Midgley gave an overview of climate change risks and impacts for grassland and pasture systems both at national and biome levels. Prof Rob Scholes' intriguing talk was entitled "Net primary production (NPP) in South African grasslands: relationship to rainfall, soil type and history". Prof Scholes presented MISR FAPAR as a powerful tool and made a compelling case that this tool might be a better proxy of NPP than NDVI in grasslands. Another keynote speaker, Prof Michiel Scholtz of the ARC-AP talked to a topic "Sustainable livestock production in the era of climate change through targeted interventions". Concluding this engaging talk, Prof Scholtz discouraged what he termed "silo mentality" and encour-

aged collaborations among different organisations to tackle climate change. The last keynote address was delivered in a special session by Dr Joh R. Herschel who talked about "Karoo trajectories of change in the Anthropocene". There is a strong likelihood for the papers presented in this session to be published in a special issue of the AJRF. Watch the space!

Thirty-seven participants remained behind on the last day of the congress and attended the Policy and Practice Workshop on Ecological Infrastructure (EI). This workshop empowered delegates with understanding of the EI concept, its various types and functions and how they relate to the agriculture and rangeland sector, recommendations for policy and practice and research outcomes.

The Sicklebush pre-congress tour was held at Bela-Bela where 17 delegates learned about possibility of using a new selective herbicide range developed by Corvera Agri Science, to control encroaching tree species such as Dichrostachys cinerea. Delegates came back from this tour enchanted by how these herbicides can help farmers improve productivity of their rangelands. For the first time, the practical sessions, which included soil assessment and analysis, tree measurements, veld condition assessments, pasture measurement etc., were held in the mid-congress tour slots. Activities such as "Pizza & Quiz" kept the delegates entertained while going through a very busy scientific programme.

After a week of a quite busy schedule of presentations, delegates needed to destress and take stock of what happened during the week. The Gala Dinner provided exactly that environment with the inauguration of new GSSA Council President, Tony Swemmer, who took over from Sigrun Ammann. The "Peter Edwards Award" was given to Mr Shimi Jonas Mokoka.

In terms of the GSSA awards, all nominations, scoring and voting for winners were done online via Dryfta. Heidi-Jayne Hawkins received (in absentia) the "Best Paper in the AJRFS" in 2018 for a well-written paper titled "A global assessment of Holistic Planned Grazing™ compared with season-long, continuous grazing: meta-analysis findings". Gareth Hempson received the "Best Presentation" award for a talk entitled "Exploring the potential value of grazing lawns in rangeland ecosystems". Marnus Smit became the winner of "Best Presentation by a Young Scientist" award for a great delivery of "The influence of phenology on browse availability for game species in a semi-arid environment of the Northern Cape Province".

The "Norman Rethman Planted Pastures" award was given to Charné Viljoen for presenting a paper on "A new nitrogen fertilisation regime for minimum tillage kikuyu ryegrass pasture in the southern Cape". The "Best Poster" was awarded to Jamie Paulse for designing an excellent poster entitled "The behaviour and diet selection of extralimital giraffe in the Little Karoo, South Africa". The "Best Research Proposal Poster" is a relatively new award that was awarded to Christoff van der Westhuizen who was among the 52 delegates who attended the GSSA congress for the very first time in 2018. Christoff's proposal poster was entitled "Management strategies to support sustainable production of lucerne in long rotation cropping systems". The "Faux Pas" was deservedly given to Justin Du Toit who won it for the second time.

The organising committee of this prestigious congress was drawn from many organisations. This committee expressed sincere gratitude to Corteva Agrisciences (DOW Agro sciences), ARC, Landbank, UNISA, DLF Seeds & Science, SANBI, Western Cape Department of Agriculture, Voermol, Nedbank and Briza for supporting and ensuring that the 53rd congress was successful. The society is so fortunate to have the best administrators in the country.

The organising committee all agreed that the 53rd GSSA congress would not have turned out as well as it did if it was not for the hard work and "supernatural" organising skills of Erica Joubert and Freyni du Toit. Over and above serving on the committee, compiling and editing the scientific programme, Janke van der Colf also scanned delegates for the SACNASP Continuing Professional Development points.

Hope to see you at the 54th congress in 2019!

Figure 2: GSSA congress delegates 2018

THE GLOBAL FOOD CHALLENGE -

How Dow AgroSciences is contributing to find *solutions for the growing world*

By 2050, the global population will reach 9.1 billion. Current trends indicate that this growing population will live in bigger cities, will have a higher disposable income, and will demand more and better quality food. In general, beef protein consumption has grown globally, but in developing countries such as South Africa, growth is higher than in all of the rest of the world.

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GSSA 2018 Award Winners

Figure 1: Peter Edwards Award winner, Mr Shimi Jonas Mokoka, with Tony Swemmer. (Photo: S. Demmer)

Figure 6: Faux Pas winner Justin du Toit collecting his trophy from Ntuthuko Mkhize and Tony Swemmer. (Photo: S. Demmer)

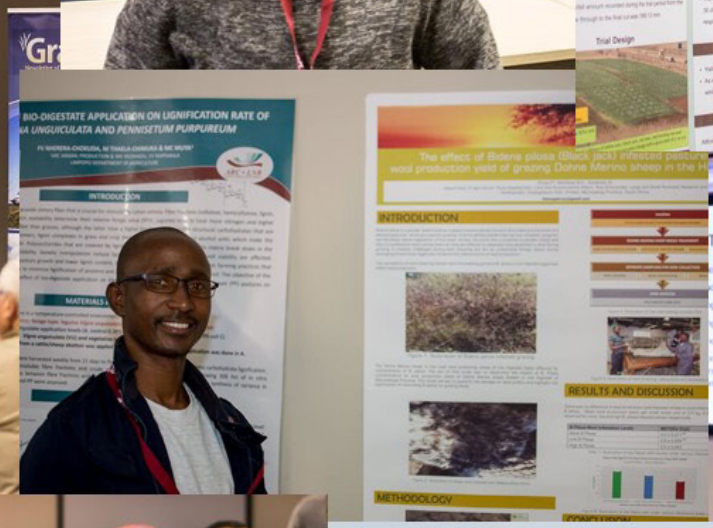
Figure 2: Best presentation winner, Gareth Hempson, with Tony Swemmer. (Photo: S. Demmer)

Figure 3: Best research proposal poster winner, Christoff van der Westhuizen, with Tony Swemmer. (Photo: S. Demmer)

Figure 5: Norman Rethman Planted Pastures award winner, Charné Viljoen, with Janke van der Colf and Sigrun Ammann. (Photo: S. Demmer)

Figure 4: Paul Malan with Marnus Smit (Best presentation by a young scientist), Imke Stehn (the UFS Best final year student in pasture science award) and Jamie Paulse (Best Poster). (Photo: S. Demmer)

GSSA Congress Moments



Photos: S. Demmer

Photos: S. Demmer

GSSA Congress Moments

Complexities and uncertainties regarding ambient temperature recordings in the field

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Abstract

In recording environmental parameters between study sites, one seeks either to compare trends between study sites or to find absolute values. The effect of solar radiation shield quality on the accuracy of the recorded data come into question during a study where ambient temperature was measured along an altitudinal gradient. It was found that homemade radiation shields of the same basic design and colour as commercial radiation shields, introduced a margin of error into the temperature data collected. While research budgets may not allow for the very best equipment to be purchased, these potential sources of error need to be recognised and accounted for when undertaking fieldwork.

Key words: Comparative temperature trends, hysteresis effect, solar radiation shield, temperature logger, ventilation shield

Introduction

Recordings of environmental parameters serve two purposes. Either one seeks comparative trends or absolute values. Sometimes, a combination of both is required. While investigating encroachment of *Vachellia sieberiana* var. *woodii* (Burtt Davy) (formerly *Acacia sieberiana* var. *woodii* (Burtt Davy) in high altitude grasslands, ambient temperature was recorded at three sites along an altitudinal gradient up the Drakensberg escarpment in northern KwaZulu-Natal, South Africa. The accuracy (i.e. how close to true ambient temperature the equipment was able to measure); the precision (i.e. how consistently the equipment was able to give the same result under the same conditions); and the interchangeability (i.e. whether equipment could be substituted among sites) of the equipment were of importance. The results lead to the consideration of the effect that the type and quality of solar radiation shields had on the quality of the data recorded.

Ambient temperature and relative humidity are commonly measured in the field using a combined air temperature and relative humidity sensor. The sensor is placed inside a solar radiation shield to protect the sensor from direct, diffuse and reflected radiation, which would result in an elevated and misleading temperature measurement. The sensor is attached to a logger which records and stores the data collected by the sensor. Besides the quality of the sensor itself, there are various types of solar radiation shields available which may affect the accuracy and precision of the sensor measurements. There are two basic designs of solar radiation shields: aspirated and naturally ventilated. The aspirated solar radiation shields are generally accepted as the most accurate (Whiteman, Hubbe & Shaw 2000). A small fan draws an air current over the temperature sensor, thereby maintaining the sensor in an environment close to, if not equal to, ambient temperature. The most commonly used naturally ventilated solar radiation shields are the Stevenson Shield (also known as the Cotton Region Shelter), the Gill shield, the Maximum-Minimum Temperature System shield and the Automated Surface Observing System shield (Hubbard, Lin & Walter-Shea 2001) (Figure 1

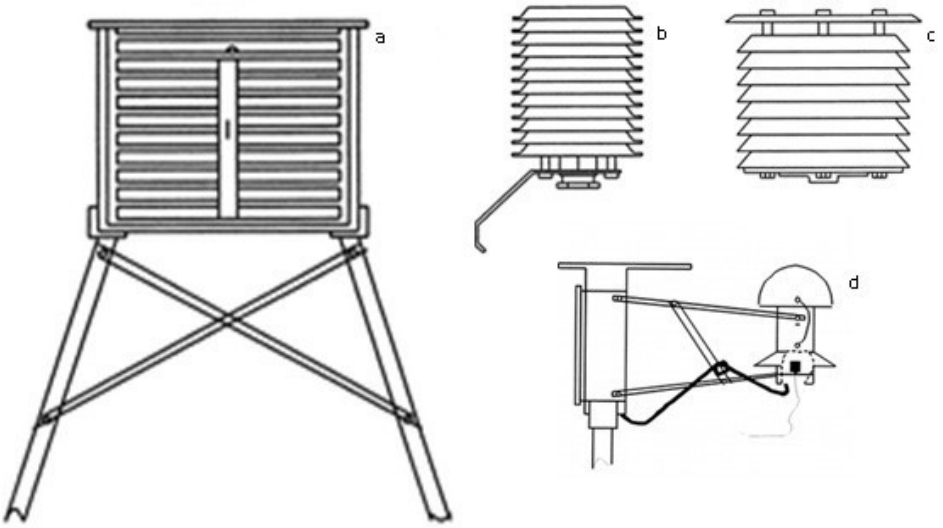

Figure 1: (Not to scale) The four most commonly used, naturally aspirated solar radiation shields: a) Stevenson Shield; b) Gill shield; c) Maximum-Minimum Temperature System shield; and d) Automated Surface Observing System shield. (Adapted from Hubbard et al. (2001) and Lin et al. (2001))

