Grassroots

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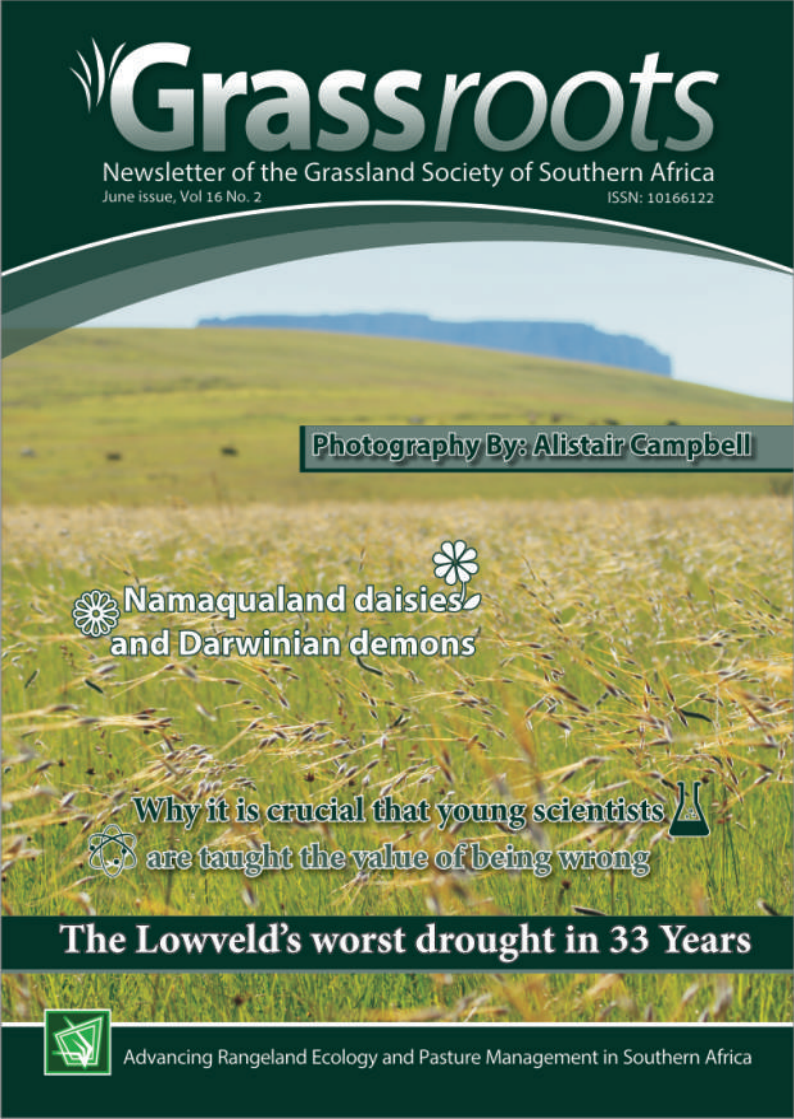


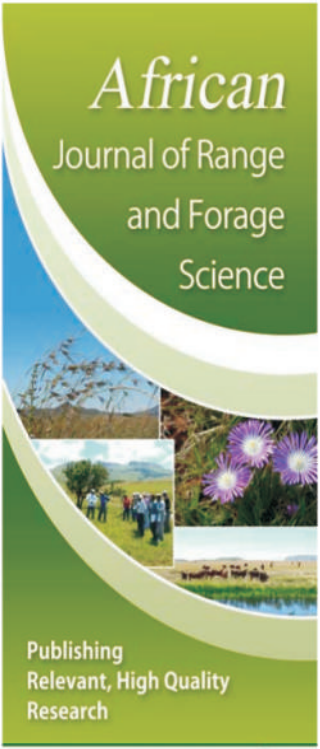
Photography By: Alistair Campbell

Namaqualand daisies and Darwinian demons

Why it is crucial that young scientists are taught the value of being wrong

The Lowveld's worst drought in 33 Years

Advancing Rangeland Ecology and Pasture Management in Southern Africa



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Editor's Note

Welcome to this issue of Grassroots. Our main feature article focus on the gripping drought that the country has experienced in the past year, and specifically focus on the Lowveld region. Futhermore, we have two articles which will be of particular interest to our early career grassland scientists. The first is about the art of reading a scientific paper, and the second is discussing why it is important that young scientists are taught the value of being wrong.

This issue is furthermore filled with news reports relating to the interest of grassland scientists. Amongst others, you can read about Namaqualand 'Daisies and Darwinian Demons', effects of frost on trees in the Karoo, women in science and student awards.

The 51st annual GSSA congress is around the corner. It will be hosted in Wilderness from 3 to 8 July 2016. Herein you will find the programme and the more information on registration, keynote speakers and technical tours.

We hope you will find this issue to be stimulating to read and shed new light on often fairly old ideas in addition to some novel and innovative ideas.

Dr. Pieter Swanepoel

Namaqualand daisies and Darwinian demons

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The term trade-off is a term familiar enough in economics which is often expressed as an opportunity cost. But in the natural world, plants have to make similar trade-offs. All living organisms have a limited amount of resources to get by on, so organisms have to "choose" how they spend those resources.

An evolutionary trade-off is the reason why the ideal organism, the so-called "Darwinian demon" doesn't exist: an organism that can do all things well, will live indefinitely and outcompete all others.

Namaqualand daisies make similar trade-offs when it comes to dispersing their seeds, something that was believed in theory, but has now been proven using laboratory experiments with actual seeds. Species that can disperse their seeds over a large area don't have the ability to stay dormant, a strategy which would allow them to spread their seeds over time. This is the finding of Caroli de Waal and colleagues from Stellenbosch Univer- sity's Department of Botany and Zoology, following three years of studying daisies in the semi-desert Namaqualand region of South Africa.

Namaqualand daisies germinate and flower in time for spring, following the relatively reliable winter rains. But rainfall patterns change over time as a consequence of climate change and the area is prone to local disturbances such as farming and overgrazing. Therefore, these daisies have adapted to this risky environment using two distinct strategies: some stagger seed germination over many seasons (dormancy), while others spread their seed over a wide distance (dispersal).

The hypothetical "Darwinian demon" would be both a spreader and a sleeper. But scientists know that evolutionary theory says this isn't possible. However, few field biologists have tested this idea using living plants. And those who had tried it came back with contradictory findings.

To clear this up, De Waal and her team took 27 different daisy species into a lab and put them to work. First, they measured the plants' ability to spread their seed: they dropped seeds down a vertical perspex tube and counted how long it took them to reach the ground. The longer it takes to fall down the tube, the better the seed's ability to catch the wind, meaning it would spread well.

