



Grassland Society of Southern Africa

54th Annual Congress

Incorporating the 10th Research Skills Workshop

Upington, Northern Cape, South Africa

1 - 4 **July** 2019

Proceedings



Advancing rangeland ecology and pasture management in Africa



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54th Annual Congress of the Grassland Society of Southern Africa

Sunday, 30 June 2019

15:00 - 18:00 **REGISTRATION** for all delegates attending the Research Skills Workshop or any field trip

Monday, 1 July 2019

08:30 - 09:00 **FIELD TRIPS DEPART**

RESEARCH SKILLS WORKSHOP - 'R' FOR BIOLOGISTS

09:00 - 10:45 Welcome, introduction to data analysis and hypothesis testing Victoria Goodall

10:45 - 11:15 **MORNING TEA**

11:15 - 13:00 Linear regression Victoria Goodall

13:00 - 14:00 **LUNCH**

14:00 - 17:00 **REGISTRATION**

14:00 - 15:15 Generalised linear models Victoria Goodall

15:15 - 15:45 **AFTERNOON TEA**

15:45 - 17:00 Principal components and correspondence analysis Victoria Goodall

OPENING OF THE 54th ANNUAL CONGRESS

17:30 - 17:40 Welcome Christiaan Harmse

17:40 - 18:00 Presidential address Tony Swemmer

18:00 - 18:45 **OPENING KEYNOTE ADDRESS: 'Myth ecology' - Revisiting ecological paradigms** Yohay Carmel

19:00 **MEET & GREET**

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Tuesday, 2 July 2019

PLENARY: ARID SAVANNAS I

08:00 - 08:45 KEYNOTE: Long-term monitoring of vegetation dynamics in the arid savanna ecosystems of Namibia Ben Strohbach

08:45 - 09:30 KEYNOTE: Restoration and management of arid Kalahari rangelands: A 15 year review of research from the Mier area Klaus Kellner

09:30 - 09:50 Aquatic rangelands of the Kalahari: A case study of Hakskeenpan and its unique grazing inhabitants Elizabeth Milne

09:50 - 10:10 Long-term *Vachellia erioloba* dynamics in the Kalahari Gemsbok National Park, South Africa Helga van der Merwe

10:10 - 10:30 Observations on the phenology of six woody and two grass species in Kimberley Thornveld in relation to climate Marco Pauw

10:30 - 11:00 MORNING TEA

PLENARY: ARID SAVANNAS II

11:00 - 11:20 Key determinants of long-term compositional variation of the herbaceous layer in a semi-arid savanna, Vaalbos National Park Tshililo Ramaswiela

11:20 - 11:40 Rainfall trends in the Northern Cape province Christiaan Harmse

11:40 - 12:00 The impact of drought on the species composition, veld condition and forage availability of Witsand Nature Reserve and implications for game management Marnus Smit

12:00 - 12:20 Challenges in determining the best rehabilitation parameters and criteria for arid areas with specific reference to the southern Kalahari region of South Africa Chrizette Neethling

12:20 - 13:00 PANEL DISCUSSION

13:00 - 14:00 LUNCH



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Tuesday, 2 July 2019

**PARALLEL
SESSIONS**

**BIODIVERSITY OF
RANGELANDS I**

**CULTIVATED PASTURES &
FEEDING ECOLOGY I**

14:00 - 14:20	(Almost) As rich as the Cape!? - Surprisingly high plant diversity and endemism in the montane grasslands of southern Africa	Ralph Clark	Exploring possible allelopathic effects of <i>Eragrostis plana</i> and <i>Sporobolus africanus</i> in the southern Cape	Sigrun Ammann
14:20 - 14:40	Vegetation type conservation targets, status and level of protection in KwaZulu-Natal in 2016	Debbie Jewitt	The assessment of growth parameters and nutrient content of three herbaceous legumes as affect by arbuscular mycorrhiza fungi and <i>Rhizobium</i> inoculation	Sanele Mpongwana
14:40 - 15:00	Impacts of landscape composition, marginality of distribution, soil fertility and climatic stability on the patterns of woody plant endemism in the Cerrado	João de Deus Vidal Jr.	Evaluation of nutritional composition, fermentation characteristics and aerobic stability of <i>Opuntia</i> -legume silage mixture at different preservation periods	Gopolang Matlabe

15:00 - 15:30 AFTERNOON TEA

15:30 - 17:00 RESEARCH PROPOSAL POSTER SESSION

Does soil type determine biome boundaries at the Benfontein Game Reserve in the Kimberley Thornbelt?	Lehlohonolo Lepholletse
Poisonous plant patches in arid rangelands of Namaqualand, South Africa: Implications for biodiversity and landscape heterogeneity	Tauriq Jamalie
Nutritional properties and feeding value of orange-lucerne silage mix on growth response of Xhosa lob-eared goat	Sibongele Ndongeni
The impact of temperature and water limitation on the germination of legume species in the genera <i>Medicago</i> and <i>Trifolium</i>	Ethan Britz
The effects of cover crops usage in suppression of weeds	Matsobane Ngoasheng
Evaluation of growth characteristics, biomass yield and nutritive value of two <i>Panicum maximum</i> cultivars cv. (Mombaca and Gatton) and <i>Brachiaria brizantha</i> at different harvests	Mihle Sokupa

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15:30 - 17:00 RESEARCH PROPOSAL POSTER SESSION

Dietary inclusion of <i>Leucaena leucocephala</i> as a climate smart agricultural strategy to reduce methane emission in beef cattle	Sanele Jiyana
Assessing the impacts of bush encroachment on the density of tick-host interactions in a South African savanna	Shaundré Hofstander
Potential of using woody encroaching species to control endoparasites in cattle grazing savanna rangelands	Taryn Jacobs
Impact of woody plant encroachment on the spatiotemporal dynamics of grazing capacity in grassland and savanna rangelands	Jillian Fredericks
Impact of herding on veld condition, livestock performance and economic returns for rural communities in Alice: A case study in semi-arid regions of the Eastern Cape, South Africa	Mpumzi Protous Mavuso
Investigating sustainable control practices for <i>Euryops floribundus</i> encroachment in communal rangelands of the Eastern Cape, South Africa	Sive Tokozwayo
Assessing livestock grazing distribution on communal rangelands of Guquka, Eastern Cape, South Africa	Thantaswa Zondani
Studies of cattle foraging behaviour and forage species trends in communal rangelands of South Africa to develop climate smart rangeland management and feeding strategies	Solomon Tefera
Cattle as cheap grass seed distributors: Fact or fiction?	Yvette Brits
Investigating the risk of non-compliance to certification in a premium value beef value chain	Nonkwenkwezi Myeki
Integration of <i>in situ</i> and remotely sensed data set for pasture quality and quantity assessment to enhance livestock production	Khuliso Ravhuhali

17:15

ANNUAL GENERAL MEETING OF THE GRASSLAND SOCIETY OF SOUTHERN AFRICA

18:30

DINNER

Advancing rangeland ecology and pasture management in Africa

54th Annual Congress of the Grassland Society of Southern Africa

Wednesday, 3 July 2019

PLENARY: ECOLOGY OF WOODY RANGELANDS

08:00 - 08:45	KEYNOTE: Bush encroachment alters grassland ecohydrology and requires novel solutions for rangeland management	Jesse Nippert
08:45 - 09:05	Why is grass production so low in Mopaneveld? An investigation of the relative effects of climate, soils, grazing and tree competition	Tony Swemmer
09:05 - 09:25	Differential plant dispersion in all growth forms across experimental burn blocks in the Kruger National Park	Brian Reilly
09:25 - 09:45	Drought amnesia: Lessons from protected areas in the eastern Lowveld of South Africa	Mike Peel
09:45 - 10:05	No fire - fewer trees: Long-term effect of fire frequency on woody plant communities at the Fort Hare Fire Trials	Susi Vetter

10:05 - 10:30 PANEL DISCUSSION

10:30 - 11:00 MORNING TEA

PARALLEL SESSIONS

BIODIVERSITY OF RANGELANDS II

CULTIVATED PASTURES & FEEDING ECOLOGY II

11:00 - 11:20	Biodiversity Stewardship milestones achieved in the Gauteng province, South Africa	Natalie Horn	Influence of nitrogen addition, defoliation and neighbouring plants on growth of a high-altitude C ₃ grass, <i>Festuca costata</i>	Kabemba Mwambilwa
11:20 - 11:40	Southern African mountain ecosystems - indicators for changes in biodiversity	João De Deus Vidal Jr	Effect of tannin deactivation methods on feed intake, dry matter digestibility and nitrogen balance in female Boer goats fed with <i>Senegalia mellifera</i> bush-based feeds	Andreas Epafras
11:40 - 12:00	A pathway to integrated objective based monitoring at mines to ensure net positive biodiversity outcomes	Chrizzette Neethling	How simulating herd migrations and applying adaptive management practices can improve soil quality and plant biomass production	Wayne Knight

Advancing rangeland ecology and pasture management in Africa

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Wednesday, 3 July 2019

**PARALLEL
SESSIONS**

**BIODIVERSITY OF
RANGELANDS II**

**CULTIVATED PASTURES &
FEEDING ECOLOGY II**

12:00 - 12:20

Impact of livestock grazing intensity on plant species diversity of species-rich montane grassland on the northern Drakensberg, South Africa

Thami Shezi

Emerging disease challenges to sustainable production of *Brachiaria* grass in Rwanda

Bellancile Uzayisenga

12:20 - 12:40

Long-term nutrient enrichment effects on productivity, species richness and soils in a natural South African grassland

Naledi Zama

Effects of dual inoculation with arbuscular mycorrhiza fungi and *Rhizobium* inoculation on soil physiochemical properties in a field grown forages legumes

Sanele Mpongwana

12:40 - 13:00

Study on the response of herbaceous species abundance and biomass production to *Solanum mauritianum* (bugweed) invasion densities on the rangelands of the Eastern Cape province

Thando Ntutha

Feeding inclusion levels of *Opuntia-Moringa* silage to blue buffalo grass based diet has effect on growth performance and carcass characteristics of mutton merino wethers

Gopolang Matlabe

13:00 - 14:00 **LUNCH**

**PARALLEL
SESSIONS**

**KAROO & DESERT
RANGELANDS I**

**INVASIVE SPECIES IN
RANGELANDS I**

14:00 - 14:45

KEYNOTE: Plant-herbivore interactions in an arid, stochastic environment: Insights from the Richtersveld

Susi Vetter

KEYNOTE: Biological control for the protection of water resources and rangelands

Iain Paterson

14:45 - 15:05

Grassland-shrubland shifts in the eastern Nama-Karoo Grassland ecotone

Gina Arena

Nassella in South Africa: A call to action

Anthony Mapaura

15:05 - 15:25

Influence of season of grazing and rainfall over time on vegetation in the eastern Karoo, South Africa

Justin du Toit

Detection of new cactus species and populations in arid areas of South Africa: potential impacts and management interventions

Travor Xivuri

15:25 - 16:00 **AFTERNOON TEA**

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PARALLEL SESSIONS	KAROO & DESERT RANGELANDS II		INVASIVE SPECIES IN RANGELANDS II	
16:00 - 16:20	The initial spread of brown locust swarms across the Karoo	Joh Henschel	The role of solid waste dumping sites in early detection of emerging alien plant species in South Africa	Tshamaano Nemurangoni
16:20 - 16:40	Germination potential of four palatable species of the semi-arid Karoo region of South Africa	Rudi Swart	Management of biological invasions in arid areas: Importance of awareness and management intervention strategies	Thabiso Mokotjomela
16:40 - 17:00	Long-term impacts of livestock grazing and browsing in the Succulent Karoo: A 20-year study of vegetation change under different grazing regimes in Namaqualand	Elelwani Nenzhele	The biological invasions' threat in the North West Parks Board nature reserves	Thulisile Jaca
17:00 - 17:20	NASSELLA INVASION IN SOUTH AFRICA—DISCUSSION SESSION FOR INTERESTED PARTIES			Anthony Mapaura
17:30 - 19:00	QUIZ			
19:00	DINNER			

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Thursday, 4 July 2019

PLENARY: COMMUNAL RANGELAND DYNAMICS

08:00 – 08:20	Restoration of degraded rangelands in semi-arid communal areas, South Africa: Short term enclosure impacts on grass and soil quality in three soil types	Ayanda Kwaza
08:20 – 08:40	Assessing livestock distribution in communal rangelands of the Eastern Cape, South Africa: Towards monitoring livestock movements in rangelands	Bukho Gusha
08:40 – 09:00	Municipal commonage status: Rangeland condition, herd composition, infrastructure and land degradation in Inxuba Yethemba Municipality	Tanki Thubela
09:00 – 09:20	Vegetation, soil, and cattle blood mineral status in severely and less severely degraded semi-arid communal rangelands of the Eastern Cape, South Africa	Nangamso Mlaza
09:20 – 09:40	Defining rangeland condition in the Riemvasmaak rural areas	Anthony Palmer
09:40 – 10:00	A stochastic frontier analysis of livestock production in communal rangelands: Towards improving livestock water productivity	Bukho Gusha

10:00 – 10:30 **MORNING TEA**

10:30 – 12:00 **STANDARD POSTER SESSION**

Woody vegetation change (>30 yr) in the interior duneveld of the Kalahari Gemsbok National Park	Helga van der Merwe
Rehabilitation of old potato circles in the Sandveld, Western Cape: soil health and soil seedbank - Preliminary results	Nelmarie Saayman
Determining species composition and landscape function of the old arable lands in the Eastern Cape province, South Africa	Unathi Gulwa
The relative feed quality of tall fescue (<i>Festuca arundinacea</i>), cocksfoot (<i>Dactylis glomerata</i>) and perennial ryegrass (<i>Lolium perenne</i>) at Cedara, KwaZulu-Natal	Derryn Nash
Pasture quality of over-sown Italian ryegrass (<i>Lolium multiflorum</i> var Supreme Q) into irrigated kikuyu (<i>Pennisetum clandestinum</i>)	Donna Berjak
Assessment of supplementary feed resources available for cattle in four local municipalities of the Eastern Cape province, South Africa	Siza Mthi
Knowledge and perception of small holding farmers on supplementation and feeding of sweet potato vines to goats	Cynthia Fikile Luthuli
The impacts of climate change on the agronomic potential of <i>Calobota sericea</i>	Francuois Müller
The effect of different herbicide treatments on herbage production and plant density of a mixed grass-legume pasture	Gideon Jordaan
The effect of <i>Rhizobium</i> inoculation on growth performance (plant height, stem diameter and chlorophyll content) and forage production of lablab cultivars	Sibongile Portia Senti

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Thursday, 4 July 2019

10:30 - 12:00 STANDARD POSTER SESSION

Effects of phosphorous fertilization on forage production of abandoned lands planted with pasture legumes	Wandile Mashece
Predicting the variability and chemical composition of fresh forage by using three different devices of near-infrared spectroscopy	Lwando Mazule
Chemical composition, in vitro dry matter digestibility and dry matter intake of five browse species	Khuliso Ravhuhali
Effects of digestate application on red and black soils on forage sorghum seedling growth	Portia Mamothaladi Moshidi
Post-burn regrowth and nutrient supplementation increase browsing time by goats	Piet Monegi
The use of indigenous chicken as a buffer to prevent acidosis and bloating on small ruminants grazing on crop maize residues	Petros Khoza
Effect of soil and subhabitat differentiation on the growth of <i>Tarchonanthus camphoratus</i> seedlings	Imke Stehn
Preliminary results of the long-term effect of various fire treatments on the woody structure in the Kruger National Park, South Africa	Naquita Faria
Large tree dynamics in Lowveld protected areas: With emphasis on drought response	Mike Peel
The application of Tree Popper™ mechanical control of woody plant encroachment in savanna rangelands	Piet Monegi
Effect of warming on trade-offs between growth and defence of <i>Vachellia sieberiana</i> seedlings growing with or without grass	Lusanda Ncisana
The extreme Knysna fire event of June 2017: Causes and impacts as evidenced from content analysis of local media and government reports	Phila Ngwilikane
The effect of fire, soil depth and <i>Seriphium plumosum</i> canopy cover on soil fertility in a South African semi-arid grassland community	Gilbert Pule
The effect of <i>Solanum mauritianum</i> on plant abundance and soil properties in the Eastern Cape, South Africa	Feziwe Sibanda
Peri-urban communal grazing and socio-economic challenges: Advancing small-scale livestock farming against all odds	Modau Norman Magoro
In a novel landscape, in the Eastern Cape, South Africa, what are the key vegetation resources that support livestock production?	William Liversage-Quinlan
The nutritional value of grass species in different communal rangelands within the soil type in Msukaligwa Municipality	Thabile Joyce Mokgakane

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Thursday, 4 July 2019

10:30 - 12:00 STANDARD POSTER SESSION

Long-term effects of a two-camp blaze and graze system on selected soil physico-chemical properties in the East Griqualand Grassland	William Diko
Veld condition status of selected Land Redistribution for Agricultural Development (LRAD) farms at Amathole region in the Eastern Cape province	Sindisile Goni
Understanding the language of ecosystem resilience by conceptualising soil formation using hypopedology: Discovering the biological separation zone	Martin Tinnefeld

12:00 - 13:00 LUNCH

PLENARY: METHODS & MONITORING IN RANGELANDS

13:00 - 13:20	A case study of drought affecting Tierberg-LTER to understand observed shrub dieback	Mthokozisi Moyo
13:20 - 13:40	Parameterisation and evaluation of the Sustainable Grazing Systems pasture simulation model for predicting native grass growth in a southern African savanna	Walter Svinurai
13:40 - 14:00	AfriCultuReS Livestock Service: An operational effort towards monitoring the status and productivity of grasslands in arid and semi-arid regions of sub-Saharan Africa	Mahlatse Kganyago
14:00 - 14:20	Comparison of holistic planned, traditional continuous and rotational grazing in the Lowveld regions of the Eastern Cape: Effects on grass species composition and biomass yield	Silas Mudyiwa
14:20 - 14:40	Effect of rainfall interception, resting and season on rangeland productivity in the semi-arid grasslands of South Africa	Thabo Magandana
14:40 - 15:00	Impacts of cattle grazing (<i>Bos taurus</i>) pressure on vegetation and soil characteristics in an arid grassland of South Africa	Gert Botha
15:00 - 15:20	The impact of climate variation on plant flammability	Wynand Calitz

15:20 - 15:45 AFTERNOON TEA

CLOSING PLENARY

15:45 - 16:30	KEYNOTE: Rangeland condition in Riemvasmaak 20 years after resettlement and what it means for conservation, communal areas and land reform in the drylands of South Africa	Timm Hoffman
16:30 - 16:45	Closing remarks from the Chair of the Scientific Committee	Ralph Clark

19:00 GALA DINNER

Advancing rangeland ecology and pasture management in Africa

54th Annual Congress of the Grassland Society of Southern Africa

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Christiaan Harmse, Northern Cape Department of Agriculture, Land Reform and Rural Development

Joh Henschel, SAEON Arid Lands Node

Marco Pauw, SAEON Arid Lands Node

Natalie Uys, Northern Cape Department of Environment and Nature Conservation

Marnus Smit, Northern Cape Department of Environment and Nature Conservation

Erica Joubert, GSSA Administrator

SCIENTIFIC COMMITTEE

Ralph Clark, Afromontane Research Unit, University of the Free State

Florence Nherera-Chokuda, National Emergent Red Meat Producers Organization

Igshaan Samuels, Agricultural Research Council

Janke van der Colf, Western Cape Department of Agriculture

Josef van Wyngaard, Voermol

Melvin Swarts, University of the Western Cape

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Rouxdene Deysel, Gauteng Department of Agriculture and Rural Development

Sigrun Ammann, Western Cape Department of Agriculture

Tony Swemmer, SAEON Ndlovu Node

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Grassland Society of Southern Africa: 2018/19 Council

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AWARDS

ADJUDICATION FORMS ARE INCLUDED ON THE CONGRESS APP FOR SMARTPHONES AND IPHONES. WE APPEAL TO ALL THE DELEGATES TO COMPLETE THESE FOR PRESENTATIONS THAT THEY ATTEND AND ASSIST IN THE JUDGING PROCESS.

PLATFORM PRESENTATIONS

Each year the Society awards a medal and certificate for the following categories, based on platform presentations:

- **Best Presentation**
- **Best Presentation by a Young Scientist.**
- **The Norman Rethman Planted Pastures Award**

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.

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 PRESENTATIONS

STANDARD POSTERS WILL BE VIEWED DURING THE TEA AND POSTER SESSIONS DURING WHICH TIME PRESENTERS CAN INTERACT WITH DELEGATES ABOUT THEIR WORK.

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. 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 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 48th Annual Congress of the Grassland Society of Southern Africa. Nominations should be received by Thursday 26th July at 3pm. Hand them in at the registration desk.

2019 RESEARCH SKILLS WORKSHOP

* R FOR BIOLOGISTS *



1 JULY 2019 @ DESERT PALACE HOTEL, UPINGTON

FACILITATOR: DR VICTORIA GOODALL

WWW.VLGSTATS.CO.ZA

Course description: R statistical software (<https://www.r-project.org/>) has become a popular tool for data storage, manipulation and particularly data analysis. R is used in many disciplines and has become one of the most common statistics platform in ecology. The program is free and open-source, runs on all major operating systems and has many graphical and statistical operations built-in. However, one of the challenges to using this software initially is the computer programming required to run the analyses. This course will focus on the use of R, via a user interface R-Commander. It will cover the analysis of biological data using common statistical techniques and interpretation of the results.

Course content: Basic descriptive statistics, hypothesis testing, linear regression, generalized linear models and principal component analysis.

Requirements: A basic knowledge of the statistics is required for this course. A brief overview of the theory will be given. The practical component will be run using R and R-Commander. Delegates must have R and R-Commander loaded on their computers. An internet connection will be provided.

*** For more information, please email info@grassland.org.za or visit <https://2019gssa.dryfta.com/en/> ***

Day 2, Monday, Jul 01, 2019

08:30 - 09:00

**Hotel
Entrance**

Tours depart

09:00 - 10:45

Vestibulo 2

Research Skills Workshop I - Descriptive and inferential statistics

10:45 - 11:15

**Conference
Rooms Foyer**

Morning tea

11:15 - 13:00

Vestibulo 2

Research Skills Workshop II - Regression

13:00 - 14:00

**Bella Roma
Restaurant**

Lunch

14:00 - 15:15

Vestibulo 2

Research Skills Workshop III - Generalized linear models

14:00 - 17:00

**Conference
Rooms Foyer**

Registration

15:15 - 15:45

**Conference
Rooms Foyer**

Afternoon tea

15:45 - 17:00 **Research Skills Workshop IV - Principal component and correspondence analysis**
Vestibulo 2

17:30 - 19:00 **Opening of the 54th Annual Congress of the Grassland Society of Southern Africa**
Vestibulo 1

OPENING KEYNOTE ADDRESS: 'Myth-ecology' - revisiting ecological paradigms

18:00 - 18:45

Presented by :

Yohay Carmel, Professor, The Technion – Israel Institute Of Technology

The science of ecology is increasingly used to support decisions in nature conservation and in land management. As ecologists, we are confident that ecology is a robust and useful science. But how true is this presumption? In this talk, I revisit three central concepts in ecology, in order to find out how robust they are. The theories to be inspected are the competitive exclusion principle (Carmel et al. 2017, *Oikos*), optimal foraging (Carmel and Ben Haim 2005, *American Naturalist*), and the intermediate disturbance hypothesis (Mackey and Currie 2001, *Ecology*). Surprisingly, in all three cases, the evidence against the theory far exceeds the evidence supporting it. At the same time, all three theories are doing well; they continue to be featured in text books, and are passed on to the new generation of ecologists as general laws. This situation may be understood in light of Kuhn's notion of paradigms (Kuhn, 1962). In this context, we will look at the fate of findings that contradict a paradigm. Two possible ways to mitigate this undesirable situation concern our own view of ecology, and the way we teach our students, respectively; they will be humbly proposed. For an encore, I will present a case study of world grasslands. We conducted a meta-analysis of the impact of grazing on species richness (Gao and Carmel, in review). We tested the well-known notion that old-world grasslands are long-adapted to livestock grazing, as oppose to new-world grasslands, which are much less resilient. Similar to paradigms (although smaller in scope), this notion gained wide acceptance but was rarely tested. We found that globally, grazing had a net positive effect on species richness; there was no difference between old-world and new-world grasslands.

19:00 - 21:00

Conference *Meet and greet*
Rooms Stoep

08:00 - 10:30 **Plenary: Arid savannas I**

Vestibulo 1

Moderators

Joh Henschel, SAEON

KEYNOTE: Long-term monitoring of vegetation dynamics in the arid savanna ecosystems of Namibia

08:00 - 08:45

Presented by :

Ben Strohbach, Associate Professor, Namibia University Of Science And Technology

Several long-term "Biodiversity Observatories" were set up throughout Namibia during 2001 and 2005, ranging from Kavango West in the north, to Karios (near the Fish River Canyon) in the south. (This transect is extended into South Africa through the Richtersveld and Namaqualand as the BIOTA Transect.) A number of approaches are followed: Conceptually, the north-south transect follows a gradient of increasing aridity within Namibia, whilst many observatories are paired to compare a land use difference. The regular resurveying (with a few exceptions, annually) of the observatories is done according to a set scheme, recording plant species and their estimated abundance on 20 × 50 m plots, and taking fixed-point photos. Since 2016, we are also utilising a drone for surveying, with which we intend to monitor the phanerophytic vegetation. Four long-term biodiversity observatories have been established within the Kalahari Basin in Namibia. This landscape is under severe threat by global climate change, with predictions of dune remobilisation over the next 50 years as far north as central Angola. These observatories stretch over a gradient from roughly 500 mm precipitation per annum in the Kavango West Region (Mile 46 and Mutompo observatories), to 450 mm at Sonop observatory (Otjiozondjupa Region), to 350 mm at Sandveld observatory in the Omaheke Region. The expected changes in composition and structure along this aridity gradient are clearly illustrated. The composition of the woody layer does not readily respond to climatic variations, but fire and anthropogenic influences (e.g. illegal felling of trees, clearing of fields) play a great role in the structure of these woodlands. The herbaceous layer, in particular, the grass sward, shows a stronger reaction to climatic variations in particular in the northern, more mesic environments. Comparing the long-term data, the northern, more mesic vegetation is far less stable than the southern, more arid vegetation. This raises fears of dramatic, near irreversible degradation of these woodlands, to the extent of forming permanent, man-made deserts in these regions. Within the Central Thornbush Savannas, bush encroachment has been reported to be a problem in the extensive grazing systems in the savannas of Namibia since the 1970s. With the aid of aerial photography (both historic aerial photographs used for topographic mapping and present-day drone photography) we can quantify the degree of bush encroachment, or in some cases, bush die-back. Aerial photography gives an impression of the density of the grass sward but provides little information on its composition and condition. This, however, becomes evident by the regular resurveying at the observatories. Again, the condition of the grass sward is highly dependent on both the climatic conditions and the land use system. Over the years, however, a distinct decline in the condition is detectable. This seems to be not only due to straight-forward "overgrazing", but rather a compound effect of transformation of the vegetation structure, erosion of wetland systems and general desiccation of the landscape.

