Grassland Society of Southern Africa

www.grassland.org.za

Advancing Rangeland Ecology
and Pasture Management in Southern Africa

47TH ANNUAL CONGRESS

ADVANCING RANGELAND ECOLOGY AND PASTURE MANAGEMENT IN AFRICA

CLUB MYKONOS

LANGEBAAN, WESTERN CAPE

16 TO 20 JULY 2012

PROGRAMME COMPILED BY FREYNI J DU TOIT

COVER DESIGN BY CATHRINE VERSVELD

WITH ORIGINAL PHOTOGRAPHS BY PHILIP R BOTHA, JUSTIN C O DU TOIT, MMOTO L MASUBELELE, JAMES R PUTTICK, NELMARIÉ SAAYMAN AND M IGSHAAN SAMUELS

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UPCOMING GSSA EVENTS: SAVE THESE DATES!!

RESEARCH SKILLS WORKSHOP, 12 TO 13 MARCH 2013, PRETORIA, GAUTENG

48TH ANNUAL CONGRESS, 15 TO 19 JULY 2013, BELA BELA, LIMPOPO

49TH ANNUAL CONGRESS, JULY 2014, FREE STATE

50TH ANNUAL CONGRESS, JULY 2015, KWAZULU-NATAL

CONGRESS PROGRAMME SUMMARY

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<tr><td>08:30-12:30</td><td>GSSA Council Meeting (Olympiad Conference Centre)</td><td>09:00-13:00</td><td>Best Farmer SA Course: Rangeland Management using the Principles of the Controlled Fodder Flow Grazing Strategy and Animal Behaviour, presented by Riaan Dames (Olympiad Conference Centre)</td></tr>
<tr><td>12:30-13:30</td><td>LUNCH</td><td>13:00-14:00</td><td>LUNCH</td></tr>
<tr><td>13:30-17:45</td><td>Registration (Athene Conference Centre Lobby)</td><td>14:00-16:00</td><td>Best Farmer SA Course</td></tr>
<tr><td rowspan="2">18:00-19:40</td><td colspan="3">OPENING OF THE 47TH ANNUAL CONGRESS OF THE GRASSLAND SOCIETY OF SOUTHERN AFRICA
Athene Conference Centre</td></tr>
<tr><td colspan="3">Welcome: M Igshaan Samuels, Agricultural Research Council – Animal Production Institute
Opening Address: Jim Walsh, Cape West Coast Biosphere Reserve & Saldanha Bay Water Quality Trust
Presidential Address: Wayne F Truter, University of Pretoria
Keynote Address: Adaptation and human flourishing in an era of global climate change, Johan P Hattingh, Stellenbosch University
Opening of Pêrels & Pampoene Art Gallery's 1st Winter Exhibition: Gretha Helberg</td></tr>
<tr><td>19:40</td><td colspan="3">MEET & GREET BUFFET (Athene Conference Centre)</td></tr>
<tr><td colspan="4">Tuesday, 17 July 2012</td></tr>
<tr><td>07:15-08:00</td><td colspan="3">Registration (Athene Conference Centre Lobby)</td></tr>
<tr><td rowspan="2">08:00-08:40</td><td colspan="3">PLENARY ADDRESS
Athene Conference Centre 1 & 2</td></tr>
<tr><td colspan="3">Fire management in Australian tropical savannas: biodiversity, greenhouse gas abatement and Indigenous livelihoods, Alan N Andersen, CSIRO Sustainable Ecosystems, Australia</td></tr>
<tr><td rowspan="2">08:45-10:05</td><td>PARALLEL SESSION A
Athene Conference Centre 1 & 2</td><td colspan="2">PARALLEL SESSION B
Athene Conference Centre 3 & 4</td></tr>
<tr><td>Session: Rangeland Fire: People, Policy and the Environment</td><td colspan="2">Special Session: Restoration of Natural Ecosystems</td></tr>
<tr><td>10:05-10:30</td><td colspan="3">TEA (Athene Conference Centre Terrace/Bouzouki Restaurant)</td></tr>
<tr><td>10:30-11:20</td><td>Session: Interactions between Plants, Animals and their Environment</td><td colspan="2" rowspan="2">Special Session: Reclaiming the Agricultural Potential of Grasslands and Savannas</td></tr>
<tr><td>11:20-12:35</td><td>Session: Plant Chemistry and Quality</td></tr>
<tr><td rowspan="2">12:35-13:00</td><td colspan="3">PLENARY SESSION
Athene Conference Centre 1 & 2</td></tr>
<tr><td colspan="3">Research Proposal Poster Viewing Session</td></tr>
<tr><td>13:00-14:00</td><td colspan="3">LUNCH (Bouzouki Restaurant)</td></tr>
<tr><td rowspan="2">14:00-15:30</td><td>PARALLEL SESSION A
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<tr><td>Special Session: The Whole and the Sum of the Parts: Exploring Alternative Approaches to Rangeland Management</td><td colspan="2">Session: Managing Biodiversity through Conservation Planning</td></tr>
<tr><td>15:30-15:50</td><td colspan="3">TEA (Athene Conference Centre Terrace/Bouzouki Restaurant)</td></tr>
<tr><td>15:50-18:20</td><td colspan="3">Annual General Meeting of the Grassland Society of Southern Africa (Athene Conference Centre 1 & 2)</td></tr>
<tr><td>19:00</td><td colspan="3">DINNER at Boesmanland Plaaskombuis</td></tr>
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TIME	PROGRAMME EVENTS		
Wednesday, 18 July 2012			
07:30-08:00	Registration (Athene Conference Centre Lobby)		
08:00-08:40	**PLENARY ADDRESS** Athene Conference Centre 1 & 2		
	Natural resource management and biodiversity conservation in the drylands of Eastern Africa, Mohammed Said, International Livestock Research Institute (ILRI), Kenya		
08:45-09:15	**PARALLEL SESSION A** Athene Conference Centre 1 & 2	**PARALLEL SESSION B** Athene Conference Centre 3 & 4	
	Session: African Rangelands and their People	**Special Session:** Bush Encroachment: Perspectives on Drivers, Dynamics and Management	
09:15-10:00	**Workshop:** Aligning Policy with the Socio-Ecological Dynamics of Rangeland Commons		
10:00-10:30	TEA (Athene Conference Centre Terrace/Bouzouki Restaurant)		
10:30-12:10	**Workshop:** Aligning Policy with the Socio-Ecological Dynamics of Rangeland Commons	**Special Session:** Bush Encroachment: Perspectives on Drivers, Dynamics and Management	
12:10-13:15		**Session:** New Approaches to Vegetation Description and Monitoring	
13:15-14:00	LUNCH (Bouzouki Restaurant)		
14:00-17:00	**Mid-Congress Tours:** • Combination Tour - Vula Environmental Services: A Scientific Approach to Environmental Rehabilitation at the West Coast Fossil Park: When the West Coast was WILD! • !Khwa ttu: A Celebration of the San Culture, Present and Past • Cape West Coast Biosphere Reserve: Focus on Langebaan RAMSAR Site and Educating Future Generations • Buffelsfontein Game and Nature Reserve: A Novel Approach to Alien Control		
17:00-18:30	**Sundowners on Langebaan Lagoon Boat Trip** (for own account, R100 per person)		
18:30	**GREEK THEMED DINNER** (Bouzouki Restaurant)		
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07:45-10:30	Registration (Athene Conference Centre Lobby)		
08:15-10:00	**PARALLEL SESSION A** Athene Conference Centre 1 & 2	**PARALLEL SESSION B** Athene Conference Centre 1 & 2	**PARALLEL SESSION C** Olympiad Conference Centre
	Session: Invasive Plants: Control and Utilization	**Session:** Production from Planted Pastures	**Session:** Water, Nutrients and Production in Rangelands
10:00-10:30	TEA (Athene Conference Centre Terrace/Bouzouki Restaurant)		
10:30-12:30	**PARALLEL SESSION A** Athene Conference Centre 1 & 2	**PARALLEL SESSION B** Athene Conference Centre 1 & 2	
	Special Session: Wildlife, Rangelands and the Services They Provide	**Special Session:** Sustainable Planted Pasture Systems	
12:30-13:30	LUNCH (Bouzouki Restaurant)		
13:30-15:00	**Session:** Rangeland Dynamics in Humid and Arid Environments	**Workshop:** Soil Quality for Sustainable Pasture Production	
15:00-15:30	TEA (Athene Conference Centre Terrace/Bouzouki Restaurant)		
15:30-16:15	**Session:** Rangeland Dynamics in Humid and Arid Environments	**Workshop:** Soil Quality for Sustainable Pasture Production	
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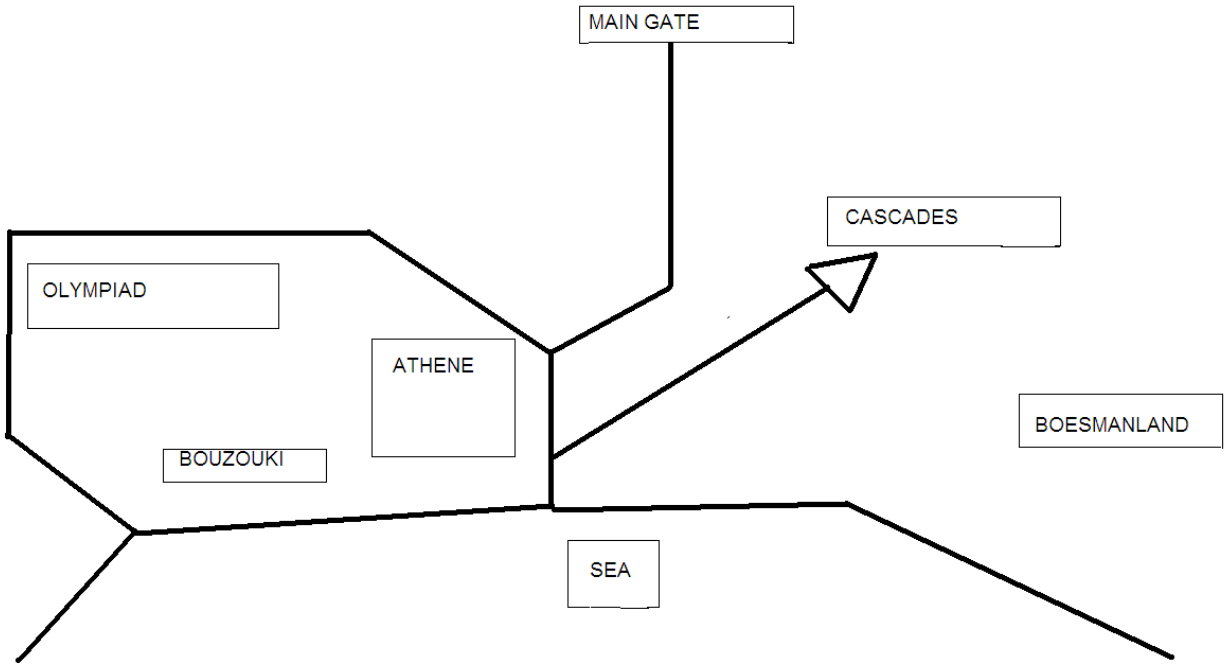
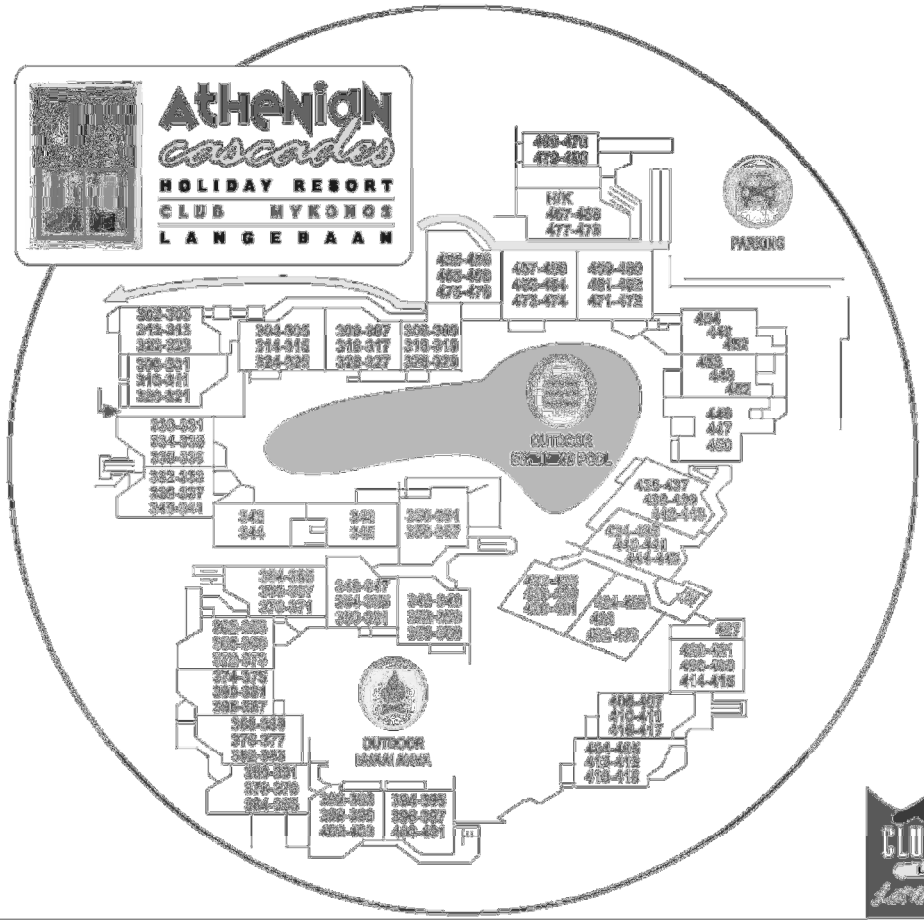
08:00-15:30	**Post-Congress Tours** (departing from outside Athene Conference Centre)**:** • Malgas Island & Verlorenvlei • Robben Island & Table Mountain		

CLUB MYKONOS CONGRESS LOCATIONS





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Clement F Cupido	Agricultural Research Council – Animal Production Institute
Shahieda Davids	South African National Biodiversity Institute - SKEP Co-ordination Unit
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Natasha Gabriels	Agricultural Research Council – Animal Production Institute
Jenifer Gouza	CapeNature
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Mmoto L Masubelele	University of Cape Town
Ian A Rushworth	Ezemvelo KZN Wildlife
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Pieter A Swanepoel	Western Cape Department of Agriculture
Melvin B V Swarts	Agricultural Research Council – Animal Production Institute
Wayne F Truter	University of Pretoria
Janke van der Colf	Western Cape Department of Agriculture
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Dianne Heesom-Green – Ceramic Artwork
Gretha Helberg – Framed Polymer Etching "Truck"
Denis Hilton Lees – Acrylic Seascape Painting
Judy Smit – Recycled Glass Bowl
Elmarié Smit – Still Life Oil Painting
Simply Bee - Gift Pack Full of Honey and Bee Skin Products

UPDATE: FRACKING SOUTH AFRICA – IMPLICATIONS FOR RANGELANDS

At the 46th Annual Congress of the Grassland Society of Southern Africa, a special session was held regarding the issue of fracking in the Karoo, in particular, and South Africa, in general. The money raised during the auction held at the Gala Dinner (R4 400.00) was handed over to Treasure the Karoo Action Group to assist them in their efforts to ensure that fracking does not have any negative effects on the South African environmental or social landscape. Below are two updates on the current position of fracking from Treasure the Karoo Action Group and Shell South Africa.

The funds raised at the Gala Dinner this year will also be handed to a worthy cause working against negative impacts on the South African environmental and social landscape. The chosen cause for this year has yet to be confirmed.

STATEMENT ON THE *STATUS QUO* OF THE SHALE GAS MINING DEBATE IN SOUTH AFRICA AS AT END JUNE 2012

Jonathan Deal

on behalf of

Treasure the Karoo Action Group, www.treasurethekaroo.co.za, email: natcoordinator@treasurethekaroo.co.za

The last 18 months, in international terms have not been good to the pro-fracking community. Many research papers have been released documenting previously unquantified costs and negative effects associated with fracking.

Formally recognized bans, moratoria and restrictions have increased to about 150 worldwide. This excludes the dozens of communities and places who are currently pushing for these measures.

The EPA in America released preliminary findings based on detailed study in Wyoming, that fracking did contaminate water aquifers, and in South Africa, a highly respected scientist, who

was initially pro-fracking has done a complete about turn after leading a competent team at the Institute of Groundwater Studies at the University of the Free State. Also at home, the Sunday times exposed a clear and direct ANC interest in the business affairs of Shell SA.

The Minister of Mineral Affairs is reputed to be planning to hand her task team report on fracking to Cabinet towards the end of July. We expect Cabinet to reflect on the document for a period, and will not be surprised thereafter to be informed that Cabinet has instructed the Minister to lift the moratorium and thus clear the way for the issuing of exploration licences.

Here are 9 fundamental reasons why fracking should not be considered in South Africa at this time. The main body of text first appeared on the Rhodes University Website – Criticalthought.co.za, authored by Jonathan Deal. Other articles in connection with fracking by the same author can also be viewed there.

Chickens and horses

Environmentalist, and anti-fracking lobbyist Jonathan Deal points out why shale gas mining applications should not succeed in South Africa at this time – and possibly ever.

Dating back to the 1970's and the emergence of the environmental movement in the US, multi-national corporations were schooled to trivialize environmental viewpoints. A simple, 'You're being emotional, we're scientific', was often sufficient to render the argument of environmentalists powerless in the face of economic forecasts and industry spin. The advent of the 'cost-benefit' analysis was particularly daunting for the environmental lobby, as for the first time, industry was able to place an arbitrary value on the environment to support its case for development. Anyone opposed to the development of a natural resource was shrewdly positioned by industry as being opposed to the growth of the economy, and a stumbling block in the path of the unemployed. And so, environmentalists shied away from an area that they perceived to be the strong ground of their opponents. Today in South Africa, and around the world, there's a new breed of environmentalist, and the oil-&-gas industry appear to be unsure on how to deal with them. In South Africa, we're not simply advocating a thorough cost-benefit analysis – we're insisting on it.

In the book 'Retaking Rationality', Levesz and Livermore, professors at New York University make a strong case for environmentalists to apply cost-benefit analysis as a tool. "It is time for progressive groups and ordinary citizens to retake the high ground by embracing cost-benefit analysis", they say. Referring in their text, to the 'emotional' label used by industry, they offer their view on the distinction between 'thinking' and 'feeling': "The difference between unthinking – failing to use the best tools to analyse policy – and unfeeling – making decisions without compassion is important – both lead to bad policy. Calamities can result from the failure to use either emotion or reason. Our emotions provide us with the grounding for our principles, our innate interconnectedness and our sense of obligation to build on that emotional foundation, and act effectively to bring about a better world." Now, in South Africa, the 'emotional' label has, in the last 15 months, been applied so often by the applicants to frack – and the government departments whose brief it is to exploit our mineral resources, that the anti-fracking lobby has of necessity eschewed any connection with that state-of-mind. This is not to say that we reject the role of emotion in reviewing information and making decisions, but rather that – at this stage – the language must be so science-and-fact based that it consequentially ignores emotion. There will be time enough for value-based considerations if this debate reaches the Constitutional Court, where the anticipated results of the actions of the shale gas industry and their proponents would be tested against our Bill of Rights.

And so, to the fact-based argument against fracking in South Africa; there are at least eight fundamental reasons why the applications to mine shale gas should not succeed. Some of these reasons present, in my view, insurmountable obstacles on a global scale. Others are germane to the South African context and the current applications.

1. As at April 22nd, shale gas mining is banned or under some form of moratorium or restriction in no less than 130 places globally. The list spans a spectrum that embraces villages and whole countries, such as France and Bulgaria. Essentially, this means that there are millions of people, represented by their governments, who choose not to licence fracking where they live, get their drinking water, grow their crops, produce meat and raise their children. There has been no answer from the applicants or the government in South Africa to this conundrum – this undeniable fact that presents a remarkably divergent view of fracking from the one enrobed in corporate marketing campaigns. And my contention, is that until, an intelligent and conclusive answer is provided, the moratorium on fracking in this country ought to stay in place.

2. There is a dearth of consensus surrounding the technology and its costs and benefits. Scientists and economists on both sides of the debate have weighed in on aspects ranging through carbon emissions, job creation, pollution, the life span of wells and many other hotly debated issues. Papers and viewpoints, many of them peer-reviewed are analysed and dissected by pro-and-anti groups, who alternately greet new reports with glee or dismay. The simple point is that although even the best science cannot be expected to be infallible, there is at this time, a gap in the opposing positions of the scientific and academic community that is too large to be ignored. The onus of proving the alleged bounty of shale gas mining is accordingly placed on those who seek to alter the status quo.

3. On March 27th, Minister Edna Molewa admitted to the national media in South Africa that there were 53 mines in South Africa operating without water licences. This fact highlights a larger problem related to mining operations in SA; the ability of state agencies to monitor and enforce environmental, safety and financial standards is dramatically inadequate. Not only in respect of existing mining operations but perhaps more especially in the policing of an industry that is challenging these standards even in much better funded and controlled environments such as the US.

4. South Africa does not possess any fracking-specific laws, guidelines or even policies. Perhaps the prime example of the relevant legislative developments in the USA is that which was produced by the New York State Department of Environmental Conservation in it's environmental impact statement ("the revised draft SGEIS") released in September 2011. The South African situation is similar to the current situation in New

York State in that, not only is there a lack of fracking-specific legislation, fracking operations cannot, due to what is now an extended moratorium, be authorised. There is, however, a crucial difference between those jurisdictions where the lawmakers are currently fashioning fracking-specific legislation, such as New York State, and the current South African approach to fracking. The difference is that fracking has already been undertaken in the USA and it is only now, as a result of a massive public outcry and perhaps the staggering number of fracking-related lawsuits, that legislation is being drafted to address the public's concerns. In other words, the horse has already bolted, so to speak, and the legislator is now trying to close the stable door.

5. A flawed investigation into fracking. The Department of Minerals (DMR) is on record as stating that 'the task team report will be completed and presented to Cabinet by the end of March 2012'. The Americans, in the second investigation into fracking, are taking no less than four years to deliver a final report in 2014. Data contained in the DMR affidavit indicates that the task team was unclear as to its mandate and composition as late as the end of August 2011. On this basis, it is both reasonable and logical, to ask if SA should be making an irreversible decision to permit shale gas mining, on the basis of an inadequate report - a report compiled in around one tenth of the time to be taken in the US, and from across the Atlantic. A report which excludes input from key ministries such as Transport, Tourism, Agriculture and Rural Development.

6. A lack of credibility of the oil-&-gas industry. Promises in national media to 'make an ecological example of the Karoo', and to 'leave the Karoo better than we found it' when juxtaposed with a litany of shale gas environmental violations in the US in 2011, by the very companies who have made these promises in SA, do nothing to advance their case here. Industry funded economic forecasts insularly underpinned by the popular oil-&-gas view ignore quantified knock-on costs to the fiscus, whilst lauding estimated knock-on benefits. Sight of the questionnaires applied in a 'public opinion survey' is refused by the company who conducted the industry funded survey which, alleges that more than 75% of South Africans are in favour of exploration of SA shale gas reserves. Why is it that the questions on which this result is alleged are concealed?

7. The precautionary principle. Under South African law, the environmental cause is championed by the National Environmental Management Act ("NEMA") which dictates that development, which would include the development of a shale gas mining industry, "must be socially, environmentally and economically sustainable." Significantly, in relation to this principle of sustainable development, NEMA dictates "that a risk averse and cautious approach is [to be] applied, which takes into account the limits of current knowledge about the consequences of decisions and actions." In other words, in line with the precautionary principle, South Africa's premier environmental statute dictates that when considering the possible advent of fracking in South Africa, "a risk averse and cautious approach" must be adopted.

8. And at home, Professor Gerrit van Tonder, released his findings on groundwater in the 'Karoo basin' – note – not only the Karoo proper. Here is the Press Statement of TKAG, dealing with that first report.

SA scientist confirms fracking will pollute groundwater

"Prof van Tonder's statement on the upward migration of fracking fluid into drinking water aquifers is literally ground breaking for South Africa." These were the words of Treasure Karoo Action Group chairman Jonathan Deal, responding to a report released by Prof. Gerrit van Tonder, of the Institute for Groundwater Studies, University of the Free State.

There is nothing ambiguous about the Professor's statements – upward migration of fracking fluids to groundwater zones will occur in the Karoo, and cement and steel well casings will inevitably deteriorate and fail over time. According to van Tonder's calculations, if only 1% of the cement and steel casings of wells to be drilled over the total application area were to fail, it would create thousands of pathways for upward migration to occur. It is not enough for industry to quote a period of 100 years or more for the integrity of a well – this may sound like a long time today, but is actually only the sum of two generations of South Africans," argued Deal, adding that "These facts are routinely denied or avoided by the applicants to frack in SA and by the oil and gas industry worldwide. We wonder, if for instance, this information is contained within the task team report, which is by all accounts, completed and soon on its way to Cabinet."

Deal was speaking from a conference in Johannesburg hosted by the Fossil Fuel Foundation, where he appeared as a presenter and member of the conference technical committee alongside well known scientists Professors Philip Lloyd of Cape Peninsula University of Technology (CPUT) and Dr. Danie Vermeulen of the Institute for Groundwater Studies.

Deal pointed out that TKAG had long been calling for a comprehensive assessment of fracking in SA across the scientific, environmental, social and economic spectrum, and emphasised that TKAG were extremely concerned about the conspicuous rush of the government to embrace fracking, and the delivery of what could only be an inadequate and poorly researched task team report to Cabinet. "If Minister Shabangu issues licences, even for exploration under these circumstances, she will literally guarantee litigation involving government, the applicants to frack and the South African tax payer."

Scientists from the Institute for Groundwater Studies have been consulted by the government task team on fracking and by the oil and gas industry in SA in connection with plans to mine shale gas here, and Prof. van Tonder has appeared as an expert speaker on this topic at shale gas conferences and presentations to industry and media.

Issued by HWB Communications Pty Ltd, on behalf of Treasure Karoo Action Group.

And so, to return to where we commenced, this debate has become fact-based and scientific. Pro-fracking industry should be compelled to answer reasonable questions and satisfy their obligation to prove that fracking is a benign technology. Government, before giving fracking the nod, even for exploration, ought to be convinced that shale gas mining is the best, and most sustainable mechanism for South Africa to create employment, generate energy and solve our greenhouse gas emissions challenges.

My contention is that this could logically be achieved on the back of a process which should include thorough scientific investigation – in line with the recommendation of Shell's own consultants, who advised that "SA should not decide before the US EPA results are released". The science alone may not make a case for shale gas mining, and this is where the cost-benefit analysis will serve SA.

A comprehensive and properly structured analysis would take into account not only the industry claimed benefits of shale gas, but would of necessity also scientifically and economically consider the value of South Africa's natural capital – eco-system services, provided unfailingly by the delicate balance of nature. These include the ability of the environment to provide water, grow crops, produce meat, regulate the weather and earn money from tourism. It may be worthwhile too, to consider the ability of alternative technologies to generate energy and jobs whilst reducing SA's carbon footprint, and also to take into account the existence of substantial natural gas reserves offshore, where many of the contentious issues related to fracking may be less so.

Whether one chooses to call this a cost-benefit analysis or a strategic environmental assessment, I believe that to proceed further down the road in SA in the absence of such a process is to impetuously count chickens before they're hatched and place carts before horses.

SHELL SOUTH AFRICA: AN UPDATE ON THE KAROO BASIN SHALE GAS PROJECT

Janine Nel

on behalf of

Shell South Africa, www.shell.co.za/karoo, email: janine.nel@shell.com

The National Planning Commission report of November 2011 provides an overview of the main challenges facing South Africa: poverty, inequality, unemployment, education and energy. It states that almost 10 million people in South Africa have no access to electricity. Shell's energy scenarios predict from 2000 to 2050, world energy demand may double. In South Africa, as a developing country, the growth in demand may even be higher. It is possible that the shale rocks under the Karoo hold significant economically recoverable natural gas reserves. If so, this resource may provide a significant contribution towards meeting South Africa's energy needs, in addition to addressing all four other challenges mentioned above.

The latest technology used to develop shale gas resources is new to South Africa, and as such some people understandably have concerns about the environmental impact that a shale gas development in the Karoo may have. Shell takes these concerns very seriously. We believe that the ecologically important Karoo can be protected even if it contains a national energy resource.

The first stage: exploration

- Objective is to find out if there is shale gas in the Karoo Basin
- If the presence of shale gas is confirmed, determine whether commercial quantities of gas can be produced
- Exploration wells will teach us more about groundwater in the Karoo
- Geophysical Acquisition (Magneto-Tellurics and Seismic) – some will be done before drilling to better understand the geology of the Karoo
- Before drilling commences, Shell will complete an environmental social and health impact assessment (ESHIA).
- The initial period of the exploration license is for three years. After that, the license can be renewed three times for two year periods. Shell may drill between 6 and 24 wells during the exploration period, spread out across Shell's three license areas.
- Activities may cease if exploration is not successful.
- Production is up to nine years away – only if exploration is successful.

Exploration wells

Wells are drilled in sections, each of which is lined with metal casing. The casing is cemented in the borehole to isolate the well from the surrounding rock layers. We pressurise each completed well section to test for leaks before proceeding to drill the next section. If the exploration wells confirm the presence of natural gas in the shale, the last section will be drilled horizontally,

keeping it entirely within the shale layer. The shale layer is then fractured to try to release the gas from the shale. Wells are generally between 2-3 km deep.

Hydraulic fracturing

Hydraulic fracturing – or "fracking" – involves pumping fluid out of a sealed-off section of a well to crack the surrounding rock and induce hair size fractures. The fluid typically consists of 99% water with a small amount of sand, and less than 1% chemical additives. Many of the chemicals used are biodegradable. The additives are selected according to the nature of the rock being fractured. The oil and gas industry has been fracking vertical wells for more than 60 years, and horizontal wells for more than 20 years. It is a routine operation used to help release more oil or gas from rocks. As long as the well is properly drilled and completed, and then pressure tested diligently, there should be no cause for concern.

Full field development

If we do decide to invest in a shale gas development in the Karoo after the exploration phase, it would typically involve some 50 drilling-rig sites, or well-pads. From each of these sites, which are about the size of a football pitch, as many as 32 wells might be drilled in different horizontal directions. These sites are typically spaced some four to five kilometres from each other. A development activity would thus be limited to a surface area that is less than one percent of the area that Shell has applied for and within this area, farming activities can continue in between the well pads.

Local job opportunities

An Econometrix economic study released in March 2012, estimates that gas resources of 20TCF (trillion cubic feet) and 50TCF respectively, could generate between 300,000 and 700,000 full-time jobs (both directly and indirectly related to the project), while contributing between three to 10% to South Africa's GDP. The complete economic benefit study can be found at www.shell.co.za/karoo. Limited jobs would be generated during the exploration stage as drilling rigs will need to be imported with skilled staff. However, Shell will support skills development (with tertiary institutions and academia) to ensure that a significant number of skilled South Africans can be employed during later gas development.

Decommissioning and rehabilitation

Following completed exploration and development activities, well sites will be decommissioned. If a well is decommissioned the process would involve placing cement at various places between the reservoir and the surface.

Shell will implement a site-specific land rehabilitation and restoration programme appropriate to the resilience of the Karoo vegetation and soils in line with industry practices and regulations. Shell will consult with local experts and communities to design and implement the most appropriate way to do this.

Shell's Karoo Commitments

We will lead in the setting of global best practices and operational standards for unconventional gas development in the Karoo.

Worldwide:

- Over the last 10 years, Shell has successfully developed tight-sandstone and shale gas fields in North America.

We will not compete with the people of the Karoo for their water needs. Nobody will go short of fresh water because of our operations either in the exploration phase, or if there is any further development.

Worldwide:

- Shell's GTL (gas to liquids) plant in Qatar (the largest of its kind in the world), was designed not to take fresh water from its arid surroundings.
- In 2010 at Groundbirch (Canada), Shell started operating water storage and recycling facilities that we built, to store fracturing and gas processing water for reuse. Pipelines transport the water to where it is needed in the field – limiting truck movement.

We will conserve and recycle the water we use wherever possible.

Worldwide:

- The return water is treated as industrial waste, not municipal waste.
- At Groundbirch in City of Dawson Creek (Canada), Shell invested in the construction of a reclaimed water plant for the City. The plant treats sewage and other waste water and will be reused in our operations and the local government (i.e. clean roads, water sports fields).
- At Pinedale and Groundbirch , we reuse gas-processing water for fracturing, reducing our water requirements by as much as 50%

Utilising best practices, we will work with impacted communities and landowners to address how they can receive direct benefits from shale gas developments. We will provide full compensation to any landowner who can show evidence of a direct negative impact or loss on their land as a result of our activities.

Worldwide:

- In China's Shanxi province (where we developed Changbei field), we funded the construction of 240 under-ground water-storage tanks and 12 water-pumping stations, providing some 3,000 people with better access to drinking water.
- In 2008, the natural gas industry in Louisiana, that includes Shell's Haynesville operations, generated more than more than $3.9 billion in new household earnings, leading to more than 30,000 jobs in that one state.

SHELL'S COMMITMENT TO SUSTAINABLE RESOURCE USE

Shell is committed to the sustainable utilisation of natural resources such as water and soils. Shell has proactively initiated a programme involving leading South African geohydrologists to characterise the groundwater resources of the Karoo. In the same manner, Shell will initiate a programme to determine the socio-ecological resilience of the Karoo.

GRASSLAND SOCIETY OF SOUTHERN AFRICA AWARDS

PLATFORM ADJUDICATION GUIDELINES

Each year the Society awards a medal and certificate for the **Best Presentation** and for the **Best Presentation by a Young Scientist**. Congress delegates are asked to help in this process by judging the platform presentations. The primary objective of these awards is to encourage and promote the standard of presentation of papers at the Congress. Platform presentations are expected to last for no more than 15 minutes and the audience and presenter are then provided with a five minute question and answer period. **The Norman Rethman Planted Pastures Award will be judged by an appointed panel of adjudicators.**

To qualify for the Best Presentation by a Young Scientist award, the presenter should meet one of the following criteria:

- be under the age of 35 at the start of the Congress, or
- have given seven or less presentations at prestigious scientific meetings, or
- have done seven or less years of work in the respective discipline associated with their presentation.

NB: Any person wishing to be considered for the Best Presentation by a Young Scientist award should enter their name with the Congress administrator before the start of the Congress

Session chairs should preferably appoint the adjudicators for the presentations in their session several hours before the session begins. Each platform presentation should be adjudicated by as many judges as possible, but session chairs should appoint **at least four judges per presentation**. Completed adjudication sheets should be collected by the session chair following the session and handed to the Congress administrator for data entry purposes.

Adjudicators give a value (1-10) to each of four questions. Considerable guidance is provided here to try to reduce variation. Additionally, judges are asked to indicate whether the subject of the presentation lies within their own interests. These values should provide some interesting patterns that will help us to be fairer in following years. Space is given for general comments about the presentation and these may be used in the case of a tie occurring but also to provide general feedback to the presenters. An example of an adjudication sheet follows on the next page.

POSTER ADJUDICATION GUIDELINES

An award is also given to the **Best Poster** on display during the Congress. Congress delegates are asked to assist in judging this award according to certain criteria which are given on the adjudication sheet. Posters will be accompanied by a three minute oral presentation which should summarise the important points presented on the poster. Two minutes are allocated to a brief question and answer session. **The Best Research Proposal Poster will be judged by an appointed panel of adjudicators.**

Session chairs must appoint the adjudicators for the presentations in their session several hours before the session begins. Each poster should be judged both BEFORE the oral presentation begins, i.e. before the session starts, and during the oral presentation. Each poster presentation should be adjudicated by as many judges as possible, but session chairs should appoint **at least four judges per presentation**. Completed adjudication sheets should be collected by the session chair following the session and handed to the Congress administrator for data entry purposes.

Essentially a poster should convey its primary message concisely, preferably within a three minute reading time. Adjudicators give a value (1-10) to each of four questions relating to the physical poster and to one question relating to the oral presentation. Considerable guidance is provided here to try to reduce variation. Additionally, judges are asked to indicate whether the subject of the presentation lies within their own interests. These values should provide some interesting patterns that will help us to be fairer in following years. Space is given for general comments about the presentation and these may be used in the case of a tie occurring but also to provide general feedback to the presenters. An example of a poster adjudication sheet follows after the platform adjudication sheet.

NB: Please note that adjudication results are sent to presenters following the end of the Congress – so positive and constructive comments are encouraged!!

GSSA ANNUAL CONGRESS PLATFORM PRESENTATION ADJUDICATION SHEET

Session Name:	
Presentation Title:	
Presenter Name:	

One	**The speaker's interaction with the audience was (CIRCLE YOUR SCORE):**	
A	Worse than I'd expect at this congress (no eye contact, stood with back to audience, did not speak audibly, etc)	1 2
B	Slightly below average – the speaker was not too bad, but needs to work on presentation skills.	3 4
C	Normal – I'd expect most presentations to be of this quality	5 6
D	Slightly above average – not a perfect presentation, but enjoyable	7 8
E	Better than I'd expect at this congress (the speaker had a very good rapport with the audience)	9 10
Two	**The quality of the visual aids was (CIRCLE YOUR SCORE):**	
A	Worse than I'd expect (too little/much information, too many/few, writing too small, pictures/graphs unclear, etc.)	1 2
B	Slightly below average – visual aids were not bad, but could use some work.	3 4
C	Normal – visual aids were understandable and supportive, and what I'd expect.	5 6
D	Slightly above average – visual aids on average were as I'd expect, but some of them stood out nicely	7 8
E	Better than I'd expect (the visual aids supported the presentation but did not distract the viewer, were exciting, gave me ideas on how I should structure visual aids in future)	9 10
Three	**The supporting evidence (data, case studies, reviews, etc.) was (CIRCLE YOUR SCORE):**	
A	Worse than I'd expect (too few data to draw conclusions, inappropriate analysis of data, omission of other important studies, poorly explained, over-complicated)	1 2
B	Slightly below average – the evidence generally held together, but there were some problems	3 4
C	Normal – the conclusions were supported by evidence and I understood what was going on	5 6
D	Slightly above average - similar to most presentations, but some of the information was particularly valuable	7 8
E	Better than I'd expect (complex ideas presented clearly, appropriate and interesting graphs, thorough reviews of other studies, clear link between data, theory and conclusions)	9 10
Four	**The overall value to the congress of this presentation was (CIRCLE YOUR SCORE):**	
A	Low (the talk did not contribute significantly to the session; perhaps should have been presented as a poster)	1 2
B	Slightly below average – valuable, but perhaps not to this audience, or the quality was a bit below average	3 4
C	Normal (this is the type of presentation I'd expect at this congress)	5 6
D	Slightly above average – similar to most other presentations, but more presentations should emulate this one	7 8
E	High (this contributed more than most other presentations)	9 10
Five	**The subject of this presentation is (TICK ONE):**	
A	Relatively foreign to me – many of the issues that are being discussed fall outside my experience and interests	
B	Relatively familiar to me – while I do not consider myself an expert in this field, I have an interest in the subject	
C	My area of direct interest – I am highly familiar with the subject, and I have direct experience in this field	

GENERAL COMMENTS RELATING TO THIS PLATFORM PRESENTATION:

GSSA ANNUAL CONGRESS POSTER PRESENTATION ADJUDICATION SHEET

Session Name:		
Presentation Title:		
Presenter Name:		
One	**The length and detail of the poster were (TICK ONE):**	
A	Too brief and lacking in detail	
B	Just right – I could read and understand it in 3 minutes or less	
C	Too busy, took too long to read and understand	
Two	**Poster presentation, i.e. colours, font size, use of graphs and pictures, etc. was (CIRCLE YOUR SCORE 1 - 10):**	
A	Terrible – this poster gave me a headache, and I could not work out what was going on	1 2
B	Below average – I could see what was going on, but some editing would really have improved things	3 4
C	Average – most of the posters at this congress have this quality presentation	5 6
D	Above average – fonts, colours, and pictures are well presented, and allow rapid appraisal and understanding	7 8
E	Spectacular - this should be used as an example of how to do a poster	9 10
Three	**The scientific content of the poster (CIRCLE YOUR SCORE):**	
A	Zero – the scientific content of this poster is totally unconvincing. Most information is wrong	1 2
B	Below average –too little information, faulty reasoning, statistics and/or results are flawed	3 4
C	Average – the information in this poster is what I would expect from this congress	5 6
D	Above average – the information here is interesting, exciting, and made me think	7 8
E	Fantastic – very interesting, publishable results	9 10
Four	**The overall value to the congress of this presentation was (CIRCLE YOUR SCORE):**	
A	Non-existent (no relevance to this type of congress)	1 2
B	Low (the poster did not contribute significantly to the session)	3 4
C	Acceptable (this is the type of poster I was expecting to see)	5 6
D	High (this contributed more than most other posters)	7 8
E	Exceptional (this was a highlight of the session, and one of the top contributions to the congress; this poster presenter should be encouraged to present platform presentations around this topic in the future)	9 10
Five	**The quality of the oral presentation (CIRCLE YOUR SCORE):**	
A	Awful – the speaker did not convey what the poster was about in the allocated time.	1 2
B	Below average – some information came across, but the speaker really should try harder	3 4
C	Average – what I was expecting, and most other presentation are like this	5 6
D	Above average – the speaker used the allocated time well, and the audience were left wanting more	7 8
E	Spectacular – this speaker held the audience enthralled – people will remember this talk for years to come	9 10
Six	**The subject of this presentation is (TICK ONE):**	
A	Relatively foreign to me – many of the issues that are being discussed fall outside my experience and interests	
B	Relatively familiar to me – while I do not consider myself an expert in this field, I have an interest in the subject	
C	My area of direct interest – I am highly familiar with the subject, and I have direct experience in this field	
GENERAL COMMENTS RELATING TO THIS POSTER PRESENTATION:		

THE PETER EDWARDS AWARD

This award is made each year to a land-user in the area of the annual Congress in recognition of the sound application and practice of the principles of range and forage science and conservation.

Objective: The aim of the award is to recognise top farmers in different areas of southern Africa, and thereby encourage the wise use of natural resources.

Criteria:
Potential recipients are identified by the Congress Organising Committee each year. The recipients are short-listed and farms or land-units visited by an adjudication panel comprising members of the Organising Committee and local advisory personnel. The recipient need not be a member of the GSSA but should be encouraged to join. Considerations when identifying potential candidates might include the following:

- The recipient should be utilising veld (range and/or pasture for domestic livestock production and/or game farming.
- Farming practices should include, as far as possible, sound cultural and management practices which are recommended to ensure the optimum economic utilisation, conservation and reclamation of natural resources.
- Contribution to his/her community by way of participation and leadership in study groups, soil conservation committees, organised agriculture, etc.
- Where a group is identified to receive the award, for example, a study group or soil conservation committee or a tribal authority or a community making use of communal land, the leader in such a group would receive the award on behalf of such a group.

THE FAUX PAS AWARD

"Every village has its own idiot . . .
Every circus has its own clown . . .
But this trophy is dedicated
to our very own star . . ."

Johannes Evert Kappeyne van de Coppello was the first recipient of this coveted award which first made itself known at the 30th Annual Congress held in Kroonstad in January 1995. Each year, Congress delegates have kept their eyes and their ears open to find the most deserving Village Idiot amongst the group and so far it has always found a home to keep it safe and in prominent view for the year.

So make a note of all the hilarious moments, the embarrassing moments, the "oops" moments, and cast your vote for the winner of the Faux Pas award of the 47th Annual Congress of the Grassland Society of Southern Africa. Nominations should be received by Thursday 19th July at 3pm. Hand them in at the registration desk.

SCIENTIFIC PROGRAMME

MONDAY 16 JULY 2012

TIME	TITLE	PRESENTER
OPENING PLENARY SESSION (Athene Conference Centre)		
Opening of the 47th Annual Congress of the Grassland Society of Southern Africa (Session Chair: M Igshaan Samuels)		
18:00-18:05	*Welcome*	***M Igshaan Samuels***
18:05-18:15	*Opening Address*	***Jim Walsh***
18:15-18:30	*Presidential Address*	***Wayne F Truter***
18:30-18:35	*Introduction of Keynote Speaker: Johan P Hattingh*	***M Igshaan Samuels***
18:35-19:20	*Keynote Address:* Adaptation and human flourishing in an era of global climate change	***Johan P Hattingh***
19:20-19:30	*Questions & Discussion*	
19:30-19:40	*Opening of Pêrels & Pampoene Art Gallery's 1st Winter Exhibition*	***Gretha Helberg***
19:40	**MEET & GREET BUFFET** (Athene Conference Centre)	

KEYNOTE ADDRESS: ADAPTATION AND HUMAN FLOURISHING IN AN ERA OF GLOBAL CLIMATE CHANGE

Johan P Hattingh

Stellenbosch University, Department of Philosophy, Stellenbosch, email: jph2@sun.ac.za

In this talk, I will undertake a value-critical analysis of policy responses to climate change, focusing in particular on what is regarded by many as the failure (or inadequacy) of policies and policy proposals based on political, market based and technical "solutions". I will then discuss a human rights agenda and a human security framework as a possible point of departure for an alternative approach to resolving the challenges of global climate change as they threaten the flourishing of both human and non-human life on earth.