Then, the researchers incubated seeds from different populations in a growth chamber, keeping temperature, light and moisture all constant. They counted the number of seeds that germinated over a period of 30 days of constant watering. Viable seeds that didn't germinate were regarded as dormant.

The researchers then tested to see if there was a relationship between these two traits, while also taking into consideration whether species were closely related or not. Their results show that the daisies' seeds which spread well generally aren't dormant in the soil. And those that are dormant don't spread well. This shows that the theory was right: these daisies make an evolutionary trade-off between spreading their seed, and being dormant. Biologists still don't fully understand the mechanisms that drive this trade-off, though. It may be that the resources used by a plant to create dispersal structures, such as wings or plumes, aren't available to make thick seed coats to allow a seed to be dormant.

Namaqualand daisies may have to "choose" only one risk-reducing strategy at the cost of the other.

Evolutionary biologists are keenly concerned with understanding the evolution of dispersal and dormancy, because it may help them understand how plants will cope with the threat of global climate change.

Climate change is expected to make important ecological factors less predictable. Rainfall, for instance, is expected to become much more sporadic in Namaqualand, meaning the daisies will experience more frequent "bad" years, so species that don't produce many dormant seeds may face a higher risk of extinction, because they can't escape these years of erratic rainfall. Dispersing well may not be a good enough risk-reducing strategy in the future, because seeds can't disperse far enough to escape the region entirely.

This study shows that Namaqualand daisies trade one survival strategy off against another. It looks as though plant species' responses to tough environments are even more complex than previously thought.

Trees get frosty reception in Karoo

Joh Henschel, Kayleigh Muller
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While sweltering temperatures elicit hot debates, it is opportune to think of the opposite - bitter cold. In the midst of a general trend of warming, sharp drops in temperatures occasionally shock the system.

Eighteen months ago, a freak cold spell gripped the eastern Karoo. The thermometer dropped further below zero than it had in a decade or two. The results were only too visible at the onset of the next summer when frost-burnt trees failed to green. Ever-ready on the lookout for environmental changes and their causes, SAEON was on the spot to investigate.

Image 1: Hill-to-valley view of frost damage at the bottom of the hill (Picture: Kayleigh Muller)

Image 2: Severe frost damage in a tree thicket in a valley in the Karoo, showing taller trees towering above the frost layer and trees on hillslopes undamaged by frost (Picture: Joh Henschel)

SAEON researchers found that the severe frost had affected the eastern boundary of the Karoo, supporting the notion that frost is a contributing factor towards delimiting the Nama-Karoo. In fact, frost could explain why trees are nearly absent in the Nama-Karoo, except on hills, though present in the adjacent savanna and grassland biomes.

Data from the South African Weather Service (SAWS) station revealed that occurrences of temperatures below minus 7 degrees Celsius have increased in Kimberley, now every decade compared to every two decades before 1977. A possible explanation is that with climate change, crystal-clear calm nights – cloudless, low humidity conditions retain less heat, cold air skinks into valleys – may have become more prevalent during winters in the Nama-Karoo. Such frigid winter nights contrast strongly with the progressively more balmy winter days, intensifying the stress.

Internal freezing

During frost events, minimum temperatures occur at one to two metres above the ground, the level of young trees. Internal freezing damages tree cells; subsequent differential thawing of sun-exposed and sheltered parts exacerbates the stress. The result is death, if not of the entire tree, then of parts.

SAEON researchers measured damage caused by the 2014 frost events on trees at study sites in the Northern Cape near Kimberley and Schmidtsdrift and in the Eastern Cape near Middelburg and Hofmeyr. They examined the effects of frost on trees in relation to their elevation along the slope between valley floor and hilltop, also, how different species or sizes of trees differ in susceptibility to frost damage, and recorded the trees' extent of regrowth during the first subsequent growth season in early 2015.

At each locality, tree damage varied. About 5% of all trees at three of the sites were killed by frost, comparable to the impacts caused by fire. The degree of frost damage declined up the slope. Typically, trees lost some 60% volume low on the slope, some 30% at 30 m higher elevation, and remained undamaged 100 m above the valley floor.

Most susceptible species

The most frost-susceptible species were three acacias with a tendency to expand into boundary areas of the Karoo during periods without severe frost, namely sweet-thorn (Acacia karroo), black-thorn (Acacia mellifera) and the umbrella-thorn (Acacia tortilis). The Karoo Kuni-bush (Searsia burchelli), which occurs on hills across the Nama-Karoo, may be confined to hills by frost, and is damaged or dies at the base.

Image 3: Regrowth on a frost-damaged tree (Picture: Kayleigh Muller)

Hardly any of the frost-damaged plants could regrow during the subsequent summer to near their previous size. It may take them several years to recover their former size provided there is not another frost. Thus, overall growth of populations of trees along the Karoo boundary appears to be limited by frost, which may, in the long run, restrain the expansion of trees into the Karoo from adjacent biomes.

IMAGE 4: Kayleigh Muller, a research assistant at the SAEON Arid Lands Node, studies a frost-damaged Searsia burchelli at the bottom of a hill.
(Picture: Joh Henschel)

IMAGE 5: Kayleigh examined the effects of frost on trees in the Karoo in relation to their elevation along the slope between valley floor and hilltop.
(Picture: Kayleigh Muller)

Bigger picture

As much as the 2014 frost event is part of a bigger picture, including other species, places and times, the SAEON study merely served to touch this little-studied subject, requiring further research. Frost is one of several infrequent events which SAEON endeavours to understand better, and be ready to observe as and when they occur.

We wish to thank the Schmidtsdrift community, Justin du Toit, Roelf and Teresa Opperman and Trevor Marrick for their assistance with fieldwork, and the South African Weather Service for providing weather data.
SOURCE: http://www.saeon.ac.za/enewsletter/archives/2016/february2016/doc07

How Africa can close its continent-wide science funding gap

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The idea that Africa's development depends critically on science, technology and innovation is embodied in the African Union's Agenda 2063. This document emphasises economies that are led by innovation and driven by knowledge. But the continent has some serious work to do if it's to create such economies.

It starts at a disadvantage: Africa is home to 15% of the world's population and 5% of the world's gross domestic product (GDP) but accounts for just 1.3% of the globe's investment in research and development (R&D). It also holds only 0.1% of the world's patents, which leads us to question how effectively the existing research and development investment is being used.

The good news is that there are grounds for optimism. And those grounds will only grow if African governments – as well as the continent's private sector – ramp up their scientific investment in the coming years.