KEYNOTE: Restoration and management of arid Kalahari rangelands: A 15 year review of research from the Mier area

08:45 - 09:30

Presented by :

Klaus Kellner, Professor, North-West University

Mier is a rainfall-driven, dryland area in the Savanna Biome of the Northern Cape province. The area is characterised by parallel dunes, pans and hard stony surfaces, typified by certain land-cover units, specific vegetation and different land-use types. Depending on the type of vegetation and prevailing environmental parameters (geology, soil and climate) the local land users resort to an array of different range-management practices. Livestock and game management are the mainland use-types in the region contributing to the financial sustainability and well-being of the local people. One of the most pressing environmental problems land users face, leading to land degradation in the region, is the thickening of woody species such as the black-thorn (*Senegalia mellifera*) and the three-thorn shrub (*Rhigozum trichotomum*). This leads to a loss in biodiversity, changes in the structure and composition of the vegetation and a reduction in forage production for livestock. Several restoration activities were implemented to address the causes of land degradation. Dune stabilisation practices were established in the 1990s by the Department of Agriculture, Forestry and Fisheries (DAFF) through the LandCare program. These include brush packing using branches from the encroaching woody species of the inter-dune streets to stabilise dunes and loosening the compacted soil surface on the hard stony areas followed by re-seeding with palatable perennial, climax grasses adapted to the area for increased biomass production. Quantitative vegetation parameters (shrub density, grass species composition and -biomass) were monitored using the step-point walking- and belt-transect, as well as the quadrant method. Results revealed a significant positive effect of bush control of three-thorn shrubs on grazing capacity. In areas where the density of the three-thorn shrub was controlled through restoration practices, the grazing capacity increased dramatically over a five-year period. The perennial grass cover also improved in areas that were well managed and restored. To evaluate land user's perceptions of local environmental change regarding rangeland management and restoration practices, the Integrated Assessment Protocol (IAPro), the photo-voice approach, as well as semi-structured interviews were applied. Documenting indigenous knowledge offered insights into the wealth of site-specific indicators used by the local farming community for the management and restoration of the land. There seems to be an overlap between local- and scientific knowledge regarding the indicators for sustainable rangeland management and restoration. These long-term monitoring outcomes emphasize the participation of all stakeholders (policy, science and land user) in the development of sustainable land management strategies and the application of restoration to combat land degradation.

Aquatic rangelands of the Kalahari: A case study of Hakskeenpan and its unique grazing inhabitants

09:30 - 09:50

Presented by :

Elizabeth Milne, Wetland Ecologist, SAEON Arid Lands Node

Hakskeenpan has become a synonym for land speed racing in South Africa. This 15,000 ha pan is the largest ephemeral wetland in the semi-arid Kalahari Desert region of the Northern Cape province. Since 2010 a British team has been preparing its surface to attempt a new land speed record. The pan was favoured for this event due to its vast, hard, flat surface. However, surficial stones could be detrimental for the race as small stones scattered across the pan's surface could slash the supersonic car's tires. For this reason, over 16,000 tonnes of stones have been removed to smoothen the 22 million m² track on Hakskeenpan in preparation for the race. This task contributed significantly in uplifting the local Mier community and the race itself is believed to greatly benefit the economy of the province. However, no attempt has been made to understand the impact this event might have had on the biodiversity and ecosystem functioning of the Hakskeenpan wetland itself. Ephemeral pans are subjected to

complete desiccation during the dry season, which can last for decades. Consequently, these pans are often regarded as degraded or dead systems by land users. However, when it rains enough for the pans to hold water, dormant aquatic organisms respond and wetlands are resurrected to produce stepping-stone biodiversity corridors in an arid landscape. The variable scale of wetness over space and time and the unpredictable rainfall regime in the Northern Cape, however, challenges consistent sampling protocols during wet spells. Therefore, the pans in the province have been shamefully neglected. The current study investigates the biodiversity of Hakskeenpan, specifically focussing on the Branchiopod crustaceans, which are the flagship species of these arid waterbodies. Dip net measured sweeps were performed in late January and mid-March 2017 after Hakskeenpan received sufficient rain for some sections of the pan to hold water over a three month period. The results reveal the unique herbivores that dominate the pan and illuminate its importance for biodiversity and ecosystem functioning.

Long-term *Vachellia erioloba* dynamics in the Kalahari Gemsbok National Park, South Africa

09:50 - 10:10

Presented by :

Helga Van Der Merwe, SAEON Arid Lands Node

Vachellia erioloba is a keystone species in the southern Kalahari because it provides food, shelter, perches, nests and roost sites to many types of animals and harbours a distinct assemblage of plant species below its canopy. There is growing concern that mortality rates in *V. erioloba* are increasing as a result of threats such as increasing fire frequency, groundwater abstraction, competition from alien invasive species, diseases, harvesting, and the effect of aboricides. The study tracks two populations in different landscapes (interior sandy dune veld versus clayey Nossob riverbed) of a large conservation area and offers valuable data on this species under natural soil moisture conditions and with limited anthropogenic influences. Two plots were surveyed intermittently over nearly four decades in the northern section of the Kalahari Gemsbok National Park. In 1978, eighteen trees were permanently marked in a 1 ha plot in the interior duneveld (Dankbaar site), and in 1979 all trees in a 1 ha plot were surveyed in the Nossob riverbed (Grootkolk site). Tree height and stem circumference were measured at both sites in order to investigate growth rates and population structure. Of the 18 marked trees at Dankbaar, six died and three showed coppice regrowth following substantial die-back after a fire but, no fire-related deaths were reported. Stem diameters increased at a mean rate of 2.50 mm/year (range 0.91–4.86 mm/year) over the monitored period. This mean annual diameter increase is less than the 3.6 mm/year established in a previous study and substantially lower than the 12–14 mm/year previously reported for *Acacia* species growing in arid and semi-arid environments. Variability in the growth rates of other tree species has been reported and the suggested underlying causes for this phenomenon include microsite conditions and/or genetic potential of individual trees. At this study site in the duneveld, the *V. erioloba* population was self-sustaining, with recruitment occurring and large individuals presumably dying of old age. At the Grootkolk site in the Nossob riverbed, surveys started in a stand of predominantly young trees, although the size class distribution at that stage already showed a lack of recruitment. Over the study period, few seedlings were recorded and few individuals appeared to be recruiting into the population illustrating that this population was gradually changing from a young and growing to a mature-to-old population. *Vachellia erioloba* trees in this stand will likely disappear; however, new young stands are appearing at other sites in the Nossob riverbed. In this national park, under negligible anthropogenic influences, it appears that some *V. erioloba* populations are increasing in size while others are decreasing, but that overall the species will persist. The continued monitoring of these populations is recommended. However, monitoring sites should also be established at additional sites outside of the park to incorporate sites in which various threats to this species can be investigated. Rainfall stations should be erected at all sites to enable the

investigation of the influence of significant rainfall events and drought on seed germination, seedling survival and adult mortality.

Observations on the phenology of six woody and two grass species in Kimberley Thornveld in relation to climate

10:10 - 10:30

Presented by :

Marco Pauw, SAEON Arid Lands Node

A handful of very long-term datasets have shown how the timing of growth and reproduction in plants can change in response to climate change. However, long-term plant phenology datasets are rare and are mostly focused on crops. The South African Environmental Observation Network and Sol Plaatje University recognised the value of such long term datasets and set out to collect data on species that are widespread in the arid savanna of South Africa. Not only would such a dataset enable us to model seasonal availability of resources in the face of climate change, but also to model population trends in plant species. The cover of different stages of flowering, fruiting, leaf growth and shoot growth were estimated by a team of observers monthly from October 2017. Climate data were recorded during the same period. Observations based on initial data, which does not yet allow for statistical analyses, are presented here. Among the woody species (*Ehretia alba*, *Searsia lancea*, *Senegalia mellifera*, *Vachellia erioloba*, *Vachellia tortilis* and *Ziziphus mucronata*), there seem to be several different strategies for flowering, fruiting, and leaf and shoot development. From the initial data, it seems that cues for flowering and fruiting are either related to day length or temperature, while growth also occurs within a window period, but requires the availability of moisture. The two grass species (*Schmidtia pappophoroides* and *Stipagrostis uniplumis*) both seem to react to rainfall in its reproductive and vegetative growth phases. Several peaks in phenological events were missed due to the intervals in observations being too far apart, especially in the grasses that have very short reproductive phases. The observed patterns and strategies need to be confirmed by long term records. Below average rainfall during the study period resulted in low magnitudes of some phenological events, which might skew the observed patterns. The necessity for more frequent observations was confirmed. There is a lot of potential for additional research to complement the current study which can expand our understanding of species responses to climate change on an individual and population level.

10:30 - 11:00

Conference
Rooms Stoep

Morning Tea

11:00 - 13:00

Vestibulo 1

Plenary: Arid savannas II

Moderators

Joh Henschel, SAEON

Key determinants of long-term compositional variation of the herbaceous layer in a semi-arid savanna, Vaalbos National Park

11:00 - 11:20

Presented by :

Tshililo Ramaswiela, Field Technician, SAEON Arid Lands Node

Management of the grazing resource in semi-arid savanna is dependent on inter-annual variation in available moisture, which is determined by rainfall, soil type and woody biomass. Understanding the effect of rainfall variability requires study over an 18-year quasi-cycle of rainfall with frequent measurement, a constraint which few southern African studies have met. The aim of this study was to determine plant functional types and how the dominant species responded to annual variation in plant available moisture as determined by rainfall timing and intensity. The herbaceous layer and woody vegetation on different soil types in the deproclaimed Vaalbos National Park, South Africa, were monitored from 1993 to 2015. To understand influence on rainfall patterns on plants, annual rainfall (July to June) was analysed for the period 1993 to 2015 averaging 396 mm per annum. Palatable and unpalatable perennial grasses both responded to rainfall of the current and previous season but in different ways. The decline of palatable perennial grasses in response to increasing rainfall was influenced in part by use of relative rather than absolute abundance. This indicates that in wet years annual grasses proliferated between perennial grass tufts and were therefore measured as closest to point of sampling. The increase trend of *Schmidtia pappophoroides* is closely associated with a rainfall peak of more than 100 mm in one month. By contrast, *Themeda triandra* increased with increasing rainfall of the previous year. *Eragrostis lehmanniana* did not show a clear response to rainfall but increase in response to soil depth. Neither dwarf shrubs nor perennial forbs showed any significant responses; annual forbs and geophytes could not be analysed owing to small sample sizes. Woody density and structure differed conspicuously across soil types, but there were no trends noticed over time for the park or for any individual soil type. There was also no change in the number of woody species or frequency distribution over this survey period. Despite considerable variation in rainfall, no densification of the indigenous woody plant species did occur nor did any new woody species enter over 22 years.

Rainfall trends in the Northern Cape province

11:20 - 11:40

Presented by :

Christiaan Harmse, Northern Cape Department Of Agriculture, Land Reform And Rural Development

The Northern Cape province of South Africa is the largest province that covers around 372,889 km² land area. Rainfall is variable with the annual rainfall ranging from 450 mm in the northeast down to less than 80 mm in the northwest. Land use is characterized by the production of livestock and game. Rainfall is the key determining factor of forage production and shifts in rainfall patterns and trends are important drivers of livestock production potential. However, rainfall stations are fairly scarce and unevenly spread across the province. Historical, long-term rainfall data were obtained for farms near the following towns: Carnarvon, (1933–2018), Copperton (1915–2018), Fraserburg (1928–2018), and Noupoot (1936–2018). All these stations are located within the summer rainfall region. Observed trends in seasonal and annual rainfall, as well as, the number of rain days were calculated. The data was analysed in order to determine possible variation in annual rainfall as well as possible seasonal shifts. Seasonal shifts in rainfall patterns are of particular interest since it can have a significant impact on agricultural management practices. Increases ($p < 0.05$) in the annual rainfall and the number of rain days were found for all four stations. Seasonal shifts are evident with earlier summer rain observed for the area surrounding Copperton. Historically, the month of March received the highest rainfall, but the data indicate that more recently the month of February receives more rain. There was also an increase ($p < 0.05$) in rain during December. A good correlation ($r = 0.6467$) was obtained between the annual rainfall measured and remotely sensed vegetation conditions for the study sites. Results from this study confirmed the projected changes towards an increase in rainfall for the summer rainfall regions of the Northern Cape province. However, long-term temperature data will be required, to better interpret the possible changes in the climate within the province and its impact on forage

production. Such, historical temperature datasets were not available for the time span of rainfall data for all four farms under investigation.

The impact of drought on the species composition, veld condition and forage availability of Witsand Nature Reserve and implications for game management

11:40 - 12:00

Presented by :

Marnus Smit, Mammalogist, Northern Cape Department Of Environment And Nature Conservation

Large parts of the south-east Kalahari has been affected by drought. During dry periods, forage resources are known to decline in both quantity and diversity. The low rainfall can cause grass mortalities, while the effect on woody plants is not well documented. In the Witsand Nature Reserve, the ever-diminishing forage availability resulted in significant game losses. As dry conditions continued to persist, the impact of the drought on this reserve's vegetation was studied and the implications for game management assessed. Vegetation surveys were conducted at the end of the rainy season (April) in 2018 and 2019. During each survey, the species composition (nearest-plant method), veld condition (Ecological Index Method) and grazing capacity (Grazer Index Method) of each of the six identified vegetation types were determined. To determine the impact of the drought on browse availability, the phenology of 20 abundant woody plant species of the south-eastern Kalahari was studied. Between 10–30 individual plants representative of the population of each of the studied woody species were marked and inspected monthly. During each inspection, plants were allocated a leaf carriage score and leaves classified into different phenophases (budding leaves, young green leaves, mature green leaves, yellowing leaves and dry leaves still attached to the plant). The presence of flowers and fruits or pods were also recorded. Mean monthly leaf carriage scores were calculated and changes in phenophases of species over a two-year cycle determined. The herbaceous species diversity, veld condition and grazing capacity of all vegetation types decreased from the first season to the second. Changes varied considerably between survey sites and vegetation types. The results indicated that veld in good condition tended to be more resilient to drought. Grazing was also found to be insufficient for the stocking rate and may have been the main attributing factor to the extensive loss of game. The drought was also observed to influence phenology of woody plants. Many winter deciduous species, such as *Senegalia mellifera* (black-thorn) and *Rhigozum trichotomum* (three-thorn), flushed new leaves much later in the second season than the first. Some evergreen species were also observed to become deciduous or semi-deciduous as the drought continued to persist. Leaf carriage (total amount of leaves on plants) was much lower for most species in the second season of study than the first. The results highlighted the extensive impact of drought on vegetation and forage resources. Grazing rapidly decrease when dry conditions persist for prolonged periods and result in sudden game losses. Woody plants are often regarded as an important food resource during drought for both grazers and browsers. This study, however, found that woody plants are also affected by drought and, depending on the species, may also become a limiting fodder resource.

Challenges in determining the best rehabilitation parameters and criteria for arid areas with specific reference to the southern Kalahari region of South Africa.

12:00 - 12:20

Presented by :

Chrizzette Neethling, Managing Director, EndemicVision Environmental Services (Pty) Ltd

Thousands of hectares are transformation in South Africa due to the inter-generational accumulation of mining impacts with the contracting of the mining industry in South Africa. The scale of mining reduced from 21% of South African gross domestic product

in 1980's to less than 7% in 2018, leaving in its wake more than 6000 derelict and abandoned mines. The mining transformation is further escalated as water supply infrastructure allows for higher population development than naturally possible in remote and arid areas. Arid ecosystems offer limited land use opportunities and respond in a non-successive, slower rate than other ecosystems. The high costs to rehabilitate arid areas is a financial challenge, especially with the uncertainty of success. This study investigates how to select the best parameters and criteria to determine rehabilitation success in arid areas. One of the main drivers to address national negative mine legacies and escalate concurrent rehabilitation is legislation, specifically the financial provision regulations. The changing, more demanding, legislation and increasing rehabilitation costs to meet mine closure obligations require a greater understanding of rehabilitation in arid areas. Rehabilitation aimed at restoring mined areas and waste rock dumps to their "predetermined natural state" as legally required is many times considered impossible. Normally, the original natural state has not been quantified before disturbance, but the broad understanding of the natural state is described as the rehabilitation benchmark in the Environmental Management Plans. Using best practice, analogue benchmarks are validated chronosequentially to determine rehabilitation success to achieve a specific reference state. The specific issue we address is which parameters and criteria should be used to determine rehabilitation success. We systematically evaluate over 40 key records in the field of arid area rehabilitation in Australia, South America, South Africa, and Namibia. Literature published from 2005 to 2015 are compared and fifteen case studies, as well as current restoration work in the Kalahari region of South Africa, are showcased. In summary, the arid landscape is more diverse and less understood than agreed by consensus. Arid areas consist of complex interactions providing real challenges to defining a workable system that can be used to determine the best parameter criteria model for rehabilitation success. Ecological systems are non-equilibrium; a change in the historic land management of reference sites require reconfiguration of the comparative results between analogue sites and rehabilitation sites. Mostly, methodologies to compare analogue and rehabilitated sites monitor only certain parameters and derive conclusions in term of success based on this limited information. In some cases, this can be defended to trade-off benefits for reduced costs. Forty-six percent (46%) of the cases use analogue models successfully. Over 114 parameters are used in arid areas to assess rehabilitation success. Through an analytical hierarchy process, we determined the best parameter combination for mines in the southern Kalahari region in South Africa.

13:00 - 14:00

**Bella Roma
Restaurant**

Lunch

14:00 - 15:00

Vestibulo 1

Parallel I: Biodiversity of rangelands I

Moderators

Chrizette Neethling, Managing Director, EndemicVision Environmental Services (Pty) Ltd

(Almost) As rich as the the Cape!? - Surprisingly high plant diversity and endemism in the montane grasslands of southern Africa

14:00 - 14:20

Presented by :

Ralph Clark, Afromontane Research Unit / University Of The Free State

With some 20,660 plant species, South Africa is one of the biologically richest countries in the world—largely thanks to the famous 90,760 km² Core Cape Flora (CCF viz. Cape Floristic Region, c. 40% of this regional diversity). Nevertheless, there is strong evidence that the Eastern Great Escarpment (EGE) contributes a significant proportion to regional plant diversity and endemism, due to a high proportion of narrow and regional mountain endemics. The 1,600 km-long, 70,000 km² EGE-comprised predominantly mesic montane grassland with high pastoral and water production value—extends from the Sneeuberg (Eastern Cape) to the Nyanga Massif (Zimbabwe-Mozambique), and includes the Maloti-Drakensberg (the highest part of Africa south of Mount Kilimanjaro). We set out to determine the combined species richness and percentage endemism of the EGE and compare it to the CFR; we anticipate that EGE diversity is c. 6,000–7,000 species with a minimum of 60% endemism, making it somewhat comparable to the CFR (in terms of both absolute values and species richness). A preliminary flora of the EGE has been determined through rigorous fieldwork, database mining, taxonomic investigation, and literature review from 2005–2019. Robust results are now available for the Sneeuberg, Great Winterberg-Amatholes, Mpumalanga-Limpopo Escarpment, and Manica Highlands. Lists in progress (through a collaborative approach) include the Stormberg, Maloti-Drakensberg and Low KwaZulu-Natal Escarpment. The cumulative flora for the EGE is 16,455 taxa—which, if we assume 70% sharing across the EGE, is a total EGE flora of 4,936 taxa. Narrow endemics (those confined to one mountain system in the EGE) comprise 1,830 taxa (i.e. 37% of the putative EGE flora), while regional EGE endemics could be around 2,000 species (or 40%—still a work in progress as there is no quick way to determine regional endemics in this context). This places total EGE endemism at 77%. The EGE is therefore not dishonourably comparable to the CCF: although not as diverse (9,500 species in the CCF) it is possibly as endemic-rich (CCF with 70%). These preliminary results indicate that relatively low elevation, denudational escarpments (like the EGE, and mirrored by the Atlantic Seaboard in South America, the Western Ghats in India, and the Great Dividing Range in Australia), may represent 'species pumps' in the same way that higher elevation, more charismatic mountain ranges do (such as the Andes and Himalayas). Determining the drivers of this diversity and endemism—anticipated as the next step in our EGE research—will offer insights into biogeographical theory around species accumulation and radiation in such landscapes, and if there are parallels with the General Dynamic Model for Volcanic Oceanic Islands. Given the pressures of afforestation, mining, urbanization, over-grazing, renewable energy, woody invasive species and climate change, it is imperative to take quantitative stock of our montane grassland diversity and endemism while there is still time.

Vegetation type conservation targets, status and level of protection in KwaZulu-Natal in 2016

14:20 - 14:40

Presented by :

Debbie Jewitt, Conservation Scientist, Ezemvelo KZN Wildlife

Systematic conservation planning aims to ensure representivity and persistence of biodiversity. Quantitative targets set to meet these aims provide a yardstick with which to measure the current conservation status of biodiversity features and measure the success of conservation actions. The conservation targets and current ecosystem status of vegetation types and biomes occurring in KwaZulu-Natal (KZN) were assessed, and their level of formal protection was determined, to inform conservation planning initiatives in the province. Land cover maps of the province were used to determine the amount of natural habitat remaining in KZN. This was intersected with the vegetation map and assessed relative to their conservation targets to determine the ecosystem status of each vegetation type in KZN. The proclaimed protected areas were used to determine the level of protection of each vegetation type. In 17 years (1994–2011), 19.7% of natural habitat was lost to anthropogenic conversion of the landscape. The Indian Ocean Coastal Belt and Grassland Biomes had the least

remaining natural habitat, the highest rates of habitat loss and the least degree of formal protection. These findings inform conservation priorities in the province. Vegetation type targets need to be revised to ensure long-term persistence. Business-as-usual is no longer an option if we are to meet the legislative requirements and mandates to conserve the environment for current and future generations.

Impacts of landscape composition, marginality of distribution, soil fertility and climatic stability on the patterns of woody plant endemism in the Cerrado

14:40 - 15:00

Presented by :

João De Deus Vidal Jr., Postdoctoral Researcher, Afromontane Research Unit / University Of The Free State

Although various theories have been proposed to explain the outstanding endemism of plants in the Cerrado, four hypotheses about the mechanisms of diversification and distribution are most supported: (1) plateau/valley, (2) stable/unstable climate, (3) core/peripheral distribution, and (4) soil fertility. The first argues that plateaus harbour more ancient lineages than valleys and therefore presents higher endemism. The second theory suggests that climatic stable environments maintained more paleoendemic species. The third scenario attributes the distribution of endemism to gradients of conditions available to locally adapted species and predicts higher endemism in nuclear than in marginal areas. The last theory suggests that lower fertility soils account for higher endemism due to the habitat specialization of its species. We compared endemism patterns with the predictions of each theory to discuss their importance. We mapped the endemism using records of 311 plant species of the Cerrado and applied spatial analysis and distribution models to summarize the importance of each predictor of endemism. We identified 28 areas in which the higher endemism of Cerrado plants was concentrated and presented a map of its distribution. We found correlations among endemism, climate stability, elevation, and marginality, which supported the plateau/valley, core/peripheral, and stable/unstable hypotheses. No association between soil fertility and endemism was detected. We propose that plateaus are more stable climatic environments, and this characteristic along with their elevation and centrality are predictive of endemism. We concluded that most of the endemism is concentrated in overlapping areas of stability of species, which are concentrated in higher elevation central regions. Soil fertility was not linked to endemism. We recommend that central plateaus in the Cerrado require special attention in conservation to optimize the protection of endemic species in the biome.

