Grassroots

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Climate change

Prickly pear: friend or foe

COMMUNAL DAIRY PASTURE

Nitrogen pollution

Advancing Rangeland and Ecology and Pasture Management in Southern Africa

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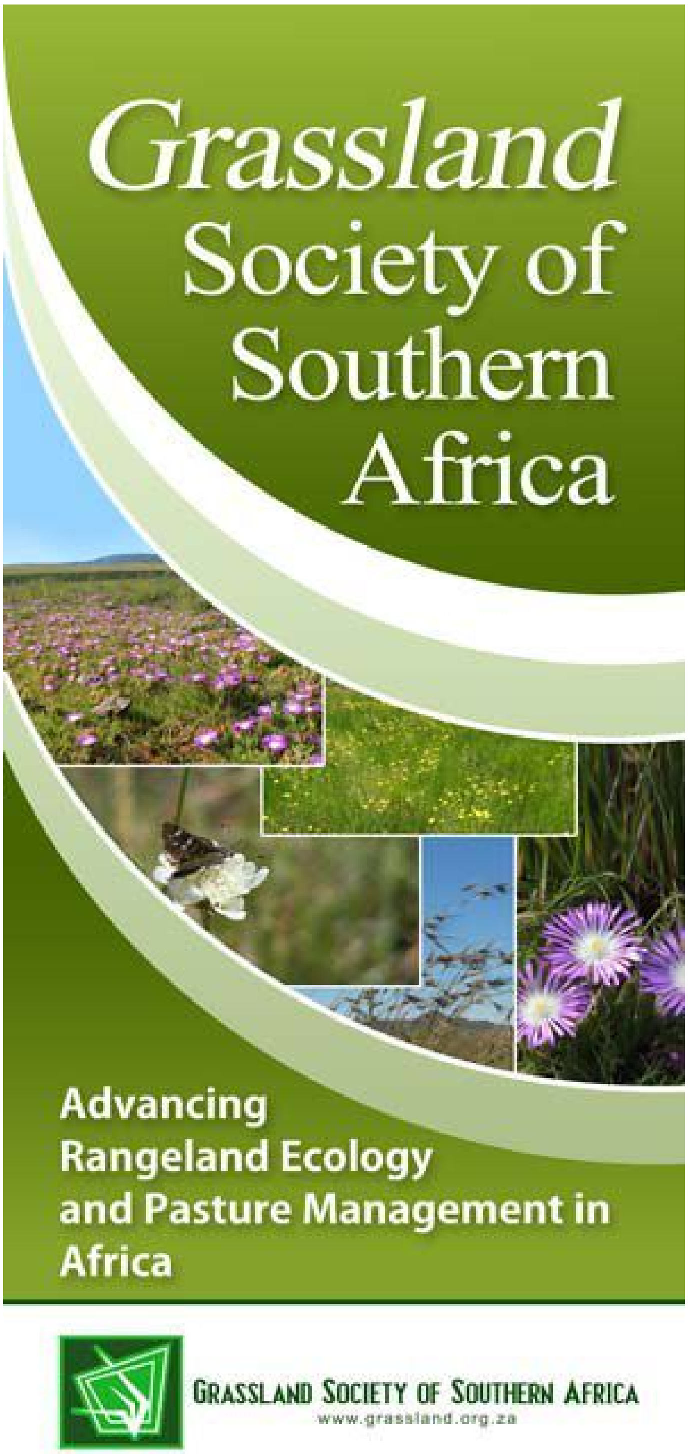

Editor's Note

It is hard to believe that it is already April. We all seem to have hit the ground running and haven't slowed down. I do hope that this year has started out well for you all.

On that note, it gives me great pleasure to welcome you to the first issue of Grassroots for 2017.

In this issue, we pay our respects to the late Bryan Mappledoram – a scientist who contributed significantly to South African agriculture during 40+ years of research and through the various leadership roles he played. Furthermore, this issue takes a look at some concerning news of the arrival of a new invasive army worm species which is creating havoc in southern Africa; the effect of water management as a climate change adaptation tool; the influence of climate change on fire activities; and much more. This issue also contains two feature articles, one relating to communal dairy pastures in the Limpopo province and the other relating to the positive side of prickly pear invasions in the rangelands of the western Free State.

The first article stresses the critical state of communal dairy pastures dominated by Increaser IIc species. The need for livestock feed supplementation and pasture improvement with resilient species cannot be ignored, while the second article highlights the surprising carbon sequestration ability of creeping prickly pear.

Remember to submit your abstracts in time for the GSSA Congress 52 which will be held at the Wits Rural Facility, near Hoedspruit/Orpen Gate on the Mpumalanga-Limpopo Border. For more detail see the information sheet at the back of this issue.

I would like to invite you to submit your news snippets, opinions, dates of important events and feature articles to *Grassroots* – we would love to hear from you all. Let's make *Grassroots* a hub of knowledge and excellence.

Thank you to those who contributed to this issue – keep those articles coming.

Happy reading!

Josef van Wyngaard

BRYAN MAPPLEDORAM

DAVE GOODENOUGH

Bryan passed away in Pretoria recently and will long be remembered for his regular attendance at GSSA congresses and for authoring or co-authoring various publications in the GSSA Journal. And much more!

Initially based at the then Natal Region's Department of Agriculture's Thabamhlope Research Station near Estcourt in KwaZulu-Natal, Bryan was actively involved in managing numerous cultivar yield trials, while also making a substantial contribution in those earlier days in an advisory and support role for those involved in Radical Veld Improvement (RVI) studies and theses. Bryan's own MSc project and thesis was on RVI, in particular improving the forage quality of veld through the introduction of cocksfoot (Dactylis glomerata) into veld.

Bryan then spent time on the Comoros where he ran a research farm and was also the Ambassador for South Africa.

With the formation of the Agricultural Research Council in the early 1990's, Bryan was transferred to the Roodeplaat Research Station where he was later to be appointed Senior Manager of various groups, including the ARC's Range and Forage Unit at Cedara where the plant breeding team was located. Those involved in this ARC Cedara Plant Breeding team in the late 1980's, the 1990's and in the years following pay tribute to Bryan's strong leadership role through his monthly visits to Cedara to view and discuss the active forage breeding projects and the release of new cultivars and breeder seed production of numerous ryegrass, tall fescue, teff, white clover, fodder radish and stooling rye cultivars. At this time RFU Cedara was also actively running cultivar trials at Cedara and co-ordinating the then National Ryegrass Evaluation Programme (NREP) at up to 10 centres throughout South Africa, and Bryan also frequently visited these NREP trials. Bryan was also actively involved with SANSOR and its members regarding new cultivar releases and trial data.

The GSSA also acknowledges Bryan's major contribution to agriculture throughout South Africa during his over 40 years of research and in his various leadership roles.

AGRICULTURE MUST ADOPT CLIMATE-SMART PRACTICES TO BETTER HELP POVERTY REDUCTION

WHAT CLIMATE CHANGE DOES IS TO BRING BACK UNCERTAINTIES FROM THE TIME WE WERE ALL HUNTER GATHERERS. WE CANNOT ASSURE ANY MORE THAT WE WILL HAVE THE HARVEST WE HAVE PLANTED.

UNITED NATIONS REPORT

http://www.un.org/apps/news/story.asp?NewsID=55316

The rapid transformation of farming and food systems to cope with a warmer world, such as adopting climate-smart practices, particularly to curb greenhouse gas emissions, is critical for hunger and poverty reduction, the United Nations agriculture agency said today in a new report.

"There is no doubt climate change affects food security," said the Director-General of the Food and Agriculture Organization (FAO), José Graziano da Silva, as he presented The State of Food and Agriculture 2016 report at the agency's headquarters in Rome.

"What climate change does is to bring back uncertainties from the time we were all hunter gatherers. We cannot assure any more that we will have the harvest we have planted," he added.

That uncertainty also translates into volatile food prices, he noted. "Everybody is paying for that, not only those suffering from droughts," Mr. Graziano da Silva said.

FAO warns that a 'business as usual' approach could put millions more people at risk of hunger, than in a future without climate change. Most affected would be populations in poor areas in sub-Saharan Africa and South and South east Asia, especially those who rely on agriculture for their livelihoods. Future food security in many countries will worsen if no action is taken today.

"The benefits of adaptation outweigh the costs of inaction by very wide margins," emphasized Mr. Graziano da Silva.

However, it is agriculture, including forestry, fisheries and livestock production, which is contributing to a warmer world by generating around a fifth of the world's greenhouse gas emissions. Therefore, agriculture must both contribute more to combating climate change while bracing to overcome its impacts, the report says.

Time for action

Without action, agriculture will continue to be a major contributor to global greenhouse gas emissions. But by adopting climate-smart practices and increasing the capacity of soils and forests to sequester carbon, emissions can be reduced while stepping up food production to feed the world's growing population, the report says.

The report provides evidence that adoption of climate-smart practices, such as the use of nitrogen-efficient and heat-tolerant crop varieties, zero-tillage and integrated soil fertility management would boost productivity and farmers' incomes. Widespread adoption of nitrogen-efficient practices alone would reduce the number of people at risk of undernourishment by more than 100 million, the report estimates.

It also identifies avenues to lower emission intensity from agriculture. Water-conserving alternatives to the flooding of rice paddies can slash methane emissions by 45 per cent, while emissions from the livestock sector can be reduced by up to 41 per cent through the adoption of more efficient practices.

"2016 should be about putting commitments into action," urged Mr. Graziano da Silva, noting the international community last year agreed to the Sustainable Development Goals (SDGs) and the Paris Agreement on climate change, which is expected to come into force early next month. Agriculture will be high on the agenda at the 22nd Conference of the Parties to the UN

Framework Convention on Climate Change (UNFCCC), known by the shorthand COP 22, in Morocco starting on 7 November.

Helping small farmers adapt to climate change risks is critical

Developing countries are home to around half a billion small farm families who produce food and other agricultural products in greatly varying agro-ecological and socio-economic conditions. Solutions have to be tailored to those conditions; there is no one-size-fits-all fix.

Helping smallholders adapt to climate change risks is critical for global poverty reduction and food security. Close attention should be paid to removing obstacles they may face and fostering an enabling environment for individual, joint and collective action, according to the report.

FAO urges policy-makers to identify and remove such barriers. These obstacles can include input subsidies that promote unsustainable farming practices, poorly aligned incentives and inadequate access to markets, credit, extension services and social protection programmes, and often disadvantage women, who make up to 43 per cent of the agricultural labour force. The report stresses that more climate finance is needed to fund developing countries' actions on climate change. International public finance for climate change adaptation and mitigation is growing and, while still relatively small, can act as a catalyst to leverage larger flows of public and private investments. More climate finance needs to flow to sustainable agriculture, fisheries and forestry to fund the large-scale transformation and the development of climate-smart food production systems.

HOW PLANTS RESPOND TO DROUGHT PROVIDES INSIGHTS INTO CLIMATE CHANGE SURVIVAL

GLOBALLY, DROUGHTS HAVE HAD A NEGATIVE IMPACT ON MANY PLANT SPECIES.

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https://theconversation.com/how-plants- respond-to- drought-provides-insights-into- climate-change- survival-44017

Globally, droughts have had a negative impact on many plant species. This has led to much higher rates of mortality than usual. Understanding how different species are likely to respond to drought is crucial to accurately predicting the impact of future climate change on plant communities.

It can be extremely challenging to find meaningful ways to describe plants' many different types of responses to drought, particularly in biodiverse areas. Scientists have been working to develop a new system in which plant functional traits can be used to assess the range of drought tolerance in diverse plant communities.

Why some plants shrivel and die and others don't

Although it may be tempting to think that drought is bad for all plant species, there is tremendous variation in their sensitivity to drought.

For several decades, plant scientists have been attempting to figure out what determines this variation. But there are no simple universal measurements of drought tolerance. Instead, scientists usually rely on long-term experimental manipulations.

The difficulty of assessing drought tolerance makes it challenging to work with large numbers of species. It is critically important that we do so, particularly within the world's biodiversity hot spots – they are incredibly important systems for the planet. They include the tropical rainforests – the lungs of the planet – and many economically significant eco systems such as South Africa's fynbos.

Trade-off between water loss and carbon uptake

A recent paper offers a solution to the challenge. It proposes using simple plant characteristics or traits to identify the different strategies that species adopt to cope with drought.