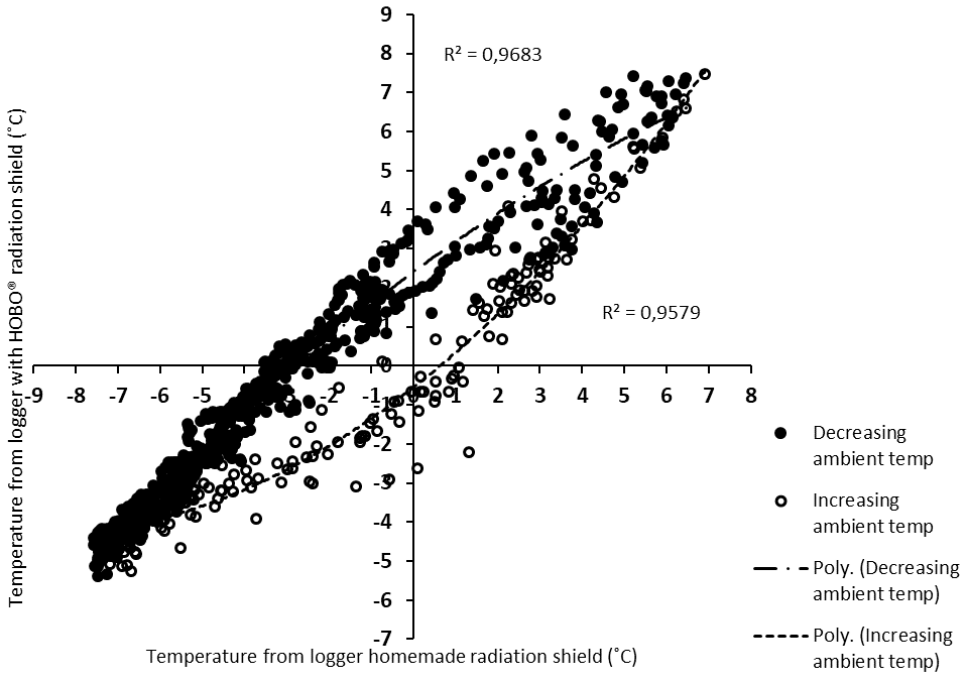

Figure 2: The hysteresis effect caused by the two different solar radiation shields used in a field experiment

a-d). Generally, solar radiation shields used in the field are naturally ventilated, due to the relatively high current drain of the electric fan of aspirated shields, which will greatly reduce the life of the batteries where no main electric power is available.

Methods

The field equipment comprised of two HOBO Pro v2® Temperature/Relative Humidity data loggers with external temperature/relative humidity sensors, manufactured by Onset, USA. Two data loggers and sensors were placed at the coldest study site (1697 m ASL). One sensor was mounted within a seven-plate HOBO® solar radiation shield (model number RS3), based on the Gill III design (Gill 1983). The second sensor was mounted within a homemade seven-plate radiation shield, also based on the Gill III design (Gill 1983). The homemade shield was made of inexpensive triangular plastic plates, measuring 170 mm x 170 mm. As with the plates of the HOBO® solar radiation shields, the plates of the homemade shield were 12 mm apart and painted white. The sensors within their respective solar radiation shields were placed within the open grass sward at tree seedling canopy height of 100 mm above ground level and were co-located, being secured to the same anchor point. Ambient temperature and relative humidity were logged on a five-minute time interval, (data logger clocks synchronized). The two loggers recorded ambient conditions for three days.

Results and discussion

Ambient temperatures ranged between -7°C and 28°C. When the recorded data of the two loggers were compared, it was found that there was up to a 3°C discrepancy between the two. In general, the sensor with the HOBO® solar radiation shield recorded lower temperatures than that of the homemade solar radiation shield, particularly at the extremes of the temperature range. As the lower end of the temperature range was of pivotal importance to this vegetation study, only temperatures of less than 5°C as recorded by the sensor with the HOBO® shield were plotted against the simultaneously recorded temperatures from the sensor with the homemade shield (Figure 2). The graph indicated a hysteresis effect. Farrell (1999) described a hysteresis effect as when "a system responds differently to identical inputs depending on the direction in which the system is being driven." (see also Haines (1930), BačA (2008), Fauchald (2010)).

In this case, the hysteresis effect can be attributed to differences in the materials used for the solar radiation shields. The Hobo® solar shields were made of acrylonitrile styrene acrylate (ASA) which is a weather resistant thermoplastic. The type and characteristics of the plastic plates of the homemade solar radiation shield were unknown. Different materials will have different thermal properties, such as surface radiation (emissivity), absorption of radiation, conductivity and specific heat (Cengel & Boles 2015). These properties directly or indirectly affect heat transference. Emissivity off the solar radiation shield plates directly affects the degree of accuracy of the temperature data. The temperature probe within the shield need not be in contact with the solar radiation shield plates for heat transference to take place (Cengel & Boles 2015). Quantity of radiation absorbed by the solar radiation shield plates, characteristic conductivity and specific heat of the material of the plates will all affect emissivity (Cengel & Boles 2015) and, therefore, have an indirect effect on the accuracy of the measurements.

The shape of the solar radiation shield plates could also play a role in creating the hysteresis. The homemade solar radiation shield was larger in diameter that the Hobo® solar radiation shields. The plastic plates also had a more pronounced lip around the edge. Although the spacing between the plastic plates was the same as that between the Hobo® solar radiation shield plates, the size and greater curvature of the homemade solar radiation shield plates could have restricted airflow around the temperature probe, thus, further insulating the temperature probe from fluctuations in ambient air temperatures.

To ascertain accuracy and interchangeability of the sensors, four temperature/relative humidity sensors and loggers were concurrently tested in a controlled environment. The sensors included the two HOBO® sensors combined with the HOBO Pro v2® Temperature/Relative

Table 1: Degree of interchangeability and accuracy of the four sensors when measuring temperature (in °C) in three different temperature regimes. Once the sensors had stabilized within the controlled environment, temperatures were recorded for one hour at one-minute intervals

	HOBO® 1	HOBO® 2	Difference between HOBO® 1 & 2	CS215®	HMP62®
Freezer	-19.8	-19.8	0.0	-19.3	-19.1
Fridge	4.7	4.4	0.3	5.0	4.8
Ambient	23.9	23.6	0.2	23.6	23.9
Average	2.9	2.7	0.2	3.1	3.2

Humidity data loggers, which had been used in the field; a CS215 sensor (manufactured by Campbell Scientific, USA); and a MNP60 sensor (manufactured by Vaisala, Finland). The data from the latter two sensors were stored on a CR200 logger, manufactured by Campbell Scientific, USA. The results showed very little variability among all four sensors (Table 1), which suggested a high level of interchangeability. This confirmed that the hysteresis effect was caused by the solar radiation shields and not the sensors. The results also showed that the comparatively less expensive HOBO® sensors were as accurate as the very expensive ones.

In seeking to measure ambient temperature in the field, potential sources of variability must be kept in mind, particularly if one is seeking comparative data. Besides quality and uniformity of the equipment, age also plays a significant role in accuracy, precision and repeatability of data collected. Although not investigated here, it has been noted that Lopardo et al. (2014) compared solar radiation shields of identical specifications, but of different ages.

They found that there was an average difference of 0.46 ˚C in daily maximum temperature measured by sensors within new and five-year old solar radiation screens (Lopardo et al. 2014). Data gathering equipment needs to be prioritized in the research budget. These findings show the importance of careful calibration of air temperature sensors against accurate standards with an assessment of the influence of the solar radiation shield prior to equipment installation.

Acknowledgments

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Forage seed systems in eastern Africa: Challenges and opportunities

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Abstract

Despite the profound livestock importance in eastern Africa, livestock productivity remains low, attributable to a number of challenges. One of the major drawbacks is the lack of quality feeds and forages. This results in poor animal performance and suboptimal use of resources. Intertwined with this lack of quality forages is the dearth of forage planting materials - including seed and vegetative material – to offer producers improved forages adapted to different ecologies and agricultural contexts. To alter the landscape, developed forage technologies coupled with awareness creation is needed along the forage value chain to support commercially functioning forage seed systems. With the projected doubling of demand for animal products (meat and milk) in sub-Saharan Africa, the pressure will be exerted on livestock feed resources. This is likely to result in a knock-on demand for forage cultivation hence forage seed demand. To be successful, the forage seed systems need to be supported by enabling policies across the region, which include: functional procedures for certification and quality control; public-private partnerships for the production and dissemination of planting materials, and; technical advice on the production and management of forages. The work reported in this paper highlights the challenges and opportunities which, if implemented, are likely to bolster forage seed system development in eastern Africa.

Keywords: Forage technologies, Kenya, Ethiopia, climate change

Introduction

While in developed economies, where livestock constitute a major agricultural component, functioning forage seed systems operate, this situation has not been realized in eastern Africa, despite livestock production being a vital agricultural component. Efficient livestock production relies heavily on the quantity and quality of feed and forage resources. Feed is the single largest variable cost of livestock production (Chamberlain and Wilkinson, 1996); which means that it inevitably takes the bulk of requirements in livestock production (Odero-Waitituh, 2017). Further to this, with more land being dedicated to crop production and the increasing requirement for livestock products to meet human demand, the competition for scarce natural resources, particularly in developing countries, is intensifying. The source of feeds is also changing and, as new market opportunities for meat and milk lead to increased prices of concentrates and agro-industrial by-products, this increase in demand is increasingly being met by crop residues and planted forages. This situation is being accentuated by the fact that the availability of grazing land is decreasing. In the face of a changing climate, it is predicted that the demand for more resource efficient and drought tolerant, productive species and varieties will grow. The genesis of a strong and stable animal feed resource base, usually the roughages, depends on the use of proven forage technologies. However, such forage technologies require the availability of seeds and planting materials (Mengistu et al. 2016) that are easily and economically accessible by the livestock keepers.

Eastern Africa that include the countries; Ethiopia, Uganda, Rwanda, Kenya and Tanzania, is a home to an estimated 109.2 Million cattle. (Leta and Mesele, 2014; Ministry of Livestock and Fisheries Development (MOLFD), 2015; Ministry of Agriculture Animal Industry and Fisheries (MAAIF), 2008). These resources, whose role is to meet the predicted increase in demand for milk and meat by 2050 (Delgado et al. 2001), will have to respond with an increased production and production efficiency, if the demand is to be met. Subsequently, accessibility to seeds and planting materials of improved forages is paramount. While annual forage seeds demand is about 90,000 tons (Andrade, 2001) in a country like Brazil with a developed forage seed system (Jank et al., 2011), it is scarcely documented for eastern Africa. However, in Ethiopia 200,000 tons have been reported to be produced between 1988 to 2002 (Alemayehu et al., 2017). Projections are that, as one of the countries with the highest cattle population in Africa, production will be about 17 tons a year by 2020 (Shapiro et al. 2015). In this country, farmers largely rely on crop residues, naturally occurring pastures and, to a limited extent, cultivated forages. To support this demand vegetative propagation is often used, but this is not without limitations. While naturally occurring pastures are likely to be of poor quality, vegetative propagation can carry the risk of the spread of diseases and pests. In addition, vegetative materials are laborious to work with due to bulkiness. For example, if a substantial land area is to be established, accessing enough quantities can be a challenge. The work reported here assessed the status of forage seed production in Ethiopia and Kenya to give an indication of forage seed status in the region.