14:00 - 15:00

Vestibulo 2

Parallel II: Cultivated pastures & feeding ecology I

Moderators

Solomon Tefera , Associate Professor, University Of Fort Hare

Exploring possible allelopathic effects of *Eragrostis plana* and *Sporobolus africanus* in the southern Cape

14:00 - 14:20

Presented by :

Sigrun Ammann, Pasture Scientist, Western Cape Department Of Agriculture

In the southern Cape region, many of the areas used for beef production are so-called old lands dominated by *Eragrostis plana* and *Sporobolus africanus* commonly called "taaipol". These secondary grasslands are characterised by poor productivity and reduced palatability as the grass matures during the growing season. Attempts have been made to sow more palatable and productive species into these old lands with

often very limited success. One reason could be the allelopathic effects of these two species and especially in the case of *E. plana*. To investigate these effects extracts were taken from two sources of above ground herbaceous material, the two species being either field collected material and leaf and stem material collected from tunnel-grown plants. The method used by Goodall et al (2010) was used for the extracts at concentrations 1%, 10%, and 25% w/v (fresh material). Each of the extract concentrations was derived from both intact herbaceous material consisting of leaves and stems, called uncut, and cut material where the leaves and stems were cut into shorter lengths. The extracts were used to germinate *Lactuca sativa* seeds (cv. Commander) in vitro in petri dishes with three replications per treatment. Distilled water was used as the control treatment. Radicle, coleoptile and leaf length were measured on the emerging seedlings. These initial results showed highly significant ($p < 0.01$) reductions in radicle length (0.55 mm), coleoptile length (3.78 mm) and leaf length (5.65 mm) for the *E. plana* field collected cut 25% w/v treatment compared with the control (25.1 mm, 10.1 mm, and 9.79 mm, respectively). The greatest effect was on the radicle length with either no radicle emergence or very stunted emergence with signs of dieback. In the *S. africanus* treatments for cut material at the high concentration there were also signs of radicle dieback at the root tip, even though the radicle length was not significantly shorter than the control ($p < 0.05$). For the tunnel collected material, the control had the shortest length for all three measurements, although this was not significant for all treatments. This either showed that the high nutrient environment reduced the concentrations of allelopathic compounds or that the results were confounded by nutrients from these treatments being present in the extract and thus favouring growth compared with the distilled water control. The most important results were from the field collected material which showed an effect especially from the plant material that was cut. The practical implications of this result for sowing more desirable species into these secondary grasslands is that the common practice of mowing the fields regularly would result in even less successful germination of the sown seeds through the phytotoxic chemicals leaching from the cut leaf litter. These results have given initial indications that more research is required to first understand the allelopathic response in various soil nutrient and climatic conditions and, secondly, the pasture management possibilities to ensure greater success of sowing other species into these old lands dominated by *E. plana* and *S. africanus*.

The assessment of growth parameters and nutrient content of three herbaceous legumes as affect by arbuscular mycorrhiza fungi and Rhizobium inoculation

14:20 - 14:40

Presented by :

Sanele Mpongwana, Student, University Of Fort Hare

Previous studies have shown that forage legume inoculation enhances N nutrient availability to plants through the improvement of biological nitrogen fixation on the plant root system. However, the biological N fixation became ineffective due to low soil P availability. To rectify that, there is a need for dual inoculation with arbuscular mycorrhizal fungus (AMF) which improves nutrient uptake particularly P and N from the soil. The dual inoculation not only assists in N-fixation and nutrient uptake but can also manipulate the environmental hazards associated with inorganic over-fertilization. The study aimed to investigate the effects of arbuscular mycorrhizal fungus (AMF) and Rhizobium inoculation on herbaceous growth parameters, nodulation, biomass yield, and nutrient content of three herbaceous legumes. The field trial was established during the summer season of 2017/2018 in a complete randomized block design with a $3 \times 2 \times 2$ factorial arrangement with four replicates per treatment. There were twelve treatment factors as follow (cowpea control; cowpea+AMF; cowpea+R; cowpea+AMF+R; lablab control; lablab+AMF; lablab+R; lablab+AMF+R; mucuna control; mucuna+AMF; mucuna+R; mucuna+AMF+R). The growth parameters measurements were observed during the course of the study. Three samples were collected at flowering stage harvest and subjected to proximate analysis. Results showed that inoculated plants

performed superior in terms of plant growth and quality over control. Forage parameter measured (plant height, stem diameter, relative mycorrhizal dependency, nodulation, fresh forage yield, dry matter yield, and nutrient composition) were significantly higher in forages samples inoculated with AMF and Rhizobium inoculation in combination as compared to sole application of AMF or Rhizobium. The most noticeable effect of dual inoculation was observed on mucuna forage compared to lablab and cowpea. Co-inoculation significantly increased plant height, stem diameter, relative mycorrhizal dependency, nodulation, fresh forage yield and dry matter yield by 20%, 8%, 12%, 25%, 22%, and 18% compared to control treatments, respectively. The results further revealed that combined application of AMF and Rhizobium particularly on lablab had significantly enhanced fibre content (ADF, NDF) as well as ether extract (EE), and ash compared to other legumes. However, co-inoculation improved cowpea crude protein (CP) and phosphorus (P) content more than other legumes. In addition, AMF and Rhizobium greatly improved lablab calcium (Ca) about 15.83%, potassium (K) about 20.45%, magnesium (Mg) about 6.54% and manganese (Mn) content about 69%, respectively. However, dual inoculation enhanced mucuna sodium (Na), zinc (Zn), and iron (Fe) contents compared to single inoculation and other legumes. It is therefore concluded that dual inoculation of AMF and Rhizobium may be of only limited consequence in high input agricultural systems.

Evaluation of nutritional composition, fermentation characteristics and aerobic stability of Opuntia–legume silage mixture at different preservation periods

14:40 - 15:00

Presented by :

Gopolang Matlabe, Animal Scientist, North West Department Of Rural, Environment And Agricultural Development

The effect of the preservation period on Opuntia-legume silage quality was evaluated using the chemical composition, fermentation characteristics, and aerobic stability. This experiment was arranged in the form of 3 (preservation periods) × 4 (experimental diets) factorial arrangement in a completely randomised design. The chopped Opuntia cladodes and ground legume plant species were mixed at a ratio of 60 Opuntia cladodes: 40 legume plant species. Legumes used were *Leucaena leucocephala*, *Moringa oleifera*, and *Acacia mellifera*. Prior to ensiling, microbial inoculants and molasses were added. After 42 days of fermentation, the silages were further stored for a period of 30, 60 and 90 days during which its quality was analysed. There were significant silage and period interaction effects ($p < 0.05$) on chemical composition and fermentation characteristics. The silage was higher in ADF (22.44 to 47.49%) compared to maize silage (22%) and this is explained by the fact that the silage was made from legumes which were totally dried before ensiling. In general, all silage mixtures, except the control (Opuntia alone) showed NDF content of below 600 g/kg DM, which should not affect gastrointestinal fullness or limit intake in ruminant animals. Chemical analysis revealed that dry matter content was significantly improved with prolongation of preservation period. There were significant preservation period and silage effects ($p < 0.05$) on pH, lactic acid, water-soluble carbohydrates (WSC) and non-significant effect ($p > 0.05$) on dry matter, yeast and mould. Mixing Opuntia with legumes increased the dry matter content. The pH for Moringa silage was lower than 4.8, which will be considered as good silage since the lower the pH, the higher the soluble sugars in the silage ingredients. The WSC concentration of different silages in the present study was lower than the minimum level of 60 g/kg required for efficient fermentation. Lactic acid (LA) is the strongest of all silage acids and was highest in Moringa silage which resulted in a decreased in pH more effectively than other VFAs. The CO₂ production was lower in Opuntia-Moringa and Opuntia-Acacia silage mixture than in control (Opuntia alone) and Opuntia-Leucaena silage mixture. The higher stability of control (Opuntia alone) and Opuntia-Leucaena mixture silage may be associated with a possibly higher concentration of organic acids, such as acetic and propionic, although these were not determined in the present study. High CO₂

production in control (Opuntia alone) and Opuntia-Leucaena silage during aerobic stability test is an indication of high activity of yeasts and moulds in the silage. This study showed that preservation period changed the chemical composition and fermentation characteristics of various mixture silages. However, the preservation period over 60 days did not provide benefits for the evaluated variables. This study concluded that Opuntia-legume silage mixture, especially Opuntia-Moringa silage mixture, can be used to make good quality silage which can be used by farmers during the dry season for a prolonged preservation period of not over 60 days.

15:30 - 16:00

**Conference
Rooms Stoep**

Afternoon Tea

15:30 - 17:00

**Conference
Rooms Stoep**

Research Proposal Poster Session

Moderators

Clement Cupido, Researcher, Agricultural Research Council

Does soil type determine biome boundaries at the Benfontein Game Reserve in the Kimberley Thornbelt?

15:30 - 17:00

Presented by :

Lehlohonolo Lephalletse, Intern, SAEON Arid Lands Node

Soil is a dynamic natural body on the surface of the earth composed of minerals, organic materials and living forms, a result of the primary factors involved in its formation and responsible for determining its final characteristics. Soil surveys, therefore, assist in providing information on soil needed not only for land use management but also as a means to understand ecotone transitions of biomes. The survey takes place in the arid Northern Cape in the Kimberley Thornbelt at the Benfontein Game Reserve where three biomes meet, namely; the Nama-Karoo Biome (characteristic of grassy, dwarf shrubland and pans with infiltration lines located across the landscape), the Grassland Biome (located on a flat subtropical setting, characterised by grass plant cover prone to grazing) and the Savanna Biome (located a little higher up the landscape and dominated by vegetation with both a lower layer of grass and an upper layer of woody plants). We make use of the long-developed South African operational soil classification system categorised into 6 methods; (1) field observation, (2) investigation of soil geographical distribution, (3) soil classification, (4) soil sampling, (5) laboratory analysis and (6) delineated soil map. The game reserve, stretching over 11,000 ha (110 km²), exists on a landscape that can be divided into a watershed koppie, plains on which pans exist and a diverse vegetation cover, features which differ in soil characteristics and water availability. This variation in the landscape is important not only for vegetation, game and livestock, but supports insects responsible for the pollination of plants and buffering the veld in times of drought.

Poisonous plant patches in arid rangelands of Namaqualand, South Africa: Implications for biodiversity and landscape heterogeneity

15:30 - 17:00

Presented by :

Tauriq Jamalie, Masters Student, University Of The Western Cape

Tylecodon wallichii, a succulent shrub that is poisonous to livestock and grows fairly widespread in South Africa, mostly on the lowermost southern slopes of mountains and hills, on sandy or stony soils. These species contain cumulative neurotoxic bufadienolides that upon ingestion cause krimpsiekte—a chronic neuromuscular disease which may cause death in livestock. As such, this plant can cause severe economic losses to livestock farmers. The aim of this study is to explore the ecology and distribution of these poisonous plant patches in arid rangelands by considering its diversity, sizes and current and future distribution as it will likely impact on the livestock economy. The study site, Steinkopf communal area, is a semi-arid rangeland situated in Namaqualand, South Africa. Livestock farming is the primary land use in this area and may be dwindling partly as a result of the consumption of these poisonous plants. Therefore, understanding the ecology of poisonous plant patches in this area may prove economical beneficial and may aid farmers to improve livestock management and production. Remote sensing and GIS tools will be used to gain insight into the distribution of these poisonous plant patches. The plant diversity of these patches will be assessed using 15 × 15 m quadrants. The expected research outcomes of this study include insights into the contribution of these patches to landscape heterogeneity, the beta diversity between two patches, understanding the plant structure and diversity of these patches and understanding the value of these plant patches from an ecological and island biogeographical perspective.

Nutritional properties and feeding value of orange-lucerne silage mix on growth response of Xhosa lob-eared goat

15:30 - 17:00

Presented by :

Sibongele Ndongeni, Student, University Of Fort Hare

Shortage of animal feed in the smallholder livestock farming sector led animal nutritionists to explore non-conventional feed sources to alleviate this problem. During the dry season, especially in winter, poor nutrition in goats results in poor growth and reproduction, thus affecting goat production. The available commercial feed supplements are expensive for smallholder farmers. Thus, fodder conservation could alleviate the dry season feed shortage. Ensiling is one of the methods that can be employed to preserve high moisture by-products. There is a need to search for cheap and locally nutritious available non-conventional feed sources, that can be ensiled and fed to goats during the dry season to support goat production. In citrus growing areas, oranges of poor quality can be processed and ensiled for use as an energy supplement in the dry winter season. The low dry matter (DM) content in orange pulp necessitates the addition of lucerne to improve the ensiling process. Assessing the potential of ensiled orange rejects as goats supplement can help in providing a financially affordable strategy for smallholder farmers in countering the high cost of conventional supplements during the winter season. The objectives of the study are to (1) determine the silage quality (chemical composition and physical characteristics of silage) of orange-lucerne silage mixes; and (2) determine growth performance (daily feed intake, feed conversion ratio, and average daily gain) of goats fed on orange-lucerne silage mixes. The orange rejects will be collected from Fort Beaufort farms, chopped into pieces, dried for a week and mixed with chopped lucerne wilted for 12 hours. Lucerne will be harvested at Fort Cox College Farm. The orange pulp will be incorporated at varying levels of 0%, 12.5%, 25%, and 37.5% to lucerne. The chopped material will be collected and mixed with Sill-All 4X4 silage additive at a rate of 2 L per ton to improve the fermentation process. A plastic drum (200 L) will be used for ensiling up to 90 days. Samples will be collected from drums on the 90th day for proximate analysis and silage quality experiment. Furthermore, 24 female goats approximately 4–5 months of age will be used in a randomized complete design. On the basis of body weight, the goats will be confined in individual pens during the experimental period for 70 days, where 14 days will be allowed for the animals to adapt to the diet. There will be four treatment groups, six goats in each group. The silage will be fed as the supplement to

Xhosa lob-eared goats that are fed ad libitum on grass hay. Daily intake feed, convention ratio, and weight gain will be measured to evaluate growth performance.

The impact of temperature and water limitation on the germination of legume species in the genera *Medicago* and *Trifolium*

15:30 - 17:00

Presented by :

Ethan Britz, Honours Student, University Of The Western Cape

The most important annual pasture legumes cultivated in the Western Cape province of South Africa are annual *Medicago* and *Trifolium* species. These species, however, are not native to the Western Cape and therefore, different cultivars of these species introduced into these agro-ecological areas first need to be tested for their ability to adapt to specific agro-ecological, bioclimatic and edaphic conditions. The current stock of commercially available forage legumes is well adapted to the current bioclimatic conditions of South Africa. However, climatic predictions for the Western Cape are indicating a trend of becoming hotter and drier, and unfortunately, no information is currently available in South Africa to predict the responses of these medic and clovers to future changes in bioclimatic conditions. These future changes in the bioclimatic conditions of South Africa, specifically the increased variability in rainfall and rising temperatures within the Western Cape, could significantly affect the success of these legume-based pastures, affecting the establishment of these species/cultivars and their persistence. It is therefore important to obtain a greater understanding of how currently commercially available cultivars of annual forage legumes will respond to the predicted bioclimatic changes, especially changes in moisture availability and rising temperatures during germination and establishment of the forages. This, in turn, could play a major role in the establishment of these forages under the predicted marginal conditions within the Western Cape. The aim of this study is, therefore, to determine the germination potentials of different legume species in the genera *Medicago* and *Trifolium* to various germination temperatures combined with different levels of water-limitation.

The effects of cover crops usage in suppression of weeds

15:30 - 17:00

Presented by :

Matsobane Ngoasheng, Scientific Technician, North West Department Of Rural, Environment And Agricultural Development

Cover crops are an important factor in reducing the cost and the labour required for controlling weeds. Herbicide use is either eliminated or reduced, since many of these plants are able to smother weeds. Legumes are able to fix nitrogen while cover crops are important for soil conservation and the increased water holding capacity by improving water infiltration. The organic matter has various positive effects on the soil. A growing cover crop can suppress weeds in several ways. It can be direct competition, allelopathy, blocking stimuli for weed seed germination and altering soil microbial communities to put certain weeds at a disadvantage. After a cover crop is tilled in, mowed, rolled or otherwise, terminated, its residues can prolong weed suppression. A vigorous, fast growing cover crop competes strongly with weeds for space, light, nutrients and moisture, and can thereby reduce weed growth by 80% to 100% for the duration of the cover crop. Therefore, the study will concentrate on selecting a champion cover crop, from oats, radish, chicory and plantain, and method of controlling weeds suited to Potchefstroom area, North West, promoting Climate Smart Agriculture. The trial will take place at Potchefstroom (Department of READ). The fields are characterised by loamy to clay soils, with an annual rainfall of 621 mm. Four different fast-growing crops - mentioned above - will be planted on a known problematic homogeneous soil weed covered area. A fifth treatment, of a mixture of these crops, will also be included. Each plot will be 5 × 5 m in size, with no distinct intra-row and inter-row spacing. Treatments will be replicated four times in a random

fashion. Chemical (control) vs. non-chemical use will be tested; therefore the layout will be repeated for both theses. A buffer zone will be present between the control and non-chemical site to ensure no translocation of the chemicals to the non-chemical site via the soil. In order to determine the dry matter yield, for the tuber crops the above-ground vegetative material, data will be collected at two different cutting frequencies. The above-ground biomass will be cut approximately at 5 cm as anything lower will damage plant ability for re-growth material. Harvesting will take place on two different frequencies at 12 weeks + re-growth at 16 weeks (four weeks after the first cut). Similarly, the cutting frequencies will apply for those non-tuber crops. Tubers will be pulled out at 16 weeks weighed and both oven dried at 70 °C until a constant weight is reached. Furthermore, the soil will be analysed, a biomass survey and weed counting will be done. As chicory and plantain are semi-perennial, it will be re-ploughed after the first year. A summer crop will be cultivated and monitored for weed count to see the after effect.

Evaluation of growth characteristics, biomass yield and nutritive value of two *Panicum maximum* cultivars cv. (Mombaca and Gatton) and *Brachiaria brizantha* at different harvests

15:30 - 17:00

Presented by :

Mihle Sokupa, MSc Student, University Of Fort Hare

Panicum maximum and *Brachiaria brizantha* are perennial species and they are indigenous to the tropical areas of southern Africa where they occur mainly in the sub-habitat under trees. Most tropical grasses are underutilised during the rainy season, hence become coarse and fibrous with a decrease in nutritional value and palatability. In contrast, these grasses are overgrazed during the dry seasons causing a decrease in nutritive value and degradation of the rangelands. This in turn leads to shortage of feed resources especially during the dry season, threatening livestock production for most resource-limited farmers who rely on rangelands. Perennial grasses are known to sustain more than 90% of livestock dietary needs. This is due to inherently higher protein (12–15%) and greater digestibility especially during the early growth stages. The main objective of this study is to conduct a comparative evaluation of growth characteristics, biomass yield and nutritive value of two *Panicum maximum* cultivars and *Brachiaria brizantha* at different harvests. Two *Panicum maximum* cultivars (Mombaca, Gatton) and *Brachiaria brizantha* will be used for the trial. The trial will be conducted at the University of Fort Hare research farm from November 2019 to April 2020. It will be laid out in a randomized complete block design, having three blocks, and each block will have six plots measuring 4 × 4 m. Therefore, each cultivar will be replicated six times. Spacing between the blocks will be 1 m, while spacing between the plots will measure 0.5 m. Harvesting will be done three times, at 42, 70, and 98 days after planting. Growth characteristics, which include germination and emergence, will be recorded for the first two weeks. Ten tufts in each plot will be randomly marked, the number of leaves, plant height, and the number of tillers will be recorded in two week intervals. Sampling will be done in the 3 × 3 m net plot with a 1 m border to avoid border effects. Three 0.5 × 0.5 m quadrats will be randomly placed in each plot and samples will be cut at 5 cm above ground level. The samples will be weighed for fresh weight, dried in the oven at 60 °C for 96 hours and weighed again to determine dry matter content thus dry matter yield. The dried samples will be milled, put in plastic bags and analysed for chemical composition (CP, NDF, ADF, and ash, Ca, P, K, Na, Mn, Cu, Zn and Fe). The outcomes expected from this study are to bridge the shortage of livestock feed during the dry season, by recommending more grass species that can be used by farmers as feed supplementation. This study aims to also increase agricultural production in South Africa and other countries, and provide scholars and researchers with updated research.

Dietary inclusion of *Leucaena leucocephala* as a climate smart agricultural strategy to reduce methane emission in beef cattle

15:30 - 17:00

Presented by :

Sanele Jiyana, PhD Candidate, Agricultural Research Council

Methane production is the main hydrogen sink for most ruminant feeds during digestion. Methane has 28 times the global warming potential of carbon dioxide over a 100 year period. Farmed ruminants account for 30% of anthropogenic methane emissions. Beef cattle, along with dairy cattle, have been identified as the major source of methane emissions among other domestic ruminants. A scientific intervention is required to ensure a reduction of methane emitted by ruminants. Any proposed intervention should be easily accessible and affordable in order to accommodate poorly resourced and emerging farmers. *Leucaena leucocephala* is one of the protein-rich plants (27–34% crude protein on dry matter basis) that have been identified as a potential solution in reduction of methane emitted by cattle, due to its richness in tannins (30–43 g/kg of leaf meal on dry matter basis). It has been well documented that tannins reduce enteric methane emissions. The proposed study will investigate if the dietary inclusion of *L. leucocephala* can be used as a viable climate-smart agricultural strategy to reduce methane emissions in beef cattle. The study will be divided into five phases. In phase one: semi-structured key informant interviews will be conducted with a total of 50 farmers from the Tshwane region (areas of Bronkhorstspuit and Rust de Winter) of Gauteng province. Twenty-five farmers will be considered per area. The aim of phase one is to assess perceptions of farmers about the significance of practicing climate-smart agriculture. In phase two: farmers will be trained on the significance of climate smart agriculture. Training will also teach farmers that a reduction of methane emissions from cattle will actually benefit them as farmers, since enteric methane production by cattle actually wastes 2–12% of dietary gross energy. In phase three: the processing of *L. leucocephala* and its inclusion in formulated experimental diets will be done. The dietary treatments will have 0%, 10%, 20%, and 30% inclusion levels of *L. leucocephala* as an alternative protein source. Chemical composition, rumen fermentation kinetics and in vitro digestibility will be done to test all dietary treatments. In phase four: growth performance, methane emissions using laser methane detector (LMD) device, and carcass quality (characteristics, composition and sensory evaluation parameters) will be measured under feedlot conditions. Experiments will be conducted at the Agricultural Research Council Irene Experimental Farm. Data will be subjected to analysis of variance using SAS software (LSD at 5%). In phase five: an inclusion level that managed to reduce methane emissions without negatively affecting animal growth performance and carcass quality will be used for on-farm feeding, to encourage the adoption of technology by the farmers.

Assessing the impacts of bush encroachment on the density of tick-host interactions in a South African savanna

15:30 - 17:00

Presented by :

Shaundré Hofständer, MSc Student , University Of The Western Cape

Bush encroachment is a universal phenomenon, which has become more prevalent in savanna ecosystems over the last century. Although the causes and impacts of bush encroachment are debatable, it is known that certain factors facilitate the spread of bush encroachment. The impact of bush encroachment on parasitology is a novel research area. Thus, the aim of this study is to understand the effects of bush encroachment on parasite density (i.e. ticks) in savanna rangelands. Furthermore, it will investigate how parasites are transferred from encroached vegetation to small mammals (primary hosts) and livestock (secondary hosts). This is of importance as livestock is greatly relied upon in terms of both dairy and meat products. Parasites play a major role in the health of livestock as they can be vectors of deadly diseases, and consumption of parasite-infested livestock products can be harmful to the human population. The study site is located at the Agricultural Research Council

Loskop Experimental Farm in the Mpumalanga province. Tick drags, and small mammals caught using Sherman live traps will be used to sample ticks. Sampling will be conducted at non-encroached, intermediate and densely encroached vegetation sites. The infestation of ticks on livestock will be sampled from animals that graze within the three different bush-encroached sites. The findings of this study could contribute to improved bush encroachment management that could lower the risks of tick infestations that will eventually affect secondary hosts.

Potential of using woody encroaching species to control endoparasites in cattle grazing savanna rangelands

15:30 - 17:00

Presented by :

Taryn Jacobs, MSc Candidate, University Of The Western Cape

Vachellia karroo is one of the most widespread and abundant indigenous tree legume species in southern Africa. Subsequently, *V. karroo* is one of the most important woody invaders and is deemed to be a severe encroacher, which negatively affects land utilisation and rangeland productivity. However, recent research interests have shifted from its eradication as an undesirable plant, to it being used as a fodder resource for livestock with the possibility of controlling endoparasites. Therefore, the main aim of this study will be focused on evaluating the potential of *V. karroo* as a measure of control of endoparasites in beef cattle and dairy cattle grazing savanna rangelands during the wet and dry season. This study will attempt to (i) determine which helminths are present in beef and dairy cattle where the eggs will be identified through faecal cultures and possibly grown in the laboratory, and (ii) determine the effect of the woody encroaching species, *V. karroo*, as a measure to control endoparasite (helminth) loads, where leaves of the plant will be collected and extracts applied to helminths under laboratory conditions. The study will ask the following questions: (1) Is there a difference in helminth diversity between beef and dairy cattle? (2) How does the helminth diversity differ between the wet and dry season? (3) Can *V. karroo* be used as a control for endoparasites? To obtain the research objectives and answer the proposed questions, sampling will occur at the Agricultural Research Council Roodeplaat Experimental Farm in the sourish mix bushveld north of Pretoria. Results of this study could thus provide insight and improve our knowledge into the future management and treatment of animals on encroached savanna rangelands.

Impact of woody plant encroachment on the spatiotemporal dynamics of grazing capacity in grassland and savanna rangelands

15:30 - 17:00

Presented by :

Jillian Fredericks, MSc Student, University Of The Western Cape

It is well documented that increasing levels of woody plant encroachment in grassland and savanna rangelands reduces the availability of good quality forage for livestock. Consequently, this negatively impacts the condition of the rangeland and the economic return from livestock. A detailed understanding of the level and stages of woody plant encroachment, and its associated effects on primary productivity, in relation to the normalized difference vegetation index (NDVI) in mesic grasslands and savannas, needs to be developed before any management intervention could be recommended. Hence, this study aims to assess how grazing capacities vary in relation to different levels and stages of woody plant encroachment in grassland and savanna rangelands in space and time. The study will be conducted at the Agricultural Research Council Loskop Experimental Research Farm in the Mpumalanga province, and the Roodeplaat and Irene farms in the Gauteng province, South Africa. The aim of this study will be accomplished by fulfilling the following research questions: (1) What is the relationship between grazing capacity and NDVI? (2) How does woody plant encroachment affect grazing capacity in grassland and savanna rangelands? (3) How would grazing capacities be affected by future projected climates? These questions will be addressed

by achieving the following objectives: (1) Analysing the relationship between grazing capacity and NDVI, (2) developing correlations by observing the variation of primary productivity in relation to woody plant encroachment over time, and (3) assessing the possible effects of future projected climates on grazing capacities. The study will be conducted using remote sensing techniques, GIS, and quantitative data collection of vegetation, where vegetation will be identified to species level for both wet and dry seasons. The results obtained on the applicability of dynamic grazing capacities may improve managerial knowledge on managing stocking rate in mesic woody plant encroached grassland and savanna rangelands for different seasons.