Coherent strategies

There are increasing signs of coherence in developing scientific strategies across the continent. The first comprehensive attempt involved the African Union and the New Partnership for Africa's Development (NEPAD) coming together in 2003 to initiate a series of consultations. These resulted in Africa's Science and Technology Consolidated Plan of Action (2005–2014).

The plan was criticised on a number of grounds, especially for not being adequately linked with other pan-African initiatives, but it recorded some real successes. Between 2007 and 2013 total investment in African R&D grew by about 54%, albeit from a low starting point. At the same time the continent's output of scientific publications rose by 60%, compared with growth in Europe over the same period of just 14%.

Its successor, the Science, Technology and Innovation Strategy for Africa, was launched by

the African Union in 2014. It is a ten-year strategic plan and has been widely bought into by national governments.

Another cause for optimism is a whole set of new initiatives to support the development of a research culture in Africa. For instance, the World Bank has partnered with national governments to create centres of excellence across the continent in many disciplines. The bank is also involved in an initiative to train 10,000 new PhDs in applied science, engineering and technology.

In 2015 the African Academy of Sciences and NEPAD, together with a group of international partners, launched the Alliance for Accelerating Excellence in Science in Africa. This is a new platform to develop and fund major initiatives in science across the continent. The alliance's establishment has been welcomed by the African Union's heads of state.

These new developments are exciting. But it is also important to be realistic about what more is required. African science needs billions – not millions – of dollars in investment. If the continent wants to achieve even the world average for the number of researchers per head of population, it will need to rapidly train one million new PhDs.

There will need to be investment in infrastructure and career development, both at universities and other research organisations. To achieve this the continent will need to invest another US$2 billion in R&D each year.

Where will the money come from?

For the most part, it will be up to countries themselves to invest this money, rather than international partners – though such partners' contributions will remain essential for targeted and catalytic effects.

Some countries are beginning to take up the baton. Between 2009 and 2013 Ethiopia increased its investment in R&D by more than 150%. In 2013 Kenya incorporated a commitment to spend 2% of its GDP on R&D in a new Science, Technology and Innovation Act. The heads of state of Mauritius, Rwanda and Senegal have all made strong commitments to a future that's led by science.

Governments are not, of course, the only potential source of funding.

In the most successful science-led economies globally a substantial proportion – sometimes the majority – of funding comes from the private sector. In South Africa and Namibia up to 30% of investment in R&D comes from business. Elsewhere in Africa there is practically no such investment.

The other important source of funding globally but untapped in Africa is philanthropy. At the beginning of 2016 there were 24 African billionaires, with assets totalling more than $100 billion. This raises the question of whether there will ever be an African equivalent of the Bill and Melinda Gates Foundation, which focuses on funding scientific research and innovation.

The money is there

Whatever the potential spread of funding, there is no doubt that the prime driver has to be African governments investing in their own future.

In 2007 African leaders committed to invest 1% of GDP in R&D. Starting from a low base, actual investment had reached 0.45% in 2013. Africa's estimated GDP is $2.4 trillion. Simply achieving the 1% already committed to would release an additional $12 billion a year for science. By 2050, on current estimates, this would rise to $300 billion dollars a year compared with today's approximately $20 billion.

The money is there. The challenge is to make sure that it is invested in science innovation and technology for Africa's development.

Investment in science and innovation is needed to help build Africa. Kate Holt/Africa Practice/Flickr
www.theconversation.com/how-africa-can-close-its-continent-wide-science-funding-gap-55957

Women underrepresented in world science report finds

JOINTLY ISSUED BY: IAP – The Global Network of Science Academies, InterAcademy Partnership and Academy of Science of South Africa (ASSAf)

Women representation and participation in national science academies globally are insignificant despite efforts to promote the role of women in science.

The first comprehensive survey of member academies of IAP: The Global Network of Science Academies, found the average share of women members across 69 national science academies to be 12%. In just under one half, 30 academies from 69, the share of women members was either 10% or less.

The report Women for Science: Inclusion and Participation in Academies of Science was supported by the IAP and published by the Academy of Science of South Africa (ASSAf). It documents the results of two surveys undertaken by the Inter-American Network of Academies of Sciences (IANAS) and ASSAf targeting member countries of the IAP.

The report points out that "great strides have been made in enrolling more women in undergraduate courses, especially in the biological and chemical sciences (success has been more limited in the areas of physics, mathematics and engineering), there remains significant challenges in ensuring that the best women scientists are able to have fulfilling careers with increasing levels of responsibility, eventually taking up leadership and decision-making positions."

National academies with the largest shares of women members are the Cuban Academy of Sciences (27%) and the Caribbean Academy of Sciences (26%). The national science academies of Mexico, Nicaragua, Peru, Uruguay and Honduras are among the list of the top 10 academies with the largest shares of women members.

Women are 'best' represented in the social sciences, humanities and arts (16% of all members in this discipline, across all science academies, are women), followed by the biological sciences (15%) and the medical and health sciences (14%). Women's representation as academy members is least in the mathematical sciences (6%) and engineering sciences (5%).

Findings for the three global science academies – Islamic World Academy of Sciences (IAS), the World Academy of Art and Science (WAAS) and The World Academy of Sciences (TWAS) – show a similar picture: women are 'best' represented among academy members in the social sciences and humanities.

The National Academy of Sciences in the US (47%), together with two European academies (Switzerland and Sweden, both 47%), have the best representation of women as members of the governing body. Outside Europe, Cuba recorded 40%, Canada, 38% and Panama, 38%. Relatively high figures were also recorded for three other European academies: the Netherlands (43%), the UK (40%) and Ireland (36%).

Grootfontein Agricultural College student award

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The GSSA trophy, together with a certificate, is awarded to a deserving third year Grootfontein student. This award is made to a final year student who achieved the highest marks for rangeland, pasture and environmental management modules, with an average of at least 70% for all modules. In 2015 this prestigious award was presented to Londeka Ntuli, during the diploma ceremony at Grootfontein. She plans to enroll for a B.Tech in Agricultural Management at the Central University of Technology in Bloemfontein.

CAPTION: Londeka Ntuli
(Photo by Niel Schoeman)

The Lowveld's worst drought in 33 years? Understanding the long-term impacts

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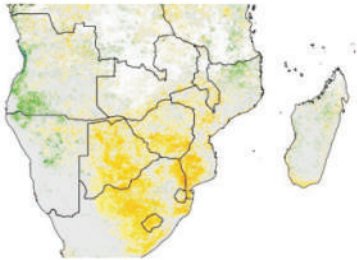
As severe drought unfolds across most parts of the country, reports on its impacts on urban and agricultural systems are regularly making their way into the mainstream media… rural villages without water, maize fields bare and unplanted, images of dead livestock…

Impacts to natural areas – from protected areas to rural rangelands, have not received as much attention. But in these areas the long-term impact of the drought may turn out to have equally important repercussions for both people and nature in rural areas.