Johan Hattingh is Professor of Philosophy at the University of Stellenbosch. Based at this university since 1980 where he taught a wide variety of themes in undergraduate and graduate courses, he specialized over the last twenty years in Applied Ethics, Professional Ethics, Ideology Critique, Development Ethics, and particularly in Environmental Ethics. In his current research and teaching, he focuses on the problem of integrating ethical considerations in environmental decision-making, and in particular on institutional responses to the ethical issues related to climate change. Until recently, he was chair of the Research Ethics Committee (Human Research: Humanities) of Stellenbosch University; and currently he still is chair of the Research Ethics Committee of the CSIR. He is also member of ECRA, the Research Ethics Committee for Research on Animals of the Medical Research Council. From 2004 to 2011 he was member of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) of UNESCO, where he also served on the Executive Board as Rapporteur since 2005. From January 2013 he will be Dean of the Faculty of Arts and Social Sciences of Stellenbosch University.

Currently he also is:

- Editor of the section on Environmental Ethics of the *Southern African Journal of Environmental Education, Ethics and Action*
- Member of the Editorial Board of the Netherlands based *Journal of Agricultural and Environmental Ethics* (since January 2007)
- President of BEN-Africa (the Business Ethics Network – Africa) since July 2008 for a period of four years
- Board Member of SpringerBriefs in Ethics (since 2011).

TUESDAY 17 JULY 2012

TIME	TITLE	PRESENTER	PAGE
PLENARY SESSION (Athene Conference Centre 1 & 2) **(Session Chair: Rina (C) C Grant)**			
08:00-08:40	*Invited Keynote* Address: Fire management in Australian tropical savannas: biodiversity, greenhouse gas abatement and Indigenous livelihoods	***Alan N Andersen***	***29***
PARALLEL SESSION A (Athene Conference Centre 1 & 2)			
Rangeland Fire: People, Policy and the Environment (Session Chair: Rina (C) C Grant)			
08:45-09:05	*Platform Presentation:* Prescribed burning in India – a key factor in promoting tiger conservation	***Winston S W Trollope***	***30***
09:05-09:10	*Poster Presentation:* Will burnt Karoo veld ever recover?	***Loraine van den Berg***	***30***
09:10-09:30	*Platform Presentation:* Effects of frequency of fire on soil water repellency and hydrologic conductivity	***Mota S Lesoli***	***31***
09:30-09:35	*Poster Presentation:* Impact of veld fires on the environment in affected areas of the North-West Province, South Africa	***J Tinus (A) D Breedt***	***31***
09:35-09:55	*Platform Presentation:* Open ended fire breaks – a significant development in fire management in South Africa	***Lynne A Trollope***	***33***
09:55-10:00	Discussion		
10:00-10:30	**TEA AND GROUP PHOTOGRAPH** (Athene Conference Centre Terrace/Bouzouki Restaurant)		
Interactions between Plants, Animals and their Environment (Session Chair: H Gilbert Pule)			
10:30-10:50	*Platform Presentation:* Minerals in the communal livestock production system of northern Namibia	***Axel Rothauge***	***35***
10:50-11:10	*Platform Presentation:* The effects of body size, diet and seed characteristics on seed recovery and germination of *Dichrostachys cinerea* and *Acacia nilotica* seeds	***T Julius Tjelele***	***36***
11:10-11:15	*Poster Presentation:* Movement patterns and impact of giraffe (*Giraffa camelopardalis*) on the woody plants of a small fenced area in the central Free State	***Francois Deacon***	***37***
11:15-11:20	*Poster Presentation:* Livestock pastoral system and savanna management proposal in peripherical zone of National Park Ankarafantsika in North West of Madagascar: case of Saint Marie Zone	***Arsène J M Randrianariveloseheno***	***37***
Plant Chemistry and Quality (Session Chair: Ntuthuko R Mkhize)			
11:20-11:40	*Platform Presentation:* Differential phenolic profiles in six African savanna woody species in relation to antiherbivore defense	***Dawood Hattas***	***39***
11:40-12:00	*Platform Presentation:* Condensed chemical and tannin composition of *Acacia nilotica*, *Dichrostachys cinerea* and *Ziziphus mucronata* harvested from different sites in South Africa	***Kgabo T Mahlako***	***39***
12:00-12:05	*Poster Presentation:* Season and veld type influence nutrient concentrations of toxic *Dichapetalum cymosum* (gifblaar) in South African rangelands	***H Gilbert Pule***	***40***
12:05-12:10	*Poster Presentation:* The quantification of condensed tannins in African savanna tree species	***Dawood Hattas***	***41***
12:10-12:30	*Platform Presentation:* Browse: quantity and nutritive value of evergreen and deciduous tree species in semi-arid southern African savannas	***Kevin P Kirkman***	***41***
12:30-12:35	*Poster Presentation:* Influence of defoliation on crude protein content of two Karoo shrub species	***Paul J Malan***	***42***
PLENARY SESSION (Athene Conference Centre 3 & 4)			
Research Proposal Poster Viewing Session			
12:35-13:00	*Research Proposal Poster:* Long-term effect of season of burning on Photosynthetically Active Radiation, Leaf Area Index, biomass production and soil chemical properties in the Döhne sourveld of the Eastern Cape, South Africa	***Zamukulunga Ndovela***	***44***
	Research Proposal Poster: The use of high yielding C4 grasses as a source of organic material for soil compaction alleviation and mitigation	***Amanuel B Abraha***	***44***

TIME	TITLE	PRESENTER	PAGE
	Research Proposal Poster: Hydro seeding versus conventional seeding for the re-vegetation of reclaimed surface coal mined lands	***Johan P Viljoen***	***45***
	Research Proposal Poster: Assessing soil microbe and plant diversity in two renosterveld vegetation types around Nieuwoudtville, Northern Cape Province	***Gabrielle M Solomon***	***46***
	Research Proposal Poster: Rangeland resources and governance: a case study on ephemeral wetlands as key resource areas for commonage users in the Kamiesberg Uplands, Namaqualand	***Melvin B V Swarts***	***46***
	Research Proposal Poster: Cattle as a management tool in protected areas - promoting community/conservation partnerships?	***Mike J S Peel***	***47***
	Research Proposal Poster: Challenges in fodder production in Macubeni, Eastern Cape, South Africa	***Landiwe T Zondi***	***48***
	Research Proposal Poster: Improving rainwater productivity for fodder through site specific nutrient management in smallscale livestock farming community in Ha-Lambani, Limpopo Province	***Gabriel Lekalakala***	***49***
	Research Proposal Poster: Fire and wetlands - yes or no?	***Linda Luvuno***	***50***
	Research Proposal Poster: Browsing-fire interaction on rangelands dominated by woody plant species	***M Michael Mokwala***	***50***
	Research Proposal Poster: Euryops pyroides encroachment in Eastern Cape communal rangelands: indigenous and scientific understandings of effects on range ecology, food security and climate change	***Masibonge Gxasheka***	***51***
	Research Proposal Poster: Effect of altitude and season on the yield and nutritive value of selected grass species in the Eastern Cape communal grazing areas	***Ayanda Kwaza***	***52***
	Research Proposal Poster: Effects of watering points on vegetation and soil in three land use systems of the Eastern Cape, South Africa	***Siyabulela Simanga***	***52***
	Research Proposal Poster: Assessment of range condition for improvement of Nguni cattle performance in the Komga and Pedi communal areas of the Eastern Cape, South Africa	***Mthunzi Mndela***	***53***
	Research Proposal Poster: Long term changes in the herbaceous layer between Athole Research Farm and Nooitgedacht Agricultural Development Centre in the Highveld of Mpumalanga Province	***M Collen Rabothata***	***53***
	Research Proposal Poster: Production potential of lucerne (*Medicago sativa*) over-sown into kikuyu (*Pennisetum clandestinum*)	***Ilze Fourie***	***54***
	Research Proposal Poster: The evaluation of different planting methods for over-sowing grass-clover mixtures into a kikuyu pasture	***Janke van der Colf***	***55***
	Research Proposal Poster: The effect of biogas slurry on fodder production at Macubeni community in the Eastern Cape	***Nobuntu Mapeyi***	***56***
13:00-14:00	**LUNCH** (Bouzouki Restaurant)		

PARALLEL SESSION A (Athene Conference Centre 1 & 2)

The Whole and the Sum of the Parts: Exploring Alternative Approaches to Rangeland Management (Session Chair: Kevin P Kirkman)

14:00-14:40	*Invited Keynote* Address: Holism: The future of range science to meet global challenges	***Jozua J S Lambrechts***	***58***
14:40-15:00	*Platform Presentation:* The use of fire and oxen as management tools in the rehabilitation of upland *Cymbopogon - Themeda* veld in the Eastern Cape, South Africa	***Robin Ford***	***58***
15:00-15:20	*Platform Presentation:* Climate-smart animal agriculture: the importance of adapted breeds of cattle in sustainable veld–livestock farming systems	***Heleen C Els***	***59***
15:30-15:50	**TEA** (Athene Conference Centre Terrace/Bouzouki Restaurant)		

GRASSLAND SOCIETY OF SOUTHERN AFRICA ANNUAL GENERAL MEETING (Athene Conference Centre 1 & 2)

15:50-15:55	Welcome	***Wayne F Truter***	
15:55-16:00	Present and apologies	***Wayne F Truter***	

TIME	TITLE	PRESENTER	PAGE
16:00-16:05	Additions to and acceptance of the agenda	***Wayne F Truter***	
16:05-16:10	Approval of the minutes of 12 July 2011	***Wayne F Truter***	
16:10-16:20	Matters arising: Congress 48 (2013)	***Chris S Dannhauser***	
16:20-16:30	Treasurer's report	***Justin C O du Toit***	
16:30-16:40	Scientific Editor's report	***Susi Vetter***	
16:40-16:50	Publication Editor's report	***T Julius Tjelele***	
16:50-17:00	Website Editor's report	***Lisa Hebbelmann***	
17:00-17:10	Public Relations Officer's report	***M Igshaan Samuels***	
17:10-17:20	Professional Affairs Committee report	***Leslie R Brown***	
17:20-17:30	Trust report	***Chris S Dannhauser***	
17:30-17:35	Election of Office Bearer: Vice President	***Wayne F Truter***	
17:35-17:40	Election of Office Bearer: Honorary Secretary	***Wayne F Truter***	
17:40-17:45	Election of Office Bearer: Honorary Treasurer	***Wayne F Truter***	
17:45-17:50	Election of Office Bearers: Additional Members (2)	***Wayne F Truter***	
17:55-18:05	General: Congress 49 (2014)	***Paul J Malan***	
18:05-18:15	General: Congress 50 (2015)	***Janet M Taylor***	
18:15-18:20	Date of next meeting	***Wayne F Truter***	

PLENARY ADDRESS (Athene Conference Centre 1 & 2) **(Session Chair: Rina (C) C Grant)**

08:00-08:40	*Invited Keynote* Address: Fire management in Australian tropical savannas: biodiversity, greenhouse gas abatement and Indigenous livelihoods	***Alan N Andersen***	***29***

PARALLEL SESSION B (Athene Conference Centre 3 & 4)

Restoration of Natural Ecosystems (Session Chair: Wayne F Truter)

08:45-09:25	*Invited Keynote* Address: Restoration of degraded grasslands and savanna: the environmental consultant's perspective	***Roy A Lubke***	***61***
09:25-09:35	*Poster Presentation:* Vegetation dynamics to assess restoration actions to combat land degradation in the semi-arid rangeland savannas of the Molopo in the North West Province, South Africa	***Christiaan J Harmse***	***62***
09:35-09:45	*Poster Presentation:* The impacts of land degradation and restoration actions on the vegetation dynamics in the Mier district of the Northern Cape, South Africa	***J Albert van Eeden***	***62***
09:45-10:05	*Platform Presentation:* Increasing adoption of warm-season, subtropical and tropical forage legumes for rangeland rehabilitation and cultivated pastures in southern Africa	***Jim P Muir***	***63***
10:05-10:30	**TEA AND GROUP PHOTOGRAPH** (Athene Conference Centre Terrace/Bouzouki Restaurant)		

Reclaiming the Agricultural Potential of Grasslands and Savannas (Session Chair: Roy A Lubke)

10:30-11:10	*Keynote Address:* The impact of surface coal mining on the agricultural potential of the grassland biome: an overview	***Wayne F Truter***	***65***
11:10-11:30	*Platform Presentation:* Heavy metals accumulation in shoots of Rhodes (*Chloris gayana*), thatch (*Hyparrhenia hirta*) and vetiver (*Vetiveria zizanioides*) grasses grown on gold, platinum and gypsum mine tailings	***Hans Kgasago***	***65***
11:30-11:50	*Platform Presentation:* Investigating the alleviation effect of different vegetative grass species root development on compacted surface mine soils	***Theo G Bredell***	***66***
11:50-12:10	*Platform Presentation:* Evaluating the effect of pre-establishment techniques on the post-emergence vigour of *Eragrostis curvula*	***Dirk J Coetzee***	***67***
12:10-12:20	*Poster Presentation:* The use of Landscape Function Analysis (LFA) and PHYTOTAB as rehabilitation monitoring tools at an opencast coal mine	***Flip (P) J J Breytenbach***	***67***
12:20-12:35	Discussion		

PLENARY SESSION (Athene Conference Centre 3 & 4)

Research Proposal Poster Viewing Session

12:35-13:00	*Research Proposal Poster:* Long-term effect of season of burning on Photosynthetically Active Radiation, Leaf Area Index, biomass production and soil chemical properties in the Döhne sourveld of	***Zamukulunga Ndovela***	***44***

TIME	TITLE	PRESENTER	PAGE
	the Eastern Cape, South Africa		
	Research Proposal Poster: The use of high yielding C4 grasses as a source of organic material for soil compaction alleviation and mitigation	***Amanuel B Abraha***	***44***
	Research Proposal Poster: Hydro seeding versus conventional seeding for the re-vegetation of reclaimed surface coal mined lands	***Johan P Viljoen***	***45***
	Research Proposal Poster: Assessing soil microbe and plant diversity in two renosterveld vegetation types around Nieuwoudtville, Northern Cape Province	***Gabrielle M Solomon***	***46***
	Research Proposal Poster: Rangeland resources and governance: a case study on ephemeral wetlands as key resource areas for commonage users in the Kamiesberg Uplands, Namaqualand	***Melvin B V Swarts***	***46***
	Research Proposal Poster: Cattle as a management tool in protected areas - promoting community/conservation partnerships?	***Mike J S Peel***	***47***
	Research Proposal Poster: Challenges in fodder production in Macubeni, Eastern Cape, South Africa	***Landiwe T Zondi***	***48***
	Research Proposal Poster: Improving rainwater productivity for fodder through site specific nutrient management in smallscale livestock farming community in Ha-Lambani, Limpopo Province	***Gabriel Lekalakala***	***49***
	Research Proposal Poster: Fire and wetlands - yes or no?	***Linda Luvuno***	***50***
	Research Proposal Poster: Browsing-fire interaction on rangelands dominated by woody plant species	***M Michael Mokwala***	***50***
	Research Proposal Poster: Euryops pyroides encroachment in Eastern Cape communal rangelands: indigenous and scientific understandings of effects on range ecology, food security and climate change	***Masibonge Gxasheka***	***51***
	Research Proposal Poster: Effect of altitude and season on the yield and nutritive value of selected grass species in the Eastern Cape communal grazing areas	***Ayanda Kwaza***	***52***
	Research Proposal Poster: Effects of watering points on vegetation and soil in three land use systems of the Eastern Cape, South Africa	***Siyabulela Simanga***	***52***
	Research Proposal Poster: Assessment of range condition for improvement of Nguni cattle performance in the Komga and Pedi communal areas of the Eastern Cape, South Africa	***Mthunzi Mndela***	***53***
	Research Proposal Poster: Long term changes in the herbaceous layer between Athole Research Farm and Nooitgedacht Agricultural Development Centre in the Highveld of Mpumalanga Province	***M Collen Rabothata***	***53***
	Research Proposal Poster: Production potential of lucerne (*Medicago sativa*) over-sown into kikuyu (*Pennisetum clandestinum*)	***Ilze Fourie***	***54***
	Research Proposal Poster: The evaluation of different planting methods for over-sowing grass-clover mixtures into a kikuyu pasture	***Janke van der Colf***	***55***
	Research Proposal Poster: The effect of biogas slurry on fodder production at Macubeni community in the Eastern Cape	***Nobuntu Mapeyi***	***56***
13:00-14:00	**LUNCH** (Bouzouki Restaurant)		
PARALLEL SESSION B (Athene Conference Centre 3 & 4)			
Managing Biodiversity through Conservation Planning (Session Chair: Tony (A) Swemmer)			
14:00-14:20	*Platform Presentation:* The economic contribution of ecosystem services in KwaZulu-Natal, South Africa	***Steve McKean***	***69***
14:20-14:40	*Platform Presentation:* Using threatened and endemic species to prioritise conservation action for intact Highland grassland	***Ian T Little***	***69***
14:40-15:00	*Platform Presentation:* Exploring the mesofilter as a novel operational scale in conservation planning: a case study from South Africa's remnant montane grassland	***Casper J Crous***	***71***
15:00-15:20	*Platform Presentation:* Conserving grassland biodiversity by using ecological networks across the commercial timber landscape	***James S Pryke***	***72***
15:20-15:25	*Poster Presentation:* The policy framework for biodiversity and	***Vhali P Khavhagali***	***72***

TIME	TITLE	PRESENTER	PAGE
	climate change response		
15:25-15:50	**TEA** (Athene Conference Centre Terrace/Bouzouki Restaurant)		
GRASSLAND SOCIETY OF SOUTHERN AFRICA ANNUAL GENERAL MEETING (Athene Conference Centre 1 & 2)			
15:50-15:55	Welcome	***Wayne F Truter***	
15:55-16:00	Present and apologies	***Wayne F Truter***	
16:00-16:05	Additions to and acceptance of the agenda	***Wayne F Truter***	
16:05-16:10	Approval of the minutes of 12 July 2011	***Wayne F Truter***	
16:10-16:20	Matters arising: Congress 48 (2013)	***Chris S Dannhauser***	
16:20-16:30	Treasurer's report	***Justin C O du Toit***	
16:30-16:40	**Scientific Editor's report**	***Susi Vetter***	
16:40-16:50	Publication Editor's report	***T Julius Tjelele***	
16:50-17:00	Website Editor's report	***Lisa Hebbelmann***	
17:00-17:10	Public Relations Officer's report	***M Igshaan Samuels***	
17:10-17:20	Professional Affairs Committee report	***Leslie R Brown***	
17:20-17:30	Trust report	***Chris S Dannhauser***	
17:30-17:35	Election of Office Bearer: Vice President	***Wayne F Truter***	
17:35-17:40	Election of Office Bearer: Honorary Secretary	***Wayne F Truter***	
17:40-17:45	Election of Office Bearer: Honorary Treasurer	***Wayne F Truter***	
17:45-17:50	Election of Office Bearers: Additional Members (2)	***Wayne F Truter***	
17:55-18:05	General: Congress 49 (2014)	***Paul J Malan***	
18:05-18:15	General: Congress 50 (2015)	***Janet M Taylor***	
18:15-18:20	Date of next meeting	***Wayne F Truter***	

WEDNESDAY 18 JULY 2012

TIME	TITLE	PRESENTER	PAGE
PLENARY ADDRESS (Athene Conference Centre 1 & 2) **(Session Chair: James Gambiza)**			
08:00-08:40	*Invited Keynote* Address: Natural resource management and biodiversity conservation in the drylands of Eastern Africa	***Mohammed Y Said***	***74***
PARALLEL SESSION A (Athene Conference Centre 1 & 2)			
African Rangelands and their People (Session Chair: James Gambiza)			
08:45-09:05	*Platform Presentation:* Communal farmers' indigenous knowledge and perceptions on livestock production, rangeland management and dynamics of the feed resource base in two communal areas of the Eastern Cape Province of South Africa	***F Alice Gwelo***	***75***
09:05-09:10	*Poster Presentation:* The National Veld and Forage Policy as a key component of a broader approach towards the sustainable use of natural agricultural resources in South Africa	***Keith A Ramsay***	***75***
09:10-09:15	*Poster Presentation:* Rangeland management and drought coping strategies for livestock farmers in the semi-arid savanna communal areas of Zimbabwe	***Bethwell Moyo***	***76***
Workshop: Aligning Policy with the Socio-Ecological Dynamics of Rangeland Commons (Workshop Facilitators: Monique L Salomon, M Igshaan Samuels and Susi Vetter)			
09:15-09:20	Opening and welcome	***Monique L Salomon***	
09:20-09:40	*Position Paper:* Development and sustainable management of rangeland commons – aligning policy with the realities of a changing rural landscape in South Africa	***Susi Vetter***	***78***
09:40-10:00	*Response Paper:* Livestock and communal rangelands in land and agrarian reform	***Ruth Hall***	***78***
10:00-10:30	**TEA** (Athene Conference Centre Terrace/Bouzouki Restaurant)		
Workshop: Aligning Policy with the Socio-Ecological Dynamics of Rangeland Commons (Workshop Facilitators: Monique L Salomon, M Igshaan Samuels and Susi Vetter)			
10:30-10:45	*Response Paper:* Institutional support for more effective monitoring and management of communal rangelands in South Africa	***Keith A Ramsay***	***78***
10:45-11:00	*Response Paper:* Wildlife or livestock? New directions for developing communal grazing land in South Africa	***Petronella Chaminuka***	***78***
11:00-11:15	*Response Paper:* The importance of herd mobility in South African rangeland commons	***M Igshaan Samuels***	***78***
11:15-11:30	*Response Paper:* The good sheperd: remedying the fencing syndrome	***Clement F Cupido***	***78***
11:30-11:45	*Response Paper:* Crop/livestock interactions: what does it mean for farmers and for policy makers?	***Brigid Letty***	***78***
11:45-12:00	*Response Paper:* Sustainable management of rangeland commons: can local practice effectively inform policy?	***Harry May***	***78***
12:00-12:15	*Response Paper:* Youth and agriculture: Deconstructing rural youth perceptions	***Melvin B V Swart***	***78***
12:15-12:45	Discussion in working groups		
12:45-12:55	Feedback and way forward		
12:55-13:00	Closure		
13:15-14:00	**LUNCH** (Bouzouki Restaurant)		
14:00-17:00	**Mid-Congress Tours** (Gathering point outside the Athene Conference Centre)		
PLENARY ADDRESS (Athene Conference Centre 1 & 2) **(Session Chair: James Gambiza)**			
08:00-08:40	*Invited Keynote* Address: Natural resource management and biodiversity conservation in the drylands of Eastern Africa	***Mohammed Y Said***	***74***
PARALLEL SESSION B (Athene Conference Centre 3 & 4)			
Bush Encroachment: Perspectives on Drivers, Dynamics and Management (Session Chair: Cobus (J) O Botha)			
08:45-09:25	*Invited Keynote Address*: CO2 and other global change *influences* vs local drivers	***William J Bond***	***82***
09:25-09:45	*Platform Presentation:* An analysis of woody cover change in the mesic eastern region of South Africa using repeat photography	***James R Puttick***	***82***
09:45-09:52	*Poster Presentation:* Vegetation change in Zululand, KwaZulu-Natal,	***Jennifer M Russell***	***83***

TIME	TITLE	PRESENTER	PAGE
	since the Anglo-Zulu War of 1879		
09:52-10:00	*Poster Presentation:* Assessing *Acacia nilotica* establishment on long-term monitoring sites, uMkhuze Game Reserve	***Janet M Taylor***	***83***
10:00-10:30	**TEA** (Athene Conference Centre Terrace/Bouzouki Restaurant)		
Bush Encroachment: Perspectives on Drivers, Dynamics and Management (Session Chair: Cobus (J) O Botha)			
10:30-10:50	*Platform Presentation:* Long-term vegetation change (1900-2010) in the Karoo Midlands biomes with climate and land use as drivers change	***Mmoto L Masubelele***	***84***
10:50-11:10	*Platform Presentation:* Are fires less important in arid areas?	***Dave F Joubert***	***84***
11:10-11:30	*Platform Presentation:* Tree-grass competition along a catenal gradient in a mesic grassland, South Africa	***Michelle J Tedder***	***85***
11:30-11:50	*Platform Presentation:* Restoration versus wood utilization - a potential conflict of interest in dealing with bush thickened areas in the Northern Cape	***G Nico Smit***	***85***
11:50-12:10	*Platform Presentation:* Tools and strategies for combatting bush encroachment: A case history of the development of an expert system for bush encroachment in Namibia. Successes, failures and challenges for the future	***Dave F Joubert***	***86***
New Approaches to Vegetation Description and Monitoring (Session Chair: Ian T Little)			
12:10-12:30	*Platform Presentation:* BECVOL 3 - an expansion of the above-ground biomass quantification model for trees and shrubs	***G Nico Smit***	***87***
12:30-12:35	*Poster Presentation:* VolCalc: Using digital photographs to determine tree dimensions and canopy volume	***Alan S Barrett***	***87***
12:35-12:40	*Poster Presentation: Possible* key species for veld condition assessment of the Lambert's Bay Strandveld along the West Coast of South Africa	***Nelmarié Saayman***	***88***
12:40-13:00	*Platform Presentation:* New methods for measuring grass biomass in semi-arid rangelands	***Tony (A) Swemmer***	***8989***
13:00-13:05	*Poster* Presentation: Using CyberTracker software in vegetation monitoring	***P Hanno (J) Kilian***	***91***
13:05-13:10	*Poster Presentation:* Optimizing variable importance for the selection of key grass species for the Zululand Lowveld	***Cobus (J) O Botha***	***91***
13:10-13:15	*Poster Presentation:* Support for the VEGMAP division of vegetation types along the West Coast of South Africa	***Nelmarié Saayman***	***91***
13:15-14:00	**LUNCH** (Bouzouki Restaurant)		
14:00-17:00	**Mid-Congress Tours** (Gathering point outside the Athene Conference Centre)		

THURSDAY 19 JULY 2012

TIME	TITLE	PRESENTER	PAGE
PARALLEL SESSION A (Athene Conference Centre 1 & 2)			
Invasive Plants: Control and Utilization (Session Chair: Dawood Hattas)			
08:15-08:35	*Platform Presentation:* Resistance of the grass weed wild oat (*Avena fatua L.*) to flamprop-m-isopropyl herbicide in Assiut Farmland, Egypt	***Sayed A Ahmed***	***93***
08:35-08:55	*Platform Presentation:* Biological control of *Cereus jamacaru* (queen of the night cactus) in the Thornveld of the Limpopo Province, South Africa	***Jorrie J Jordaan***	***94***
08:55-09:15	*Platform Presentation:* Assessing the impacts of *Acacia mearnsii (*dywabase; black wattle) on grazing provision and livestock production in South Africa	***Thozamile Yapi***	***95***
09:15-09:35	*Platform Presentation:* The influence of invasion by *Pteronia incana* on landscape functioning and local pastoralists' perceptions on invasion	***James Gambiza***	***95***
09:35-09:55	*Platform Presentation:* Genetic diversity studies of *Seriphium plumosum* - a grassland encroacher plant	***Mzamose Hadebe***	***96***
09:55-10:00	*Poster Presentation:* How *Chromolaena odorata* affects phytodiversity, productivity and pastoral value of Guinean pastures in Benin (Western Africa)	***Valentin M Kindomihou***	***96***
10:00-10:30	**TEA** (Athene Conference Centre Terrace/Bouzouki Restaurant)		
Wildlife, Rangelands and the Services They Provide (Session Chair: Harry C Biggs)			
10:30-11:10	*Invited Keynote* Address: Rangeland sustainability, capital and investment in ecosystem services: a social-ecological systems approach	***Urs P Kreuter***	***98***
11:10-11:30	*Platform Presentation:* Big tree trends in the Sabi Sand Wildtuin of South Africa: with implications for rangeland management	***Mike J S Peel***	***99***
11:30-11:50	*Platform Presentation:* Managing elephant in large conservation areas: a wicked problem with no definitive solution	***Rina (C) C Grant***	***99***
11:50-12:10	*Platform Presentation:* Direct benefits from ecosystem services in South African National Parks – A case study of thatch and mopane worm harvesting in Kruger National Park	***Louise K Swemmer***	***100***
12:10-12:15	*Poster Presentation:* Effect of moisture and nutrients on coppice response of harvested *Terminalia sericea* tree stumps	***Hlonipani P M Mthunzi***	***101***
12:15-12:20	*Poster Presentation:* Status of game species on private and provincial game reserves in the Free State, including exotic and TOPS species	***Beanélri Janecke***	***102***
12:20-12:25	*Poster Presentation:* Economic aspects relating to wildlife and wildlife-based activities in the eastern Lowveld savanna, South Africa	***Mike J S Peel***	***102***
12:25-12:30	Discussion		
12:30-13:30	**LUNCH** (Bouzouki Restaurant)		
Rangeland Dynamics in Humid and Arid Environments (Session Chair: P Hanno (J) Kilian)			
13:30-13:50	*Platform Presentation:* A reconstruction of Ngongoni Veld in the absence of livestock	***C Rob Scott-Shaw***	***104***
13:50-14:10	*Platform Presentation:* Long-term changes of the vegetation on the plateau areas of Mountain Zebra National Park: 1980 – 2011	***Leslie R Brown***	***104***
14:10-14:30	*Platform Presentation:* Biodiversity and edaphic factors in grasslands of the Free State, South Africa	***Mamokete N V Dingaan***	***105***
14:30-14:50	*Platform Presentation:* Rangeland degradation in Swaziland: dip–tank use effects on woody plant structure and range condition in three soil types	***Solomon B Tefera***	***106***
14:50-14:55	*Poster Presentation:* Influence of different veld management strategies on biomass production within a 16 year trial in the False Thornveld of the Eastern Cape	***Craig Trethewey***	***106***

TIME	TITLE	PRESENTER	PAGE
14:55-15:00	*Poster Presentation:* A pilot study on the value of karroid species for grazing in semi-arid savanna and thicket	***Theunis L Morgenthal***	***107***
15:00-15:30	**TEA** (Athene Conference Centre Terrace/Bouzouki Restaurant)		
15:30-15:50	*Platform Presentation:* Land deterioration of a semi-desert grazing area in the north-eastern zone of Libya (Cyrenaica)	***Yakub M El-Barasi***	***108***
15:50-16:10	*Platform Presentation:* Effects of overgrazing, habitat transformation and rainfall on the structure and spatial patterning of soil seed banks: a fence-line contrast approach from arid Namibia	***Niels Dreber***	***108***
16:10-16:15	*Poster Presentation:* Evaluation of range conditions in Kwezana and Dikidikana communal rangelands of the Eastern Cape, South Africa	***Thembelihle Mjamba***	***109***
PARALLEL SESSION B (Athene Conference Centre 3 & 4)			
Production from Planted Pastures (Session Chair: Janke van der Colf)			
08:15-08:35	*Platform Presentation:* Dry material production of *Cenchrus ciliaris* (blue buffalo grass) treated with organic fertilizer enhancers	***Jorrie J Jordaan***	***111***
08:35-08:40	*Poster Presentation:* The dry matter production of eight sub-tropical grass species under rain-fed conditions in the southern Cape of South Africa	***M Dalena (M) Lombard***	***112***
08:40-09:00	*Platform Presentation:* The evaluation of dry matter yield and forage quality for four pastures as influenced by three frequencies of flood irrigation in the False Upper Karoo	***Phillip T Nengwenani***	***113***
09:00-09:05	*Poster Presentation:* The effect of planting date on the seasonal growth pattern of different annual winter fodder crops	***Chris S Dannhauser***	***114***
09:05-09:10	*Poster Presentation:* Acceptability of selected pearl millet cultivars by goats	***Chris S Dannhauser***	***115***
09:10-09:30	*Platform Presentation:* The effect of seed coating on the germination and emergence of lucerne (*Medicago sativa L.*) in sub-optimal environments	***Leana Nel***	***116***
09:30-09:35	*Poster Presentation:* Feasibility study on establishment methods of *Lespedeza cuneata* (Serecia) in the Highveld of Mpumalanga Province	***Thabile J Mokgakane***	***117***
09:35-09:40	*Poster Presentation:*	***Yvette Brits***	***118***
09:40-09:45	*Poster Presentation:* Overwintering of Drakensbergers steers on veld or supplemented kikuyu pastures in the Highveld of Mpumalanga Province	***Modau N Magoro***	***119***
10:00-10:30	**TEA** (Athene Conference Centre Terrace/Bouzouki Restaurant)		
Sustainable Planted Pasture Systems (Session Chair: Philip R Botha)			
10:30-11:05	*Invited Keynote Address:* Future challenges for the dairy industry	***Nelius van Greunen***	***120***
11:05-11:15	Discussion		
11:15-11:30	Platform Presentation: Kikuyu based pasture systems for sustainable milk production	***Janke van der Colf***	***121***
11:30-11:40	Discussion		
11:40-11:55	*Platform Presentation:* Profitability of milk production from kikuyu/ryegrass pasture	***Robin Meeske***	***122***
11:55-12:05	Discussion		
12:05-12:20	*Platform Presentation:* Sustainability of planted pastures in a no-till system	***Pieter A Swanepoel***	***123***
12:20-12:30	Discussion		
12:30-13:30	**LUNCH** (Bouzouki Restaurant)		

TIME	TITLE	PRESENTER	PAGE
Soil Quality for Sustainable Pasture Production (Session Chair: Jim P Muir)			
13:30-14:10	*Invited Keynote Address:* Peering beneath carbon offsets and soil surfaces	***Anthony J Mills***	***124***
14:10-14:30	*Invited Platform Presentation:* The essence of mesofaunal diversity in soils	***Schalk v d M Louw***	***125***
14:30-14:50	*Invited Platform Presentation:* The microbial ecology of pasture soils	***Wijnand J Swart***	***126***
14:55-15:00	Discussion		
15:00-15:30	**TEA** (Athene Conference Centre Terrace/Bouzouki Restaurant)		
15:30-15:50	*Invited Platform Presentation:* Nematodes as bio-indicators of soil health with special reference to pastures	***Sheila G Storey***	***127***
15:50-16:10	*Platform Presentation:* Establishing baseline values for soil quality indicators in the southern Cape	***Pieter A Swanepoel***	***127***
16:10-16:15	Discussion		
PARALLEL SESSION C (Olympiad Conference Centre)			
Water, Nutrients and Production in Rangelands (Session Chair: Sue J van Rensburg)			
08:15-08:35	*Platform Presentation:* A water-use efficiency map for southern African rangelands – integrating net primary production and evapotranspiration	***Tony (A) R Palmer***	***129***
08:35-08:55	*Platform Presentation:* How does continuous grazing effect evapotranspiration on an Eastern Cape grassland?	***Andiswa Finca***	***130***
08:55-09:15	*Platform Presentation:* Predicting C3 and C4 grass nutrient variability using in-situ canopy reflectance	***Clement Adjorlolo***	***130***
09:15-09:35	*Platform Presentation:* Mapping grass nutrients as an indicator of rangeland (forage) quality using remote sensing in the savanna ecosystems	***Abel Ramoelo***	***131***
09:35-09:55	*Platform Presentation:* Analysis of remotely sensed data to estimate aboveground biomass production along a rainfall gradient in the Eastern Cape	***Theunis L Morgenthal***	***131***
09:55-10:00	*Poster Presentation:* Rainfall over the Eastern Cape Province associated with cut-off lows	***Samuel Molekwa***	***132***
10:00-10:30	**TEA** (Athene Conference Centre Terrace/Bouzouki Restaurant)		
CONTINUE TO PARALLEL SESSIONS A OR C (Athene Conference Centre)			
Scientific Programme of the 47th Annual Congress of the Grassland Society of Southern Africa ENDS			

ABSTRACTS: TUESDAY 17 JULY 2012

*Note: *Presenting Author (if more than one author), #Corresponding Author (if different from presenting author)*

Rangeland Fire: People, Policy and the Environment

SESSION CHAIR: RINA (C) C GRANT

Tuesday 17 July 2012, 08:00 – 09:35

Keynote Address and Platform and Poster Presentations

INVITED KEYNOTE ADDRESS: FIRE MANAGEMENT IN AUSTRALIAN TROPICAL SAVANNAS: BIODIVERSITY, GREENHOUSE GAS ABATEMENT AND INDIGENOUS LIVELIHOODS

Alan N Andersen

CSIRO Sustainable Ecosystems, Tropical Ecosystems Research Centre, Darwin, Australia, email: alan.andersen@csiro.au

Anthropogenic burning has been a dominant feature of the vast savanna landscapes of northern Australia for more than 50 000 years, with currently about 400 000 km^2 burned each year. Traditional Aboriginal burning has been severely disrupted following European colonisation, which has seen Aboriginal people move off their traditional estates into regional towns. Fire is now largely unmanaged across large regions, and this has resulted in fire regimes dominated by extensive, high-intensity fires occurring late in the dry season. There is widespread concern that such fire regimes are seriously degrading regional biodiversity values, and, in particular, are contributing to the dramatic population declines in many small mammals that have occurred across northern Australia in recent decades. It is likely that fire is interacting with other threatening processes, especially by increasing rates of predation by feral cats. Savanna burning makes a significant contribution to Australia's greenhouse gas emissions, and there is growing interest in reducing fire extent and severity in a greenhouse gas abatement context. In addition to improving biodiversity management, this has the potential to transform regional economies in northern Australia, especially by providing culturally appropriate livelihood opportunities for remote Aboriginal communities where mainstream economies are very limited. CSIRO has formed a partnership with the Aboriginal people of the Tiwi Islands north of Darwin to examine the biophysical, economic and social potential of fire management for greenhouse gas abatement on the Tiwi Islands. The Tiwi Carbon Study features a major new long-term fire experiment, where Tiwi land management rangers are working with CSIRO scientists to document the effects of experimental fires on carbon sequestration and biodiversity. Combined with social research on the willingness and capacity of Tiwi people to change current fire management practices, results will be used to develop an integrated Tiwi fire management plan that best meets the cultural, environmental and economic aspirations of Tiwi people.

PLATFORM PRESENTATION: PRESCRIBED BURNING IN INDIA – A KEY FACTOR IN PROMOTING TIGER CONSERVATION

Winston S W Trollope[1], Lynne A Trollope[1], Chris de Bruno Austin[1], H S Pabla[2], H S Mohanto[2], J S Chauhan[2], Rangaiah Sreenivasamurthy[2] and C K Patil[2]*

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At the invitation of Dr H S Pabla, Principal Chief Conservator of Forest (Wildlife), a fire ecology team from Working on Fire International visited the Kanha, Bandhavgarh, Panna and Pench Tiger Reserves in Madhya Pradesh India during November/December 2011. The aim of the visits was to assess the ecological status and necessity for prescribed burning in the grassland and forest communities supporting the wild ungulate populations in the four tiger reserves as a management strategy for conserving the highly threatened tiger population in India. Surprisingly a field assessment of the herbaceous grass sward in the grassland and open forest communities in the different reserves showed remarkable similarities to the grass genera and species occurring in African grasslands and savannas. Grass species like *Themeda triandra, Heteropogon contortus, Digitaria eriantha,* and *Eragrostis* and *Sporobolus* species were both common and dominant to varying degrees in the different vegetation units. Consequently the following criteria used for prescribed burning in African grasslands and savannas were applied to formulate fire regimes for the different tiger reserves:

- Prescribed burning should not be applied if the grass sward is in a pioneer condition dominated by Increaser II grass species caused by overgrazing. This is to enable the grass sward to develop to a more productive stage dominated by Decreaser grass species. Conversely when the grass sward is in an under grazed condition dominated by Increaser I species, it needs to be burnt to increase the better fire adapted and more productive and palatable Decreaser grass species.
- Prescribed burning is necessary when the grass sward has become overgrown and moribund as a result of excessive self-shading. These conditions develop when the standing crop of grass is generally >4000 $kg.ha^{-1}$ as estimated with a disc pasture meter.

These criteria were used to formulate and recommend appropriate fire regimes for the four tiger reserves. These were based on preliminary assessments of the condition of the vegetation. The recommendations were accepted and the implementation of the burning program is being monitored with post burn vegetation surveys.

POSTER PRESENTATION: WILL BURNT KAROO VELD EVER RECOVER?

Loraine van den Berg[*] and Justin C O du Toit

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Fire is a major driver of rangeland structure and composition. In the Karoo, it is likely that fire has historically been a rare occurrence, except possibly in mountainous areas where fuel loads are often relatively high. The limited amount of work that has been conducted on the effects of fire on karroid vegetation suggests that a single fire may kill many species of dwarf shrubs, resulting in a collapse of their populations. Another driver of the vegetation composition of karroid rangelands is rainfall, where wet summers benefit grasses (C_4) more than dwarf shrubs (C_3). The rainfall in the Eastern Upper Karoo has been significantly higher than average over the past approximately twenty years, and this has led to an increase in grass growth and fuel accumulation. A third important driver of community composition is grazing, where there would be two anticipated effects: first, grazing may kill newly germinating plants; second, summer grazing generally benefits dwarf shrubs, while winter grazing generally benefits grasses.

This project, still in its early stages, explores the interaction between fire, rainfall, grazing, and vegetation in the Eastern Upper Karoo, with the main aim of determining whether a combination of high rainfall and fire, possibly modified by grazing, will drive a change towards a grassier landscape.

The study is being undertaken on the farm The Mills, situated 12 km from Hanover towards Richmond in the Northern Cape. On 24 October 2011, 652 ha of natural vegetation were burnt during an uncontrolled accidental fire. This fire provided the baseline for an experiment into drivers of vegetation change in the area.

In January 2012, soil samples (to a depth of 15 cm) were collected and vegetation composition was described on burnt and unburnt veld. Species composition was assessed using the descending point method (200 points replicated thrice in each survey site). As very little rain had fallen since the fire, identification of plants to genus and species level was impossible and only the life form of the plant closest to the point was recorded, i.e. grass, dwarf shrub, or pioneer (ephemeral).

There were no significant differences in soil chemistry and structure between the burnt and unburnt sites. Detrended Correspondence Analyses (DCA) testing the correlation between the different survey sites as well as their correlation to the various life forms showed a strong similarity between the four unburnt sites and between the four burnt sites. The unburnt sites were correlated with the dwarf shrub life form, while the burnt sites were closely correlated with grass, pioneer life forms, and bare ground. It was obvious that dwarf shrubs were largely absent on the burnt sites three months after the burn occurred.

The short-term effects of the fire, therefore, were restricted to the relative abundance of life forms, and canopy cover (for which bare ground is a proxy), with soil chemical and physical characteristics appearing unaffected. Monitoring will continue over the next ten years to document changes. It is anticipated that the experiment will have important implications for understanding vegetation dynamics after burning, in the presence of a changing climate.

PLATFORM PRESENTATION: EFFECTS OF FREQUENCY OF FIRE ON SOIL WATER REPELLENCY AND HYDROLOGIC CONDUCTIVITY

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Fire is an extensively used management technique to simultaneously achieve several objectives in southern Africa savanna rangelands. However, fire is one of the key causative factors of soil water repellency, through its potential to cause the build-up of a water repellent soil layer. This occurs via the translocation of volatilised water repellent organic compounds into the soil profile, which condense in cooler soil layers and coat soil aggregates. The objective of the study was to determine the effects of rangeland fire and its frequency on soil water repellency.

The study was conducted at the long-term burning site of the University of Fort Hare Honeydale Farm (32° 47'S, 26° 52'E and altitude of 518 m). The mean annual rainfall is 500 mm of which 70% occurs between October and March. The maximum temperature ranges between 26 – 41°C and the minimum ranges from 5 – 11°C. The vegetation type is Bhisho Thornveld, which consists of grasses infrequently interspersed with *Acacia karroo*. The rangeland is in good condition for livestock production purposes and consists of dense sward dominated by *Themeda triandra, Panicum maximum* and some invasion of *Digitaria eriantha* and *Sporobolus spp*. The main karroid shrub is *Chrysocoma tenuifolia*. The soil is silty loam of the Glenrosa form or Ochric Cambisol, which is characteristically shallow with a stony surface.

The experiment was established in 1980 on a freshly burnt site to ensure relative uniformity in vegetation and soil conditions at the take off point for all treatments. The burning treatments consist of annual, biennial, triennial, quadrennial and sexennial burns, and a control (no burn). Each treatment was laid out on a 100 m x 50 m plot with a border space of five meters between plots. The experiment was laid out in completely randomised design with two replicates. Burning of the plots takes place every August and it is often preceded by a vegetation assessment exercise.

Water Drop Penetration Time (WDPT) and Mini Disc Infiltrometer (MDI) tests were conducted at six depths (0, 1, 2, 3, 4, and 5 cm) at six systematically selected locations along two parallel 100 m line-transects. The results for both MDI and WDPT indicate that the control and quadrennial burning treatments absorbed more water per minute than the other treatments. There was a negative relationship between MDI and WDPT, indicating that the infiltration rate increased with the reduced time for WDPT. This implies that, at the plots that were not burnt, WDPT was shorter but a higher volume of water was absorbed. Quadrennial burning was observed to be the best burn treatment for optimum soil infiltration and water repellency.

POSTER PRESENTATION: IMPACT OF VELD FIRES ON THE ENVIRONMENT IN AFFECTED AREAS OF THE NORTH-WEST PROVINCE, SOUTH AFRICA

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Fires are often used in grassland and savanna management, but uncontrolled fires may cause severe damage to vegetation and soil components, especially if grass and trees are utilized afterwards by livestock for grazing and browsing.