Impact of herding on veld condition, livestock performance and economic returns for rural communities in Alice: A case study in semi-arid regions of the Eastern Cape, South Africa

15:30 - 17:00

Presented by :

Mpumzi Protous Mavuso, Student, University Of Fort Hare

Rangelands are important natural ecosystems that provide local communities with food, habitat for wildlife, and forage for livestock. Livestock production plays a diverse, significant role in the livelihoods of rural people; economically, socially and environmentally. However, despite the numerous benefits gained from livestock production in rural communities, the lack of a livestock and rangeland management strategy adversely affects the continuous supply of these benefits. Currently, most livestock owners in the Eastern Cape only lead their animals to the communal grazing areas in the mornings and leave them there to graze in an uncontrolled manner. Therefore, this study intends to evaluate the impact of herding and uncontrolled grazing on livestock performance and communal rangeland condition, as well as on economic returns for rural communities in the Eastern Cape. The study will be carried out in three case study sites, namely Guquka, Sompondo and Giltoni, and will involve the selection of two cattle from ten participating households (twenty from each study site). Out of the twenty animals, ten will be herded every day for six weeks and the remainder will carry on grazing as usual. All the selected animals will be fitted with collars with global positioning system (GPS) trackers to establish their grazing distribution (patterns) in the wet and dry seasons for a month in each season to determine their seasonal grazing preferences and their performance, while monitoring ecosystem health and assisting with management decisions. Following the establishment of the grazing patterns, veld condition assessments will be done on the frequently grazed areas indicated on the map from the GPS collars in order to determine herbaceous species composition, diversity, biomass production, basal cover, woody composition, density, tree equivalents, and browsing unit of those areas. Prior to fitting of the GPS collars, selected cattle will be weighed to determine body weight change; body condition scoring will be used to determine condition or amount of subcutaneous fat. A structured questionnaire will be administered at the beginning of the study to establish the perceived rangeland quality, livestock ownership, performance, mortality, and economic benefits of cattle in the three study sites. After the removal of the GPS collars, the questionnaires will be conducted again to ascertain if herding has made any difference. It is expected that this study will show that herding plays a positive role on rangeland health, livestock, and on people's livelihoods. Additionally, findings from this study will feed into a bigger research project that is aimed at finding rangeland management strategies that can be adapted to local conditions.

Investigating sustainable control practices for *Euryops floribundus* encroachment in communal rangelands of the Eastern Cape, South Africa

15:30 - 17:00

Presented by :

Sive Tokozwayo, Eastern Cape Department Of Rural Development And Agrarian Reform

The vegetation structure in grasslands is gradually changing from grass-dominated to bushland ecosystems. This change has resulted in poor livestock performance and reduced grazing capacity. There are many factors that trigger bush encroachment such as fire exclusion, high grazing pressure, and climate change. Loss of rangeland productivity due to encroachment by *Euryops floribundus* has been a growing concern in communal grazing lands. *Euryops floribundus* is known as unpalatable woody plant species to browsers, and also has a suppressive effect on grasses species. The response of herbaceous vegetation and soil properties to control practices such as fire, bush clearing, and combined treatments (fire and bush clearing) has not been explored. This study will be investigating the response of herbaceous vegetation and *E. floribundus* to fire, bush clearing, and combined treatments (bush clearing plus fire). Furthermore, it aims to advance the understanding of communal farmers of the control aspects of *E. floribundus* with the aim of improving rangeland productivity and livestock performance. This study will be conducted at Mxe village in Cala of the Eastern Cape in South Africa. In this experiment, a plot of 3.94 ha will be measured and fenced; this plot will be further divided into 12 subplots of 800 m² spaced 5 m apart. All fenced subplots will be closed or rested for vegetation recovery for two months. After vegetation recovery, three treatments (fire, bush clearing, and fire-bush clearing) will be randomly assigned and each replicated three times. Bush clearing and fire treatments will be applied once a year in spring. Combined treatments will be applied in winter (clearing) and fire in spring. Species composition will be determined using a quadrat (0.25 m²). This quadrat will be placed randomly within a subplot and replicated three times. Herbaceous vegetation within that quadrat will be identified and recorded to species level. Tuft to tuft distance and tuft diameter size will be quantified to determine soil cover, and herbaceous vegetation within a quadrat will be harvested using a scissor. Harvested herbaceous vegetation samples will be oven dried for 48 hours at 60 °C. Dry weight will be quantified using a weighing scale. Forage production will be determined as kg/ha. Woody plant density per subplot will be determined by physically counting the number of trees. Tree height and tree diameter will be measured before applying treatments. Nine soil samples per subplot will be randomly sampled at a soil depth of 0–20 cm using a soil auger. Soil samples will be oven dried at 60 °C for 48 hours and later will be analysed for soil pH, soil carbon, micro and macronutrients. Collected data will be analysed using the general linear model of SAS.

Assessing livestock grazing distribution on communal rangelands of Guquka, Eastern Cape, South Africa

15:30 - 17:00

Presented by :

Thantaswa Zondani, Senior Research Assistant, Agricultural Research Council – Animal Production Institute

Rangelands play a vital role and contribute significantly to the livelihoods and well-being of South Africans by providing livestock with forage as well as supporting them through the provision of several goods and services. Communal livestock is currently managed under a continuous grazing system where livestock free range with the absence of herding. The aim of this study is to assess the effect of livestock grazing patterns on plant species (*Digitaria eriantha*, *Themeda triandra*, etc.) composition in the communal rangelands of Guquka. GPS collars will be used to determine cattle grazing patterns. The GPS collars will be fitted on cattle to record their position at 15 minutes interval in the dry and wet season. The data will be downloaded using CatLog Generation 2 and R Studio i386 3.1.1 (statistics package). Data will then be imported into ArcGIS 10.1 to create density maps showing areas that are frequently grazed. The species composition of these frequently grazed areas will be determined using a point to tuft distance method. The expected outcome is that the frequently grazed areas will have reduced decreaser grass species such as *Digitaria eriantha* and *Themeda triandra*, which shows the palatability and health of the rangelands. When overgrazed these grass species stand the risk of being replaced by increaser grass species.

Studies of cattle foraging behaviour and forage species trends in communal rangelands of South Africa to develop climate smart rangeland management and feeding strategies

15:30 - 17:00

Presented by :

Solomon Tefera , Associate Professor, University Of Fort Hare

Climate change has already increased the vulnerability of rural African agro-pastoral systems that depend on agriculture for livelihoods. This is particularly critical for sub-Saharan Africa, where more than 60% of people live in rural areas producing more than 85% of their food from crop and livestock farming. In southern Africa, no comprehensive studies have investigated climate change impacts on forage resources and livestock foraging patterns on natural pastures, nor identified climate-smart pasture management and feeding strategies as an adaptive and/or pro-active measure. To carry out the current study, first, a social survey will be conducted in two agro-ecological core-grazing sites to get farmers' perceptions of rangeland plants, and climate change and its impacts on forage resources. Then, field vegetation surveys will be conducted in three communal grazing areas selected per ecological site. The vegetation surveys are aimed to assess the current status of forage species, and select key forage species to determine their response to a simulated change in climate (greenhouse experiment). Diet selection behaviour of cattle will be studied in four seasons (spring, summer, autumn, and winter) over two year periods to determine the most preferred forage species. At the end of each season, blood samples will be collected to determine the macro and micro elements contribution of the preferred forage species to grazing animals. Forage species contributing to the major diet of the animals will be harvested to determine the nutritional and anti-nutritional factors and their suitability for feeding. All the data will be combined to ultimately select forage species under threat (or potentially) in a changing climate and grazing scenario, and recommend climate-smart pasture management and utilisation, as well as conservation practices for further study in the next phase of the project. Social survey data will be analysed using SPSS software 2011, and field vegetation and foraging be analysed with SAS software.

Cattle as cheap grass seed distributors: Fact or fiction?

15:30 - 17:00

Presented by :

Yvette Brits, Scientist Production Grade C, North West Department Of Rural, Environment And Agricultural Development

Utilising livestock as grass seed distributors, by mixing seed into their feed is a practice often used by land users for veld improvement. However, the results are both poorly documented and inconsistent. It is difficult to monitor this method in a natural veld setting as too many variables, including varied soil seed banks, a diverse grass species composition and other distribution methods over large areas might have an influence on the current composition of the veld. Past international studies on the effect of the digestive processes on the ability of seed to germinate rarely concentrated on seed germination directly in a natural environment: after passing the digestive tract, the manure was collected, seed isolated and germination tested in germination chambers; in addition, limited work was done on sub-tropical grasses. Although these international studies have shown a decline in seed viability, some land users locally claim that this practice was successful on their farms. The aim of this proposal is to, under a controlled environment, include a variety of sub-tropical grass species in a cattle feed ration, monitor the survival of these seeds through the digestive tract, observe the germination, and evaluate the production potential of these grasses over a period of time. To achieve this, the study will be conducted on a piece of land where no sub-tropical grass species have been cultivated before. This suitable portion was identified at the experimental farm of North West READ, Potchefstroom. A forage

sorghum land (camp) will be divided into 4 × 0.125 ha paddocks. Each paddock will represent a replicate, which will be grazed by four growing weaners, for the study, i.e. 16 in total. Sub-tropical grass seed will be mixed into the feed ration and roughage will form part of the ration. Enough clean drinking water will be available. Grass seed to be used includes *Cenchrus ciliaris*, *Chloris gayana*, *Digitaria eriantha*, *Panicum maximum*, and *Panicum coloratum*-non-coated. The weaners will act as seed depositors in these paddocks for four weeks. After the four weeks acting as distributors, the weaners will be withdrawn and put in corrals (pens). At the corrals, the weaners will be fed the same ration and hay bales, as a feed source, correlating with the seed mix, for one week, following an adaptation period. Dung will be collected on a daily basis. Dung will be placed on another virgin portion of land - no sub-tropical grasses cultivated on before. Over the one week trial period, half of the daily collected dung will be placed as "wet" collected dung on the site on the day. The other half will be dried under natural conditions simulating dry dung, before being placed on the allocated plots. For both dry and wet collection, three 1 × 1 m plots, will be placed and demarcated with a date. For both the distributor and dung collection studies, the initial parameter to be monitored will be germination. Over a period of time plant composition, density, and biomass production will form part of the physical surveys. All results will be analysed and compared to conclude whether or not the livestock, more specifically, cattle can successfully and effectively be used as seed distributor units in our efforts to restore and rehabilitate larger areas of degraded veld.

Investigating the risk of non-compliance to certification in a premium value beef value chain

15:30 - 17:00

Presented by :

Nonkwenkwezi Myeki, Research Technician, Agricultural Research Council – Animal Production Institute

In South Africa, livestock production has long been accepted as one of the most critical farming practices. On the other hand, understanding the value chains of livestock production has only recently assumed importance in livestock marketing. This study focus on beef produced from cattle kept in a natural environment where they are free to roam around the veld for their entire lifecycle, or finished on a grass and forage based diet without antibiotics, pain, injuries or diseases and fear. The value of beef produced is usually higher applied to free range products that certify as better quality, than other meat products on the local market. Furthermore, compliance information on premium value beef and planting grass is crucial for verifying market specification compliance, rangeland management and animal health assessments. Nevertheless, there is a growing concern about whether these participants will be able to improve beef, comply with certification and meet specifications of the marketing value. To this end, the aim of the study is to assess the risk level of non-compliant certification participant farmers on ethical and other specifications, such as carcasses that meet free-range market of premium beef value chain, and understand the animal ethics involved in the certification of the premium beef value chain. Lastly, to determine the performance of free-ranging beef breed on different rangelands in South Africa. The data for this study will be collected using different breeds such as bonsmara, simbra and, a mix of bonsmara and simbra. That will be divided into three groups of young steers and heifers placed on different vegetation to obtain body weight. Questionnaire survey will be conducted to gather information on the ethics involved in the certification of premium beef at Cradock abattoir value chain. The data will be captured on KoBoCollect, an Android-enabled app, immediately during the interviews and will be transferred to Microsoft® Excel spreadsheet format later to get general descriptive statistics. Data will be analysed using R statistical and Statistica software package. This study will form an important contribution on necessary understanding and the implications of non-compliance to certification particular for the commercial-oriented smallholders in the Eastern Cape province using natural veld, no antibiotics and no stimulations. This study is expected to help farmers understand the cost caused by the non-compliance in premium beef market and the importance of

rangeland management. The study will also help the commercial-orientated smallholder farmers to be aware of the importance of market specification and how critical it is to know what consumers need.

Integration of in-situ and remotely sensed data set for pasture quality and quantity assessment to enhance livestock production

15:30 - 17:00

Presented by :

Khuliso Ravhuhali , Senior Lecturer, North-West University

This study will be conducted by integrating in-situ and remotely sensed datasets to assess the quality of grasslands and mapping the spatial distribution of aboveground biomass from different geographic locations in the Mpumalanga province, South Africa. The study will be conducted from the 15th of October 2019 to the 31st of March 2020. SPOT 6/7 will be acquired for the rainy seasons of 2019 and 2020 by corresponding the dates of the field data collection and image acquisitions. The images will then be processed. Pasture samples will be collected using a stratified sampling technique from various plots. Prior to grass harvest, solar radiation that is reflected from grass canopies will be taken from each sampling quadrat at all sampling locations using a spectroradiometer. After harvesting the sample, the grass will immediately be transported to a laboratory. The sample will be oven dried and weighed to determine the dry biomass. Chemical analysis will be carried out to determine protein and fat content. Regression analyses will be performed to find functional relationships between each of the processed satellite data and N-fat concentration and forage quantity for the study site. This will be used to develop a model for rangeland pasture quantification and quality assessment and determine the carrying capacity of grasslands in the area.

17:15 - 18:15

Vestibulo 1

Annual general meeting of the Grassland Society of Southern Africa

18:30 - 20:00

Lapa

Dinner

08:00 - 10:30

Plenary: Ecology of woody rangelands

Vestibulo 1

Moderators

Justin Du Toit, Production Scientist, DAFF- Grootfontein ADI

KEYNOTE: Bush encroachment alters grassland ecohydrology and requires novel solutions for rangeland management

08:00 - 08:45

Presented by :

Jesse Nippert, Professor, Kansas State University

Grasslands are a widespread and globally important biome providing key ecosystem services including C storage, regulation of the water cycle and diverse assemblages of grasses, forbs, and woody plant species. These plant species often have unique physiological and morphological mechanisms that facilitate persistence through time. Plant survival strategies often require trade-offs that balance competitive efficiency for resources, and an ability to tolerate (or avoid) frequent periods of resource limitation. In addition, alterations in bottom-up or top-down drivers (or their interactions) have the potential to modify coexistence dynamics among diverse species assemblages. Grasslands face multiple threats, including changes in drought intensity and bush encroachment - a process that results in increased woody plant abundance corresponding with decreased herbaceous plant abundance. The combination of reduced soil moisture and shifts in plant dominance from herbaceous to woody are likely to alter water pools in the soil profile. Altered ecohydrology may occur because woody plants tend to utilise soil moisture at deeper soil depths, while grasses are typically dependent on surface soil moisture. In order to predict changes in grassland vegetation structure and the hydrological cycle following bush encroachment, a greater understanding of changes in soil water pools at multiple soil depths is required, as well as the responses of these pools to changes in precipitation patterns. The Konza Prairie Biological Station in eastern Kansas, USA, supports ecological research focused on the dynamics and drivers of tallgrass prairie. In addition to biotic research, detailed landscape and hydrological characterisation of the site have provided insight about the roles of climate and land-use history on site ecohydrology. Fire frequency on Konza is prescribed at varying intervals for different watersheds, resulting in C4 grass dominance with frequent fire, mixed species assemblages with c. three-year fire frequencies, and bush encroachment in areas that were infrequently burned. Here, I will present a conceptual overview linking the physiological and morphological characteristics among C4 grasses, C3 forbs, and C3 woody plants. Fundamental ecophysiological differences among woody and herbaceous plants are manifest as distinct traits when competition for water is high, compared to coexistence when water is plentiful. Ultimately, these hydraulic traits and ecohydrological strategies among species influence landscape patterns, ecosystem processes, and susceptibility to drought. I will provide evidence that woody plants alter the ecohydrological dynamics of grasslands by changing infiltration pathways, altered groundwater recharge, and distinct patterns of plant water use. Identifying these unique traits of woody shrubs may prove useful for successful ecosystem management by utilising management strategies that increase stress among undesirable woody species and maximise the likelihood of mortality during prescribed fires.

Why is grass production so low in Mopaneveld? An investigation of the relative effects of climate, soils, grazing and tree competition

08:45 - 09:05

Presented by :

Tony Swemmer, Research Manager, SAEON

Mopaneveld ecosystems cover approximately 555,000 km² of rangelands and protected areas across southern African, and support extensive cattle and game farming, and eco-tourism. Grass production is critical for sustaining these industries, but is apparently lower in Mopaneveld than other savannas with similar rainfall, i.e. the grass layer in Mopaneveld has a low rain-use efficiency (RUE). Is this due to the abiotic environment (climate or soils), or biotic factors that could be managed (tree cover and grazing)? Four hypotheses that may explain the low productivity of Mopaneveld grass communities were tested by comparing Mopaneveld sites with nearby sites of non-Mopaneveld savanna in the central Lowveld region of South Africa: 1) The climate of Mopaneveld is less favourable for grass growth; 2) The soils of Mopaneveld are less favourable for grass growth; 3) A long history of over-grazing has degraded the grass productivity of Mopaneveld; 4) Mopane trees suppress grass productivity by reducing soil water content in the upper soil layers. Contrary to expectations, means for 5 to 10 years of annual biomass data from four Mopaneveld and four non-Mopaneveld sites in the central Lowveld had a similar range of RUE (0.06 to 0.39, and 0.05 to 0.22 g/m²/mm rain, respectively). Historical rainfall and temperature data for stations close to each group of sites revealed only minor differences in aridity (evaporation / rainfall) and intervals between rainfall events, between each group of sites. Soil types did not differ substantially between sites. The hypothesis that Mopaneveld is less productive because of historical overgrazing was supported, as sites with low RUE had long histories of heavy grazing. Plots within these sites that were recently protected from grazing had similar RUE to protected plots at the non-Mopaneveld sites. Support for the final hypothesis, that Mopane trees suppress grass productivity, already exists from the results of bush-clearing trials in Mopaneveld in other regions. Additional support for this was found in the form of increased grass production in response to thinning Mopaneveld at one of the sites. These results suggest that low grass productivity in Mopaneveld is caused by over-grazing and/or bush thickening rather than any abiotic factors. Better grazer management and bush-clearing should therefore form an integral part of any efforts to restore the extensive areas of degraded Mopaneveld in the communal rangelands and game farms of southern Africa.

Differential plant dispersion in all growth forms across experimental burn blocks in the Kruger National Park

09:05 - 09:25

Presented by :

Brian Reilly, Head Of Department, Tshwane University Of Technology

There is a paucity of information on plant dispersion in African savannas, in particular the grasses, herbaceous plants and dwarf shrubs of the herbaceous layer. This is partly due to the lack of data analyses on plant dispersion derived from density estimates, specifically adequately replicated data sets allowing for full statistical evaluation. Recent comprehensive replicated density surveys across controls and three burn treatments in four landscapes of the Kruger National Park have facilitated the calculation of density indices for all species encountered. Variance estimators were generated using randomisation with replacement which, together with the mean density, allowed computation of dispersion indices. These indices indicate random, uniform or contagious dispersion. These indices are compared and shown to differ across the landscapes under three different fire regimes illustrating the effect of fire on plant dispersion per growth form. Results show a range of influences on dispersion. This is a step in the understanding of the functioning of vegetation structural layers under differing management regimes.

Drought amnesia: Lessons from protected areas in the eastern Lowveld of South Africa

09:25 - 09:45

Presented by :

Mike Peel, Specialist Scientist, Agricultural Research Council – Animal Production Institute

Protected areas (PAs) adjacent to the Kruger National Park (KNP) are divided into fenced and unfenced properties. I discuss land use development to provide context of how these savannas have evolved over the last century. While the PAs have embraced the basic philosophies of the KNP management approach and have similar high level objectives, they function at different spatial, and thus temporal scales due largely to fencing and the subsequent provision of water in these areas. I examine bottom up (environmental, rainfall) conditions leading into five drought periods dating back to 1982/83 and top down drivers focusing on animal number and type on fenced versus areas open to the larger KNP system. We then examine the response variables, grass species composition, cover and standing crop and the capacity of these to attain a variety of potential land use objectives. Using a data set spanning some thirty years, we provide scenarios that offer an early warning system to managers irrespective of land use objectives and management approach (laissez faire or active). We present scenarios, one of which illustrates a case where despite early warnings to landowners over a two year time period, a lack of landowner action resulted in a failed grass layer and ultimately an 85% mortality of the buffalo population during a drought.

No fire – fewer trees: Long-term effect of fire frequency on woody plant communities at the Fort Hare Fire Trials

09:45 - 10:05

Presented by :

Susi Vetter, Associate Professor, Rhodes University

In the Eastern Cape (MAP ~ 600 mm), bush encroachment and transition of savanna to broadleaf thicket are widespread. We examined the effect of fire frequency on woody plant density, size structure, and composition at the University of Fort Hare long-term fire trials, where five experimental burn regimes (without any grazing) have been applied since 1980: one, two, three, four, and six-year burns plus unburned controls. We wanted to determine (1) the trend in woody density over time from 1980 to 2018, (2) whether high fire frequency acted as a filter excluding broadleaf species associated with thicket, and (3) whether fire reduced tree density compared to unburned controls. Tree densities and size class distribution had been monitored in fixed plots at approximately five-year intervals between 1980 and 2009. In 2018, we conducted a full census of woody individuals > 50 cm height in the experimental plots and determined the density of individuals < 50 cm height in smaller subplots. Woody density had increased substantially over the course of the experiment and was dominated by *Vachellia karroo*, but all tree species persisted even under frequent fires. The density of *V. karroo* and total tree density were greatest at fire frequencies of between 2–4 years, while the unburned control plots had the lowest tree densities. *Vachellia karroo* individuals in the larger height classes (> 2 m) were found in all treatments but were most abundant under triennial burning. This suggests that fire alone does not maintain the savanna state and that herbivory is likely to play an important role in keeping trees from escaping into the larger size classes. The low density of trees in all size classes in the unburned controls suggests that either a lack of seed scarification reduces germination, or that grass competition reduces seedling recruitment. This will be experimentally tested.

10:30 - 11:00

Conference
Rooms Stoep

Morning Tea

11:00 - 13:00

Vestibulo 1

Parallel I: Biodiversity of rangelands II

Moderators

Ralph Clark, Afromontane Research Unit / University Of The Free State

Biodiversity Stewardship milestones achieved in the Gauteng province,
South Africa

11:00 - 11:20

Presented by :

Natalie Horn, Biodiversity Officer, Gauteng Department Of Agriculture And Rural Development

The Gauteng province has committed to expanding the number of hectares of land under formal protection in 2018/2019 by 9,000 ha, and biodiversity stewardship has been identified as the most cost-effective mechanism with which to achieve this. The Gauteng Biodiversity Stewardship Programme (GBSP) is a collaboration between the Gauteng Department of Agriculture and Rural Development (GDARD), the Endangered Wildlife Trust (EWT) and the World Wide Fund for Nature (WWF) Nedbank Green Trust. The programme was formed to catalyse the implementation of biodiversity stewardship in the Gauteng grasslands and as the project concludes, we will ascertain if the GBSP project met its objectives and will explore what is next for the GBSP. Since its inception in 2015, the GBSP project has made enormous progress towards understanding the natural landscape in Gauteng and the identification of institutional processes needed within the GDARD to ensure effective implementation of stewardship in the province going forward. The project is now at an exciting stage with the 'Intent to Declare' being published in both the Provincial Government Gazette as well as two national newspapers for two proposed protected areas, one north of the Vaal Dam and the other near the town of Devon. The publication in the Provincial Government Gazette initiated the 60 days public participation period and, once this period has been completed, any comments and objections will be put before the MEC for consideration. These actions are as per the legislative process stipulated in the National Environmental Management: Protected Areas Act No. 57 of 2003 (NEM: PAA). The project's measurable target of publishing the 'Intent to Declare' for 5,000 hectares of privately owned land under biodiversity stewardship has not only been achieved, but has also been surpassed. The GDARD Biodiversity Stewardship Unit has also been working with a group of > 100 private landowners towards declaring a protected area north of Diepsloot west of Pretoria consisting of 116 land parcels. The 'Intent to Declare' for this proposed protected area has also been published in the Provincial Government Gazette as well as two national newspapers and is also in the 60 days public participation period. The abovementioned three proposed protected areas will be the first privately owned protected area declared under the NEM: PAA in the Gauteng province. Whether or not the declarations were successful, will be shared at the Congress.