Microcosm

The Lowveld region of South Africa is currently experiencing as severe a drought as any other part of the country, and provides a microcosm for recording and researching the impacts of the drought in many parts of southern Africa. The satellite-derived image below, courtesy of the Famine Early Warning Systems Network, shows deviations from expected Normalized Difference Vegetation Index (NDVI) values. The yellow and orange areas indicate that vegetation is less green than normal, providing an indication of the severity of the drought in the central and eastern parts of southern Africa.

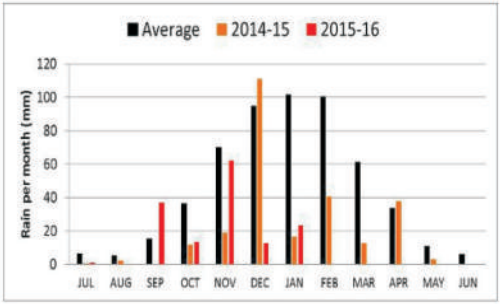


Climatological data for Phalaborwa provides an example of the severity of the current drought. The 2014-15 rainfall year was one of the driest on record, with just 255 mm of rain recorded compared to the long-term average of 533 mm. So far, the 2015-16 summer is turning out to be even drier, with all months except one receiving below-average rainfall. Over the past 12 months, only two have received average or above-average rainfall.

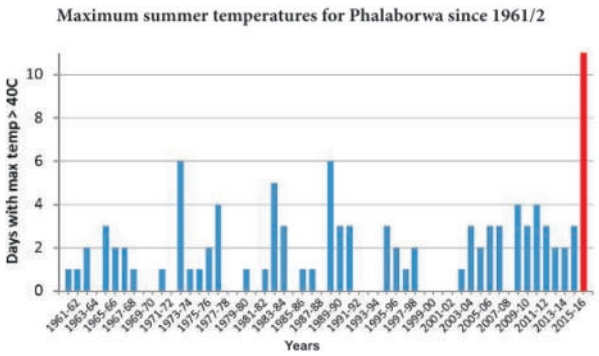
Two consecutive years of such low rainfall is extremely rare in the highly erratic rainfall history of Phalaborwa. The last time this occurred was in the severe drought of 1982 to 1984. The combined rainfall for those two years was 602 mm, while the current two-year total is just 404 mm.

Given that the long-range forecasts are for continued below-average rainfall for the next few months, it is unlikely that the current two-year total will catch up to the 662 mm of 1982-1984, meaning that this drought will go down as the most severe in Phalaborwa since record keeping began in 1954.

Monthly rainfall for Phalaborwa over 2 years (2014/15 and 2015/16)



Extreme heat is also contributing to the severity of the drought this year, with an unusually large number of very hot days that result in greater evaporation of the little rain that has fallen. The graph below shows the number of days that maximum temperatures have exceeded 40°C for each summer since 1960-61. This summer (red bar) still has a few months to go, but eleven days above 40°C have already been recorded, far more than any summer in the past.



Impact on vegetation

The most obvious impact of the drought in and around Phalaborwa, so far, is the pitiful grass production in both protected areas and rural rangeland. Normally by this time of the year, grasses are reaching their maximum sizes and consist of tufts of bright green foliage.

Currently, throughout the Lowveld, most grasses such as these tufts of *Themeda triandra* (below) in the Kruger National Park have no or few green leaves and many may have already died. The re-establishment of large, productive tufts of grasses such as these will take many years, resulting in increased soil erosion, altered water and nutrient cycles, and reduced forage for grazing herbivores for many years after the drought ends.

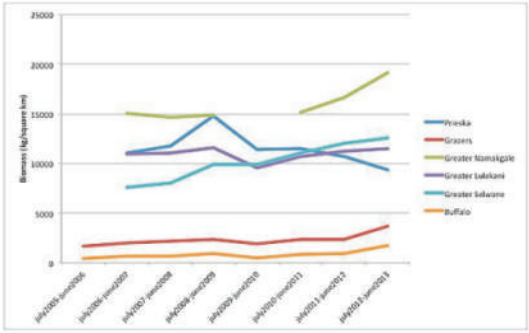
Herbivore mortalities

The inevitable impact of reduced grass growth is the death of grazing herbivores, such as cattle in rural rangelands and many of the large species of antelope in protected areas. Cattle that have died of starvation, such as the one pictured here, are now becoming a common sight in many rural areas in the central Lowveld, with reports of thousands of animals already lost in the Giyani area.

Cattle have been maintained at high numbers in the region for many years, due to good rains in the first part of the millennium, a multitude of dams and the increasing tendency of cattle owners to buy feed for their cattle in the winter.

However, this year feed was exceptionally expensive and is already in short supply. In addition, many of the dams scattered through the rural rangelands have dried up, and cattle need to be moved to other areas to survive, at great expense to local cattle owners. A dramatic decline in cattle numbers now seems inevitable.

The graph below shows the high numbers of cattle (expressed here as biomass of cattle per km^2) for four rural rangelands in the Phalaborwa area, in contrast to the relatively low and more stable numbers of grazers (red and orange lines) in a nearby private game reserve (the Balule Private Nature Reserve).



Other impacts on rural livelihoods

While cattle owners constitute a relatively small part of the rural population, the drought impacts rural livelihoods in other ways. For example, Mopane worms make an important contribution to the diets of thousands of rural households during late December or early January when the adult worms are harvested, dried, sold and eaten. This year, very few worms emerged and most of those that did, perished before reaching their adult size. This is the first summer that no worms have been recorded on Mopane trees since surveys began in 2009 at a benchmark site in the Kruger National Park (graph below).

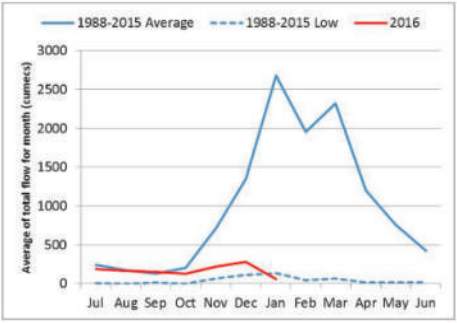
Will the wildlife survive the winter?

The death of wildlife in private game reserves and the Kruger National Park has also begun, with reports of hippo dying in the Kruger Park as the smaller dams and rivers dry up. In the picture below a few remaining hippo lie submerged in a large muddy puddle that is all that remains of the water body of the Mazithi Dam. Other grazing animals which depend on a high quantity or quality of grass, such as buffalo and impala, are already emaciated in numerous parts of the park, and many are likely to perish during the coming winter.