The beauty of using plant traits is that they are relatively easy to measure, and can be gathered for a large number of species. The system uses combinations of easily measured plant traits to get an index for drought tolerance in much the same way as body mass index works in humans. You can measure relatively simple traits like weight and height and combine these to determine how a person might react to stress or exercise.

To predict how different plant species respond to drought the researchers focused their trait selection on the classic water-loss versus carbon-uptake trade-off that plants face. When land plants open their stomata to allow carbon dioxide to enter the leaf for photosynthesis, they inevitably lose water. This creates a carbon-uptake-water loss trade-off, particularly under water limiting conditions.

During periods of drought plants face a dilemma – to continue to photosynthesise and risk desiccation or close the stomata to conserve water but risk starvation.

Tracking two plant traits

The scientists recognised that two plant traits would be critical to determine which side of the trade-off different species tended to err towards.

The first trait relates to how a plants' internal plumbing responds to dehydration: the ability of the xylem to withstand desiccation. Water is transported from the soil through the stem to the leaves under tension, which gets greater under drought stress.

When the plants become too dehydrated the water column breaks and air enters the stem, which blocks the vessel. This is similar in some sense to an embolism in human arteries and is potentially as fatal for a plant as it prevents them from moving sugars to where they are needed.

The second trait relates to the breathing apparatus, or stomatal response of a plant. Stomata operate like variable resistors on the leaf surface, opening and closing in response to desiccation. The sensitivity of the stomata varies between species. In some species they may be highly responsive to changes in water status and less so in others.

Scientists have known for a while that both xylem vulnerability and stomatal response varies between species. But the association between these traits and the ability of a species to survive droughts remained unclear.

The key missing element was how the xylem and stomatal responses are co-ordinated within a species. Very few studies have addressed co-ordination between stomatal regulation and xylem vulnerability and then used this to predict how likely a species is to die during drought.

Lessons offered up by Fynbos

To test the system, the authors studied fynbos communities in South Africa's Western Cape. These highly species-rich plant communities are recognised as one of the world's biodiversity hotspots and contain three major plant functional types: the familiar proteas, restios and ericas.

Different species adopted a continuum of strategies. It ranged from a risky, low safety-margin response to a more conservative approach to water loss. A key finding was that species which were more conservative and closed their stomata earlier in response to desiccation were less likely to incur xylem embolism. On the other hand, species that closed their stomata later were more likely to incur xylem embolism.

It was also possible to make predictions about how different species might die during drought. Worryingly, the study suggests that many restios and ericas appear to be particularly sensitive to drought. This may lead to shifts in the future composition of fynbos communities.

On a more positive note, the study also showed that all three familiar fynbos plant types had representative species from the full range of responses. This suggests we are less likely to see any one plant type disappear. It highlights the importance of biodiversity for landscape resilience. Having species of each functional type respond differently to drought may allow a community to be more resilient in the face of change.

MANAGING WATER IS KEY TO ADAPTING AFRICAN AGRICULTURE TO CLIMATE CHANGE

WATER AND AGRICULTURE IS HIGH ON THE AGENDA AT THIS YEAR'S CLIMATE TALKS.

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A unanimous decision on how to take action on climate change is incredibly rare. Yet, African nations have overwhelmingly included climate resilient agriculture in their indicative pledges to the United Nations. And agriculture is seen as a major focus through a common position of the African Union on climate adaptation.

Agriculture employs more than 60% of Africa's working population. But low productivity and high levels of food insecurity persist. So the inclusion of agriculture in strategies should come as no surprise. The question is: how are African nations going to move from pledges to progress?

The Moroccan government, host of this year's COP22 climate talks, is seeking the answer with the launch of the ambitious Adaptation of African Agriculture initiative. The initiative is high on the agenda. The aim is to mobilise $30 billion to make agriculture more resilient to the changing climate.

Improved water management

This is one of the three key pillars of the initiative – and for good reason. Globally, agriculture uses around 70% of freshwater supply. But water sources are increasingly under threat.

Thanks to climate change, annual rainfall in some regions of Africa – especially southern and northern Africa – is expected to decrease. Droughts will be more frequent, more intense and will last longer.

Increasing the amount of water for agriculture through water storage at all levels from field to reservoir will be a part of the solution. But existing water sources also can be managed better.

In fact, certain regions in Africa have untapped water. Take west Africa, for example, where Ghana withdraws less than 2% of the available surface and groundwater resources. Yet crops are still perishing when drought hits, and people are still going hungry.

The challenge across the region is to provide an environment that enables countries to draw on the water where needed and use it in the most effective and sustainable way possible.

Where water supplies are already under pressure, improving the productivity of water use in agriculture would make more water available for other uses.

The urban, energy and industrial sectors can also encourage productivity gains and more ustainable and climate resilient practices through benefit sharing mechanisms like the Tana Water Fund.

Investment in water storage

Farmers will increasingly need to rely on water storage as part of the adaptation agenda. It is important to increase investment in a range of water storage techniques. Such techniques include banking groundwater during the wet season, harvesting rainwater and storing water in the ground by conserving soil moisture. In countries like India and Thailand for example, scientists are making progress on capturing floodwater underground, which can then be used for irrigation. Such measures can be considered alongside more conventional surface storage systems for buffering variability, like small farm ponds and large reservoirs.

Improved soil management practices have potential to both improve the utilisation of water and increase production. They are increasingly seen as a natural way to store carbon, turning soils into a carbon sink. This can open up new funding prospects that will have multiple benefits.

Adopting water management practices to a local context is crucial. This will improve resilience by bridging the dry spells that are increasingly occurring during the rainy season and increasing or opening up the opportunity for additional dry-season agricultural production. It's also necessary to learn lessons from past projects where outcomes have not been effective.

More efficient use of water

Increasing yield per unit of water used will be critical for agricultural adaptation. New efficient irrigation technologies, like drip and sprinkler irrigation, are already showing much promise.

For example, experience from Asia has shown that – when used in conjunction with high-yielding crop varieties and good soil management practices – yields and water savings have increased by 40% in the Coimbatore District of Tamil Nadu, India.

A training programme helped farmers to improve their knowledge of how to use and maintain subsidised drip irrigation systems. It also showed them fertigation techniques, in which fertiliser is applied to crops through the irrigation system. This is a precise and efficient method that saves both time and money.

One banana farmer was able to reduce the daily duration of irrigation from three hours to as little as an hour and 45 minutes. At the same time, his yields nearly doubled. The initiative is now being scaled up across the neighbouring region and has potential in many parts of Africa.

Getting advice to farmers

Farmers, as well as decision-makers and insurance firms, need improved information and early warning systems to better respond to climate variability. In Egypt, Sudan and Ethiopia, a new SMS system is being piloted, which is delivering field-specific information and advice in local languages.

Farmers can track crop growth and water efficiency and receive daily irrigation advice. In addition, online data portals enable local advisers to monitor the status of all individual registered fields. Based on observed differences between farms, or even within a single field, advisers can spot problems and help the farmer in need.

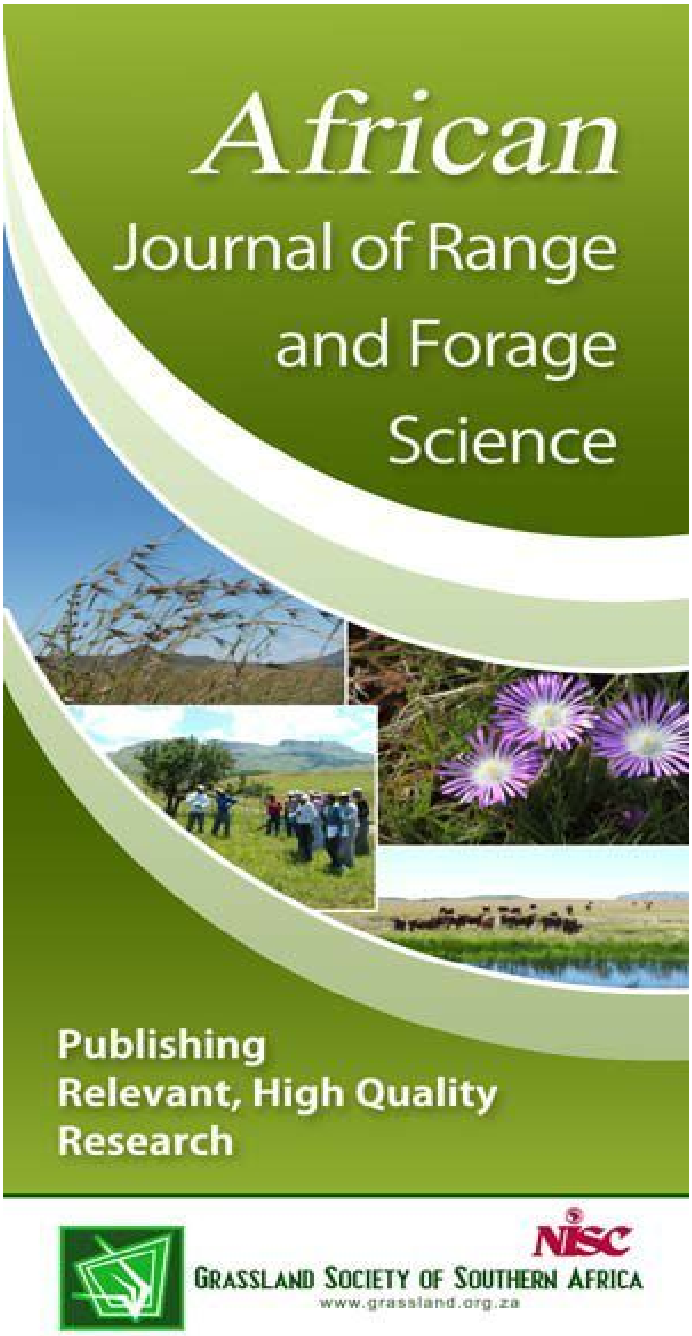
To implement these key strategies, significant funding will be required. Currently, Africa the Sustainable Development Goals related to reducing hunger, improving health and

Africa attracts only 5% of the world's climate-related funding, even though 65% of the African population is directly exposed to the efects of climate change.

By harnassing climate funding for improved agricultural water management, African nations will reap multiple rewards. These rewards will be in the form of improved resilience to extreme weather events, and a food-secure future. Both of these are central to achieving the Sustainable Development Goals related to reducing hunger, improving health and livelihoods, as well as combatting climate change.

The Morocco climate talks are a golden opportunity for making strides on the adaptation of African agriculture. African countries have made their commitment to this issue clear. They now need to be empowered with the tools and strategies for taking action.

Improved water management approaches may



COMING OF AGE: ROBOTS IN FARMS

SMRITI DANIEL - SCI DEV NET

http://www.scidev.net/global/farming/multimedia/age-robots-farming-tech.html

Robots will soon be fixtures in farms. From tracking cattle and measuring crop health to counting yields and dispensing agro-chemicals, the new technologies promise solutions to pressing farm labour shortages, yield and productivity issues as well as growing environmental concerns.

"We are starting to see more and more robots on the farm, doing farm tasks and eventually, we are going to get to the stage where you see semi-automated or even fully automated farms happening," Salah Sukkarieh, director of research and innovation at the Australian Centre for Field Robotics (ACFR), said during the Falling Walls conference (7-11 November) in Berlin.

Pointing out that leaps forward in computing power have made real time data gathering and analysis possible, Sukkarieh said farmers would now be able to make critical decisions that address the issues of an individual plant, tree or animal, rather than having to apply decisions on a whole farm or orchard.

The robots are equipped with instruments that collect hyper-spectral and multi-spectral images and infrared, thermal and laser data. This information is then fed into machine learning algorithms that enhance the robot's performance. Other tools such as precision nozzles allow them to target specific plants for the application of pesticides and fertilizers, dramatically cutting chemical use. Powered by solar panels, robots such as RIPPA are able to function for days.

This photo gallery (use the link above) explores the exciting developments in field robotics that were presented during the conference, touching on the capabilities of different robots and the information they are now able to supply farmers. Presently, the robots are still beyond the means of small farms in developing countries, admits Sukkerieh. But the ACFR, which is one of the largest robotics research institutions in the world, is hopeful that the technology will become increasingly affordable, particularly thanks to developments in 3D printing.

CONSERVATION EFFORTS MUST INCLUDE SMALL ANIMALS. AFTER ALL, THEY RUN THE WORLD

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https://theconversation.com/conservation-efforts- must-include- smal - animals- after- all-they- run-the- world-73612

Humans like to think that they rule the planet and are hard wired to do so. But our stewardship has been anything but successful. The last major extinction event, 66 million years ago, was caused by a meteorite. But the next mass extinction event, which is under way right now, is our fault.