In August 2011, extreme wind speeds encouraged fires to sweep through grasslands and savannas in the North-West Province. On 23 August 2011 there were an estimated thirteen fires burning simultaneously, destroying grazing and the infrastructure on many farms, mainly in the Ventersdorp, Lichtenburg and Amalia areas. Shortly afterwards the area was declared a “disaster area” by the National Government. The African Centre for Disaster Studies (ACDS) at the North-West University was asked to do an assessment of the damage caused by the fires. As part of the technical task team, the School of Environmental Sciences and Development evaluated the damage caused by the fire on certain vegetation (grasses and trees) and soil parameters.

The FIXMOVE (Fixed Point Monitoring of Vegetation) methodology was used to determine the grazing capacity, patch distribution composition and some phenological parameters (reproductive or vegetative) of grasses with a certain ecological status. Canopy cover, density, height and browsing capacity of the woody species were determined.

The surveys were conducted 5 to 6 months after the fires occurred in burned and unburned plots characterised by the same habitat conditions (soil and topography). Results show that in the burned sites, the average grazing potential for all areas was 9.11 $ha.LSU^{-1}$, compared to 4.85 $ha.LSU^{-1}$ for the unburned sites. In terms of the composition in ecological status of grasses, the burned sites had a higher frequency of Decreaser and Increaser II grass species than the unburned sites, but this difference was tested and found to be insignificant. The percentage bare patches was much higher in burned sites than in unburned sites, while organic matter was higher in unburned sites. Browsing capacity and canopy cover were lower in the burned sites than in the unburned sites. A difference in browsing capacity of 6.33 $ha.BU^{-1}$ was found between the burned and unburned sites. The fire was followed by a very dry summer with lower than average annual rainfall making the recovery of grasslands and savannas difficult.

The information provided by this study will be used by the ACDS in their larger project to provide information on the planning, policy and decision-making regarding fires in the North-West Province. Results are also to be used as a guideline for National Government in the payment of compensation to farmers after an area has been declared a disaster area due to uncontrolled fire events.

PLATFORM PRESENTATION: OPEN ENDED FIRE BREAKS – A SIGNIFICANT DEVELOPMENT IN FIRE MANAGEMENT IN SOUTH AFRICA

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The necessity for developing an effective, economical and safe method of creating fire breaks along boundaries and/or over extensive distances using minimum manpower and fire fighting equipment is sorely needed. Recent developments in Australia using aerial ignition of fires have provided a possible and practical means of creating cost effective and ecologically acceptable **open ended fire breaks** spanning vast distances. These are effective in controlling damaging wild fires and are aesthetically in keeping with natural landscapes in conservation areas like the Kruger National Park in South Africa. Such fire breaks are based on the concept that controlled burns applied as a continuous ignition line in the late afternoon/early evening to partially cured grass fuels during the late summer, will burn and spread very slowly and will subsequently be extinguished when dew forms later in the night. Recent trials in South Africa have successfully developed continuous lines of fire using an Aerial Incendiary Device attached to a Bell 206 helicopter which delivers an ignition capsule that ignites after a delay of 30 to 40 seconds with pin point accuracy using a GPS which allows for safe burning. Best Operating Procedures (BOP's) detailing parameters such as grass fuel loads, percentage grass curing, air temperature, relative humidity and wind speed required to ensure the safe application of this technique have been developed and tested. The prescriptive weather conditions for late afternoon/early evening ensure the subsequent formation of dew during the night resulting in the fire dying out. These BOP's have paved the way for safely developing extended **open ended fire breaks** in the Kruger National Park.

Interactions between Plants, Animals and their Environment

SESSION CHAIR: H GILBERT PULE

Tuesday 17 July 2012, 10:00 – 11:10

Platform and Poster Presentations

PLATFORM PRESENTATION: MINERALS IN THE COMMUNAL LIVESTOCK PRODUCTION SYSTEM OF NORTHERN NAMIBIA

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Namibia's agricultural sector depends on extensive meat production (ranching) in commercial and communal areas, contributes 5-8% of GDP and offers a livelihood to about two-thirds of the population (mainly in communal areas). Communal rangeland is traditionally utilized by open access grazing but land is increasingly fenced. An initiative funded by the Millennium Challenge Account intends to improve animal health and nutrition in the northern communal areas (NCA, 31% of the land area with 1.1 million people, 1.5 million cattle and 1.1 million goats) to integrate them into the export-driven commercial beef sector south of the veterinary cordon fence. One component, the community-based rangeland and livestock management (CBRLM) programme, aims to improve rangeland condition, predominantly by directed herding of livestock. Another component, a baseline nutrition survey, aims to establish the level of nutrients in soil, drinking water, forage plants, cattle and goats in two paired sites in each of the four major agro-ecological zones (AEZ) of the NCA (Kaokoveld/KO, Kalkveld/KA, Ekuma Floodplains/EFP, Kalahari Sand Plateau/KSP) during the three seasons of the year (cold-dry and hot-dry seasons 2011, hot-wet season 2012). Sample sites were characterized botanically and functionally. Only the analyses of the cold-dry season are currently available. Following the baseline survey, a nutrient supplementation pilot trial will attempt to address observed nutrient deficiencies.

Chemical analysis of dominant rangeland soils (sampled to 30 cm depth) across all AEZ indicated generally low nutrient content except for K and Mg. However, KSP soils stood out due to their low to extremely low conductivity (1.4 $mS.m^{-1}$), active organic matter (0.4%) and content of extractable P (0.6 ppm), N (0.03%), Na (5.5 ppm), K (25.5 ppm) and Ca (240 ppm). In all AEZ, nutrient content of soils taken from cultivated fields did not differ much from rangeland soils despite occasional application of manure and crop rotation. A slightly elevated fluoride level was measured in 25% of the drinking water samples.

Analysis of animal tissue indicated widespread mineral deficiencies in the dry season in the NCA. The P content of faeces of cattle (236±71.7 $mg.100g^{-1}$ OM) and goats (273±86.5 $mg.100g^{-1}$ OM) exceeded the threshold value of 200 $mg.100g^{-1}$ OM in all AEZ, but the P content of blood serum was considerably less than optimum (4 $mg.dL^{-1}$) in EFP cattle, KA cattle and KO goats and marginal in KSP cattle and KA goats. A P deficiency was confirmed by observations of pica in the field. Analyses of liver samples indicated moderate Cu and severe Zn deficiency in most AEZ; the latter more pronounced in goats than in cattle. This was confirmed by Cu and Zn analysis of blood serum: only the level of Cu in goat serum exceeded the requirement (80 $\mu g.dL^{-1}$). The Zn content of hair was also far below the requirement (250 ppm) in all AEZ and livestock types. Liver Mn content was severely deficient in livestock of all AEZ. Liver Fe content was satisfactory across all livestock and AEZ but was appreciably lower in goats than in cattle. Liver Co and Se content were satisfactory in livestock of all AEZ, as was the level of Mg in blood serum. The Ca content of serum was marginally deficient in livestock of all AEZ except in KA. Faecal N levels were marginal in cattle of all AEZ (1.4±0.27% DM) but sufficient in goats (1.9±0.24% DM). The extremely low level of Se, Cd and Pb in hair indicated absence of pollution but Ar in hair (0.7±0.46 ppm) exceeded the safe level in cattle and goats in all AEZ. The iodine level of milk could not be determined because of the high fat content of milk.

Standing, air-dry herbaceous yield increased from west to east along with average rainfall from 220 $kg.ha^{-1}$ in the drier KO (250-300 $mm.yr^{-1}$) to 2 205 $kg.ha^{-1}$ in the wetter KSP (550-600 $mm.yr^{-1}$). Similarly, 1.5 m-high bush equivalents increased west-east from 2 925 to 8 075 per hectare. Judging by the contribution to yield of climax grasses (8.7±0.13%), *Aristida* grasses (16.5±0.15%) and the density of woody seedlings (4 400 per ha), all sampling sites were degraded.

Nutrient supplementation (*per os,* sub-cutaneous) will commence in the cold-dry season of 2012 to address observed deficiencies. It is hoped that the combination of improved livestock nutrition, health and rangeland condition (through the CBRLM programme) will facilitate the integration of communal meat farmers in the NCA into Namibia's lucrative meat export market.

In conclusion, soils in northern Namibia generally exhibit a low level of plant nutrients except for K and Mg. Drinking water was generally safe for livestock except for occasionally slightly elevated F content. During the cold-dry season, herbaceous standing biomass increased from west to east by a factor of 10, in accordance with a doubling in rainfall and tripling in bush density along the same gradient. Rangeland condition at all sites appeared to be degraded. A variety of tissue samples drawn from cattle and goats in the northern communal areas of Namibia during the cold-dry season indicated widespread mineral deficiencies, especially of Cu, Zn and Mn but not of Co and Se. A subsequent phase of the trial, when livestock will receive nutrient supplements, will attempt to address the observed deficiencies.

PLATFORM PRESENTATION: THE EFFECTS OF BODY SIZE, DIET AND SEED CHARACTERISTICS ON SEED RECOVERY AND GERMINATION OF *DICHROSTACHYS CINEREA* AND *ACACIA NILOTICA* SEEDS

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The pods of many woody plant species form an important part of the diet of livestock during the dry season due to their high nutritive value. The objectives of this study were to determine the effect of animal species (goats *vs* sheep and goats *vs* cattle), diet (*Medicago sativa* (lucerne) hay and *Digitaria eriantha* (grass) hay) and seed characteristics (size, hardness) on the effectiveness of animal seed dispersal and potential germination of *Dichrostachys cinerea* and *Acacia nilotica* seeds. The mean ± SE length of *A. nilotica* seeds (6.9 ± 0.1) was larger than *D. cinerea* seeds (4.2 ± 0.1). Each animal in all comparison (goats *vs* sheep and goats *vs* cattle) (n = 20 of each livestock species) received 1000 *A. nilotica* seeds and 1000 *D. cinerea* seeds mixed with feed. We assessed the effects of the abovementioned factors on seed recovery from the dung and then on germination percentage. Owing to a difference in the time of performing this study, we compared goats and sheep and then goats and cattle separately. In the goats *vs* sheep comparison, a significant effect of diet (lucerne hay 47.40% ± 4.65; grass hay 30.21% ± 3.24) was observed on cumulative percentage seed recovery. No significant effect of animal species and seed type was found on seed recovery (goats *vs* sheep comparison). Diet (lucerne hay 5.30% ± 0.67; grass hay 7.53% ± 0.84) and seed type (*D. cinerea* 7.54% ± 0.72; *A. nilotica* 5.20% ± 0.82) had a significant effect on mean cumulative germination percentage in this comparison. In the goats *vs* cattle study, the only significant factor was animal species, both on seed recovery (goats 31.98% ± 6.44; cattle 50.29% ± 4.27) and cumulative germination percentage (goats 14.07% ± 1.48; cattle 9.33% ± 0.94). The results show that animal species, diet and seed characteristics play a role in seed dispersal and germination of *D. cinerea* and *A. nilotica* seeds.

POSTER PRESENTATION: MOVEMENT PATTERNS AND IMPACT OF GIRAFFE (*GIRAFFA CAMELOPARDALIS*) ON THE WOODY PLANTS OF A SMALL FENCED AREA IN THE CENTRAL FREE STATE

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Various game farmers struggle to find the balance between stocking rate and stocking with suitable species. This statement is in particular true if natural resources are explored and utilised. This study was conducted on a wildlife estate located in the grassland biome of the central Free State. Despite being located within the grassland biome, the vegetation can in part be classified as riparian thicket with an abundance of *Acacia karroo, Searsia lancea, Olea europaea, Diospyros lycioides* and *Ziziphus mucronata* trees. In common with many game ranches in the region some game species were not historically present and it is thus essential to study their adaptation and impact on their introduced habitat. The objectives of the study were to evaluate the movement and the impact of *Giraffa camelopardalis* (giraffe) on the woody plants of the estate.

The species composition, density, height distribution, productivity and condition of woody plants influence the browsing capacity of such areas, and needs to be assessed for application in management programs. Vegetation data was collected over a period of 18 months and involved an estimate of the browsing capacity of the woody plants with the aid of the BECVOL 3 model and the calculation of the browsing capacity based on the leaf and shoot production of the trees on a maximum browsing height of 5.0 m. Movements of the eight giraffes on the estate were monitored for a period of three months by fitting one of the animals with a GPS satellite collar.

The browsing capacity of the estate was estimated at 7.7 ha.BU^{-1} for September (month with the lowest browse availability due to the deciduous nature of some of the tree species) (1 Browse Unit (BU) = the metabolic equivalent of a kudu with a body mass of 140 kg). Based on this estimate, the estate can only support 26 BU during September without the need for supplementary feeding. At the time it was estimated that all the browsers on the estate represented 70 BU, thus exceeding the browsing capacity by 44 BU. The eight giraffe comprised 42 BU of the 70 BU, the remainder being made up by species such as kudu, nyala and impala. The effect of this overstocking was clearly visible, with tree species such as *A. karroo* showing signs of heavy browsing and broken branches, which will ultimately result in the severe degradation of the browse resource and potential loss of animals. It was also observed that the giraffe do not feed only on the plant material above 2 metres, but that browse material at lower heights is also intensively utilized. This brings the giraffe in direct competition with smaller browsers that can feed only on lower strata. These results emphasize the importance of balancing the stocking rate with the browsing capacity to ensure proper management that will optimise the production of the animals as well as ensure the sustainable utilization of the browse resource.

POSTER PRESENTATION: LIVESTOCK PASTORAL SYSTEM AND SAVANNA MANAGEMENT PROPOSAL IN PERIPHERICAL ZONE OF NATIONAL PARK ANKARAFANTSIKA IN NORTH WEST OF MADAGASCAR: CASE OF SAINT MARIE ZONE

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Pastoral activities have many ecological impacts for the savannas and protected areas in the peripherical zone in the National Park Ankarafantsika – North Western Madagascar. The biotic and abiotic parameters were surveyed and monitored to assist in developing a savanna management policy. The vegetation composition and forage biomass (kg dry matter per hectare) were monitored with six square quadrants (1 m^2) and six transects (50 m x 1 m) per site. Soil samples from each site were analysed to assess the carbon, nitrogen, C/N index and available

phosphorus. The stocking rate and the carrying capacity were calculated during two periods (October 2000 and April 2001). Using GIS, the vegetation map was established with aerial photography. The data was subjected to analysis of variance (ANOVA) to estimate the significant difference and Principal Component Analysis (PCA) to establish the rangeland typology. Eleven savanna formations were identified with 534.62 ± 185.26 hectares. There were some dominant species: *Heteropogon contortus*, *Chrysopogon sp.*, *Hyparrhenia rufa, Cynodon dactylon, Hyphaen shatan* and *Bismarckia nobilis*. The granulometic characteristics were richest in silts fraction with 40.14 ± 3.66 %, for the sands with 34.70 ± 2.59 % and clay deficiency (23.61 ± 1.98 %). The savannas were richest in carbon content 1.84 ± 0.31 %, 0.086 ± 0.009 %o nitrogen content, available phosphorus content 0.080 ± 0.020 %o and 21.62 ± 4.26 C/N value. These savannas and woodlands have poor biomass production (2.180±0.005 kg.DM.ha^{-1}), a low carrying capacity (0.41 ± 0.09 Livestock Tropical Unit per hectare). Using PCA, three pastureland zones were recorded as the good, medium and poor. In fact, the grassland management improvement allows to restoration of the ecology of the savannas and maintenance of the protected areas.

Table 1: Pastureland zone in peripherical zone of National Park Ankarafantsika in North West of Madagascar

	Zone I	**Zone II**	**Zone III**
	Amboromaika Ankoraibe Anketrakabe	Ambalavia Ambitsika	Antanatsara Antsahafa Banajandrafotsibe Bejaboady Mantsaboribevoalavo Sainte Marie Elevage
Rangeland type	Rich	Sufficient	Poor
Vegetation type	*Heteropogon contortus – Hyparrhenia rufa*	*Heteropogon contortus*	*Heteropogon contortus – Aristida rufescens*
Geology form	sandy sandstone	high basalt	high basalt
Texture	slimy- sandy	slimy-sandy	slimy-sandy
C/N value	better 16.8 ± 2.99	satisfactory 20.5 ± 0.66	low 24.4 ± 2. 94
Available P %o	sufficient 0.113 ± 0.024	low 0.077 ± 0.021	low 0.073 ± 0.014
Canopy cover %	average cover 51.66 ± 6.65	low level 46.77 ± 3.71	low level 47.94 ± 4.69
Biomass kg.DM.ha^{-1}	high 2.700 ± 0.360	sufficient 2.180 ± 0.220	sufficient 2.280 ± 0.490
Area (hectares)	extended 414.86 ± 59.23	limit 336.11± 4.40	large 660.66 ± 154.29
Carrying capacity TLU.ha^{-1}	sufficient 0.43 ± 0.05	sufficient 0.46 ± 0.05	sufficient 0.09
Pastoral pressure	missed	dry season	wet season
Hydric regime	sufficient	sufficient	better

Plant Chemistry and Quality

SESSION CHAIR: NTUTHUKO R MKHIZE

Tuesday 17 July 2012, 11:20-12:35

PLATFORM PRESENTATION: DIFFERENTIAL PHENOLIC PROFILES IN SIX AFRICAN SAVANNA WOODY SPECIES IN RELATION TO ANTIHERBIVORE DEFENSE

Dawood Hattas[1], Joakim Hjältén[2], Riitta Julkunen-Tiitto[3], Peter F Scogings[4] and Tuulikki Rooke[5]*

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Low molecular weight phenolics are suggested to have a role in mediating diet selection in mammalian herbivores. However, very little is known about low molecular weight phenolic profiles of African savanna woody species. We determined low molecular weight phenolic profiles of six woody species with different life history, morphological and functional traits. We investigated interspecific phytochemical variation between species and found that:

1) Related *Acacia* species were chemically dissimilar;

2) Similarity percentage analysis revealed that *Acacia grandicornuta* was most dissimilar from other species and that the evergreen and unpalatable *Euclea divinorum* had a qualitatively similar chemical profile to the deciduous and palatable *Acacia exuvialis* and *Combretum apiculatum*;

3) *Combretum apiculatum* had the highest chemical diversity;

4) Relative to spineless plants, spinescent plants contained significantly less HPLC phenolics and condensed tannins; and

5) The major quantitative difference between the evergreen and unpalatable *E. divinorum* and other species was its high myricitrin concentration.

This information provides a platform from which we can further pursue our understanding of plant secondary chemical defenses in savanna woody species in relation to herbivory.

Published in Phytochemistry 2011, http://dx.doi.org/10.1016/j.phytochem.2011.05.007

PLATFORM PRESENTATION: CONDENSED CHEMICAL AND TANNIN COMPOSITION OF *ACACIA NILOTICA*, *DICHROSTACHYS CINEREA* AND *ZIZIPHUS MUCRONATA* HARVESTED FROM DIFFERENT SITES IN SOUTH AFRICA

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The chemical and tannin compositions of *Acacia nilotica, Dichrostachys cinerea* and *Ziziphus mucronata* harvested from three agro-ecological zones of high, medium and low rainfall areas, represented by three villages, were studied.

Chemical composition

Averaged overall zones, *D. cinerea* had higher (P<0.05) ash content than the other two species. *Z. mucronata* had the highest (P<0.05) crude protein content followed by *D. cinerea* and *A. nilotica*. *D. cinerea* had the highest NDF level followed by *A. nilotica* and then by *Z. mucronata.* Trees that grew in the medium rainfall zone had the highest CP level followed by those that grew in the low

rainfall zone whilst those that grew in the high rainfall zone had the lowest CP content *A. nilotica* and *D. cinerea* did not differ in ADF and phosphorus but had higher levels than *Z. mucronata. A. nilotica* had high chlorine content than the other trees. In addition the high and low rainfall trees had a high fluorine levels than the medium rainfall trees.

Tannin composition

Soluble (TST) and bound (TBT) condensed tannin composition were determined by the n-butanol HCl method using *Mimosa* tannin as the standard. The data were analyzed by analysis of variance for a 3x3 factorial in a completely randomised design using the General Linear Model (GLM) procedure of SPSS version 19. *Z. mucronata* trees that grew in low rainfall areas had the highest ($P<0.05$) total tannin content of 382 $g.kg^{-1}$ *Mimosa* tannin equivalent. Tree species affected TST, TBT and TT ($P<0.01$) but the agro-ecological zones did not ($P>0.05$). *Z. mucronata* had a significantly higher TST content ($P<0.01$) than the other two species. For *A. nilotica,* samples harvested in the low rainfall zone had the highest TST and TBT content ($P<0.01$) followed by those from high and the medium rainfall zones. On the other hand, for *D. cinerea*, trees that grew in the high rainfall zone had higher TST and TBT level ($P<0.01$) than those that grew in the medium and low zones; trees that grew in latter two zones did not differ from one another. For *Z. mucronata*, the trees that grew in the medium rainfall zone had higher levels of total soluble tannins and total bound tannins ($P<0.01$) than those that grew in the high and low rainfall zones which did not differ from each other.

The study showed that the three forage legumes species are of good nutritive value but are high in condensed tannins. These trees could have potential for integration into ruminant livestock production in Limpopo Province of South Africa.

POSTER PRESENTATION: SEASON AND VELD TYPE INFLUENCE NUTRIENT CONCENTRATIONS OF TOXIC *DICHAPETALUM CYMOSUM* (GIFBLAAR) IN SOUTH AFRICAN RANGELANDS

H Gilbert Pule[1,2], Wayne F Truter[2] and Luthando E Dziba[3]*

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Nutrients and toxins in plants vary spatially and temporally, not only amongst plant species, but also within individual plants. Little of this information is available on poisonous plants occurring in South African rangeland communities, yet plant poisoning of livestock is a major challenge, particularly amongst emerging farmers. Our study investigated how season and veld type, influenced nutrient concentrations in *Dichapetalum cymosum* using 14 sites in two veld types, 9 and 5 respectively, with varying mean annual rainfall (400–600 and 600–800 mm per annum) over four seasons. Season had a significant influence ($P<0.05$) on dry matter (DM) (92.60±0.10 (mean ± SE)), moisture (7.40 ± 0.10), crude protein (11.46 ± 0.40) and neutral detergent fibre (NDF) (53.65 ± 1.14). Veld type significantly influenced DM (92.64 ± 0.24), moisture (7.36 ± 0.24) and NDF (52.99 ± 0.65; P<.0001). Crude protein, moisture and phosphorus contents were high during the spring and autumn months, when *D. cymosum* poisoning of livestock has been reported. The relatively high crude protein of 11.46% in *D. cymosum* during spring and autumn months may account for its over ingestion and poisoning of livestock, probably due to high proportion of positive (nutrients) to aversive (toxins) postingestive feedback.

POSTER PRESENTATION: THE QUANTIFICATION OF CONDENSED TANNINS IN AFRICAN SAVANNA TREE SPECIES

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We compared *Quebracho* with *Sorghum* tannin as standards for condensed tannin (CT) quantification in selected African savanna tree species in relation to the acid-butanol assay for CTs. Without exception, the use of *Quebracho* tannin as a standard overestimated CTs, ranging from 0.7 to as much as 8.3 times. *Sorghum* tannin underestimated CTs by 0.26 to 0.79 times, except in one species where there was no difference in the CT concentration. Condensed tannins in African savanna trees showed qualitative and quantitative differences in chemical composition which may explain the variable reactivity in the acid-butanol assay. We propose the use of condensed tannins purified from the plant under investigation be used as standard since it will closely represent the CT structure and presumably chemical reactivity in the acid-butanol assay.

PLATFORM PRESENTATION: BROWSE: QUANTITY AND NUTRITIVE VALUE OF EVERGREEN AND DECIDUOUS TREE SPECIES IN SEMI-ARID SOUTHERN AFRICAN SAVANNAS

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Browse selection, intake, utilisation, palatability, quality and production are tightly linked and need to be considered together in trying to improve our understanding of browsing dynamics and the interactions between browsers and vegetation. Such an understanding is necessary in order to re-evaluate determinations of browser carrying capacities, and evaluating actual and potential impacts of browsing animals on vegetation composition and diversity. Browser carrying capacity is determined by both the quantity and the nutritive value of forage. The measurement of browse quantity and nutritive value, and the matching of browse supply to browser demand are central to sustainable utilisation and the monitoring of vegetation health.

Southern African savannas are poorly studied with respect to tree canopy growth and browse production making it difficult to quantify the available browse biomass on which browsing capacity estimations are based, and consequently difficult to estimate levels of browsing that are sustainable. This study addressed these issues by investigating browse dynamics, broadly aiming to (1) explore factors affecting browse production, biomass and nutritive value; (2) develop models to assess and monitor these parameters across seasons and properties; (3) use the resultant models in improving our understanding of how to determine browser carrying capacities. More specifically, our study sought to examine the effects of plant physiognomy, forage nutritive value, canopy stratum, defoliation, temperature, rainfall and soil nutrient status on the browse production of evergreen (*Carissa bispinosa, Euclea divinorum, Gymnosporia senegalensis*), semi-deciduous (*Spirostachys africana, Ziziphus mucronata*) and deciduous (*Acacia nilotica, Dichrostachys cinerea*) savanna tree species from June 2003 – June 2005 in three sites along the northern Zululand coastline of KwaZulu-Natal.

A study was undertaken to determine which factors may influence browse production in a southern African savanna. Regression tree models for the browse production identified that the dominant factors influencing browse production were available canopy volume (m^3), season, species and height to the lowest leaves of the tree canopy (m). The length of the growing season

had a marked effect on the production potential of savanna tree species, suggesting that improved conditions for growth, i.e. greater rainfall, soil moisture content and improved soil nutrient availability, result in a longer period of rapid sustained growth. Species was identified as an important contributing factor to differences in browse production rates, suggesting the need for the development of species or species group models.

Mean annual browse production of evergreen trees was greater than that of deciduous and semi-deciduous trees. Mean quarterly (three monthly) browse production was highest, for all trees, during the wet season, with the greatest difference between wet and dry season production being observed in deciduous forms. Evergreen forms showed continuous growth over the whole study, with enhanced growth over the wet season. Deciduous forms, on the other hand, concentrated growth in spurts, when environmental conditions became favourable, with most production occurring during a short growing season.

Browse nutritive value was found to be greatest during the wet season, when growth and photosynthesis are at their greatest. Further, browse nutritive value was greatest in deciduous species. Evergreen trees were found to have greater acid detergent fibre concentrations than both the deciduous and semi-deciduous trees. By contrast, crude protein concentrations were greater in semi-deciduous and deciduous species than in evergreen species.

Predictive models for the production of browse on deciduous, semi-deciduous and evergreen trees in northern Zululand were developed using multivariate adaptive regression spline functions. The best predictors of growing season browse production in all three tree guilds (defined here as a group of trees having a characteristic mode of living) were primarily measurable tree dimensions, while the prevailing environmental conditions had little impact.

Differences in the production, nutritive value and available browse biomass between the different tree forms and seasons have a profound effect on the determination of browser carrying capacities and need to be incorporated into any game or conservation management plan.

POSTER PRESENTATION: INFLUENCE OF DEFOLIATION ON CRUDE PROTEIN CONTENT OF TWO KAROO SHRUB SPECIES

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Although information on the influence of defoliation (intensity and frequency) on cultivated pastures is available, such information for rangelands is very limited, particularly for shrubs of the Nama Karoo. This study investigated the influence of different defoliation treatments on the crude protein (CP) content of two Karoo shrub species, namely *Nenax microphylla* (Daggapitkaroo) and *Pentzia incana* (Ankerkaroo).

Plant material was collected from Middelburg (Eastern Cape), multiplied through stem cuttings and planted in pots in a greenhouse. Plants were defoliated at three different frequencies (intervals of three, six and twelve months). The defoliation intensities were to heights of 50, 125 and 200 mm. Defoliated material was separated into edible (leaves and twigs with diameter <2 mm) and non-edible (twigs with diameter >2 mm) parts, and oven-dried at 80°C to constant weight. The edible portions were analysed for CP with the Truspec CN Carbon/Nitrogen Determinator (Leco Corporation).

Table 1: Crude protein content for *Nenax microphylla* and *Pentzia incana* at different defoliation treatments.

Nenax michrophylla					***Pentzia incana***			
Frequency (months)	3	6	12		Frequency (months)	3	6	12
Mean CP (%)	13.29	10.37	8.11		Mean CP (%)	14.93	11.89	9.47
Intensity (to heights [mm])	50	125	200		Intensity (to heights [mm])	50	125	200
Mean CP (%)	13.59	12.30	11.89		Mean CP (%)	14.35	13.67	13.28

For both species, CP content decreased as the period between defoliation events increased, while CP content increased as cutting height decreased (Table 1). *Pentzia incana* had a slightly higher CP content than *Nenax microphylla*.

Although this study indicates that a frequent, high intensity defoliation results in a higher CP content, the edible dry matter yield as well as the root growth of such plants are important aspects that need further investigation under the same treatments.

Research Proposals

Tuesday 17 July 2012, 12:35 – 13:00

Poster Presentations

RESEARCH PROPOSAL POSTER: LONG-TERM EFFECT OF SEASON OF BURNING ON PHOTOSYNTHETICALLY ACTIVE RADIATION, LEAF AREA INDEX, BIOMASS PRODUCTION AND SOIL CHEMICAL PROPERTIES IN THE DÖHNE SOURVELD OF THE EASTERN CAPE, SOUTH AFRICA

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There is a widespread belief that fire upsets the natural balance between vegetation, insects, birds and animals and causes soil erosion, and should, therefore, be prevented wherever possible. However, it seems that judicial use of fire, at least in sourveld regions, plays an important role in the maintenance of rangelands, thus enhancing livestock performance. There is need to provide scientific evidence of the benefits of prescribed burning to rangeland and animal productivity. A study will be conducted to investigate the effect of season of burning on Photosynthetically Active Radiation (PAR), Leaf Area Index (LAI), biomass production and soil properties in the long-term fire trial at Döhne Agricultural Institute of Development. The trial was set up in 1988 and treatments comprise a July, August, September, October and November burns applied annually on 15x15 m plots, each replicated 3 times in a Randomised Block Design. PAR and corresponding LAI values will be measured above and below grass canopies using a PAR Ceptometer on cloudless days between 11h30 and 13h00. Biomass production will be determined by harvesting all aboveground herbaceous material within randomly placed 1 m^2 quadrats. Samples will be oven-dried to constant mass at 60°C and weighed. Soil samples will be collected randomly at 15 cm depth (3 sub-samples per plot) and analyzed for soil organic matter, pH, N, K, P, Zn, Mn, and Fe. All data will be collected in 2012 before burning (June) and after burning (December).Treatment effects on PAR, LAI and biomass production ($g.m^2$) and soil properties will be tested using Analysis of Variance, while Least Square Difference test will be used to compare treatment means. Regression analyses will be conducted to test the relationships between burning season, PAR and biomass production and macronutrient content. The analyses will be performed using GenStat 12th Edition.

RESEARCH PROPOSAL POSTER: THE USE OF HIGH YIELDING C_4 GRASSES AS A SOURCE OF ORGANIC MATERIAL FOR SOIL COMPACTION ALLEVIATION AND MITIGATION

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Most of the coal mines in South Africa are situated on the Highveld of the Mpumalanga Province. The mining industry plays an important role in the economy of the country, but often the mining operation changes the physical properties of the soil which leads to soil compaction. Soil compaction is known to be a common result of poor soil management. Increased soil organic matter is often associated with better soil physical, chemical and biological properties. Imported organic materials and stimulated plant root development may lead to reduced effects of soil compaction and an increased amount of moisture in the soil profile which becomes available for plant growth during the growing season.

The objective of this study will be to evaluate the influence of organic material, composted or non-composted, primarily produced from the aboveground biomass of high yielding C_4 grasses. This organic material will be used as a soil ameliorant, and its effects on the root development, which is regarded as the secondary production of organic matter, will be measured as well. The study will be conducted in a field trial on degraded surface coal mined soils in the Mpumalanga Province. The trial will be duplicated in an experimental facility at the University of Pretoria's experiment farm. Results from this study will contribute to our understanding of how the incorporation of organic material produced by high yielding C_4 grasses will condition degraded soil to ultimately alleviate and mitigate soil compaction. These objectives will be achieved by measuring and monitoring the change in soil properties, such as organic carbon fractions in the soil, in addition to changes in soil pore spaces through aeration and bulking, thereby improving the water holding capacity and root development.

RESEARCH PROPOSAL POSTER: HYDRO SEEDING VERSUS CONVENTIONAL SEEDING FOR THE RE-VEGETATION OF RECLAIMED SURFACE COAL MINED LANDS

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The establishment of pastures on reclaimed surface coal mined land presents many challenges, considering that these soils are usually compacted and infertile. With more emphasis being placed on minimum tillage practices in the agricultural sector, and on sensitive reclaimed mine soils, the need for new methods of re-vegetating reclaimed mined areas has grown, especially areas that have been reseeded and have failed stands. One of the main attributes of these soil surfaces to be re-vegetated to pastures is that they do not necessarily have the best prepared seedbed, and this complicates the re-vegetation practice. In addition many other soil chemical, physical and microbiological properties of the reclaimed soil have changed and these conditions require different amelioration methods to facilitate revegetation. Hydro seeding is a developing process that addresses most of these challenges faced by mines when establishing and re-vegetating pastures on inaccessible areas and areas where soils are not well prepared. The research question however remains, whether hydro seeding provides a sustainable and productive cover as compared to conventional seeding of reclaimed mined land? The vegetation establishment and growth parameters and associated soil parameters facilitating vegetation establishment, will be measured and compared between hydro seeding/mulching methods and conventional seeding methods. This will be done on established pastures on newly reclaimed land, as well as reinforcing older pastures on reclaimed surface coal mined lands. This study will entail the application of hydro seeding/mulching and conventional seeding treatments to various sites to determine the establishment success and production potential of these planted pastures on reclaimed mined land.

RESEARCH PROPOSAL POSTER: ASSESSING SOIL MICROBE AND PLANT DIVERSITY IN TWO RENOSTERVELD VEGETATION TYPES AROUND NIEUWOUDTVILLE, NORTHERN CAPE PROVINCE

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Studies have shown a positive link between aboveground plant diversity and belowground soil microbe diversity.

This study will focus on natural and transformed renosterveld sites on conservation areas and commercial livestock farms, comparing plant and soil microbe diversity.

Soil microbes are sensitive to environmental changes and are early indicators of disturbance. Their main functions in agro-ecosystems are nutrient cycling and the maintenance of soil fertility. Agricultural practices (including grazing, cropping and chemical treatments) may damage these belowground organisms and affect their ability to provide ecosystem services. If these microbial species and their services are lost, they might only be recoverable with strong interventions, at considerable effort and expense.

Renosterveld is a type of vegetation which exhibits high endemism and diversity, and is especially rich in geophytes. It falls under the Greater Cape Floristic Region and has been mostly transformed due to its soil being rich and suitable for agriculture. Disturbed renosterveld is dominated by *Elytropappus rhinocerotis* (renosterbos) to the detriment of overall plant diversity, including more palatable grasses.

Plant surveys will be conducted, in order to establish plant diversity, and soil samples collected and analysed for soil microbes. Weather data (rainfall and temperature) will be obtained. Discussions will take place with landowners and managers, and information regarding land management, including stocking rates and grazing history, will be taken into account when analysing the data. Data will be statistically analysed using multivariate techniques.

This study will contribute to the understanding of the composition and diversity in plant communities, soil ecology and sustainable agriculture within renosterveld vegetation types

RESEARCH PROPOSAL POSTER: RANGELAND RESOURCES AND GOVERNANCE: A CASE STUDY ON EPHEMERAL WETLANDS AS KEY RESOURCE AREAS FOR COMMONAGE USERS IN THE KAMIESBERG UPLANDS, NAMAQUALAND

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South Africa is home to over 110 000 wetlands, which play a vital role in rural livelihoods. Wetlands are important arable lands and act as key resource areas by providing forage and water for livestock. About 35–60% of South African wetlands have been lost, resulting in, amongst others, diminished water security, desertification, reduced food security and increased vulnerability to natural disasters. In the Kamiesberg in Namaqualand, more than 60% of wetlands have been transformed due to overgrazing, water abstraction, invasive vegetation and crop farming. These impacts are further compounded by poor governance of common property resources at national and local levels. In order to assess the long term sustainability of wetlands, we need to consider land use practices, the biophysical condition, livelihoods of users, as well as governance arrangements. Many studies that examine resource degradation do not consider governance as a critical factor for sustainable land use. There is a need to promote an integrated

approach to research that explicitly recognizes the linkages between wetland degradation and livelihood vulnerabilities including the underlying drivers such as the lack of governance.

In South Africa, co-management is encouraged within governance structures to promote participatory democracy and improve natural resource management. However, it appears that, the 'action space' created by natural resource management policies for community-based natural resource management, is not being claimed by rural communities. For example, in the Kamiesberg Municipality in Namaqualand, the responsibility and power to manage commonage was devolved to the Commonage Committee but the committee subsequently disbanded. Thus in this case, as in many others, there is an urgent need to formulate a wise-use approach to manage and use wetlands to optimize the conservation of biodiversity and to support the farming community who depend on these ecosystems for their livelihoods.

This study will attempt to identify governance options for the sustainable use of ephemeral wetlands in commonages in Namaqualand. Thus, the main objectives are:

1. Raise the discourse on appropriate community-based governance mechanisms for key natural resources in communal lands

2. Understand the use and governance of wetlands as part of a complex socio-political and ecological system in Leliefontein Communal Area

3. Identify key stakeholders who would play crucial roles in wetland governance in the Kamiesberg Municipal Area

To reach these objectives the following questions will be asked:

1. Who has the rights to wetland resources?

2. Who is deriving benefits and carrying what costs from wetland use?

3. Who has which responsibilities and where?

4. Who has the authority to do what over wetland resources?

RESEARCH PROPOSAL POSTER: CATTLE AS A MANAGEMENT TOOL IN PROTECTED AREAS - PROMOTING COMMUNITY/CONSERVATION PARTNERSHIPS?

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It is contended that there are three major factors contributing to aridification in African rangelands: too few animals overgrazing plants while over resting the land and/or fire, leading to soil exposure and thus reduced effectiveness of the available rainfall. Modern soil conservation techniques are failing and despite the de-stocking of livestock, millions of hectares of rangeland are turning into arid wastelands. Savory contends that desertification is now being reversed using cattle to restore grass, water and flowing rivers to areas where soils were severely degraded. This is done using a management and planning process termed "holistic planned grazing" where livestock are integrated with wildlife and other land uses to both maintain grassland health and reverse desertification. We explore the situation at Dimbangombe Ranch in Zimbabwe where cattle, in addition to a full component of wild herbivores and predators, are used to "manage" degraded rangeland with compelling results. This approach to management has facilitated a significant increase in wildlife through an improved water cycle, increases in plant available moisture, nutrients and ultimately a resilient functional grass sward.

But how can we apply this type of management in protected areas? The nearest wild herbivore to cattle is buffalo which move in large herds over extensive areas, are not sedentary around a

single water point and therefore have a generally beneficial effect on the vegetation. This is because in high densities they break soil crusts by their hoof action, reduce the height of moribund grass thus allowing sunlight to penetrate the shorter vigorous grass tufts while reducing the temperature of the soil and making it more suitable for rainfall infiltration and retention. They also deposit concentrated amounts of dung and urine. All of the above promotes seedling establishment, particularly in bare areas and promotes a healthy productive perennial sward of grasses. Closer plant spacing (increased density) with a better litter layer (organic matter) and stable soils results in greater rainfall infiltration and less soil surface evaporation or runoff, restoring former rainfall effectiveness. The presence of pack hunting predators, in particular lion and wild dog causes herds to remain bunched much of the time thus intensifying these impacts. Buffalo however, unlike cattle cannot be grazed in a planned way.

We therefore examine the feasibility, albeit fraught with potential for conflict, of using communal or even privately owned cattle in protected areas for the purpose of restoring function in degraded rangelands within protected areas. In many conservation areas the high grass biomass produced in good rainfall years is removed by regular hot fires in the dry season. Here we would like to evaluate whether well- managed communal cattle- herds could be used to remove the biomass, thus providing forage to the animals and decreasing carbon emissions.

The advantages of using communally used cattle to the rural communities would be evaluated in terms of the benefits of extra available forage in an area where the forage is very limited (but without creating an expectation of assumed annual use). If fire can be decreased, it will also raise the possibility of making use of carbon credits as an extra source of income for communities.

RESEARCH PROPOSAL POSTER: CHALLENGES IN FODDER PRODUCTION IN MACUBENI, EASTERN CAPE, SOUTH AFRICA

Landiwe T Zondi and James Gambiza

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Livestock is an essential component of the agricultural sector, directly supporting the livelihoods of millions of small-holder farmers in Africa and providing a range of social and economic benefits. Livestock production in small-holder systems is often limited by both the unavailability and low quality of feed. High levels of grazing frequently contribute to rangeland degradation leading to bush encroachment and high levels of soil erosion. The negative effects on livestock associated with the shortage of feed include increased mortality and reduced animal productivity. There is a need to improve the availability of forage for livestock which plays such a key role in people's livelihoods. With few studies having investigated the key challenges on fodder production in small-holder systems, the aim of this study will be to investigate the opportunities and challenges small-holder farmers face in growing fodder in Macubeni, Eastern Cape, South Africa. Data will be collected through two sets of questionnaires which will be issued at the household level. The aim of the first questionnaire is to determine what proportion of households grow fodder and the aim of the second questionnaire is to do an in-depth survey of the challenges faced by households that grow fodder. The successful completion of this study will help shed light on the challenges livestock farmers face in growing fodder and provide possible interventions that will help contribute to improved livestock production and sustainable livelihood opportunities not only in Macubeni but possibly similar areas around the country.

RESEARCH PROPOSAL POSTER: IMPROVING RAINWATER PRODUCTIVITY FOR FODDER THROUGH SITE SPECIFIC NUTRIENT MANAGEMENT IN SMALLSCALE LIVESTOCK FARMING COMMUNITY IN HA-LAMBANI, LIMPOPO PROVINCE

Gabriel Lekalakala[1], Brilliant Petja[1], Jorrie J Jordaan[1], Ntuwiseni E Mmbi[1], Richard Ngwepe[1], Mpolokeng Mokoena[1], Suzan Mashego[1], Wisane Maluleke[1], Patricia Masikate[2], Andre van Rooyen[2] and Trevor Rikhotso[1]*

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Ha-Lambani Village, located in the Limpopo Province and about 10 km from the Punda Maria Gate of the Kruger National Park, is a communal area characterised by high levels of poverty and a great reliance on the land for food security. Rainfall in this area is variable and sparsely distributed, while temperatures are generally high. Productive planted pastures are scarce, as most of the grassing land is on steep mountain slopes, soil fertility is low and irrigation water is limited.

Innovation Platform (IP) is a mechanism to promote and enhance communication and networking across value chain actors as well as providing them with a platform for identifying bottlenecks and opportunities in production, marketing and the policy environment. IP was used as an entry point into the community as the key player in the agricultural supply chain. This process enabled farmers to identify challenges and opportunities for interventions in their agricultural practices. Inadequate livestock feed or pastures were identified as a major constraint limiting productivity. The need for fodder production as a mechanism for ensuring feed for livestock was amongst the highlighted challenges.

The aim of the proposed study is to improve fodder productivity under dryland production and different soil conditions through site specific nutrient application. The hypotheses that fodder production will increase more than two fold in the area will be tested at three different sites in the Ha-Lambani Village. This assessment will be conducted using a randomized complete block design with three and two different perennial and annual grasses respectively, with two replications. In addition to field data collection, productivity of such sites will be evaluated and monitored using satellite imagery.

The selected perennial grasses are *Cenchrus ciliarus* (blue buffalo grass), *Digitaria eriantha* (finger grass), *Anthephora pubescens* (bristle seed grass), and the annual grasses are *Pennisetum glaucum* (babala), and forage sorghum-sudan grass. The general soil types on which the experiments will be conducted will be sandy, clayey and loamy, however detailed soil analysis are still to be conducted. The fertilizer application rate to be used is 50 kg of nitrogen and 5 kg of phosphate per hectare; however these application rates may vary from area to area based on the soil analysis. The study will be conducted for 3 to 5 years. In the first year of planting the data collected will be observations of % germination. The data to be collected from second year onwards will be the dry matter (DM), crude protein (CP) and in vitro digestibility (IVDOM) which will be harvested monthly from quadrats.

The proposed project is envisaged to improve fodder production and hence reduce food insecurity. Further outcomes include a guide for fodder production under dryland conditions and nutrient management in different soil conditions for various stakeholders identified through the IP process.

RESEARCH PROPOSAL POSTER: FIRE AND WETLANDS - YES OR NO?

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Water is a crucial component of the natural world and human survival, but water sources (river systems and wetlands) are becoming increasingly degraded and less functional. In particular, the increase of woody C_3 species into wetlands is a cause for concern, as they invade wetlands which are predominantly herbaceous. Woody species use more water than herbaceous species and this impacts wetland function. In moist savannas and grasslands, woody species are influenced significantly by fire, and fire is consequently used widely as a means of reducing woody plant density. However, there is uncertainty about the effectiveness of fire in combating woody plant encroachment as well as the general impact of fire in wetlands.

The Kwambonambi wetlands of South Africa have recently been experiencing an invasion by woody species which are both indigenous and alien. These wetlands support a rich diversity of herbaceous plant species, including the only known wild population of the critically endangered *Kniphofia leucocephala.* This area was historically herbaceous and experienced frequent natural fires but is now largely under timber plantation and thus fire has been mainly excluded. This has led to a continual increase of woody species into the wetlands which have changed from mainly herbaceous species to a matrix of ferns, grasses and sedges, and an invasion of swamp forest species such as *Macaranga natalensis.* This has affected ecosystem functions and changed fire behaviour in these wetlands. There are a few studies that have investigated the influence of fire on wetland structure and composition, and those available indicate contrasting ideas. Those focusing on hydrology as a driver of vegetation type propose that burning induces soil crusting, thereby lowering the water table thus allowing woody non-wetland species to invade. Contrasting views propose that fire is an efficient strategy to manage the invasion of woody non-wetland species when the burn timing is correct. This ambiguity highlights the need for more focused research that will influence management decisions.