Rivers and freshwater ecosystems

The effects of the drought on the rivers and freshwater ecosystems in the Lowveld are now developing rapidly, with low rainfall in the catchment areas to the west contributing both directly and indirectly to low flows at a time when river flows normally begin to peak (the indirect effects stem from reduced outflows from dams upstream, as dam managers attempt to maintain as much water as possible for the coming dry season).

The Olifants River, the largest of the region, is close to drying up and flow for the month of January was the lowest it has been for at least 18 years. The graph below shows the average and minimum monthly flows for the Olifants River (in blue), as recorded at Mamba Weir where the river enters the Kruger National Park, as well as the monthly flows for the 2015-2016 rainfall year (in red).



The Letaba River, another major perennial river of the Lowveld, has run dry within the Kruger National Park. A view from the Letaba Rest Camp, taken in December 2015, shows the flow reduced to a trickle within the wide expanse of the floodplain of this normally expansive river (almost exactly three years before the day this photo was taken, the river was in flood and flowing over the top of the fence and paving as seen in the bottom right hand corner).

Fish deaths are an inevitable consequence of the prolonged low flows experienced. The photo below shows the carcasses of a variety of species that died when the Letaba River ceased flowing upstream of the Kruger National Park in early January of this year.

The positives of droughts

In the field of ecology, theories have been developed as to the positive role of droughts in ecosystems, savannas in particular. Droughts can regulate populations of herbivores, thus preventing overgrazing and degradation of the vegetation in the long term. In addition, severe droughts may kill off many trees in savannas, thus helping to maintain a favourable balance between trees and grasses.

The picture below shows a small Mopane tree which appears to have died this summer. This tree would normally have a full canopy of bright green leaves at this time of year. The widespread death of trees and shrubs like these would actually be a positive effect of the drought, counteracting decades of bush encroachment throughout the region, and promoting the re-establishment of a vigorous grass layer.

Due to the rarity of droughts that are severe enough to have such impacts, there is little data to test these ideas. SAEON is now well positioned to document the impacts of a severe drought and provide the type of data needed to understand the long-term role of climate - and climate change - in controlling natural and semi-natural ecosystems.

SOURCE: http://www.saeon.ac.za/enewsletter/archives/2016/february2016/doc02

Fibre composition and rumen degradation of agro- by-products utilized in steer fattening and dairy cattle rations

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ABSTRACT

The objective of the study was assess fibre fractions and rumen degradation of major agro-industrial by-products imported into South Africa and utilized as ingredients in steer fattening and dairy cattle rations. Three agro-industrial by-products (wheat bran (WB), hominy chop (HC), cotton seed oil cake (CSOC)) were sampled biweekly April through May at an inland port of entry. Groundnut hulls (GH) were sampled from a local market in Gauteng province. Samples were pooled and subsampled. The by-products were assessed for fibre fractions and incubated for In Sacco dry matter degradability for 0, 2, 4, 8, 18, 24, 48 hrs. Groundnut hulls and WB had the highest (P<0.01) NDF. Acid detergent fibre was high in all by-products. The CSOC and GH consisted of mostly cellulose (>47%) and less hemicellulose (28%); WB was high in hemicellulose and lignin (22% DM). The CSOC and GH were poorly degradation (P<0.01) 36.3% and 26%, respectively. Wheat bran degraded to about 54% and HC was 87%. Imported hominy chop was highly degradable compared to the high value by-product CSOC.

Keywords: *in Sacco*, degradability, oilseed, hominy chop, wheat bran
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Introduction

South Africa imports by-products of cereal grain and oilseed processing. Maize groats, meal Soybean meal, wheat bran, hominy chop and seed oilcake are major trade commodities worldwide. Wheat bran is a by-product of Triticum sativum L. milling consisting of cuticles, pericarp, seed coat and small amounts of the starchy endosperm of the kernel. Hominy chop is a mixture of maize bran, broken kernels, and germ residue after oil extraction, pericarp and endosperm (Zea mays L. Poaceae) processing (Heuze et al., 2015). The composition of structural and non-structural carbohydrates dependents on

processing methods. The structural polymers are essential for maintaining cell rigidity and strength. Oilseed by-products are protein rich, exceeding 30% crude protein (Arieli, 1998). By-products are used extensively in formulation of compounded concentrates and homemade feeds to supply carbohydrates for energy.

Ruminants are adapted to digestion of fibrous feeds. The high content of structural carbohydrates increases chewing and stimulate saliva flow, which maintain rumen pH above 6.0 for optimum rumen microbial growth and function (Mertens et al., 2012; Arelovich et al., 2008). The fibre portion/ structural component include cellulose, hemicellulose which are degraded slowly and undegradable portion lignin (Van Soest et al., 1991; Van Soest and Robertson, 1991). Microbes degrade the fibre to volatile fatty acids, mostly acetic acid which are used in energy metabolism. Low fibre levels cause acidosis and lowered milk fat %. Staples et al., (1992) reported low milk production in cows on a 39% neutral detergent fibre (NDF) diet. Hoover et al., (1991) noted that a diet of 37% non-structural carbohydrates was optimum for microbial protein synthesis. Hominy chop contains at least 30-45% starch and sugars and is a good source of NSC (Heuze et al., 2015). The NRC (2001) recommends 25-35% dietary NDF to optimize microbial growth. Achieving optimum fibre levels in diets of feedlot and dairy rations is challenging when utilizing NDF rich by-products. Quality control on imported agro-by products is therefore essential. In South Africa, the quality of industrially manufactured animal feeds is regulated by Act 36 of the "Feeds and Fertilizer Bill 1947". The objectives of this study were to determine the fibre composition and assess in Sacco degradability of major agro-industrial by-product imports utilized in steer and dairy cattle rations.

Materials and Methods

The research was carried out at the Animal Production Institute, Agricultural Research Council in Irene, South Africa (longitude 28 13'S: latitude 25 55'E, altitude 1524 m). Samples of cotton seed oil cake (CSOC), hominy chop HC and wheat bran WB (Triticum sativum) samples were collected at Golela Border Post South Africa in April and May 2014, pooled and subsampled. Groundnut hulls (Arachis hypogaea L. (Fabaceae) samples were collected at a fresh produce market in Gauteng during the same period. The samples were milled through a 2 mm screen and dried at 100∘C in a conventional oven for 24hrs to determine dry matter (DM; method 934.01) and organic matter (OM; method 942.05) (AOAC (2005). Neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) were assessed according to Van Soest et al., (1991) and hemicellulose, cellulose and non-polar extracts calculated from the fibre fraction. All analyses were done in

triplicate.