Geologists have even given this era in the history of the Earth a new name to reflect our role: the Anthropocene, the age of humans.

It's the first time in the history of the Earth in which one species dominates all the others. These "others" numbers are probably around 10 million. The vast majority are the invertebrates, the animals without backbones. Not all are so small – some squids and jellyfish are several metres long or across.

Most, though, are small and unassuming. And they are hidden in plain view. They are busy maintaining the fabric of the world around us. They are the warp and weft of all natural systems. They make the soil, pollinate the flowers, spread seeds, and recycle valuable nutrients back into the soil. They are also food for many birds that are so loved, and keep other small animals in check by eating or parasitising them.

Yet most of us are oblivious of the many roles of these mostly small, even tiny, animals. If all their services were gone tomorrow, many plants would soon go extinct. Crops would be lost overnight. Many birds would die from lack of food, and soil formation would largely halt. The knock-on effects would also be huge as food webs collapse, and the world would quite literally fall apart.

So how can all the small animals be saved?

Saving small animals

Future generations depend on these small animals, so the focus must be on increasing awareness among the young. Research has shown that children are intrinsically interested in what a bee, cricket, butterfly or snail is. Their small world is at the same level as this small world of insects and all their allies without backbones. Yet strangely, while we care about our children, we care so little for all the small creatures on which our children depend on now and into the future.

Children must be shown that the bee is keeping the flowering plant species alive and well, the grasshopper is recycling scarce food requirements for plants, the millipede is making the soil, and the ladybug is stopping pests from eating all our food. Showing children that this miniature world is there, and that it's crucial, is probably one of the best things to do to help them survive the future in this world of turmoil.

Being aware of what the various species actually do for maintaining ecosystems is crucial to understanding how complex the world around us is. Pointing out that a bee is intimately connected with flowers and so seeds are produced, and an ant is the cleaner of the forest floor, taking away all the debris from other small animals, and the caterpillar is feeding the soil by pooing on it. Then we can conceptually jump to the whole landscape, where there are millions of little claws, mandibles and tongues holding, munching and sucking nectar all the time, even though we rarely see it happening.

Natural communities

A good way to understand this complexity is to view a small community of 1000 species. This can lead to potentially half a million interactions between the various species. Yet the natural communities around us are usually much larger than that. This makes understanding this world too mind boggling, and conserving its complexity too unwieldy. What this means is that for conservation, while we use conceptual icons, like the bee and the butterfly, the actual aim is to conserve landscapes so that all the natural processes can continue as they would without humans.

Conservationists have developed approaches and strategies that maintain all the natural processes intact in defined areas. The processes that are conserved include behavioural activities, ecological interactions and evolutionary trends. This umbrella approach is highly effective for conserving the great complexity of the natural world. This doesn't mean that particular species are overlooked.

Small-creature conservationists in reality work on and develop strategies that work at three levels. The first is at the larger scale of the landscape. The second is the medium scale of the features of the landscape, which includes features like logs, ponds, rock crevices, patches of special plants, among many others. The third is the still smaller scale of the actual species.

The third is really about a conceptual scale because some particular species actually need large spatial areas to survive. At this fine scale of species, conservationists focus attention on identified and threatened species that need special attention in their own right. The beautiful *Amatola Malachite* damselfly, which is endangered, and lives in the Eastern Cape mountains of South Africa, is a case in point.

The common thought is that it's only tigers, whales and parrots that need conserving. But there are hundreds, if not thousands, of small creatures that all need special conservation focus like bees for example. And this focus becomes increasingly and critically important every year, if not every day, that passes. It's crucial to think and conserve all these small animals that make up the platform for our future survival on the planet.

Time is short as the Anthropocene marches on. Putting in place strategies that conserve as many animals as possible, along with the rest of biodiversity, is not a luxury for the future.

New strategies are possible, especially in agricultural and forestry areas where the aim is to optimise production yet maximise on biodiversity conservation and the maintenance of natural ecosystem function.

A NEW APPROACH TO UNDERSTANDING SUBSPECIES CAN BOOST CONSERVATION

A NEW UNDERSTANDING OF SUBSPECIES, SUCH AS REICHENOW'S HELMETED GUINEAFOWL, CAN HELP CONSERVE THE BIRDS

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https://theconversation.com/a-new-approach-to-understanding-subspecies-can-boost-conservation-68364

Earth is home to an estimated 1 trillion species. To date, only about 1.2 million have been identified and described scientifically. There's good reason to increase this number. Each species could offer an adaptive, evolutionary solution to the many challenges presented by changing landscapes.

Biological species are often comprised of geographically distinct entities. These are known as subspecies, races or management units.

Taxonomists and phylogeographers armed with this information ought to be able to identify those species with multiple evolutionary "solutions" in progress. These "solutions" should then be catered for to ensure the relevant species can be effectively conserved.

But this approach hasn't been particularly successful, as the story of one giraffe species shows.

Giraffa camelopardalis has traditionally been partitioned into 11 subspecies. New research suggests it actually comprises only four morphogenetic "entities" within it that warrant conservation action.

All four should be elevated to full species status. Why? To greatly simplify the strategy that's needed for effective giraffe conservation.

A similar approach could help in developing meaningful conservation plans for many other species.

A new approach is needed

The subspecies category has been blatantly and subjectively misused to name biologically trivial entities. Historically, it was heinously abused to recognise up to 30 "races" of humans.

It's difficult to sort out the conservation "wheat" from the "chaff" when too many subspecies are defined. It diverts conservationists' attention from what's really important to maintain current diversity. It also distracts them from what is needed to cater for species' ongoing evolution.

It's time to rethink which entities are worthy "currency" for comparative biological research and conservation action. The answer might lie in evolutionarily significant units, or ESUs.

Taxonomists could then identify structured morphological and genetic variation within species. They could also highlight species' evolutionary capacities to respond to changing environments. The greater this capacity, the more species can contribute to long-term macro-biodiversity over the landscape they occupy.

We tested this approach on two species: the Helmeted Guineafowl, and the Pocket Gopher.

Conservation strategies

There are currently 31 recognised subspecies of Helmeted Guineafowl. The evolutionarily significant units approach reduced this number to nine. For the Pocket Gopher, the number dropped from 195 to three.

There are three important points of assessment in this approach.

First is the co-possession of multiple, correlated morphological characteristics and genetic markers. These suggest a common phylogeographic genealogy.

Second is the co-possession of heritable, arguably adaptive anatomical, behavioural and ecological differences. These suggest there has been constrained interbreeding between well-marked subspecies.

Third is having geographically similar distributions to those of other well-marked evolutionarily significant units and full species.

This approach has enormous potential. If it's properly applied, it could maximise the biggest evolutionary "bang" for limited conservation "bucks". It's a positive step towards focusing conservation efforts on products of past and ongoing evolution.

Conservation strategies should be directed towards maintaining the process of evolution, not just preserving its perceived products. Scientists need to understand more about how evolution in particular species has occurred. Then they can plan for those species' future survival.

HOW DUNG BEETLES ARE DUPED INTO ROLLING AND BURYING SEEDS

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Dung beetles find their food - which is dung - by pungent smell. Once found, dung beetles then roll and bury dung balls or dung pellets to later eat or to lay eggs in. But in the De Hoop Nature Reserve of the southern Cape plants called *Ceratocaryum argenteum* have managed to dupe dung beetles into rolling and burying their seeds. These seeds look and smell like dung pellets, so this is a classic case of plants deceiving animals.

Ceratocaryum argenteum is a tall grass-like plant in the Restionaceae family and is a part of sand plain fynbos. Fynbos is the local name for Cape shrub lands, a biome that regularly experiences natural fires. These seeds are the same rounded shape and brown colour as a dung pellet from local antelope like bontebok and eland. Fresh seeds are really stinky and the scent profile of the dung of these herbivores and that of the seeds is remarkably complex, yet similar.

Given the right weather conditions, such as after rain, within minutes of putting seeds out, dung beetles arrive and rapidly roll and bury the seeds. Dung beetles typically eat soft dung, mostly as developing larvae inside a dung ball but also, to a lesser degree, as adults. The hard seeds of *C. argenteum* are therefore inedible to dung beetles and thus there is no reward for the dung beetles that disperse these seeds.

Our research shows the deception is not that costly to the beetles as they do not lay eggs on the seeds. When they try to lay eggs in the hard seeds, they realise something is wrong and they leave.

Small mammals shy away

Originally, we thought that these large seeds would be dispersed and buried by small mammals in a process known as scatter-hoarding. Scatter-hoarders bury seeds and then later return to find their stash when they are hungry. Their memory is less than perfect and some buried seeds eventually escape seed predation, germinate and establish.

Two species of Cape small mammals are scatter-hoarders; the spiny mouse and the hairy footed-gerbil. But neither of these two species occurs in southern Cape sandy fynbos where *C. argenteum* grows.

Here the most common small mammal, the four-striped mouse, seems to be repelled by the seed coat. Interestingly, if the hard seed coats are cracked open, this rodent avidly consumes the inner nutritious part of the seed.

The benefit to the plant of being buried by dung beetles is very significant because large seeds do not easily get buried passively. Large seeds left on the soil surface would then be prone to incineration. This is through natural, mainly lightning-caused fires, that typically burn through fynbos about every 10 to 20 years. The seeds would also be prone to desiccation as they wait for post-fire conditions in which to germinate and establish. So burial is crucial.Dung beetles rolling and burying seeds.

Implications

This discovery has several implications. This is probably the best example globally of deception in plant seed dispersal. The only realistic previous example of deception of animal dispersers by plants, concerned red and black hard seeds, the so-called "lucky-beans". The idea was that these mimic red fleshy fruits and deceive birds into eating and dispersing them.

But often these seeds are poisonous and birds hardly ever take them. So, this is not deception but aposematism or warning colouration. Many animals use red and black colouration to warn predators that they are harmful.

The evolution of dung beetle deception in a fynbos plant implies the long term presence of dung and thus the presence of large herbivores. Fynbos is generally considered to be unpalatable and therefore that large herbivores would be absent.

In contrast, our results suggest the sustained presence of dung. It also raises the question of why dung beetle deception has not evolved in the herbivore rich savannas of Africa. I guess that this system works best in ecosystems where dung is in limited supply because the plant is so dependent on burial.

The final point regarding the significance of this work is that many novel natural history observations can still be made in the Western Cape and elsewhere. Although this is hardly big science emerging from big labs or big computers, I have been amazed at the enormous public and scientific interest this paper has had.

There certainly is large public interest in natural history and since the public often funds science, its great to have had public impact. I suspect that much of the public interest is because deception is the "dark" side of evolution, it is unexpected that plants can deceive animals. Also dung beetles are such interesting, hardworking and charismatic beasts; they attract public attention.

NITROGEN POLLUTION

THE FORGOTTEN ELEMENT OF CLIMATE CHANGE.

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https://theconversation.com/nitrogen-pollution-the-forgotten-element-of-climate-change-69348

While carbon pollution gets all the headlines for its role in climate change, nitrogen pollution is arguably a more challenging problem. Somehow we need to grow more food to feed an expanding population while minimising the problems associated with nitrogen fertiliser use.

In Europe alone, the environmental and human health costs of nitrogen pollution are estimated to be €70-320 billion per year.

Nitrogen emissions such as ammonia, nitrogen oxide and nitrous oxides contribute to particulate matter and acid rain. These cause respiratory problems and cancers for people and damage to forests and buildings.

Nitrogenous gases also play an important role in global climate change. Nitrous oxide is a particularly potent greenhouse gas as it is over 300 times more effective at trapping heat in the atmosphere than carbon dioxide.

Nitrogen from fertiliser, effluent from livestock and human sewage boost the growth of algae and cause water pollution. The estimated A$8.2 billion damage bill to the Great Barrier Reef is a reminder that our choices on land have big impacts on land, water and the air downstream.

Lost nitrogen harms farmers too, as it represents reduced potential crop growth or wasted fertiliser. This impact is most acute for smallholder farmers in developing countries, for whom nitrogen fertiliser is often the biggest cost of farming. The reduced production from the lost nitrogen can represent as much as 25% of the household income.

The solution to the nitrogen challenge will need to come from a combination of technological innovation, policy and consumer action.

The essential ingredient

Nitrogen is an essential building block for amino acids, proteins and DNA. Plant growth depends on it; animals and people get it from eating plants or other animals. Nitrogen gas (N_2) makes up 78% of the air, but it cannot be used by plants. Fertilisers are usually made from ammonia, a form of nitrogen that the plants prefer.