Southern African mountain ecosystems - indicators for changes in
biodiversity

11:20 - 11:40

Presented by :

João De Deus Vidal Jr., Postdoctoral Researcher, Afromontane Research Unit / University Of The Free State

Southern hemisphere mountain ecosystems are not as well represented on the global stage as those in the northern hemisphere. As a result, southern hemisphere mountain systems are often less well understood, and therefore often prone to assumptions for management and mitigation of human-induced degradation biased to northern perspectives. For example, the absence of a clear tree-line in these grassland-dominated systems often masks the effects of climate change compared to typical northern hemisphere systems in which upward movement of trees and shrubs can be monitored and correlated with thermal changes. Also, the natural role of fire in these semi-arid and drought-prone southern systems drives a biodiversity suite that is very different in ecology and life strategy to those in northern systems. Thus, different means of measuring and monitoring change in grass-dominated southern hemisphere mountains are necessary. We use the endemic-rich Maloti-Drakensberg as a case study to show the potential for measuring change through (1) considering the masking effects of immediate anthropogenic change (usually a more dramatic and immediate concern in real time), and (2) considering background subtle change. For the latter, we explore potential indicators such as biodiversity erosion, species composition shifts, C3-C4 grass community changes, woody species expansion, and colonisation by non-native species (invasive and naturalised). Challenges to these indicators being effective are-as mentioned-the masking effects of immediate change, but also the gradual erosion of ecosystem resilience from long periods of unsustainable use (e.g. communal rangeland degradation since the 1800s). Given the extremely high water production value of these mountains in arid and semi-arid southern Africa, the long-term resilience of such ecosystems should be a high priority for research, policy, and practice.

A pathway to integrated objective based monitoring at mines to ensure net positive biodiversity outcomes

11:40 - 12:00

Presented by :

Chrizette Neethling, Managing Director, EndemicVision Environmental Services (Pty) Ltd

Land management on mines cannot be effective without useful, reliable information on changes in the environment they are responsible for managing. Biodiversity inventory is a point-in-time effort to quantify presence, abundance, or distribution of species resources in space (Odum, 1971). Ecological monitoring is the "sequential measurement of ecological systems over time with the primary purpose of detecting trends in the components, processes or functions" (Odum, 1971). Mining companies with biodiversity impacts or land management obligations are required to monitor biodiversity as part of their environmental authorisation obligations. South African legislation does not prescribe monitoring methods or requirements and provides no guidance from the regulator on monitoring submitted to the department. The result is monitoring with extremely different scopes and limited value for comparisons over time and between land managers. Many monitoring programs are repeat inventories of isolated fields with limited decision support capabilities. Monitoring programs and specialist studies are expensive; meeting legal obligations with no other return on investment. Because of this, confidence in biodiversity monitoring is poor; reducing budgets over time; long-term data collection is interrupted, and data integrity of existing programs reduced to the point that continuation cannot be justified. Besides the legal obligations, the inherent importance of monitoring must be understood to ensure that the best possible program and management benefits prevail in the long term. We make a case that if an objective-based monitoring framework is in place, land management will be informed practically and increase net biodiversity value. Using the same methodologies in the scope of works for environmental impact assessment specialist studies and intern programs on mines, comparing data across similar vegetation types of different land managers, the site-specific and regional body of knowledge will be increased for best possible biodiversity performance. The legal and material risks to the operation are the starting point of the framework. Legal

compliance is the driver for monitoring, and as such, the alignment to legal requirements sets the basis of the monitoring framework. The EMP conditions and legal obligations in terms of water resource management, biodiversity and closure must be integrated. Biodiversity risk assessment results indicate further monitoring obligations for integration. From this point, the site level drivers and specific monitoring objectives are determined. The long-term and short-term key questions are formulated by management to provide accurate results. The monitoring parameters and criteria are then determined with supporting monitoring methods and schedules. Finally, the monitoring site determination and plot layout are designed, to obtain the most considerable monitoring and data use efficiency. We present a monitoring framework based on reverse planning principles; with objectives addressing key questions to improve biodiversity management through setting up parameters, criteria and benchmarks in an integrated way. The pathway to construct such a framework is presented using two frameworks applied in the Kalahari and Bushmanland context.

Impact of livestock grazing intensity on plant species diversity of species-rich montane grassland on the northern Drakensberg, South Africa

12:00 - 12:20

Presented by :

Thami Shezi, Student, Wits University/SAEON

Livestock grazing intensity is expected to impact on the plant species composition and plant diversity of Drakensberg grasslands. These montane grasslands are important for providing goods and services for the local and the national population, in part through supporting livestock on communal rangelands. Montane communal rangelands are generally heavily stocked, although grazing pressure is expected to be concentrated around kraals and to show a decreasing gradient with distance. The aim of this study was to determine the impact of livestock grazing on plant species composition and diversity of montane grassland in the northern Drakensberg (Thabo Mofutsanyane district). A grazing gradient from a kraal site to beyond the average foraging distance of cattle was examined. A second approach examined fence-line contrasts between communal rangeland and the protected areas of Golden Gate Highlands National Park (GGHNP) and Royal Natal National Park (RNNP). Nine transects were sampled (using 90 5 × 5 m plots) in order to define a gradient, ensuring relative uniformity of environment by sampling only spurs and crests. The fence-line contrast between GGHNP and QwaQwa was sampled using 40 adjacent pairs of plots (5 × 5 m), that of RNNP and communal rangeland using 20 adjacent pairs. The percentage cover of each species on each plot was estimated using the Domin scale. Soil from each plot was analysed for levels of P, K, Ca, N, Mg, Zn, Mn, Cu, exchangeable acidity, acidity saturation, total cations, pH (KCl), organic carbon, and percent clay. The presence of a grazing gradient defined by distance was supported by a decrease in the amount of cattle dung with increasing distance from a kraal, described by a non-linear relationship. Distance was not confounded with altitude, solar radiation, or slope, nor with variation in soil physico-chemical properties as described by the first three axes of a Principal Component Analysis (PCA). An effect of grazing intensity was supported by a relationship between increasing distance and increasing species richness, an increasing abundance of graminoids, indigenous plants, and perennial plants, a decreasing abundance of shrubs, dwarf shrubs, annual herbaceous plants, and alien plants (especially *Richardia brasiliensis* and *Hypochaeris radicata*), and a change in herbaceous composition. However, most compositional variation was unexplained. For the contrast between GGHNP and the QwaQwa communal area, species composition was different and GGHNP supported more endemic species. RNNP compared with the adjoining communal rangeland showed greater species richness and plant diversity, a greater abundance of grasses, dicotyledons and indigenous plants, and a lesser abundance of dwarf shrubs. In conclusion, a gradient study and fence-line contrasts both provided support for an effect of livestock grazing on the composition and diversity of montane grassland in the northern Drakensberg. However, despite a long history of communal livestock grazing a total of more than 320 indigenous plant

species indicates these grasslands make some contribution to biodiversity conservation, but this contribution is compromised in the vicinity of kraals. Rangeland under reduced grazing intensity may therefore offer a means of maintaining the plant diversity of communal grassland grazing systems.

Long-term nutrient enrichment effects on productivity, species richness and soils in a natural South African grassland

12:20 - 12:40

Presented by :

Naledi Zama, Student, Agricultural Research Council

Nutrient addition influences grassland ecosystem structure and composition, typically manifested by reduced species richness and increased productivity. Quantifying long-term impacts of nutrient addition on grasslands contributes to understanding and predicting impacts of eutrophication and nitrogen (N) deposition on grassland, particularly for grasslands adapted to low soil nutrient status. A nutrient addition experiment on a natural C4 grassland was set up in 1950 on the Ukulinga Research Farm, South Africa (mean annual precipitation 838 mm falling in summer; mean monthly maximum temperature 26.4 °C in February; winters mild with occasional frost). Continuously applied treatments on plots measuring 2.7 × 9 m include combinations of nitrogen at 0, 7, 14, and 21 gm⁻² per annum, phosphorus (P) at 0 and 2.8 gm⁻² per annum and lime (L) at 0 and 225 gm⁻² applied every 5 years. Nitrogen sources included ammonium sulphate (AS) (acidifying) and limestone ammonium nitrate (LAN) (less acidifying). In 2018, samples taken at 0–200 and 200–400 mm depth were analysed for all relevant soil parameters. In 2019, a full vegetation survey, including light measurements, was completed using a modified Daubenmire technique. We aimed to determine the long-term effect of nutrient addition on grassland productivity, species richness and soil chemistry. Control plots were less productive than enriched plots. Increasing levels of N increased productivity, except at the highest level of applied N where there was a marked reduction in vegetation cover, and consequent increase in bare ground area, counteracted the higher soil nutrient status. The impacts of N on productivity were enhanced in the presence of P addition. Soil nutrient status strongly influenced species richness and composition, with richness declining under higher nutrient status. Addition of P strongly influenced species composition, and in the presence of N was associated with tall, broad leafed grass species. Soil acidity increased with AS addition, and influenced species richness and composition, with acidity associated with lower richness, particularly forb richness. Intermediate vegetation and soil surveys throughout the 69 years of nutrient addition indicate rapid initial vegetation composition change, followed by continual reduction in richness coupled with invasion of species adapted to high levels of above-ground competition. Results facilitate predictive modelling of grassland change under conditions of increased soil nutrient status, with selected species traits (including specific leaf area, plant height, growth form) associated with varying levels of productivity and light availability.

Study on the response of herbaceous species abundance and biomass production to *Solanum mauritanium* (bugweed) invasion densities on the rangelands of the Eastern Cape Province

12:40 - 13:00

Presented by :

Thando Ntutha, Student, University Of Fort Hare

Global climate change is rapidly altering species range distributions and interactions within communities. Some researchers claim that global climate change results in the establishment and invasion of shrubs such as *Solanum mauritanium*. Shrub invasion in turn may alter diversity and community stability, but this depends on the shrub invasion and other environmental factors such as soil organic matter content. In South African, almost all the province excluding those with inland, *S. mauritanium* was

considered as one of the invasion shrub expanding and few parts of the Eastern Cape Province. However, the influence of *S. mauritianum* invasion on herbaceous vegetation under different environments was little understood. Therefore, this study was conducted to investigate the influence of *S. mauritianum* invasion on herbaceous species abundance and biomass production. To conduct this study, three areas referred to as the ecologies (Butterworth, Bisho, and Flagstaff) differing in climatic conditions were identified. In each ecology, vast homogenous vegetation units (HUVs) differing in density of the shrub were selected, namely, open grassland (control), lightly, moderately and heavily invaded sites. Each homogenous unit was further divided in to 50 × 50 m plots to serve as replication and record vegetation. A step point method was used to determine the herbaceous species abundance relative to invasion. Three 50 m long transects were laid in each plot with an equidistance of 10 m apart. Ten 0.25 m² quadrat were used to harvest grass biomass production along each transect. The current study indicated that *S. mauritianum* invasion abundances were inversely proportional to herbaceous species abundance and dry matter yield. We conclude that changes in community stability due to altered interspecific interactions may be one mechanism by which biodiversity declines in grasslands following shrub invasion.

11:00 - 13:00

Vestibulo 2

Parallel II: Cultivated pastures & feeding ecology II

Moderators

Sigrun Ammann, Pasture Scientist, Western Cape Department Of Agriculture

Influence of nitrogen addition, defoliation and neighbouring plants on growth of a high-altitude C₃ grass, *Festuca costata*

11:00 - 11:20

Presented by :

Kabemba Mwambilwa, Principal Livestock Research Officer, MInistry Of Fisheries And Livestock, Climate Resilient Livestock Management

Understanding the mechanisms by which plants cope with environmental stresses is critical for gaining an understanding of the likely effects of global climate change on species and communities. In Afro-temperate grasslands of southern Africa, increasing abundance of evergreen C₃ grasses may displace C₄ grasses and impact fire regimes. Using a pot experiment in a greenhouse, we evaluated the effect of the addition of limestone ammonium nitrate (LAN) fertiliser on the performance of a C₃ grass, *Festuca costata*, when subjected to defoliation treatments (i.e. no defoliation, defoliation of *F. costata*, defoliation of a neighbouring plant and defoliation of both *F. costata* and a neighbouring plant). The *F. costata* plants were grown in different neighbourhood types, i.e. *F. costata* growing alone, growing with *Themeda triandra*, or with *Aristida junciformis*. At six-week intervals over a five-month period, we counted the number of tillers on *F. costata* and concurrently measured above-ground biomass production by clipping the target plants at 50 mm aboveground, tuft circumference, and specific leaf area (SLA). The effect of the treatments on these dependent variables was compared using generalised linear models. Nutrient addition showed a significant negative effect on the number of tillers of *F. costata* and tuft size but showed no significant effects on above-ground biomass production and SLA. Defoliation significantly reduced above-ground biomass production, number of tillers and tuft circumference while SLA increased. Plant neighbourhood types showed significant negative influences on tuft circumference. The interactions between defoliation of the focal plant and *F. costata* growing with *A. junciformis* were significant. Defoliation accounted for the most variations in reduced tuft size, above-ground biomass and number of tillers, however, it resulted in increased SLA. Consequently, a management strategy using selective herbivory may alter the relative dominance on common C₃ species in the high altitude range of the Drakensberg grasslands.

Effect of tannin deactivation methods on feed intake, dry matter digestibility and nitrogen balance in female Boer goats fed with *Senegalia mellifera* bush-based feeds

11:20 - 11:40

Presented by :

Andreas Epafra, Master Student, University Of Namibia

Bush encroachment/thickening by *Senegalia mellifera* (black thorn) has long been considered as an environmental and economic problem in the rangelands of Namibia and other southern African countries. Recently, harvesting bush thickets (encroacher bushes) and manufacturing various products from these woody plants has gained popularity. Among various products, bush-based feed production has gained special interest from farmers, as it has the potential to enhance livestock feed availability. The objective of this study was to determine the dry matter intake (DMI), apparent digestibility and nitrogen retention of Boer goats fed with *S. mellifera* bush-based feeds treated with tannin deactivating methods. Eight female Boer goats, with an average initial body mass of 31.5 ± 2.5 kg were randomly assigned to a total mixed meal ration made of 40% of browse plant (*S. mellifera*), 25% crushed yellow maize, 25% marula cake press and 10% minerals and vitamins. The four treatments; wood ash (WA), polyethylene glycol (PEG) and biochar (BIO) were evaluated against the control (CNT) diet as tannin deactivation treatment methods and were added in a powder form at a level of 5 g per day during feeding time. Goats were penned individually in metabolic cages where total faecal and urine outputs were determined. Goats were fed in a 4×4 cross over Latin Square Design with two goats assigned per diet during the four experimental feeding periods. Each period lasted for 17 days (10 days of adaptation and 7 days of data collection). Goats were fed the meal diets twice daily at 09:00 h and 16:00 h. All diets had a protein content of 14% and neutral detergent fibre of 41%. The level of dry matter (DM) of feed offered was 4% of body weight. The study showed that the apparent digestibility coefficient of DM, organic matter and neutral detergent fibre were not significantly different ($p > 0.05$) among treatments and the control diet. Goats fed BIO treated diet had the highest ($p < 0.05$) nitrogen intake of 13.7 g/d, faecal nitrogen of 8.43 g/d and nitrogen retention of 5.11 g/d, while goats fed the control diet, PEG and WA were similar ($p > 0.05$). All treatments resulted in positive nitrogen retention ($p > 0.05$) with mean values ranging from 3.79 to 5.11 g/d. There were a lower DMI and nitrogen balance ($p < 0.05$) in Boer goats fed with *S. mellifera* feeds treated with WA, PEG, and BIO compared with the control diet. The study concluded that the high protein content (14%) of the *S. mellifera* bush based feeds, if treated with WA, PEG or BIO and mixed with various agricultural by-products such as marula oil cake press can be considered as a suitable supplement for poor quality (low nitrogen content) natural pastures and crop residues such as grass hay, straw and stover. The study, therefore, recommends that each detannification method should be tested at different rates of inclusion in *S. mellifera* bush-based feed resources.

How simulating herd migrations and applying adaptive management practices can improve soil quality and plant biomass production

11:40 - 12:00

Presented by :

Wayne Knight, Farmer, Solar Addicts (Pty) Ltd

Water is a major limiting resource in South Africa. More carbon in soil has many positive effects - more microbial biomass and activity, and better water uptake and holding capacity. The higher the carbon content of soils, the more nutritious the food and fodder produced, and the more abundant the biomass yield from that soil. This review paper will show how managing livestock in a way that mimics herd migrations of early Africa (pre-1800) does rejuvenate soil microbial life and improve water infiltration. Soil plots under adaptive management do capture more water than plots on equivalent soils under either low, continuous stocking densities, or no stocking.

These results will be explained in terms of the findings of pioneering soil microbe researchers. These researchers have shown how planned grazing improves water infiltration and the carbon content in the soil, leading to improved fodder production. Grazing animals are key to healthy soils. References will be drawn to Dr Richard Teague's work on Adaptive Multi-Paddock (AMP) grazing versus set stocking or low-density rotational grazing in the United States and Australia. This research includes varied soil and environmental conditions. It is essential to highlight the critical interactions within an ecosystem (soil, microbe, plant, grazer, predator), and how these interactions are key drivers of ecosystem function. Aligning management to these key functions unlocks ecological potential.

Emerging disease challenges to sustainable production of Brachiaria grass in Rwanda

12:00 - 12:20

Presented by :

Bellancile Uzayisenga, Ph.D. Student, International Livestock Research Institute

Brachiaria grass is one of the most important tropical forages native to Africa. It is adapted to drought and low fertility soils, and known for palatability and high-quality biomass production, and thus improves livestock productivity. Due to these desirable attributes, Brachiaria grass has become increasingly popular among livestock farmers in Africa. However, the susceptibility of Brachiaria grass to diseases has been observed as an emerging challenge to the sustainable production of the grass in Africa, and current knowledge on the diseases affecting Brachiaria grass in Africa is inadequate. Therefore, this study was carried out to assess incidence, severity, and distribution of Brachiaria grass diseases in Bugesera, Huye, Nyagatare, Nyamagabe and Rwamagana districts representing five agro-ecological zones of Rwanda during the dry (July–August 2018) and wet (November 2018–January 2019) seasons. A total of 25 and 75 Brachiaria fields were surveyed in the dry and wet seasons, respectively. Disease incidence and severity were assessed on 20 stools per field from four different quadrats following established procedures. Leaf blight, rust, and leaf spot were the major Brachiaria diseases in Rwanda. The surveyed districts significantly ($p < 0.001$) differed in the incidence and severity of all the three diseases in both seasons. Leaf blight incidence ranged from 26% to 72% in the dry season and 24.7% to 64% in the wet season. Rust incidence ranged from 20% to 47% in the dry season and 11.3% to 47.7% in the wet season. Leaf spot incidence ranged from none to 56% in the dry season and 3.7% to 66% in the wet season. Similarly, leaf blight severity ratings ranged from 0.62 to 1.92 in the dry season and 0.37 to 1.14 in the wet season. Rust severity ratings ranged from 0.68 to 1.55 in the dry season and 0.24 to 0.86 in the wet season. Leaf spot severity ratings ranged from none to 1.85 in the dry season and 0.14 to 0.99 in the wet season. Huye, Nyamagabe and Bugesera districts had the highest incidence and severity of leaf blight, rust, and leaf spots diseases, respectively in both seasons. This study showed leaf blight, rust and leaf spots as emerging disease challenges for sustainable production of Brachiaria grass in Rwanda. This warrants immediate attention towards the development of effective management methods that are affordable to smallholder farmers in Rwanda.

Effects of dual inoculation with arbuscular mycorrhiza fungi and Rhizobium inoculation on soil physiochemical properties in a field grown forages legumes

12:20 - 12:40

Presented by :

Sanele Mpongwana, Student, University Of Fort Hare

The interaction between arbuscular mycorrhizal fungi (AMF) and Rhizobium bacteria is known to enhance N fixation and nutrient uptake on the plant host. Soil microorganisms commonly known as biofertilisers can be used to decrease input of fertilisers, pesticides and other chemicals in agriculture. By doing so, they increase soil

fertility, elevate soil pH, and nutrient availability in the soil profile. To support this view, the current experiment was conducted to study the influence of AMF and Rhizobium inoculation on soil physiochemical properties in field grown forages legumes in Alice, South Africa. Three forage legumes were sown in the field trial, being cowpea, lablab, and mucuna. This was laid out in a complete randomised block design with four replicates per treatment. There were twelve treatment factors as follows (cowpea control; cowpea+AMF; cowpea+R; cowpea+AMF+R; lablab control; lablab+AMF; lablab+R; lablab+AMF+R; mucuna control; mucuna+AMF; mucuna+R; mucuna+AMF+R). Soil analyses were done prior to planting, during the early stage, and after harvesting the forage legumes. The soil chemical properties were determined using standard procedures. It was observed that the addition of dual inoculation over time greatly improved soil physiochemical properties compared to the control, which resulted in improved soil condition. This was advocated by a significant ($p < 0.05$) increase in soil pH, SOC, SOM, and concentration of macronutrients (total N, P, Ca, K, Mg, Na, S, and Fe) on soil varying from mucuna and cowpea legumes. On the other hand, the concentration of CEC was significantly ($p < 0.05$) higher on cowpea treated with Rhizobium compared to other treatment combinations. The control treatment of mucuna forage greatly improved ($p < 0.05$) the concentration of micro minerals (Mn, B, Cu, Mo, and Zn) over other treatment combinations only before the flowering stage. However, after harvesting the concentration of micro minerals were significantly higher on the treatment combination of lablab and single inoculation of AMF. Thus, it can be concluded that interactive effect of AMF and Rhizobium inoculation has the potential to increase some soil properties including soil pH, SOC, SOM and concentration of macro nutrients (total N, P, Ca, K, Mg, Na, S, and Fe). However, it did not significantly affect the concentration of some micro minerals and the concentration of micro minerals efficiency was differentiated by control treatments.

Feeding inclusion levels of Opuntia-Moringa silage to Cenchrus ciliaris (blue buffalo grass) based diet has effect on growth performance and carcass characteristics of mutton merino wethers

12:40 - 13:00

Presented by :

Gopolang Matlabe, Animal Scientist, North West Department Of Rural, Environment And Agricultural Development

The main aim of the study was to determine different inclusion levels of Opuntia-Moringa (OPM) silage to Cenchrus ciliaris (blue buffalo grass) on growth performance and carcass characteristics of mutton merino wethers. The chopped Opuntia cladodes and ground Moringa leaf meal was mixed at a ratio of 60 Opuntia cladodes: 40 Moringa and prior to ensiling, microbial inoculants and molasses were added and ensiled for 42 days. The composition of the diet was chemically analysed and the experimental diets were 0 (OM0), 50 (OM50), 100 (OM100), 150 (OM150), and 200 (OM200) g/kg DM, producing five dietary treatments. The experimental design was a completely randomised design. Thirty (30) mutton merino wethers were treated for internal parasites and vaccinated for heart water and pulpy kidney one week before the trial commenced. Growth performance was measured for a period of 30 days and carcass characteristics were measured upon slaughter at the end of the feeding period. The effect of the experimental diets on the final body weight showed that there was a significant differences ($p < 0.05$) among the dietary treatments. The higher final body weight observed in the diet containing 20% silage could be ascribed to better protein quality and mineral contents of the silage. This is because Moringa has been reported to have a very good amino acids profile and is also rich in mineral content. It could also be due to higher feed intake and a better feed conversion ratio. The higher weight gains in the diet containing 15% and 20% silage may be due to a better protein quality, likely arising from higher methionine supply as well as lysine. Methionine and lysine are normally required for optimum growth in animals. The best feed conversion ratio was obtained in the diet containing 15% and 20% silage. The poorer feed conversion ratio in control, 5% and 10% could be due to lower feed intake and weight

gain. The significant higher feed intake obtained in the diet containing 15% and 20% silage may be due to its higher protein quality, greater palatability and higher protein content of the diet. This is in line with the statement that diets high in protein content increase intake. Intake, body weight, weight gain and carcass weight showed improvement when the blue buffalo grass was supplemented with the OPM silage diet. The wether fed diet containing 15% and 20% had higher slaughtering weight, hot carcass weight and cold carcass weight. This was due to higher deposition of muscle and fat in the carcasses, however, the fat amount in the carcasses remained optimal because the animals were slaughtered at the same age and with very close weights. The diet containing 15% and 20% silage inclusion had the best performance.

13:00 - 14:00

**Bella Roma
Restaurant**

Lunch

14:00 - 15:30

Vestibulo 1

Parallel I: Karoo & desert rangelands I

Moderators

Tony Swemmer, Research Manager, SAEON

**KEYNOTE: Plant-herbivore interactions in an arid, stochastic environment:
Insights from the Richtersveld**

14:00 - 14:45

Presented by :

Susi Vetter, Associate Professor, Rhodes University

Arid and semi-arid rangelands are characterised by strong seasonality, inter-annual rainfall variation and periodic droughts. Understanding the relationships between spatial and temporal variation in rainfall, forage availability and the dynamics of herbivore populations is crucial to inform management. We monitored plant productivity and composition in the Richtersveld National Park (RNP), as well as body condition and demographic rate data on 500 tagged female goats, to disentangle the effects of environmental stochasticity and density-dependent processes. During the four-year study period, annual rainfall varied nearly four-fold from 230 mm in 2006 to 60 mm in 2009, with considerable spatial variation across the RNP. Goats utilize areas of seasonally green Succulent Karoo vegetation around stock posts in the wet winter months, and evergreen woody vegetation in the riparian zone of the Orange River during the dry summer. Plant productivity in the wet season range responded strongly to rainfall, whereas it was more stable in the riparian zone. Grazing impacts on the wet season vegetation were evident in the vicinity of stock posts, where perennial plant cover had decreased and became dominated by unpalatable species. Composition and productivity of annuals responded primarily to rainfall, with no evidence of increased production of annuals near stock posts where perennial cover had decreased. Goat populations showed a density-dependent seasonal decline in body condition in response to depletion of the dry-season forage in the riparian zone. Loss in body condition reduced pregnancy rates, litter sizes, and pre-weaning survival. Survival was lowest following the most severe dry season and for juveniles. Population growth was determined by the length of the dry season and population size in the previous year. Within the riparian zone, browse was depleted more rapidly lower down in the canopy and where goat densities were greater, producing a distinct browse line that moved higher as the dry season progressed. Smaller goats thus experienced more acute forage deficits earlier in the dry season, leading to asymmetric effects on individuals of

different sizes. Our research shows that herbivore populations in arid and stochastic environments are not in disequilibrium with their forage resource, but that consumer-resource coupling is largely restricted to a subset of resources in the seasonal cycle. In the case of the RNP, the goat population is in dynamic equilibrium with their dry season forage resource, and the riparian zone thus constitutes the key resource of the population. This has a number of management implications in the RNP and other arid areas. The long-term carrying capacity of the area as a whole is largely determined by the availability and stability of forage in the key resource. Identifying a population's key resource and ensuring access to it is thus crucial for maintaining the population trajectories of wild and domestic herbivores. Larger, more productive and more stable key resource areas support higher herbivore populations, which influences the intensity of herbivory on the wet season resource. Understanding the spatial and temporal dynamics between herbivores and their wet-and dry-season resources is thus important for managing herbivore populations and their impacts.