The objective of this study is to determine the influence of fire on wetland vegetation composition and structure. Five wetlands have been chosen for this purpose. In principle, this study is a space for time substitution obtained from sampling vegetation in plots with differing disturbance histories (fire, alien plant removal and forest clear felling). To measure the short term effect of fire on species composition and structure, burn experiments will be done. Vegetation sampling will be carried out pre- and post-burn experiments. Vegetation sampling will be carried out across the wetlands to determine species diversity of the herbaceous species and the density of trees within these wetlands. Vegetation composition and structure will be described together with physical descriptors of the wetland, including soil type and level of wetness. Based on ordination analysis, the relationship between the different vegetation types and physical descriptors will be established. A change detection analysis will examine the long term influence of fire on these wetlands and relate it back to species composition and structure as well as provide a historic view of the study area.

RESEARCH PROPOSAL POSTER: BROWSING-FIRE INTERACTION ON RANGELANDS DOMINATED BY WOODY PLANT SPECIES

M Michael Mokwala[1,2], T Julius Tjelele[1], Ntuthuko R Mkhize[1] and David M Ward[2]*

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Bush encroachment in grasslands and savanna has become a serious problem to farmers interested in herbaceous production for their livestock. Woody plant encroachment reduces the carrying capacity of rangelands which negatively affects livestock production. It is well known that prescribed burning is an important ecological factor for managing grassland and savanna ecosystems. Burning young *Acacia* trees limits recruitment into adult size classes. Furthermore, *Acacia* trees are more likely to become accessible to shorter browsers, such as goats. Strategic supplementation (supplemental nutrients such as proteins) will enable animals consume more plant secondary metabolites food and create opportunities to use goats as a tool to manage woody

plant encroachment. The objectives of this study are to explore the use of fire (post-burn forage) and protein blocks (nutrient supplement) for goats to increase the use of chemically defended woody plant species in livestock production systems.

Four replicate paddocks of 0.25 ha will be established at Roodeplaat Experiment Farm and wire fenced with the following four treatments: 1) control (no burn and no protein block supplementation), 2) goats foraging from post-burn forage, 3) goats supplemented with protein blocks and 4) goats foraging from post-burn forage and supplemented with protein blocks. Each paddock will be surveyed to estimate the standing biomass and tree density before the goats are moved in. Selection of paddocks will be randomized and each paddock will receive 10 goats.

Direct observation of foraging behaviour of goats will be used, after acclimation to the presence of humans. Subsequent assessments of tree density will be performed after the goats have been removed. The results from this study will contribute to our understanding on managing browsers together with fire as an approach to controlling bush encroachment.

RESEARCH PROPOSAL POSTER: *EURYOPS PYROIDES* ENCROACHMENT IN EASTERN CAPE COMMUNAL RANGELANDS: INDIGENOUS AND SCIENTIFIC UNDERSTANDINGS OF EFFECTS ON RANGE ECOLOGY, FOOD SECURITY AND CLIMATE CHANGE

Masibonge Gxasheka[1], Solomon B Tefera[#*], Mota S Lesoli[2] and N Lily-Rose Mlisa[1]*

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Euryops pyroides is a woody shrub which is encroaching in several communally grazed rangelands of Eastern Cape Province. Visual assessment reveals that grass cover is very low beneath the shrub canopies where the shrub occurs at high density. The current study is proposed to understand the distribution of *Euryops pyroides* and its impact on grass productivity (competitive or allelopathic), soil, livestock production and food security. From the perception of communal people, the study seeks to find the evolutionary process of *E. pyroides* in relation to long-term climate change. The study will be conducted in Cala communal areas at Upper Mnxe (Highland sourveld). Five areas with encroachment levels of heavy (>50% cover), moderate (30-50% cover), low 10-30% cover, very low (<10%), and no encroachment (0%) will be selected. Three plots of 100x20 m will be laid on each area. Three 100 m transects per plot will be laid parallel to each other to collect vegetation and soil data for the determination of species composition, richness, biomass yield, soil nutrients and seed bank. Opinions of the communal herders on the history and effects of the encroachment on their livelihood will be gathered from individual interview and group discussions with the selected elders of three villages. Univariate data will be analysed with parametric or non-parametric tests as appropriate, while multivariate data will be used to analyse multivariate responses.

RESEARCH PROPOSAL POSTER: EFFECT OF ALTITUDE AND SEASON ON THE YIELD AND NUTRITIVE VALUE OF SELECTED GRASS SPECIES IN THE EASTERN CAPE COMMUNAL GRAZING AREAS

Ayanda Kwaza, Solomon B Tefera and Keletso Mopipi#*

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A major challenge of livestock production in the communal grazing lands is low quantity and quality of forage characterised by seasonal fluctuations. This problem can be partially remedied through planning of proper grazing management and fodder flow programmes to complement the available feed resources. We anticipate that nutritive value is the combined effect of both genetic and environmental effects. Little is known about the yield and the nutritive value of dominant grass species grazed by ruminants in the communal grazing lands of the Eastern Cape. A study will therefore be conducted in Hala and Gqumashe communal grazing areas to determine forage yield, macro and micro elements, crude protein and fibre contents of dominant grass species at different altitudes and seasons. A 2x3 factorial experiment will be used with season and altitude being the main factors. Three altitude regimes will be selected in each area, namely; bottom, gentle slope and upland sites. In each altitude site, three plots 50x10 m will be marked with the shortest side of the plot laid perpendicular to the direction of the gradient. Biomass production will be determined by harvesting selected grass species in two seasons from six 0.25 m^2 quadrat per plot. Neutral detergent fibre (NDF) and acid-detergent fibre (ADF) contents will be analysed. Minerals will be determined using atomic absorption spectrophotometer (AAS), while Na and K will be determined using a flame photometer. Crude protein will be determined by the micro-Kjeldahl procedure (%N x 6.5). Chemical composition and biomass production data will be analysed using the general linear models (GLM) procedure of SAS (1999) to test differences between species, altitudes and between seasons.

RESEARCH PROPOSAL POSTER: EFFECTS OF WATERING POINTS ON VEGETATION AND SOIL IN THREE LAND USE SYSTEMS OF THE EASTERN CAPE, SOUTH AFRICA

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Rangelands are the main source of forage for livestock, and provide habitats for a variety of native plants and animals. Watering points are the focal points for grazing by domestic and wild animals. Development of water points may cause rangeland degradation, which consequently leads to poor ecosystem services including food insecurity, soil erosion, reduced farm's income and the land's potential to appropriate green-house carbon. A study will be conducted to investigate the effect of animal movement around watering points on the surrounding vegetation and soil properties with the intent to understand the drivers of ecological processes around water points in three land use systems (communal grazing land, commercial and game ranches). The study will also investigate the level and extent of rangeland degradation around the water points, and make recommendations on restoration, sustainable utilization, and management and conservation of the areas. Two 500 m transects will be laid along selected watering points and will be divided in to sub-transects (25 m, 50 m, 100 m, 200 m, 300 m and 500 m). A 10x10 m plot will be marked in each sub-transect. Three quadrats (1 m^2) will be laid randomly to record basal cover, species composition and biomass production, and collect soil samples for soil fertility. Furthermore, within each plot lowest browsable material (LBM), plant height and frequency of occurrence of woody plants will be recorded. Univariate data will be analysed with parametric or non-parametric tests as appropriate, while multivariate data will be used to analyse multivariate responses. The Shannon diversity index will be used to compute species diversity for each site. For data that do not require analysis, simple descriptive statistics will be employed where appropriate.

RESEARCH PROPOSAL POSTER: ASSESSMENT OF RANGE CONDITION FOR IMPROVEMENT OF NGUNI CATTLE PERFORMANCE IN THE KOMGA AND PEDI COMMUNAL AREAS OF THE EASTERN CAPE, SOUTH AFRICA

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There is abundant data reporting the decline in condition or desertification of the world's rangelands. Some land is characterized by bare patches and is eroded while other areas are rendered less productive due to transformation to fibrous or ephemeral species. It is vital to assess the degree of change through measures of attributes such as species composition, basal cover and soil surface condition as determinants of the veld condition. Reports indicate that in communal rangelands of South Africa, stocking rates often exceed the carrying capacity of the veld. These necessitate scientific research to be taken for informed policy-making. A study will be conducted to assess veld condition and soil chemical properties of the Komga and Pedi communal areas of the Eastern Cape so that appropriate veld management practices can be recommended to enhance the veld condition for the success of the Nguni cattle project. The hypothesis that veld condition of Pedi and Komga communal areas are in good condition for sustainable Nguni cattle production will be tested. The two areas will be demarcated into Homogeneous Vegetation Units (HVU's), and a 100x50 m transect will be laid in each HVU. The step-point technique will be used to determine herbaceous species composition, while height, lowest browseable material and frequency of occurrence of woody plants will be recorded. Basal cover will be determined by estimating the point-to-tuft distance between herbaceous species, with 200 recordings per transect. To determine biomass production, 1 m^2 quadrats will be randomly laid in each sample site and grass sickles will be used to harvest plant material within each quadrat. Soil samples will be collected from each HVU at a depth of 15 cm, and the samples will be analysed for SOM, Ph, C, N, P, K, Mn, Fe, ZN and Cu. Descriptive statistics will be used to indicate species abundances for each HVU, while appropriate univariate and multivariate analysis will be used to determine variation in the response variables between the two communal areas.

RESEARCH PROPOSAL POSTER: LONG TERM CHANGES IN THE HERBACEOUS LAYER BETWEEN ATHOLE RESEARCH FARM AND NOOITGEDACHT AGRICULTURAL DEVELOPMENT CENTRE IN THE HIGHVELD OF MPUMALANGA PROVINCE

M Collen Rabothata[1,2], Thabile J Mokgakane[1], Modau N Magoro[1], Oupa Keromecwe[1], Jan Theron[1], Kevin P Kirkman[2] and Tim G O'Connor[3]*

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Grazing experiments conducted at Nooitgedacht ADC and Athole Research Station between 1988 and 1997 resulted in conspicuous grass compositional differences (in response to stocking rate and system of grazing). During the 15 years since cessation of the grazing treatments, the former grazing trials have each been subjected to a relatively uniform, moderate grazing pressure and occasional fire. This offers an opportunity to examine system response to grazing-induced change. At the same time, any changes that are consistent across treatments and would appear to be directional in change may be considered evidence of change induced by an extrinsic driving variable, such as climate change or an increase in atmospheric CO_2. An advantage is that baseline monitoring has already been instituted.

During this study, each of the grazing experiments will be resampled in the same manner as sampled in 1999, with the main variables being sward composition and production. Further

variables which were not included previously will be size and location of *Hyparrhenia* patches at Nooitgedacht. This will include all patches within the experimental paddocks as well as patches surrounding the paddocks along the road or on fallow lands. Firstly, a GIS surface will be prepared of the *Hyparrhenia* patches in relation to paddock distribution and points of disturbance within paddocks (leplekke, licks, water troughs etc.). Then the composition and production of these patches will be measured. Plant diversity, including that of the *Hyparrhenia* patches, will be assessed using modified Whittaker plots. These additional variables will be included to assess directional change, especially the loss or otherwise of medium-height grasslands.

RESEARCH PROPOSAL POSTER: PRODUCTION POTENTIAL OF LUCERNE (*MEDICAGO SATIVA*) OVER-SOWN INTO KIKUYU (*PENNISETUM CLANDESTINUM*)

Ilze Fourie and Philip R Botha*

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Economical beef and dairy farming in the southern Cape is based on the sustainable productivity of planted grass and legume pastures in a low input fodder flow system. Milk production under irrigation is primarily carried out on kikuyu (*Pennisetum clandestinum*) over-sown with ryegrass (*Lolium* spp.).

Although this system can be highly productive it has inherent deficiencies. Kikuyu possesses anti-quality factors, mineral imbalances and pasture shows seasonal fluctuations. In terms of management, kikuyu is dependent on expensive fertiliser inputs and has a high water requirement. Sustainability of this system is of concern (or under pressure) due to increasing input costs, while occurrence of droughts also becomes more frequent. Introduction of lucerne (*Medicago sativa*) into the current pasture system may increase the production potential because it has a high forage quality nutritional value, is capable of fixing atmospheric N, is adapted to local conditions and has a high water use efficiency.

A major obstacle to the adoption of systems based on lucerne, is that many soils suited to lucerne cultivation in the southern Cape are under kikuyu-ryegrass pastures. Due to the difficulty of eradicating kikuyu from such areas, ways to successfully establish lucerne into kikuyu need to be investigated. Although lucerne has been successfully sown with oats and other companion grasses, there is limited information available on the production potential of lucerne sown into existing kikuyu. The aim of this study is to determine the production potential of different lucerne cultivars over-sown into kikuyu pasture.

Two cultivars from each of four lucerne dormancy classes will be selected and sown into kikuyu on soils identified as suitable for Lucerne production. Three different establishment methods will be evaluated. For the first treatment kikuyu will be sprayed with glyphosate, grazed to a height of 50 mm, mulched to ground level, seed drilled directly into the soil with a no-till planter and rolled. The second method entails spraying with glyphosate, followed by grazing to a height of 50 mm, mulching to ground level, shallow cultivation and rolling. Seed will be broadcast and the area rolled again. The third method is similar to the latter, but will not be sprayed with any herbicide prior to establishment.

A germination study will be done according to the International Seed Testing Association (ISTA) guidelines. Emergence counts will be taken to determine initial and final time of emergence, duration of emergence, seedling survival and final emergence success. Plant persistence and botanical composition will be determined on a seasonal basis. Dry matter (DM) yield (kg DM.ha^{-1}) and content (%) will be determined every 35 days by cutting three 0.25 m^2 per plot to a height of 50 mm, after which pastures will be grazed by Jersey cows. In addition, pasture height will be measured with the rising plate meter (RPM) at each of these sampling points from which linear calibration equations will be constructed for the RPM that relates pasture height to DM production. The statistical design will be a randomised complete block design with the 25

treatments, randomly allocated within each of 3 blocks. The experiment will be carried out over 3 years to investigate seasonal effects.

The outcome of the study is to identify lucerne cultivars that can be productive and sustainable within a kikuyu pasture system and contribute towards a low input pasture system. The study will determine the effect lucerne has on the production potential of a kikuyu/lucerne pasture system. The study will evaluate the performance of lucerne in a kikuyu/lucerne pasture production system.

RESEARCH PROPOSAL POSTER: THE EVALUATION OF DIFFERENT PLANTING METHODS FOR OVER-SOWING GRASS-CLOVER MIXTURES INTO A KIKUYU PASTURE

Janke van der Colf and Philip R Botha*

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Research on kikuyu (*Pennisetum clandestinum*) over-sown with temperate grass and legume species has aided in the development of a kikuyu-ryegrass system that is highly productive in terms of pasture and animal production. However, the sustainability of this system has become questionable due to the economic risks associated with the reduced availability of irrigation water, its poor resilience under extreme climatic conditions, and the high fertilizer costs required to maintain production. Alternative systems, based on the inclusion of grasses and legumes with higher drought tolerances, will have to be developed. However, limited information is available on over-sowing methods, production potential and persistence of such mixtures. This research will thus aim to develop methods whereby perennial grass-clover mixtures can be over-sown into kikuyu in an effective, sustainable and economical manner.

The study will be carried out over three years on approximately 2.5 ha of existing kikuyu under permanent overhead irrigation. The treatments will consist of four pasture mixtures established according to nine different methods. The pasture mixtures will consist of a kikuyu base over-sown with white (*Trifolium repens*), red clover (*Trifolium pratense*) and Italian ryegrass (*Lolium multiflorum* var. *italicum*), perennial ryegrass (*Lolium perenne*), cocksfoot (*Dactylis glomerata*) or tall fescue (*Festuca arundinacea*). Kikuyu that is not over-sown will act as a control treatment whereby the production potential of unimproved kikuyu can be quantified. The establishment methods used during the study will be aimed at including techniques based on herbicidal and mechanical control of kikuyu. Three different cultivation techniques will be repeated in a factorial manner during the study where the kikuyu will be sprayed with paraquat or glyphosate prior to planting. The different degrees of cultivation, described as no-till, minimum till and tillage are described in detail in Table 1.

Table 1: Description of the cultivation techniques to over-sow kikuyu.

No till	Minimum till	Tillage
Graze to 50 mm Broadcast seed Mulch to ground level Roll with teff roller	Graze to 50 mm Mulch to ground level Plant with Aitchison seeder Roll with teff roller	Graze to 50 mm Mulch to ground level Rotavate to 120 mm Roll with teff roller Broadcast seed Roll with teff roller

RESEARCH PROPOSAL POSTER: THE EFFECT OF BIOGAS SLURRY ON FODDER PRODUCTION AT MACUBENI COMMUNITY IN THE EASTERN CAPE

Nobuntu Mapeyi[1], James Gambiza[2] and M Qambata[1]*

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Winter supplementation of livestock in communal areas is generally neglected by farmers due to, amongst other factors, limited income. This results in animals suffering from poor nutrition due to the low quality and quantity of natural forage during the winter period in these areas. One potentially economic method for improving feed quality is the use of forage legumes. This study plans to investigate the effect of biogas slurry on forage legume production.

The study will be carried out in Macubeni, Lady Frere in the Eastern Cape Province. The rainfall ranges between 501-600 mm per annum, while the soil types are mudstone and sandy soils with dolerite intrusions, and grassland vegetation. The study will be done in two phases: a survey and a research trial. Phase one will involve the assessment of the current status of rangeland condition through questionnaires and veld condition assessments at Macubeni.

The second phase will test the effect of biogas slurry on fodder production. A factorial experimental design with three replicates and two levels of slurry applications will be used at each homestead. The annual legume/grass mixture (ALG) will consist of *Trifolium vesiculosum* (arrow leaf clover) and *Avena sativa* (oats) and the perennial legume/grass mixture (PLG) will consist of *Trifolium repens* (white clover) and *Festuca arundinaceae* (tall fescue). The slurry treatments will be zero slurry application and slurry application at a rate still to be determined. Slurry application will be done during the active growth stage of forage as a top dressing at six weeks after germination. All plots, including the control, will be irrigated with same amount of water. Forage will be cut during the twelfth week after planting/germination and analysed as fresh hay for dry matter content (DM), crude protein (CP), acid detergent fibre (ADF) and minerals. ANOVA statistical analyses will be used.

SESSION CHAIR: KEVIN P KIRKMAN

Tuesday 17 July 2012, 14:00 – 15:30

Keynote Address and Platform Presentations

INVITED KEYNOTE ADDRESS: HOLISM: THE FUTURE OF RANGE SCIENCE TO MEET GLOBAL CHALLENGES

Allan Savory[#] and Jozua J S Lambrechts[*]

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It is appropriate that we meet on Jan Smut's home ground because it is his construct of holism that has guided my work in striving for practical solution to Africa's and the world's desertification problem. Range science has attempted to deal with rangeland management through a plethora of management systems and the use of fire and technology. Throughout the years of well-meaning effort we have witnessed desertification expanding. Not being trained in range science I have been more free to explore other avenues which have brought us into conflict now ending as signalled by your magnanimity in inviting this talk. For reasons explained, and based on good science replacing deeply held beliefs that have assumed scientific validity, only livestock in greatly increased numbers can now reverse desertification. Management of grasslands always involves social, economic and environmental complexity. Management needs to be holistic based on Smuts' theory and can never be reductionist. The development of the holistic framework to address complexity and holistic planned grazing as a simple planning process to replace rotational and other grazing systems has proven consistently successful on four continents over the past forty years when practiced. Due to the profound importance of range science as the main profession dealing with about two thirds of the world's land area I urge that you consider replacing management by prescriptive systems in favour of process management. Proactive management replacing adaptive management. Desertification is only a symptom of biodiversity loss leading to less effectiveness of the available rainfall, and desertification is contributing enormously to climate change. Biodiversity loss, desertification and climate change are treated as three issues by our institutions, in conferences and management and no profession is better positioned to bring the three together. In the years ahead as the perfect storm of our own making approaches you have a great role to play. Let it not be said that desertification continued to expand on your watch. A great opportunity is before you to think afresh and truly lead.

PLATFORM PRESENTATION: THE USE OF FIRE AND OXEN AS MANAGEMENT TOOLS IN THE REHABILITATION OF UPLAND *CYMBOPOGON - THEMEDA* VELD IN THE EASTERN CAPE, SOUTH AFRICA

Robin Ford[1], Wayne F Truter[1#] and Mike J S Peel[2]*

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The grazing value of areas supporting low quality, high producing, climax veld such as *Cymbogon plurinodis* is extremely low and practical measures are required to benefit from this generally unutilized resource. This study demonstrates the combination of fire and high density grazing as tools in the management and subsequent conversion of *Cymbopogon plurinodis* veld on Glen Gregor Farm, Bedford, Eastern Cape to valuable grazing. Site selection was based on camp age, expressed as time since the initiation of comparable burn and grazing treatments. Therefore, vegetation sampling was carried out on six camps (10, 7, 5, 3, 2, 1 years) in different stages of succession following the suppression of the climax type *C. plurondis* under fire and high pressure grazing. An untreated control (unburned, ungrazed) was included depicting the original condition of all treatment camps and functioned as a benchmark for comparisons. Species composition, basal cover, bare ground, and primary productivity were monitored in top and bottom slope sites in each camp. Preliminary within camp analysis shows vegetation response to be significantly related to topographical (top slope vs bottom slope) differences influencing grazing distribution at each site. Frequency of *C. plurinodis* diminished significantly in bottom slope sites compared to top sites with an overriding effect of time determining overall species composition in all camps. Although, species diversity increased linearly with camp age, bottom slope sites revealed the highest rate of species change compared to top slopes where this effect was dampened. Basal cover was highest, and bare ground least in bottom slopes compared to top slopes; these values improved from a minimum in the control to a maximum in the ten year old camp. Primary productivity was generally higher in top slopes associated with increased frequency of high producing, low quality *C. plurinodis*. From the initial data measurements collected, it can be concluded that the combination of fire and oxen as management tools, has delivered significant benefits in improving the grazing value of *Cymbopogon - Themeda* veld**.**

PLATFORM PRESENTATION: CLIMATE-SMART ANIMAL AGRICULTURE: THE IMPORTANCE OF ADAPTED BREEDS OF CATTLE IN SUSTAINABLE VELD–LIVESTOCK FARMING SYSTEMS

Heleen C Els[1] and Keith A Ramsay[2]*

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Climate-smart agriculture, a term used by the Food and Agriculture Organisation of the United Nations (FAO) and other partners refers to “agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances achievement of national food security and development goals”. Climate-smart **animal** agriculture refers to farming systems that are based on sound animal and veld husbandry principles that take current and projected climatic and vegetation conditions into consideration to ensure long term sustainability. This includes farming with indigenous, locally developed, and locally adapted breeds and species capable of surviving and producing under conditions such as higher temperatures, less rainfall, an increase in animal diseases and parasites, and changes in the natural vegetation.

Over the past few years, grazing cattle have gained an unfortunate reputation as the villains in global warming. Initial work has shown that cattle on natural rangeland and planted pastures contribute more to global warming than their counterparts in intensive farming systems. Recent work, however, has indicated that grazing ruminants in sustainable farming systems are, in fact, contributing to the storage of greenhouse carbon and the improvement of the soil - effectively, such ruminants provide milk and meat from grass while contributing to soil fertility and the mitigation of climate change.

If the adaptive behaviour and traits of indigenous and locally developed breeds of cattle in extensive veld–livestock farming systems are added to this equation, it becomes clear that they are, in fact, one of the best options for climate-smart animal agriculture. Important traits include smaller size, which reduces the impact of trampling, and the ability to walk longer distances that distributes waste over a larger area and reduces overgrazing close to water points. Nguni cattle, for example, are non-selective grazers and selective browsers, making far better use of the available herbage than most exotic breeds that often struggle to get sufficient nutrition from the same resource. Other traits such as more effective sweat glands, respiratory heat dissipation, smooth motile hides to displace biting and sucking insects, tick and internal parasite tolerance and a restful temperament help reduce the stress load associated with hot humid environments and enable such breeds to focus on grazing and breeding (any stress will have a negative influence on reproductive efficiency) as opposed to the endless struggle that temperate exotic breeds would have to adapt and to get sufficient food to survive.

More work needs to be done on veld based systems to quantify the measureable advantages of adapted breeds in sustainable systems as this information will help offset any negative publicity that may still exist. It could also lead to a system of carbon credits for those involved in such systems.

SESSION CHAIR: WAYNE F TRUTER

Tuesday 17 July 2012, 08:45 – 10:05

Keynote Address and Platform and Poster Presentations

INVITED KEYNOTE ADDRESS: RESTORATION OF DEGRADED GRASSLANDS AND SAVANNA: THE ENVIRONMENTAL CONSULTANT'S PERSPECTIVE

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The first reclamation projects in South Africa probably occurred along the coast at the ports of Cape Town, Durban and Port Elizabeth where land from the dune systems was modified by the earlier settlers to establish these cities. However, the first attempts to stabilise sites after large scale disturbance such as mining by establishing a vegetation cover were first carried out in the 1930s on the West Rand of Gauteng. Air and water pollution from the sand dumps (tailings produced from rock processed for gold) posed a threat to the urban environments and the beginnings of "restoration ecology" in South Africa thus took place along the Witwatersrand goldfields. By the 1970s the process was thought to be well in hand and the "greening of the gold" tailing dumps was carried out over extensive areas. Research indicated that this process was not as viable a solution to land restoration when compared with the European approach of reclamation, whereby degraded land could be used productively. An unfortunate precedent of establishing a vegetation cover without consideration of the future land use of the disturbed areas was thus set. This approach is one that has been followed in many other projects in South Africa.

Major rehabilitation projects, such as dune mining on our south east coast, for example, looks to the re-establishment of natural environments with little cognisance of the potential for the land to be of sustainable use by the local people. Likewise the clearing of invasive alien woody plants is being carried out with little or no planning for the final use of the restored land, whether for grazing, intensive agriculture or conservation.

The reasons for not considering future land use in South Africa rehabilitation projects may be attributed to a number of factors:

- Historically, there appears to be plenty of space for all land uses without the need to reclaim land for future use.
- Lack of consultation with the local rural communities and an authoritarian approach to land use by the government and local authorities.
- The altruistic belief that the restoration of natural ecosystems is best for our country and conservation of the environment, i.e. the strong conservation ethic that perseveres amongst the controlling authorities.

Environmental Impact Assessments (EIAs) for mining projects in which we have been involved have shown that the rehabilitation strategy must take cognisance of the land use required by the local people. Consequently we have looked at the approach of rehabilitation following disturbance due to mining, alien removal, and related disturbances. We have devised an approach that takes cognisance of the social, economic, natural and institutional sustainability, the four pillars of sustainability on which restoration principals should be founded. We use case studies from over 40 years of experience in the consulting industry and research into degraded systems to elaborate on what we believe is the most appropriate strategy.

POSTER PRESENTATION: VEGETATION DYNAMICS TO ASSESS RESTORATION ACTIONS TO COMBAT LAND DEGRADATION IN THE SEMI-ARID RANGELAND SAVANNAS OF THE MOLOPO IN THE NORTH WEST PROVINCE, SOUTH AFRICA

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Over-utilization of rangelands by domestic livestock and game is a serious problem in the semi-arid rangelands of the western Molopo area in the North West Province of South Africa. A deterioration of natural resources negatively affects ecosystem functioning, which leads to land degradation characterized by a loss in vegetation cover and imbalance in the grass: bush ratio. The increase in the abundance of woody plants, i.e. bush encroachment, and the loss of palatable grasses result in a decrease of biodiversity, rangeland productivity and carrying capacity. Accordingly, farmers have to cope with profound economic losses.

The study forms part of the multinational and integrated PRACTICE project (Prevention and Restoration Actions to Combat Desertification: An Integrated Assessment), and aims at investigating and evaluating the actions implemented by commercial and communal farmers in the Molopo area to combat land degradation. The main three actions implemented included a better grazing management strategy (e.g. rotational grazing with periods of rest), the control of bush/woody species by different methods (chemical, manual and mechanical measures) and revegetation to improve the forage production for grazing animals. Site-specific indicators of the herbaceous- and woody species composition and soil components are used to assess the impacts of the different actions and to measure the changes regarding the following criteria used in the PRACTICE project: ecosystem goods, carbon sequestration, water and soil conservation, and biodiversity. The Fixed Point Monitoring of Vegetation Methodology (FIXMOVE) was used to also determine the veld condition, as well as the grazing and browsing capacity, in order to compare and quantify the results between the three different actions.

The rotational grazing management strategy and revegetation increased biomass production and carrying capacity of the rangelands the most. The continuous grazing management strategy that is more commonly found on communal and lease farms in the semi-arid rangelands of the Molopo region had the poorest grazing capacity, mainly due to the low dry matter production and high bush densities. As expected, the browsing capacity and canopy cover were lower in the areas where woody species had been eradicated. High bush densities were found in the non-rotational overgrazed areas and veld considered by farmers as poor grazing veld.

The results indicated that the restoration actions implemented to combat land degradation in the semi-arid rangeland savannas of the Molopo do have a definite effect on the veld condition, especially on improving the grazing capacity of the veld and on decreasing bush densities.

POSTER PRESENTATION: THE IMPACTS OF LAND DEGRADATION AND RESTORATION ACTIONS ON THE VEGETATION DYNAMICS IN THE MIER DISTRICT OF THE NORTHERN CAPE, SOUTH AFRICA

J Albert van Eeden and Klaus Kellner*

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The Mier district forms part of the Kalahari region in the Northern Cape Province of South Africa. This area is especially susceptible to land degradation and desertification due to the semi-arid climate of the area combined with poor farming practices and overutilization of the natural resources. Land degradation and desertification impact negatively on the socio-economic standing of the people living in the southern Kalahari. The aim of this study forms part of the multinational and integrated PRACTICE project (Prevention and Restoration Actions to Combat Desertification an Integrated Assessment) to investigate the actions implemented by commercial and communal farmers in the Mier district to combat land degradation and desertification. The four actions or methods that the farmers implemented to restore their degraded land, include bush/shrub control, dune stabilization, revegetation and the implementation of better grazing management strategies. Surveys were done on commercial farms in the dune veld and on communal farms in the hard veld.

The Fixed Point Monitoring of Vegetation Methodology (FIXMOVE) was used at each site where the different actions were implemented to determine the grass species composition and the extent of bare and litter patches. The same method was used at the sites where no actions were implemented. The latter served as the control plots. Disc pasture meter readings were used to determine the amount of biomass for the calculation of the grazing capacity. Soil samples were taken at a depth of 30cm to determine the active and total organic carbon in the soil surface. Through the abovementioned methods, the vegetation dynamics of degraded and non-degraded plots and the success of the restoration actions were evaluated.

In general the commercial farms had a higher biomass and species diversity than the communal farms. There was a marked difference between the sites where dunes were stabilized and revegetated, bush control and grazing management strategies were implemented and sites where these actions weren't implemented in terms of a higher biomass, grazing capacity and species richness. Through the use of the treatments, the actions of the farmers to combat land degradation and improve the grazing capacity, as well as the effects on the veld condition could be evaluated. The results indicate that it would be advantageous for farmers to apply bush/shrub control, good grazing management strategies, dune stabilization and revegetation because it improves the biomass and grazing capacity and ultimately the sustainability of their farms in an ecological and economic sense.

PLATFORM PRESENTATION: INCREASING ADOPTION OF WARM-SEASON, SUBTROPICAL AND TROPICAL FORAGE LEGUMES FOR RANGELAND REHABILITATION AND CULTIVATED PASTURES IN SOUTHERN AFRICA

Jim P Muir[1], Jamie L Foster[1], Jose C B Dubeux Jr[2] and William D Pitman[3]*

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The Past. The enormous amount of intellectual energy and funds invested in researching and divulging warm-season, subtropical and tropical forage legumes for rangeland rehabilitation and cultivated pastures throughout the world have produced disappointing results. A few cases of regional adoption exist, but the majority of cultivar development, peer-reviewed publications, and extension efforts have fallen flat. In many cases germplasm showed agronomic promise but had fatal faults such as low seed production or poor persistence under competition or grazing. In other cases, the economic incentive for adoption did not exist, for example, in unfavorable land tenure situations or when nitrogen fertilizers were inexpensive. Extension efforts have also fallen short due to poor understanding of land manager reality, narrow discipline focus, or short-term involvement.

The Present. The result is that current investment in forage legume development for warm-season, subtropical and tropical rangelands and pastures is at an all-time low. Entire education and research programs have atrophied in traditional strongholds such as the southeastern United States. Funding support is difficult to acquire and, when successful, is often surreptitiously couched in bioenergy or environmental programs. This occurs precisely at a time when fossil fuel costs and environmental awareness should be boosting efforts to insert legumes into all forms of agriculture.

The Future. Our thesis is that the future for warm-season, subtropical and tropical forage legumes is promising if we 1) learn from our past mistakes, 2) educate our colleagues, funding agencies, end-users and society at large to their benefits and 3) reinforce our own belief in their potential. We predict that the use of agro-industrial inputs such as fertilizers, irrigation, herbicides, insecticides and mechanization in pastures and rangeland will decline and that ruminant production will increasingly be relegated to low-input, infertile and arid regions by society's need to cultivate grains and pulses. Because of their ability to fix atmospheric nitrogen, access sub-soil moisture and persist in multi-species (plant and animal) environments, adapted forage legumes, especially of local origin, will be ideally suited to maintain productivity, persistence, and health of these ecosystems.

Reclaiming the Agricultural Potential of Grasslands and Savannas

SESSION CHAIR: ROY A LUBKE

Tuesday 17 July 2012, 10:30 – 12:20

Keynote Address, Platform and Poster Presentations

KEYNOTE ADDRESS: THE IMPACT OF SURFACE COAL MINING ON THE AGRICULTURAL POTENTIAL OF THE GRASSLAND BIOME: AN OVERVIEW

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Many soils are impacted by activities such as intensive agronomic practices or surface mining activities. Surface mining of coal is widespread in the grassland areas of the Mpumalanga Province in South Africa. Currently, these industrial operations are regarded as the main cause of many detrimental environmental impacts. To ensure healthy and productive vegetation after the reclamation process, disturbed soils need to be ameliorated and re-vegetated with locally adapted grass species. To date, conventional methods of liming, fertilization and seeding, to improve the productivity of impacted soils, have been sub-standard practices. This process is, however, very expensive and is not necessarily sustainable. The question remains whether we are achieving reclamation of mined land in the grassland biome? Not only does this biome provide good quality natural and planted pasture to support the cattle industry to meet the increasing protein demands of our growing population, but is also home to a large proportion of our country's arable farmland. The main objective of reclaiming surface coal mined soils, is to reinstate the pre-mining agricultural potential. This is closely linked to the land capability of an area which is determined by its own set of soil quality criteria. Often the grazing land capability class, which makes up more than half of the reclaimed surface coal mine soils, has a better agricultural potential than the original pre-mined land. The sustainability of these reclaimed environments, however, is determined by the maintenance of the established vegetation which is often poor. It can be concluded, that sufficient data has shown that reclaimed surface coal mine soils can serve as a valuable resource to the animal production industry as well as to local communities, if managed correctly.

PLATFORM PRESENTATION: HEAVY METALS ACCUMULATION IN SHOOTS OF RHODES (*CHLORIS GAYANA*), THATCH (*HYPARRHENIA HIRTA*) AND VETIVER (*VETIVERIA ZIZANIOIDES*) GRASSES GROWN ON GOLD, PLATINUM AND GYPSUM MINE TAILINGS

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Vegetating mine tailings is one of the sustainable and cost effective methods of minimising and preventing liberation of heavy metals into natural environment. These heavy metals are responsible for pollution of water resources (surface and ground), soil and air. Revegetating these mine tailings is imperative, but it must be borne in mind that not all plants can survive hostile growing conditions of mine tailings enriched with toxic heavy metals. Some plants are accumulators of heavy metals while others are excluders. The former tend to be risky option especially whereby post mining land uses include livestock grazing. An experiment growing three different grasses including Rhodes (*Chloris gayana*), thatch (*Hyparrhenia hirta*) and vetiver (*Vetiveria zizanioides*) into five different growth mediums (gold, platinum and gypsum tailings, clay

and red sandy soils) was conducted. Results showed that grasses accumulated different and varying levels of heavy metals. Rhodes and vetiver grasses were the highest accumulators of As, Mn, Zn, Cr, Fe and Mo while thatch was the poorer accumulator. Among growth mediums, platinum tailings and red sandy soil were superior mediums by producing highest valves of Cr, Fe, Mo and Mn. It was concluded that Rhodes grass should be excluded from the list of mine tailings revegetation grasses due to its potential to accumulate heavy metals into its aboveground tissue parts, especially when post-mining land use includes livestock farming, due to risk of fodder toxicity and human exposure. On the other hand, vetiver grass can be considered for mine tailings rehabilitation due to low or no exposure of fodder toxicity since it is not consumed by animals.

PLATFORM PRESENTATION: INVESTIGATING THE ALLEVIATION EFFECT OF DIFFERENT VEGETATIVE GRASS SPECIES ROOT DEVELOPMENT ON COMPACTED SURFACE MINE SOILS

Theo G Bredell[1], Wayne F Truter[2#] and Willem Fergusson[1]*

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Soil compaction is a key problem that affects rehabilitation of land after surface coal mining. It has been documented that soil physical and chemical properties deteriorate resulting in compaction due to traffic of heavy vehicles, machinery and chemical hardsetting. Mechanical impedance of soil restricts root growth and development, and varies depending on the level of compaction which is determined by soil water content, soil texture, soil structure and organic matter content.

This research aim was to determine how vegetative grasses with aggressive root systems can alleviate compaction and improve soil physical properties. Experimental work was conducted on two native grass species and two exotic species. *Hyparrhenia hirta* (common thatching grass), *Themeda triandra* (red grass), *Vossia cuspidata* (hippo grass) and *Vetiveria zizanioides* (vetiver grass) were grown without a fertilizer treatment option. In addition, *H. hirta* and *T. triandra* were grown with and without fertilizer. All species were established on open-cast rehabilitated mine soils.

Research results confirmed that fertilizer treatment during the establishment period can have a significant impact on root development in the upper soil profile 0 - 200 mm, as opposed to 201 - 300 mm which is evidently a function of species. The active root zone of each treatment was analysed and penetrometer readings indicated improvement at a critical depth of 100 – 140 mm for all treatments options. Significant reduction in resistance penetration of the penetrometer was evident for *V. zizanioides.* In addition to this *V. cuspidata* indicated superior root biomass production.

The correct selection of species with a known root structure and basic management requirement has, therefore, the potential to be useful in creating an organically rich, alleviated and more sustainable soil environment to ensure improved rehabilitation results of surface coal mines.

PLATFORM PRESENTATION: EVALUATING THE EFFECT OF PRE-ESTABLISHMENT TECHNIQUES ON THE POST-EMERGENCE VIGOUR OF *ERAGROSTIS CURVULA*

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Establishing pastures in the high rainfall areas of South Africa is essential where pastures have deteriorated or monoculture crops have been planted. *Eragrostis curvula* is the species most favored as a planted pasture by farmers in the subtropical regions under dry-land conditions. Many production guidelines exist for planting pastures. However, the new technology involving the coating of seeds with substances required by the seedling for growth still needs to be researched in depth. With respect to coated seed, there are no production guidelines available on the interactions, importance and significance of specific pre-establishment techniques involved in seeding of grasses. Practices such as fine seedbed preparation, rolling, the use of a nurse crop such as *Eragrostis tef,* and the adaptation of seeding rates required for better, more economical establishment of coated seed are unknown.

The aim of this study is to establish if there is a correlation between pre-establishment techniques and plant establishment and vigour. During this study conducted on the University of Pretoria Experimental Farm, treatments were all tested in a field trial, and the interactions of the different cultural practices on using coated seed are highlighted. Established *Eragrostis spp.* and annual grass weeds were counted. Data suggested that preparing a fine seedbed did not have as big an effect on *Eragrostis* establishment as rolling did, but did influence weed numbers. It was noted that coated seed established better than clean seed. When taking into consideration that recommended seeding rates for coated and non-coated seeds are the same (in mass of seed), it can be determined that non-coated seeds were planted at more than twice the amount of coated seeds. It can be concluded that even seeding rates had a definite effect on *Eragrostis* establishment in the first season in addition to the importance of the nurse crop competing well with annual grass weeds.

POSTER PRESENTATION: THE USE OF LANDSCAPE FUNCTION ANALYSIS (LFA) AND PHYTOTAB AS REHABILITATION MONITORING TOOLS AT AN OPENCAST COAL MINE

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Ecological restoration is to enhance, repair or reconstruct degraded ecosystems and optimise biodiversity returns. Rehabilitation is the term used for the progression towards the reinstatement of the original ecosystem. Monitoring of rehabilitated areas is to detect any change, positive or negative, in the soil or vegetation and is important for the day-to-day management of restoration areas. The objective of the study was to use Landscape Function Analysis (LFA) and PHYTOTAB as a combination to assess and monitor vegetation and soils on rehabilitated areas of opencast coal mines. The monitoring surveys were done at an opencast coal mine near Witbank on the Mpumalanga Highveld using PHYTOTAB for the vegetation and LFA for the soil assessment. Sixteen survey sites in 8 rehabilitated areas were surveyed. PHYTOTAB was used to determine the plant species composition, total canopy cover, canopy cover of the grass component and the standing grass biomass of the area. A 200 point line transect was used for estimating the basal cover of the area. The LFA survey was used to determine infiltration/runoff, stability and the nutrient cycling status of the soils. The results of the LFA survey of the soils showed that the soil stability ranged from 46.7% (area 7) to 53.6% (area 2), the soil infiltration/runoff from 25.1% (area 7) to 37.8% (area 3) and the nutrient cycle status from 16.0% to 23.1% (area 3). The results of the PHYTOTAB surveys of the vegetation showed that the mean canopy cover ranged from 24.7% (area 8) to 88.3% (area 3), the mean canopy cover of the grass component from 20.2% (area 8) to 85.9% (area 3), the basal cover from 10.0% (area 7) to 21.0% (area 3) and the standing grass biomass from 1 533 kg.ha^{-1} (area 6) to 3 530 kg.ha^{-1} (area 2). The results of the LFA survey of the soils together with the vegetation results of the PHYTOTAB surveys of the different rehabilitated areas, can be used by rehabilitation officers at the colliery to make decisions regarding management of the areas including re-seeding, using different ways to revoke soil compaction, combat soil erosion, and manage invasive and weed species.

Managing Biodiversity through Conservation Planning

SESSION CHAIR: TONY (A) SWEMMER

Tuesday 17 July 2012, 14:00 – 15:20

Platform and Poster Presentations

PLATFORM PRESENTATION: THE ECONOMIC CONTRIBUTION OF ECOSYSTEM SERVICES IN KWAZULU-NATAL, SOUTH AFRICA

Steve McKean[1], Debbie Jewitt[1], Lehlohonolo Phadima[1] and Myles Mander[2]*

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Natural areas provide many of the ecological goods and services which are critical for development and the wellbeing of people. However, little awareness of their roles and full values to society exists. This has contributed significantly to these areas not receiving the adequate political and economic support they deserve. In addition, natural areas are often transformed and over-exploited for financial reasons without considering their full economic value to society. To remedy this situation, the role that such areas play in meeting the needs of modern society must be identified, properly valued and explained in relevant terms. This assessment is the first attempt to address such needs at a provincial scale in KwaZulu-Natal (KZN).

Ezemvelo KZN Wildlife has the responsibility of leading KZN in dealing with the challenges of natural resource degradation and the ability of ecosystems to continue providing goods and services to people. This presentation briefly discusses an assessment of habitat types and condition in KZN, identifies and assesses some ecosystem services supplied by the habitat types in KZN, assesses the demand for ecosystem services and estimates their value.

Twenty six different ecosystem services were identified as important services supplied by the twelve dominant habitat types in KZN. The value to society of these services is estimated at R150 billion annually, while provincial GDP is R204 billion per year. Some 9.5 million rural people in KZN are particularly dependant on ecosystem services for livelihood support as few alternatives are available to them in many instances. Data show that ecosystems and their services in KZN are being lost and degraded at a rapid rate (some 1.4% per annum), imposing risks and costs to the people of the province and of the country.