A century after the development of the Haber-Bosch process gave us a way to manufacture nitrogen fertiliser, our demand for it has yet to level off.

The use of nitrogen fertiliser has risen from 11 million tonnes in 1961 to 108 million tonnes in 2014. As carbon dioxide levels continue to rise in the atmosphere, some plants such as grains will also likely demand more nitrogen.

In fact, nitrogen from fertiliser now accounts for more than half the protein in the human diet. Yet some 50% of applied nitrogen is lost to the environment in water run-off from fields, animal waste and gas emissions from soil microbe metabolism.

These losses have been increasing over the decades as nitrogen fertiliser use increases.

Reactive nitrogen causes wide-ranging damage, and will cause more damage if nitrogen losses are not reined in.

Faced with a growing population and changing climate, we need more than ever to optimise the use of nitrogen and minimise the losses.

From farm to fork

One way to understand our nitrogen use is to look at our nitrogen footprint – the amount of nitrogen pollution released to the environment from food, housing, transportation and goods and services.

Research by University of Melbourne PhD candidate Emma Liang shows Australia has a large nitrogen footprint. At 47kg of nitrogen per person each year, Australia is far ahead of the US, which came in with 28kg of nitrogen per person.

A high-animal-protein diet appears to be driving Australia's big nitrogen footprint. The consumption of animal products accounts for 82% of the Australian food nitrogen footprint.

Animal products carry high nitrogen costs compared to vegetable products. Both products start with the same cost in nitrogen as a result of growing a crop, but significant further losses occur as the animal consumes food throughout its life cycle.

The N-Footprint project aims to help individuals and institutions calculate their nitrogen footprints. It shows how we can each have an impact on nitrogen pollution through our everyday choices.

We can choose to eat lower nitrogen footprint protein diets, such as vegetables, chicken and seafood instead of beef and lamb. We can choose to reduce food waste by buying smaller quantities (and more frequently if necessary) and composting food waste. The good news is, if we reduce our nitrogen footprint, we also reduce our carbon footprint.

Back to the farm

In the meantime, efforts to use nitrogen more efficiently on farms must continue. We are getting better at understanding nitrogen losses from soil through micrometerological techniques.

From sitting in the sun with plastic bucket chambers, glass vials and syringes, scientists now use tall towers and lasers to detect small changes in gas concentrations over large areas and send the results directly to our computers.

We now know nitrification (when ammonia is converted to nitrate) is an important contributor to nitrogen losses and therefore climate change and damage to ecosystems. It is a process researchers – and farmers – are targeting to reduce nitrogen losses.

Nitrification inhibitors are now used commercially to keep nitrogen in the ammonium form, which plants prefer, and to prevent the accumulation of nitrate, which is more easily lost to the environment.

As this technology advances, we are starting to answer the question of how these inhibitors affect the microbial communities that maintain the health of our soil and form the foundation of ecosystems

.

For example, our research shows that 3,4-dimethylpyrazole phosphate (better known as DMPP) inhibits nitrification without affecting soil microbial community diversity.

There have also been exciting observations that the root systems of some tropical grasses inhibit nitrification. This opens up a management option to slow nitrification rates in the environment using genetic approaches.

Solving the challenge of nitrogen use will require research into more efficient ways for primary producers to use nitrogen, but it will also need government leadership and consumer choices to waste less or eat more plant protein. These tools will make the case for change clearer, and the task of feeding the world greener.

HOW FARMERS IN AFRICA ARE FINDING WAYS TO SUSTAINABLY USE WETLANDS

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-element-of-climate-change-69348

Swamps, marshes, floodplains and mangrove forests, all known as wetlands, are a precious resource. In their natural state they provide a range of eco-system services. They regulate water flows, store eroded materials and nutrients and provide water, food and raw materials. Wetlands are defined as areas that are subject to seasonal or permanent flooding up to a depth of 6m.

Throughout history, the general trend has been to convert wetlands from their natural state to allow other more intensive uses. In some parts of the world this has involved the creation of rice paddies, sugar estates or even fish farms. In Europe, North America, Australia and New Zealand more than 50% of wetlands were converted to other uses during the 20th century by controlled flooding and drainage. Mostly they were used for intensive farming and urban development.

In recent decades, particularly in Africa, wetlands have become a new agricultural frontier. In response, a number of agencies are trying to explore sustainable wetland management as a way of reducing rural poverty, improving food security and strengthening livelihood resilience in the face of climate change.

Wetlands as a buffer against disaster

World Wetland Day is marked ever year as part of an effort to highlight their importance and value. This year, the focus is on the vital role of healthy wetlands in reducing the impact of extreme events such as floods, droughts and cyclones on communities and in helping to build resilience.

The best known example of wetlands for disaster risk reduction is probably the mangrove swamps in the tropics. On the east and west coasts of Africa these areas provide a buffer against storm surges, cyclones and tsunamis, as well as providing breeding grounds for fish and storage of carbon.

There are also several examples in sub-Saharan Africa of wetland use which can help reduce disasters and improve resilience. For example, the small-scale cultivation of inland wetlands, such as the bas fonds in West Africa or dambos in southern Africa. These play an important role in helping communities survive during the long dry season and avoid seasonal hunger. In this way disaster risks are reduced.

Wetlands are also feeding towns and generating income, as well as savings, for farmers. They can use this extra cash to develop their farms and diversify their enterprises. In Mpika, northern Zambia, some successful wetland farmers have developed retail and house rental enterprises, whilst others have used their newly accumulated capital for trading in grain.

In Europe, flood control and water management agencies are now re-discovering the natural role of floodplains in reducing flood levels. In the Netherlands, for example, the government is negotiating with farmers to allow farmland to be flooded to reduce the height of floods and the threats to settlements.

Managing wetlands better

In Africa, a range of organisations, from community groups to international agencies have recognised the way in which wetlands can be important for poverty reduction, livelihood security and resilience in the face of climate change. A number of initiatives are underway to explore how wetlands can be managed sustainably.

One example is the Striking a Balance project in Zambia and Malawi. In many parts of both countries farmers are heavily dependent on wetlands. Research shows that in three sites in Simlemba, central Malawi, 88% of farmers use wetlands for more than water collection. Their other activities, primarily cultivation but also reed collection, derived from wetlands account for 37% of their domestically consumed food and generate 55% of their cash income.

But with growing rural populations, the degradation of upland fields due to prolonged farming, and climate change wetlands are under increasing pressure as farmers seek out fertile and moist sites. However, the increased flows of water from degraded uplands into the wetlands and the disturbance of natural vegetation by cultivation in the wetlands threatens erosion and damage to these valuable sites.

During the project, farmers analysed the risks they faced in relying so heavily on wetlands and identified measures they could take to make wetland use more sustainable and productive. These included:

- adjusting cultivation sites to the water table at different times of the year, using raised bed as the flood declines and depression beds in the driest times when the water table is lowest
- using compost to improve soil structure and mulching with plant residues between plants to reduce water loss in the hottest time of the dry season, and
- not cultivating in the middle of wetlands which can encourage gulley formation during the flood season.

Farmers also realised that the wetlands depended on well-managed catchment areas. Measures were identified to improve upland management. These included improving land use through using soil and water conservation measures, inter-planting crops with agro-forestry trees, and maintaining areas of natural vegetation all of which facilitate water infiltration. This water percolates through to the wetlands several months later.

This landscape approach pioneered by Striking a Balance is being explored in other locations across Africa to build resilience in the face of climate change.

For example, in West Africa, the inter-governmental Africa Rice Center is working to develop community planned and managed wetland use. It's estimated that transforming just 10% of wetlands can provide food security for the region through rice cultivation. The rest of the wetlands can be left in a natural state to stabilise flows and reduce flooding and erosion in the cultivated areas.

Managing wetlands more effectively and efficiently in Africa is inextricably linked to improving people's livelihoods and their resilience in the face of disasters. The way to progress this, is to empower communities to manage wetlands themselves, using their local knowledge and building institutions to develop and apply practices for productive use.

Opuntia humifusa (Credit: Justin du Toit)

PRICKLY PEAR CARPETS, GRASSES AND SHRUBS OF THE WESTERN FREE STATE RANGELANDS

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Abstract

Nutrient harvesting by ruminants grazing rangelands is threatened by droughts, poor management and alien species. The objectives of the study were to determine nutrient composition and carbon sequestration in the degraded semi-arid rangeland of the South-western Free State. Approximately 420 ha of rangeland grazed by beef cattle was stratified into blocks based on *Opuntia humifusa* (creeping prickly pear) density as either low density (LD) with <2 cacti colonies/plot, moderate density (MD) with 3–20 cacti colonies/plot and high density (HD) with >20 cacti colonies/plot. Species abundance and composition were determined mid-summerusing the line transect method, point survey method and random quadrat surveys. *Themeda triandr*a (red grass) was present in low proportions in both LD and MD, but absent in HD. Unpalatable shrubs, disturbance indicators and intermediate grasses dominated in the HD zone. The crude protein (CP), fat, calcium and phosphorus content of flowering herbaceous forages were low. The CP content of *Walafrida geniculata* and *Felicia muricata* were 132 and 100 g/kg dry matter DM, respectively. The nutrient composition of both Increaser and Decreaser species was low, which indicated that both forage quality and quantity limited performance of ruminants grazing the south-western Free State rangelands. The results suggested that supplementary feeding should be the norm throughout the year, but such a practice is likely to put pressure on the system and make it unsustainable. High levels of carbon sequestration by the prickly pear suggest that the creeper has a more important ecological function and should not only be viewed as a threat as the sinking of C influences soil organic matter and micro fauna, and could influence veld recovery positively.

Introduction

Rangeland degradation is widespread in Southern Africa and affects plant species diversity and nutrient yield, allowing opportunistic species to invade and dominate. *Opuntia spp*. (prickly pear) is one of the fastest invaders in semi-arid regions of the western Free State, owing to its high metabolic efficiency for space, water and nutrient utilisation. As crassulacean acid metabolism (CAM) species dominate, nutrient deficiencies are exacerbated. Unpalatable dwarf shrubs and large colonies of Opuntia are progressively dominating the landscape. A shift in species composition alters carbon sequestration and nutrient supply. Although the South African National Biodiversity Institute (SANBI) monitors ecological and vegetation shifts of the South African biomes, components such as fluctuations in forage quality and carbon sequestration on rangelands colonized by succulents are limited. Effects of invasive succulents on carbon stocks and soil organic matter accumulation should be recognized in view of low soil organic matter content and the vulnerability of semi-arid areas to climate change reflected in fluctuating rainfall data. *O. humifus*a is a single species without variety and grows in clumps up to 10 cm in height (Abella and Jaeger 2004). It propagates through vegetative means and seed, reaching maturity at 6 to 8 years (Abella and Jaeger 2004).

The shallow root system and epidermis that repels water and reflects sun light, increases water utilization efficiency (Potter et al. 1984; Tegegne 2001) In temperate climates flowering occurs from May to July, however in warm Karoo climate flowering is year-round (Wunderlin 1998).

O. humifusa may colonize the terrain through animal excretion and detached cladodes. It is fair to say *O. humifusa* is completely naturalized under Nama Karoo climatic conditions. In poorly managed rangelands and during periods of drought, when the rangeland reaches its nutritional bottleneck, *O. humifusa* becomes an alternative feed source (Figure 1 and 2). The cladodes can have a CP content as high as 100 g/kg of DM, however the plant have glochids on the stems which causes severe blisters inside the mouth of livestock which could be fatal.