Approach

The two countries, Kenya and Ethiopia, were selected for the review based on their livestock, and especially cattle,

populations and their contributions to livelihoods. Both countries have sizable cattle populations of approximately 17.4 and 54 million, respectively found under rain-fed conditions (Steinfeld et al., 2006). A review of the past and current initiatives on forage seed systems in the two countries were synthesized against the status of current and projected contributions of livestock to human nutrition. Scopus and Google Scholar search engines were used to filter out the information using relevant keywords, including forage seed, commercial, eastern Africa and prospect/potential.

Results and discussion

A search of the relevant journal papers, reports, working papers and books returned a minimal amount of published work that has been performed on forage seed demand or its potential in eastern Africa. Of the 658 peer-reviewed articles referencing forages, only 2 were touching on forage seed production and not on the commercial aspect. The few articles on forage seeds, including other accessible reports, were synthesized and reported.

Ethiopia

According to Ethiopian livestock masterplan done in 2014, the estimated forage seed quantity within the country was 2.2 thousand tons and is projected to increase by about 300 % by the year 2020. The projections are influenced by the increase in carcass weight per animal from 107 kg to 138 kg, and annual milk production per cow from 189 liters to 313 liters in 2020. Similarly, production in commercial dairy farms would grow from the 4,608 liters to 5,080 liters in 2020. Over the same period, the crossbred dairy cow population would increase from 450,000 to 4.5 million. It has been shown that the opportunity exists to double production in response to improved nutrition with these effects amplified when considering profitability (Mayberry et al., 2017). These scenarios precipitate a likely increase in demand for forage seeds to support the improvements. Evidence shows that farmers understand the use of improved fodder, which results in increased productivity (Tekalign, 2014), but access to such material at affordable prices is key. Despite this understanding, and livestock contributing up to 35% of the agricultural gross domestic product in Ethiopia. Only 1% of feed resources are currently derived from planted forages with the major feed resources derived from crop residues (50%) and grazing unimproved natural pasture (35%) ((Tolera et al., 2012; Shapiro et al., 2015).

The forage seed value chain is weak and barely functional with inadequate research on forage seeds and a general lack of reliable forage seed production, processing and distribution schemes. Along with; poorly developed seed marketing systems and limited involvement of private seed companies (Fikre, 2018). Ethiopia currently relies mainly on opportunistic seed production, or, contract seed production by farmers, farmer's cooperatives and/or the establishment of specialized plots by governmental and non-governmental organizations (Mengistu et al., 2017). This lack of functionality is attributable to a number of challenges. This includes the lack of promotion of forages determined to be useful in different systems and agro-ecologies, as well as, weak or non-existent institutional linkages. Although both formal and informal sectors are at play, with the informal involving farmers who grow forage seeds, there is a general lack of certified seeds and technology. The producer–consumer linkages that would otherwise contribute to commodity flow and connect to the market for sustainability are lacking. The formal sector, that includes the Ethiopian Seed Enterprise which involves farmers with contractual arrangements, is not well elaborated as the emphasis is usually on food crops. Work undertaken previously has shown, there is the potential to produce seeds locally. For example, the Smallholder Dairy Development Program (SDDP) from 1987-1991 and the Fourth Livestock Development Project (FLDP) that lasted between 1988 to 1994. During the implementation of the FLDP, national forage seed production reached 150 tons per year but this was not sustained after the completion of the project (Mengistu et al., 2016). This was due to low seed prices against the high cost of seed production. As such, exploring on forage seed business models that could be suitable, whether locally produced or through importation, is worth pursuing. More recently, the 'FeedSeed' pilot project, aimed at developing climate-adaptive forage seed systems in Ethiopia, ran from October 2013 to January 2016. The project successfully identified and trained thirty seed entrepreneurs. Twelve of these enterprises dedicating a total of 210 ha of land to forage seed and planting material production. Selling USD 616,000 of improved forage seeds during 2015/16 (ILRI. 2016) will hopefully produce more sustainable outcomes.

Kenya

Kenya is estimated to have a cattle population of 17.4 million. With an estimated 5.8 million livestock keepers involved under rain-fed conditions in arid, semi-arid, humid, sub-humid and tropical areas (Steinfeld et al., 2006). Unlike Ethiopia, Kenya lacks any information on estimated forage seed demand. While Kenya has developed seed systems especially for the main staple food crops, e.g. maize, it is under-developed for the forage seeds. Although there are several registered seed companies – representing "the formal forage seed segment" – only the Kenya Seed Company deals with a significant amount of forage seeds (Mwendia et al., 2016). However, only for limited forage species. Nevertheless, "the informal forage seed segment" which includes the use of planting materials especially from research centers and exchange of planting materials among farmers, also exists. Anecdotal evidence, however, shows that farmers are embracing forages that are productive and proven to work. For example, recently there had been a promotion of Brachiaria (Syn. Urochloa) species through projects and development partners in Kenya (Njarui et al., 2016; International Center of Insect Physiology and Ecology (ICIPE), 2011) and Rwanda (Mupenzi and Everson, 2012). So far, three *Brachiaria* forage hybrids (Cayman, Cobra, and Mulato II) were formally licensed in Kenya

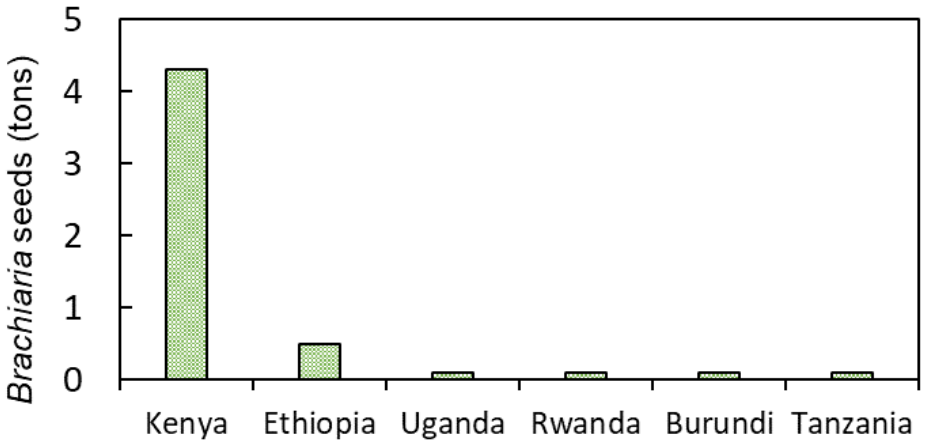

Figure 1: *Brachiaria* seed (tons) sold across eastern African countries (2017-April 2018) from Advantage Crops Limited. (Data obtained from Advantage Crops Limited).

on the 8th July 2016 (Kenya Gazette - Vol. CXVILI—No. 74, 2016). Information from the company licensed to sell the seeds (Advantage Crops Limited) shows a soaring demand (C. Wasonga Pers. Comm.). The company had already sold about 5 tons of the seeds by early 2018, and have received demand from different countries (Fig. 1). However, since the hybrids were licensed in Kenya, their movement to other countries has been on a research permit, most likely limiting the uptake (C. Wasonga Pers. Comm).

Worldwide, the global forage seed market has been growing. In 2014, the seed market was estimated at USD 10,789 million expected to reach about USD 17,508 million by 2020 (Transparency, 2015). This reflects the importance they serve in the production of milk and meat for the global human population projected to reach about 9 billion by 2050 (World Bank, 2014). It is likely, that the forage seed demand in eastern Africa will grow over time driven by the livestock revolution - increase in demand for animal source foods. The demand for milk and meat in sub-Saharan Africa (SSA), has already surpassed developed economies (Steinfeld et al., 2006; FAO, 2006). The human population in SSA has been increasing steadily at ≈3 % (World Bank, 2014) and by 2016 had reached a billion. In addition, cattle numbers have also been increasing implying more forage requirements. This could be linked to the high number of livestock keepers, at about 5.7, 5.9, 2.1, 8.3, and 15 million for Uganda, Kenya, Rwanda, Tanzania, and Ethiopia respectively (Steinfeld et al. 2006). As such, this may impact on forage seed requirements to meet the feed resource base.

A recent study on economic foresight on the use of Brachiaria species in eastern Africa showed there is a potential to increase milk production by up to 40 % (Gonzales et al., 2016). If indeed farmers experience this and achieve convincing results, the demand for such species is likely to grow. Awareness creation for such forage grasses aimed at reaching the livestock keepers would thus be key. To be able to empower the livestock keepers with the information that is required, awareness creation could happen through multiple avenues such as demonstration plots, media, and field-days. Usually, farmers lack information and technical knowledge on how to access and grow (Franzel, 2014), and how to feed the animals appropriately. It is likely that these shortcomings have contributed to the low Brachiaria sales observed in these countries (Fig. 1), except for Kenya where the seeds are licensed. Addressing such weaknesses will be necessary for the uptake of technologies to take effect. The policy environment should be supportive for seed access by livestock keepers across countries. The Common Market for East and Southern Africa (COMESA) initiative on harmonizing seed trade across the region, to increase efficiency and supply market needs (Mukuka, 2014) is a step likely to boost forage seed adoption.

Seed development and distribution infrastructure are essential for the success in the use of quality productive forages (Makkar, 2016). Currently, in eastern Africa this requires attention. Ideally, this could benefit from the infrastructure developed for other seeds (such as food crops), by having the same dealers incorporate forage seeds in their portfolio. However, this has to make economic sense. Using a model that is most feasible, i.e. importation or local seed production, could also be variable depending on the type of seeds in question.

Conclusions

The rise in demand for animal products in SSA will most likely lead to increased forage cultivation coupled with rising demand for forage seeds in eastern Africa. It is likely that both formal and informal approaches would work and has the advantage of synergizing as some seeds have been found not to be profitable to companies. The private sector is mostly interested if there are financial returns from forage seeds. However, not all seeds are likely to have the same business potential. Grasses that form the basal diet are likely to trade in large volumes compared to legumes that are for supplementation.

Opportunities that exist include the development of productive forage technologies coupled with awareness creation. Evidence of improved animal performance would contribute to forage uptake and increased forage seed uptake. Facilitative policy on seed movement across countries in the eastern Africa will support forage adoption.

Acknowledgement

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How eating seaweed can help cows to belch less methane

Emissions from the nearly 1.5 billion cattle on earth are a major source of methane, a powerful greenhouse gas. Now, researchers in California and elsewhere are experimenting with seaweed as a dietary additive for cows that can dramatically cut their methane production

Judith Lewis Mernit

Reprinted from: http://bit.ly/2MYcZDF

The spring morning temperature in landlocked northern California warns of an incipient scorcher, but the small herd of piebald dairy cows that live here are too curious to care. Upon the approach of an unfamiliar human, they canter out of their barn into the already punishing sun, nosing each other aside to angle their heads over the fence.

Some are black-and-white, others brown; all sport a pair of numbered yellow ear tags. Some are more assertive than others. One manages to stretch her long neck out far enough to lick the entire length of my forearm.

"That's Ginger," explains their keeper, 27-year-old Breanna Roque. A graduate student in animal science at the University of California, Davis, Roque monitors everything from the animals' food rations to the somatic cells in their milk — indicators of inflammation or stress. "The interns named her. She's our superstar."

Ginger is one of 12 Holstein cows participating in an experiment being conducted by Roque's animal science professor, Ermias Kebreab, into reducing methane emissions from livestock by supplementing their diets with a specific type of seaweed.

Methane is a potent greenhouse gas, with roughly 30 times more short-term, heat-trapping power than carbon dioxide. In California alone, 1.8 million dairy cows, together with a smaller number of beef cattle, emit 11.5 million metric tons of carbon dioxide equivalent every year — as much as 2.5 million cars.