PLATFORM PRESENTATION: USING THREATENED AND ENDEMIC SPECIES TO PRIORITISE CONSERVATION ACTION FOR INTACT HIGHLAND GRASSLAND

Ian T Little

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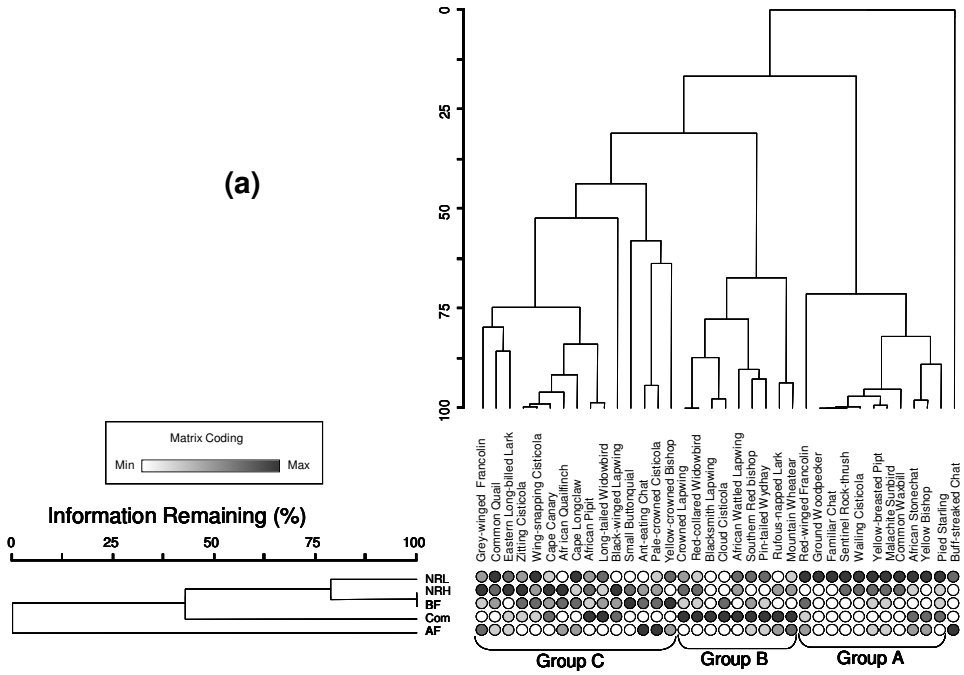
This study assessed the responses of various grassland nesting passerines to habitat management, with the aim of understanding which moist highland grassland birds could be used for the purpose of rapidly assessing the detrimental impacts of intensive management in commercial livestock areas. The two primary hypotheses that were tested here were whether process oriented data (nesting success) or simple count data were sufficient for assessment of ecological integrity, and whether any particular species proved to be particularly effective as indicators of habitat condition.

This study was conducted in the open grasslands of the northern Drakensberg system near the town of Dullstroom in the Mpumalanga Province of South Africa. Grassland bird species were both counted in fixed line transects and nest searches were conducted in randomly selected 25ha plots. Nests that were located in this process were monitored to completion and analysed using Programme MARK nest success function. Bird species abundance data were analysed using PC-Ord multivariate statistical software. Bird assemblages reflect habitat disturbance in a diversity of ways, driven by factors ranging from direct disturbance to changes in habitat structure and functioning, and shifts in food availability. In particular, fire frequency strongly influences grassland-breeding birds because farms are burnt in the territory-forming stage of the breeding cycle. Insectivores and nectarivores were disproportionately impacted by intensive management. Of particular concern in this system is the Yellow-breasted Pipit, *Anthus chloris*, which is a regionally and globally *vulnerable species* because of habitat loss. This species is sensitive to any form of habitat disturbance, highlighting the need for conservation attention in these grasslands. From this it can be concluded that the presence alone of a species such as this is sufficient indication of ecological integrity. All of these factors illustrate how sensitive the grassland biome is to poor land-use management and the need for farmer co-operation and conservative management.

Table 1: Summed AICc weights for Burn and HaLAU indicating the extent of support in the data for inclusion of these covariates within the models. This illustrates the relative influence of each of these factors for each species' nesting success.

Common Name	Scientific Name	Burn	HaLAU	ΔAIC
Long-Tailed Widowbird	*Euplectes progne*	0.936	0.019	2.146
African Stonechat	*Saxicola torquata*	0.898	0.03	3.429
African Pipit	*Anthus cinnamomeus*	0.835	0.074	2.72
Yellow-Breasted Pipit	*Anthus chloris*	0.334	0.362	1.2
Wing-Snapping Cisticola	*Cisticola ayresii*	0.089	0.714	2.442
Cape Longclaw	*Macronyx capensis*	0.037	0.879	2.46



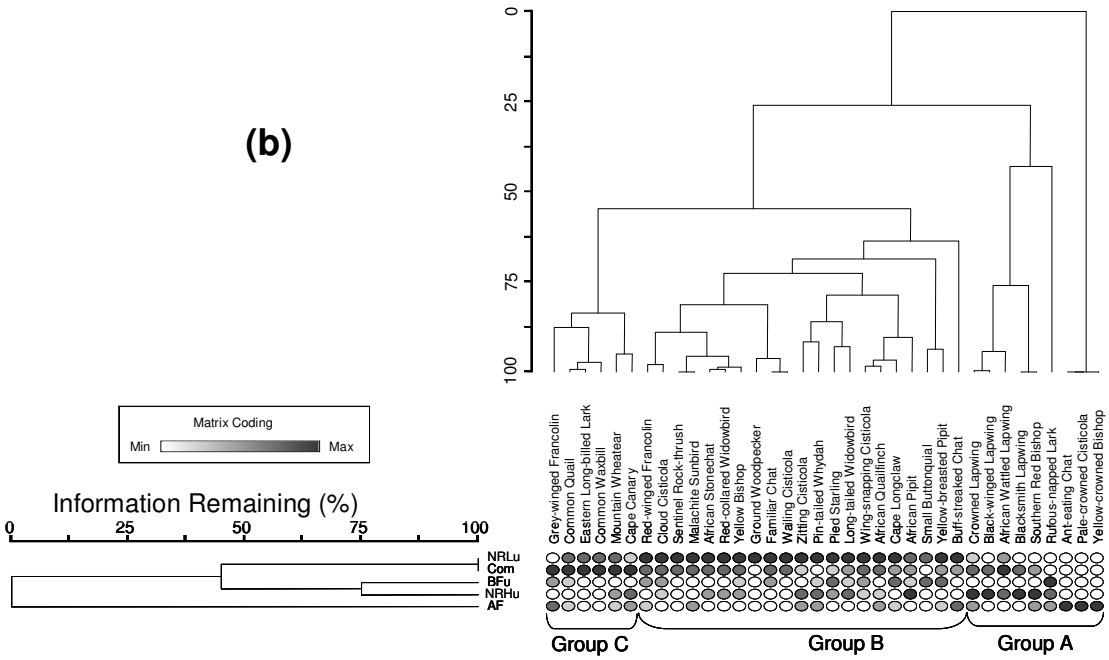


Figure 1: Bird species assemblages (based on abundance) as a function of whether or not a site was burnt in the focal year: (a) includes only abundance measures from sites that were burnt in that season, while (b) includes only abundance measures from sites that were not burnt in that year. Communal lands and the annually burnt farm were included in both (a) and (b) for comparative purposes (they are both managed in the same way in all years).

PLATFORM PRESENTATION: EXPLORING THE MESOFILTER AS A NOVEL OPERATIONAL SCALE IN CONSERVATION PLANNING: A CASE STUDY FROM SOUTH AFRICA'S REMNANT MONTANE GRASSLAND

Casper J Crous, Michael J Samways and James S Pryke*

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Increased emphasis is being placed on developing effective biodiversity conservation tools for practical conservation planning. The mesofilter is such a biodiversity planning tool, but has yet to be explored fully to appreciate its effectiveness. The key premise of the mesofilter is that ecosystems contain certain physical elements which are specifically associated with a variety of species. Identifying such mesofilters could therefore complement existing conservation planning tools such as coarse- and fine-filters. To explore the value of the mesofilter as a novel operational scale in conservation planning, we studied 18 remnant patches of endangered montane grassland in KwaZulu-Natal, South Africa, using a physical landscape feature, patch rockiness, as an abiotic surrogate for biodiversity. The objective was to see whether the mesofilter of rockiness can predict variation in species richness and composition for three dominant grassland taxa (plants, butterflies and grasshoppers) at the landscape scale. Variable levels of patch rockiness had significant interactions with all three focal taxa. Plants and grasshoppers responded similarly to the mesofilter, both having significantly higher species richness in areas of higher rockiness. However, in butterflies the mesofilter only predicted significant differences in species composition. The results indicate that use of an abiotic surrogate such as rockiness can predict biodiversity value across multiple taxa. It is therefore a valuable surrogacy and congruency tool for practical biodiversity conservation at the small spatial scale. The mesofilter also has value in the design and management of protected areas.

PLATFORM PRESENTATION: CONSERVING GRASSLAND BIODIVERSITY BY USING ECOLOGICAL NETWORKS ACROSS THE COMMERCIAL TIMBER LANDSCAPE

James S Pryke and Michael J Samways

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Understanding edge effects between transformed landscapes and conservation areas is critical to conservation planning. Conservation areas in landscape mosaics are often composed of linear corridors, resulting in more edges than would occur naturally. Plantation forestry has transformed much of South Africa's grassland, with ecological networks (ENs) currently being used to mitigate this biodiversity loss and to maintain ecosystem processes. I compare arthropod biodiversity along transects that ran from within plantation blocks or indigenous forest patches (as a natural reference) into indigenous grassland corridors or into protected areas. Arthropods are the focal taxa for this study as they are abundant, diverse, and environmentally sensitive at point localities and so represent a wide range of taxa. Two types of exotic commercial trees and various tree age classes were studied. There was a 32 m edge zone from plantation blocks into grassland corridors. Few significant edge effects from plantation blocks occurred at greater distances than this, suggesting that grassland corridors with a width <64 m are mainly edge. This situation is complex, with different taxonomic groups responding differentially to these edges, although by 32 m from the plantation blocks, arthropod richness and species composition was similar to those of neighbouring protected areas. Indigenous forest supported many additional species, not just within the forest, but also with associated grassland corridors. This means that natural edges are important for maintaining biodiversity, while linkages within transformed habitats need to be wide enough to overcome edge effects.

POSTER PRESENTATION: THE POLICY FRAMEWORK FOR BIODIVERSITY AND CLIMATE CHANGE RESPONSE

Vhali P Khavhagali

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South Africa is home to a significant portion of global biodiversity, and many of its natural ecosystems are relatively intact, despite the changes in land cover that have accompanied societal development. South Africa also possesses an established network of protected areas that contribute both to conservation targets and to income from nature-based tourism. However, it is now increasingly appreciated that unmitigated anthropogenic climate changes are likely to cause increasingly adverse impacts on the country's ecosystems and biodiversity. These will play out on a landscape dominated by human impacts of some degree of severity. Both the impacts of climate change on wild species, and their adaptation to climate change thus interact strongly with human impacts.

With the envisaged potential impacts from climate change, Department of Environmental Affairs has developed the biodiversity and climate change policy framework that is based on the premise that biodiversity and healthy ecosystems are critical for human wellbeing and quality of life. This framework will guide the national adaptation biome response to climate change and its potential impacts. The policy framework addresses the following main components (i) understanding of climate change adaptation (ii) principles and strategic response (iii) implementation framework (iv) key policy directions; thus the national policy will give guidance to sector departments, whose policy in turn influences implementation structures of the department.

The scope of the biodiversity sector climate change response comprises both the biodiversity and ecosystem resource (species, ecosystems, and ecosystem processes and services), and their interaction with natural resources. Given the general consensus that climate change is affecting our biodiversity and ecosystem services, there is a need to adapt to increased climate variability as well as long-term climatic shifts. It is also noted that the vulnerability and adaptive capacity of ecosystems is closely linked to the social and economic systems that surround them. This policy framework document will benefit a range of groups including community members, research organizations, biodiversity sectors and all spheres of government.

ABSTRACTS: WEDNESDAY 18 JULY 2012

African Rangelands and their People

SESSION CHAIR: JAMES GAMBIZA

Wednesday 18 July 2012, 08:00 – 09:20

Keynote Address and Platform and Poster Presentations

INVITED KEYNOTE ADDRESS: NATURAL RESOURCE MANAGEMENT AND BIODIVERSITY CONSERVATION IN THE DRYLANDS OF EASTERN AFRICA

Mohammed Y Said[1], Abdillahi A Aboud[2], Philip K Kisoyan[2], An M O Notenbaert[1], Jan de Leeuw[1], Pablo Manzano[3], Jonathan M Davies[3], Guyo M Roba[3], Shadrack O Omondi[4], Michael O Odhiambo[4], Michael Waithaka[5] and Jane W Gitau[1]*

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Drylands cover about 41% of the world's land surface and are home to more than 2 billion people. In eastern Africa it is estimated that drylands cover approximately 75% of the region, and have a total population of significantly more than 62 million. Most of East Africa's land mass falls in the arid and semi-arid lands (ASAL) where pastoralism based on extensive livestock production serves as the bedrock of livelihoods and culture. The ASAL regions are among the region's poorest, where weak infrastructure, widespread insecurity, frequent droughts and limited livelihood options keep many residents in conditions of poverty and vulnerability. Nonetheless, because population densities in the ASAL are low, central governments, donors and non-governmental organizations (NGOs) pay relatively little attention to the particular challenges that confront residents of the ASAL regions and thus to policies necessary to sustain and improve their livelihoods.

Based on the Theory of Change, this study endeavours to provide data on the importance of biodiversity to pastoralism and vice versa, and to provide guidance for policy reforms for sustainable investments which will then contribute to policy dialogue and advocacy and that will lead to changes resulting in more sustainable land use and improved livelihood security. The primary goal of the research is to make a significant contribution to understanding social and environmental problems and high priority national and regional policy issues and potential reforms that will favour improved and sustainable biodiversity conservation and enhance livelihoods in pastoral areas of the Eastern African region. Its objectives are to: (1) inform policy harmonization in sustainable management of dryland and pastoral areas biodiversity; (2) develop tools that will guide sustainable investment options in dryland and pastoral areas; and (3) promote a regional approach to drylands and pastoral areas conservation and use.

Empirical evidence generated from this study tend to challenge the misconceptions, with that the collected data suggesting that with supportive national and regional policy, potential reforms and investments, pastoralism will ensure improved and sustainable biodiversity conservation, which in turn will enhance livelihoods in pastoral areas, and vice versa.

PLATFORM PRESENTATION: COMMUNAL FARMERS' INDIGENOUS KNOWLEDGE AND PERCEPTIONS ON LIVESTOCK PRODUCTION, RANGELAND MANAGEMENT AND DYNAMICS OF THE FEED RESOURCE BASE IN TWO COMMUNAL AREAS OF THE EASTERN CAPE PROVINCE OF SOUTH AFRICA

F Alice Gwelo, Solomon B Tefera and Voster Muchenje*

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Livestock play an important role in the livelihoods of the rural people of South Africa. Communal farmers use both individual as well as common knowledge to sustain their livestock production. However, very few surveys have been conducted to document the indigenous knowledge and perceptions of the sedentary communal livestock farmers in the Eastern Cape province of South Africa. This study was done with the aim of determining the communal farmers' perceptions on livestock production, rangeland management and feed resource dynamics in two communal Nguni cattle project areas (Kwezana and Dikidikana) of the Eastern Cape, South Africa. A total of 36 farmers from Kwezana and 41 from Dikidikana were interviewed. Of the interviewed farmers, 55% were male and 45% were female. At Kwezana, female farmers owned 14.8% of the cattle, 38% of the goats, 100% of the sheep and 68% of the poultry. Similarly, at Dikidikana females owned lower proportions of cattle and goats (1% and 38%, respectively) and all sheep. At Dikidikana an association was found between age and farming objective (P=0.02), with 50% of the farmers who were less than 30 years of age keeping livestock only as a hobby. Of the farmers interviewed at Dikidikana and Kwezana, 58.5% and 50% of the farmers, respectively regarded livestock as a source of wealth. About 83% of the respondents at Kwezana and 88% at Dikidikana indicated that feed availability was the major constraint of livestock production. Supplementation and grazing management were practised by less than 20% of the farmers. Lucerne and barley were the common supplementary feeds in the study areas. Livestock numbers did not differ significantly between the farmers who supplemented and those farmers who did not. Similarly, farming experience did not influence (P>0.05) farmers to give supplementary feed. In this study, 83.1% of the respondents did not know grass and/or browse species that were most preferred by their cattle. Most farmers agreed that there was evidence of rangeland degradation though they did not specify the observable signs or identify the indicators. There is need for the communal farmers at Kwezana and Dikidikana to receive training on livestock–range management practices. This would help bridge the knowledge gap and empower the farmers to better manage their range resource. More assessment is required on the fed resource bases to identify additional forage resources that could serve as supplementary feeds. Development initiatives can be proposed to improve the small stock production with the aim to increase the income of women.

POSTER PRESENTATION: THE NATIONAL VELD AND FORAGE POLICY AS A KEY COMPONENT OF A BROADER APPROACH TOWARDS THE SUSTAINABLE USE OF NATURAL AGRICULTURAL RESOURCES IN SOUTH AFRICA

T Victor Musetha[1], Kedibone Chueu[1], Hein Lindeman[2], Paul L Avenant[3], Anneliza Collett[3] and Keith A Ramsay[1]*

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Animal agriculture in South Africa is largely dependent on natural veld, and the National Livestock Development Strategy (LDS) that was endorsed and published in 2005 highlighted the need for a Veld and Forage Policy to support the sustainable use of this resource at all levels. It also gave the necessary institutional support to develop the current document that has been subjected to wide consultation - including presentations at previous GSSA congresses.

At the time, the draft provided sufficient motivation to initiate a National Rangeland Monitoring and Improvement Program (NRMIP) that was managed by the Agricultural Research Council - Range and Forage Institute (ARC-RFI) from 2006 to 2011. This initiative is currently under review and recent developments support the fact that this policy – as well as the NRMIP - should be part of a broader approach towards the sustainable use of the natural agricultural resources in South Africa.

The development of a policy document to support this approach is currently under way.

Progress made with the NRMIP as a key component of the draft policy has highlighted the need to afford this program similar status to the National Livestock Improvement Schemes that have been proclaimed and are maintained in terms of National Legislation (Animal Improvement Act, 1998 (Act 62 of 1998)).

While this would not be possible in terms of this Act, the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) could provide the necessary legislative framework to ensure that the use of natural resources by livestock and wildlife in sustainable farming systems can be monitored and improved as a key component of climate-smart animal agriculture.

Climate-smart animal agriculture refers to farming systems that are based on sound animal and veld husbandry principles that take current and projected climatic and vegetation conditions into consideration to ensure long term sustainability. This includes farming with indigenous, locally developed and locally adapted breeds and species capable of surviving and producing under conditions such as higher temperatures, less rainfall , an increase in animal diseases and parasites and changes in the natural vegetation.

POSTER PRESENTATION: RANGELAND MANAGEMENT AND DROUGHT COPING STRATEGIES FOR LIVESTOCK FARMERS IN THE SEMI-ARID SAVANNA COMMUNAL AREAS OF ZIMBABWE

Bethwell Moyo[1], Sikhalazo Dube[2] and Mota S Lesoli[1]*

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The southern region of Zimbabwe (Matabeleland) is characterized by a low and highly variable rainfall pattern. The main agriculture livelihood strategy is livestock production and production of drought resistant crops. Livestock production in this region is more of a rudimentary form of pastoralism characterized by various types of strategic mobility to access water and grazing resources. The region is prone to drought which results in significant loss of livestock and crop failures, hence leaving most families food insecure.

There have been many strategies of trying to improve grazing management and thus survival of livestock in communal areas of Matabeleland during years of below average rainfall. These include the “Model D” resettlement scheme, which was a grazing-based resettlement model planned in the 1980s but never fully implemented because of dissident violence during the political disturbances and a lack of local participation. It later evolved into what is known as the “Three-Tier” resettlement model. In this model, farmers from neighbouring communal areas graze their livestock, usually in drought years, in the purchased farms which remained the property of the state. There was no maintenance of fences, so people who without grazing rights to the land also grazed their animals leading to poor or outright lack of grazing management in this model. From 2000 to mid-2003 the government also allocated some communal farmers plots under the fast track land resettlement program so as to decongest the communal areas of both people and livestock. It is important to understand the impact of such interventions on rangeland condition and utilization practices in these communal areas.

A single-visit survey method was used to gather data through a structured questionnaire in 34 households. All the respondents indicated that their rangelands were not fenced and hence continuous grazing was practiced. The following rangeland management practices were not practiced: herding (97%), prescribed burning (100%), stocking rate control measures (100%), monitoring of veld condition (50%), and exclusive use of the rangeland resource by the legitimate

community (32%). Respondents indicated that there was a rangeland management committee (53%), and collective decisions (63%) were taken in relation to rangeland use. About 60% of the respondents indicated that the rangelands were good and had plenty of grass in summer, and were very poor with little grass in winter (71%). The level of erosion was considered high (41%) and suspected to be caused by overgrazing (49%) and deforestation (43%), the latter being considered very high (47%). Woody plants are used for fencing (58%), firewood (18%) and shelter (11%). Fifty eight percent of the respondents observed that there was disappearance of certain grass species and an increase in *Colophospermum mopane* and *Acacia karroo* trees in the rangeland over the last 30 years. Bush encroachment (55%) was observed mostly along major rivers, and it was assumed to be caused by low rainfall (54%). Browse trees utilized during the dry season were *Combretum apiculatum* (20%), *Colophospermum mopane* (20%) and *Grewia* species (15%). Drought coping strategies included mobility to relief grazing farms (22%), moving animals to key resource areas (16%) and supplementation (54%). High income households had large herd sizes and supplemented during drought, while low income households had small herd sizes and resorted to mobility.

The main suggestions for improving rangeland management was assistance from government for paddocking of grazing lands (40%), controlling deforestation (45%) and preventing overgrazing (10%). Almost three quarters of the households indicated that there were interventions by government after independence to relieve grazing pressure in communal rangelands by allocating relief grazing in nearby farms under the Model D resettlement scheme. More than sixty percent view this intervention as a failure since fences were removed and there is no more restriction to rangeland access or any grazing management practice. It is assumed that lack of effective and relevant institutional support (73%) and non-supportive policies (68%) might have led to the failure of this initiative. There is a need for community cooperation in the utilization and maintenance of the common pool resources for efficient livestock production and successful risk management in this drought prone area of Matabeleland. Poor institutional arrangements in the use of the communal rangelands and relief grazing farms makes it difficult to enforce decisions among multiple resource users as observed in this study. It is recommended to increase common understanding on the best method of utilising relief grazing farms between the local and policy levels, especially increasing the extent to which the official policy systems understand the communal users' suggestion on the best use of these farms. Local institutions need to be informed and supported on how best to guide collective action in managing key resource areas and relief grazing farms.

Workshop: Aligning Policy with the Socio-Ecological Dynamics of Rangeland Commons

WORKSHOP FACILITATORS: MONIQUE L SALOMON, M IGSHAAN SAMUELS AND SUSI VETTER

Wednesday 18 July 2012, 09:15 – 10:00, 10:30-13:15

Position Paper and Responses with Discussion

This workshop provides a platform for researchers, policy makers, and development workers to engage in dialogue on issues emerging from policy and practice in communal rangeland management in South Africa. A position paper will be presented on issues and challenges emerging from more than ten years of research in communal rangelands in South Africa, to be considered in the draft Policy for the Sustainable Management of Veld (Range) and Forage Resources as well as other relevant policies. Invited speakers are asked to respond to a position paper by supporting or challenging a particular idea or issue presented. The workshop will culminate in a special issue of the African Journal of Range and Forage Science[1].

WORKSHOP PROGRAMME

09h15 Opening and welcome

09h20 Position Paper

Development and sustainable management of rangeland commons – aligning policy with the realities of a changing rural landscape in South Africa

Dr Susanne Vetter, Rhodes University

In South Africa, policy affecting the rangeland commons has largely been based on inappropriate ecological and economic models. This has resulted in a misalignment between policy and the needs, aspirations and constraints of rural people, which is at least partly to blame for the general lack of long-term success most rural development initiatives have had. This paper examines the current policy situation and discusses some of the most pervasive ecological and economic models that have influenced development in the rangeland commons: the aim to commercialise livestock farming; the emphasis in livestock development on selling cattle; the assumption that communal rangelands are all overstocked and degraded and that destocking, fencing and rotational grazing are the answer; and that communal tenure per se is the root cause of degradation and privatisation is the answer. A wealth of research now shows that these models are flawed. Instead, policy should support and enhance multiple livelihoods to enhance livelihood resilience and reduce risk; strengthen common property management and tenure security to improve resource management; support agriculture in ways that support the aims and overcome the disadvantages of smallholder farmers; and integrate livestock development with a broader development agenda. Rangeland commons differ considerably in their ecological, social and economic characteristics and policy thus also needs to provide for plurality in ecological and economic models appropriate to different contexts.

09h30 Response Paper

Livestock and communal rangelands in land and agrarian reform

Prof Ruth Hall and Prof Ben Cousins, University of the Western Cape

09h45 Response Paper

Institutional support for more effective monitoring and management of communal rangelands in South Africa

Mr Keith Ramsay, Ms Kedibone Chueu and Mr Victor Musetha, Department of Agriculture, Forestry and Fisheries

[1] Besides the speakers listed in the workshop programme, there are a few other authors of response papers who are not able to attend the GSSA Congress.

10h00 TEA

10h30 Response Paper

Wildlife or livestock? New directions for developing communal grazing land in South Africa

Dr Petronella Chaminuka, University of Venda

10h45 Response Paper

The importance of herd mobility in South African rangeland commons

Mr Igshaan Samuels, Dr Nicky Allsopp, and Prof Timm Hoffman, Agricultural Research Council, SAEON and University of Cape Town

11h00 Response Paper

The good shepherd: remedying the fencing syndrome

Mr Clement Cupido and Dr Monique Salomon, Agricultural Research Council and University of KwaZulu-Natal

11h15 Response Paper

Crop/livestock interactions: what does it mean for farmers and for policy makers?

Ms Brigid Letty and Mr Rauri Alcock, Institute of Natural Resources and CAP

11h30 Response Paper

Sustainable management of rangeland commons: can local practice effectively inform policy?

Mr Harry May and Dr James Bennett, Surplus People Project and Coventry University

11h45 Response Paper

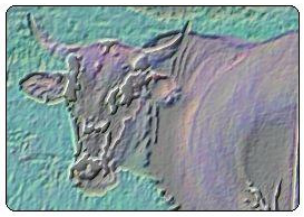
Youth and agriculture: Deconstructing rural youth perceptions

Mr Melvin Swart and Dr Michael Aliber, Agricultural Research Council and Department of Agriculture, Forestry and Fisheries

12h00 Discussion in working groups

12h45 Feedback and way forward

13h00 Closure



Bush Encroachment: Perspectives on Drivers, Dynamics and Management

SESSION CHAIR: COBUS (J) O BOTHA

Wednesday 18 July 2012, 08:45 – 10:00, 10:30 – 12:00

Keynote Address, Platform and Poster Presentations

INVITED KEYNOTE ADDRESS: CO_2 AND OTHER GLOBAL CHANGE INFLUENCES *VS* LOCAL DRIVERS

William J Bond

University of Cape Town, Department of Botany, Cape Town, South Africa, email: william.bond@uct.ac.za

Abstract included on programme insert

PLATFORM PRESENTATION: AN ANALYSIS OF WOODY COVER CHANGE IN THE MESIC EASTERN REGION OF SOUTH AFRICA USING REPEAT PHOTOGRAPHY

James R Puttick[1], M Timm Hoffman[1] and Tim G O'Connor[2]*

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Increases in woody cover in grasslands and savannas is a phenomenon observed worldwide over the last century and has social, economic, and conservation impacts due to associated losses in herbaceous productivity and biodiversity. Woody thickening is well documented in South Africa although most studies have been focused at local scales. We examined woody cover change over the last century for the mesic eastern region of South Africa using repeat photography. Two hundred repeat photographs were spread over an altitudinal gradient from the coast to the Drakensberg, and a latitudinal gradient from the Tugela Valley in the north to the Border region in the south. Woody cover change was quantified within landform units defined for each repeat photograph pair based on slope, aspect and catenal position. Woody cover increased within 64% of the landform units (n = 488), while 30% remained stable and 6% experienced a decrease in woody cover. Woody cover increases were greatest within the savanna, Albany thicket and Indian Ocean coastal belt biomes but also occurred within the grassland biome, particularly at the lower altitudes of the grassland range. Quantile regression of woody cover change versus altitude revealed a ceiling on woody cover increase, which declined with increasing altitude. Although a maximum ceiling on woody cover increase was apparent, observed woody cover change was highly variable ($r^2 = 0.07$) along the altitudinal gradient. We propose that the ceiling on woody cover increase is determined by global drivers such as climate and CO_2 concentration while local land use drivers and abiotic factors such as soils and landform type contribute to the observed variability between sites.

POSTER PRESENTATION: VEGETATION CHANGE IN ZULULAND, KWAZULU-NATAL, SINCE THE ANGLO-ZULU WAR OF 1879

Jennifer M Russell and David M Ward*

University of KwaZulu-Natal, School of Life Sciences, Pietermaritzburg, South Africa, email: jennifer@resourceman.co.za, ward@ukzn.ac.za

It has become of great concern among land managers that the quality of the environment is declining as a consequence of woody plant encroachment. Increases in woody density will have an impact on land use as well as on long-term planning for future land use. Therefore, change in landscape is not merely of academic interest. It also has practical implications for agriculturists, pastoralists, conservationists and environmental impact analysts. Changes in the tree:grass ratio in savannas will affect the sustainability of commercial and subsistence livestock farming and the management of conservation areas. The aim of this project is to track the changes in vegetation at selected sites in KwaZulu-Natal, concentrating on the battlefields of the Anglo-Zulu War of 1879.

Historic photographs show that, in many areas of northern KwaZulu-Natal, there has been a significant increase in woody vegetation cover, in some places up to 80%. These ground photographs, dating back to the Anglo-Zulu War of 1879, were used as the basis for fixed-point repeat photographic techniques. Seven sets of aerial photographs were used to highlight the rate of change in northern KwaZulu-Natal. The area falls within mesic savanna and grassland biomes. The aerial photographs spanned 56 years, starting in 1944 and were taken at roughly 10 year intervals. ArcGIS 10 was used to prepare the photographs. Analysis of vegetation cover was done manually as dark areas on the photographs, denoting burnt patches, interfered with textual analysis techniques. Floristic sampling has been undertaken at the study sites, using the Whittaker Plot Method. Sampling identifies which woody species are responsible for encroachment and patch thickening. It also provides a baseline for areas that have not, as yet, undergone woody ingress.

Inspection of the photographs showed that the hillsides underwent woody encroachment more rapidly than the plains. Also, hillsides facing north or west were more rapidly encroached than the other hillsides. The aerial photographs, combined with the ground photographs, show a gradual increase in woody cover, suggesting that the change is unidirectional. Possible factors influencing the rate of bush encroachment are human activities such as grazing, cultivation or fire, geographic factors such as slope and aspect, and global factors such as increased atmospheric CO_2 concentrations.

POSTER PRESENTATION: ASSESSING *ACACIA NILOTICA* ESTABLISHMENT ON LONG-TERM MONITORING SITES, UMKHUZE GAME RESERVE

Janet M Taylor[1,2] and G Nico Smit[1]*

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Many of the savanna areas in KwaZulu-Natal are currently experiencing *Acacia nilotica* thickening. This is reducing the extent of savannas and hence the productivity and biodiversity of the land. This study, undertaken in uMkhuze Game Reserve, aims to determine the conditions leading to the increase in tree density. uMkhuze has a series of fixed-point photographs taken over the past 27 years as well as good aerial photo coverage since 1937. These fixed-point and aerial photos are used to detect when the woody plant thickening occurred in different parts of the reserve and are able to illustrate the environmental variables that influence vegetation cover (ie. a rainfall, drought or fire event). Currently, about 27% of the park is covered by *A. nilotica*. In 1985, 13 of the 32 sites were free of *A. nilotica*, while in 2007, only 5 sites are free of *A. nilotica*.

PLATFORM PRESENTATION: LONG-TERM VEGETATION CHANGE (1900-2010) IN THE KAROO MIDLANDS BIOMES WITH CLIMATE AND LAND USE AS DRIVERS CHANGE

Mmoto L Masubelele[1], M Timm Hoffman[1] and William J Bond[2]*

University of Cape Town, [1]Plant Conservation Unit, [2]Department of Botany, Rondebosch, Cape Town, South Africa, email: mmoto.masubelele@uct.ac.za, timm.hoffman@uct.ac.za, william.bond@uct.ac.za

Global climate predictions suggest aridification due to drought in the central interior of South Africa. Biomes in this region are expected to undergo dramatic decline in cover of grasses as shrubs spread from the Nama-Karoo into the Grassland biome. Long-term changes in the vegetation within biomes of the Eastern Karoo Midlands Region were studied using historically repeated photography. The aim of the study was to understand the direction of change and also quantify the nature of change for the past 100 years. Firstly, historical changes in climate variables such as rainfall, drought, temperature and drought were analyzed. Second, changes in stocking rate between 1910 and 1996 were assessed. Third, 65 repeat photographs were taken within the region and analyzed in terms of the major changes that have occurred within key landform units of the area (e.g. slopes, plains and rivers). We calculated the decadal change in the cover of grasses, dwarf shrubs, tall shrubs and total cover within each landform and biome. Results showed no long-term change in annual rainfall and drought incidence while temperature had increased and evaporation rate was variable. Nama-Karoo biome sites showed an increase in the incidence of wet periods and an increase in early seasonal rainfall while the Grassland and the Albany Thicket biomes showed no significant changes. Stocking rates within all three biomes declined in the 20th century. Grass cover increased substantially across the region while dwarf shrubs declined in the Nama-Karoo and Grassland biomes. The cover of tall shrubs increased in Grassland and Albany Thicket biomes. Historical accounts of the region's climate and land use are important since they help to determine the direction and trajectory of change. Trajectories of change are opposite in sign to what is anticipated in the latter part of the 21st century. A long-term monitoring approach, incorporating historical assessment is needed in order to understand how landscape level processes affect human and ecosystem wellbeing.

PLATFORM PRESENTATION: ARE FIRES LESS IMPORTANT IN ARID AREAS?

Dave F Joubert[1], G Nico Smit[2] and M Timm Hoffman[3]*

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Fire is an integral part of savanna dynamics. However, fire has long been considered less important in arid savannas than in mesic savannas. The rationale behind this perception is that fuel loads are rarely sufficient in arid savannas to maintain and suppress the development of saplings. In mesic savannas, the role of fires appears to be maintaining saplings at a size where they are easily top-killed and kept in a fire prone state, whereas in more arid savannas fire is perceived as only working in tandem with browsers. We conducted experiments on seedlings, saplings (young trees up to 1 m in height) and mature adult shrubs of *Acacia mellifera* to test this perception in the arid Highland Savanna of Namibia from 2007 to 2009. Moderately hot fires killed 97.1% to 99.3% of planted *Acacia mellifera* seedlings in 3 experimental fires. While most saplings with stem diameters <10 mm and mature shrubs were topkilled, more than half of the saplings with stem diameters >10 mm survived. Resprouting of these saplings was relatively rapid, when compared to larger, mature shrubs. This suggests that fire could control larger shrubs in arid systems but this is cautioned against because of the frequency with which such fires might be needed, with negative consequences to grass and soil. In arid savannas, the absence of fires coincident with recruitment events is the primary cause of bush thickening. Recruitment is rare for phenological reasons, and therefore fires are only needed rarely.

PLATFORM PRESENTATION: TREE-GRASS COMPETITION ALONG A CATENAL GRADIENT IN A MESIC GRASSLAND, SOUTH AFRICA

Michelle J Tedder[1], Kevin P Kirkman[1], Craig D Morris[2] and Richard W S Fynn[3]*

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Increasing woody recruitment in African savannas has severe consequences for both livestock production and habitat integrity in wildlife conservation. It is, therefore, critically important to develop a deeper understanding of the mechanisms responsible for maintaining an open grassland/savanna state and how these mechanisms may be affected on productivity gradients. The interaction, both above and belowground, between tree saplings and the surrounding grass sward is dependent on many factors, such as rainfall, soil depth, tree species and sward composition. These factors, as well as the presence or absence of defoliation, dictate whether the system will remain in a transition state as savanna or move towards a stable woodland state. The individual effects of above and belowground competition between grasses and two species of *Acacia* and the effects of soil depth on these interactions were examined by planting *Acacia karroo* and *Acacia nilotica* seedlings into a natural grass sward on three different soil depths. Three aboveground treatments; full shading, reduced shading by tying back the neighbouring grasses and reduced shading by clipping, and two belowground treatments; full and no belowground competition, were used. Soil depth constrained plant size in both tree species, with the largest plants growing on the deepest soils. The intensity of belowground interactions on tree biomass was unaffected by soil depth. The removal of belowground competition increased sapling biomass by half ($P < 0.05$) on all three soil depths. By contrast, reducing shading by tying back neighbours had little effect at all soil depths, whereas reducing shading by clipping increased tree biomass (47%) on shallow soils only ($P = 0.027$). This indicates that woody recruitment on shallow soils may result from factors that decrease root vigour and thus belowground competition from the surrounding grasses rather than light competition. Irrespective of soil depth, however, root competition appeared to be the major factor influencing tree growth rates, thus grazing management practices that reduce grass root productivity are expected to result in woody encroachment.

PLATFORM PRESENTATION: RESTORATION VERSUS WOOD UTILIZATION - A POTENTIAL CONFLICT OF INTEREST IN DEALING WITH BUSH THICKENED AREAS IN THE NORTHERN CAPE

G Nico Smit, Gideon Janse van Rensburg and Francois Deacon*

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Many farms in the savanna areas of the Northern Cape suffer from bush thickening. At the same time, there is a growing interest in the utilization of wood from indigenous trees as a source of firewood and biofuel, especially by mining companies who are currently using coal in their combustion ovens. A proposal was subsequently formulated by a group of farmers and a mining company to utilize wood from problem woody species (mainly *Acacia mellifera*), harvested on farms within a 20 km radius of the mine to be used in the form of wood chips as partial replacement of coal as fuel source. The rationale of this operation is threefold: (i) the wood chips represent a biofuel that will reduce carbon emissions during combustion compared to coal, (ii) it is potentially more cost-effective due to the close proximity of the source, and (iii) the bush thickening problem on the farms can be reduced by selectively harvesting the surplus woody plants and, in doing so, increase grass production, and potential animal production, by increasing the grazing capacity. The objective of the study was to quantify the wood resource on a number of farms in the vicinity of the mine and to make recommendations on the harvesting of the wood.

Twenty sites on five farms located in the Savanna Biome of the Northern Cape were included in the study. At each identified survey site a belt transect of 100 x 2.5 m (250 m^2) was laid out in such a way as to best represent the woody vegetation of that site. The dimensions of all rooted, live woody plants were measured and dry mass estimates of the leaves and wood in three stem diameter classes (<0.5 cm, >0.5 – 20 cm and >20 cm) were calculated using the newly developed BECVOL 3 model. The total wood dry mass (all fractions) of the 20 plots varied from a low 3 562 $kg.ha^{-1}$ to a high of 438 884 $kg.ha^{-1}$ with an average of 67 450 $kg.ha^{-1}$. On average the wood >20 cm in diameter made up 79.8% of the total wood mass, while the stems >0.5 – 20 cm and shoots <0.5 cm made up 13.4 and 6.8% of the total wood mass respectively. Should the trees be harvested during the summer months when the trees have their full leaf carriage, the leaves would add another 2.7% to the total tree dry mass. It can, however, be expected that most of the leaves will probably be lost during the harvest and chipping process as they dry and fall from the branches.

From the data it is also clear that a high wood mass per hectare is without exception related to the presence of very large trees. Wood mass per hectare increased exponentially with an increase in the number of very large trees, while plots with a predominance of small to medium sized trees - even at very high densities - yielded a much lower wood mass. The fact that the highest wood yields reside in large trees, presents a potential conflict of interest. From an ecological point of view, larger trees should be retained during the thinning operations, while the highest and most cost-effective wood harvests will also be from these larger trees. It is thus a matter of weighing short-term benefits (cash flow and income generation) against long-term benefits (ecological stability and rangeland restoration). It is thus important that priorities are clearly identified prior to the harvesting operation. The best solution is probably a compromise during which as many trees as possible are harvested, while still retaining the benefits of some remaining trees. The recommendation is that trees be selectively harvested, starting with the smallest plants and progressively moving to larger plants until a set target has been reached. The stumps of harvested trees must also be treated with an ecologically safe arboricide to prevent regrowth without risk to the remaining trees.

PLATFORM PRESENTATION: TOOLS AND STRATEGIES FOR COMBATTING BUSH ENCROACHMENT: A CASE HISTORY OF THE DEVELOPMENT OF AN EXPERT SYSTEM FOR BUSH ENCROACHMENT IN NAMIBIA. SUCCESSES, FAILURES AND CHALLENGES FOR THE FUTURE

Dave F Joubert[1], Jens Fendler[2], Ibo Zimmermann[1] and Heike Winschiers-Theophilus[2]*

Polytechnic of Namibia, [1]School of Natural Resources and Tourism, [2]School of Information Technology, Windhoek, Namibia, email: djoubert@polytechnic.edu.na, ibozim@polytechnic.edu.na

Bush thickening is an economic problem in Namibia, estimated to reduce beef production revenue by around N$ 1.5 billion per annum. We have over the years developed a simple rule-based low tech online Wiki expert system (wikiDSS), as well as an A5 hard copy booklet, with emphasis on bush thickening management for arid and semiarid savannas in Namibia as an adaptive rangeland management intervention strategy. The online WikiDSS is easily edited, and is thus potentially also a great tool for communication and education. Some key Critical Success Factors (CSF) for expert systems include user involvement, user training, ease of use, use of information sources, participatory development, manageability and size (small is better), top management support and level of managerial activity. Despite having achieved most of these CSFs, and despite our firm belief in the potential value this wikiDSS to improve rangeland management, it is questionable whether the DSS will ever achieve this goal. Contributions to the knowledge base from the wider community, as well as use, have thus far been minimal. Since users continue to respond positively about the system when it is being demonstrated to them, we believe that a fundamental flaw (in this we are not alone) has contributed significantly to the thus-far "failure" of our DSS: lack of ownership. Newly introduced systems (in the widest sense) heavily depend on at least one dedicated person in a dedicated position taking ownership. Such ownership is necessary throughout the lifetime of a system, and sustainability and long-term success rely on this. Explicit planning for this is usually lacking, and similar projects of potentially great value have been discontinued due to this. We still hope that through continued promotion we will eventually motivate sufficient users to contribute and to eventually lead the DSS into a new, more successful, phase.

New Approaches to Vegetation Description and Monitoring

SESSION CHAIR: IAN T LITTLE

Wednesday 18 July 2012, 12:10-13:15

Platform and Poster Presentations

PLATFORM PRESENTATION: BECVOL 3 - AN EXPANSION OF THE ABOVE-GROUND BIOMASS QUANTIFICATION MODEL FOR TREES AND SHRUBS

G Nico Smit

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With the development of the original concept of the BECVOL model the following three aspects of the ecological implications of woody plants in savannas were considered the most important: (i) competition with herbaceous vegetation for soil, water and nutrients (bush thickening); (ii) food for browsers, and (iii) creation of sub-habitats suitable for desirable grass species. An approach to a quantitative description of woody plant communities that addresses these aspects quantitatively was proposed during 1989 as the BECVOL model (Biomass Estimates from Canopy Volume). The previous model (version 2.0) provides estimates of the leaf volume and leaf dry mass (total and stratified) at peak biomass, based on the relationship between the plant's spatial canopy volume and its leaf dry mass and leaf volume. The spatial canopy volume is calculated from measurements of the canopy of each plant. This paper reports on the completion of version 3.0 of the BEVCOL-model, which is the seventh variation of the original model.

Regarding estimates of the browsable component of woody plants, the original model only estimated the leaves, while young, new season's shoots less than 0.5 cm in diameter also constitutes an important component of the browsable part of woody plants. A fourth aspect not considered in the original model is the importance of the wood component of woody plants, specifically for firewood, charcoal and biofuel production. To address these limitations of the original model, additional trees of a number of species were harvested. Selected individuals included all size classes representative of the population. The wood component of the harvested trees was separated in three stem diameter classes: shoots <0.5 cm, stems >0.5 – 20 cm and stems >20 cm. Material was dried (70˚C) and weighed. Regression analyses were applied with the different plant dry mass fractions as dependent variables and canopy volume as the independent variable. Highly significant regressions ($P<0.001$) were achieved with the exponential regression model that yielded the highest correlation coefficients. These newly developed regression equations incorporated in the new BECVOL model will enable users to make more accurate estimates of the browsable component of tree populations, and also provide estimates of the biofuel production potential of woody plants, especially in bush thickened situations.

POSTER PRESENTATION: VOLCALC: USING DIGITAL PHOTOGRAPHS TO DETERMINE TREE DIMENSIONS AND CANOPY VOLUME

Alan S Barrett and Leslie R Brown*

University of South Africa, Department of Environmental Sciences, Applied Behavioural Ecology and Ecosystem Research, Florida, South Africa, email: barreas@unisa.ac.za, lrbrown@unisa.ac.za

Studies on browse capacity and plant phenology often require effective methods to rapidly quantify tree dimensions. In general, current methods for calculating tree volumes involve spending protracted periods in the field to collect the various tree dimension data. Using digital photography to determine tree dimensions provides a rapid means of collecting field data. Such data are not limited to tree volume calculations and can also be used for a variety of related applications, including the determination of browsing height by various browsers, the height of animals, monitoring of tree growth and canopy spread, and determination of resource abundance. We present a rapid and efficient method for estimating tree dimension parameters and calculating canopy volume. Using a measuring staff, a digital camera and our new software called VolCalc, researchers and ecologists can reduce the amount of time spent collecting data in the field, while improving data fidelity and reducing inter observer variability. To quantify the dimensions of a tree using VolCalc, place a clearly marked measuring staff adjacent to the trunk of a tree. Step away from the tree and take a digital photograph of the tree and measuring staff, ensure that the

entire tree is in the camera's view finder before taking the photograph. After doing this for all the trees you need dimension parameters for, open the digital photographs in VolCalc individually and calibrate them by selecting the marked portion of the measuring stick in the photograph, provide the length of the marked portion in metres. After calibrating a photograph, follow the on screen prompts in VolCalc and use the mouse to select the various dimensions that need to be quantified for canopy volume calculations. When capturing the various parameters, click the mouse button at the starting point for a particular dimension to be determined, this will initiate a rubber band that can be dragged to the ending point of the dimension. Clicking the mouse button again at this point will measure the distance between the starting and ending points in pixels and convert these to metres. The relevant dimensions parameter on the screen will be populated with the measured value. The same process is followed for all dimensions. After all dimensions for a particular tree have been captured, the software calculates the canopy volume for the tree and displays this. The user can then continue to calculate canopy volumes for more trees, or they can exit the software. If the user exits the software, all tree volumes calculated and their dimension parameters are written to a Microsoft Excel spread sheet that is opened for the user to save. Comparisons of the amount of time taken to collect various tree dimension parameters by independent observers using three different methods showed that VolCalc was significantly faster than the other methods. Comparisons of the combined variability for various tree dimension parameters collected using VolCalc and other prominent canopy volume calculation software, showed that parameters obtained using VolCalc are more accurate and less prone to observer bias than from the other software.