In Sacco degradability: Degradation of CSOC, HC, WB and GH was assessed using the in Sacco technique (Ørskov et al., 1979). Six samples of each product weighing 3 g/sample were weighed into ANKOM nylon bag (53 µm and 5 cm*3 cm). Nylon bags were placed in the ventral rumen sac and attached to 50 cm of string. Zero hour samples were washed in clean running water until clean. Two cannulated cows in late lactation fed a diet of dry cow concentrate and Lucerne with adlib access to Eragrostis hay and water were used for the 0, 2, 4, 8, 18, 24, and 48 hours incubations. At termination bags were washed under running water and oven dried at 70°C oven for 48 hours for determination of dry matter degradability (DMD).

Nutrient composition and in Sacco dry matter degradation data were assessed for normality and equal variance and then analyzed using one-way analysis of variance (ANOVA) using GLM procedures of SAS (2013). Treatment means were compared using Tukey's multiple comparison test and significance declared at $P < 0.05$.

Results and discussion

Chemical composition of the agro-industrial products are presented in Table 1. All the roughages were high in organic matter content. Fibre components were much higher than values reported in literature. Groundnut hulls and WB had the highest ($P<0.01$) NDF and corresponding lower levels of non-structural components. Cotton seed oilcake had the highest ($P<0.05$) NPE of 22% which indicates that the material sampled were products of a semi-complete oil extraction process. Acid detergent fibre was high in all by-products and highly variable. The CSOC and GH constituted mostly of cellulose (> 47%) and 28% hemicellulose. Good quality HC averages 45% NDF and less than 20 ADF, the proportions observed in this study were 2-3x higher with 32% hemicellulose and 36% cellulose. This variance is expected as HC is a mixture of various components; and cuticles are mostly structural fibre. Wheat bran contained mostly hemicellulose and high levels of lignin (22% DM). Lignin is a barrier in primary walls and reduces digestion of ingested material. Rumen degradation of the by-products (Figure 1) was slow during the first 24 hours due to hydrolyzation of the fibrous components and colonization by fibrous bacteria. Differences in degradation were apparent from 18 hours. The CSOC, a protein supplement was poorly degraded; only 36.3% at 48 hr of incubation. Such variance is expected among by-products that

are heat treated; as resultant maillard products are indigestible. Intense heat used during processing also reduce degradability and availability of amino acids (Van Soest, 1991). According Mehrez et al., (1977) ammonia levels less 24 mg/100 ml rumen fluid reduce efficiency of fermentation. Cottonseed oilcake supplements protein in ruminant diets but its use in monogastrics is limited because of gossypol, which cause poisoning in pigs and poultry. Gossypol denatured in the rumen (Lindsey et al., 1980). The combination of high metabolizable energy (>2.6 Mcal/kg DM), CP and total digestible nutrients 69% DM (Kearl, 1982) places CSOC as a valuable import by-product. However, CSOC in this study was poorly degraded. Cellulose has a high rumen retention time and longer incubation periods should be used to assess DMD. The batches of CSOC sampled during the period April to May were low in rumen available nutrients.

Table 1 Chemical composition of major agro-industrial by-products (units are expressed in %DM)

		Wheat bran		Hominy chop		Cotton seed oilcake		Groundnut husk	
Variables		Mean	StDev	Mean	StDev	Mean	StDev	Mean	StDev
Dry matter %	%	89.2^{a}	0.06	83.6^{b}	0.10	92.8^{a}	0.85	91.9^{a}	0.24
Organic matter	%DM	94.9^{c}	0.17	97.4^{a}	0.16	94.8^{c}	0.11	96.5^{b}	0.19
Ash		5.1^{a}	0.17	2.7^{c}	0.16	5.2^{a}	0.11	3.5^{b}	0.19
Non-polar extracts		8.3^{bc}	1.86	11.5^{b}	0.50	22.0^{a}	0.3	6.0^{c}	0.47
Hemicellulose		59.2^{a}	5.91	32.1^{b}	4.26	26.1^{b}	5.58	28.1^{b}	7.03
Cellulose		9.8^{c}	5.9	38.8^{b}	1.01	47.3^{ab}	12.50	61.8^{a}	2.58
Acid detergent lignin		22.5^{a}	3.16	17.4^{a}	3.80	4.5^{b}	3.79	4.2^{b}	1.4
Neutral detergent fibre		91.7^{a}	1.86	88.5^{a}	0.50	78.0^{b}	1.6	94.1^{a}	0.47
Acid detergent fibre		32.5	4.04	56.4	4.76	51.9	8.71	66.0	7.49

Stdev: standard deviation; ^{a,b,c} Means in the same row with different superscripts differ; P<0.01

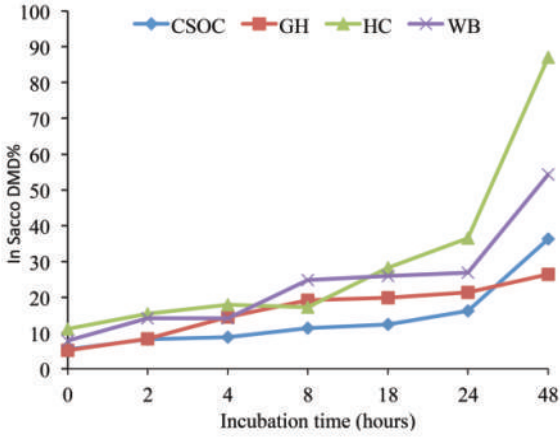

Figure 1. In Sacco degradability of dry matter (%DMD) of WB: wheat bran; HC: hominy chop; CSOC: cotton seed oil cake; GN: groundnut husks

Wheat bran had 54% DMD and HC was 87%. Good quality HC is moderate in CP (10% CP), less than 50% NDF, 30-40% starch and sugars and is high in total digestible nutrients and is recommended for high level inclusion in ruminant diets. The high degradation was not expected as the NDF was very high. Mertens (1992) stated that fibre occupy more gut space and is retained longer in the rumen to enable particle size reduction. The incubation period in this study was short, as Ørskov et al., (1979) observed that poor quality roughage, high in cellulosic material require 48 to 72 hours to reach the asymptote. Although diets of 25%-35% NDF and 19-24% ADF are optimal (NRC 2001) for high performance animals, Muya et al., (2011) noted that higher NDF diets did not seem to affect milk production; however the ferulate cross links of lignin and structural polysaccharides are known to reduce digestion (Grabber et al., 2005). The formulation of diets using agro-by products is a therefore function of both ADF, which is related to rumen degradation and NDF which is correlated with dry matter intake. About 30% of forage material exit the rumen undigested.