Grassland-shrubland shifts in the eastern Nama-Karoo – Grasslands ecotone

14:45 - 15:05

Presented by :

Gina Arena, PhD Student, University Of Cape Town, Plant Conservation Unit

Biome boundaries offer valuable opportunities to monitor climate or land-use driven vegetation change to detect shifts in vegetation regimes. Reports of change in historically over-utilised natural rangelands in South Africa have suggested that under persistent livestock overgrazing, the drier dwarf shrublands have encroached further eastwards into the grasslands. Historical vegetation surveys and landscape photographs from the mid-20th century collected from sites spanning the Nama-Karoo – Grasslands Biome boundary have provided the opportunity to monitor these environments, thereby revisiting the 'expanding Karoo hypothesis' through repeated observation in time and space. The aim of this study was to identify the dominant vegetation changes in terms of i) species composition and growth form abundance, ii) rangeland condition (based on veld condition score) and iii) grazing capacity (ha/Large Stock Unit) of the sampled area, at 27 study sites spread across an east-west gradient of decreasing precipitation. The descending-point method was used to record initial plant species counts from 1000 points per transect at sites between 1956 and 1962 and the same method was used in 2017–18. Total canopy cover per species from each survey was used to calculate the percent change in all growth forms over time. Non-metric multidimensional scaling analysis using the Bray-Curtis distance measure was also employed to examine site dissimilarities and trajectories of vegetation change in relation to the preceding 20-year mean annual precipitation and mean annual temperature at Karoo (K), Grassland (G) and Escarpment (E) sites. Overall, mean percent change in plant cover has increased significantly at all sites ($p < 0.05$; $K = 11.21\% \pm 3.29$; $G = 7.81\% \pm 2.48$; $E = 5.19\% \pm 1.88$). This increase is characterised by an increase in perennial grasses ($K = 31\%$; $G = 35\%$; $E = 22\%$) and perennial shrubs ($K = 22\%$; $G = 2\%$; $E = 4\%$). Comparisons of site dissimilarity between years indicate that sites have followed a similar change of trajectory between K, G and E vegetation units and that there is a greater distinction between the cool, temperate E sites, and the K and G sites. Veld condition scores indicate an improvement at all K (1960 = 55.54; 2018 = 295.60), G (1960 = 190.98; 2018 = 503.24) and E (1960 = 222.28; 2018 = 342.08) sites. Comparably, grazing capacity scores of surveyed areas have improved over time (K: 1960 = 105.81 ha/LSU, 2018 = 20.05 ha/LSU; G: 1960 = 26.49 ha/LSU, 2018 = 9.67 ha/LSU; E: 1960 = 29.48 ha/LSU, 2018 = 14.32 ha/LSU), indicating that more area was required to graze one LSU historically, than is needed today as a result of the improvement in veld condition. These findings are at odds with changes observed in most other shrubland-grassland ecotones where shrubs have generally replaced grasses in recent decades. Due to a complex mix of interacting climatic and land use changes and feedbacks, rangelands in the eastern grassy Karoo have experienced a

regime shift to grassland-dominant vegetation, with an overall improvement in condition.

Influence of season of grazing and rainfall over time on vegetation in the eastern Karoo, South Africa

15:05 - 15:25

Presented by :

Justin Du Toit, Production Scientist, DAFF- Grootfontein ADI

The influence of rainfall and grazing in the Karoo are well documented. Good rains allow increased plant growth in general, and increased grass growth in particular. Droughts can kill both grasses and dwarf shrubs, with the former being more susceptible to water stress. Historically, most grazing effects arose from sporadic large migrations of springbok. In the late 1800s, livestock were introduced and numbers increased to cause novel levels of herbivory. Concomitantly the incidence of grazing by springbok declined. Dwarf shrubs are primarily of the C3 photosynthetic pathway, and can grow when water is available nearly throughout the year. Grasses, which are predominantly C4, grow mainly during the warm midsummer months if sufficient moisture is available. Accordingly, grasses can be damaged if grazed in summer, and be largely unaffected by winter grazing as they are dormant then. The influence of summer grazing on dwarf shrubs is much more variable owing to variations in palatability, growth form, and patterns of deciduousness. The objective of this research was to understand the influences of season of grazing and of rainfall on vegetation composition, and on grass:shrub balances in the eastern Karoo. Plant compositional data from long-term trials situated at the Grootfontein Agricultural Development Institute and collected from the mid-1940s to 1970 were used. Grazing treatments varied in the proportion of grazing that took place during summer (October–March) and winter (April–September) respectively. Annual rainfall decreased over the period, with exceptionally dry periods occurring around 1950 and in the late 1960s. Eighty-six plant species from twelve growth-forms were encountered, with the most common perennial species from the most common growth forms being *Chrysocoma ciliata* and *Pentzia incana* (dwarf shrubs) and *Eragrostis lehmanniana* and *Tragus koelerioides* (grasses), and the most common short-lived species was the grass *Aristida congesta*. In general, grasses, in particular *E. lehmanniana* and *A. diffusa*, responded well to winter grazing, while summer grazing was associated with the shrubs *P. incana*, *C. ciliata* and *Phymaspermum parvifolium*. Creeping grasses showed differing responses to rainfall trends, with *Cynodon incompletus* decreasing and *T. koelerioides* increasing in abundance over time. Short-lived grasses were highly responsive to rainfall and were negatively impacted by summer grazing. Perennial grasses and dwarf shrubs declined over time as rainfall decreased. Droughts induced rapid declines in grass populations, which then recovered. Dwarf shrub populations collapsed following a minor drought that had followed a severe drought. Plant response to drought was largely unrelated to grazing. It was concluded that season of grazing and long-term rainfall trend strongly influenced perennial vegetation composition, and that season of grazing was a potent determinant of grass cover for most grass species, and influenced shrub cover. Furthermore, recent rainfall influenced mainly short- to medium-lived grasses. Long-term rainfall trend was associated strongly with cover of most growth forms and species, but the mechanisms of this remained unexplained.

14:00 - 15:30

Vestibulo 2

Parallel II: Invasive species in rangelands I

Moderators

Thabiso Mokotjomela, Provincial Programme Coordinator, SANBI: Biological Invasions Directorate

KEYNOTE: Biological control for the protection of water resources and rangelands

14:00 - 14:45

Presented by :

Iain Paterson, Senior Researcher , Centre For Biological Control, Rhodes University

Arid rangelands in South Africa are impacted and threatened by invasive alien plant species. These plants reduce the carrying capacity of grazing land, are major water users, and some species directly harm indigenous animals and livestock. Indigenous plants are also directly affected by invasive alien plants which alter the functioning of ecosystems and compete with indigenous plants for resources. The arid north-west of South Africa, as well as the riverine vegetation along the Orange River, is impacted by a variety of invasive alien plants, some of the most serious being various cactus species and mesquite (*Prosopis* sp.). The control of these invasive alien species should be a priority for farmers and conservationists in the region. In the Kalahari, boxing glove cactus, *Cylindropuntia fulgida* var. *mammilata*, was a serious problem prior to the release of the biological control agent *Dactylopius tomentosus* 'cholla'. Three years after the release of this agent, large boxing glove cactus infestations were completely destroyed with no live plants remaining. The agent is now redistributed by farmers and biological control practitioners to new sites when required and is providing complete and permanent control. Another serious cactus weed in the region is Devil's rope cactus, *Cylindropuntia imbricata*, which is controlled with a different lineage of the same species of cochineal, *D. tomentosus* 'imbricata'. Devil's rope cactus can be controlled using integrated control. The biological control agent will kill small plants and defoliate large trees in the first few years after release, after which large trees should be felled and left as reservoirs for the biological control agent. This integrated method results in complete control of *C. imbricata* in most cases. The worst invasive alien plant in riverine vegetation in the arid north-west of South Africa is mesquite (*Prosopis* sp.). Mesquite is a major water user and completely dominates rivers and watercourses to the detriment of indigenous flora and fauna. One biological control agent for mesquite has been released in South Africa but provides negligible control. There is however a new agent, the seed feeding weevil, *Coelocephalopion gandolfoi*, that will be released soon; as well as other agents that could be sourced in native distribution, which are predicted to have a significant impact on the tree populations. Mass-rearing and redistribution of biological control agents will be required in order to implement biological control on a meaningful scale in the region. Currently, the only cactus agent mass-rearing facility in the country is in the Eastern Cape and there is no mass-rearing of mesquite agents. Plans are underway to initiate mass-rearing of these species in Upington to serve the north-west of the country. This project is also an opportunity for employment, and especially for the employment of people with physical disabilities. With a large mass-rearing and redistribution effort, biological control will reduce the impact and future threat of these invasive alien plant species in the region, with significant benefits to agriculture, conservation and ecosystem functioning.

Nassella in South Africa: A call to action

14:45 - 15:05

Presented by :

Anthony Mapaura, Student - PhD, Afromontane Research Unit / University Of The Free State

Nassella (Trin.) E.Desv. is a grass genus with over 115 mostly perennial tufted species. It is mostly native to South American countries while six species are also found in the United States and Canada. Eleven of the species have been recorded growing outside their natural range. Of these, *N. neesiana*, *N. tenuissima* and *N. trichotoma* are naturalised in Australia, Europe, New Zealand, South Africa and the USA. They invade disturbed areas, especially overgrazed pastures. *Nassella trichotoma* is generally regarded the most serious invader in Australia, New Zealand and South Africa. In South Africa, *N. trichotoma* and *N. tenuissima* are declared weeds. Infestations of *N. tenuissima* are mainly in the Eastern Cape Drakensberg; while *N. trichotoma* occurs in the Western, Eastern and Northern Cape provinces, with unconfirmed records in

Limpopo, Gauteng, Free State and Mpumalanga. *Nassella neesiana* is currently not listed as invasive, although it is known to have naturalised. *Nassella* can easily grow in a wide range of climatic conditions, soil types and topographical situations, with most of the Grassland Biome in southern Africa at potential risk of invasion. *Nassella* can self-pollinate and outcross, thus benefiting from the advantages offered by both breeding systems to become successful invaders. Mature plants can produce as many as 90,000 seeds per plant per year, which are dispersed over long distances by animals, machinery, people, vehicles and wind. The plants have a short juvenile stage, reaching maturity within a year. The major impact of *Nassella* species is on natural rangelands, where they out-compete desirable pasture species and dramatically reduce carrying capacity. Their high fibre content and a low nutritive value mean they are not favoured by livestock and thus flourish at the expense of good pasture plants. The fibres can form indigestible balls which block the gut of animals making them lose condition rapidly, leading to mortalities. The sharp seeds can cause injury to livestock, including blindness and severe irritation to the skin of young lambs. The awns also reduce the quality of wool. In Australia and New Zealand, it was reported that the cost of control of heavy infestations can exceed the value of the land. Research work done in South Africa in the 1970s and 1980s, especially by M.J. Wells, led to vigorous awareness and control campaigns at that time. *Nassella* species are not easily distinguishable and so do not readily lend themselves to citizen science (e.g. SAPIA). Hence the need for a rigorous reassessment of *Nassella* in South Africa, to determine current distributions of all three species; invasiveness and drivers of invasiveness; and potential responses to climate change and various management methods. *Nassella* highlights the challenges presented by cryptic invaders not readily distinguishable from native grasses, such as *Festuca*.

Detection of new cactus species and populations in arid areas of South Africa: Potential impacts and management interventions

15:05 - 15:25

Presented by :

Travor Xivuri, Eradication Contracts Manager , Biological Invasions Directorate (SANBI)

Many cactus species have been introduced in South Africa and the invasive subset has multiple negative impacts on natural resources especially the underground water in arid areas. For containment of invasion problems, convenient methods of eradication strategies ranging from mechanical to biological control are applied depending on the scale of the problem. Unexpectedly, new species and their populations displaying the invasion potential, are increasingly being detected by the Biological Invasions Directorate of South African National Biodiversity Institute. The aim of the study is to report the emerging cactus species, observed negative impacts as well as their management interventions in arid areas of South Africa. A combination of the stratified and systematic surveys for species populations were conducted in different arid localities across Western Cape, Free State, Northern Cape, and North West provinces. Drive-by surveys and guided interviews were conducted to increase the detection effort. Additional species occurrence data was obtained from different platforms of citizen science (e.g. iSpot database). Large and dense populations of a new unlisted cactus species *Cylindropuntia prolifera*, native to Southern California, have been detected in the Karoo region of Western Cape. Also, more new populations of Category 1a species such as *Cylindropuntia pallida*, *Tephrocactus articulatus*, *Austrocylindropuntia cylindrica*, *Myrtillocactus geometrizans*, *Harrisia pomanensis*, and *Cylindropuntia spinosior* have been detected. *Cylindropuntia pallida* is avoided by livestock and thus displays potential to reduce grazing land while also negatively impacting on wild animals through fatal skin damage in, for example, trapped snakes, birds and lizards. Effective management intervention by chemical methods substantially (96%) reduce the population. Post-eradication monitoring suggest that follow-up controls are needed to clear plants that might have been missed and the resprouting individuals.

15:30 - 16:00

Conference
Rooms Stoep

Afternoon Tea

16:00 - 17:00

Vestibulo 1

Parallel I: Karoo & desert rangelands II

Moderators

Tony Swemmer, Research Manager, SAEON

The initial spread of brown locust swarms across the Karoo

16:00 - 16:20

Presented by :

Joh Henschel, SAEON

The brown locust *Locustana pardalina* is a polymorphic species, endemic to South Africa, Namibia, and Botswana, normally occurring only at low densities in the solitary phase, alternating with periodic occurrences of high densities in the gregarious phase. Phase change from solitary to gregarious is intermittently initiated at point locations, generating hopper bands. Under certain conditions, when many hopper bands simultaneously form in an area, these unite to form swarms of gregarious adult locusts, which quickly strip many plants of their leaves and migrate in search of more food. Unlike locusts of the solitary phase, which breeds slowly, and only in certain areas, gregarious locusts breed quickly and indiscriminately. Locust outbreaks can thus spread rapidly across much of southern Africa and can pose a threat to food security in the subcontinent. Due to their impacts on agricultural productivity, records of locust outbreaks have been kept in South Africa since 1797. Details of such records improved when concerted efforts of controlling outbreaks were initiated at the beginning of the previous century. Between 1989 and 2006, the Locust Research Unit (LRU) of the Plant Protection Research Institute (Agricultural Research Council) was tasked to compile data of outbreaks, recording dates, locations, hopper and adult development stages, as well as size class of hopper bands or swarms. These data were obtained from locust district officials managing the application of insecticides to locusts. The period of 17 years during which the LRU data were compiled encompassed several different outbreak events during which the locations of 469,000 locust swarms and hopper bands (juveniles) were recorded, each comprising many thousands of locusts, 88% of which were hopper bands, whose occurrence strongly correlated with swarms ($r = 0.91$). By analysing the timing and locations of hopper bands during different years and times of years, it is possible to analyse the climatic conditions and other factors accompanying outbreaks. This will improve knowledge concerning how outbreaks are triggered, and what drives particular outbreak centres. Initial analyses point to the Bushmanland Karoo as the most important outbreak region (61% of all locust groups) with irruption hotspots located in 1000-km² areas near Marydale and Gamoep at the eastern and western extremities of the Bushmanland Arid Grassland respectively, where most of the high variable annual rain falls towards the end of summer (MAP = 137 mm). From there, outbreaks often extend into the Upper- and Lower Karoo (35% of outbreaks), particularly the vicinity of Richmond (MAP = 266 mm). Only 4% of outbreaks during the study period extended beyond the Karoo. Our analyses prompt further detailed investigations of solitary locusts in the Bushmanland hotspots in terms of their ecology, egg bank dynamics and population dynamics, and how climate affects these. Such a study should eventually allow better interpretation of the available 212 years of information on locust outbreaks in South Africa and how their patterns have changed in relation to control interventions, land management, and climate change.

Germination potential of four palatable species of the semi-arid Karoo region of South Africa

16:20 - 16:40

Presented by :

Rudi Swart, Scientific Technician - Rangelands, Western Cape Department Of Agriculture

The rangelands of the semi-arid Succulent Karoo and Nama Karoo Biomes of the centre and south-west of South Africa are often degraded due to injudicious livestock management. The palatable plants of these rangelands have been greatly reduced in number or extirpated from some areas. In order to return palatable plants to degraded rangelands and improve rangeland productivity, many restoration projects have been attempted that involve reseeding. The sowing of seeds into degraded rangelands, or other disturbed areas, has often provided disappointing germination results. This study attempts to determine what some of the main aspects are that affect the germination of Karoo seeds, both positively and negatively. The seeds of four palatable Karoo plant species harvested at the Worcester Veld Reserve (33°37'22.1"S, 19°28'6.8"E) were selected to be subjected to germination trials and viability testing. The species selected are *Osteospermum sinuatum*, *Eriocephalus africanus*, *Gorteria integrifolia* and *Chaetobromus involucreatus*. These species were selected since they have been used in previous restoration projects, their seeds are readily available, and they are valuable fodder plants. This study used germination trials under controlled light and temperature conditions, as well as 2-, 3-, 5-triphenyl tetrazolium chloride tests to determine whether the four species of Karoo seeds harvested at the Worcester Veld Reserve for rangeland reseeding projects were viable and germinable. The established practice of drying seeds at the Worcester Veld Reserve after harvesting was tested to determine the effect of drying on seed germination. The germination of these seeds were also tested over 17 intervals of three weeks to determine the effect of storage time on seed germinability. Germination trials were also conducted in a nursery to determine whether there was a difference in seedling emergence between seeds planted at 10 mm depth compared to seeds planted on the surface with a partial covering of sand. The seed viability of all four species studied was found to be below 50%. Drying only significantly improved the germination of *O. sinuatum* seeds ($p < 0.05$). The seeds of *O. sinuatum* and *E. africanus* germinated reasonably well throughout the 17 time-intervals, while the seeds of *C. involucreatus* and *G. integrifolia* germinated poorly during the first six months after harvesting, after which germination improved markedly. Seedling emergence of all four species studied was significantly higher when planted at the substrate surface, compared to seeds planted at 10 mm depth ($p < 0.001$). The findings of this study show that while the viability of the seeds harvested for rangeland reseeding projects are quite low, the appropriate pre-treatment, seed age, and planting depth will allow a significant increase in germination. This increase in germination should provide a greater chance of establishing palatable plants in rangeland reseeding projects.

Long-term impacts of livestock grazing and browsing in the Succulent Karoo: A 20-year study of vegetation change under different grazing regimes in Namaqualand

16:40 - 17:00

Presented by :

Elelwani Nenzhelele, Lecturer, Sol Plaatje University

This study used a fence-line contrast approach to investigate the long-term impact of high grazing pressure on the vegetation at a site in Namaqualand, South Africa. Forty pairs of permanently marked plots were surveyed in 1996, 2006 and 2016. The main objective was to investigate changes in the vegetation structure and species composition between the near-continuously grazed communal rangelands and the relatively lightly grazed commercial rangelands over the 20-year period. The results showed a decline in total vegetation cover in both commercial and communal

rangelands in 2016 relative to the two earlier sampling periods. The decline was as follows: in 1996 the percentage of vegetation cover in the commercial was 52.2 2.0a, and in the communal was 48.13.0ab. In 2006, the percentage of vegetation cover for the commercial was 35.11.3bc and communal 33.58cd. In 2016 the decline was as follows: commercial 27.31.0de and communal 21.11.4e . This can be attributed to the low rainfall in 2016 and was due largely to a reduction in annual plant cover, especially on the communal rangeland. Perennial shrub species provided a fodder bank that could be utilised by livestock in times of drought and can buffer short-term deficits in forage supply. However, the annuals that dominate the vegetation of the communal rangeland do not form such fodder banks and, consequently, do not have the same multi-year buffering capacity as perennial shrubs. This provides the mechanism whereby long-term continuous grazing decreases resilience to rainfall fluctuations and increases livestock variability, thereby promoting non-equilibrium-type dynamics in the system.

16:00 - 17:00

Vestibulo 2

Parallel II: Invasive species in rangelands II

Moderators

Ralph Clark, Afromontane Research Unit / University Of The Free State

The role of solid waste dumping sites in early detection of emerging alien plant species in South Africa

16:00 - 16:20

Presented by :

Tshamaano Nemurangoni, Intern Groen Sebenza At Sanbi, University Of The Free State

Disturbed rubbish dumps present favourable conditions for invasive alien species and act as sinks and sources of their propagules. The Biological Invasions Directorate of the South African National Biodiversity Institute was formed to control and manage emerging alien species in order to mitigate the associated future invasion risks. The aim of the study was to document the alien species in dumping sites in various towns in the Free State and Northern Cape provinces, and to determine if dumping sites can be targeted in efforts to detect emerging alien species. Systematic surveys for alien species were conducted in dumping sites in different localities and the recorded alien species were categorised according to the National Invasive Species Regulations Guidelines. Photographic evidence of each species was obtained and used for identification and herbarium storage. Drive-by surveys and guided interviews were conducted to increase detection success. Preliminary results from 30 sites show that 95% of the recorded species were established invaders while 3% were emerging and 2% were "SUSPECT" alien species. Species abundance and diversity were negatively correlated with distance from the dumping sites to private gardens which supports the existence of a sink-source. We suggest that detection efforts for emerging alien species should focus on private gardens and botanical nurseries as major sinks of newly introduced species.

Management of biological invasions in arid areas: importance of awareness and management intervention strategies

16:20 - 16:40

Presented by :

Thabiso Mokotjomela, Provincial Programme Coordinator, SANBI: Biological Invasions Directorate

Many alien species have been introduced in South Africa and the invasive subset has substantial negative impacts on natural resources. Invasive alien species change the function of the ecosystems and eliminate the associated natural capital for human wellbeing in South Africa. Management interventions apply different methods of

eradication strategies ranging from mechanical to biological control depending on the scale of the problem. Surprisingly, new species and populations displaying high invasion potential are increasingly being detected by the Biological Invasions Directorate of South African National Biodiversity Institute (SANBI-BID). The aim of the presentation is to highlight the importance of early detection of alien species and their eradication and different challenges posed by invasive alien species with reference to the Northern Cape province. To improve stakeholder understanding of the impacts of invasive alien species, different mechanisms through which invasive species have immediate threats in the local environment are discussed. We also propose and discuss several models (e.g. multi-stakeholder approach) for handling and managing different invasive alien species with reference to Early Detection and Eradication work done by SANBI-BID in the Northern Cape province. It is emphasised that farmers (i.e. subsistence and commercial) should report new alien species occurrences, and take responsibility by managing the environment as outlined in the National Alien Invasive Species Regulations.

Biological invasion threats in North West Park's Board nature reserves, North-West province, South Africa

16:40 - 17:00

Presented by :

Thulisile Jaca, Regional Coordinator, South African National Biodiversity Institute: Biological Invasions Directorate

The North West Parks Board nature reserves are the most important pristine and natural areas in the province. They support an outstanding abundance of biodiversity, provide critical resources for indigenous landowners, eco-tourism and wildlife economy, and are a major tourist attraction. However, the province is dominated by agriculture and mining and is located largely within the Savanna and Grassland Biomes that contain a total of 41 South African vegetation types and two subtypes. These reserves are also under threat from a range of high-impact invasive alien plants. The aim of this study was to assess the responses of managers to these invasive alien plants and if the responses varied substantially. We documented the history of introduction, invasion status and management interventions in North West Parks Board nature reserves, and to explore reasons for the different managers' responses to avoid a squandering of the efforts made so far from controlling species such as *Opuntia humifusa*. *Opuntia humifusa* invades 80% of the reserves whilst *Arundo donax* invades in all the reserves with water-bodies. The results show that the management of threats from the *O. humifusa* and *Cerurus jamacaru* were well-resourced and considered as a case study of best practice for weed management. In contrast, there has been limited response to other invasive species such as *A. donax*, *Echinopsis schickendantzii*, *Melia azedarach*, *Physalis viscosa*, *Populus* sp., and *Verbena brasiliensis* which suggest that their impacts are likely to increase biodiversity loss. It is recommended that these species must also be given management interventions equivalent to the former set of species to suppress the associated negative impacts.