POSTER PRESENTATION: POSSIBLE KEY SPECIES FOR VELD CONDITION ASSESSMENT OF THE LAMBERT'S BAY STRANDVELD ALONG THE WEST COAST OF SOUTH AFRICA

Nelmarie Saayman[1], Mark B Hardy[1], Craig D Morris[2], Hannes (J) C Botha[1], Christie G Rheeder[3] and Albertus V Dyason[4]*

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To ensure sustainable production and use of veld it is necessary to be able to determine veld condition and monitor trends in a scientific way. No method of assessment for veld condition has been developed specifically for the Winter Rainfall Region of South Africa. Those methods currently used, require the operator to know all plant species that are encountered in the assessment. The advantage of key species methods is that the operator only needs to know and measure those few key species to objectively determine veld condition.

Twenty one 1000-point line-point plant surveys were done in the Lambert's Bay Strandveld on seven farms within 10 km of the sea. All sites were on deep sandy soil on relatively flat terrain, and the average annual rainfall for the area is 175 mm. Sites were selected to avoid previously cultivated areas and therefore to represent veld where only grazing had an impact on the species composition and veld condition.

The sites on each farm were selected to present a degradation gradient using different distances from the watering point. The data was analysed with Detrended Correspondence Analysis (DCA) to determine a degradation gradient, select key species, as well as allocating weights for each key species from the DCA Axis 1 scores for each species. The selection of key species was based on its position along DCA Axis 1, its relative abundance over at least a portion of the degradation gradient, having either a high or low grazing potential and being common in the veld depending on veld condition, easy to identify, and are perennial species. The key species were identified and the veld condition determined using the key species and tested against a second set of data collected in the area, using line-point surveys on undisturbed rangelands. It was also tested against a different method using the palatability scores of all species encountered in the plant surveys.

Six key species were identified and weights were allocated to each, namely *Galenia africana* (0.0), *Lycium* spp. (6.0), *Tetragonia fruticosa* (7.0), *Hermannia scordifolia* (8.0), *Eriocephalus racemosa* (9.0) and *Ehrharta calycina* (10). Using these weightings it was possible to determine the veld condition under different grazing regimes and states of degradation. We therefore conclude that using the weighted key species to calculate veld condition indices give satisfactory results to use it for monitoring of veld condition. Since there are no other methods available to quantify veld condition in the study area it is recommended that the weighted key species be used. The key species and their weightings should be subjected to further evaluations over the long term and adapted where necessary.

PLATFORM PRESENTATION: NEW METHODS FOR MEASURING GRASS BIOMASS IN SEMI-ARID RANGELANDS

Tony (A) Swemmer[1], Alfredo G R Delgado[2] and Robert A Washington-Allen[2]*

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The production of grass forage is a critical variable for understanding and managing rangeland ecosystems, particularly in semi-arid systems where forage quantity can be more limiting for herbivores than forage quality. While the disc pasture meter is used extensively for monitoring grass production in mesic rangelands, its accuracy is too low to be useful in many semi-arid systems where there is a low cover of grass tufts and/or where the dominant species are thin, wiry grasses. Furthermore, in systems where a significant fraction of the grass production is consumed during the growing season, biomass needs to be measured regularly through the season. This requires a method that is accurate for a range of sward heights, and relatively cheap and rapid to conduct. We investigated two new methods for accurately measuring biomass of the grass layer in the Phalaborwa area of the Kruger National Park. The first was a multi-disc mini pasture meter (MMM), which is simple and inexpensive, but labour intensive. The second was a LiDAR method using a ground-based laser scanner, which has low field-labour requirements, but is relatively expensive and highly technical. The accuracy of both methods was tested by calibration with hand-clipped biomass. Both methods produced reliable estimates of total herbaceous biomass, with statistically significant linear relationships. The MMM allowed for separate estimates of grass and forb biomass, and a crude estimate of canopy cover, sward height and sward greenness at a quadrat scale. The LiDAR method was a good estimator of total biomass at a larger scale of 80 m^2 (Figure 1). This method also allows for detailed estimates of sward cover and height, at different height strata, and cover and volumes of any shrubs and trees present (Figure 2). We conclude that neither method is suitable for extensive monitoring by farmers or extension officers due to the sampling times required. However, both can provide a high quality data needed for mechanistic studies of grass forage production (and, in the case of the LiDAR method, browse production). Development of software for the LiDAR method would also result in a product that would allow technicians to survey herbaceous biomass over much larger areas than any other method.

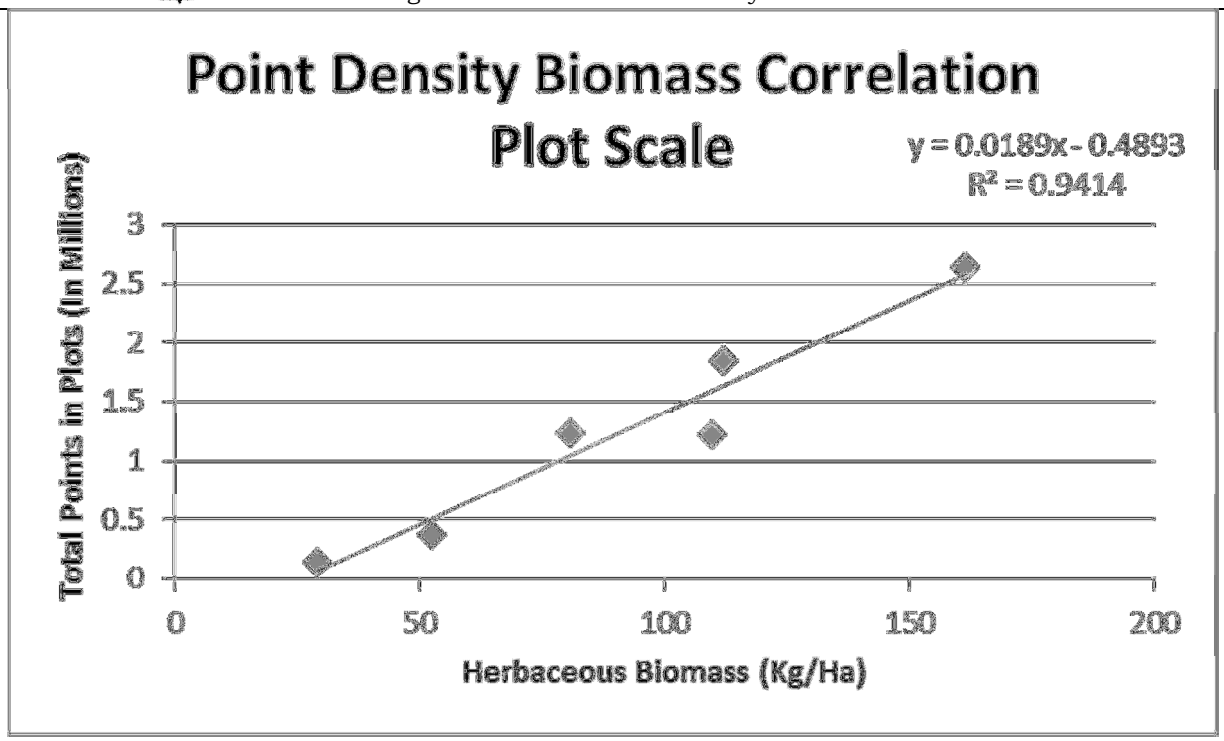

Figure 1: A linear regression of herbaceous biomass of 80 m² plots (calculated from 20 hand-clipped subsamples per plot), against the point density of the sward calculated from the LiDAR data.

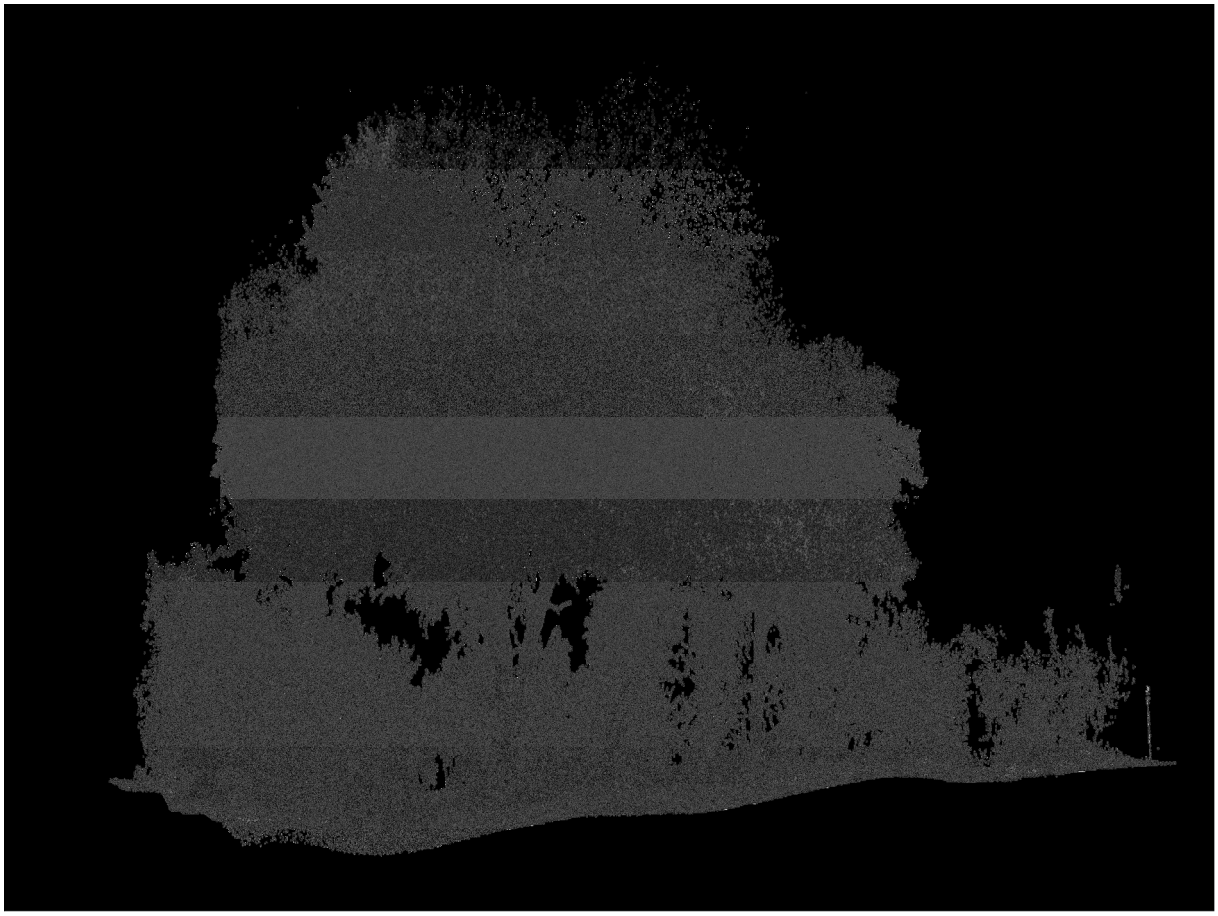

Figure 2: An example of ground-based LiDAR image data, showing the detail of both herbaceous and woody vegetation captured.

POSTER PRESENTATION: USING CYBERTRACKER SOFTWARE IN VEGETATION MONITORING

P Hanno (J) Kilian, J C J Muller, F N Rademan and E le Roux*

Khamab Kalahari Reserve, email: ecologist@khamab.co.za

Vegetation monitoring can be a laborious task, requiring many data sheets, and data that need to be captured afterwards. Not only is it time consuming, but it also leaves space for errors during capture. CyberTracker software was developed to use on a handheld computer to assist illiterate Bushmen trackers to collect field data of their observations. In the meantime the software has developed further into an efficient method of GPS field data collection, but is still almost exclusively used to collect data on animals. We have used the cybertracker software on a handheld computer to assist us in collecting and capturing vegetation data in our annual monitoring programme. We found that it did not only save time when capturing the data, but was much easier to use than a clipboard and paper in the field. It also assisted the field staff to collect the correct data because it instructs them what to collect, thereby reducing errors. The biggest advantage was during the data capture stage, as the handheld device only needs to be connected to the computer, and data are automatically downloaded and backed up. In this poster we present our experience when using the software, information on the programming, and extracts from the data that were collected. We also investigated the time that was saved when using the software compared to capturing data by hand.

POSTER PRESENTATION: OPTIMIZING VARIABLE IMPORTANCE FOR THE SELECTION OF KEY GRASS SPECIES FOR THE ZULULAND LOWVELD

Cobus (J) O Botha and Clement Adjorlolo*

KwaZulu-Natal Department of Agriculture and Environmental Affairs, Cedara, Pietermaritzburg, South Africa, email: cobus.botha@kzndae.gov.za, clement.adjorlolo@kzndae.gov.za

Rangeland condition assessment techniques should be objective appraisals that are simple and reliable for rapid use by farmers, extension services and wildlife managers. It should also be useful in guiding management decisions related to stocking rate over a wide range of vegetation types. The key grass species method fulfils the above criteria. It involves monitoring of species which have the greatest effect on range condition and which are also responsive to management. Four variable importance approaches were assessed, grouped into wrapper techniques, which include partial least squares (PLS) and random forest (RF), and filters techniques, based on significantly correlated species and species abundance/frequency. The results obtained from stepwise multiple regression analysis for all selected variables indicate $r^2 = 0.97$ and root mean square errors of 63.17, 53.47, 41.19 and 31.84 in range condition score, respectively. These results show that the methods can explain significant variability in the suite of key species selected with the different variable selection techniques. In addition to its higher predictive accuracy, the species abundance/frequency filter technique yielded a model that was more representative of the variability in the vegetation of Zululand Lowveld than the other three approaches. This study highlights the significance of deductive variable selection techniques, such as the abundance/frequency filter, to mitigate against the selection of unrepresentative species.

POSTER PRESENTATION: SUPPORT FOR THE VEGMAP DIVISION OF VEGETATION TYPES ALONG THE WEST COAST OF SOUTH AFRICA

Nelmarie Saayman and Hannes (J) C Botha*

Western Cape Department of Agriculture, Institute for Plant Production, Elsenburg, Stellenbosch, South Africa, email: nelmaries@elsenburg.com, hannesb@elsenburg.com

Acocks (1975) identified 70 broad, agriculturally-based veld types in South Africa, stressing that vegetation changes take place over short distances depending on the soil and management of the veld. Low and Rebelo (1996) simplified Acocks' vegetation types, basing their map on structure and floristics. The new VEGMAP of Mucina and Rutherford (2006) is a more detailed map based on vegetation cover, structure and floristic composition that is useful for planning at regional and local levels.

Acocks (1975) classified the west coast of South Africa, north of Eland's Bay as Strandveld of the West Coast, while Low and Rebelo (1996) named the same area Strandveld Succulent Karoo.

The vegetation type receives 50-300 mm rain per annum, mainly in winter and is mainly on the sandy western coastal plains. Mucina and Rutherford (2006) however divided the West Coast into Lambert's Bay Strandveld, in the south, forming part of the Fynbos Biome, and Namaqualand Strandveld, in the north, forming part of the Succulent Karoo. The boundary between these two vegetation types is located just south of the Olifants River. Division of vegetation types is important as each require different management practices for animals, erosion prevention and control, and planning for agricultural and regional development.

Question: Which one of these three broad vegetation types is most suitable when doing vegetation surveys in the area?

Species composition data, based on canopy spread using the descending point method, were collected at 48 different sites in Low and Rebelo's (1996) Strandveld Succulent Karoo covering the area from Lambert's Bay to the northern border of the Western Cape Province along the West Coast. A similar number of survey sites were located within each of the two vegetation types delineated by Mucina and Rutherford (2006). A Detrended Correspondence Analysis (DCA) was conducted using the vegetation data from all the sites. The DCA (Figure 1) clearly shows that the data from our vegetation surveys support the division of the Strandveld Succulent Karoo (Low and Rebelo 1996) into the two different vegetation types described by Mucina and Rutherford (2006).

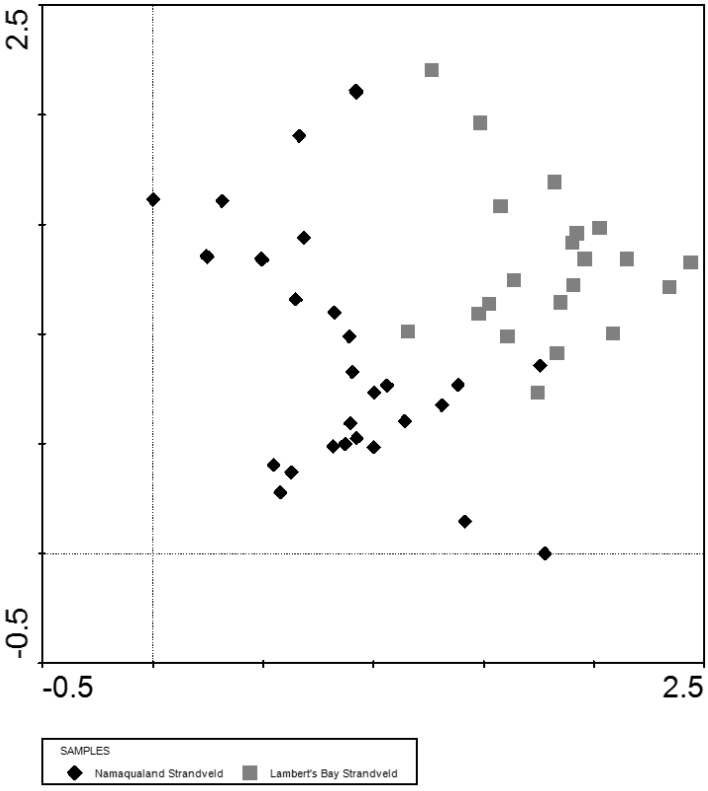

Figure 1: Detrended Correspondence Analysis (DCA) of Namaqualand (black) and Lambert's Bay (grey) Strandveld data showing the separation between the veld types.

ABSTRACTS: THURSDAY 19 JULY 2012

Invasive Plants: Control and Utilization

SESSION CHAIR: DAWOOD HATTAS

Thursday 19 July 2012, 08:15 – 10:00

Platform and Poster Presentations

PLATFORM PRESENTATION: RESISTANCE OF THE GRASS WEED WILD OAT (*AVENA FATUA L.*) TO FLAMPROP-M-ISOPROPYL HERBICIDE IN ASSIUT FARMLAND, EGYPT

Sayed A Ahmed[1], Gamal I Ahmed[2], Abdel-Raouf M El-Gharib[1] and Ibrahim A Mohamed[1]*

Assiut University, Faculty of Agriculture, [1]Plant Protection Department, [2]Genetics Department, Assiut, Egypt, email: s.ashour@gmail.com

Resistance of weed species to herbicides is considered one of the main problems encountered in weed management. The level of resistance can be monitored using herbicide efficiency and weed genetics. Trials were conducted to test the resistance of wild oat (*Avena fatua* L.) in the Assiut area to flamprop-m-isopropyl (Suffix BW) herbicide that has been used for a long period in the area. Two pot experiments were carried out in the greenhouse at the farm of Faculty of Agriculture, Assiut University, Egypt.

Data were collected using Gel Electrophoresis Total Protein Assay (GETPA). Prepared proteins were separated by SDS-PAGE then stained with staining solution to detect the pattern of protein bands of the different treatments. Bands with molecular weight of approximately 32, 31 and 27 KD were detected in both the control and all treatments (625, 1 250, 2 500 and 5 000 ppm). Bands of 24 KD were detected in all treatments and not in the control. The bands pattern of the 1 250 and 2 500 ppm treatments were similar and had one more band than the 625 ppm treatment. This band was approximately 28 KD molecular weight, and was also not detected with the 5 000 ppm treatment. In the 5 000 ppm treatment, the band with molecular weight of about 23 KD had also disappeared.

Results revealed that all plants of wild oat accessions collected from the different fields and provinces of Assiut Governorate were classified as resistant to the concentrations 625, 1 250 and 2 500 ppm of the herbicide. However, these wild oat accessions were considered susceptible to the concentration 5 000 ppm of the herbicide. Wild oat plant accessions of some fields in certain provinces showed the highest range of resistance to the concentrations of the herbicide compared with the accessions of other provinces. Wild oat plant accessions of Alghanayem province, especially accessions collected from the first field, were the least resistant to these concentrations of herbicide than the accessions of the other provinces and fields.

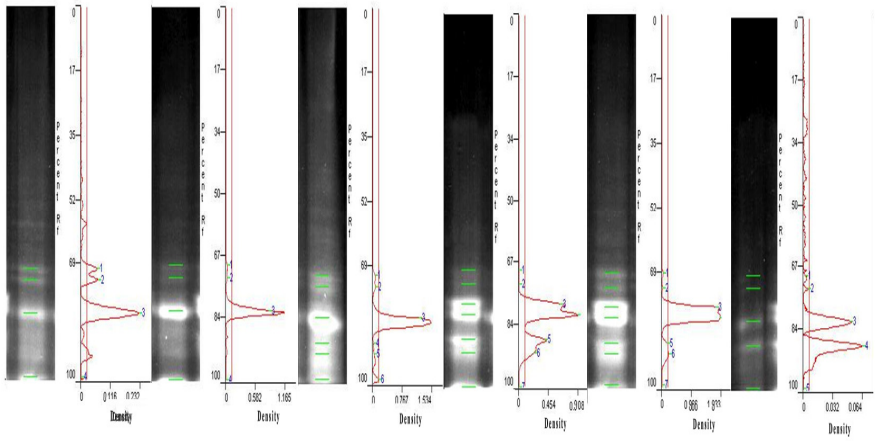

Figure 1: Pattern of protein bands separated on SDS-PAGE of different treatments of grass weed wild oat *Avena fatua* L. using flamprop-m-isopropyl herbicide (from left to right: marker, control, 625, 1 250, 2 500 and 5 000 ppm concentrations) and band detection by computerized software.

It is concluded that wild oat biotypes showed different behaviours with the herbicide. With the lower concentrations, new bands were detected which confirm that herbicide at lower rate stimulates new gene expression. The new gene expression (as indicated by new detected bands) and high level of gene products (as indicated by the dye intensity of bands), in response to increased concentration of herbicide, revealed that altered metabolism may confer some degree of resistance to the herbicide in the resistant *A. fatua* L. biotype. The high rate of herbicide (5 000 ppm) caused inhibition and degradation of protein synthesis that resulted in a reduced number of bands and reduced dye intensity of the bands

PLATFORM PRESENTATION: BIOLOGICAL CONTROL OF *CEREUS JAMACARU* (QUEEN OF THE NIGHT CACTUS) IN THE THORNVELD OF THE LIMPOPO PROVINCE, SOUTH AFRICA

Jorrie J Jordaan and Tshenolo M Mantji*

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Cereus jamacaru (queen of the night cactus) has invaded large parts of Limpopo during the past few decades. It has been a problem plant in South Africa since the 1980's and is listed in the Conservation of Agricultural Resources Act (Act 43/1993), as a Category I invader. Current chemical control of *C. jamacaru* involves intensive treatment with MSMA. Small plants are sprayed as they are standing; large plants must be injected via holes in the upright stems (vascular system) of mature plants, 1.5 to 2.0 m apart. Any untreated or discarded piece of the cactus is a source of new infestation. Two insect species introduced to control the harrisia cactus (*Harissia martini*) also attack *C. jamacaru*. They are the harrisia cactus mealybug, *Hypogeococcus pungens,* and a stem-boring cerambycid beetle, *Alcidion cereicola*, both indigenous to Argentina and Paraguay. Thirty *C. jamacaru* plants of various heights and ages were treated with the harrisia cactus mealybug at the Towoomba ADC during October 2008. Thirty were left untreated. Cuttings from plants infected with the insect were placed on uninfected plants, out of direct sunlight and as close as possible to young actively growing points. During April 2012, plants were surveyed to determine the effectiveness of the treatments. All growth points of plants that were treated were successfully infected. Typical symptoms encountered were the presence of insects as white, woolly masses on stem tips, areoles, flower heads and fruit buds. Although no mortalities occurred, young growth and reproduction of infected plants were severely retarded. During 2012, no flowering or fruit formation occurred at treated plants, while up to 15 fruit.plant^{-1} were counted at untreated plants. Distorted growth occurred where plants were treated, compared to untreated plants, which grew and reproduced freely without any effect on plant growth. Almost no spreading of the insects from treated to untreated plants occurred. The experiment illustrated the ability of the insects to slow encroachment down, which warrants the use of the harrisia cactus mealybug as a biological control agent of this invader species.

PLATFORM PRESENTATION: ASSESSING THE IMPACTS OF *ACACIA MEARNSII (*DYWABASE; BLACK WATTLE) ON GRAZING PROVISION AND LIVESTOCK PRODUCTION IN SOUTH AFRICA

Thozamile Yapi[1,2], Patrick O'Farrell[1], Luthando E Dziba[1] and Karen J Esler[2]*

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Many of South Africa's natural ecosystems have been invaded by invasive alien plants, and these pose a major threat to biological diversity and ecosystems. Invasive alien tree species and shrubs negatively affect ecosystems in various ways and often result in the decline of ecosystem services. For example, the reduction in stream flow, water availability, the loss of potentially productive land for cropping and the reduction in grazing potential of our rangelands are consequences of degradation by alien species. This study investigated the ecological impacts of the invasive alien plant species *Acacia mearnsii* on the function and productivity of rangelands in South Africa and their ability to sustain livestock production. We analysed the spatial relationships between alien invasion and livestock production at a national level. Here livestock production and invasive alien plant distribution were contrasted, using both present and historical data on livestock numbers from various GIS databases. The result was a number of areas were identified where invasions were severely impacting high quality rangeland. The Stutterheim region was one such area suitable for investigating local level impacts. Field trials in this area examined sites with different levels of invasions within a single vegetation type. The different levels of *A. mearnsii* invasions were classified as densely invaded, light invaded, uninvaded and cleared. Sites were compared in terms of losses in veld condition score across the different invasion levels.

PLATFORM PRESENTATION: THE INFLUENCE OF INVASION BY *PTERONIA INCANA* ON LANDSCAPE FUNCTIONING AND LOCAL PASTORALISTS' PERCEPTIONS ON INVASION

*Adam Sutton-Pryce and James Gambiza**

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Vegetation degradation in the form of cover reduction as well as alterations in species composition is a major environmental problem facing many parts of South Africa, particularly in communally owned rangelands. *Pteronia incana* (blue bush) has been identified as one of the most widespread invader species in the Eastern Cape, and it is spreading rapidly from stream valley bottoms onto abandoned fields and grazing lands. We assessed the functioning of invaded and non-invaded landscapes and pastoralists' perceptions of rangeland invasion by *P. incana*. We interviewed 90 pastoralists from three villages to determine their perceptions of invasion. About 54% of the pastoralists rated the current condition of the rangeland as poor. Pastoralists considered the condition of the rangeland to be declining over time. Only 30% of the pastoralists rated rangeland condition as poor five years earlier. Pastoralists relied on both vegetation and livestock indicators when assessing rangeland condition. Although pastoralists argued that invasion by *P. incana* adversely affected rangeland functioning, they did not know the causes of the invasion. Non-invaded landscapes had significantly higher water infiltration, nutrient cycling and soil stability indices than invaded landscapes. Thus, *P. incana* has serious implications for the functional integrity of the rangeland, hence influencing the provision of ecosystem services such as forage production.

PLATFORM PRESENTATION: GENETIC DIVERSITY STUDIES OF *SERIPHIUM PLUMOSUM* - A GRASSLAND ENCROACHER PLANT

Mzamose Hadebe, Peter Stegmann and Michael Pillay*

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Seriphium plumosum is a grassland encroacher that decreases the grazing capacity of grasslands in South Africa. With the extensive spread of *S. plumosum* in most parts of South Africa there is a need to better understand the genetic characteristics of this successful invasive plant. The success of this plant as an invader has not been addressed in detail. The objective of this study is to ascertain the genetic diversity of *S. plumosum* using RAPD (Random amplified polymorphic DNA) in order to understand the relationship between the genetics and the invasiveness of the species.

Plant material was obtained from seven different locations (Lydenberg, Bronkhorstspruit, Nelspruit, Bethlehem, Windberg, Vanderbijlpark, and one sample from the National Herbarium). DNA was extracted according to the CTAB protocol described in Pillay *et al.* (2001).

Ten RAPD primers from Operon Technologies were used in PCR reactions to generate banding profiles of the samples. The PCR was run with the following amplification conditions: an initial 3 min denaturation at 94°C followed by 35 cycles of 50 sec at 94°C, 50 sec at 40°C, and 1.5 min at 72°C, with a final extension step of 7 min at 72°C.

The 10 RAPD primers produced a total of 396 bands among the samples. The percentage polymorphic fragment (P) was 77.8% and the Shannon's information index (*H'*) gave an average of 0.18. The RAPD analysis data indicated that there is high genetic variation and diversity in *S. plumosum*. This high genetic diversity and variation is perhaps one of the reasons that make this plant highly successful as an encroacher species by enabling the species to adapt and survive to the changing environment. However, this may not be the only factor that enables the success of this invader.

POSTER PRESENTATION: HOW *CHROMOLAENA ODORATA* AFFECTS PHYTODIVERSITY, PRODUCTIVITY AND PASTORAL VALUE OF GUINEAN PASTURES IN BENIN (WESTERN AFRICA)

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In the Guinean zone of Benin, grassland degradation is often caused by the encroachment of plants that are toxic to cattle. *Chromolaena odorata* is one of the main toxic weed species that dominate such degraded grasslands. The present study aims: (i) to measure the levels of degradation of grasslands invaded by *C. odorata*; and, (ii) to evaluate how far degradation affects floristic richness in Benin.

We examined six sites: two pastures sown with *Andropogon gayanus* and *Panicum maximum* respectively; two degraded pastures dominated by *Cynodon dactylon* and *P. maximum*, and by *Brachiaria ruziziensis* and *C. odorata* respectively; and two rangelands dominated by *P. maximum* and *Paspalum scrobiculatum*, and by *P. maximum* and *C. odorata* respectively. *C. odorata* was observed in all sites but its cover ranged from 0 to 50%. In sites where *C. odorata* had a high cover percentage, no other species occurred, thus decreasing grassland productivity. In old fallows,

cattle movement is limited during the grazing time while *C. odorata* recruitment increases. Frequency of *C. odorata* among other species varied from 0 to 36%, and higher value was obtained in highly degraded grasslands. Biomass of *C. odorata* varied from 0 to 1.43 t.DM.ha^{-1} representing 0 to 12.6% of total biomass according to the degradation level. Biomass of *C. odorata* increased more and more from young fallow to degraded artificial and native degraded pastures. The highest *C. odorata* biomass as well as the lowest grazing value was obtained in the native grassland of *P. maximum* and *C. odorata.* Grazing values varied from 44.3% to 84.4%; the highest grazing values were obtained where *C. odorata* regrowth is low in grasslands. Shrub percentage varied from 0.06 to 0.5 according to degradation level. The highest value of shrub percentage was obtained in stations dominated by *C. odorata.* As conclusion, *C. odorata* affects negatively phytodiversity, productivity and pastoral value of Guinean pastures in Benin. Frequency, biomass, and recovery rate of species appeared to be relevant indicator parameters in defining degradation levels of pastures.

Wildlife, Rangelands and the Services They Provide

SESSION CHAIR: HARRY C BIGGS

Thursday 19 July 2012, 10:30-12:30

Keynote Address, Platform and Poster Presentations

INVITED KEYNOTE ADDRESS: RANGELAND SUSTAINABILITY, CAPITAL AND INVESTMENT IN ECOSYSTEM SERVICES: A SOCIAL-ECOLOGICAL SYSTEMS APPROACH

Urs P Kreuter

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Rangelands cover about half of the world's landmass. They provide many ecosystem goods and services that are critical for human well-being, that are derived from natural biophysical functions and processes underpinning the productivity and resilience of ecosystems, and that are affected by human economic activities. Accordingly, rangelands represent socio-ecological systems with complex linkages between the biophysical and human subsystems. In the past, ecosystem goods and services have been regarded as free benefits from nature. However, as human population pressure on rangelands has increased, there is a growing need to provide incentives, including public payments, to ensure the future delivery of ecosystem services through more effective rangeland management and more sustainable use of resources they provide.

In this paper I present a conceptual framework that explicitly links resilience, sustainability and capital in the context of rangeland ecosystems. Next I address appropriate spatial scales for implementing strategies to manage rangelands across man made boundaries. Finally, I present two Texas case studies that enhance resilience and sustainability by fortifying various forms of capital.

The first case study is the Prescribed Burning Association (PBA) initiative launched in 1997 and that has spread across the central USA. This initiative enhances social capital (networks, trust and reciprocity) in an effort to restore woody plant infested rangelands to open savannas and grasslands. It underscores the importance of adult learning principles to enhance social capital in the context of rangeland restoration practices. The second case study is the Recovery Credit System (RCS) initiative launched in 2008 to improve endangered species habitat. The RCS concept is now being adopted for endangered species impact mitigation by military training facilities across the USA. This initiative provides economic capital (financial incentives) to landowners who provide endangered species habitat. It demonstrates the importance of institutional mechanisms that build trust between the private and public sectors and that disseminate public funds over time to pay for the delivery of ecosystem services. Together the two case studies demonstrate the importance of using diverse integrated approaches for building capital to enhance rangeland resilience and sustainability.

PLATFORM PRESENTATION: BIG TREE TRENDS IN THE SABI SAND WILDTUIN OF SOUTH AFRICA: WITH IMPLICATIONS FOR RANGELAND MANAGEMENT

Mike J S Peel[1], W Fred de Boer[2], Jordi van Oort[2], Rina (C) C Grant[3], John M H Peel[1], Moloko L Manaka[1] and Jakes (A) F Jacobs[1]*

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The aesthetic value of large trees is equally acceptable as an aspiration as one of the more "concrete" objectives like preventing biodiversity loss within protected areas in southern Africa. The potential decline in tall trees, due to elephant and associated potential knock on effects such as fire, is therefore a concern and forms the focus of this presentation.

Elephant can modify habitats rapidly and extensively, and as such may precipitate a cascading effect through the ecosystem, affecting many co-existing plants and animals. It is contended that one manifestation of a high elephant density is a loss of large trees and perennial grasses which could lead to bush encroachment, and a concomitant loss of sensitive grazing species, so that the rangeland is replaced by short closed woodland with an increasing number of species such as impala and kudu.

To investigate the impact of elephant in the >5m size class we examine two sets of data collected in the Sabi Sand Wildtuin:

1. Marked trees – direct observation six years of data;

2. Tree densities measured in belt transects going as far back, in some cases, as 1992/93.

We focus on *Sclerocarya birea* and *Acacia nigrescens,* and try to determine the primary impact of elephant that may:

1. Lead to elevated adult mortality through direct impact; and

2. Be magnified by attributes that affect selection and the manner of utilisation which render the trees vulnerable to higher mortality rates (e.g., through fire).

PLATFORM PRESENTATION: MANAGING ELEPHANT IN LARGE CONSERVATION AREAS: A WICKED PROBLEM WITH NO DEFINITIVE SOLUTION

Rina (C) C Grant

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Various interpretations of the way ecological, technical and social systems are structured help inform our management decisions. For instance, at the "lower" operational organisational level, problems tend to be dealt with as "complicated", relying on expertise to find solutions - while societal values and the consequences of unexpected outcomes dominate the "higher" more "complex" levels. Most of our efforts regarding elephant management have been focused on the lower levels, to obtain sufficient information to evaluate the extent of elephant impacts. It has been shown, for example, in one study, that elephant can remove up to 30% of large trees over two years in certain landscapes. However, in spite of all the years of research, we are still uncertain of many aspects such as the recruitment into the large tree cohort, prompting further research. To be able to respond to research findings, we need to agree on the level of impact that should be defined as unacceptable, and the scientific information only fills part of the picture. Aesthetic values and tourist expectations also inform the desired state. These values differ between different segments of society, and 'higher' organisational levels are required to address these concerns. An even more complex problem is uniting the social expectations around large

trees with the ethical and emotional concerns around elephant management. Many stakeholders feel that it is unethical to reduce elephant numbers, while poor communities around parks see the potential of 'excess' elephant as a potential food resource. Lastly, even if all these challenges can be met, we still need to think very clearly about the possible and expected long and short term responses to the management on which we eventually decide. We will have to acknowledge that these systems are "wicked" - they cannot be definitively optimized. The goalposts will keep shifting and surprises will keep emerging, and we will be forced to adjust our decisions as new facts and facets emerge.

PLATFORM PRESENTATION: DIRECT BENEFITS FROM ECOSYSTEM SERVICES IN SOUTH AFRICAN NATIONAL PARKS – A CASE STUDY OF THATCH AND MOPANE WORM HARVESTING IN KRUGER NATIONAL PARK

Louise K Swemmer

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Together with the change in the emphasis of conservation within the South African National Parks (SANParks) over the past two decades, has come an urgent need for clearer, more effective and tangible benefit sharing arrangements in parks. This is reflected in the recently revised SANParks 2011 vision statement which reads "*To develop, manage and promote a system of national parks that represents biodiversity and heritage assets by applying best practice, environmental justice, benefit sharing and sustainable use*". Benefits may vary in type and degree of tangibility, and often differ in importance or value between stakeholder groups, based on individual or group perceptions of what constitutes a benefit. Sharing benefits often goes hand in hand with making cost-benefit tradeoffs between stakeholder groups, the balancing of which requires effective and strategic management approaches. Each of the 19 national parks under SANParks' custodianship is located in its own unique physical, social, economic, cultural, historical and political environment. This environment defines the context in which the expectations, perceptions and reality of potential, realized (and failed) benefit sharing arrangements are set. Recognising, unpacking and acknowledging this context is required in order to shape the most appropriate and effective benefit sharing arrangements in each case, as these can be and are usually vastly different between parks. Although extractive resource use as an ecosystem service has a long history within SANParks, there is a current drive to promote benefits that are derived from resources harvested from within parks. A pilot project that involved the harvesting of mopane worms in the north of the Kruger National Park was implemented between December 2010 and January 2011. A total of 6 villages participated, involving 62 people who collectively harvested 1 520 liters of mopane worms. The households earned between R1 606 and R2 393 per month, relied heavily on social grants (84%), livestock (52%) and crops (100%), and mostly used wood for cooking (97%) despite having access to reticulated electricity (87%). Similarly, thatch is also harvested in Kruger, as part of an ongoing project that has been implemented for decades at varying scales through the years. In 2011, 33 944 bundles of thatch were harvested by 20 people, and collected and packed by 5 people. The social and economic impact of these two projects will be discussed, in the context of strategic adaptive management.

POSTER PRESENTATION: EFFECT OF MOISTURE AND NUTRIENTS ON COPPICE RESPONSE OF HARVESTED *TERMINALIA SERICEA* TREE STUMPS

Hlonipani P M Mthunzi, Wayne Twine and Mary C Scholes*

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There is much concern about the sustainability of intensive harvesting of trees for fuelwood in communal areas. Cumulative overharvesting in these landscapes has resulted in degraded woodlands and diminished wood supply. Rotational coppice harvesting has been proposed as a management intervention for the sustainable production of usable wood. However, there is a lack of information on coppicing dynamics of savanna trees, including environmental and management factors that may enhance or hinder coppice production. This study, therefore, set out to investigate the effects of manipulating water and nutrient availability on coppice growth on harvested *Terminalia sericea***.** Harvested *T. sericea* tree stumps were supplemented with water and nutrients at different levels and monitored for total number of shoots per resprouting tree stump and, shoot-diameter and length of a chosen resprouting shoot at a six-monthly intervals after initial harvesting.

Supplementing harvested trees with water did not increase average total number of shoots per stump after 6 and 18 months of treatment, while nutrient addition significantly increased average total number of shoots ($P = 0.0001$). Water addition had a significant negative effect ($P = 0.0001$) after 12 months of water addition, with high water additions reducing the average total number of shoots produced. Nutrient addition had no significant effect on total shoot production after 18 months of addition. Nutrient addition significantly increased ($P<0.0001$) total shoot production after 18 months of addition. Shoot-diameter of resprouting trees increased with water addition ($P<0.0001$), increasing shoot-diameter by about 90% after 6 months compared to trees not supplemented and then by 35% after 12 months of addition. Nutrient addition had the same significant effect ($P<0.0001$) on average shoot-diameter, with additions increasing diameter by about 25% after 6 months and also by about 30% after 12 months of addition. Nutrient addition did not affect shoot-diameter after 18 months of addition.

Average shoot-length was increased due to water additions for all the time periods considered in the study ($P<0.0001$), with a similar trend observed when nutrients were added. Resprouting vigour was increased due to water and nutrient additions. Low water additions were not effective in increasing the response of coppicing trees, with the same effect of low nutrient additions observed. Increasing soil moisture availability through water additions in the dry dormant season improved the growth rate of resprouting trees through maintaining the leaf material well into the dry season, thereby ensuring that photosynthesis continued through maximizing what-ever limited sunlight was available in the short winter days. Continued photosynthates production meant continued maintenance of apical dominance. We propose that adding nutrients to resprouting trees may have helped activate microbial activity and mycorrhizal activity which helped improve degradation of nutrients for easier uptake, yielding positive improved resprouting responses in fertilized trees compared to trees not supplemented Such information is important because it can be used, depending on demands, for the purpose of maximizing biomass production through improved resprouting growth rates and also for managing the fuel-wood resource. Such information can also be used by ecosystem managers because the resprouting capacity of trees has been recognized as an important plant characteristic that determine the persistence of a population after a disturbance such as a harvest.

POSTER PRESENTATION: STATUS OF GAME SPECIES ON PRIVATE AND PROVINCIAL GAME RESERVES IN THE FREE STATE, INCLUDING EXOTIC AND TOPS SPECIES

Beanélri B Janecke[1], G Nico Smit[1] and Dave Hayter[2]*

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In recent times, establishment of game ranches on former livestock ranches has increased dramatically. Objectives of this study were to quantify the number of privately owned game ranches in the Free State Province at the end of 2010; compile a list of large wildlife species present; and identify species not historically present, as well as exotic, and threatened or protected species (TOPS). Data were obtained from the database of the Free State Department of Economic Development, Tourism and Environmental Affairs. All the privately owned game ranches in possession of non-obligatory Adequate Fencing Certificates were included in the database in the form of location in relation to the nearest town, game species present and their numbers. Game ranches in the vicinity of each town were counted and presented along with provincial nature reserves on a map of the province. Thirteen proclaimed, and one non-proclaimed, provincial nature reserves, one national park, one RAMSAR site and 343 private game ranches were recorded in the database. Several other private and government wildlife areas were excluded due to the absence of a fencing certificate. A total number of 64 game species was listed for the province with an additional seven colour variants of some species. Of these species, 18 were not historically present in the province and 17 are exotic. TOPS numbered 16 in total. The large number of private game ranches and the possibility of creating corridors between wildlife areas emphasize the potentially important role that these areas can play in conservation of specific plant and animal species, as well as unique ecosystems. In general, this conservation potential has not been realized due to incorrect management practices and the profit-driven objectives of game ranches that do not always comply with conservation objectives. There are concerns that the over-commercialization of wildlife may in the long term have a negative impact on conservation of species and ecosystems. Some of these concerns include deliberate breeding of colour mutations, hybridization of species and subspecies, as well as the introduction of exotic species. Profit-driven overstocking and the stocking of unsuited species for a specific environment (i.e. historically absent or exotic species) may have a detrimental effect on its vegetation. Further study is needed to determine the impact that these species may have on the environment.

POSTER PRESENTATION: ECONOMIC ASPECTS RELATING TO WILDLIFE AND WILDLIFE-BASED ACTIVITIES IN THE EASTERN LOWVELD SAVANNA, SOUTH AFRICA

Mike J S Peel, John M H Peel, Moloko L Manaka and Jakes (A) F Jacobs*

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Humans have been associated with Africa for more than two million years as hunters, pastoralists and cultivators, an association that has had a profound effect on the structure and extent of the savanna biome. Early European travellers described the sub-continent as an area inhabited by large numbers of a wide variety of wild herbivores (although there is some conjecture as to the reliability of many of these anecdotes). The last half of the nineteenth century is known worldwide as the 'century of extermination' as these settlers effected large-scale reductions in the numbers of indigenous wild herbivores. The rinderpest epidemic of the 1890s further diminished herbivore numbers in South Africa. The 'century of extermination' was followed by the 'century of

conservation'. Concerted efforts during the twentieth century resulted in an increase in the number of wild herbivores to levels where non-consumptive use is possible, and even to the point where consumptive use is necessary.