The aim of the study was to determine the distribution and nutritive value of palatable grasses and shrubs and estimate carbon sequestration in a semi-arid rangeland dominated by *O. humifusa.*

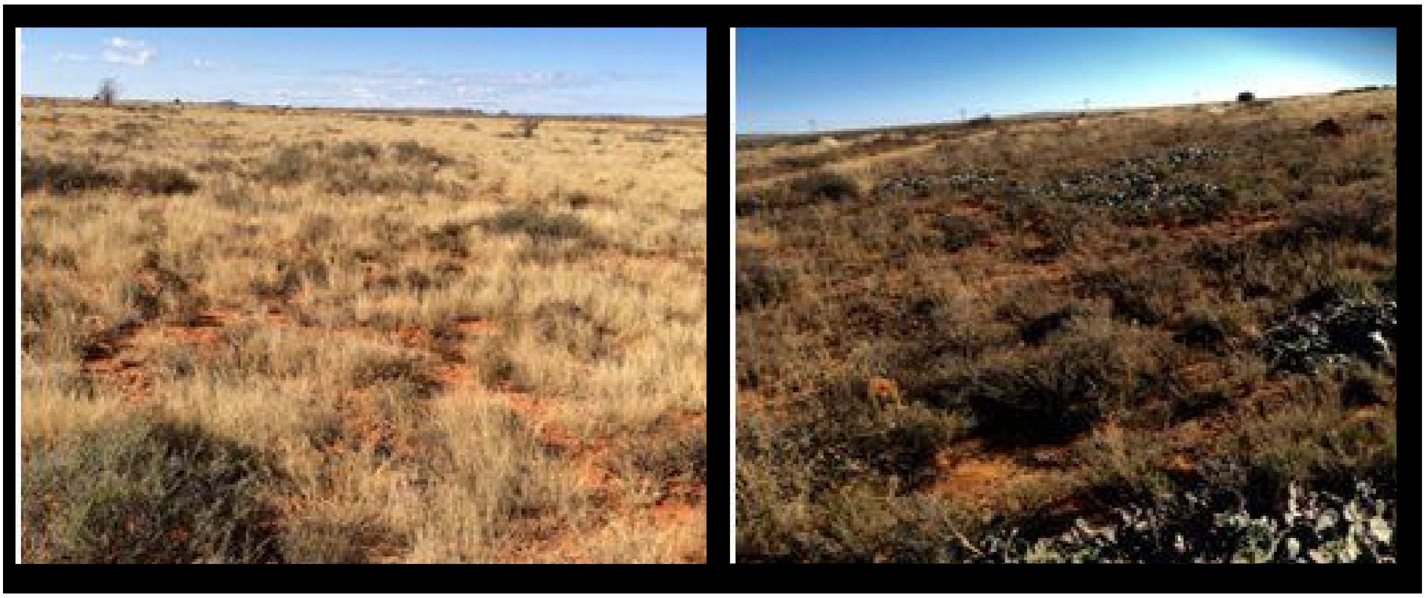

Figure 1 and 2: Grazing area invaded by *O. humifusa* dominated by chaemophytes and non-invaded area dominated by hemicryptophytes.

Materials and methods

A rangeland of 420 ha under continuous grazing by beef herds was selected (29°16′59″S; 24° 59′1″E). In 1980 the grazing capacity (GC) of the rangeland was reported to be 15 ha/LSU, whilst the most recent GC, following a continuous grazing regime for the last 30 years, is reported to be 17 ha/LSU. Within this area, *O. humifusa* colonies dominate the landscape, with large colonies of 3-5 m in diameter present in the south western region (120 ha) and density rogressively declining eastward. Twelve plots (25 m x 25 m) were marked and *O. humifusa* population was assessed by counting large colonies within each plot. Following counting, plots were defined as either low density (LD) with <2 cacti colonies/plot, moderate density (MD) with 3–20 cacti colonies/plot and high density (HD) with >20 cacti colonies/plot. Three plots at each density were then selected for assessment. The following model by Curt et al. (2011) was fitted to estimate cactus biomass weight in the nine plots: dry weight = 0.0345 x L (cm) x W (cm) x D (cm). Carbon stock was determined with the following model assumption: cactus carbon is 10% of dry matter (DM). Samples of *O. humifusa* leaves (new and mature) were collected from all plants for organic matter determination.

Species abundance was determined in the nine plots along a 5 m transect using 1 m x 1 m quadrat after every 5 m (du Toit 2011). Transect lines were placed every 5 m within each 25 m x 25 m plot. Herbage samples were collected for all species within each quadrat. Samples of palatable, intermediate grasses and palatable shrubs, as described by Fouche *et al.* (2014) were pooled for every five consecutive quadrats and sub-sampled for analysis of CP, fat, neutral detergent fibre (NDF), Ca and P. Samples were dried in a conventional oven at 65 °C for 72 h and milled through a 1-mm screen. Sub-samples were dried in a conventional oven at 100 °C for 24 h DM (AOAC 1995; method 930.15). Neutral detergent fiber (NDF) was determined using the ANKOM A200 . Filter Bag Technique (FBT) (ANKOM Technology Corp, Macedon, NY) (Van Soest et al. 1991). All assessments were done during mid-summer of 2015. Characterisation of plant species was done using descriptive procedures in SAS (2013). Chemical composition was reported as means and standard deviations and data on carbon stocks and sequestration was subjected to one-way analysis of variance using SAS (2013) procedures.

Results and discussion

Species abundance

The veld in this study falls within the Koffiefontein rangeland described by Acocks (1953) as False Arid Nama Karoo veld type. This is a rangeland in gradual transition to most neighbouring types, which consist of predominately savannah and the grassland biomes.

There were no palatable grasses in HD, whereas *Themeda triandra* and *Schmiditia pappophoroides* constituted 4% in MD and 18% in LD. Proportions of intermediate grasses varied (P< 0.01) across all densities. Intermediate grasses (mostly *Eragrostis* and *Heteropogon* spp.) and disturbance indicators *(Aristida, Chloris virgata and Cynodon spp.*) constituted 10 and 22% in HD, 18 and 35% in MD and 24 and 46% in LD, respectively. Most common intermediate grasses included *E. chloromelas, E. obtuse, E. superba, H. contortus, E. lehmanniana, and E. Trichophora*, which are important forage sources in overgrazed pastures. Disturbance indicators were *A. adscensionis, A. congesta, A. stipatata, C. virgata, C. hirstus, C. dactylon* and palatable shrubs included mostly *Felicia muricata and Walafrida geniculata.* Unpalatable shrubs such as *Pentzia calcarea, P. globosa, Zygophyllum incrustatum, Pteronia tricephala, Chrysocoma ciliata, W. saxitilis, Thysium hystrix, Gnidia tricephala, Asaparagus spp., Euryops asaparagoides, Lycium spp.* were noted. *Pentzia calcarea* and *P. globosa* dominated in both the MD and HD zones, with 15, 45 and 55 plants/plot in the LD, MD and HD zones, respectively. Plant species identified are within the important taxa identified by Acocks (1953, 1988). However, the high shrub density reported in this study, in the heavily invaded *O. humifusa* zones (HD) also echoed findings by Acocks (1953) who indicated that there was shrub invasion in the Nama Karoo biome and attributed the phenomena to heavy grazing. In the current study, shrub dominance in HD had a strong and positive correlation (r = 0.8) with abundance of *O. humifusa*. Heavy grazing and alien invasive species can all be factored as disturbance regimes lamented by Acocks (1953). The Koffiefontein rangeland that is not invaded, low in *O. humifusa* densities and in some areas that has moderate *O. humifusa* densities, is in transition toward grassland biome. Low and Rebelo (1996) described this state of rangeland in Fake Arid Karoo as "dry facies of grassland biome". Mucina et al. (2006) noted that Nama karoo and Karoo like biomes had chaemophytes and hemicryptophytes as the most co-dominant forms of life. However, in the Koffiefontein rangelands the presence of succulent invasive alien species offsets the report and findings of Mucina *et al.* (2006).

Grass and shrub nutritive values

Table 1 presents mid-summer chemical composition of common grass and shrubs in Koffiefontein. Rangeland grasses in our study were lower in nutrients compared with nutritive with nutritive value reported by other researchers in the same area (Boyazoglu, 1973). Crude protein (CP) of grasses was low, fairly below 70 to 80 g/kg of DM required for rumen microbial growth (Van Soest, 1994). Neutral detergent fibre was 67.8 to 83.1% of DM in grasses and below 65% in shrubs. Crude protein of palatable shrubs was 132 g/kg of DM (*W. geniculata*) and 100 g/kg for *F. muricata*. The chemical composition of grasses and shrubs in the Koffiefontein rangeland is of critical concern. Milford and Minson (1968) reported a reduced feed intake in sheep when fed a 7% CP diet, further more Sollenberger and Vanzant (2011) noted that forages of low nutritional quality affected daily gain. Diets lower than 1.5% nitrogen are deficient in amino acids and affect appetite. Humphreys (1972) observed that protein deficiency was common in tropical native grasses due primarily to poor soil fertility. Ali *et al.* (2011) reported a range of 1.7 to 5% CP in cultivated tropical grasses *(Cenchrus ciliaris, Panicum antidotale, Penisetum purpureum and E. superba*) and Norton (1982) reported P and Ca concentrations of 0.22% and 0.4%, respectively. Grasses mature early and protein content rapidly declines with plant growth (Heuzé 2017), as structural carbohydrates increase and become lignified (Van Soest 1994). The high NDF content of grasses is associated with bulk and increased rumen fill. Animals grazing forages high in NDF are therefore limited bygut fill, small ruminants have a limit of approximately 3% of body weight daily. Mynhardt *et al.* (2016) reported that poor quality forages do not stimulate optimum rumen fermentation. Grass quality was very poor at the end of summer, which necessitates extended supplementation to sustain grazing herds. Unfortunately, such feeding regimes can be unsustainable within extensive livestock production systems that have inherently low offtakes. Supplementation is typical during dry seasons, when forage supply is low and nutrient levels are low. The limited choice in forage species entails that grazers may have to shift to alien cacti species and adapt to glochids, which could cause gut injuries and ultimately mortalities.

Carbon sequestration

Within the current study, the diameter of *O. humifusa* colonies ranged from 100 to180 cm, height was 25 to 35 cm and thickness of the padswas between 0.5 and 1.0 cm. In HD, carbon sequestration was higher (10.1 ± 2.3 g/plant) (plant) ($P< 0.001$) than in MD (3.0± 2.3 g) and LD (0.8 ± 0.43 g). Likewise, total carbon stocks were the highest ($P< 0.0001$) for HD (1050 ± 122 g carbon) compared with MD (199±87 g carbon) and LD (24±16 g carbon).

Species mortality and the decline in proportions of ephemerals, geophytes, C3 and C4 grasses and chamaephytes are high in overgrazed rangelands and alien invasive species such as *O. humifusa* are common. Although *Opuntia spp.* seems to be the major challenge in this rangeland, it is important to review other ecological attributes of the species. The high levels of carbon sequestration and coverage of bare areas by large colonies will influence soil fertility.

Conclusion

The low occurrence of palatable grasses and pioneers, and the dominance of karoid shrubs, indicated that the veld was in subclimax ad in transition. Rangeland restoration occurs over long periods when there are no interventions, in severely degraded areas such as the Koffiefontein rangeland, human intervention is essential. There is evidence that invasive species have a negative impact on rangeland productivity. It is however, essential to assess how invasive species influence other ecological components such as micro-climates, soil organic matter and fauna. This highlights the need to improve carrying capacity of natural veld.