Conclusion

In South Africa domestic feed use exceeds production and the gap is filled by imports of agro-by products. The slowly degradable fibre fractions were very high and lignin varied. By-products had lower rumen degradation with the exception of HC. The poor degradability of imported CSOC is worrisome and warrants continuous quality monitoring. Lower amounts of by-products such as CSOC, wheat bran and groundnut hulls must be included in diets of high performance ruminants. The GH are a poor roughage and should be used with caution when formulating diets for feedlot or dairy cattle. Regular quality monitoring of imported agro-by-product is a measure that safeguards nutrition and productivity of feedlot and dairy cattle. By-products such as CSOC tend to command high prices on the feed market and prices should be matched with feed quality. Further research on characteristics of by-product fibre fractions and proportional degradation of components is recommended

Acknowledgements

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The art of reading a scientific paper

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Reading and understanding research papers can be a daunting task, but it is a skill that every scientist has to learn. Sadly, it is a skill seldom taught at tertiary level. Even undergraduate science students are expected to use scientific literature for projects and assignments, but this is never proceeded by a "How to" lecture.

Scientists read scientific papers for various reasons - to stay up to date with the latest developments, to find evidence to support or their own ideas, broaden their avenues of research, gain background information on a topic and determine how other scientists conducted their research. The reason for reading a scientific paper should determine how the paper is read. The abstract and introduction along with your own research needs can be used to determine whether to just skim through the paper or whether you should read the paper more thoroughly. Regardless of whether you just skim through the paper or whether comprehensive reading is required, the ultimate goal of reading a scientific paper is to fully understand the scientific contributions the authors are making to their field of research. Therefore, reading a scientific paper is completely different from reading a novel or even reading a popular science article in a science magazine such as New Scientist.

Reading a scientific paper requires a reader to wear two thinking caps - a critical thinking cap and a creative thinking cap. Many an inexperienced reader will read a scientific paper in a linear fashion starting with the abstract. The abstract contains a succinct summary of the entire paper, and by starting with the abstract a reader runs the risk of being inadvertently biased by the author's interpretation of the results. Therefore, it is recommended that the abstract should be the last part of the paper to be read.

The following steps are guidelines on how to read a paper more critically:

Step 1: Consider the article as a whole

The first step is to examine the scientific paper as a whole. Try to establish the purpose and content of the paper as well as the audience it was written for. Some specific questions

to guide you through this step are:

- What are the major ideas that are being addressed in the article?
- Who are the authors? Are the authors' affiliations credible?
- Is the article published in a reputable journal?

Reading a scientific paper requires a reader to wear two thinking caps - a critical thinking cap and a creative thinking cap

Step 2: Skim read the article

The second step is to skim through the paper to identify the problem that the field of research within which the paper falls is trying to address; in other words what is the "Big Picture". It is essential to identify and look up any unfamiliar terms, techniques and key concepts. It will be difficult to fully understand scientific papers if there are key terms and concepts that you do not understand.

Step 3: Re-read the article

After the "Big Picture" has been identified and all unfamiliar terms, techniques and key concepts have been looked up, a second read through the article is warranted. This should be a dedicated, focused, distraction-free attempt aimed at understanding the details of the article.

When reading the different sections of the paper, starting at the introduction, try answering the following questions:

- **Introduction:**
- What is the purpose of the article? Is it a review of previous studies or does the article present new results?
- What topic is being researched and why is it an interesting topic?
- What is already known about the topic?
- Where are the gaps and how does this article fill these gaps?
- What are the specific questions/hypotheses addressed?
- **Methods:**
- What research techniques are used and how do they compare to other techniques?
- Is the method employed appropriate?
- Has any variable been overlooked?
- What assumptions were made?
- **Results:**
- What do the figures and tables show? Scrutinise the figures and tables before reading the author's interpretations of the results.
- How do the results relate to the questions/hypotheses presented in the introduction?
- Are the results reported and analysed in an unbiased manner?
- Are there other ways of interpreting the data presented?
- **Discussion:**
- Have the appropriate interpretations been made?
- Are there ways of interpreting the results that have not been considered?
- Is the evaluation of the findings unbiased?
- What are the implications of the findings?
- What suggestions are being made about future research efforts on this topic?

Step 4: Criticism and evaluation of article

The final step is to criticise and evaluate the article. While it is important to note the shortcomings of the research and the way in which it is presented, it is also important to take note of the strengths of the paper.

Some questions to help you evaluate a paper are:

- Was anything left unfinished? Did the author raise any questions/make points that were left orphaned?
- Did the paper make its case convincingly?

- What does the point made by the authors' argument mean in terms of the larger context of the discipline?
- Is the organisation of the article clear?
- Were there any problems with grammar, sentence structure/word usage?
- What did you learn?

And on a more positive note:

- What good ideas were presented in the paper?
- What are the possible applications of these ideas?
- What improvements would you have made?
- Is there anything in the paper, be it writing style, methods used, graphics, that you can use for your own research?

The guidelines provided here can serve a double purpose. Firstly, they can help you improve your critical reading skills. In the beginning, following the steps provided might be a lengthy process, but with practice, reading scientific papers can become as straightforward as reading more conventional material. Secondly, appreciating how academics write and why they write the way they do may help you improve your own writing.

SAEON's Egagasini Node initiated regular paper discussion sessions for all the oceanography postgraduates forming part of the node.

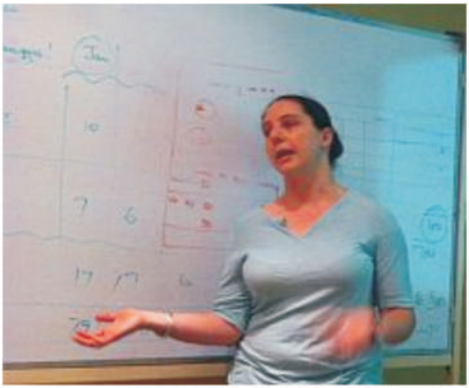
Critical reading in action

In 2015, Dr Juliet Hermes of the SAEON Egagasini Node initiated regular paper discussion sessions for all the oceanography postgraduates forming part of the node. During the course of the year, each student got the opportunity to present a critical analysis of a scientific paper relevant to their project or of general interest to the group, resulting in one to two paper discussion sessions per month between 12 postgraduates.

Due to the extensive collaboration network of the node we have been able to invite well-established scientists from SAEON, the University of Cape Town, Nelson Mandela Metropolitan University, Department of Environmental Affairs and, on occasion, the Department of Agriculture, Forestry and Fisheries to present their work to the students or to provide feedback on their papers presented by students.

This year, we are hoping to build on last year's success with more students joining the group and more frequent paper discussion sessions.