South Africa's wildlife commands a high value both regionally and globally. However, this value is often ignored because it is difficult to quantify, and the depletion of wildlife and natural resources is not generally seen as an economic cost to society. The value of wildlife is not fully represented in economic decisions and wildlife-based activities are often viewed as being less profitable than activities that generate more easily quantifiable benefits and outputs to society. By demonstrating wildlife values and expressing them in monetary terms, wildlife is placed on an equal footing with other sectors of the economy. This provides important information for justifying and financing wildlife conservation, for using wildlife as a means of economic development, and for setting in place economic activities that promote sustainable resource use.

In this presentation we outline the history of wildlife conservation and the development of the wildlife industry in the eastern Lowveld. This is followed by a synthesis of the causes of and problems associated with bush encroachment. We go on to examine the economic costs and ecological implications of bush control using a number of different management scenarios with differing primary objectives and based on actual case studies.

Rangeland Dynamics in Humid and Arid Environments

SESSION CHAIR: P HANNO (J) KILIAN

Thursday 19 July 2012, 13:30 – 15:00, 15:30 – 16:15

Platform and Poster Presentations

PLATFORM PRESENTATION: A RECONSTRUCTION OF NGONGONI VELD IN THE ABSENCE OF LIVESTOCK

C Rob Scott-Shaw

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The discovery of grasslands inaccessible to livestock and areas protected from them for over 70 years and both burnt regularly has enabled studies to enumerate the species composition (graminoid and non-graminoid) and compare them with grasslands grazed by livestock. The study areas fall within the national vegetation types: KwaZulu-Natal Sandstone Sourveld and Pondoland-Ugu Sandstone Coastal Sourveld both parts of Acocks' Ngongoni Veld. The most significant finding is that the Increaser III grass *Aristida junciformis* (Ngongoni) is absent in the livestock excluded sites. The mean Decreaser species percentage composition for the livestock excluded grasslands is 61%. *A junciformis* has become dominant or co-dominant (highest percentage composition) in most grasslands of South Africa's east coast. This implies that it has invaded millions of hectares of grassland replacing naturally occurring species such as the Decreaser species *Themeda triandra*, *Diheteropogon amplectens*, *Monocymbium ceresiiforme* and *Panicum natalense*.

PLATFORM PRESENTATION: LONG-TERM CHANGES OF THE VEGETATION ON THE PLATEAU AREAS OF MOUNTAIN ZEBRA NATIONAL PARK: 1980 – 2011

Leslie R Brown[1], Hugo Bezuidenhout[2] and Peter A Novellie[2]*

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The vegetation of permanently marked plots distributed within two plateau grassland communities was monitored by means of point surveys for canopy spread cover over a 22 year period spanning from 1989 to 2011. Datasets were collected over four periods (1989, 1993, 2001, 2011). The observed changes between 1989 and 2001 conformed to some extent to the succession model that forms the basis of veld condition assessment for the Nama-Karoo biome. Annual grasses were abundant after the drought season in the 1980's and decreased with an increase in perennial grasses after a few years. The nature of the rainfall-induced changes differed between different communities with the perennial Decreaser grasses in one area never becoming dominant. It seemed that rainfall influenced the vegetation and that grass species reacted the quickest to rainfall. Total cover for both grass and dwarf shrub species declined in dry years and increased in wet years. The monitoring of these areas was repeated in 2011. Three above average rainfall years preceded this monitoring. The prominent and dominant grass and dwarf woody shrub species were analysed with the expectation that the perennial grasses would have increased with the above average rainfall. The new data did not conform to the previous trend. Results indicate that the perennial Decreaser grass species *Themeda triandra* and *Digitaria eriantha* and the Increaser

Eragrostis curvula have decreased in both communities, while the Increaser grass *Cymbopogon plurinodis* has increased. The most dominant dwarf shrub in both communities, *Helichrysum dregeanum*, which is a Decreaser shrub, also has not increased with above average rainfall. Possible external factors such as fire, grazing and browsing of wildlife could have impacted on the reaction of these plant species. These factors as well as other possible amendments to monitoring procedure are discussed.

PLATFORM PRESENTATION: BIODIVERSITY AND EDAPHIC FACTORS IN GRASSLANDS OF THE FREE STATE, SOUTH AFRICA

Mamokete N V Dingaan[1], Mitsuru Tsubo[2], Sue Walker[1] and Terence S Newby[3]*

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There are growing concerns about the potential ecological consequences of the increased impact of human activities on natural and managed landscapes, especially loss of biodiversity. The sustained loss of biodiversity has the potential to affect ecosystem functioning and processes, and therefore the services derived by humans. Biodiversity is in turn strongly influenced by environmental variability, especially nutrient availability and precipitation regimes. In this study we investigated the relationships of plant diversity with soil factors in semi-arid grassland, focusing on the following question: which soil chemical properties are possible indicators of plant diversity in semi-arid grasslands?

The study was carried out in the Free State Province of South Africa, lying between 26.6 – 30.7°S and 24.3 – 29.8°E. We carried out vegetation surveys in agricultural grasslands around Bethlehem and Bloemfontein in the Free State Province of South Africa, including parts of Kimberley, which is situated east of the Northern Cape Province, following the Braun-Blanquet phytosociological method. Species richness (*S*) and the Shannon-Wiener diversity index (*H'*) were used to compare plant species diversity of grassland sites along a geographical gradient. Soil samples were taken from 0 to 10 cm depth to investigate the relationship between biodiversity and soil chemical properties, i.e. calcium (Ca), potassium (K), magnesium (Mg), sodium, phosphorus, total nitrogen (N), total carbon (C), and pH (H_2O).

S decreased with increasing Ca, Mg and pH at a regional scale (across the three locations) and local scale (in Bloemfontein). *H'*, on the other hand, only had significant (negative) correlations with Ca and pH at the regional scale. In addition to soil acidity, both diversity indicators (*S* and *H'*) showed a positive association with total N and total C across the study area. In Bloemfontein, K had a positive relationship with *H'*, and also positively correlated with total N, implying a possible positive correlation between plant diversity and soil N. This finding is not consistent with previous studies which have reported a decline in species richness with increased N amounts in N addition experiments. The soil N in Bloemfontein is relatively low (0.04–0.17%), far lower than the 0.5% N level which has been reported as the possible optimum for high plant diversity.

PLATFORM PRESENTATION: RANGELAND DEGRADATION IN SWAZILAND: DIP–TANK USE EFFECTS ON WOODY PLANT STRUCTURE AND RANGE CONDITION IN THREE SOIL TYPES

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Rangelands are a vital livelihood source of the communal people of southern Africa. Degradation of these common lands has been widely reported in many parts. The causes of degradation have been debated to be either internal (demographic and abiotic), external (mainly interventions) or a combination of the two. This study investigated the effect of dip–tanks on woody vegetation structure and rangeland condition in three soil types.

Eight dip–tanks, three each in sandy, and loamy, and two in stony ground soils were selected. All the dip–tanks have been used for over 40 years. *Dichrostachys cinerea* and *Acacia tortilis* were the dominant woody species in all areas. In sandy soils, *D. cineria* density was affected by distance from dip–tank up to 150 m (P=0.03), where the density of *A. tortilis* was low (P=0.02). In loamy soils, lowest and highest (P=0.05) *D. cineria* density was recorded at 150 and 700 m from dip–tanks, respectively. Inconsistent results were found on the piosphere formation of total woody density and cover. Nevertheless, large areas surrounding dip–tank had a bush cover >50%. Most sites were dominated by woody seedlings and saplings (>0-2 m). Total herbaceous yield (range: 176–363.8 kg.DM ha^{-1}) and grazing capacity (47.5–111.5 $ha.LSU^{-1}$) were very low. Palatability and ecological values of grasses were 18.7–67.6% and 43.2–64.1%, respectively.

This study concluded that there was heavy bush encroachment around many dip–tanks despite the harvesting of woody species by the local community. The rangeland condition around the dip–tank areas was generally poor. Therefore, there is a need to develop a sustainable and integrated bush control and rangeland restoration program which provides conservation plans for species valuable for food and livelihood security. The program should be based on community participation, and consider changing of dip–tank sites and resting of degraded areas to restore the forage biomass, and burning or thinning to control the progress of bushes, followed by stocking and rotation policies.

POSTER PRESENTATION: INFLUENCE OF DIFFERENT VELD MANAGEMENT STRATEGIES ON BIOMASS PRODUCTION WITHIN A 16 YEAR TRIAL IN THE FALSE THORNVELD OF THE EASTERN CAPE

Craig Trethewey[1] and Theunis L Morgenthal[2]*

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A long-term trial to investigate the optimum grazing system and stocking rate for cattle in False Thornveld of the Eastern Cape was initiated in 1996. This trial has been ongoing for 16 years. Since its inception animal weight and species composition has been monitored annually. The effect of different grazing systems (continuous *vs* rotational) at the three different stocking rates (recommended, 50% overstocked and 100% overstocked) on herbaceous biomass production has not been investigated. A study to quantify the impact of different grazing systems on the herbaceous production was initiated in 2009. A similar study by Danckwerts and Barnard (1981) investigated the short term effect of defoliation on herbage yield in three different veld conditions and found that the original veld condition was the overriding factor that influenced productivity.

The aim of the study was to investigate the long-term effect of stocking rate and grazing management on seasonal biomass production. The study investigated the biomass production within four of the eight treatments that are applied within the trial. Biomass production was measured at three stocking rate levels (recommended stocking rate, 50% higher than the

recommended stocking rate and 100% higher than the recommended stocking rate) and within a six camp system at a recommended stocking rate. Biomass production was estimated by setting up 5 exclosure cages within long-term monitoring plots at the onset of the growing season. The total seasonal biomass was harvested at the end of the growing season (May) within the exclosure and outside of the exclosure using a 1 m^2 circular quadrat. Samples were dried for 48 hours at 65°C and weighed.

Biomass production varied between 1 137 and 514 $kg.DM.ha^{-1}$ during 2009 and 2011. The highest production was measured in camps dominated by *Sporobolus fimbriatus*. Forage utilization within recommended stocking rate treatments were low (below 40%) whereas the forage utilization within extreme heavy stocking rates (100% above recommended stocking rate) was close to 90%.

Reference

Danckwerts JE & Barnard HJ. 1981. Short term effects of defoliation on herbage yield at three veld condition sites in the False Thornveld of the Eastern Province. *Proceedings of the Grassland Society of Southern Africa*, 16: 79-84.

POSTER PRESENTATION: A PILOT STUDY ON THE VALUE OF KARROID SPECIES FOR GRAZING IN SEMI-ARID SAVANNA AND THICKET

Theunis L Morgenthal[1] and Craig Trethewey[2]*

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The value of karroid species is mostly ignored during veld condition assessments as they are considered of very little value to grazing in semi-arid savanna and thicket. Karroid species can, however, form a significant part of the vegetation on flood plains and pediments in semi-arid savanna and thickets of the Eastern Cape. This study was initiated as karroid species were found to be well-utilized during drought periods together with larger shrubs by cattle and goats at Adelaide Research Station. The pilot study investigates the potential of including karroid species within benchmark data for semi-arid savanna and thickets.

An inventory was made of karroid species occurring in semi-arid savanna and thickets at Adelaide that can potentially contribute to grazing. Four species were identified that could contribute to grazing namely *Felicia muricata* (6.2), *Helichrysum dregeanum* (6.3), *P. incana* (5.7) and *Selago geniculata* (7.0). The productivity of *Pentzia incana* was investigated by selecting four populations of *P. incana*. Old material was clipped at the beginning of the growing season and each stem was marked. The growth and survival over five months were monitored and photographed within 1 m^2 marked plots.

At plant densities of 24 $plants.m^2$, an annual dry matter production of 62 $g.m^2$ was recorded for *P. incana*. The study only reports on preliminary results. Further research will aim at increasing the sample size and including other karroid species.

PLATFORM PRESENTATION: LAND DETERIORATION OF A SEMI-DESERT GRAZING AREA IN THE NORTH-EASTERN ZONE OF LIBYA (CYRENAICA)

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The study focused on one of the important contemporary environmental problems: land deterioration; and was carried out on a semi-desert rangeland constrained by aridity, in an area stretching between two small cities in north-east Libya.

The analysis of 210 25 m^2 quadrats revealed that the plant life is mainly confined to wadiis (valleys) and average vegetation cover ranged between 39.53–69.2%, the dominant species was *Haloxylon scoparium*, biomass ranged between 28.33–129.42 $gm.m^2$, average soil depth was between 30–50 cm, while 25% of the area was covered by hummocks.

The total number of seeds counted in soil seed bank samples was 25.870 $seed.m^2$, in which the important forage family Fabaceae constituted 450 $seed.m^2$. Other lifeforms in the samples were 55.2% Therophytes, 26% Chamaeopytes, 11.4% Cryptophytes and 7.1% Phaneropytes. The large proportion of Therophytes indicates the prevalence of aridity. Alpha diversity was 1.3–3.4% while beta diversity was 11.9–77.6%. The soil chemical characteristics showed low organic matter and a tendency towards alkalinity.

The study showed that the area is characterized by low rainfall and suffers from degradation, low productivity, retrogressive succession , soil erosion ,and sandy encroachment from the desert, mainly due to accumulative anthropogenic pressure which host actions that upset the ecological balance in this area in form of overgrazing, over collection, mining, shifting cultivation, ploughing and plant eradication. All these activities destroy the vegetation cover that protects the land from water and wind erosion.

PLATFORM PRESENTATION: EFFECTS OF OVERGRAZING, HABITAT TRANSFORMATION AND RAINFALL ON THE STRUCTURE AND SPATIAL PATTERNING OF SOIL SEED BANKS: A FENCE-LINE CONTRAST APPROACH FROM ARID NAMIBIA

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Soil seed banks (SSBs) play an important role in vegetation dynamics of arid rangelands. Under severe grazing pressure seed set may be drastically reduced, and thus the replenishment of SSBs hindered. Over time, local seed reserves become depleted and recruitment dependent on both the arrival of diaspores from nearby plant communities and the availability of safe sites for seed retention and provisioning of suitable conditions for germination and establishment. Together, overgrazing and drought cycles can significantly transform the biophysical environment through changes in vegetation structure and soil erosion. The associated redistribution of resources may indicate reduced landscape functionality in terms of trapping dispersing diaspores and accumulating them in the SSB. Consequently, availability and quality of naturally occurring seed traps is crucial for the capacity of a degraded system to maintain a SSB suitable for vegetation regeneration. Therefore, understanding the impact of environmental changes in relation to grazing on SSBs is highly important for grazing management and restoration purposes.

Comparing the standing vegetation and associated SSB of an open, highly degraded communal rangeland with an adjacent reference site representing an intact grassy shrubland of southern Namibia, Dreber et al. (2011) showed that the magnitude of divergence of the systems was significant with respect to species composition and community structure after decades of overgrazing. Related data on seed densities and species numbers from two subsequent years were

analyzed in order to evaluate the degraded systems' ability to trap and accumulate dispersing diaspores. The study addressed the effects of grazing intensity on the spatial patterning of SSBs, considering both the role of available microsites and their interaction with diaspore size in determining seed distribution (for details see Dreber & Esler 2011).

Long-term overgrazing significantly increased seed densities and species richness of the SSB across microsites by favoring small- and tiny-seeded species. However, the spatial patterning of the SSB was not affected and showed similar to patterns found under sustainable grazing an overall clumped dispersion of seeds and general decline in seed densities and species numbers from underneath shrub canopies to small physical barriers in the open matrix to bare ground. This small-scale environmental heterogeneity interacted with diaspore size in seed distribution. Results show that besides shrub cover, in degraded environments even low stature barriers like deadwood and surface rocks contribute significantly to the maintenance of functionality in terms of trapping and accumulating readily germinable seeds over time. Observed temporal patterns highlight the importance of the condition and sequence of preceding rainfall seasons and availability of safe sites in shaping SSBs. Overall, results are of relevance for restoration in degraded arid rangelands.

References:

Dreber, N., Esler, K.J., 2011. Spatio-temporal variation in soil seed banks under contrasting grazing regimes following low and high seasonal rainfall in arid Namibia. Journal of Arid Environments 75, 174-184.

Dreber, N., Oldeland, J., van Rooyen, M.W., 2011. Species, functional groups and community structure in seed banks of the arid Nama Karoo: Grazing impacts and implications for rangeland restoration. Agriculture, Ecosystems and Environment 141, 399-409.

POSTER PRESENTATION: EVALUATION OF RANGE CONDITIONS IN KWEZANA AND DIKIDIKANA COMMUNAL RANGELANDS OF THE EASTERN CAPE, SOUTH AFRICA

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Rangelands represent a valuable source of feed for livestock production in the Eastern Cape Province of South Africa. Cattle production is the most important livestock sector, and one of the common indigenous breeds used by communal cattle enterprises is the Nguni breed. Range assessment was conducted in during the dry season (winter) and wet season (summer) in two communal areas, namely Kwezana and Dikidikana. The range condition surveys were carried out in twelve homogenous vegetation units (HVU) in each village. In each HVU two belt transects were established across the HVU and were permanently marked for future re-assessments. Each transects was 100 x 2 m in size. Grass species composition and basal cover was determined using the step point method between the two transect markers. The plant nearest to the step point was identified and recorded. One hundred step point observations were made per transect. In surveying the browsing capacity of the range, the highest and lowest browsing was measured using the rod to determine browsing unit and the tree equivalence and the harvesting technique was using to measure the dry matter whereby the sample were oven dried and weight measured and recorded. A two-way ANOVA was used to test seasonal effects on species relative abundances of trees and grass species, and a one-way ANOVA was used for plant dry matter and basal cover. LSD test was used to compare season means. The species relative abundances were significantly different ($P<0.01$), but season did not have significant effects on the relative abundances ($P>0.01$). There was no significant interaction between treatment and type of species ($P>0.01$). Season had significant effects on dry matter ($P<0.01$), but did not significantly affect basal cover ($P>0.01$). Slopes had no effect on the species composition of grasses and trees distribution.

Production from Planted Pastures

SESSION CHAIR: JANKE VAN DER COLF

Thursday 19 July 2012, 08:15 – 10:00

Platform and Poster Presentations

PLATFORM PRESENTATION: DRY MATERIAL PRODUCTION OF *CENCHRUS CILIARIS* (BLUE BUFFALO GRASS) TREATED WITH ORGANIC FERTILIZER ENHANCERS

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A trial was conducted during the 2011/2012 growing season at the Towoomba ADC, situated on the southern part of the Springbok flats, near Bela Bela in the Limpopo Province (28°21'E, 24°25'S) on a Hutton soil. The aim of the study was to determine the effect of two newly launched fertilizer enhancers on the production of an existing *Cenchrus ciliaris* sward. Two products, namely PT4® and Alpha X®, were evaluated. Both products consist of a solution of essential amino acids, combined with low quantities of macro- and micro nutrients. The products activate enzymatic functions associated with plant growth (Alpha X®) and root development (PT4®) and are claimed to give an approximate 30–40% increase in grass production, as well as increased drought tolerance. The experiment was laid out as a small plot (5 x 5 m), completely randomized block design, with twelve treatments and three replications. Treatments included were as follows:

- T1: PT4® at a rate of 1.0 l.ha^{-1}
- T2: Alpha X® at a rate of 1.5 l.ha^{-1}
- T3: Alpha X® at a rate of 1.5 l.ha^{-1} and PT4® at a rate of 1.0 l.ha^{-1}
- T4: Fertilizer at a rate of 75 kg N.ha^{-1} and 7.5 kg P.ha^{-1}
- T5: Fertilizer at a rate of 150 kg N.ha^{-1} and 15 kg P.ha^{-1}
- T6: PT4® at a rate of 1.0 l.ha^{-1} and fertilizer at a rate of 75 kg N.ha^{-1} and 7.5 kg P.ha^{-1}
- T7: PT4® at a rate of 1.0 l.ha^{-1} and fertilizer at a rate of 150 kg N.ha^{-1} and 15 kg P.ha^{-1}
- T8: Alpha X® at a rate of 1.5 l.ha^{-1} and fertilizer at a rate of 75 kg N.ha^{-1} and 7.5 kg P.ha^{-1}
- T9: Alpha X® at a rate of 1.5 l.ha^{-1} and fertilizer at a rate of 150 kg N.ha^{-1} and 15 kg P.ha^{-1}
- T10: Alpha X® at a rate of 1.5 l.ha^{-1}, PT4® at a rate of 1.0 l.ha^{-1} and fertilizer at a rate of 75 kg N.ha^{-1} and 7.5 kg P.ha^{-1}
- T11: Alpha X® at a rate of 1.5 l.ha^{-1}, PT4® at a rate of 1.0 l.ha^{-1} and fertilizer at a rate of 150 kg N.ha^{-1} and 15 kg P.ha^{-1}
- T12: No fertilizer, no Alpha X®, no PT4® (control)

The annual rainfall during the study was approximately 50% of the annual average, which led to lowered grass production. Treatments involving the high fertilizer rate produced significantly higher than low fertilizer or no fertilizer treatments. All treatments where fertilizer was applied produced higher than treatments where only fertilizer enhancers were applied. The best results were obtained where the two products were used in combination at high fertilizer rates. The presence of adequate available soil nutrients appears to be a pre-requisite for the fertilizer enhancers' success.

POSTER PRESENTATION: THE DRY MATTER PRODUCTION OF EIGHT SUB-TROPICAL GRASS SPECIES UNDER RAIN-FED CONDITIONS IN THE SOUTHERN CAPE OF SOUTH AFRICA

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The reduced availability of water for irrigation, changing rainfall patterns, and high summer temperatures have resulted in a need to identify pasture species which are better adapted to these adverse conditions. Sub-tropical grasses may hold the potential to address these shortcomings in milk and beef production systems in the southern Cape. Fifteen sub-tropical grass cultivars were planted on an Estcourt soil form under rain-fed conditions (mean annual rainfall 728 mm) in a small plot trial during March 2010 at Outeniqua Research Farm near George in the Western Cape Province of South Africa. The aim of this study was to evaluate the production potential of summer producing perennial sub-tropical grass cultivars. The treatments were managed as foggage and sampled on a 90 day cycle.

The dry matter (DM) content of *Eragrostis curvula* cv. Ermelo (pelleted) within the four seasons was similar to or higher than any other cultivar. The summer and autumn DM production rate of *Chloris gayana* cv. Katambora and Katambora (pelleted) was similar to or higher than the highest producing cultivar, and thus their total DM production was also higher than most of the cultivars. Similarly, the summer and spring DM production rate of *Eragrostis curvula* cv. PUK E436 resulted in it having a similar total DM production to Katambora and Katambora (pelleted). *Ehrharta calycina* cv. Mission had the highest DM production rate during the winter. The DM production of the cultivars differs and should be taken into account for selection in a fodder flow program.

Table 1: The seasonal DM matter production rate and total annual DM production for the period summer 2010 to spring 2011 of perennial sub-tropical grass cultivars evaluated under rain-fed conditions at Outeniqua Research Farm (^{abcde} Means with no common superscript differ significantly (P<0.05); LSD=Least significant difference; #Pelleted seed)

Species	Cultivar	DM production rate (kg DM.ha^{-1}.day^{-1})				Total DM production (kg DM.ha^{-1}.year^{-1})
		Summer	Autumn	Winter	Spring	
Anthephora pubescens	Wollie	0.00^{f}	1.41^{f}	0.00^{f}	0.00^{f}	152^{g}
Brachiaria brizantha	Brachiaria	22.56^{cde}	54.74^{ab}	2.65^{ef}	19.60^{e}	10037^{ef}
Chloris gayana	Katambora	49.88^{a}	62.74^{a}	8.72^{cd}	44.33^{bc}	16412^{abc}
Chloris gayana	Katambora#	49.27^{a}	65.41^{a}	11.03^{c}	55.42^{ab}	17929^{a}
Cynodon dactylon	Bermuda	0.45^{f}	2.54^{f}	0.00^{f}	0.00^{f}	315^{g}
Cynodon dactylon	Vaquero	0.10^{f}	1.00^{f}	0.00^{f}	0.00^{f}	114^{g}
Digitaria eriantha	Irene	14.79^{ef}	32.74^{de}	1.77^{f}	62.07^{a}	10380^{ef}
Digitaria eriantha	Irene#	16.21^{def}	35.25^{de}	1.49^{f}	67.58^{a}	11202^{def}
Eragrostis curvula	PUK E436	40.80^{ab}	43.60^{cd}	24.79^{b}	54.47^{ab}	16806^{ab}
Eragrostis curvula	Ermelo#	38.06^{abc}	37.63^{de}	9.14^{cd}	61.30^{a}	14104^{bcd}
Eragrostis curvula	Agpal	22.05^{cde}	26.96^{e}	6.55^{de}	37.51^{cd}	9087^{f}
Eragrostis curvula	Ermelo	30.49^{bcde}	37.30^{de}	10.89^{c}	55.45^{ab}	13147^{cde}
Panicum maximum	Gatton	29.85^{bcde}	49.07^{bc}	9.77^{cd}	44.27^{bc}	13250^{cde}
Panicum maximum	PUK 8	17.94^{de}	51.14^{bc}	9.71^{cd}	37.60^{cd}	11779^{def}
Ehrharta calycina	Mission	32.18^{bcd}	6.53^{f}	39.98^{a}	23.89^{de}	11749^{def}
LSD (0.05)		**16.773**	**11.037**	**4.329**	**13.744**	**3270.8**

PLATFORM PRESENTATION: THE EVALUATION OF DRY MATTER YIELD AND FORAGE QUALITY FOR FOUR PASTURES AS INFLUENCED BY THREE FREQUENCIES OF FLOOD IRRIGATION IN THE FALSE UPPER KAROO

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Water is a scarce resource, particularly in the False Upper Karoo area where the average rainfall is 350 mm per year. Water, therefore, has to be used efficiently to avoid over-irrigation and under-irrigation of cultivated pastures. The efficiency of flood irrigation, as used by farmers in the area is low, with most of them uncertain about the impact of water on the dry matter (DM) yield and forage quality of different cultivated pastures. Due to the water constraints in the False Upper Karoo area, it is essential to provide flood irrigation guidelines to farmers for different annual and perennial pastures, as well as their response to different irrigation frequencies.

The aim of this research is to determine the optimal flood irrigation frequency, as to obtain maximum DM yield and forage quality of four different cultivated pastures. Four cultivated pastures which are commonly used by the farmers in the False Upper Karoo area were evaluated under three frequencies of flood irrigation, namely, *Trifolium resupinatum* (Persian clover), *Medicago sativa* (lucerne), *Lolium multiflorum* (Italian ryegrass) and *Festuca arundinaceae* (tall fescue). The three frequencies of the flood irrigation treatments were: flood irrigation once per week (W1), flood irrigation once in two weeks (W2) and flood irrigation once in three weeks (W3). The amount of water applied was measured using a V notch and rainfall was recorded. Monthly dry matter DM yields were measured. Monthly forage samples were taken and analyzed for crude protein (CP), calcium (Ca), potassium (K), magnesium (Mg), sodium (Na) and phosphorus (P) content. *In vitro* dry matter digestibility (IVDMD) was determined on a monthly basis.

Irrigation frequency affected ($P<0.01$) Ca, P and IVDMD of Persian clover and had no effect ($P>0.05$) on DM, CP, K, Mg and Na. In lucerne, irrigation frequency affected ($P<0.01$) Ca, Mg and P while there was no ($P>0.05$) effect on DM, CP, K, Na and IVDMD. Frequency of irrigation affected ($P<0.01$) DM, Na and CP ($P<0.05$) and had no effect ($P>0.05$) on Ca, K, Mg, P and IVDMD for Italian ryegrass. In tall fescue, frequency of irrigation influenced ($P<0.01$) DM, Ca, Mg, Na and P with no influence ($P>0.05$) on CP, K and IVDMD. Dry matter, CP, Ca, K, Mg, Na, P and IVDMD varied ($P<0.01$) over time (months) for Persian clover, lucerne and tall fescue. Italian ryegrass varied over time ($P<0.01$) with regard to CP, Ca, K, Mg, Na, P and IVDMD with no ($P>0.05$) influence on DM. A flood irrigation program could be designed from the results obtained for the pastures evaluated during this study, and provide farmers with guidelines to do so.

POSTER PRESENTATION: THE EFFECT OF PLANTING DATE ON THE SEASONAL GROWTH PATTERN OF DIFFERENT ANNUAL WINTER FODDER CROPS

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Irrigated winter fodder crops are used with great success in agriculture, but information on the production potential of these species under supplementary irrigation in the warmer summer rainfall areas of the Limpopo Province is limited.

Six winter crops (Witteberg and Overberg oats (*Avena sativa*), LS 35 and LS 62 stooling rye (*Secale cereale*), and Rex and Cloc 1 triticale (*Triticum x Secale*)) were planted on four different planting dates (7 February, 28 March, 14 May and 13 June). On establishment, 150 kg.ha^{-1} 2:3:4 (22) fertilizer was applied, followed by two applications of 125 kg.ha^{-1} LAN (28%) at six and twelve weeks after establishment. All treatments were cut six weeks after planting and thereafter every six weeks. Irrigation was applied at a rate of 20–25 mm on a weekly basis.

The following results are production trends that were measured during the winter of 2008 for each planting date separately.

The early planting date (7 February) yielded five cuttings. The highest dry matter production of all cultivars occurred during the first cut (28 March), with Overberg oats at 4.5 t.ha^{-1} and Witteberg oats at 4.4 t.ha^{-1}. After the first cut there was a significant (LSD 0.298) decline in production (average for all cultivars) *viz.*: 4.0 t.ha^{-1} on 28 March; 1.5 t.ha^{-1} on 23 April; 1.0 t.ha^{-1} on 11 June; 0.9 t.ha^{-1} on 30 July and 0.5 t.ha^{-1} on 16 September.

The 28 March planting date yielded four cuttings. The highest production (LSD 0.496) for this planting date was on 14 May (1st cut) for Witteberg oats at 3.1 t.ha^{-1}. The lowest mean production of all cultivars was on 24 June (2nd cut), with 0.6 t.ha^{-1}, and after that 0.7 t.ha^{-1} on 13 August and 0.8 t.ha^{-1} on 1 October. The average production over cultivars did not differ significantly (LSD 0.203) on the different cutting dates, but there was an insignificant increase towards spring.

The 14 May planting date yielded three cuttings. The highest production was on 24 June (1st cut), with a small non-significant (LSD 0.463) between cultivars (1.1 t.ha^{-1} to 1.6 t.ha^{-1}). The average production (over cultivars) was 1.4 t.ha^{-1}on 24 June, 0.5 t.ha^{-1} on 13 August and 1.0 t.ha^{-1} on 1 October. These values differ significantly from each other (LSD 0.1890). The production of Witteberg oats and Rex triticale was 1.2 t.ha^{-1}, for both, on 1 October, a significant (LSD 0.463) increase towards summer, for these two species alone.

During the last cut of the late planting date (13 June)the average higher production (over all cultvars) was 2.1 t.ha^{-1}. Individual production figures were 2.7 t.ha^{-1} for LS 35 stooling rye, 2.6 t.ha^{-1} for Rex triticale and 2.4 t.ha^{-1} for Witteberg oats, which did not differ significantly from each other, but was significantly higher than that of LS 62, Overberg and Cloc 1(LSD 1.408). The mean production of the second cut (16 July) was low (0.6 t.ha^{-1}) for all cultivars, and for the third cut (5 November) 1.5 t.ha^{-1}.The average production between these two cuts differed significantly (LSD 0.575). The highest values in the third cut were was 2.0 t.ha^{-1} for LS 35 stooling rye, 1.9 t.ha^{-1} for Rex triticale and 1.7 t.ha^{-1} for Witteberg oats. These values did not differ significantly from each other, but were significantly higher than that of LS62, Overberg and Cloc 1(LSD 1.408).

Table 1: Preliminary production trends (t.ha^{-1}) of the six annual winter fodder crops on the four planting dates (2008) (*seed for Cloc 1 was not available on 7 February 2008). No statistical analysis has been done on these results.

Cultivars	7 February	28 March	14 May	13 June	Average
Rex	7.8	4.1	3.2	5.2	5.1
LS 62	7.0	3.1	2.8	3.8	4.2
LS 35	6.8	4.4	2.8	5.3	4.8
Overberg	8.7	4.6	3.1	2.7	4.8
Witteberg	8.9	6.2	3.3	4.8	5.8
Cloc 1	-*	2.9	2.2	3.2	2.8
Average	7.8	4.2	2.9	4.2	

POSTER PRESENTATION: ACCEPTABILITY OF SELECTED PEARL MILLET CULTIVARS BY GOATS

Chris S Dannhauser and Mapula J Meso*

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Pearl millet (*Pennisetum glaucum*) has been grown in India and Africa since ancient times. It is generally accepted that pearl millet originated in Africa and was subsequently introduced into India. Its origin has been traced to tropical Africa, in the Sahel zone of West Africa. From there cultivation subsequently spread to east and southern Africa and southern Asia.

Pearl millet is well adapted to low rainfall and low soil fertility. It is also more drought tolerant and tolerates lower soil pH conditions than fodder sorghum (*Sorghum bicolor*). Pearl millet is widely cultivated as a summer fodder crop and reported to reach 50% flowering at approximately 60 to 70 days after establishment. It is well adapted to areas characterised by warm days and where soil temperatures remain above 5°C. New cultivars of hybrid millet hold the potential to provide summer fodder for animals in the Gauteng Province, but have not yet been evaluated in terms of adaptability and acceptability. The aim of this study was to evaluate the dry matter production and intake of hybrid pearl millet for grazing animals in Gauteng.

The study was conducted on the Dewageningsdrift Experimental Farm of Hygrotech Seed Company in the Moloto area in Gauteng. The four cultivars evaluated during the study were Nutrifeed, Hy Pearl Millet, Babala and Agrigreen. Two replicates of each cultivar were established during December 2010 on 0.4 ha plots. The material was grazed by Boer goats at the foggage stage starting from 3 August 2011. The dry matter (DM) production and average height of plant material was measured before grazing and at the end of the grazing period. Dry matter production was estimated by cutting, drying and weighing. Height was measured using a Filip's Folding Plate meter (#400). The rate of disappearance of material (mass and height) over a period of 21 days was taken as an indication of the acceptability of the material. Grazing stopped on the 25 August 2011. The project is not finalised and the results shown in Figure 1 and Table 1 are thus preliminary trends with no statistical analysis.

The decline in height of the different pearl millet cultivars is shown in Figure 1. The highest rate of disappearance was observed with Nutrifeed and Babala while that of Hypearl Millet and Agrigreen was lower. The highest DM production was for Nutrifeed, followed by Hypearl Millet and Babala, and the lowest was for Agrigreen. The interaction between initial production and rate of disappearance still needs to be investigated.

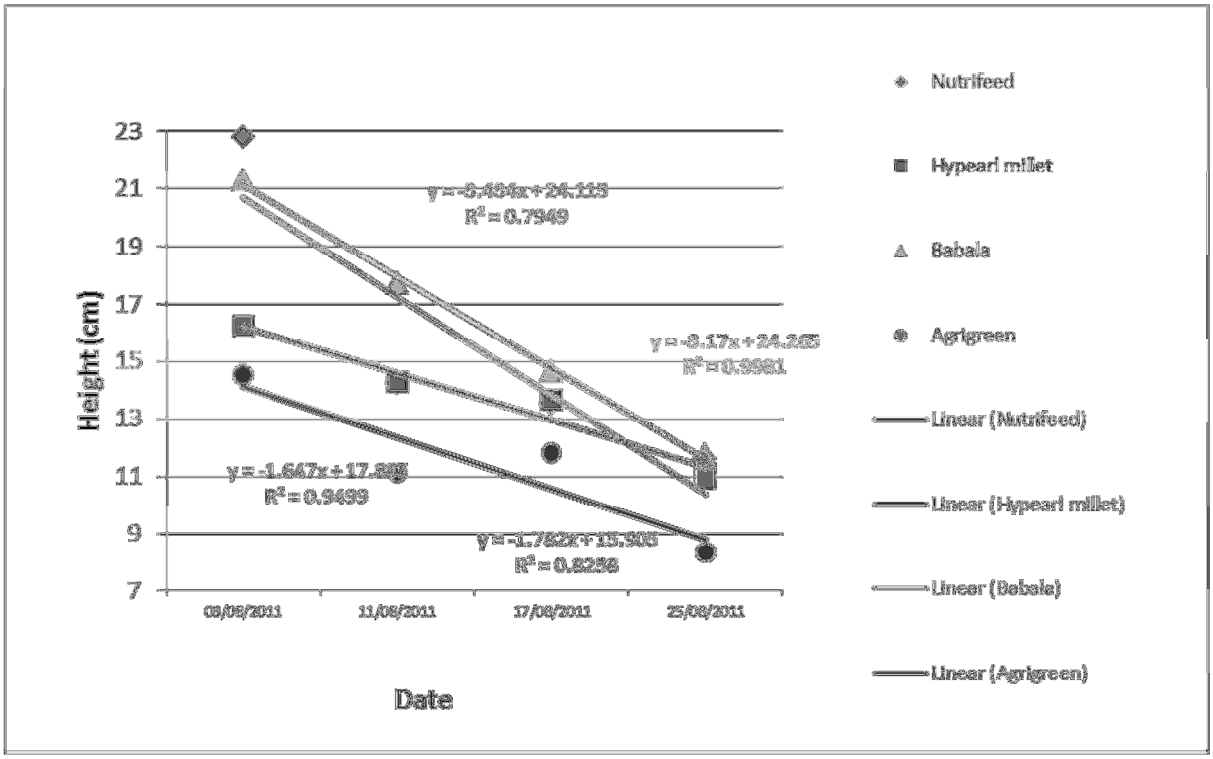

Figure 1: Rate of disappearance of pearl millet cultivars represented by decrease in height over 21 days.

Table 1: Dry matter (DM) production (kg.m^{-2}) before and after grazing

Cultivar	DM production (kg.m^{-2}) before grazing	DM production (kg.m^{-2}) after grazing
Nutrifeed	0.65	0.31
Hypearl Millet	0.55	0.30
Babala	0.58	0.26
Agrigreen	0.49	0.30

PLATFORM PRESENTATION: THE EFFECT OF SEED COATING ON THE GERMINATION AND EMERGENCE OF LUCERNE (*MEDICAGO SATIVA L.*) IN SUB-OPTIMAL ENVIRONMENTS

Leana Nel[1], Wayne F Truter[1#] and Lucas Swart[2]*

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Environmental issues have become critical for most industries. Food safety and security are inseparably intertwined with environmental issues. Bad agricultural practices contribute to soil degradation, such as salinization, crusting and compaction, but are often performed by inexperienced producers to maintain crop productivity. These conditions increase the risk that pasture establishment in these sub-optimal growing conditions will be unsuccessful, and it is therefore essential to identify ways to reclaim these affected sites. Seed coating technology is evolving into an important and very useful tool in aiding establishment and the application of remedial substances like micro-organisms.

The aim of the study was to determine if seed coating technology can be used to improve germination and survival of lucerne (*Medicago sativa*) in saline conditions. Germination and emergence trials were conducted to evaluate the efficacy of seed coatings used on two lucerne cultivars (SA Standard and Cuf 101) grown in sub-optimal (saline) environments. Using a NaCl concentration gradient (distilled water and 250, 500, 750 µS.cm^{-1}), the coated and non-coated lucerne seed were germinated using a Jacobson/Copenhagen apparatus. A follow-up trial was conducted in different growth mediums (silica and sandy loam) and was irrigated with the same NaCl water concentration as was used in the germination trial. There was a significant difference in the response of the two cultivars to the environment and the seed coatings. Germination of coated seed at higher electrical conductivity (500 µS.cm^{-1}) showed a significantly higher germination percentage than the other treatments. Although there was an observed delay in germination of the coated seed, the environmental conditions played a significant role in the delay, as coated seed regularly showed higher germination percentages at day 4 for SA Standard.

Emergence data (up to 15 days after planting) showed that in most conditions (growth mediums and salt concentrations) there were no significant differences between coated and non-coated seed. At 500 µS.cm^{-1} there was however a trend of higher emergence for coated SA Standard seed in a sandy loam growth medium. This trend was to some extent weakened in a silica growth medium. Even though an exact answer to why this reaction was weakened is not known, it is theorized that the reaction interface of silica is not as effective as that of agricultural soil containing a clay fraction. It can therefore be concluded that the data obtained to date, indicate that coated seed can be successfully used in saline conditions and that seed coating technology has the potential to become an integral part of successful and sustainable pasture establishment, especially in sub-optimal growing conditions.

POSTER PRESENTATION: FEASIBILITY STUDY ON ESTABLISHMENT METHODS OF *LESPEDEZA CUNEATA* (SERECIA) IN THE HIGHVELD OF MPUMALANGA PROVINCE

Thabile J Mokgakane, Modau N Magoro, Oupa Keromecwe, M Collen Rabothata and Jan Theron*

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Rejuvenating existing *Eragrostis curvula* (weeping lovegrass) pasture in the Highveld with legume pasture species is a common method of encouraging nitrogen supplemention of grass pasture species. The main objective of the study was to evaluate the best establishment method of *Lespedeza cunueta* (Serecia) on existing *E. curvula* pastures. Five 10x10 m plots were laid out on the existing *E. curvula* pasture, with an additional plot added to act as a control. Each plot was divided in half and allocated planting densities of 10 kg ha^{-1} and 20 $kg.ha^{-1}$. This gave a total of ten 5 x10 m plots.

Four over-sowing methods served as treatments, i.e:

- *L. cunueta* was established on a well prepared, weed-free seedbed.
- Existing *E curvula* pasture was shallow tilled and *L. cunueta* seeds were broadcast, rolled and trampled by cattle.
- Untilled *E. curvula* pasture was broadcast with *L. cunueta* seeds and trampled by cattle.
- *E. curvula* pasture was treated with a glyphosate based herbicide (2%) to reduce the cover, and was then shallow tilled, *L. cunueta* seeds were broadcast and then rolled.
- *E. curvula* pasture was broadcast with *L. cunueta* seed as a control.

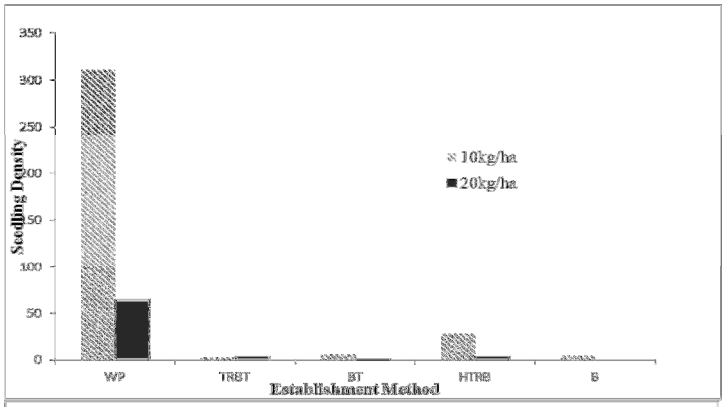

Figure 1: *Lespedeza cuneata* seedling count per plot (WP=well prepared; TRBT=tilled, rolled, broadcast and trampled; BT=broadcast and tilled; HTRB=herbicides, tilled, rolled and broadcast; B=broadcast)

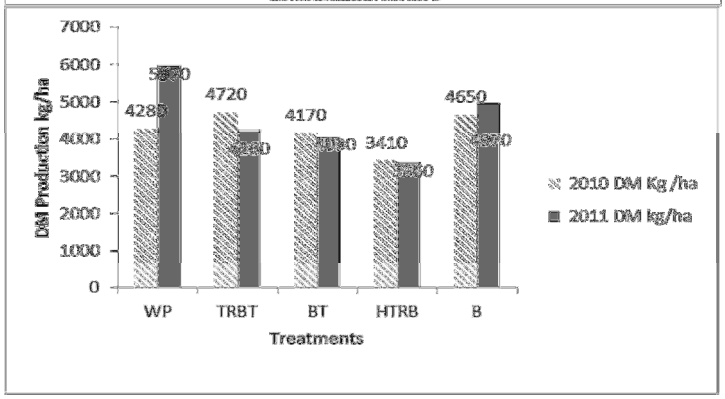

Figure 2: Dry matter (DM) production 2010-2011 growing season

The study was conducted at Nooitgedacht Agricultural Development Centre during the 2007 - 2011 growing season, and the emergence data were collected during the 2010-2011 growing season. *L. cunueta* seedlings were counted within each treatment. Emergance results are reflected in figure 1. Results showed that a well prepared seedbed was the best method of *L. cunueta* establishment followed by herbicide treatment; broadcast and trampling, till, roll broadcast and

trampling, respectively. Dry matter (DM) production (Figure 2) showed the highest production of 5 970 kg.ha^{-1} with the WP treatment and the HTRB treatment was the lowest at 3 410 kg.ha^{-1}. The study indicates that well prepared seedbed with recommended sowing density results with better establishment method for *Lespedeza cuneata.*

POSTER PRESENTATION: WHAT'S ON THE MENU? RYEGRASS (*LOLIUM MULTIFLORUM* VAR. *WESTERWOLDICUM*) AND SUPPLEMENTATION

Yvette Brits[1] and Johan Mouton[2]*

[1]North West Department of Agriculture and Rural Development, Technology, Development and Transfer: Pasture Science, Potchefstroom, South Africa, email: ybrits@nwpg.gov.za, [2]Molatek (Animal Feeds), Malalane, South Africa, email: mouton@tsb.co.za

The utilization of irrigated pasture to finish off weaners is a practice explored especially during times of high maize prices. Limited data is available for the production potential of beef weaner calves that are finished off on irrigated annual winter crops with molasses based supplementation on the high veldt of South Africa with an economical analysis. The aim of this study was to evaluate the effects of different supplementation, namely phosphate, protein and energy (all molasses based), on the economical production of weaner calves grazing irrigated annual *Lolium multiflorum* var. *westerwoldicum* and to develop strategies for best management practices for such a system. Key objectives were to determine the economic viability of finishing off calves on annual grazing and the advantages, if any, of using the supplementation in conjunction with winter grazing.