17:00 - 17:20

Vestibulo 1

Nacella invasion in South Africa - Discussion session for interested parties

Moderators

Anthony Mapaura, Student - PhD, Afromontane Research Unit / University Of The Free State

18:00 - 20:00

**Bella Roma
Restaurant**

Dinner

08:00 - 10:00

Plenary: Communal rangeland dynamics

Vestibulo 1

Moderators

Tim O'Connor, Scientist, SAEON

Restoration of degraded rangelands in semi-arid communal areas, South Africa: Short term enclosure impacts on grass and soil quality in three soil types

08:00 - 08:20

Presented by :

Ayanda Kwaza, Scientist, Eastern Cape Department Of Rural Development And Agrarian Reform

Land deterioration or degradation is pervasive in African rangelands utilized under continuous grazing system. Restoration efforts should, therefore, be of a great concern to the land users as well as to help mitigate CO₂ emissions. Grazing exclusion can be an effective strategy in southern Africa, but its effect to restore rangelands is not well understood. We tested for differences in vegetation and soil characteristics between enclosures and adjacent open-grazed lands over three year periods. Treatments were established in six semi-arid communal lands located in three soil types: shallow, red stony-ground (SRSG), shallow, dark sandy-loam (SDSL) and deep, dark clay-loam (DDSL soil). Average estimates of herbage removed by grazing animals were: 47% (SRSG soil), 59% (DDSL), and 62% (SDSL soil) of the total amount produced during the growing season. Compared to the grazed sites, grazing exclusion increased grass biomass by 98%, 138%, and 152% in SRSG, SDSL, and DDSL soil, respectively. Most forage nutrients of samples harvested from the enclosure and the grazed sites were adequate to meet ruminants' requirements. In all soil types, soil magnesium (Mg), organic carbon (OC), nitrogen (N), phosphorus (P), and manganese (Mn) were higher ($p \leq 0.05$) in the enclosure than the grazed sites. Results suggested that continuous grazing was detrimental to soil and vegetation in the semi-arid rangelands, but this can be restored with the application of grazing abandonment practice. We conclude that short-term enclosures may enhance C and N sequestration, and improve aboveground forage biomass without compromising forage quality.

Assessing livestock distribution in communal rangelands of the Eastern Cape, South Africa: Towards monitoring livestock movements in rangelands

08:20 - 08:40

Presented by :

Bukho Gusha, PROFESSIONAL Student Development, PROFESSIONAL Student Development

Rangelands are an important part of the ecosystem to support livelihoods, biodiversity, and livestock production. In the past, rangelands were managed in a semi-nomadic manner; where pastoralists would distribute livestock to different parts of the rangeland dependent on forage availability. It is important to understand livestock grazing distribution in a communal rangeland system, because livestock try to make use of the patchy mosaic of available forage in time and space in order to maximize intake. This study made use of Global Positioning Systems (GPS) to assess livestock distribution in a communal rangeland of the Eastern Cape province, South Africa. Six animals, which included three sheep and three cattle, were selected randomly from participating households and fitted with a neck GPS collar over a three month period for both wet (November 2016–January 2017) and dry (July 2017–September 2017) seasons. Geographic positions of the animals were recorded at five-minute intervals during both the wet and dry season of 2016/17 in order to assess rangeland use by

livestock. Animal daily weight gain was assessed by weighing animals in the mornings on the day of collaring and on the day of removing collars for both dry and wet seasons. The difference between initial and final weight was divided by the number of days to get the daily animal weight gain. Grass species were surveyed from three production domains where livestock grazing was concentrated. Lastly, normalised difference vegetation index (NDVI) for the area was downloaded from Landsat imagery using Google Earth Engine (GEE) to determine the most productive parts of the rangeland. Livestock grazing distribution was analysed using time local convex hull (T-LoCoH) installed in R. Hull sets were created to identify the areas where livestock spent most of their time grazing during the day, which showed that livestock spent most of their time grazing in areas that are associated with human features. The grass species survey revealed that *Hyperrenia hirta*, a robust perennial C4 grass that is moderately resistant to continuous grazing, was the dominant grass species. This was followed by *Eragrostis plana*, suggesting that the rangeland had been disturbed. Furthermore, areas around the homesteads had a higher NDVI, which could possibly be another reason for the strong association of livestock with human features. In this study, it is assumed that lack of livestock herding might have been the reason why livestock spent most of their time grazing around the homesteads, together with the fact that the animals are saving energy and that this area is close to the drinking water. These results suggest a need for livestock owners to use herders so that the animals can use rangelands optimally. This is hoped to improve the grazing distribution, species composition and the forage quality and quantity and reduce soil erosion.

Municipal commonage status: Rangeland condition, herd composition, infrastructure and land degradation in Inxuba Yethemba Municipality

08:40 - 09:00

Presented by :

Tanki Thubela, Eastern Cape Department Of Rural Development And Agrarian Reform

Provision of access to land and its resources in South Africa is considered one of the great challenges facing the post-apartheid South African government. The Municipal Commonage Programme has been one of the means of addressing this matter. South African government policy emphasises municipal commonage in improving the livelihoods of poor urban residents by providing a grazing resource for livestock owned by the urban poor. However, increased urbanisation, heavy stocking rates and ineffective management have raised concerns regarding the degradation of these rangelands. This paper observes the rangeland condition of the Inxuba Yethemba (Cradock and Middelburg) municipal commonages to assess the sustainability of this rangeland in improving livelihoods. Veld types on the commonages and on the farms within commonages were identified and their condition assessed separately by examining plant species composition. Visual assessment was used to collect both ecological and livestock data. Lease costs for tenants were also calculated to estimate municipal commonage revenue and assess if it had an impact on commonage management negligence and range degradation. The analysis revealed that both commonages were highly overstocked, plant cover was poor, and surface condition was prone to degradation. A substantial amount of revenue was received by the municipality, which could trigger negligence in monitoring stock numbers based on the carrying capacity on commonages. Rotational grazing and adaptive management such as reduction of stock during times of drought appear to be ideal measures to ensure the sustainability of the resource. Interviews with commonage users indicated that they believe it is the municipality's role to maintain infrastructure such as fencing at these commonages as they pay to keep livestock.

Vegetation, soil, and cattle blood mineral status in severely and less severely degraded semi-arid communal rangelands of the Eastern Cape, South Africa

09:00 - 09:20

Presented by :

Nangamso Mlaza, Student, University Of Fort Hare

The Eastern Cape has vast communal grazing lands with the potential to sustain large herds of livestock. However, large parts of these rangelands are degraded to varying extents. Understanding the vegetation and soil dynamics in response to rangeland degradation is therefore essential to plan land use and management interventions, and recommend sustainable restoration efforts. This study assessed grass species composition, biomass production, forage nutrients, soil chemical properties, and blood serum mineral concentration of cattle in two degraded communal rangelands (less degraded and severely degraded) located in the Amathole district of the Eastern Cape. Three communal grazing lands each were identified in the two degraded conditions. A total of nine 100 × 20 m plots were established at each communal grazing area surrounding a homestead to record the soil and vegetation data. Blood samples were collected for dry and wet seasons from a total of eight Nguni cattle (2.5–3 years of age) per degradation level to determine the serum macro and micro-element concentrations. All data were analysed using the General Linear Model (GLM) procedure of SAS (2007). Results showed that *Themeda triandra*, *Cynodon dactylon*, *Digitaria eriantha*, *Aristida congesta* and *Eragrostis chloromelas* were recorded as dominant species in the study areas. Generally, decreaser species were dominant in less severely degraded land, whereas increaser species dominated the severely degraded land. Grass biomass was higher ($p < 0.05$) in less severely degraded land. Forage macro- and micro mineral elements did not show a difference between degradation levels. However, soil nitrogen (N), copper (Cu), and manganese (Mn) concentration were greater ($p < 0.05$) in less degraded (0.18 ± 0.011 , 4.17 ± 0.268 and 330.21 ± 23.712 , respectively), than severely degraded areas (0.13 ± 0.011 , 2.07 ± 0.268 and 231.35 ± 23.712 , respectively). The interaction between soil and forage in severely degraded areas was not significant in all minerals except Mn, whereas in less severely degraded areas, a strong correlation ($P < 0.05$) between soil and forage was observed for N, P, and Ca. The blood mineral concentration of the cattle showed variation between dry and wet season for both severely and less degraded rangelands, with winter recording more deficient nutrients. Forage and blood levels seemed to show correlations for some observed minerals. The study concluded that ruminants may suffer intake of minerals in both degraded areas, but could be worse under severely degraded land conditions. Animals could also experience deficiencies in P, Fe, and Cu in winter season in both severely and less degraded rangeland, though the gap in deficiency may be wider under the latter than the former.

Defining rangeland condition in the Riemvasmaak Rural Areas

09:20 - 09:40

Presented by :

Anthony Palmer, Principal Researcher, Agricultural Research Council - AP

Measuring and confirming the net primary production (NPP) that is achieved by semi-arid ecosystems is a vital part of the sustainable management of rangeland resources. There are several innovative in-field sampling techniques available for measuring aboveground production, and when compared with modelled NPP, the results can provide informed guidelines to management about the quantity of the service that the ecosystem provides. Using GIS and earth observation products, we stratified the Riemvasmaak Rural Area prior to field surveys. We defined a gradient of biomass and elevation classes within the study area, and selected sample sites, taking into account the elevation and active green biomass signals from the vegetation. The former were derived from a high-resolution digital terrain model of the study area (ASTER DEM at 30 m spatial resolution) and the latter was derived from the Landsat TM image of January 2010, as well as MODIS LAI images for the study area. The cadastral boundaries of the study site were used to ensure that sample sites fell within the farms that make up the Riemvasmaak Rural Area. Based on a 100 m transect at each site, we used the nearest plant method to identify 100 plants along each transect. The

species name and the distance from the point to the plant were measured (point to tuft distance or PTD). Plant samples were taken to ensure correct identification. We have defined a scale of veld condition based on the following five categories: very poor, poor, moderate, good, very good. In the "very poor" class are samples with high cover of woody shrubs (*Senegalia mellifera*, *Rhigozum trichotomum*), and low cover of grasses. PTD > 30 cm. "Poor" class comprises moderate invasion of *S. mellifera* or *R. trichotomum*. Grass species are present, but usually, comprise the undesirable *Schmidtia kalahariensis* or *Stipagrostis uniplumis*. PTD = 20–30 cm. "Moderate" condition had *Euphorbia gregaria* dominating the biomass of the site. Woody species such as *S. mellifera* and *R. trichotomum* are less abundant or even absent. PTD = 15–20 cm. "Good" condition comprises those sites where woody encroachment is less obvious, with higher diversity and the occurrence of other woody species. Grass species present include the desirable grasses such as *Stipagrostis amabilis* and *Enneapogon cenchroides*. There were no samples in the "very good" condition class. The condition of the "poor" class is likely driven by intensive wet season herbivory, which would have promoted the success of phreatic shrubs and less palatable grasses. Future research should consider reversing this trend by testing management techniques that promote grass cover.

A stochastic frontier analysis of livestock production in communal rangelands: Towards improving livestock water productivity

09:40 - 10:00

Presented by :

Bukho Gusha, PROFESSIONAL Student Development, PROFESSIONAL Student Development

Communal rangelands in South Africa are perceived to be on the brink of ecological collapse because they are vastly overstocked compared to those rangelands used by commercial agricultural enterprises. Livestock production plays a significant role in satisfying human needs such as beneficial economic, social and cultural services, and these may be converted into cash through sales. This paper assesses the performance of households engaged in livestock production in the north Eastern Cape communal areas of South Africa. Survey data from 120 households from Mgwalana and Mahlunqulu villages collected in 2015 and 2016 were used in a stochastic frontier model to estimate technical efficiency scores and evaluate determinants among households in a communal production environment where rangelands are the cheapest source of fodder for livestock. Livestock water productivity (LWP) for various households in rural villages was described and the livestock goods and services that benefit rural households were assessed. Further, the study focuses on the water used by the rangelands, which is calculated using MODIS ET. The findings of the study revealed that households use available resources sub-optimally and produce less output compared to the theoretical average. The average technical efficiency score of 0.79 was obtained in this study. These results show that households have a high ability to attain livestock beneficial goods and services. These findings suggest that there is significant potential to improve outputs using existing inputs and to address the wide variation in the performance among households. Female-headed households were found to perform better with the help of hired labour. Furthermore, slight variations in LWP among households in different wealth categories were found, as better off (0.34 USD.m⁻³) attain a high LWP followed by middle-wealth and poor households (0.29 USD m⁻³). These results could be explained by the differences in livestock ownership, availability of labour, dwelling type, and net beneficial goods and services obtained by different household. Livestock holdings, the gender of the household head, and labour have a positive impact on improving LWP. The study provides essential information for understanding the productive performance among households in both villages, and thus provides important policy directions and possible interventions to improve production efficiency and reduce the livestock water footprint.

10:00 - 10:30

Conference
Rooms Stoep

Morning Tea

10:00 - 12:00

Conference
Rooms Stoep

Standard poster session

Moderators

Andiswa Finca, Junior Researcher, Agricultural Research Council

Woody vegetation change (>30yr) in the interior duneveld of the Kalahari Gemsbok National Park

10:00 - 12:00

Presented by :

Helga Van Der Merwe, SAEON Arid Lands Node

The growing awareness around ecosystem change has highlighted the importance of long-term data sets. Yet, there are still relatively few biodiversity time-series that span decades and this is particularly true for woody species. The objective of the current study was to investigate woody vegetation change at and away from a watering point over nearly four decades. Monitoring was initiated at three sites in the interior duneveld of the park between 1978 and 1982. At two of the sites, one at a watering point (WP) and the other five kilometres away from the watering point (NoWP), dense stands of even-aged *Vachellia erioloba* saplings were noticed after a number of years with above average rainfall. The third site (EoWP) represented a mature mixed stand of *V. erioloba* and *V. luederitzii* trees. In each plot, all woody individuals were counted by species. Additionally, seedlings were noted separately from the sapling/mature individuals. All three plots were monitored intermittently between the date the initial survey was conducted and 2016. Tree density declined at all three sites over the nearly four decades. The most prominent declines, particularly of *V. erioloba* and *V. luederitzii* sapling/mature individuals, occurred from the early 1980s until the mid-1990s, a period when the mean annual rainfall was below average for most years. This dry period followed on a wet cycle in the late 1970s. The large numbers of seedlings of these two species could have been the aftermath of the wet cycle and their demise as a result of the following dry cycle in the 1980s. This result supports numerous authors reporting large numbers of *V. erioloba* seedlings following above average rainfall periods, however, survival of seedlings is low. The large decrease in density in the dense sapling stands could also be partially attributed to density-dependent self-thinning. As was the case for *V. erioloba*, a similar trend was noted for *V. luederitzii* sapling/mature individuals at WP. The mature population at EoWP did not show the same sharp declines in density as the dense sapling stands. At all three sites, shrub densities generally decreased or remained relatively constant. Densities of three known encroachers (*Grewia flava*, *Rhigozum trichotomum*, *Senegalia mellifera*) remained relatively constant or decreased over time at all sites and no evidence of bush encroachment could be found. This result supports the notion that bush encroachment in arid savannas is driven primarily by land-use practices and not by elevated carbon dioxide levels. Overall, the floristic data indicated a slight directional trend in the vegetation at EoWP. At WP and NoWP vegetation change seemed to follow a semi-circular pattern indicating a progressive return to the initial conditions. The results of this study support the findings of previous studies conducted in the Kalahari Gemsbok National Park. The vegetation in this large natural conservation area showed definite changes in the short to medium term, mainly in reaction to long wet and dry cycles, a long-term ecological balance prevails and should continue if the large size of the conservation area is maintained.

Rehabilitation of old potato circles in the Sandveld, Western Cape: Soil health and soil seedbank - Preliminary results

10:00 - 12:00

Presented by :

Nelmarie Saayman, Scientist, Western Cape Department Of Agriculture

The Sandveld region along South Africa's west coast is known for its potato production circles. Some of these lands became economically unviable and were withdrawn from the production cycle. Many of these circles are in the endangered Leipoldtville Sand Fynbos and rehabilitation has become a priority. Potato lands have high phosphorous levels (up to 80 mg/kg) that will likely inhibit the establishment of fynbos species, which normally grows in soil with P-levels of around 8 mg/kg. One way to lower the soil-P levels is to sow an initial crop mixture that includes lupines, and harvesting and removing it at the end of the season. The addition of annual crops can also initiate nutrient cycling in the soil. We addressed the question "Does cultivation and sowing of initial crops have an impact on the soil health and soil seed bank of three rehabilitation sites one year after cultivation?". The study was conducted at three different sites in the Leipoldtville Sand Fynbos, all in sandy soils with high soil-P levels (35–63 mg/kg). The long-term average annual rainfall (LTA) is 281 mm. The rainfall in 2017 was 50% of the LTA and in 2018 in line with the LTA. At each site shallow-tillage (100 mm) with a tine-implement was done in June 2017 and initial crops were sown in twelve 5 × 5 m plots following a completely randomised design. Due to the drought, it was repeated in May 2018. The crops were harvested and removed in September 2018 before seed set. In each of these plots, soil samples were taken in May 2017 to determine the soil seed bank composition and soil health - doing Solvita® and Biolog tests. The Solvita® test gives an indication of the microbial soil respiration, and the Biolog test, of the microbial diversity in the soil. The soil seed bank test was repeated in May 2018 and the soil health tests in September 2018. A non-metric multidimensional scaling analysis (NMDS) based on Bray-Curtis distances (log-transformed data) and a permutation multivariate analysis of variance (PERMANOVA) were used to analyse differences in the seed bank composition, and principal component analysis (PCA) was performed on the Biolog tests data, for each site and year. A one-way ANOVA was done on the Solvita® data. Due to low rainfall received during the study period, few plants from the initial crop established and did it not have an impact on the soil-P levels. The addition of the initial crop did have a slightly positive impact on initiating nutrient cycling with higher microbial soil respiration and microbial diversity in the second year. There were no clear differences in soil seed bank composition between cultivated and control sites ($p = 0.398$) in both years. The overall seed bank composition changed however from 2017 to 2018 ($p = 0.002$) because of the disappearance of some species and a marked decline in the abundance of others, most likely due to low rainfall in 2017. Rainfall remains the deciding factor on the success of any restoration/rehabilitation project in the arid regions.

Determining species composition and landscape function of the old arable lands in the Eastern Cape province, South Africa

10:00 - 12:00

Presented by :

Unathi Gulwa, Eastern Cape Department Of Rural Development And Agrarian Reform

The study was conducted at Dudumashe communal area, located at 32°12'00"S 27°56'00"E in Ngqamakwe, Eastern Cape province, South Africa. The communal area belongs to the Amathole District Municipality, stretching from the coast through a large part of the former Transkei and inland across the Amatola Mountains. Dudumashe falls within Dohne Sourveld, receiving a mean annual rainfall of 600–700 mm. The common soil type in the area is a black lithic soil with a reddish colour, representing the Wesleigh soil forms. The study was conducted to assess species composition and landscape function of the old arable lands. The treatments were old arable lands with

legumes planted in 2008 (OL 08), old arable lands with legumes planted in 2009 (OL 09), old arable lands without legumes (OL NL), and natural veld (NV). Old lands with legumes (i.e. OL 08, OL 09) were planted to 14 annual and perennial leguminous pastures. Planting was done by oversowing legumes into the natural grasses using an Aitchison Mini seeder, (six-row no-till pasture seeder) at 5 kg/ha seeding rate. Based on the soil analysis results of samples that were taken before planting, phosphorous (P) level was corrected to the level of 20 mg P/kg by applying (50 kg super-phosphate) per hectare at planting. The P application was a once off during planting. Line transect (100 m) were laid out in each treatment and species composition and landscape functional analysis (LFA) data were collected along each transect. LFA data were taken to determine soil surface indicators while a step point method was used to determine herbaceous species composition. All data collection was done once in spring (September-November), summer (December-February), autumn (March-May) and winter (June-August) seasons, respectively during the year 2012. All data were analysed using two-way analysis of variance (ANOVA) of the generalized linear model (GLM) procedure of SAS (2001) statistical program. Treatment and season were the main factors, while species composition and soil surface indicators were the dependent variables. The results of the study showed that OL 08 was dominated ($p < 0.05$) by *Hyparrhenia hirta* and *Cymbopogon plurinodis*, respectively. OL 09 and OL NL were dominated by *Sporobolus africanus*, respectively. *Trifolium repens* and *Medicago truncatula* were dominant ($p < 0.05$) in the OL 09, while OL 08 was dominated by *T. repens*. *Eragrostis plana* was the most dominant species in the NV, while *C. plurinodis* was the least prevalent species. Regarding soil surface indicators, there was higher ($p < 0.05$) rain splash protection in the NV in comparison to the rest of the treatments. OL NL was less stable when a slake test was conducted in comparison with the rest of the treatments. Only annual forage legume species were still persistent during the time of the assessment. All treatments were dominated by increaser grass species. Old lands with legumes had a lower prevalence of forbs and bare patches in comparison with old land without legumes therefore, legume inclusion enhanced soil surface cover.

The relative feed quality of tall fescue (*Festuca arundinacea*), cocksfoot (*Dactylis glomerata*) and perennial ryegrass (*Lolium perenne*) at Cedara, KwaZulu-Natal

10:00 - 12:00

Presented by :

Derryn Nash, Senior Researcher, KwaZulu-Natal Department Of Agriculture And Rural Development

Perennial ryegrass is a popular temperate season species on the eastern seaboard of South Africa. However, its low acid tolerance, low water use efficiency (WUE) and low tolerance to high environmental temperatures lead to a general lack of persistence. With global warming, finding a more suitable pasture is imperative. Both tall fescue and cocksfoot are possible alternatives. They have similar yields in year one, are more acid tolerant, have a higher WUE and tolerate higher environmental temperatures. The question is do they have acceptable quality? Forage samples from a number of cultivar evaluation trials were taken at harvesting. These samples were analysed for crude protein (CP), non-structural carbohydrates (NSC), acid detergent fibre (ADF) and neutral detergent fibre (NDF). This data allowed the formulation of a relative feed value (RFV) to compare the different species. While perennial ryegrass generally had a slight RFV advantage over fescue and cocksfoot, fescue was a close second, especially in autumn (100 vs 107) and slightly better in winter (134 vs 132).

Pasture quality of oversown Italian ryegrass (*Lolium multiflorum* var Supreme Q) into irrigated kikuyu (*Pennisetum clandestinum*)

10:00 - 12:00

Presented by :

Donna Berjak, Candidate Scientist, KwaZulu-Natal Department Of Agriculture And Rural Development

Oversowing Italian ryegrass (*Lolium multiflorum* var. Supreme Q) into kikuyu (*Pennisetum clandestinum*) in autumn is a strategy employed to improve the quality and quantity of pasture during the winter and early spring months when kikuyu is not actively growing. A study was conducted at the Cedara Research Station in KwaZulu-Natal to evaluate the effectiveness of two application rates of herbicide, four different times of herbicide application and two mowing heights in reducing kikuyu competitiveness prior to oversowing with Italian ryegrass. Glyphosate was applied at 400 ml/ha (G4) or 800 ml/ha (G8) either three weeks, two weeks, one week or one day before planting. Kikuyu in the mowing treatments was cut to a canopy height of 5 cm or 2 cm one day before planting. Glyphosate was applied at 4 L/ha, for a complete kill of the kikuyu, as a ryegrass control (Lm control). The autumn DM yields were low and comprised primarily of kikuyu, therefore herbage quality was only determined for the kikuyu control treatment. In winter the kikuyu was dormant, therefore herbage quality was analysed for all treatments barring the kikuyu control. In spring only, the ryegrass and kikuyu controls were analysed for quality. The Acid Detergent Fibre (ADF) content of kikuyu during autumn at 31.8%, is higher than the recommended 19% to 21% minimum dietary ADF for lactating dairy cows, but is within a normal range for kikuyu. In winter the ADF and Neutral Detergent Fibre (NDF) results were not significantly different between ryegrass treatments, with a mean of 21.34% and 52.78%, respectively. During spring the ADF content was not significantly different between the kikuyu and ryegrass control treatments. The NSC in autumn was 5.25% for kikuyu. The NSC content differed ($p < 0.05$) between ryegrass treatments during winter, with the mean content of 13.4%, regarded as acceptable for lactating dairy cows. Although, not all statistically different from one another, the G8 treatments ranked higher than the G4 or mowing treatments for NSC content during winter. In spring NSC content for kikuyu and ryegrass controls were lower than in winter at 7.1% and 9.58%, respectively. The CP of kikuyu in autumn was 15.5%. In winter the CP results were significantly different between treatments, with a mean of 24.16%, with ryegrass control having the highest CP at 28.12%. Interestingly, the G8 treatments had the lowest CP percentages in winter, indicating the inverse relationship between CP and NSC. These G8 treatments had the NSC: CP ratios closest to 1.0 of all the treatments with a mean of 0.65. In spring the kikuyu control had a higher CP than ryegrass control at 31.02% and 28.93%, respectively. This may indicate a luxury uptake of nitrogen by the kikuyu as it was emerging from dormancy and had young growth.

Assessment of supplementary feed resources available for cattle in four local municipalities of the Eastern Cape province, South Africa

10:00 - 12:00

Presented by :

Siza Mthi, Researcher, Eastern Cape Department Of Agriculture

Livestock production in communal farming systems is constrained among others, by the shortage of good quality feed, particularly during the dry seasons. A survey was conducted from September 2010 to October 2015 to assess feed resources commonly used for general use as well as for supplementation feeding of cattle. A total of 365 households in Amahlathi, Mbhashe, Ngcobo and Mnquma local municipalities were selected based on cattle numbers and access to cattle owners. Data was collected by pre-tested questionnaire with individual households and analysed using SPSS (2004) to generate frequencies, figures, tables and percentages. Demographic characteristics of the respondents showed that 60% of respondents were male between the ages of 40–70 years with primary education. Sheep accounted for the largest proportion across the four local municipalities followed by cattle. All respondents indicated that a shortage of feed was among the constraints affecting livestock productivity. Natural pasture (65.5%), commercial diet (15.3%), browse plants (9.2%), crop residues (8.9%) and brewers' grain (1.1%) were the major feed resources used in livestock production. Maize stover was the main source of crop residues, whereas leaves of *Vachellia karroo*, *Ziziphus mucronata*, *Diospyros dichrophylla*, *Vepris lanceolata*, *Haemanthus coccineus*,

Grewia occidentalis, *Schotia latifolia*, *Calpurnia aurea*, *Olea europaea* subsp. *Africana*, *Cordia rudis* and *Mimusops obovata* were the major indigenous fodder trees used to supplement livestock in the dry season. The commercial diets mostly used to supplement lactating animals in order to improve milk production included Master 20, bran mixed with maize and protein blocks. Some of the main reasons for the shortage of livestock feed supplementation mentioned were building of homesteads (55%), expansion of cropping fields (28.7%) and land degradation (16.3%). It was concluded that cattle farming can be enhanced by the production of herbaceous, trees and forage legumes through intercropping. These practices could potentially improve nutrient supply and livestock productivity in communal farming systems, particularly during the long dry periods. However, policymakers should develop policies that seek to guide the management of rural communities as far as grazing resources are concerned.