Figure 1: Holstein cows feeding at a dairy farm in Merced, California. MARMADUKE ST. JOHN / ALAMY

In the U.S., domestic livestock contribute 36 percent of the methane humans cause to be put into the atmosphere.

The enormity of those numbers, in part, motivated California lawmakers to pass a law to reduce methane emissions and other short-lived "climate pollutants" by 40 percent below 2013 levels by 2030. The California Air Resources Board subsequently ordered a majority of the reductions in the new law to come from the dairy industry. Other cuts will come from diverting organic waste from landfills and eliminating fugitive emissions associated with oil and gas operations.

The UC Davis study will contribute to a global store of knowledge on how to limit the methane produced by "enteric fermentation" — the digestive process in a ruminant's upper stomach chamber, or rumen, where microbes predigest fibre and starch, releasing gases when they belch and exhale. It's "one of a handful of options in various stages of development that seem to have the potential to reduce [enteric] methane by 30 percent or more," says Ryan McCarthy, science advisor to the Air Resources Board.

Kebreab's experiments with seaweed additives to cattle feed have now surpassed that 30-percent figure, with one type of seaweed slashing enteric methane by more than 50 percent. In the fight to slow climate change, such

Figure 2: Scientist Ermias Kebreab has studied how to reduce cow methane emissions for more than a decade. GREGORY URQUIAGA/UC DAVIS

reductions are no small matter: In the United States alone, domestic livestock — including cattle, sheep, goats, and buffalo — contribute 36 percent of the methane humans cause to be put into the atmosphere, according to the U.S. Environmental Protection Agency.

Researchers worldwide are working on the livestock methane problem. In the past, scientists have tried mixing microbes from the low-methane-producing kangaroo forestomach into bovine gut microbes, selectively breeding less gassy cows. Researchers have also tried vaccinating to suppress "methanogens" — the bacteria that turn carbon and hydrogen into methane in the rumen. (That last idea was a little like trying to develop a flu vaccine that would work every year, in every corner of the world. "There were too many different methanogens," Kebreab says. "We couldn't calibrate it for all of them.")

Feed additives have shown more promise. Three years ago, Alexander Hristov, a researcher at Penn State University, achieved a 30 percent reduction in enteric methane by salting ruminant feed with a substance called 3-nitrooxypropanol, or 3NOP (the substance is currently awaiting FDA approval). Kebreab believes seaweed might prove to be an even better solution. A native of Eritrea who came to the U.S. after working in the United Kingdom and Canada, the 45-year-old researcher has been working on the problem for 15 years. "It's taken up pretty much my whole career," he says.

In the research barn at UC Davis, Roque opens a large foil bag to reveal fistfuls of dried algae the colour of old bricks: Asparagopsis, still off-gassing the ocean — fish and sulphur with bright notes of iodine. Interns have ground up the clumps and poured them into orange buckets. Roque puts on latex gloves to blend the dried seaweed with molasses to produce a shiny, viscous slop that the cows evidently find delicious. Palatability is key: One study in the UK that added curry to feed in a simulated cow rumen looked promising until the real-life cows refused to eat the curry.

Farmers in ancient Greece and 18th-century Iceland deliberately grazed their cows on beaches.

"They're pretty picky eaters," Roque says. Foraging animals have to sort nourishment from potential poisons in the pasture. "If they run across something unfamiliar, they'll avoid it."

Four of the cows eat a mixture of alfalfa and hay, heavily spiked with the seaweed-molasses mixture. Four more will eat the same feed, with less seaweed added in. The rest are the control group — they'll eat plain feed, without any additives at all. Roque spent nearly two weeks training the cows in how to access their own specific feeding berths, affixing each one with a transponder that allows the cow to open an electronic door to her individual trough. Not all the cows are down with the program. One, large, black-masked Holstein repeatedly shoves her smaller, more compliant neighbour aside from the open door of her berth. The smaller cow obliges every time. Roque raps the bolder cow on the nose, and it withdraws, but not for long.

"They're eating the exact same thing," Roque says, a bit exasperated. In the paddock as in the pasture, "the grass really is always greener."

When they finish eating, they're enticed by the drop of a "cow cookie" to visit a compartment where an instrument, much like a breathalyser, analyses their emissions. "They hear it drop and come over," Roque says. "We try to get each of them there three times a day." Each cow wears a ring on its ear that transmits an identification code along with its breath analysis to a database. Roque and Kebreab can view the results on their computers and smartphones.

The results have exceeded everyone's expectations, including Kebreab's. His three-month study of Ginger and her cohort found that spiking cows' ordinary rations with one kind of marine macroalgae in particular, Asparagopsis, reduces enteric methane by 58 percent. More than other seaweeds, Asparagopsis contains compounds that inhibit the production of methane, or CH4, and interrupt the process by which carbon and hydrogen bind together.

"We did not expect these numbers in the doses we used," Kebreab says. Milk production held steady or increased. A panel of tasters detected no differences among the different cows' milk.

There's nothing novel about cows eating seaweed, notes Joan Salwen, an environmental science fellow at Stanford University who introduced UC Davis scientists to the seaweed solution, and formed a non-profit, Elm Innovations, to help focus and fund research. "Cows eat what's available," she says. In California, they eat almond hulls; in Georgia, they eat cottonseeds. Documented evidence attests to farmers in ancient

Greece and 18th-century Iceland deliberately grazing their cows on beaches.

It was, in fact, an ordinary farmer who hit upon the idea of supplementing cows' feed with seaweed — not for the climate, but simply for his animals' overall health. On the shores of Prince Edward Island in Canada, Joe Dorgan observed that his beach-paddocked cows got pregnant faster and produced more milk than his inland pastured cows. When he retired from dairy farming in 2011, he launched a new business, North Atlantic Organics, to make "stormtoss shoreweed" from Prince Edward Island available to inland farmers who graze their cows during seasons of scanty forage.

Because it appears to promote milk production, the seaweed cure might catch on in other dairy states.

When Dorgan wanted data to market his product, he approached an environmental scientist named Rob Kinley, who was then at Dalhousie University in Nova Scotia. In 2014, Kinley and his colleague Alan Fredeen analysed different varieties of seaweed that washed up on beaches, mixed in vitro with rumen microbiota, for their nutritional value and health impacts on ruminants.

But being environmental scientists, Kinley says, "'what if?' possibilities are always in our peripheral vision." With an interest in how all livestock feeds affect enteric methane, they measured their samples for methane production as well.

Kinley discovered in his laboratory tests that seaweeds could reduce methane production by as much as 16 percent. "That was the spark to deepen the search for more potent seaweeds," he says.

By this time, Kinley had moved to Australia, where he went to work at the Commonwealth Scientific and Industrial Research Organisation (CSIRO). In partnership with James Cook University and Meat and Livestock Australia, Kinley began screening different seaweeds for their impact on methane emissions from ruminant livestock. That process revealed Asparagopsis as the anti-methanogenic seaweed of choice. But Kinley is quick to warn that it does not grow in abundance all over the planet. If it breaks out as a global solution to enteric methane, it will need to be farmed.

Figure 3: Ground-up Asparagopsis, a type of seaweed, which can reduce cow methane emissions up to 50 percent when added to feed. GREGORY URQUIAGA/UC DAVIS

Which is not, Kinley argues, a bad thing. Seaweed cultivation takes up excess nitrogen and dissolved carbon dioxide from ocean waters; cultivating it could create new economies in impoverished regions. Researchers still need to figure out how that would work. "There is no depth of knowledge in cultivation of Asparagopsis using any method," says Kinley.

"As far as we know," says Salwen, "this supplement, if it proves out in all animal testing, could be offered in all livestock production systems that we know about." Pasture-raised cows that eat primarily grass could have the supplement added to their water or to their salt licks.

Even though the California dairy industry at large fought hard against what farmers initially considered onerous regulation, at least some dairy farmers are tentatively enthusiastic about seaweed additives. "Methane is an indication of an inefficiency in the animal's digestion," says Jonathan Reinbold, sustainability program manager for Organic Valley, a cooperative of more than 1,800 dairy farmers, including 35 in California. "If you can increase the digestion efficiency of a cow by 5 percent you could remove 5 percent of the land you use for production for cows. It can go back to fallow or be used to grow other kinds of food."

And because it also appears to promote milk production, the seaweed cure might catch on in other dairy states without many climate regulations. The California Air Resources Board's McCarthy sees a future for seaweed boosting dairy production in developing countries. Reinbold imagines it spreading across his company's U.S. cooperative.

"If the benefits are real and make sense financially, why wouldn't we have the entire cooperative of 1,800 dairy farmers using it?" Reinbold says. "We certainly hope that's the case."

VIDEO - WATCH:

A look at how scientists are measuring methane from cows:
http://bit.ly/2MYcZDF
(Credit: UC Davis)

Biological control of invasive tree species in South Africa

FAC Impson and CL Lyons

Reprinted from: http://bit.ly/2CuoT3m

Across South Africa and indeed globally, a number of tree species are considered highly invasive and problematic. Typically, invasive trees and shrubs share several similar characteristics. Most are fast growers that reach reproductive maturity within a few years, many are adaptable to varying climates and soils and, perhaps most importantly, they generally produce large quantities of long-lived seed. In turn, it is the adaptability and vigorous growth of many tree species that historically led to widespread introductions of such plants, and this undoubtedly exacerbated the problems.

Many tree species are well known for their uses in agroforestry, the ornamental market, stabilisation of drift sands and for animal fodder as well as providing a source of human food. Whilst not all "useful" trees are invasive, the realities of managing those that are, is not always easy and without controversy. Mechanical and chemical control of invasive trees is generally difficult and expensive, and often temporary due to constant regeneration of seedlings, and biological control integrated with one or other of these methods should be promoted as a more long-term and sustainable method where possible.

South Africa has a long history in weed biocontrol and is considered a world leader in terms of biocontrol of perennial trees. Some of the better-known introduced tree species in this country include Acacias, Hakeas, Pines, Prosopis and Eucalyptus trees. These, along with many others, are categorised as invasive, to varying degrees, requiring different levels of control. But, what dictates whether these species are targets for control or eradication?

As with many species, but particularly with tree species, whether they are considered to be beneficial, be it on a commercial or small-scale basis, plays an integral role in their management plan as far as biological control is concerned. Where there are no clear benefits to having an invasive tree species present, it is possible to utilise control mechanisms that will ultimately lead to death of the tree. One of the most successful examples to illustrate this is that of Red sesbania (*Sesbania punicea*), which was considered a serious invader of watercourses across the country. However, following the release of three biocontrol agents - two targeting the reproductive capacity of the plant and a third, which impacts the growth of the plant; the abundance and density of this weed has been reduced to such an extent that the tree is no longer considered a weed of major significance. Hakea species would also fall into this category, and once again biological control efforts against this invasive group of weeds make use of the combined efforts of both seed and flower feeders as well as a stem borer.