Thus Molatek, in association with Technology, Development and Transfer, Potchefstroom, undertook a pilot study using Afrikaner/Simmentaler/Bonsmara cross weaner calves on the above mentioned pastures. Animals were randomly allocated to one of three supplementation strategies, i.e. energy, protein energy combination or phosphate only. Supplementation was available *ad – lib*. Weight records were kept on the animals on a monthly basis, with beginning and end mass on empty stomach. Once the trial was completed (191 days), they were slaughtered and carcasses graded. Lick intake were monitored on a daily basis. Representative pasture production (dry matter) was carried out before camp rotation and pasture samples were also analysed for protein content at specific rotations.

Due to an abnormal wet autumn which delayed pasture establishment together with severe cold winter hay had to be supplemented during July due to a dry matter shortage from the pasture. Supplementation for the three different groups continued and grazing capacities were adjusted accordingly.

The 1000 kg live mass per hectare produced was less than the norm of 1200 kg, and this was probably a result of a severe winter, combined with delayed establishment. Soil type is an Oak leaf with clay content of 21%. However, considering the circumstances, the production number is still satisfying.

This study found that it was economically viable to finish off weaner calves on irrigated ryegrass pastures and supplementation. The energy supplement showed to have a better animal production as well as economical advantage, and resulted in better growth, especially in the adjustment phase.

The protein supplement did, however, result in increased animal production, but not necessarily to economical performance, in comparison with the energy supplement, due to the cost of protein.

In conclusion, energy supplementation coming from molasses with a carrying capacity of 8–9 weaners calves with starting mass of 220 kg gave the best overall economical results although the difference between energy and energy/protein combination was small. Animals which only received phosphorus supplementation also finished off but on lower carcass weights. Out of this trail it seems energy supplementation with protein content of 10% seems to be the ideal for the fattening of cattle on irrigated pastures.

POSTER PRESENTATION: OVERWINTERING OF DRAKENSBERGERS STEERS ON VELD OR SUPPLEMENTED KIKUYU PASTURES IN THE HIGHVELD OF MPUMALANGA PROVINCE

Modau N Magoro, Thabile J Mokgakane, Oupa Keromecwe, M Collen Rabothata and Jan Theron*

Mpumalanga Department of Agriculture, Rural Development and Land Administration, Sub-Directorate: Veld, Pasture Management and Nutrition, Nooitgedacht Agricultural Development Centre, Ermelo, South Africa, email: magoro@mpg.gov.za, mokgakanetj@gmail.com, ontiretsek@webmail.co.za, mcrabothata@mpg.gov.za, theronjan1@gmail.com

Overwintering is a challenge for beef production in the Highveld region of South Africa. Farmers are normally caught with insufficient fodder storage during the dry season. Increasing human settlement, mining, afforestation and cultivation takes up a notable proportion of grazing lands, which results in a shortage of grazing for livestock. As result, livestock have to graze on marginal land. The objective of the study was to evaluate the effect of overwintering livestock on veld or kikuyu (*Pennisetum clandestinum*) supplemented with *Eragrostis curvula* hay. The aim of this study was to compare the over-wintering of steers grazing veld or kikuyu pasture supplemented with *E. curvula* hay.

The study was conducted during the 2007/2008 growing season on 6 ha of veld and 21 ha of kikuyu pastures at Nooitgedacht Agricultural Development Centre. The veld area was divided into 24 paddocks of approximately 0.25 ha and grazed rotationally for the entire growing season by four Drakensberger steers. The kikuyu pasture was subdivided into equally sized paddocks that were grazed rotationally during summer to a post-grazing height of 50 mm above ground level by four Drakensberger steers. During winter animals grazing kikuyu received supplementary *E. curvula* hay. All trial animals received a winter and summer lick in addition to grazing. Animals body mass were measured at two weeks interval from inception day in September 2007 to August 2008.

The mean initial body mass of the steers grazing veld and kikuyu were 211 kg and 208 kg, respectively. Steers grazing kikuyu and supplemented with *E. curvula* hay maintained body mass during winter and achieved a mean final body mass of 426 kg. Animals grazing veld showed a decrease in body mass from summer (319 kg) to winter (275 kg). The study results indicate ($P<0.05$) that an over-wintering system based on supplementing kikuyu pastures with *E. curvula* hay, results in higher body mass of steers at the end of the winter season than a system based on veld.

Sustainable Planted Pasture Systems

SESSION CHAIR: PHILIP R BOTHA

Thursday 19 July, 10:30 – 12:30

Keynote Address, Platform Presentations and Discussion

Pasture production, efficiency of pasture utilized by animals, stocking rate and milk production per cow are key drivers determining profitability of milk production from pasture systems. Research on dairy pasture systems and evaluation of all stages ranging from cultivar yield trials, establishment methods, animal performance and economics is crucial to ensure sustainability of pasture systems. This special session will focus on sustainability of dairy pasture systems with emphasis on profitability and future challenges in the dairy industry in South Africa.

INVITED KEYNOTE ADDRESS: FUTURE CHALLENGES FOR THE DAIRY INDUSTRY

Nelius van Greunen

Van Greunen Boerdery, George, South Africa, email: nelius@vangreunenbdy.co.za

A brief overview of the market and production trends of the South African and International Dairy Industry will be given. Particular reference will be made to the demographic trends in production, the underlying drivers thereof and the challenges associated with such trends. The different feeding regimes of dairy cows will be highlighted, with special reference to the pasture-based production system and the research opportunities that exist.

Nelius van Greunen is the Managing Director of Van Greunen Boerdery, a family owned farming venture located in George, in the Western Cape Province of South Africa. He was born and raised on his parents' farm in George, studied for a BComm at the University of Stellenbosch and started farming with his family in 1983. He was appointed as Managing Director with the establishment of Van Greunen Boerdery in 1988, a legal entity in which the farming business was developed. He was responsible for the development of the farming business, as a market orientated venture, consisting of agri production units with a sustainable competitive edge. Van Greunen Boerdery was nominated as the farmer of the year on two separate occasions over the past 20 years by the Agriculture Writers Association. The enterprise includes blueberry farms, a potato production unit and four dairy farms. He pioneered the focus on biological farming methods within Van Greunen Boerdery, based on a proper understanding of the natural resources and a drive to achieve optimal production sustainably. The dairy farms are all pasture-based and the pasture system comprises the backbone of the Van Greunen farming system. He has served as a producer member in all structures of the dairy industry over the past 20 years, as well as in the positions of director and chair. He was instrumental in leading initiatives transforming industry structures to become functional in a deregulated economic environment. He has a holistic insight in the dairy industry, the farming sector and the business environment.

PLATFORM PRESENTATION: KIKUYU BASED PASTURE SYSTEMS FOR SUSTAINABLE MILK PRODUCTION

Janke van der Colf and Philip R Botha*

Western Cape Department of Agriculture, Outeniqua Research Farm, George, South Africa, email: jankevdc@elsenburg.com, philipb@elsenburg.com

Two system trials aimed at determining the pasture and animal production potential of kikuyu over-sown with temperate grass and clover species were conducted on the Outeniqua Research Farm near George in the Western Cape. In study one kikuyu was over-sown with white and red clover or annual ryegrass, and in study two with Italian, Westerwolds or perennial ryegrass. These studies were carried out on the same site and according to the same methods. These data present an important overview of no-till systems based on kikuyu in the area and can assist in identifying future research needs.

In study one the total annual dry matter (DM) production of over-sown kikuyu was found to be higher than that of pure kikuyu, but the annual DM production of kikuyu-clover was lower than for kikuyu-ryegrass. The ease of management favoured the kikuyu-ryegrass system, while the lowered fertilisation costs on the kikuyu-clover system was its main advantage. The seasonal distribution of pasture production was found to differ between the systems based on the different species. Summer was the highest producing season in all kikuyu based systems, while temperate species were found to increase the winter and spring DM production compared to pure kikuyu pastures. Both studies indicated that the DM production of the temperate species during spring lowered the DM production of kikuyu during summer, primarily due to the over-shadowing effect on kikuyu recovery. In all systems the metabolisable energy and protein content decreased, while the neutral detergent fibre content increased from winter to summer as the kikuyu component increased.

All the over-sown pastures achieved a higher annual milk production than pure kikuyu pastures, with similar annual milk production obtained per ha from the kikuyu-ryegrass and kikuyu-clover pastures. Study one showed that the grazing capacity of a kikuyu-clover system was lower than the kikuyu-ryegrass system, but milk production per animal was higher. This was primarily attributed to the improved forage quality associated with the clover, compared with grass-only systems. Study two showed that within a kikuyu-ryegrass system, grazing capacity was the main driver of milk production per ha, rather than milk production per cow. The total annual DM production, mean annual grazing capacity, milk production per ha and fat corrected milk production per ha during study one and study two are shown in Table 1.

All the systems were highly productive in terms of animal and pasture production. The best species to over-sow into kikuyu will be determined by the unique conditions on different farms and the prevalent economic conditions.

Table 1: The total annual DM production (kg DM.ha^{-1}.annum^{-1}), mean annual grazing capacity (cows.ha^{-1}), daily fat corrected milk production (kg FCM.cow^{-1}.day^{-1}) and total annual fat corrected milk production per hectare (kg FCM.ha^{-1}) of kikuyu and kikuyu over-sown with Westerwolds ryegrass (Kik-West), clover (Kik-clov), Italian ryegrass (Kik-Ital) or perennial ryegrass (Kik-per).

Study 1	Total annual DM production (kg DM.ha^{-1}.annum^{-1})	Mean annual grazing capacity (cows.ha^{-1})	Daily fat corrected milk production (kg FCM.cow^{-1}.day^{-1})	Total annual fat corrected milk production per hectare (kg FCM.ha^{-1})
Kikuyu	13786	6.72	15.3	23811
Kik-West	16966	7.94	17.0	32627
Kik-clov year 1	13303	5.53	17.8	32932
Kik-clov year 2	14570	5.57	17.5	24103
Study 2				
Kik-West	16461	6.01	18.5	32055
Kik-Ital	16123	5.89	18.5	32322
Kik-per	17143	6.45	17.3	34177

PLATFORM PRESENTATION: PROFITABILITY OF MILK PRODUCTION FROM KIKUYU/RYEGRASS PASTURE

Robin Meeske

Western Cape Department of Agriculture, Institute for Animal Production, Outeniqua Experimental Farm, George, South Africa, email: robinm@elsenburg.com

The profitability of kikuyu pasture systems over-sown with ryegrass has been under severe pressure due to increased input costs and low milk prices. During March and April milk prices increased substantially to above R3.60 per litre of milk, bringing some relief. However, dairy farmers need to optimize efficiency of milk production from pasture systems.

Recent research has shown that annual pasture production and intake of 16 to 18 t DM.ha^{-1} is possible from kikuyu over-sown with ryegrass under permanent irrigation. If cows are supplemented with 4 kg of concentrate and take in 10 kg DM pasture per day, the average stocking rate should be 4.4 to 4.9 cows.ha^{-1}. The pasture growth varies during the year and is at its lowest during winter months of June and July at only 20 to 25 kg DM.ha^{-1}.day^{-1} resulting in roughage shortages. If insufficient roughage has been stored (grass silage or maize silage produced on farm) to overcome shortages, lucerne has to be bought in at double the cost of pasture. To reduce risk and optimize profit, the number of cows on the farm should be in balance with the roughage production on the farm. Farmers should target 85% pasture utilization. The limited availability of water for irrigation and increasing electricity costs necessitate efficient irrigation.

The cost of intensively rearing a replacement heifer to point of calving at 24 months of age varies between R6 500 and R7 000. The return on a cull cow when slaughtered is R3 500. The difference between the cost of a replacement heifer and the return on a cull cow (R3 000-R3 500) has to be divided by the number of lactations that a cow has completed and then be subtracted from her profit per lactation. The margin over specified cost per cow in the herd may be R3 600 to R5 000 per lactation. Cows that are culled after 1 or 2 lactations are therefore very detrimental to the profitability of dairy farms. Optimal management, breeding and genetics can contribute to improve the longevity of cows in the herd. Cows should complete at least 6 lactations in the herd.

Pasture quality of kikuyu/ryegrass is at its lowest during autumn (Feb-April) with NDF levels of 60% or higher. This results in lower pasture intake and reduced milk production. Increasing the perennial ryegrass component of the pasture and incorporating legumes into the system improves pasture quality and milk production.

The cost of concentrates fed to cows is 3 times higher than that of pasture. The response on concentrate feeding should therefore be monitored. Profitability will not improve when less than one kg of milk is produced per kg of concentrate fed (when milk price.kg^{-1}=concentrate cost.kg^{-1}). Research has shown than Jersey cows produced 13.5 kg of milk over the entire lactation when grazing kikuyu, ryegrass, clover and lucerne pasture when no concentrate was supplemented. Milk production should increase by one kg for each kg of concentrate fed. Herds that supplement 5 kg of concentrate.cow^{-1}.day^{-1}should produce 18.5 kg of milk.cow^{-1}.day^{-1} (270 g concentrate.kg^{-1} milk) if pasture quality is high. When concentrate is fed at higher levels (350 g concentrate.kg^{-1} milk) less milk is produced from pasture resulting in an increased production cost of milk. At low milk prices and high concentrate costs, feeding less concentrate may be more profitable.

Stocking rate (cows.ha^{-1}) and milk production per cow are key drivers determining profitability of milk production from pasture systems. The level of concentrate feeding and the milk response on concentrate supplementation have a major impact on profitability. High genetic merit cows will respond better to higher levels of concentrate feeding than low genetic merit cows. Producing high yields of pasture with a high digestibility at a low cost is fundamental to profitable milk production from pasture systems.

PLATFORM PRESENTATION: SUSTAINABILITY OF PLANTED PASTURES IN A NO-TILL SYSTEM

Pieter A Swanepoel and Philip R Botha*

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Sustainability implies food security without damage to the environment and economically viable production, and as such should be the main objective of innovation in current farming systems. There is concern amongst agriculturalists about the sustainability of planted pasture systems. No-till pasture systems form the base of milk production in the southern Cape region of South Africa. Pasture productivity is generally the primary management goal. Kikuyu-ryegrass no-till systems are highly productive and have the potential to produce 19 t DM.ha^{-1} per annum. However, productivity should not be seen as the sole management goal of pasture systems, since it may contribute to soil degradation and thus would not support sustainability. Additional challenges, such as climate change, reduced availability of water and elevated input costs, place even more strain on farmers and renders sustainability of pasture systems vulnerable. Current research is focused to a large extent on fertilization, species choice, stocking rate and enhancing productivity of pastures, especially by incorporation of legumes. Research that focuses on the interaction of plants with soil and the management of soil quality as the foundation of plant production within agro-ecosystems is lacking.

Recent research on Outeniqua Research Farm has shown that soil quality is a fundamentally important factor affecting pasture productivity. Extensive research has been performed on chemical and physical components of soil, and to a lesser extent on the biological component. However, the interaction between the three components of soil quality needs to receive attention and should be related to plant productivity in the long run.

Proactive research on the assessment of soil quality is needed to identify problem production areas. Important subjects among researchable topics deemed necessary for sustainable pasture production in the southern Cape will be discussed with special reference to making realistic estimates of pasture productivity, monitoring changes in environmental quality due to the agricultural management, and assisting government departments in formulating research strategies for sustainable dairy production from pastures. Devising practical measures of soil quality in order to extend scientific findings to small and commercial farmers should be an important phase of the research.

Soil Quality for Sustainable Pasture Production

SESSION CHAIR: JIM P MUIR

Thursday 19 July 2012, 13:30 – 15:00, 15:30 – 16:15

Keynote Address, Platform Presentations and Discussion

Farmers, agricultural researchers and conservationists realize the importance of managing soil as a non-renewable, natural resource that needs to be conserved and maintained to ensure ecological and economical sustainability.

Soil quality is of utmost importance for the future focus on conservation agriculture, conservation of our natural resources and acceptability of agricultural products on international markets, and it is imperative that soil conservation be achieved while the system remains profitable. These factors have increased the interest of farmers in assessing the quality of their soils and in implementing sustainable soil management practices. The session is dedicated to introducing novel research and future research trends in the field of soil quality (soil health) for sustainable pasture production systems.

INVITED KEYNOTE ADDRESS: PEERING BENEATH CARBON OFFSETS AND SOIL SURFACES

Anthony J Mills

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There is a lot of vocal opposition to carbon offsets in the news. One of the frequently cited complaints is that carbon offsets give society an excuse to continue emitting carbon dioxide from fossil fuels. In this presentation I discuss how carbon markets can potentially be a powerful force promoting conservation and enhancing agricultural productivity in a wide variety of landscapes across the Earth. However, there are many potentially pitfalls that need to be navigated before realizing such benefits. These pitfalls are also presented.

Dr Anthony Mills is an ecologist and soil scientist. His academic background includes a BSc Zoology (University of Cape Town), MSc Environmental Geochemistry (University of Cape Town), MPhil Environment and Development (University of Cambridge) and a PhD in Soil Science (Stellenbosch University). Anthony consults on adaptation and mitigation and undertakes ecological research with a soil science focus. His consulting focuses on innovative, evidence-based solutions for adapting to climate change, conserving and restoring ecosystems, mitigating climate change through carbon sequestration, and capacity building in developing countries. He also conducts primary research on soil-plant relationships and ecosystem functioning through the Department of Soil Science at Stellenbosch University and is the primary author on 24 peer-reviewed scientific papers. Anthony's work within his company C4 EcoSolutions includes: i) design and implementation of adaptation projects for a range of clients (predominantly, the IFC, UNDP and UNEP) in more than twenty countries across Asia and Africa, and ii) the development of CDM/Verified Carbon Standard and REDD+ afforestation/reforestation projects in Africa. He has also established AfriCarbon (Pty) Ltd, a company which facilitates ecosystem-based adaptation investments, specifically the restoration of degraded landscapes in the Eastern Cape, South Africa, through the international carbon market.

INVITED PLATFORM PRESENTATION: THE ESSENCE OF MESOFAUNAL DIVERSITY IN SOILS

Schalk v d M Louw

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In soil systems, like any other ecosystems, biological diversity determines the initiation and maintenance of ecological processes, which in turn defines functional diversity, with the latter pivotal to ecosystem analysis scenarios. This statement is further supported with the recent proposal that the structure and function of ecosystems should actually be understood according to theories of emergence, self-organization, networks and non-linear dynamics. Albeit that an overall improvement in soil knowledge is starting to develop in the broader agricultural, horticultural, forestry and natural landscape context, there still exists a certain degree of ignorance regarding soil system complexity. In numerous published cases, where indicators of soil quality are determined, only technical soil parameters are used and biotic components are completely ignored. It is here argued that the disentanglement of the micro-, meso- and macrofaunal species assemblages of any soil should be instrumental in determining the ecological integrity and health of the soil. To stress the point, the ecological function of the mesofauna of soils, which are mostly comprised of arthropods and which fall more or less in the middle of the size range (100 μm–2 mm) of soil organisms will be discussed. A soil system as such consists of three levels, i.e. above ground surface where organisms move freely in "open" conditions, a below ground level where organisms are more restricted in movement and sensory cues under 'closed' conditions, and an interface level between the two. Through multiple facilitation, tolerance and inhibition interactions in and amongst these levels of the soil community, soil mesofauna contribute significantly to the larger soil system infrastructure. These contributions are deliberated on with reference to ecotoxicology, soil nutrition, litter decomposition, niche occupation, trophic webs, interaction strength, system stability, ecological succession and complexity management.

Schalk Louw was born and completed his schooling in Windhoek in the erstwhile South West Africa (Namibia). All his degrees from BSc through to DSc were obtained from the University of Pretoria, with his post-graduate studies focussing on the ecology and systematics of terrestrial Coleoptera (beetles) of the Afrotropical Region. His first appointment was in 1976 as Curator of Invertebrates at the State Museum in Windhoek, followed by him accepting the position of Head of the Department of Entomology at the National Museum in Bloemfontein in 1981. In 1991 he was appointed Senior Lecturer in the Department of Zoology and Entomology at the University of the Free State (UFS). His written scientific contributions encompass 83 publications in accredited journals, 50 semi-popular articles, 35 scientific reports, 4 chapters in books and two books as editor, whilst his international and national scientific presentations consist of 125 congress papers and posters, 35 semi-popular and scientific local guest lectures and 15 international scientific guest lectures. He has also organized 2 international and 4 national congresses. In terms of post-graduate student training he has delivered 24 MSc and 5 PhD students and of these two MSc students were recipients of the Junior Captain Scott Medal of the South African Academy for Science and Art for the best dissertation in zoological and botanical sciences in South Africa. He has acted as external examiner for 16 Masters and PhD students from tertiary institutions both locally and abroad and he serves on the external moderator panels of numerous South African universities. He has also served as vice-president of the Entomological Society of Southern Africa (2003–2005) and deputy chairperson of the Management Committee of International Congresses of Entomology (2004–2008). He was co-founder of the Southern African New Crop Research Association, the Centre for Plant Health Management and the Cactus Pear Working Group, the latter two both a the UFS. Schalk Louw's research addresses the ecological function and integrity of natural and agricultural landscapes and soils, with emphasis on above ground – below ground multirophic interactions of the meso- and macrofauna of cropping systems. His current position is that of Section Head and Professor of Entomology in the Department of Zoology and Entomology at the UFS.

INVITED PLATFORM PRESENTATION: THE MICROBIAL ECOLOGY OF PASTURE SOILS

Wijnand J Swart

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Regardless of how they are viewed, all terrestrial ecosystems involve complex food webs which begin underground with a large variety of microorganisms. These food webs have profound direct or indirect influences on biotic and abiotic interactions above and below the ground. Microorganisms, especially fungi and bacteria, are responsible for the biogeochemical cycling of most elements essential to soil health in agro-ecosystems such as pastures. They both cause and control plant disease, mycorrhizal and rhizobial symbiosis with plants, decomposition of animal, plant, and chemical waste, and soil structural formation and stability. The resilience of a pasture to withstand biotic and abiotic stress and produce maximal yields is directly related to the level of microbial diversity above and below ground, species composition and the distribution of all biotic entities in time and space. Pasture-based production systems are inherently complex and subject to a wide range of management practices including grazing, cropping and chemical treatments that may affect micro-organisms either positively or negatively. If microbial species and their ecosystem services are lost, they might only be recoverable with strong interventions, at considerable effort and expense. The microbiological processes within pasture-based agro-ecosystems are, however, poorly understood and knowledge gains in the past were hampered by technological limitations. Most research in the past was based at organism level or focused on single processes. Soil microbes are very sensitive to environmental changes and the use of bio-indicators is therefore an innovative approach for assessing the qualitative and quantitative effect of anthropogenic influences such as fertilization, tillage, irrigation, pesticide application, etc. on the dynamics of a particular agro-ecosystem. Bio-indicator-based studies also have the potential to make a major contribution to optimising different farming systems and their input practices as well as understanding and manipulating the overall stability and sustainability of these agro-ecosystems. As such, there is potential to manage soil biology and processes for both production and environmental gains. Recent benefits gained from a better understanding of soil biology have already been of immense benefit to the pasture industry.

Wijnand J. Swart was born and schooled in Johannesburg where-after he studied at the University of Stellenbosch obtaining a B.Sc. degree in Forestry/Nature Conservation in 1980 and a M.Sc. Agric. (cum laude) degree in Plant Pathology in 1986. In 1988, he was appointed lecturer in the Department of Plant Pathology at the University of the Free State where he obtained his Ph.D. degree in 1991. He has authored or co-authored more than 98 scientific publications in accredited scientific journals and presented more than 160 papers at national and international congresses. He has supervised or co-supervised 20 M.Sc., 10 Ph.D. candidates and hosted 4 post-doctoral students in his lab. He has acted as referee for scientific articles in numerous international scientific journals and also as external examiner for master's and doctoral students from numerous South African and international universities. During 1996, he spent a 9-month sabbatical at the Department of Plant Pathology, University of Wisconsin, USA and in 2001 a 5-month sabbatical at the Kearney Agricultural Center, University of California. He is a member of various national and international scientific societies, among which is the American Phytopathological Society and the Southern African Society for Plant Pathology where he was vice-President from 2003-2006. Wijnand co-founded the Southern African New Crop Research Association (SANCRA) and served as its president from 1998-2001. In 2005, he also co-founded the Centre for Plant Health Management (CePHMa) at the UFS. The main aim of his research programme is to adopt a "systems approach" to the cultivation of crops in semi-arid regions by utilizing the taxonomic and functional diversity of microorganisms, above- and below ground, as bio-indicators of soil and plant health. He is currently Professor of Plant Pathology in the Department of Plant Sciences at the UFS and Director of the UFS Strategic Academic Cluster: Technologies for Sustainable Crop Industries in Semi-arid Regions.

INVITED PLATFORM PRESENTATION: NEMATODES AS BIO-INDICATORS OF SOIL HEALTH WITH SPECIAL REFERENCE TO PASTURES

Sheila G Storey[1] and Caro Kapp[1, 2]*

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Soil is a fundamental, non-renewable resource in all agricultural ecosystems, and the need for sustainable food production makes it imperative to develop ways in which to measure and sustain soil health. Soil health is a complex interaction between chemical, physical and biological factors. The latter has always been difficult to measure.

Since nematodes can be more readily identified (due to the lower overall genus diversity) than microbes, the use of nematodes as biological soil health indicators is a feasible approach for a detailed analysis of a specific group of life in the soil, Nematodes can be classified based on their feeding habits into several functional groups, including entomopathogens, bacteriovores, fungivores, predators, omnivores and herbivores (plant-parasites), and this information is used to calculate various indices (Maturity Index (MI), Enrichment Index (EI), Structural Index (SI), Basal Index (BI), Channel Index (CI) and plant-parasitic index). These indices describe the functionality of the soil ecosystem in general by using nematodes as indicators of processes that describe nutrient enrichment or stress.

Nematode community structures within natural soil environments must be established before their community structures can be used as a tool for the biological measurement of soil health on land altered for agricultural production. Soil samples from 48 different fynbos localities were analyzed. The abundance of nematodes at each site was determined and the community structure up to family level identified. These results were then used to evaluate nematode food webs for trophic group distribution and enumerated by the indices based on the weighted abundance of colonizer-persister guilds. Results indicated fynbos soils to have a high level of enrichment and a moderate level of diversity.

These results will be used as a baseline to compare the structure and function of soil nematode communities within various cultivation and management treatments in a pasture-based dairy production system.

Sheila Storey is the owner of Nemlab, a nematode diagnostic laboratory. She obtained her BSc (Agric) in 1981 majoring in Entomology and Plant Pathology. She then obtained a MSc (Agric) in Nematology. After a sojourn as researcher in Potchefstroom and Elsenburg as well as lecturing at UWC she established Nemlab in 1987. The past twenty odd years have resulted in an in-depth knowledge of nematode diagnostics, problems relating to nematodes and an holistic approach to recommendations made to producers. Sheila registered with the South African Council for Natural Scientific Professions in 1987 and has been a member of the Nematological Society of Southern Africa since 1981. With 85% of the lab's samples coming from the deciduous fruit industry, Sheila has gained a fair insight into the problems nematodes cause in the fruit industry. In the last few years her interest has turned to soil health with particular reference to the role beneficial nematodes play in soil health. Nemlab is a dynamic firm which is committed to excellence. This excellence is sought, in the service offered to clients, through updated knowledge and the latest laboratory extraction procedures.

PLATFORM PRESENTATION: ESTABLISHING BASELINE VALUES FOR SOIL QUALITY INDICATORS IN THE SOUTHERN CAPE

Pieter A Swanepoel[1], Philip R Botha[1], C C du Preez[2] and Hennie A Snyman[3]*

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Commercial dairy farming on pasture is commonly practised in the southern Cape region of South Africa. In terms of its sustainability, quantification of the impact of dairy-pasture management on soil quality is essential. Soil quality integrates the biological, chemical and physical components of soil and their interactions. To comprehend the behaviour of soils in terms

of quality, indicators should be assessed to screen the general direction of change in soil quality (enhancing, maintaining or degrading) within a management system. Development of a soil quality assessment framework necessitates establishment of baseline values for soil quality indicators. Baseline values were developed from data measured on Outeniqua Research Farm near George. Sandy loam podzolic soils were assessed at 0–100 mm, 100–200 mm and 200–300 mm depth intervals. Results from 53 physical, chemical and biological indicators on a permanent no-till kikuyu-ryegrass pasture system were compared to those of a conserved, virgin soil in close proximity. Stratification ratios, which demonstrated the rate at which the indicator decreased with depth, were assessed for soil organic matter (SOM) related indicators. A significance level of $P \leq 0.01$ was established *a priori*.

Biological indicators

All SOM related indicators (loss-on-ignition, organic C, active C and microbial biomass C) behaved similarly, i.e. higher values were recorded in the surface layers of the planted pasture soil than the virgin soil ($P \leq 0.01$). The differences decreased with depth, and values were similar ($P > 0.01$) in the 200–300 mm soil layer. Stratification ratios for these indicators were higher ($P \leq 0.001$) in the planted pasture soil than in the virgin soil. Soil enzyme activity (β-Glycosidase, urease, phosphatase, dehydrogenase) was higher ($P \leq 0.001$) in the planted pasture soil than the virgin soil.

Biological indicators show a well-established and well-functioning microbial population in the planted pasture soil. Stratification ratios demonstrate that the soil quality of the planted pasture system was improved by no-till management.

Chemical indicators

Fertility levels (pH, total N, extractable P, exchangeable Ca, Mg, K and Na, extractable Cu, Mn and Zn, and cation exchange capacity (CEC)) of the planted pasture soil were higher ($P \leq 0.001$) than the virgin soil with the exception of B and S which were similar ($P > 0.01$). This was expected since the virgin soil was not fertilized, while the fertility status of the planted pasture soil was maintained with fertilization at the required nutrient levels for a kikuyu-ryegrass pasture. Potentially mineralizable nitrogen was higher in the planted pasture soil than in the virgin soil ($P \leq 0.01$).

Chemical indicators show that the impact of nutrient management was favourable for pasture productivity. A principal component analysis (PCA) showed that the chemical and biological components were more closely associated in the managed pasture than in virgin soil.

Physical indicators

Bulk density did not differ between sites in the 0–100 mm ($P = 0.907$) and 100–200 mm layers ($P = 0.043$), but was higher ($P = 0.002$) in the 200–300 mm layer of the planted pasture soil than the virgin soil. Clay content, water holding capacity and infiltration rate did not differ between sites ($P > 0.01$). Water stable aggregate percentage was lower ($P \leq 0.001$) in planted pasture soil than in the virgin soil.

Physical indicators demonstrate that current management practices adversely impact the ability of the soil to provide physical support and structural functionality. The evidence of subsurface compaction and lower aggregate stability may inhibit root growth, gaseous exchange or water cycling and renders the soil vulnerable to erosion.

These data from Outeniqua Research Farm were used in developing a first approximation of baseline values. As these baseline values may differ spatially and temporally, further research into baseline values at representative commercial dairy farms in the southern Cape is required.

Water, Nutrients and Production in Rangelands

SESSION CHAIR: SUE J VAN RENSBURG

Thursday 19 July 2012, 08:15 – 10:00

Platform and Poster Presentations

PLATFORM PRESENTATION: A WATER-USE EFFICIENCY MAP FOR SOUTHERN AFRICAN RANGELANDS – INTEGRATING NET PRIMARY PRODUCTION AND EVAPOTRANSPIRATION

Tony (A) R Palmer[1, 2], Craig Weideman[2], Andiswa Finca[1], Niall P Hanan[3], Isa Yunusa[4], Lesley Gibson[5] and Alan D Short[6]*

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Global pressure is mounting to assess and improve the performance of landscapes to capture carbon, produce biomass for food and fibre, and improve water use. There is evidence that rangeland water use is being equated to that of more water demanding crops and land cover types, resulting in pressure to convert rangeland to cropland. Defending the sustainable functionality of natural rangelands as compared with other land-use use options (e.g. carbon sequestration and biofuel production) is vital and this requires improved evidence-based methods for estimating production and water use.

Water use efficiency (WUE) is a powerful index of considerable value in describing the functionality (including ecosystem health, condition and productivity) of natural rangelands. In this study, WUE defines the ability of an ecosystem to produce above-ground biomass (kg.DM) per unit of actual evapotranspiration (mm). It is a unifying concept which has already been calculated for a range of condition classes at single sites in arid and semi-arid rangelands throughout Africa. In the past, efforts at developing landscape scale estimates of WUE have been hampered by the scarcity of reliable net primary production and evapotranspiration surfaces. With the recent availability of accurate, spatially explicit estimates of actual evapotranspiration (ETa), it is now possible to prepare annual ETa for southern Africa at a spatial resolution of 1 km. We have validated these ETa surfaces for southern Africa using a range of instruments and approaches. In addition, using the principle of light use efficiency, a global annual net primary production (NPP) surface is available for 11 years from 2000-2011. By combining these two products (WUE=NPP/ETa), we have prepared the first spatially explicit estimate of water use efficiency for natural rangelands in southern Africa for 2009. The results indicate that WUE varies spatially, with values ranging from 0.1 kg DM mm^{-1} ha^{-1} y^{-1} in the arid western regions to >8 kg $DM.mm^{-1}.ha^{-1}.y^{-1}$ in the forests and grasslands of the eastern region. Using data from several ground-based measurements of WUE, we validate the national WUE surface and show that this is a very useful product for comparing landscape management strategies and condition classes.

This product has the potential to be used to compare the WUE of conflicting land management strategies, and to provide evidence of trends in WUE which are predicted to accompany climate change.

PLATFORM PRESENTATION: HOW DOES CONTINUOUS GRAZING EFFECT EVAPOTRANSPIRATION ON AN EASTERN CAPE GRASSLAND?

Andiswa Finca and Tony (A) R Palmer*

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Catchment-scale water balances are necessary for assessing sustainable land and water resource management practices, and depend on accurate estimates of run-off, recharge and evapotranspiration (ET). The ET component of the catchment-scale water balance was the focus of this study, and the aims were to explore the effect of two different grazing strategies on ET, and to validate modelled ET using an open top chamber (OTC). Two contrasting, but adjacent quaternary catchments, namely P10A (a high biomass site) and Q91C (a low biomass site) were selected within the Bushman's River primary catchment. Within each catchment, a relatively homogenous pixel of 1 km^2 was selected, representing contrasting examples of high and low intensity grazing. From a 10 year MODIS leaf area index (LAI) data stack (March 2000–2010), 8-day LAI values were extracted for each 1 km^2 pixel. The actual ET was then estimated by adjusting potential evapotranspiration (ET_0) using the MODIS LAI. The results obtained showed that MODIS LAI ET (ET_{MODIS}) obtained for the ten year period for both pixels decreased consistently, reflecting a general trend in declining LAI throughout the Eastern Cape. The mean annual ET_{MODIS} obtained over the 10 year period from P10A 1 km^2 pixel was higher by 80 mm than the mean annual ET_{MODIS} obtained from Q91C 1 km^2 pixel. For each year, ET_{MODIS} in the P10A pixel was higher than in the Q91C pixel. This confirmed that the high biomass site had higher ET than the low biomass sites under continuous grazing. Although these results show that more water is lost to the atmosphere from the high biomass site, we argue that this site has higher production and lower storm flows than the continuously grazed site. The modelled ET_{MODIS} results were validated for each 1 km^2 pixel using an OTC. The OTC sums the water lost from vegetation and soil within the chamber. This validation was conducted during the growing season of 2010–11. Wind speed, relative humidity and temperature were measured at the inlet and the outlet of the chamber on five clear sunny days at each site. Modelled ET_{MODIS} for the same day was compared with ET_{OTC} using the regression analysis and a good relationship was observed (r^2=0.7065). The relationship confirmed that ET_{OTC} closely approximates ET_{MODIS} and that the OTC can be used as a tool to validate ET_{MODIS} on clear, sunny, windless days.

PLATFORM PRESENTATION: PREDICTING C_3 AND C_4 GRASS NUTRIENT VARIABILITY USING IN-SITU CANOPY REFLECTANCE

Clement Adjorlolo[1,2] and Onisimo Mutanga[1]*

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Climate-change induced alterations in C_3 and C_4 composition of grasslands will affect the carbon cycle and forage nutrient quality. Probable increases in abundance of C_3 grass, *Festuca costata*, which is relatively poor in nutrient quality, is a key concern within the African montane grasslands. Forage quality in these grasslands depends on limiting nutrients: nitrogen, crude protein, moisture and, nutrients (non-digestible fibre) that constrain the intake rates of herbivores. Using in-situ reflectance data, variability in C_3 and C_4 grass nutrient quantities were predicted at full canopy coverage. Results obtained from the partial least squares (PLS) analysis indicate 80%, 79%, 71% and 71% of the variance in nitrogen, crude protein, moisture and fibre concentrations respectively. This explains the variation among three grass species: *F. costata, Themeda triandra* and *Rendlia altera*. All nutrients show a response to the 13 chosen wavebands of known spectral absorption/reflectance features. The adopted spectral resampling technique, not only reduced dimensionality, but was also a useful method for optimizing the limits of spectral resolutions. This study provides an appropriate platform for further studies in establishing the variance in C_3 and C_4 grass nutrient concentrations, focusing on various growth stages, a variety of environments and the level of canopy.

PLATFORM PRESENTATION: MAPPING GRASS NUTRIENTS AS AN INDICATOR OF RANGELAND (FORAGE) QUALITY USING REMOTE SENSING IN THE SAVANNA ECOSYSTEMS

Abel Ramoelo[1,2], Moses A Cho[1], Renaud Mathieu[1], Andrew K Skidmore[2], Martin Schlerf[3] and Ignas M A Heitkonig[4]*

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Information on the nutrient content of grass as an indicator of quality can inform decision making regarding the planning and management of savanna ecosystems. Nutrients such as nitrogen play a crucial role in understanding the distribution, densities and feeding patterns of both wild herbivores and livestock as nitrogen is one of the major nutrient requirements for herbivores. Grass nutrients have rarely been mapped at the regional scale because of the lack of satellite-based sensors that sample reflected electromagnetic energy in the red-edge region which is sensitive to foliar chlorophyll and nitrogen (N). Medium resolution satellites are also generally not suitable to discriminate grass and tree signals in heterogeneous and patchy savannas. The emergence of high resolution multispectral sensors with red-edge information such as RapidEye, SumbandilaSat, and Sentinel-2 (to be launched in 2013) provides new opportunities for rangeland quality assessment at regional levels. The objective of this study is to estimate and map grass N as an indicator of rangeland quality using vegetation indices derived from RapidEye images. The study area covers Kruger National Park (KNP), SabiSands and Bushbuckridge communal rangelands. Grass samples were collected in the field and were chemically analysed for foliar N concentration. RapidEye images were collected at the same time as the field data. The red-edge based vegetation indices and the conventional vegetation indices were compared, and foliar N regression models were developed. The red-edge based indices yielded higher estimation accuracy as compared to the conventional ones, such as normalized difference vegetation index, without the red edge band. Generally, the spatial pattern of foliar N (Figure 1) conforms to the underlying geological classes. The study exhibited a potential to map grass nutrients at a regional scale to inform the decision makers (farmers, resource and park managers as well as policy makers) for effective planning and management of the savanna ecosystems.

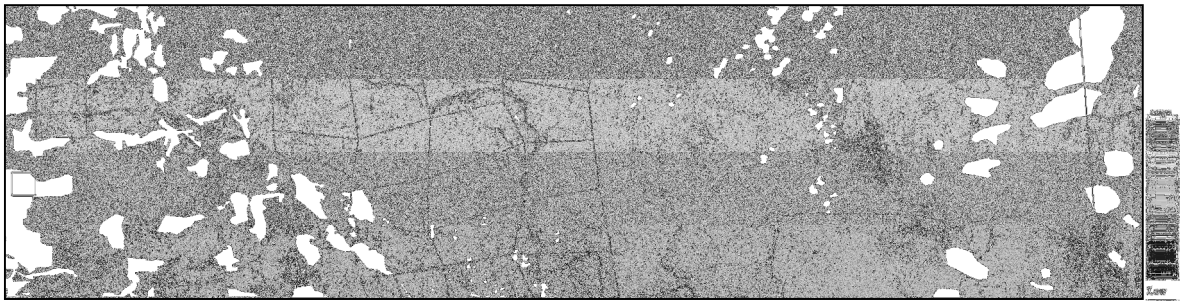

Figure 1: The grass nitrogen map (white spots are clouds and built-up areas).

PLATFORM PRESENTATION: ANALYSIS OF REMOTELY SENSED DATA TO ESTIMATE ABOVEGROUND BIOMASS PRODUCTION ALONG A RAINFALL GRADIENT IN THE EASTERN CAPE

Theunis L Morgenthal and Nolonwabo Jokani*

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Two global net primary production (NPP) datasets, derived from the high resolution remotely sensed satellite programmes MODIS and SPOT-VEGETATION, are available to estimate aboveground dry matter production. The accuracy of these remotely sensed datasets to estimate herbaceous dry matter production in the Grassland and Nama-Karoo biomes has not been evaluated. The study investigates the relationship between the MODIS and SPOT-VEGETATION NPP products and standing herbaceous dry matter production measured at four localities in the Grassland and Nama-Karoo biomes in the Eastern Cape. The field data were collected at Döhne ADI, Tarkastad, Mountain Zebra National Park and Grootfontein ADI along a rainfall gradient

from 795 to 369 mm since 2009. Within the Grassland biome, aboveground biomass production was measured in 15 1 m^2 exclosure cages in a 200x200 m size plot. Biomass production at Mountain Zebra was measured in 8x20 m^2 exclosures set up in 1998 for a fire experiment. At Grootfontein ADI biomass production was measured in 5x9 m^2 exclosure plots set up in 2009. Within the Grassland biome (Döhne ADI, Tarkastad and Mountain Zebra National Park) the change in standing biomass was measured monthly using a disc pasture meter. The field data were compared with the 250 m MODIS NDVI and MODIS NPP data as well as the 1 km SPOT-VEGETATION and the 1 km SPOT-VEGETATION dry matter production raster datasets using regression analysis. The study evaluates the accuracy of the two primary production datasets to indicate the monthly growth and total seasonal production. Dry matter production between the four datasets varied between 4300 $kg.ha^{-1}.yr^{-1}$ (Döhne ADI) and 580 $kg.ha^{-1}.yr^{-1}$ (Grootfontein ADI). Regression analysis indicate that annual production data related better to dry matter data derived from SPOT-Vegetation (R^2=0.80) than from NPP data derived from MODIS (R^2=0.60). Dry matter data using SPOT-VEGETATION underestimated the production of moist sour grasslands but was more accurate to predict production of semi-arid grasslands.

POSTER PRESENTATION: RAINFALL OVER THE EASTERN CAPE PROVINCE ASSOCIATED WITH CUT-OFF LOWS

Samuel Molekwa[1], C J deW Hannes Rautenbach[2] and C J Engelbrecht[1]*

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Cut-off low (COL) pressure systems are regarded as important synoptic scale weather systems that occur over the sub-tropics of southern Africa, and are normally associated with widespread rainfall with about one out of five systems that result in flood events, especially along the southern and eastern coastal belts and adjacent interior of South Africa. The Eastern Cape Province makes an important contribution to the agricultural economic sector in South Africa but is known for having high rainfall variability. It also experiences flood events due to the occurrence of cut-off lows. In this study we investigate the COL which is one of the temperate mid-latitude disturbances associated with the westerly airflow, and is associated with heavy rainfall over the Eastern Cape Province.

In this study, COL events over South Africa were identified by visual inspection of the geopotential height fields of the 1000 hPa and 500 hPa pressure levels from the National Center for Environmental Prediction (NCEP) reanalysis data for the period of 1979–2009. Daily rainfall data from 22 weather stations in the Eastern Cape were utilized to identify the COL events that are associated with rainfall over this province. This was done for various rainfall categories (0-10 mm, 0-20 mm, 0-30 mm, 0-50 mm and >50 mm) where at least one station had to report rainfall.

From the total of 353 COL systems that occurred over South Africa during the study period, 255 were associated with rainfall over the Eastern Cape and 95 caused heavy rainfall whereby at least one station reported more than 50 mm of rainfall for the period of 1979 to 2009 over the Eastern Cape. Of these, 5% contributed to rainfall amounts of between 0-10 mm, 11% contributed to rainfall amounts of 0-20 mm, 16% contributed to rainfall amounts of 0-30 mm, 24% contributed to rainfall amounts of 0-50 mm and 44% contributed to rainfall amounts of more than 50 mm. The contribution of COL systems to the total annual rainfall varies from one year to the next and also in areas such as along the coast and interior of the province. The highest annual contribution to rainfall by COL systems over this province occurred in 1979, 1981, 1985, 1993 and 1994.

Increased occurrences of COL pressure systems are associated with a larger contribution to the total annual rainfall but it also depends on the intensity, duration and the location of the systems.

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