Acknowledgement

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Table 1: Mean (±SD) nutrient composition (g/kg of DM) of most abundant grasses and shrubs in Nama Karoo rangeland

Plant Species class	Plant species	Crude protein	Fat	NDF	Calcium	Phosphorus
Palatable grasses	*T. triandra*	22.3 ± 0.5	9.1 ± 1	753 ± 36.4	3.0 ± 0.6	0.3 ± 0.06
Intermediate grasses	*E. obtusa*	31.4 ± 0.5	9.0 ± 0.6	776 ± 23.2	2.0 ± 0.6	0.4 ± 0.21
	E. lehmanniana	32.2 ± 1.3	6.8 ± 1.3	789 ± 17.4	3.0 ± 0.6	0.7 ± 0.2
	H. contortus	31.3 ± 0.7	15.0 ± 2.3	812 ± 34.5	2.9 ± 0.6	0.7 ± 0.18
	E. chloromelas	29.1 ± 0.4	7.3 ± 0.8	723 ± 49.6	3.9 ± 1.0	0.8 ± 0.5
	E. trichophora	26.1 ± 0.5	8.9 ± 0.6	752 ± 24.3	2.8 ± 0.6	0.3 ± 0.15
Disturbance indicators	*A. congesta*	20.3 ± 0.6	7.3 ± 3.4	831 ± 38.4	3.1 ± 0.6	0.2 ± 0.05
	Cynodonspp	30.9 ± 0.6	20 ± 4.9	678 ± 41.3	3.0 ± 0.6	0.3 ± 0.06
	A. adscensionis	22.0 ± 0.6	12.2 ± 1.9	811 ± 26.1	1.7 ± 0.5	0.6 ± 0.15
Palatable shrubs	*W.geniculata*	132.3 ± 4.8	19.5 ± 2.1	643 ± 16.4	8.5 ± 1.0	1.6 ± 0.15
	F. muricata	100.0 ±5.2	16.0 ± 0.5	574 ± 13.5	8.1 ± 1.0	0.8 ± 0.4

SD – standard deviation

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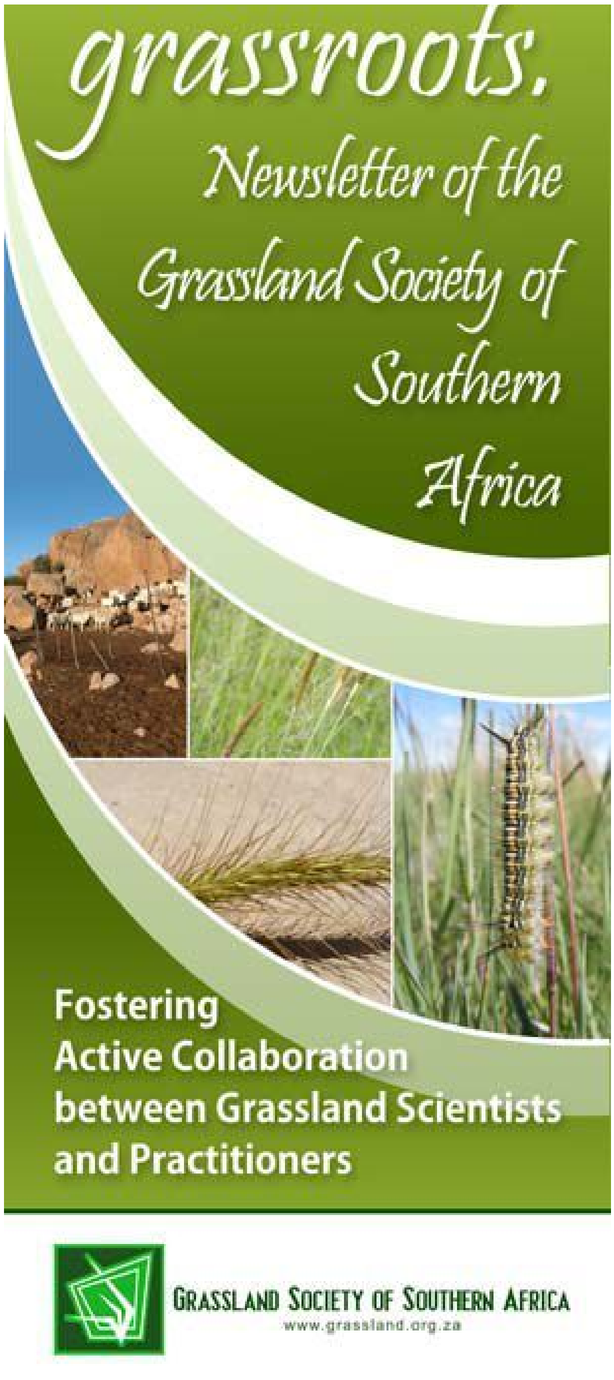

DAIRY CATTLE NUTRITION ON SEKHUKHUNE COMMUNAL AREA PASTURES

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Abstract

Increasingly human population and climate change threaten rural livelihoods in semi-arid rangelands of south-eastern Limpopo province. As the human population increases, so does the stock numbers, and additional pressure from exotic dairy breeds could exacerbate loss of palatable annual species. The reverse is true that introduction of exotic breeds could alleviate grazing pressure as farmers are shifting to dryland forage banks in support of the exotic breeds, the indigenous animals benefit peripherally from residue forage and seed dispersal.

The objective of the study was to characterize grass species composition in a communal area rangeland, evaluate forage nutrient supply and performance of grazing dairy cattle. The communal grazing areas are degraded – with a very low proportion of palatable grasses and indigenous herbaceous legumes were insignificant. *Aristida congesta* dominated, *Cyanodon dactlyon* and *Eragrostis lehmannian*a were relatively abundant and bare patches were notable. Body condition score (BCS) of primiparous dairy cows grazing the communal area pasture was low; at calving BCS ranging between 2.0 and 2.5 at calving and remained low through early lactation. Milk yield averaged 8.9 L/cow/day at peak and milk urea nitrogen was between 9.0 and 18 mg/dL. Sekhukhune communal area pastures are severely degraded and hence animal performance is mostly affected by low nutrientsupply. Alternative forage diets are critical to improve nutrient utilization and performance of dairy cattle grazing communal area pastures in Sekhukhune district.

Introduction

The Sekhukhune communal area grazing lands are degraded. Ecological shifts associated with grazing pressure and climate change are natural phenomena that influence livestock turnover on natural pastures. Recent introduction of small sized dairy breeds such as the Jersey,on communal area pastures, will certainly increase grazing pressure on the fragile ecosystems. Tainton (1999) described Sekhukhune district as eastern mid-bushveld with carrying capacity of 6–15 LSU/ha, with increaser grasses *(Heteropogon contortus* and *Eragrostis lehmaniana* and *Hyparrhenia hirta)* dominating the pastures. However, communal area management of grazing lands is a complex matter influenced by land tenure, population growth, resource availability, urbanization of rural areas and climate change among others. The Forest and Veld Conservation Act (Act 13 of 1941), the Conservation of Agricultural Resources Act, (Act 43 of 1983) and the National Grazing Strategy (1985) are critical policy instruments to achieve and sustain the management of communal area resources. The objective of the study was to characterise grass species composition and performance of dairy cattle foraging on natural pastures in Sekhukhune district.

Materials and methods

Natural pasture assessment and performance of grazing dairy herds

Species identification and abundance were determined in three natural pastures shared among three communal area wards of Makhuduthamaga municipality. Large herds of indigenous cattle, sheep, goats and a small herd of Jersey cattle (less than 100) continuously graze the pasture. Veld assessment was done in April 2016. The transect line method (Tidmarshand Havenga 1955) was used. Nine plots of 100 m^2 were selected. Two transects of 100 m and 5 m apart were marked within each plot. The wheel point method (Roux 1963) was used to determine species presence.

Performance of 22 primiparous Jersey cows that calved between November and December 2015 were selected for the monitoring study. Cows averaged 2.5 years old at first calving and were offered between 4 and 6 kg of dairy concentrate per animal daily depending on production level. The feed was divided into AM and PM portions. Hand milking of cows was done once in the morning. Milk yield was recorded daily for 10 weeks. Separation of calves and dams was done overnight. Cows grazed communal lands with other ruminant livestock herds during the day. Body weight, body condition score, blood glucose and milk urea nitrogen were assessed from calving to three months. All data was characterized using descriptive procedures in SAS (2013).

Results and discussion

Grass species

Figure 1 illustrates the composition of grasses in a communal area pasture in Sekhukhune district. Decreaser species were low (3.1%), Increaser grasses IIa and IIb represented 38.2%, Increaser IIc represented 40.3%, forbs were low (4.5%), and indigenous legumes (1.9%) were insignificant (Figure 1). There are five classes of grasses: decreaser/reducers, increaser I, increaser II, increaser III and invader species. The insignificant presence of Decreaser species is due to their very sensitivity to poor veld management such as the over-grazed conditions of the communal lands in the area (Acocks 1988; Palmer and Ainsle 2005). *Digitaria eriantha* (common finger grass), *Schmiditia pappophoroides, Brachiaria nigropedat*a (black footed signal grass), and *Themeda triandra (*red grass) are common palatable species in southern Africa. Isolated plants of *Themeda* were detected but proportionally insignificant to other palatable species. Increaser I grasses proliferate when the veld is under-utilized and increaser IIa have a higher presence in lightly overgrazed areas. Increaser IIb and IIc dominate overgrazed pastures. *Aristida congesta var. congesta* (tassel awn grass) is an increaser IIc species. It was the most dominant species, followed by *Cynodon dactylon* (couch grass) and *Eragrostis lehmanniana.* The later grasses are palatable. *Hyparrhenia hirta* (thatching grass) was sparsely distributed. Animals graze *Hyparrhenia* when the grass is immature but it rapidly lignifies with maturity. Other species reported include *Heteropogon contortus* (Increaser IIa), *Bothriochloa insculpta, Aristida adscensionis, Senecio microglossus, Eragrostis gummiflua* and *Elionurus muticus.* Van Wyk (2001), Siebert et al. (2002) and Victor et al. (2005) reported that Sekhukhune land was degraded, but had pockets of undisturbed areas with diverse grass species. Golluscio and Sala (1993) reported that retrogressive succession occurs in overgrazed areas; fewer species become dominant and provide ecosystem services. The most dominant species, *A. congest*a (Figure 1) is hardy, grows on poor soils and is of poor value to livestock. Ellery et al. (1995) and Cowling and Richardson (1997) noted that excessive overgrazing affects species

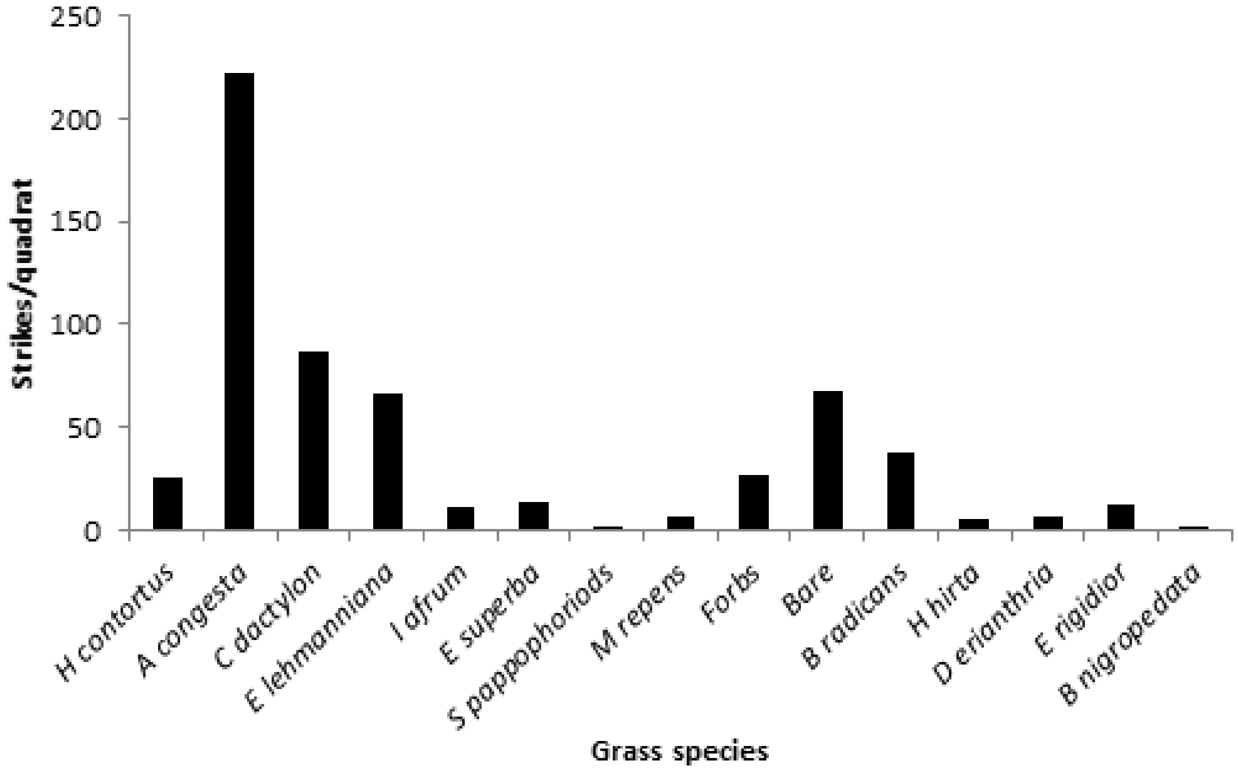

Figure 1: Species composition in Makhuduthamaga communal grazing lands of Sekhukhune district

composition.

Clearly, poor veld condition was the first limiting factor to animal performance in Sekhukhune communal areas. The south-eastern region of Sekhukhune district hosts the large herds of beef cattle (52 000 – 55 000), sheep (11 000 – 12 000), and goats (40 000 – 45 000) on natural pasture. Dairy cattle are few but add to grazing pressure on degraded communal lands. Dairy cattle farming is a relatively new venture in Limpopo communal areas. The communal area dairy businesses are facilitated projects "the village dairy value chain" aligned to South Africa's national strategic goals of food and income security, transformation of the dairy milk industry and rural economic and industrial development. The communal area pastures (mostly grass) and crop residues provide roughage for dairy cattle but constitute the sole diets of beef cattle and small ruminants. Dairy cattle are preferential supplemented though at low levels to stimulate milk production. Supplementation is however, dependent on resource availability.