Figure 1: Typical heavy pod loads on the black wattle

On the flip-side of the coin, trees such as Eucalypts and pines are grown commercially for their timber, and the former also play an extremely important role in the apiary industry. In addition, several acacias (i.e. black and green wattle), are grown and harvested to extract tannin from the bark and pulp (for paper production) from the wood, others (i.e. blackwood, *Acacia melanoxylon*) produce high quality timber for the furniture industry or are prized for firewood (*Acacia cyclops*). Lastly, the wood from *Prosopis* species is used to make charcoal, and pods from the plant are used by farmers as a fodder for livestock, and even created into prosopis flour for human consumption on a small scale. Species that fall into this category, are usually considered 'industry species', which have both positive and negative consequences for the economy, however, there are inevitable conflicts of

Figure 2: *Sesbania* before

Figure 3: *Sesbania* after

Figure 4: Flower galling midge on black wattle

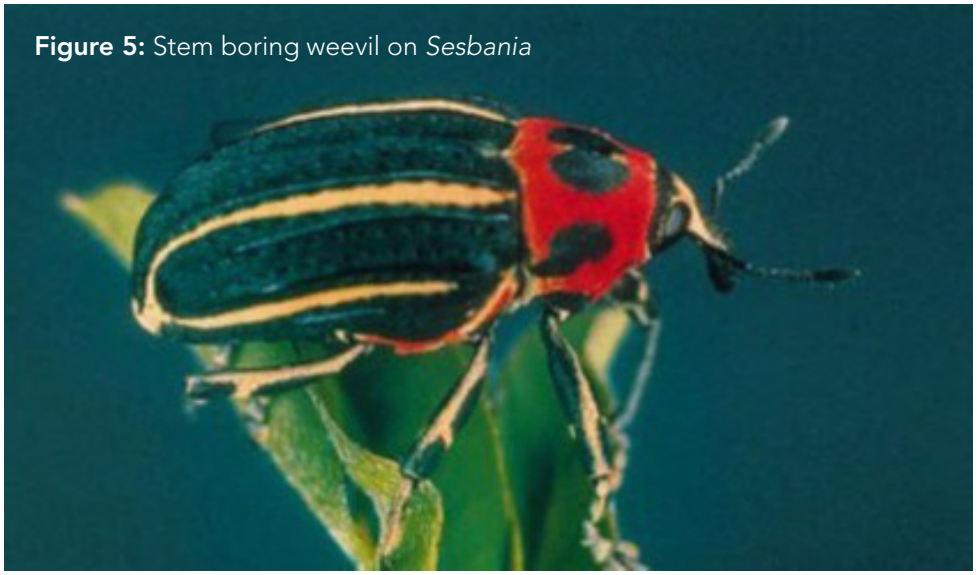


Figure 5: Stem boring weevil on *Sesbania*

interest that arise between those wanting to control or eradicate the plants due to their negative environmental impacts and those wanting to maintain and develop them for commercial gain. In South Africa the preferred method of controlling invasive trees that are potential conflict species, is by using biocontrol agents that reduce the reproductive output of the host plants. Agents that target the buds, flowers and/or seeds are often the focus for research endeavours to manage the spread of such species.

By utilising these methods of control, annual seed production can be limited, thus reducing both numbers of seed for spread and further accumulation of seed in the soil, but at the same time, adult trees remain in the system and can continue to be utilised for their commercial and social benefits.

Notably, South Africa was the first country globally, to initiate a biocontrol programme against an invasive tree, using a seed-feeding insect, when a seed weevil was released against *Hakea sericea* in 1970. Subsequently, the investigation into agents which limit reproductive-potential for tree species has expanded, with a total 20 species of invasive trees currently being managed in this manner with varying degrees of success.

The process to initiate a biocontrol programme against any species, but specifically a 'conflict-of-interest' species, is a time-consuming one. Besides the ecological studies to establish whether the selected agents are suitably host specific, and the best option for the target weed; open communication and discussions are required at various levels of stakeholder engagement, including government, managers, researchers, farmers and industry to avoid controversy.

In short, biocontrol of invasive trees can be successful if integrated correctly with other management strategies, and if all stakeholders' opinions and concerns are given due credit. The importance of industry species is undisputable, but so too is the conservation of natural resources such as biodiversity.

Thus, finding the delicate balance between these concerns requires consideration of all affected parties, and, although there are always several avenues to consider when initiating such a biocontrol programme, South Africa has experienced a great deal of success on this front.

Figure 6: Damage by stem boring weevil

Figure 7: Seed-feeding weevil on black wattle

Community-based conservation management has positive effect on wildlife

Putting land management in the hands of local communities helps the wildlife within, according to new research by a Penn State scientist. A new study demonstrates the positive ecological impacts of a community-based wildlife conservation area in Tanzania. The research is summarized in a paper that appears online [date] in the Journal of Wildlife Management.

Derek Lee

Current Address: Wild Nature Institute, Penn State
Reprinted from: http://bit.ly/2oPiSEG

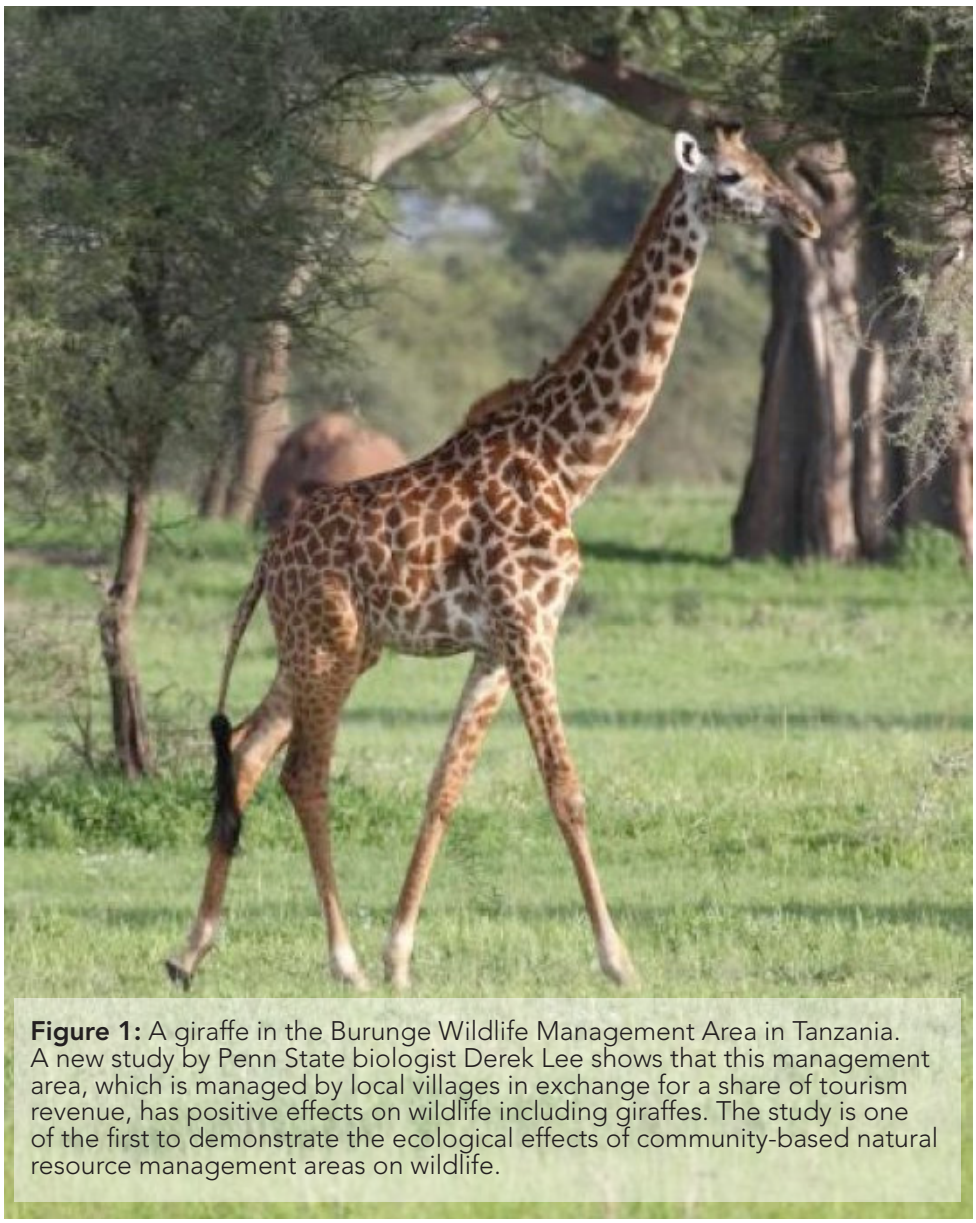


Figure 1: A giraffe in the Burunge Wildlife Management Area in Tanzania. A new study by Penn State biologist Derek Lee shows that this management area, which is managed by local villages in exchange for a share of tourism revenue, has positive effects on wildlife including giraffes. The study is one of the first to demonstrate the ecological effects of community-based natural resource management areas on wildlife.

"Community-based natural resource management has become one of the dominant paradigms of natural resource conservation worldwide," said Derek E. Lee, the author of the paper, associate research professor at Penn State, and principal scientist at the Wild Nature Institute.

"This type of strategy transfers the resource management and user rights from central government agencies to local communities. The impact of these projects on wildlife is rarely rigorously assessed, so we compared wildlife densities inside and outside the community conservation area. My data demonstrate that one of the first areas of this type in Tanzania has had positive ecological outcomes in the form of higher wildlife densities and higher giraffe population growth," said Lee.

In Tanzania, efforts to decentralize wildlife management to local communities occur through the creation of Wildlife Management Areas, whereby several villages set aside land for wildlife conservation in return for a share of tourism revenues from these areas. Nineteen Wildlife Management Areas are currently operating, encompassing 7% (6.2 million hectares) of Tanzania's land area, with 19 more planned. Tourism in Tanzania generates around $6 billion US dollars annually, which represents about 13% of their total gross domestic product, so there is good incentive for villages to participate in these management areas.

"For six years, I studied the Burunge Wildlife Management Area in Tanzania, which was formally established in 2006 and added increased wildlife protec-

tions in 2015," said Lee. He observed higher numbers of wildlife inside the protected area compared to the village lands just outside the area as well as lower densities of livestock, including cattle, sheep, and goats. He also observed higher numbers of wild ungulates -- hooved mammals -- and lower numbers of livestock in the management area after the increased wildlife protections began.

"This suggests that the specific management activities implemented in 2015 have a positive effect on wildlife within the Burunge Wildlife Management Area," said Lee. "These include performing anti-poaching activities to protect wildlife, reducing wood cutting, preventing livestock encroachment, and providing training and equipment to village rangers so that they can perform these activities."

The change to management activities also improved survival and population growth of giraffes within the management area. Lee did not observe any change in giraffe demographics outside of the management area in the adjacent Tarangire National Park over the same time period.

"It is very gratifying to see the positive role of community conservation areas in saving Africa's endangered and declining species," said Philp Muruthi, Senior Director of Conservation Science for the African Wildlife Foundation who was not involved in the study. "Clearly to save the giraffe will take more than the formal national parks. And the benefits to the species and landowners are immense into the future."

This study highlights the usefulness of monitoring wildlife to evaluate specific management strategies as well as the general concept of community-based natural resource management. In particular, locally based monitoring schemes could lead to more sustainable community-based conservation.

"We know from this and previous studies that these management areas can have positive effects on wildlife," said Lee. "But there have been some social and economic critiques of wildlife management areas. For example, there is a higher incidence of poverty around protected areas compared to other rural areas.

Although it can be challenging for community-based natural resource management to achieve both conservation and human development goals, the concept appears to be the best opportunity for Tanzania to retain its place as one of the most famous and profitable wildlife tourism destinations while also sustainably developing local communities."