SOURCE: http://www.saeon.ac.za/enewsletter/archives/2016/february2016/doc12



Postdoctoral researcher Charine Collins discusses a scientific paper

Why it's crucial that young scientists are taught the value of being wrong

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Albert Einstein is the most famous scientist of all time. From Calgary to Cape Town the image of the wild-haired, contemplative lone genius holed up in a messy office, changing the universe, has evolved into the archetype of how society sees scientists. More than that, it has shaped the social perception of the whole scientific endeavour.

True science, we are led to believe from a very young age, is never wrong. True scientists – the Galileos, Newtons and Curies – stare into the abyss and return with deep truths about the universe we inhabit. Anything less and, well, you might as well throw in the towel. And so scientists spend their careers desperately trying to be right in every classroom, seminar and paper.

But this is not how science works. It's not even how science is supposed to work.

The scientific method is built on four cornerstones: observation, hypothesis, experiment and the revision of the hypothesis based on the results of the experiment. The last is just a fancy way of saying "admitting that you were wrong".

And since it is this sequence by which hypotheses evolve into theories which grow into paradigms, science itself cannot progress without scientists admitting – to themselves even more than to society at large - to being wrong.

Even Einstein erred

By now, few people are unaware of the recent monumental detection of gravitational waves by the LIGO team. This was heralded as the final great test of Einstein's General Relativity.

But many people probably don't know that in 1936 Einstein himself, together with Nathan Rosen, submitted a paper for publication claiming that such gravitational waves could not exist. The paper was rejected. Einstein was wrong! It wasn't the first, nor the last time either.

More recently, in 2014, the BICEP collaboration announced that it had detected evidence of gravitational waves from the cosmic microwave background. After much fanfare in popular media and back and forth in the scientific community, it emerged that they, too, were wrong.

So, why is it so important to realise that scientists being wrong is not a bug but a feature of science?

Guarding the future of science

First of all, we live in an age where information has never been more accessible. Ironically, with this growth of access to information has come a commensurate distrust in the expertise of scientists and even in the very science that has brought humankind to this juncture.

One has only to think of the surge of the anti-vaccine movement, resistance to GMOs, anxiety around wi-fi and even the raging non-battle between evolution and intelligent design.

In each of these cases, a small but vocal body pursuing its own agenda latched onto uncertainties and doubts expressed by scientists. Instead of appreciating this as the natural progression of the scientific process, these groups painted it as a dramatic failing of science and of scientists.

In some cases, as in former South African president Thabo Mbeki's HIV/AIDS denialism, these views can have life or death consequences.

A second, perhaps more important reason, is for the very future of science itself. Even scientists sometimes don't take the importance of being wrong seriously enough. This is due in no small part to the confirmation bias that seems built into our humanity. We are more likely to seek out and place value in information that confirms our own existing beliefs.

These views and the culture in which they form are then passed on to the next generation – our students pursuing science degrees at university.

The way forward

The current generation of students go through their degrees petrified of being wrong or of looking "stupid" among their peers and lecturers. This is particularly true in patriarchal environments that pervade Africa, where indeed many young people are taught not to question anything they're told by elders.

And so no questions get asked. No guesses get made and no risks get taken as students grow more and more uncomfortable with being uncomfortable in lectures. For a continent that's striving to produce the next Einstein, this is a cycle that desperately needs breaking.

Fortunately breaking the cycle is not as difficult as it might seem. As much as we'd like to think otherwise, being wrong is something we as humans are inherently very good at. It is something that is manifest in how young children learn about the world, through play.

Natural scientists learn by trial and error, without fear of getting the answer wrong. Perhaps we as adults, students and teachers alike ought to take some lessons from them, cast aside our egos and embrace losing to nature.

But what do we know – we're probably wrong anyway.

SOURCE: www.theconversation.com

Movers and Shakers

Tunde Amole, International Livestock Research Institute (ILRI)

As a Postdoctoral Livestock Feed Scientist at ILRI (West Africa), Tunde Amole is working on several projects focusing on the application of participatory methods in identifying promising feed intervention strategies in smallholder systems in West Africa, testing of livestock-related options for sustainable intensification of crop-livestock systems, intervention options in livestock production for climate-smart agriculture in West Africa and improving water use for efficient livestock production in the drylands of West Africa.

New Members

Donna Berjak - KwaZulu-Natal Department of Agriculture and Rural Development

Garreth Champion - Agreenco BioEngineering Pty Ltd

Irenie Chakoma - International Livestock Research Institute (ILRI)

Jimmy Wilson-Smith - International Livestock Research Institute (ILRI)

Lourens van Essen - Nyengere Environmental and Wildlife Solutions

Michael Seiderer - GreenThorn Environmental Solutions

Member Resignations

Alan Wheeler - CapeNature

Clive Buntting - Retired

Coral Birss - CapeNature

Denisha Anand - Agricultural Research Council

Johann van Heerden - Retired

Leana Nel - Advance Seed (Pty) Ltd

Louis Strydom - Lima Sierra Advisory and Investments (Pty) Ltd

Luke Gallant - - Agricultural Research Council

Maureen Wolfson - Retired

Obeid Katumba - Gauteng Department of Agriculture and Rural Development

Suzette Bezuidenhout – KwaZulu-Natal Department of Agriculture and Rural Development

Yonela Jafta - University of Pretoria

GSSA Council News May 2016

Congress 51 is approaching fast and will be held in the beautiful coastal town of Wilderness. This year the congress runs slightly earlier than normal (4-8 July) to avoid clashing with the 10th International Rangelands Congress being held in Saskatoon, Saskatchewan, Canada (16-22 July). The congress will again run back-to-back with the Research Skills Workshop (3-4 July), which has proved popular at previous congresses. An Invasive Species Workshop will then follow the congress on 8 July.

The council have held two meetings this year, both of which were conducted via Skype to reduce our carbon footprint, costs to the society and time commitments for council members. Both these meeting were well attended. The main issues dealt with by the council this year have been the way forward for the administration of the GSSA trust and the accreditation of the society to run recognised professional development courses. Significant progress has been made on both these fronts and council members will report back to the society at the Annual general meeting.

There are a few positions opening on the GSSA council for the 2016/2018 term. The positions opening are Vice-President, Honorary Secretary, Publications Editor and three additional members (assistant publications editor, assistant website editor and assistant treasurer). Nominations can be sent to Freyni du Toit (admin@grassland.co.za). Council members will be elected at the AGM to be held during Congress 51 on Tuesday 5 July 2016. Please note that members must be present at the AGM to be elected to council.

Congress 52 will be held in Mpumalanga on the Kruger to Canyons route and planning is already underway. Watch this space for more details.