Dairy cattle performance

Body condition score (BCS) of the primiparous dairy cows in Sekhukhune ranged between 2.0 (thin cow) and 2.5 (moderate) at calving (Figure 2), which indicates inadequate nutrition in late pregnancy. Approximately 50% of the cows were thin during the first month of calving. The lactation profiles were flat with a mean daily milk yield of 8.9 L/cow, as also noted by Grobler et al. (2008). Early lactation MUN ranged between 9.0 and 18 mg/dL, most cows were above 14 mg/dL. Milk response to concentrate feed was however, favourable (1.6 L/kg) given this was an extensive grazing system.

Low BCSs are normal in early lactation as cows have a higher nutrient demand for milk production but lower feed intake due to gut limitations associated with high foetal growth in late pregnancy. Bauman and Currie (1980) stated that it is normal for dairy cows to mobilize adipose tissue in early lactation because energy demand for milk production exceeds supply. High milk producing cows can tolerate energy

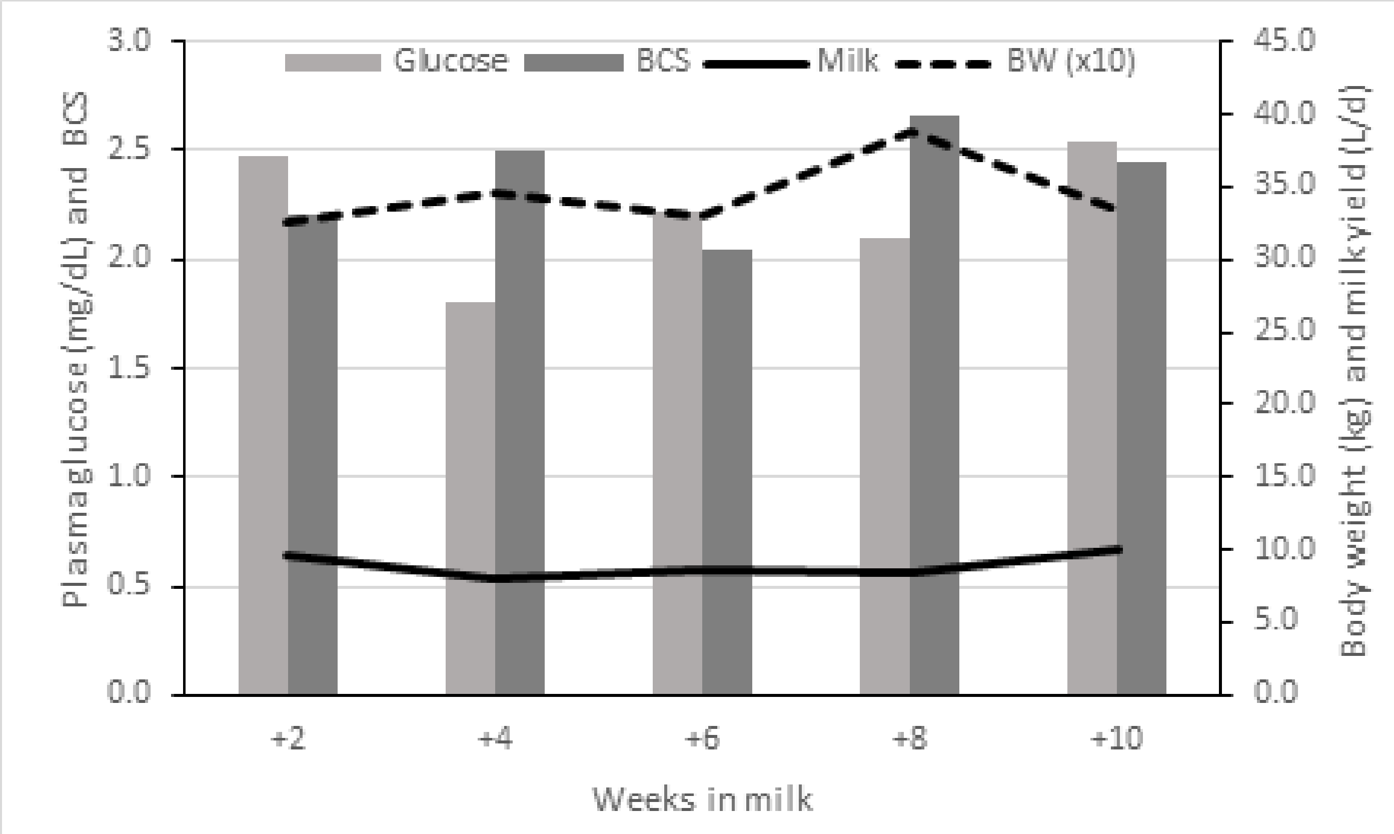

Figure 2: Change in milk yield, body weight (BW), body condition score (BCS) and plasma glucose during the first 10 weeks after calving by Jersey cows in the Sekhukhune district.

deficits of 4 to 6 Mcal/d for about three weeks postpartum (NRC 2001). The energy balance becomes positive, three to four months post-calving, as cows replenish body reserves in preparation for the next lactation. Body condition scores were still low 10 weeks post-partum, which has negative implications on future performance of the grazing dairy cows. Rapid loss of body condition pre-disposes cows to severe metabolic stress and low milk yield (NRC 2001). In the present study, cows produced an average milk yield of 8.9 L/d. Nherera (2006) also reported that dairy cows on smallholder farms calved when body condition was low, produced low milk (8 L/d) and did not persist in lactation. The MUN was rather high for the level of milk production (NRC 1989), which suggests an inefficient use of dietary nitrogen or shortage of energy supply (Jonker et al. 1998; Kohn 2002; Nousiainen et al. 2004). The intake of low quality forage or rather inadequate intake from natural pasture most likely affected nutrient utilization efficiency. Farmers noted that dairy cattle grazedin open spaces around homesteads and farmers did not graze them beyond 1 km, as did the indigenous animals. The daily concentrate portion was therefore the main source of food, scavenging the veld and streets added to energy demand. Iwaasa et al. (2014) reported that forage composition, availability and utilization by the animal affects profitability of ruminant livestock systems. Early summer rains promote flushing in shrubs and new grass tillers improving forage quality and nutrient supply to animals.

Primiparous Jersey cows require 8–11 kg dry matter feed intake per day. Since the concentrate intake represented 50–65% in our study, at least 4 kg/day of good quality veld forage would supply the balance of required nutrients. An estimated daily forage harvest of 250–500kg/day from the communal pastures is therefore required to support the new herds of lactating dairy cows and their followers. Establishment ofadaptable forages (forage sorghum, cowpea, smuts finger and *Opuntia ficusindica*) on fallow lands would improve the carrying capacity in Sekhukhune communal areas. Following this assessment, the authors engaged the community in focus group discussions. Smallholder farmers indicated that establishment of adaptable forage crops on old lands was a preferred strategy for mitigating nutritional stress of their grazing cattle herds and reducing pressure on the natural pasture.

Conclusion

Natural pasture condition affects livestock turnovers from communal areas. The dominance of increaser IIc indicates retrogressive succession in communal area pastures, which has devastating effects on ruminant herds in these semi-arid zones. Competition for grazing among indigenous herds and dairy cattle will further deplete valuable palatable species, and exacerbate nutrient imbalance in lactating dairy animals. The low proportion of indigenous nitrogen fixing legumes is alarming. The continued reduction in plant diversity, dominance of unpalatable grasses and alien species invasion due to mismanagement of communal area natural resources are critical areas and affect livestock offtakes.

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WHAT EXACTLY IS THE SCIENTIFIC METHOD AND WHY DO SO MANY PEOPLE GET IT WRONG?

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Claims that "the science isn't settled" with regard to climate change are symptomatic of a large body of ignorance about how science works.

So what is the scientific method, and why do so many people, sometimes including those trained in science, get it so wrong?

The first thing to understand is that there is no one method in science, no one way of doing things. This is intimately connected with how we reason in general.

Science and reasoning

Humans have two primary modes of reasoning: deduction and induction. When we reason deductively, we tease out the implications of information already available to us.

For example, if I tell you that Will is between the ages of Cate and Abby, and that Abby is older than Cate, you can deduce that Will must be older than Cate.

That answer was embedded in the problem, you just had to untangle it from what you already knew. This is how Sudoku puzzles work. Deduction is also the reasoning we use in mathematics.

Inductive reasoning goes beyond the information contained in what we already know and can extend our knowledge into new areas. We induce using generalisations and analogies.

Generalisations include observing regularities in nature and imagining they are everywhere uniform – this is, in part, how we create the so-called laws of nature.

Generalisations also create classes of things, such as "mammals" or "electrons". We also generalise to define aspects of human behaviour, including psychological tendencies and economic trends.

Analogies make claims of similarities between two things, and extend this to make new knowledge.

For example, if I find a fossilised skull of an extinct animal that has sharp teeth, I might wonder what it ate. I look for animals alive today that have sharp teeth and notice they are carnivores.

Reasoning by analogy, I conclude that the animal was also a carnivore.

Using induction and inferring to the best possible explanation consistent with the evidence, science teaches us more about the world than we could simply deduce.

Science and uncertainty

Most of our theories or models are inductive analogies with the world, or parts of it.

If inputs to my particular theory produce outputs that match those of the real world, I consider it a good analogy, and therefore a good theory. If it doesn't match, then I must reject it, or refine or redesign the theory to make it more analogous.

If I get many results of the same kind over time and space, I might generalise to a conclusion. But no amount of success can prove me right. Each confirming instance only increases my confidence in my idea. As Albert Einstein famously said:
No amount of experimentation can ever prove me right; a single experiment can prove me wrong.

Einstein's general and special theories of relativity (which are models and therefore analogies of how he thought the universe works) have been supported by experimental evidence many times under many conditions.

We have great confidence in the theories as good descriptions of reality. But they cannot be proved correct, because proof is a creature that belongs to deduction.

The hypothetico-deductive method

Science also works deductively through the hypothetico-deductive method.

It goes like this. I have a hypothesis or model that predicts that X will occur under certain experimental conditions. Experimentally, X does not occur under those conditions. I can deduce, therefore, that the theory is flawed (assuming, of course, we trust the experimental conditions that produced not-X).

Under these conditions, I have proved that my hypothesis or model is incorrect (or at least incomplete). I reasoned deductively to do so.

But if X does occur, that does not mean I am correct, it just means that the experiment did not show my idea to be false. I now have increased confidence that I am correct, but I can't be sure.
If one day experimental evidence that was beyond doubt was to go against Einstein's predictions, we could deductively prove, through the hypothetico-deductive method, that his theories are incorrect or incomplete. But no number of confirming instances can prove he is right.

That an idea can be tested by experiment, that there can be experimental outcomes (in principle) that show the idea is incorrect, is what makes it a scientific one, at least according to the philosopher of science Karl Popper.

As an example of an untestable, and hence unscientific position, take that held by Australian climate denialist and One Nation Senator Malcolm Roberts. Roberts maintains there is no empirical evidence of human-induced climate change.

When presented with authoritative evidence during an episode of the ABC'S Q&A television debating show recently, he claimed that the evidence was corrupted.

Professor Brian Cox explains climate science to senator Malcolm Roberts.

Yet his claim that human-induced climate change is not occurring cannot be put to the test as he would not accept any data showing him wrong. He is therefore not acting scientifically. He is indulging in pseudoscience.

Settled does not mean proved

One of the great errors in the public understanding of science is to equate settled with proved. While Einstein's theories are "settled", they are not proved. But to plan for them not to work would be utter folly.

As the philosopher John Dewey pointed out in his book Logic: The Theory of Inquiry:

In scientific inquiry, the criterion of what is taken to be settled, or to be knowledge, is [of the science] being so settled that it is available as a resource in further inquiry; not being settled in such a way as not to be subject to revision in further inquiry.

Those who demand the science be "settled" before we take action are seeking deductive certainty where we are working inductively. And there are other sources of confusion.

One is that simple statements about cause and effect are rare since nature is complex. For example, a theory might predict that X will cause Y, but that Y will be mitigated by the presence of Z and not occur at all if Q is above a critical level. To reduce this to the simple statement "X causes Y" is naive.

Another is that even though some broad ideas may be settled, the details remain a source of lively debate. For example, that evolution has occurred is certainly settled by any rational account. But some details of how natural selection operates are still being fleshed out.