Journal Reference

Derek E. Lee. Evaluating conservation effectiveness in a Tanzanian community wildlife management area. The Journal of Wildlife Management, 2018; DOI: 10.1002/jwmg.21549

New protected environment announced for Eastern Cape

Reprinted from: www.wildernessfoundation.co.za

MEC for Finance, Economic Development, Environmental Affairs and Tourism, Honourable Lubabalo Mabuyane, recently announced the enactment of Protected Environment status for the Indalo Game Reserves Protected Environment, through the Eastern Cape Parks and Tourism Agency (ECPTA) under the Eastern Cape Biodiversity Stewardship Programme.

Indalo, meaning "creation", is a voluntary collaboration of Eastern Cape private game reserves who support biodiversity based eco-tourism, strive for sound ecological management and commit to the promotion of positive socio-economic upliftment.

Indalo reserves employ around 1 079 people and support an additional 3 992 dependents.

The newly enacted Indalo Game Reserves Protected Environment, covering 68 075 hectares, spans three local municipalities, namely: Sundays River Valley Local Municipality, Ndlambe Local Municipality and Makana Local Municipality, all located in the Eastern Cape Province, South Africa.

The Indalo Game Reserves Protected Environment is comprised of eight private game reserves, including Amakhala Game Reserve, Hopewell Private Game Reserve, Kariega Game Reserve, Kwandwe Game Reserve, Oceana Beach and Wildlife Reserve, Pumba Game Reserve, Shamwari Game Reserve and Sibuya Game Reserve.

Figure 2: Mark Palmer, Conservation Manager of Amakhala Game Reserve and recently elected Chairman of Indalo

Figure 1: Amakhala Game Reserve is one of eight Eastern Cape reserves that form part of the newly-enacted Indalo Game Reserves Protected Environment, which recently received "Protected Environment" status under the Eastern Cape Biodiversity Stewardship Programme through the Eastern Cape Parks and Tourism Agency (ECPTA)

A tiny beetle and its deadly fungus is threatening South Africa's trees

Wilhelm de Beer

Current Address: Associate Professor, University of Pretoria
Reprinted from: www.agrikultuur.com

Sandton is Johannesburg's economic hub – home to numerous companies' headquarters and the Johannesburg Stock Exchange. Now it has a new, unwelcome resident: a tiny beetle that could lay waste to several tree species found in the suburb and potentially the wider Johannesburg area. This is particularly concerning, as Johannesburg is considered one of the world's largest urban forests, with more than 10 million trees.

The polyphagous shothole borer, or *Euwallacea fornicatus*, seems to be a newcomer to South Africa. It was discovered in the country for the first time in 2017 by Dr Trudy Paap, a postdoctoral fellow at a biotechnology institute at the University of Pretoria.

During a survey for diseases in the KwaZulu-Natal Botanical Gardens in Pietermaritzburg, Paap found a lane of infested plane trees. The identity of the beetle was subsequently confirmed and the tiny beetle – they are each about 2mm long – has been found at work in gardens and roadsides in Johannesburg, about 500 km from Pietermaritzburg.

"The polyphagous shothole borer is tiny - but a fungus it's commonly associated with can be deadly for trees."
Wilhelm de Beer

The beetle isn't alone. It carries several fungal species with it when it infests living trees. One of these, *Fusarium euwallacea*, seems to be a permanent associate of the beetle. This fungus can eventually kill a beetle-infested tree. The beetle and the fungus have devastated trees in California in the US as well as in Israel. Insecticides aren't effective because the beetles bore deep into the wood. The only known method of managing the spread is to cut down infested trees and burn them. But research is underway to find more effective methods.

A threat to native forests and fruit trees

In late January my colleagues and I at the Forestry and Agricultural Biotechnology Institute were contacted by Niel Hill, an urban forestry consultant in Johannesburg. He was concerned about several dying trees in the Sandton area. Symptoms varied on different tree species from patches of white powdered wood (called frass), to blotches of oozing resin, on the bark surrounding the beetles' entrance holes. On some trees he had also spotted small, elevated lesions on the bark resembling shotgun wounds.

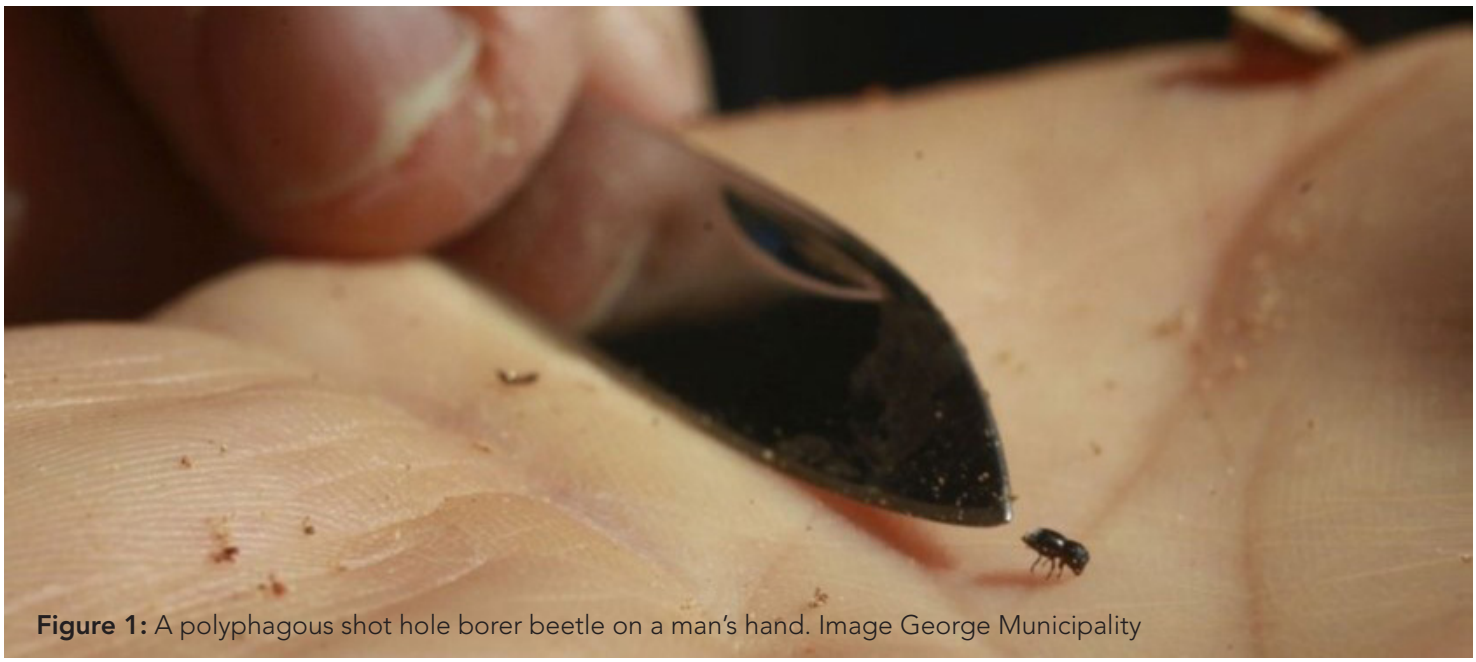


Figure 1: A polyphagous shot hole borer beetle on a man's hand. Image George Municipality

Figure 2: A close-up of the polyphagous shot hole borer beetle. Image George Municipality

Hill said that trees had already started dying with these symptoms in 2015, but the cause was unknown. Microscopic and DNA tests in the institute's laboratories confirmed that the polyphagous shothole borer and its fungus had arrived in Sandton.

The tree species affected in the Sandton area include non-native ornamental trees such as Japanese and Chinese maple, London plane, kapok, and liquid amber. Several paper bark trees, native to South Africa, were also heavily infested and dying.

The polyphagous shothole borer doesn't appear to have done much damage to trees in Southeast Asia, its place of origin. That's probably because tree species evolved with the beetle and the fungus and have developed resistance towards them. It might also be because there are natural enemies controlling populations of the beetle in its native habitat.

But it's a different story in California in the US and in Israel. The beetle and its fungus were introduced in these countries during the past 15 years and have caused serious damage, especially on avocado trees.

Paap's work has confirmed that the South African beetle and fungus are the same genotypes as those found in Israel and California.

An extremely wide range of host tree species

Astonishingly, surveys in two botanical gardens in Los Angeles have shown that the beetle-fungus complex can infest more than 200 tree species from 58 plant families. This is quite unusual; forest pests usually affect trees of the same genus or family.

The lists of infested trees from California include important crop trees like avocado, macadamia, pecan, peach, orange and grapevine. Some of the susceptible trees are South African species that have been planted in the Los Angeles botanical gardens. These included the cabbage tree, common calpurnia, monkey plum, dwarf and common coral trees, and the honey flower, also sometimes called kruidjie-roer-my-nie.

The fact that native South African tree species are susceptible is particularly worrying. Although the California study provided some clues about the range of tree species susceptible, scientists simply don't know and cannot predict what the beetle and fungus will do in South Africa – on crops like avocado or on native trees. This has prompted the institute to start several research projects that range from developing fast DNA-based diagnostic tools for the fungus and beetle, to possible control measures.

During the past week scientists and government officials, representing the Department of Agriculture, Forestry and Fisheries and the Johannesburg City Parks and Zoo met with our team to discuss next steps. A working group has been set up to co-ordinate monitoring the spread of the beetle and managing research efforts. It will also advise government agencies, municipalities, industry and private tree growers.

Next steps: The public can help, too. We've made an appeal to gardeners to watch out for the beetles. Details including photographs of the symptoms, GPS coordinates or a street address, the host tree species and the reporter's contact details can be sent to diagnostic.clinic@fabi.up.ac.za.

We're also appealing to people not to spread the problem by moving plant material with signs of beetle infestation. Instead, infested branches should be cut into small pieces and put into refuse bags, sealed and kept in direct sunlight. The heat from the sun will kill the insect and its larvae. Alternatively, wood should be burnt on site.

A working group has been set up to co-ordinate monitoring the spread of the beetle and managing research efforts. It will also advise government agencies, municipalities, industry and private tree growers.

Acknowledgement:

Wilhelm de Beer, Associate Professor, University of Pretoria: A tiny beetle and its deadly fungus is threatening South Africa's trees originally published in, February 27, 2018 https://theconversation.com/a-tiny-beetle-andits-deadly-fungus-is-threatening-south-africastrees-92050 Republished under Creative Commons License

Figure 3: Elevated blue-black lesions on a tree's bark, resembling shotgun wounds or cigarette burns, indicate borer beetle infestation. Image: George Municipality

Woody plants on the march: trees and shrubs are encroaching across Africa

Zander Venter

Current Address: PhD candidate in agroecology, University of Cape Town

Reprinted from: http://bit.ly/2CwrMRg

Forests are being cleared by humans at an alarming rate. Since 2000, roughly 20 % of Africa's forests have been wiped out. This deforestation has serious consequences, among them a loss of biodiversity and the potential to remove carbon dioxide (CO_2), a greenhouse gas, from the atmosphere.

But trees and shrubs, collectively known as woody plants, appear to be fighting back on another front. Many of these species are gradually encroaching into grasslands and savannas across Africa, particularly in places like Cameroon and the Central African Republic.

Taken at face value, this may seem to be good news. Woody plants mean more fuel wood for rural communities and increased food for browsing livestock like goats. It may offset the loss in carbon sequestration caused by deforestation.

But more woody plants also mean less habitat for grass and other herbs that make grasslands and savannas such productive systems. And that's a direct threat to the productivity of cattle and certain wild herbivores which rely on grass for sustenance. This is significant because in 2016, Africa produced 6.3 million tonnes of beef – more than double the meat production from sheep and goats combined. Woody plants can also take up precious water resources.

Until recently, scientists relied on historical photographs from land and aeroplanes to investigate changes in vegetation cover over decades and even centuries. This only gives information at a few locations, but these valuable studies have consistently shown that woody plants are expanding their range over parts of Africa.

We set out to expand on this research by exploring change in woody plant cover outside of forests for the entire sub-Saharan Africa region using satellite imagery going back to 1986.

We found that woody plants' cover has increased in large swathes of the continent in the past three decades. Our findings also suggest why this may have happened: because wildfires have decreased and there are more grazing animals rather than those that just browse. This combination, along with increases in rainfall, temperature and CO_2 emissions, has driven the march of woody plants in the region.

On the march

In our research, published in Nature Communications, we found that over the past three decades the cover of woody plants increased in more than half (55 %) of all non-forested areas.

Much less of the land (16 %) actually lost tree and shrub cover, leaving only 29 % relatively unchanged. Some of the countries experiencing the greatest increases in woody plant cover were Cameroon and the Central African Republic. Others, like Congo and Madagascar, underwent a net loss of woody plants.

The cause of tree cover loss is gener-

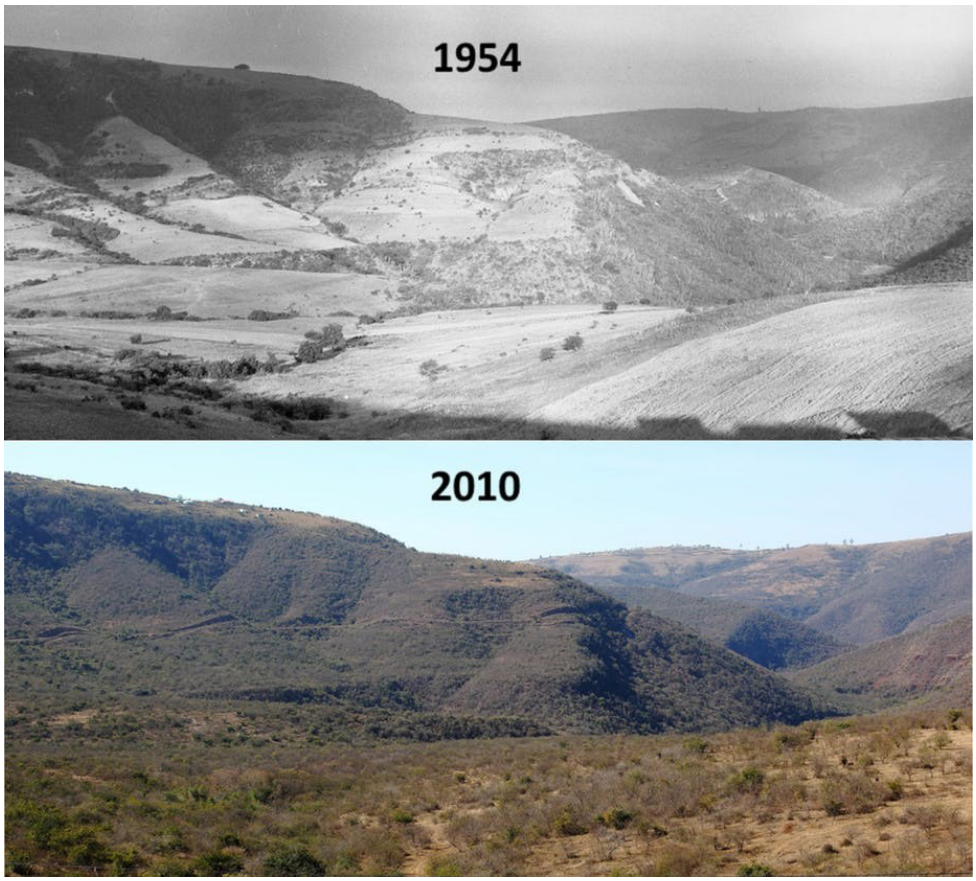


Figure 1: An example of woody plant encroachment over Eagle-Siding in South Africa's Eastern Cape province. D Edwards (1954) and James Puttick (2010). Images courtesy of rePhotoSA

Figure 2: How woody plant cover in the Jumbla Range in South Africa's Eastern Cape province has changed. Images courtesy of [rePhotoSA](http://rephotosa.adu.org.za/index.php). John Acocks (1945) and Zander Venter (2018)

ally well understood: it's dominated by human-induced clearing for agriculture, timber and fuelwood. But it's less simple to understand what's caused the gradual increase in woody plant cover we and others have recorded. The answer may lie with atmospheric CO_2.

Atmospheric CO_2, a by-product of burning fossil fuels but also a key ingredient for plant photosynthesis, has been on the rise since the industrial revolution around 1800. Scientists have suggested that this is causing the increase in woody plants because some experiments have shown that trees benefit more from elevated CO_2 than grasses do.

African experiments with elevated CO_2 have been conducted in greenhouses and plant growth chambers, where factors that limit plant growth in grasslands (like herbivores, fires, limited soil nutrients and water) are absent. And early botanical records, which aren't online, report that "thornveld" (woody savannas) expanded during the early 1900s, when CO_2 levels were still relatively low. This highlights the complexity of natural systems and the dangers of attributing change to any one factor.

In our study we found that fire and herbivores are possibly as important as climate or CO_2 emissions in shaping Africa's savannas. Over the past few decades, as human populations have grown, we have reduced the spread and intensity of fires and replaced browsing animals like elephants, kudu and goats with grazers like cattle. This has allowed woody plants to proliferate.

What can be done

Managers and conservationists who wish to mitigate woody plant encroachment can consider diversifying their livestock or wildlife.

Although reintroducing elephants and their ilk might be beyond the bounds of practicality for most livestock farmers, some goats or wild browsers like kudu will go a long way to helping. Some African countries have always had a market for goats and other countries have recently opened up those markets and so now would be a good time to farm with goats.

Targeted and prescribed burning practices could also help keep woody plants under control.

Technology can also be enormously helpful. Since 2017, hundreds of earth observation satellites, including the toaster-sized ones launched by satellite company Planet, have given us the ability to monitor every point on the planet every day. This could be harnessed to monitor how woody plant cover responds to management interventions, to see what works or doesn't, and where. This information should be made readily available to scientists, governments and land managers to inform future interventions.

To explore other changes in woody plant coverage, visit this interactive map.

Disclosure statement

Zander Venter receives funding from GreenMatter, the Oppenheimer Memorial Trust, Red Meat Producers Organization and Cape Wools SA.

Partners

University of Cape Town provides funding as a partner of The Conversation AFRICA.

Interactive map:
http://bit.ly/2wSMndk

We are facing down a 6th mass extinction event

Reprinted from: http://bit.ly/2wPQqGh

Life has existed on Earth for roughly 3.7 billion years. During that time, we know of five mass extinction level events – dramatic episodes when many, if not most of life forms have vanished in a geological flash of the eye – once gone never to come back - extinction is forever.

The most recent of these was the fifth mass extinction event that claimed the dinosaurs and many other species around 66 million years ago.

Recent articles in the Ecologist by respected scientists Bill Laurence and Paul Ehrlich and journalist Alexandra Simon-Lewis of WIRED confirm that there is now undeniable growing scientific evidence that we are on the brink of a sixth mass extinction event. This event, unlike all previous extinction events, is driven largely by the increasing impacts of humanity on this earth.

These authors claim that the beginning of this extinction event is mainly focused on Wildlife and Invertebrates – (animals without backbones), making up about 99 % of all animal species, most of which are insects. Invertebrates include crabs, snails, worms, corals, as well as insects such as bees; beetles and flies. These species fill many vital roles in ecosystems (and our agriculture industry) as pollinators, recyclers of nutrients, scavengers and food for others. The current rate of extinction of these species is at least 1 000 times higher than at any time in human history.

Simon Lewis argues that the sixth great extinction is playing out in other ways too, especially in the widespread destruction of millions of animal and plant populations. Just as species can go extinct, so can their individual populations. This locally can affect humans through agriculture production; tourism and other ecological services like water.

Environmental disasters are on the increase due to climate change and biodiversity loss. As an example, the recent war in Syria, which has caused great loss of human life and mass migration of people around the middle East and to Europe, with all the strife and displacement that has gone with it, started as a result of severe drought and repeated crop failures.

Three quarters of the world's largest carnivores including big cats, bears, otters and wolves, are declining in number. These species on average have lost at least 50 % of their former range i.e. their natural habitat.

- There were 400 000 lions in the wild

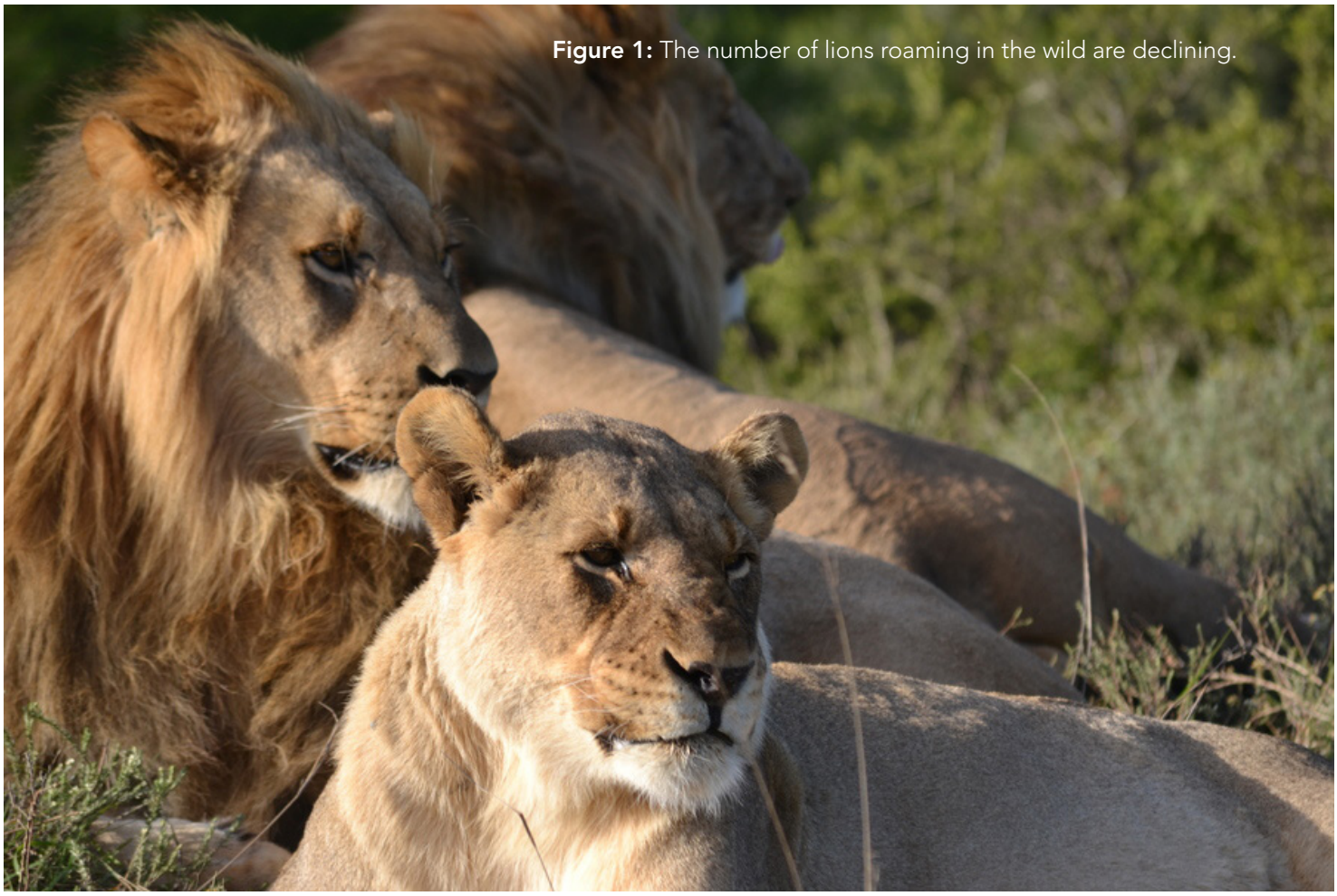


Figure 1: The number of lions roaming in the wild are declining.

in 1950. Today there are less than 25 000
- Giraffe numbers have dropped over the past 30 years by 40 % from 157 000 to 97 500 today
- Ancient trees which survived for over a thousand years such as Baobabs and Lebanese Cedars (known as the tree of god), are now dying off.