To confuse the details of natural selection with the fact of evolution is highly analogous to quibbles about dates and exact temperatures from modelling and researching climate change when it is very clear that the planet is warming in general.

When our theories are successful at predicting outcomes, and form a web of higher level theories that are themselves successful, we have a strong case for grounding our actions in them.

The mark of intelligence is to progress in an uncertain world and the science of climate change, of human health and of the ecology of our planet has given us orders of magnitude more confidence than we need to act with certitude.

Demanding deductive certainty before committing to action does not make us strong, it paralyses us.

THE PEER-REVIEW SYSTEM FOR ACADEMIC PAPERS IS BADLY IN NEED OF REPAIR

THE SCIENTIFIC REFEREEING PROCESS CAN BE TEDIOUS, TIME-CONSUMING AND ISN'T VERY REWARDING.

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Peer review, or scientific refereeing, is the basis of the academic process. It's a rigorous evaluation that aims to ensure only work which advances knowledge is published in a scientific journal. Scientists must be able to trust this system: if they see that something is peer reviewed, it should be a hallmark of quality.

When the editor of scientific journal receives a manuscript, they ask other another scientist – a specialist in their field – to review it. The referee is required to advise the editor whether the manuscript should be published and to give feedback to the authors.

The system is not flawless. There have been instances of fraud and manipulation due to refereeing, but these are – we hope – isolated cases.

But there are much bigger systemic problems associated with peer review. These are negatively affecting scientific credibility. These include the fact that, globally, it is hard to find referees: reviewing a manuscript requires a lot of time and minimal reward. Very few journals pay referees, and most academics who act as referees are doing so for free in their spare time.

On top of this those who do act as referees often struggle to deliver on time. Worse still, their reports are not always helpful to editors or authors.

Some journals work actively to tackle these issues, but more can be done to ensure that the scientific refereeing system retains its integrity.

The challenges

Journal editors are frustrated about the dearth of referees. In an open letter to the scientific community, a group of editors wrote that, despite: … so much weight [being] given to peer-reviewed publication the essential "backroom" tasks of editing journals and reviewing articles are rarely acknowledged as aspects of academic performance.

No wonder they're worried: more than 1 million research articles are published globally each year. That requires a lot of referees. But finding appropriate referees is just one part of the bigger task facing editors.

Editors have to get referees to stick to the agreed deadlines. That's not easy: people tend not to prioritise their review tasks since time spent on their own research is more rewarding.

An experiment conducted with the Journal of Public Economics based in Cambridge in the US found that its referees are late with their reports half of the time. There are also instances, across journals, of referees simply never delivering even though they've promised to do so.

In some disciplines, these problems have given rise to a serious publication lag – the time between when the manuscript arrives to the actual publication. Over the past 30 years this lag has nearly tripled in economics, from 11 months to just under 30 months.

It not only takes longer to disseminate ideas. The publication lag also worsens the prospects of young scientists who need publications to be hired.

Another problem with the existing system is that referee reports do not always adequately inform the editor nor really suggest ways of fundamentally improving the article.

It's not just authors who complain about this: journal editors do too. One explanation is that referees may follow their own interests, which are not necessarily those of the editor nor the author.

All too often they try to impress editors by making blemishes look like flaws. Economists call this problem "signal jamming". At worst it may turn down innovative research.

Possible changes

The good news is that journals are aware of these problems, and are committed to tackling them.

Journals should develop and nurture a large base of potential referees, constantly adding new ones and retaining old ones. And these referees need proper recognition. This could involve simply thanking referees publicly, or perhaps awarding prizes for good refereeing.

Journals should also consider paying referees. The estimated value of unpaid referee time is as much as £1.9 billion a year – it is clearly a service that requires some financial reward.

Small changes help, too. Shorter deadlines reduce turnaround time work referees often just submit before the deadline. A public list of referees' turnaround encourages them to stay on time, too.

Editors should also reject articles that are too sloppy, rather than letting a referee improve them.

Editors should also engage in "active editing", instructing the author to ignore referee requests that are merely asking them to fix blemishes.

Editors should also pare down the demands on referees, perhaps by asking them to separate necessities from suggestions. The guiding principle should be that the work is the author's – not the referee's.

New approaches are being tested

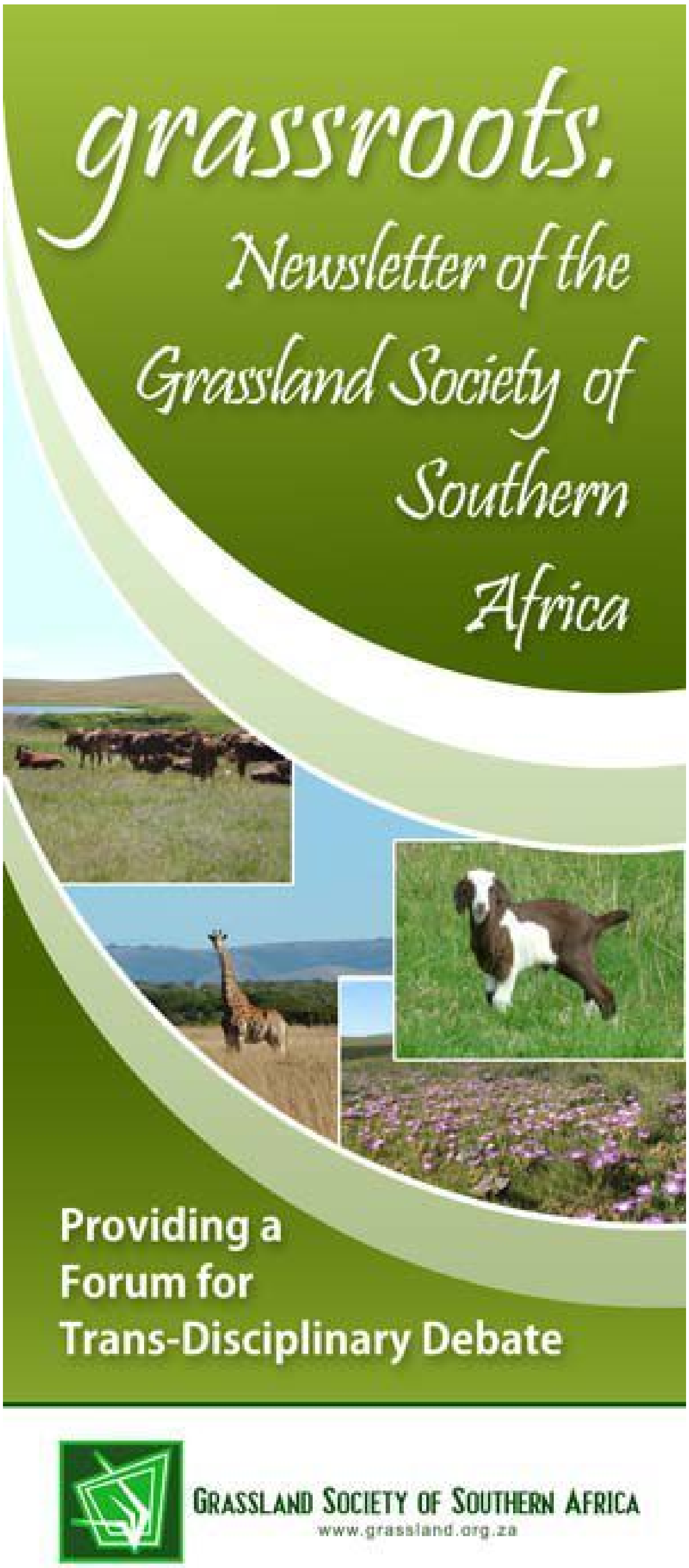
Journals are already testing new approaches. For instance, some require their editors to judge the quality of a referee to weed out those people who are simply unhelpful.

Elsevier, a major publisher, has launched a platform which publicly lists referees and how often they have written referee reports. A similar, independent platform is Publons.

"Open peer review" is also growing in popularity. Traditionally, reviewers remain anonymous to guarantee an unbiased opinion. Open peer review goes the opposite way: the referee's name and report are published together with the article. Everyone can see who the referee was, which is meant to encourage transparency. Not everyone is convinced about this approach.

Another option is post-publication peer review, in which articles are open for comments all the time from anyone. Sadly, internet trolls have tainted this process for many scientists.

It is encouraging that the problems of peer review are being debated and that new approaches are being tested. The peer-review process is very important and its challenges must be taken seriously if academics are to keep publishing quality articles that disseminate new ideas.



IMPROVING GOVERNANCE OF PASTORAL LANDS

IMPLEMENTING THE VOLUNTARY GUIDELINES ON THE RESPONSIBLE GOVERNANCE OF TENURE OF LAND, FISHERIES AND FORESTS IN THE CONTEXT OF NATIONAL FOOD SECURITY

J. DAVIES. P. HERRERA, J. RUIZ-MIRAZO, C. BATELLO, I. HANNAM, J. MOHAMED-KATERERE

FAO GOVERNANCE OF TENURE TECHNICAL GUIDES
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The Technical Guide on Pastoralism builds on a number of initiatives and studies from recent years that have shone a light on pastoral governance and land tenure: on the inherent challenges pastoralists face, the shortcomings of governments in securing pastoral tenure, and the emerging examples of success and progress from around the world. This Technical Guide provides solutions to securing pastoral governance and tenure without undermining the inherent, necessary complexity of customary arrangements. The solutions are within a rapidly changing context, in which traditional practices and crucial patterns of livestock mobility are transforming. The technical guide on improving the governance of pastoral lands is designed for several audiences including government and non-government actors. While most readers will have a basic knowledge of pastoralism, many will be unfamiliar with the great diversity of pastoralist systems and cultures throughout the world. The guide addresses those who recognize the importance of securing pastoral land tenure and who are looking for practical guidance on how to proceed. The guide is, therefore, not an advocacy document, but it provides arguments in Section 1 for securing pastoral tenure that can be used by different actors to strengthen their justification for such work. While these guidelines provide practical advice that can be operationalized, further work will be required to translate the current document into more local user-friendly products for pastoral communities.

An interesting analysis but not one which is going to arrest the degradation of rangelands (pg.13). Not one mention of Allan Savory and his success in reversing decline in grassland in Africa and elsewhere. Is he 'persona non grata' in FAO circles? Goals (pg. 7) should be headed by 1. reversing the decline and improving productivity of pastoral land. The goals listed by the report's authors will only be feasible if and when pastoral grazing is improved. Savory and others have tested and used methods are known and tried. The challenge is to get this information and change adopted across the 500m global pastoralists. Knowledge of the legal and social background is an essential part. These can change with time and circumstances. When grassland becomes work out and unproductive the social and legal rules will change. So when pastoral improvement is shown to work so societal changes are possible. This makes the social aspects of this report so useful. The challenge is integrating the legal and social systems in these areas with the needed changes in grazing practice. A difficult, but not impossible task. Getting the attention and support of graziers is the first step.

Kruger to Canyons

52nd Annual Congress

Grassland Society of Southern Africa

incorporating

the 8th Research Skills Workshop

and a

Policy & Practice Workshop

23 to 28 July 2017

Wits Rural Facility,
Near Hoedspruit, Mpumalanga, South Africa

Advancing rangeland ecology and pasture management in Africa www.grassland.org.za

IMPORTANT DATES & DEADLINES

Workshop and special session proposals	28 FEB'17	C52 & RSW2017 registration closes	7 JUL'17
Early bird payments	3 APR'17	C52 & RSW2017 payments due	12 JUL'17
Abstracts (platforms and standard posters)	10 APRIL'17	Policy & Practice Workshop registration closes	17 JUL'17
Student sponsorship applications	10 APRIL'17	Policy & Practice Workshop payments due	19JUL'17
Abstracts (research proposal posters)	12 MAY'17	Late payments	4 AUG'17

REGISTRATION open Sunday, 09h00-10h30, 23 July, Monday, 14h00-17h30, 24 July, Tuesday to Friday, 07h30-08h30

RESEARCH SKILLS WORKSHOP, Sunday 10h00-18h00, 23 July and Monday, 08h00-17h00, 24 July

ANNUAL CONGRESS opens Monday, 18h00, 24 July, then Tuesday to Thursday, 08h00-17h00

MID-CONGRESS TOURS will be on Wednesday 26 July (Pastures is full day, other tours will be half-day)

POLICY& PRACTICE WORKSHOP (theme tbc), Friday, 08h00-17h00, 28 July