Most of us can identify with the rhino; a remnant of the dinosaur era; a charismatic and flagship species that acts as a symbol or icon of modern day conservation efforts. In many of our lifetimes two sub species of rhino (western black and northern white) have already become extinct and as South Africans we are now custodians of more than 80 % of what is left of this rhino in the World.

Can one of our fastest economic growth industries in Southern Africa – eco and nature-based tourism – survive without the rhino and lion in the wild?

Mass extinctions by definition involve a dramatic loss of biodiversity. We are one of more than thirteen million species that make up our planet. It is commonly accepted that by the year 2050 (32 years' time), over 20 % of the species that currently inhabits the earth (2 600 000 separate species), will either be extinct or on the brink of extinction.

This is due in part to the perfect storm of population growth, unsustainable resource utilization and the human impact on climate change. Another way of seeing this is that our life support system, which is everything that makes up our living ecosystem, is going to be 20 % depleted.

Can we survive as a human species in the same way that we are now, with 20 % less; and what will this mean for our everyday living and our dependency on the ecological services of nature for survival? Some will say that we as humans will find solutions to our problems through technology and innovation – the 4th Industrial Revolution is upon us – technology has advanced more in the past 15 years than the previous 200 years.

Whilst this does have an element of truth to it; what about the millions of other species we share this planet with? Can artificial intelligence; 3D printing; nano technology and virtual reality recreate eco systems and natural processes? Are we as humans prepared to take that risk of losing what we have now in the chance we may get it back later?

The sixth mass extinction is already here and the window for effective action is very short. Many experts such as Bill Laurence and Paul Ehrlich feel we have two or three decades at most. I don't want to spell out doom and gloom, far from it – but what we are all saying is that life on Earth is ultimately a zero-sum game. Humans cannot keep growing in numbers and consuming ever more land, water and natural resources and expect all to be well.

Clearly the answers to these questions cannot come from one discipline or sector alone, but are reliant on multi-sectoral collaboration and individuals; businesses and communities making a meaningful commitment to sustainable living.

We can do something about this by keeping this issue relevant and in the public domain. This call to action by all people and businesses is well illustrated in the words of the American poet William Stafford: "well, it is time for all the heroes to go home. It is time for us to give up these hopes and expectations that only breed dependency and passivity, and that do not give us solutions to the challenges we face. It is time to stop waiting for someone to save us. It is time to face the truth of our situation—that we're all in this together, that we all have a voice—and figure out how to mobilize the hearts and minds of everyone in our work places and communities."

There is hope. We can stop the sixth mass extinction if we protect approximately 50 % of what is left of each the 846 eco-regions that provide habitat for all of Earth's biodiversity. That means finding leaders and organizations around the world willing to align existing efforts around protecting and interconnecting nature in their region.

Nature Needs Half is an example of international coalitions / growing global movements of scientists, conservationists, non-profits, and public officials defending nature at the scale she needs to continue to function for the benefit of all life.

As Wilderness Foundation Global, a founding member of this movement, we've got a global ground game in place that will protect 50 % of the planet by 2050, turning the tide in favor of Earth's life support systems and transforming society's relationship with nature, one Eco region and country at a time.

The 6th Mass Extinction has been a focus area at the last 3 events of the World Economic Forum that I have attended, which illustrates the seriousness of this issue on a global stage. Let's keep the conversation alive.

Improving grassland and pasture management in temperate agriculture

Professor Athole Marshall and Dr Rosemary Collins

Current Address: IBERS, Aberystwyth University, UK

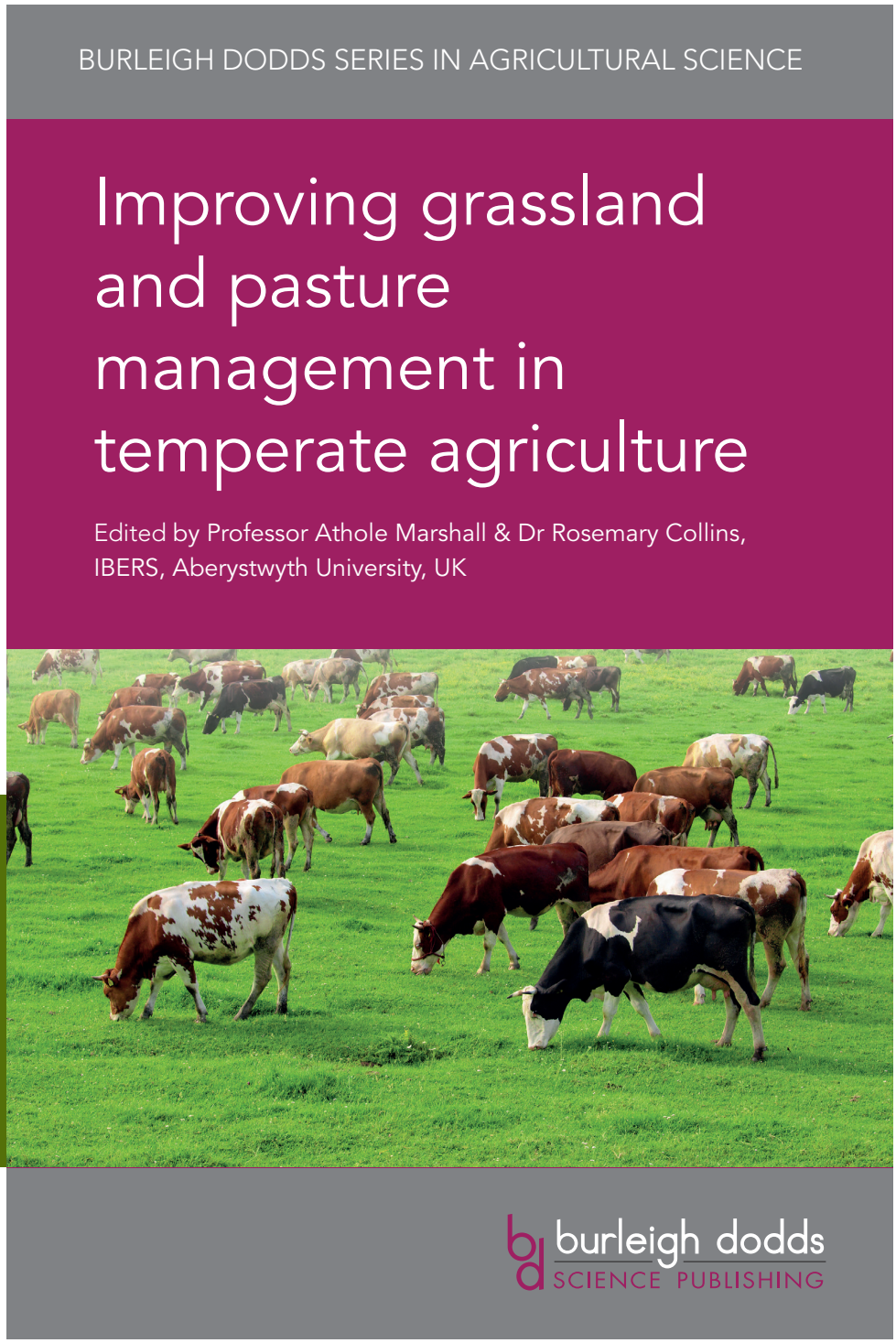
A NEW book from Burleigh Dodds Science Publishing – Improving grassland and pasture management in temperate agriculture edited by Professor Athole Marshall, Head of the internationally-renowned Public Good Planting Breeding Team at the Institute of Biological, Environmental and Rural Sciences (IBERS), Aberystwyth University, UK as well as Past President of the European Grassland Federation and Dr Rosemary Collins, Principal Investigator at IBERS focussed on developing new varieties of legumes such as clover for a more sustainable agriculture.

Full details can be found here: bit.ly/2Cy0SZm

"This book provides comprehensive coverage of the aspects of temperate grassland that are of crucial importance for the 21st Century. The Editors are renowned grassland scientists and there is a fantastic team of authors not only from Europe, but also from Australasia and North and South America. I commend this book to all serious researchers and extension specialists involved with temperate grassland."

Roger Wilkins, Emeritus Researcher, Rothamsted Research, UK; Life President, European Grassland Federation

Order your own copy with a special 20% discount online in our Bookshop (quote promotion code: EGF20) or you can use the Librarian Recommendation form at http://bdspublishing.com/library



UPCOMING EVENTS

3 - 5 October 2018

12th Fire Management Symposium to be held at George, NMU (George Campus), Southern Cape, South Africa. Contact tiaan.pool@mandela.ac.za or 044 8015024 and sonia.roets@mandela.ac.za or 044 801 5091.

15 - 19 October 2018

5-Day Veld Management Course to be held at ALUT farm, Modimolle/Nylstroom, South Africa. Visit http://www.alut.co.za/ for more information or email courses@alut.co.za or phone Frits van Oudtshoorn at 078 228 0008.

16 & 17 October 2018

9th Annual Oppenheimer De Beers Group Research Conference to be held at the De Beers Corporate Headquarters in Ormonde, Johannesburg. To attend, e-mail a completed registration form to duncan.macfadyen@oppenheimer-generations.com.

16 – 18 October 2018

AZEF (Arid Zone Ecology Forum) conference to be held at the Callie de Wet Sport Centre in Robertson, Western Cape. For more details contact AZEF secretariat Gill Murray at gill@azef.co.za or 083 609 1773. www.azef.co.za

17 October 2018

Information Day on Milk Production from Planted Pasture to be held on the Outeniqua Reseach Farm, George, by the Western Cape Department of Agriculture. For more information contact Hennie Gerber or Machelle Zeelie at 044 803 3723/7.

5 - 9 November 2018

Symposium of Contemporary Conservation Practice to be held at St. Ives, KwaZulu-Natal Midlands, South Africa. Visit www.conservationsymposium.com for more information.

22 - 27 September 2019

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

2020

CALL FOR ABSTRACTS
Joint International Grassland-International Rangeland Congress to be held in Nairobi in 2020. Information is available here: http://bit.ly/2NY3CQR

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