Knowledge and perception of small holding farmers on supplementation and feeding of sweet potato vines to goats

10:00 - 12:00

Presented by :

Cynthia Fikile Luthuli, Scientific Technician, KZN-Department Of Agriculture And Rural Development

Goats are often raised in conditions which do not allow them to achieve their maximum performance nor express their genetic potential. They are raised on poor quality feeds, with low energy and protein content. In order for goats to perform to their full potential as small ruminants, they require nutritious feed, especially during high producing periods. However, supplementation can be done using fresh green feeds, protein blocks or vitamin supplements as well as traditional food crop residues. This study outlines the knowledge and perceptions of goat farmers concerning feeding sweet potato vines to goats. This study was conducted at KwaMthethwa community area, Umfolozi Local Municipality, KwaZulu-Natal, which consist of seven wards. Surveys were administered through structured questionnaires and 15 households were interviewed per ward, making a sample size of 105 participants. Participants were randomly selected at their willingness to participate in an interview. Data was analysed using the frequency procedure of SPSS 2015. Results of this study showed that 56.2% of the respondents were males and 43.8% were female, demonstrating a male dominance in the goat farming sector in the area. The results also revealed that 71.4% of households keep goats for socio-cultural purposes such as lobola, traditional functions and status, whereas 15% and 9% is kept for income generating purposes and consumption, respectively. The majority of respondents (71.4%) were aware and do practice some sort of supplementary feeding. The feed sourced through purchasing was 34.3%, the remainder from other sources: 26.7% was sourced from food crop residues, 9% from the branches of indigenous trees and the other 11% was unclear (and were assumed not supplementing). The majority of respondents (72.4%) cultivate sweet potatoes for different uses, such as generating income (53.3%) or for consumption (27.5%). A further 8% use it for both consumption and income, whilst 16% do not cultivate sweet potatoes. Sweet potato vines were being discarded as waste or burnt (32.4%), left on the field as manure (25.7%), conserved as propagation material (8.6%), and fed to livestock by 7.6% of respondents respectively. However, most of the participants (78.1%) rejected the use of sweet potato vines as feed to livestock. Their assumption behind rejecting sweet potato vines needs to be studied further, since they believe that the vines course fatal diarrhoea to goats. The findings concur with previous studies that indicate that small holding farmers keep livestock for socio-economic purposes. Most participants seem to know about supplementation, however they have little understanding concerning the concept of supplementation, since most were giving maize to goats every afternoon for goats to come back for kraaling in the afternoons without a herder. Government still has a major role to play, to ensure more women partake in agricultural sector. Furthermore, there is a need to develop farmers in goat farming through training and workshops concerning supplementary feeding for farmers to be able to supplement in a profitable manner.

The impacts of climate change on the agronomic potential of *Calobota sericea*

10:00 - 12:00

Presented by :

Francois Müller, Junior Researcher, ARC-AP

Calobota sericea is a perennial legume species from South Africa that has the potential to be developed as a fodder crop in water-limited agro-ecosystems. Very little is currently known about how future climate change scenarios may influence the bioclimatic niche of *C. sericea* and how this, in turn, may influence its agronomic potential. In this study we aimed to characterise the adaptability of *C. sericea* to future bioclimatic conditions using ecological niche modeling techniques. We found that *C. sericea* will most likely be able to expand its potential adaptation range outside of its current distribution with future climate change. Special attention should be given to the collection of genetic resources from populations that are currently located within the adaptation trend zone, which represents an optimistic distribution range of *C. sericea*. The genetic resources from this adaptation range will likely be the key to successfully exploit the potential of *C. sericea* to expand into areas characterized by the bioclimatic conditions of the adaptation trend zone, under future bioclimatic conditions.

The effect of different herbicide treatments on herbage production and plant density of a mixed grass-legume pasture

10:00 - 12:00

Presented by :

Gideon Jordaan, Production Scientist, Eastern Cape Department Of Agriculture, Rural Development And Agrarian Reform

Old lands in the Eastern Cape province suffer from low pasture productivity, due to low diversity in the forage species available. Previous experimental work identified a suite of annual and perennial legume pastures to fill the winter feed gap and significantly increase animal production. However, to ensure the long-term sustainability of these pastures, there is a need to provide a seeding rest every three years. For the temperate species, this is typical during the summer season when maize is grown. Therefore the idea was to develop an intercropping system that can utilize any excess nitrogen produced by the pasture legumes for maize production while affording the legumes an opportunity to set seed. In order to achieve that, a field experiment was conducted with the aim of developing a weed control system that will suppress grass and legume growth sufficiently in order to successfully establish maize seedlings without eradicating the pasture legumes. For the purposes of this trial, an existing grass and legume pasture at Kubedlana village were selected. Eight different herbicide treatments were applied, in a randomised block design with three replications, during the first week of November 2016. The treatments were: glyphosate at 50% of recommended rate (RR); haloxyfop-R methyl (RR); no herbicide (control); bendioxide (50% RR); paraquat (50% RR); bendioxide (RR); paraquat (RR) and haloxyfop-R methyl (RR) with bendioxide (50% RR). Herbage production was determined by cutting five 1 m² quadrats per plot at six and 18 months after the treatments were applied. At six months post-treatment, glyphosate was the only herbicide that significantly reduced total DM production (16.2 gm⁻²). No treatment effects could be detected at 18 months after application. Stand density was determined by doing a frequency count. This was done by placing ten 0.25 m² quadrats randomly in each plot and counting the number of legume plants and the number of grass plants. Counting was done before application of the treatments and at 12 and 24 months thereafter. The glyphosate (10 plants.m⁻²) and paraquat (50% RR) (16 plants.m⁻²) treatments reduced plant density of the legumes the most ($p < 0,05$), while the density of the grass plants was only reduced by the glyphosate (8 plants.m⁻²) and bendioxide (50% RR) (15 plants.m⁻²) treatments ($p < 0.05$). It is recommended to use glyphosate (50% RR) as a herbicide on old lands in

communal areas to control weeds without having a long-term negative effect on the pasture legumes.

The effect of Rhizobium inoculation on growth performance (plant height, stem diameter and chlorophyll content) and forage production of lablab cultivars

10:00 - 12:00

Presented by :

Sibongile Portia Senti, Master' S Student, University Of Fort Hare

Poor livestock nutrition is a major problem for small-holder farmers especially during the dry season when forage from natural pastures is of low quality and biomass. Thus, in some areas, crop residues are used to improve the fodder flow. The quality of crop residues is improved by supplementing with protein-rich leguminous forages. The optimum production of these leguminous forages in semi-arid communal areas is limited by low rainfall and infertile soils, with the latter worsened by climate change. In order to improve the biomass and quality of these legumes, bio-enhancers/bio-fertilisers like rhizobia can be inoculated into legumes during planting so as to improve nutrient uptake and water absorption. The study was conducted at Fort Hare Research Farm to determine the effect of Rhizobium inoculation on growth performance (plant height, stem diameter and chlorophyll content) and forage production of Rongai and Highworth cultivars. The experiment was a 2×2 factorial arrangement with two Rhizobium inoculation levels (R0 and R+) and two lablab cultivars (Rongai and Highworth). These treatments were laid in a randomised complete block design and each treatment was replicated four times. Plant seedling emergence was affected ($p < 0.05$) by the combination of both varieties and inoculation. Rhizobium inoculation increased ($p < 0.05$) plant height and stem diameter in both varieties (Highworth and Rongai). Nodule parameters (nodule number, nodulation rate, active nodules, and nodule dry yield) were significantly different ($p < 0.05$) and they were favoured by inoculation. Therefore, this shows that inoculation had a great impact on nodule number production. The results showed that the presence of Rhizobium inoculation improved forage yield in both Highworth and Rongai cultivars. Generally, there is a direct relationship between age and biomass production of forage legumes. When the forage legumes are still at the early stage of growth, the biomass production is low and the biomass increases as the plant grow up until the flowering stage and after flowering, it starts to decline.

Effects of phosphorous fertilisation on forage production of abandoned lands planted with pasture legumes

10:00 - 12:00

Presented by :

Wandile Mashece, University Of Fort Hare

Environmental and socio-economic changes are leading to increased levels of land abandonment worldwide. Most croplands are abandoned as the result of land degradation and leaching of micro- and macro-nutrients from the soil. The abandoned old croplands in the Eastern Cape province are now converted to grazing lands but are so degraded that they do not provide adequate quantity and quality forages to the ruminants. The Eastern Cape Department of Rural Development and Agrarian Reform, in partnership with the Western Australian Government and Murdoch University, initiated a research project called "The Eastern Cape Communal Arable Lands (ECCAL)" in 2006. The aim of the research was to evaluate varieties of forage legume species for use to restore the abandoned lands in different agro-ecological zones of the province. The current study evaluated the effect of phosphorous fertilisation on forage production and plant density of pastures planted with selected legume species in two ecological zones of the Eastern Cape viz: Sinqumeni and Kubedlana. Four P rates were evaluated (0 P kg/ha, 10 P kg/ha, 20 P kg/ha, 40 P kg/ha) each treatment replicated 4×4 m. At each site, an area previously planted with legume species and characterised by

a well-established and even stand of legumes was selected. For both experimental sites, experimental design consisted of plot size of 25 × 25 m for phosphorus plot with 5 × 10 m of subplot planted with an even stand of pasture legumes arranged in a randomised complete block design (RCBD). In each small plot, data was collected on forage biomass and plant density (species count). Results for two years indicated that phosphorus fertilisation had a significant ($p < 0.05$) effect on forage dry matter (DM) yield at Kubedlana site. During year 1, the control plot (KP0) treatment produced the highest DM yield and P40 yielded the lowest, whereas during year 2 P40 had the highest DM yield and KP0 yielded the lowest DM production. Treatment P20 yielded high total density (TD) and control plot (KP0) produced the lowest. At P20, the total number of legumes was high (TL) and P10 had the lowest for both years. At Sinqumeni, there was no significant effect of treatment between years but there was a recorded increase in DM yield from year one to year two. During year one, P40 produced the highest DM yield and control plot (SP0) had the lowest DM yield, whereas, in year two, P20 yielded high DM and P40 produced the lowest DM yield. Plot P40 generated high TD and P20 had the lowest compared with P0 plot. At SP0 plot there was a high number of legumes density (TL) and all P treatments produced the lowest with P10 being the lowest producing treatment plot. Therefore, the study concludes that, from data obtained revealed that for both site, during year one of harvest there was low DM yield than year two, which means that P fertiliser was still immobile in soil during year one than year two and that resulted in increase in DM yield and plant density during year two on both sites. In summary, application of P fertiliser positively increased the biomass yield of experimented plant densities.

Predicting the variability and chemical composition of fresh forage by using three different devices of near-infrared spectroscopy

10:00 - 12:00

Presented by :

Lwando Mazule, Student, University Of Fort Hare

Livestock farmers with intensive or extensive management need to understand the quality of their forage to improve efficiency and profit. This, in turn, needs the determination of the nutritive value and chemical constituents. Standard chemical analytical techniques usually offer a high level of accuracy and precision, but at a high cost, high labour input, and delay in reporting. In addition, many standard techniques involve the destruction of the test sample, which could have a negative impact in the case of valuable and scarce materials (Font et al., 2006). Since recently, the use of fast analytical techniques, such as near-infrared reflectance spectroscopy (NIRS), has been considered as a better and alternative method and seems to have many advantages over the standard analytical techniques. The objective of this study was to develop a model to predict the quality of fresh forage using three near-infrared reflectance spectroscopy (NIRS) devices of different normal and restriction wavelength (Foss 5000, ASD lab spec 5000, and MicroNear Pro 1700). Undried samples of fresh forage grasses ($n = 300$) were collected from selected farms in La Renion island to estimate the dry matter (DM), crude protein (CP), total ASH, cellulose, neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) and digestibility (DMSauf) using the three devices. Finally, the optimal models were developed based on the laboratory data or wet chemistry reference value and the spectral information by using modifier partial least squares (MPLS) regression. The results revealed that the best calibration models were obtained on Foss 5000, ASD lab spec 5000 on normal wavelength and using some statistical criteria like coefficient of determination in cross-validation (1-VR) and ratio of prediction to deviation (RPD). The Foss 5000 and ASD lab spec 5000 coefficient 1-VR value could be considered between excellent and good for all nutritive parameters except for ASH and ADL on the normal wavelength in both devices, The ratio of performance to deviation (RPD) on normal wavelength were greater than 2.5 for CP and DMSauf, the others were less than 2.5 for DM, NDF, ADF, Cell, Ash, and ADL calibration equations. We conclude that NIRS calibrations based on undried fresh forage spectra have the capability of predicting a wide range of chemical and

digestibility parameters which would afford a rapid assessment of the forage for diet formulation. The MicroNIR is close to the other two devices and that it is particularly suitable for assessing the composition of green fodder in herds (that is it shows a good compromise between precision and miniaturization).

Chemical composition, in vitro dry matter digestibility and dry matter intake of five browse species

10:00 - 12:00

Presented by :

Khuliso Ravhuhali , Senior Lecturer, North-West University

Many browse species are undervalued due to insufficient knowledge about their potential feeding value. One way to lessen the devastating effect of droughts is to have an understanding of the chemical composition of browse available in arid and semi-arid areas. The study was conducted to evaluate chemical composition, in vitro dry matter digestibility and dry matter intake of *Melia azedarach*, *Leucaena leucocephala*, *Searsia lancea*, *Moringa oleifera*, and *Acacia hebeclada*. Browse trees replicated 10 times from each of the five browse species were randomly selected and marked for harvesting during the summer. The leaves were collected by handpicking and air-dried at room temperature in a well-ventilated laboratory. Samples were ground in a hammer mill for both chemical and rumen degradability analyses. Chemical composition, dry matter digestibility, in vitro ruminal degradability and dry matter intake were determined and estimated respectively. All data were analysed by ANOVA using the one-way analysis of variance of GLM procedure of SAS (2010) for completely randomised design. *Melia azedarach* leaves had the same ($p < 0.05$) CP value as *L. leucocephala* and *M. oleifera*. *Acacia hebeclada* had the same ($p < 0.05$) CP value as *S. lancea* and *L. leucocephala*. Neutral detergent fibre content was higher in *A. hebeclada* than all other leguminous species leaves. *Leucaena leucocephala* and *M. oleifera* had the least NDF values (306.1 and 309.3 g/kg DM, respectively). *Searsia lancea* and *L. leucocephala* leaves had the lower ($p < 0.05$) ADL content (99.7 and 112.6 g/kg DM respectively) than those of *A. hebeclada* (226.7 g/kg DM), *M. oleifera* (125.99 g/kg DM) and *M. azedarach* (118.0 g/kg DM). *Leucaena leucocephala* had higher (19.1 kg) DMI than all other species. *Acacia hebeclada* had the lowest ($p < 0.05$) DMI (11.6 kg). *Melia azedarach* and *M. oleifera* had higher ($p < 0.05$) DMD36 values (646.6 and 845.4 g/kg DM, respectively) than *S. lancea* and *A. hebeclada*. There was a negative correlation between metabolizable energy and fibre content, and a positive correlation to crude protein content. All browse species had CP values of above 10% which is above the minimum required in the diet for adequate digestive activities. *Moringa oleifera*, *Leucaena leucocephala* and *Melia azedarach* leaves had the highest metabolizable energy, dry matter intake, total digestible nutrients, relative feed value and dry matter degradability as compared to other browse plants. The results from the study suggest that *Moringa oleifera*, *Melia azedarach*, and *Leucaena leucocephala* can be recommended to be used as a supplement during the dry season and in case of low-quality forage feeding.

Effects of digestate application on red and black soils on forage sorghum seedling growth

10:00 - 12:00

Presented by :

Portia Mamothladi Moshidi, Research Student , Agricultural Research Council – API

Biogas production through anaerobic digestion is becoming a very fast-growing market generating huge amount of bio-digestate that can be used as fertiliser. This study was conducted to determine the effects of agro-digestate application on sorghum seedling development on two soil types under dryland conditions. The study was designed as a 2×4 factorial treatment: two soil types and four treatments, viz. control, digestate, cow manure and inorganic fertiliser. Two adjacent blocks of cultivated pasture with different soils were selected, one being rich in ferric iron oxides and hereafter called

'Red' (40 ha), and one being rich in organics and hereafter called 'Dark' (30 ha). Soils were analysed for nitrogen levels, and amendments for sorghum nitrogen requirements were done. Twelve plots of 2 × 8 m were randomly selected within each block after mechanical seeding of forage sorghum at the beginning of February 2019. Plant height and number of leaves were determined on days 30, 45, and 60 after sowing. The results showed that plants were 2–3 times taller in 'Dark' soil as compared to 'Red' soil for the control, manure and fertiliser treatments, and 3–7 times taller for digestate. On 'Red' soil, plant height was lower ($p < 0.05$) on digestate-amended soil than for the rest of soil on day 30 (0.155 vs 0.45 m) and day 60 (0.55 vs 0.83 m) after planting. On 'Dark' soil, no differences in plant height were observed amongst treatments at each measurement period. There was no difference in the number of plant leaves between 'Red' and 'Dark' soils on day 30 after planting. After days 45 and 60 'Dark' soil plants had one and two leaves more ($p < 0.05$) respectively than 'Red' soil. Sorghum on 'Red' soils was shorter, which could be a result of the moisture holding capacity of the soil, and lower nutrient availability from less soil microbial activity compared to the richer organic 'Dark' soil. This was more pronounced on digestate-amended 'Red' soil suggesting, an interaction with 'Red' soil properties.

Post-burn regrowth and nutrient supplementation increase browsing time by goats

10:00 - 12:00

Presented by :

Piet Monegi, Agricultural Research Council

This study tested the hypothesis that goats browsing on post-burn forage and receiving protein supplements in paddocks spend more time browsing than goats in the control paddocks. Paddocks (0.25 ha) were sited in a closed woodland dominated by *Vachellia karroo*. Treatments consisted of: (a) control, (b) fire, (c) nutrient supplements, and (d) fire-and-nutrient supplement combination. Goats received 100 g of soya oil cake. To conduct the study, foraging behaviour of two goats from each treatment was observed and recorded over a period of eight days for every month of the experimental duration. Each observation lasted for 15 minutes for each goat. Analysis of variance was used to analyse the data. Goats supplemented with nutrients and exposed to post burn regrowth spend more of their time browsing than the control goats ($p < 0.05$). There were significant differences in the time spent browsing between control goats and fire goats ($p < 0.05$). However, we found no significant differences in browsing time between the control goats and goats supplemented with nutrients ($p > 0.05$). The hypothesis that a combination of nutrient supplementation and post-burn regrowth enhances browsing by goats was supported by the results. Individually, only the post-burn regrowth results were consistent with findings from other studies showing that herbivores exposed to post-burn regrowth may increase their intake of chemically defended woody plants and achieve higher feed intake. The results obtained from goats that were supplemented with nutrients alone, were not consistent with findings from other studies. Nevertheless, the highest browsing time was observed in goats that were supplemented with nutrients and exposed to post burn regrowth than goats from other treatments. Management strategies that improve a herbivore's ability to consume woody plants may increase forage availability and inform bush control programmes.

The use of indigenous chicken as a buffer to prevent acidosis and bloating on small ruminants grazing on crop maize residues

10:00 - 12:00

Presented by :

Petros Khoza, Scientist, Mpumalanga Department Of Agriculture, Rural Development, Land And Environmental Affairs

Ruminants may have acceptable gains if allowed to selectively graze crop residues. The challenge for most ruminants is grain overload which causes acidosis poisoning or

bloating. The grain releases carbohydrate into the animals rumen and this rapidly ferments rather than being digested normally. Bacteria in the rumen produce lactic acid, resulting in acidosis, slowing of the gut, dehydration and often death. Smallholder ruminant farmers in the Lowveld of Mpumalanga province have experienced mortalities from bloating and acidosis as a result of feeding ruminant livestock on crop residues. These farmers lack the capacity and resources to buy adequate hay, lime based lick and buffer licks to serve as supplementary buffers for overwintering their livestock on crop residues. This study was conducted to determine the effect of using indigenous chicken to consume loose grain before introducing ruminants to graze crop residues, thus ultimately reducing the incidence of acidosis poisoning and bloating. The research trial was conducted at Nkomazi local municipality at Ehlanzeni district in the Lowveld region of Mpumalanga province characterised by savanna shrubs biome. The rainfall varies from 550 mm/annum to about 1050 mm/annum. The elevation is 394–452 m above sea level. Trial sites were identified at the Lowveld region where trial sites without indigenous chicken and trial sites with indigenous chicken were allocated 50 goats each for eight weeks. Indigenous chicken have a capacity to consume large quantities of maize grain without any negative effect on their health, this can be attributed to the monogastric stomach anatomy which has different physiological processes to those of ruminants. The indigenous chicken are able to pick up the loose grains after the main harvest thus reducing exposure of ruminants to loose grains which are the source of acidosis poisoning and bloating. Data was collected for the eight weeks duration and analysed using Excel graphs to determine the mortality rates between the two sites one with indigenous chicken and the other without the introduction of indigenous chicken. The results illustrated that the number of goat mortality declined from 10 goats in trial site without indigenous chicken to only 3 goat mortalities in the trial site with indigenous chicken. These yielded a significant difference of 14% reduction in mortality rates of goats grazed on crop residues, since mortality rate of goats grazed without introduction of indigenous chicken declined from 20% to 6% on goats grazed with the introduction of indigenous chicken at confidence interval of $p < 0.05$. The experimental trial affirms a negative correlation between the number of indigenous chicken introduced per site and the mortality rate of goats, whereby goat mortality rate declined with a concurrent increase in the number of indigenous chicken introduced at the crop residue site. The results of this study suggest that the dual feeding of small ruminant goats and indigenous chicken on crop residues is an efficient and affordable technique, which can be used by smallholder ruminant farmers for their ruminant livestock to reduce incidences of acidosis and bloating.

Effect of soil and subhabitat differentiation on the growth of *Tarchonanthus camphoratus* seedlings

10:00 - 12:00

Presented by :

Imke Stehn, Student, University Of The Free State

Water and nutrient availability are the primary factors which, among others, influence the growth rate of plants in the semi-arid savannas of South Africa. Allelopathic effects of some savanna plants however, can also inhibit the germination and growth of other plants in their nearby surroundings. In an attempt to understand *Tarchonanthus camphoratus*, as a species that can cause bush-thickening, it is important to investigate factors which influence its seedling establishment and growth rate. The objectives of this study were, therefore, to investigate (1) whether *T. camphoratus* exhibits allelopathic effects in the soil and (2) if soil originating from different sub-habitats will have an effect on the growth rate of seedlings. This trial forms part of a larger study on the ecology of *T. camphoratus* in the Northern Cape province of South Africa, and was conducted under controlled conditions in a greenhouse. Topsoil from three sub-habitats around *T. camphoratus* namely, (1) < 25 cm from the stem, (2) the middle of the canopy and (3) the uncanopied zone was collected from two sites with different soils i.e. deep sandy soils and shallow rocky soils. The trial consisted of six treatments

with ten replications each and started in September 2018 when *T. camphoratus* seeds were planted. The soil and seeds were collected at the Rooipoort Nature Reserve near Kimberley. In addition, soil nutrient (Na, Mg, K, Ca, P, and N) analyses were performed on the soils from the different sub-habitats. Seeds germinated abundantly in all the pots of sampled soil confirming that there are no allelopathic effects preventing their germination. Significantly higher plant heights, leaf numbers, and growth rates were observed in seedlings growing in the soil originating from the canopied zone compared to seedlings growing in the uncanopied zone, while no significant differences existed between the seedlings growing in soil from the same sub-habitat but different soil potential. Higher soil nutrient status, as well as the absence of allelopathic effects inhibiting growth, are considered to be responsible for better growth of *T. camphoratus* seedlings in the canopied sub-habitats. This has implications for tree thinning operations as areas where mature trees are removed may subsequently present ideal areas for seedling establishment and growth.

Preliminary results of the long-term effect of various fire treatments on the woody structure in the Kruger National Park, South Africa

10:00 - 12:00

Presented by :

Naquita Faria, Research Assistant, Tshwane University Of Technology

The objective of this research was to determine the long-term effects of various fire treatments on the woody vegetation structure in the four Experimental Burn Plots (EBP's) in the Kruger National Park by surveying selected treatment plots. The four treatments surveyed within each replicate were the No Burn Treatment, Triennial February Burn, Triennial August Burn, and Annual August Burn. All woody plants rooted in a 10 × 100 m belt transect, centrally placed within the treatment plot, were recorded. A total of forty-eight 1000 m² belt transects were sampled with a total area of 4.8 ha. The height for all woody plants in the belt transects was measured and assigned a height class. These classes were dwarf shrubs up to 0.5 m; dwarf shrubs between 0.5 to 1 m; shrubs between 1 to 1.5 m; shrubs between 1.5 to 2 m; and trees 2 m and higher. Canopy cover percentage for each species, in their respective height classes, was estimated using the Plant Number Scale technique. The Pretoriuskop EBP had the highest canopy cover percentage, within all the treatments (39.4% No Burn Treatment; 32.2% Triennial February Burn; 32.1% Triennial August burn; and 31.5% Annual August Burn), and the Satara EBP had the lowest canopy cover (4.3% No Burn Treatment; 6.4% Triennial February Burn; 5.9% Triennial August burn; and 2.8% Annual August Burn). The less intense burns (No Burn Treatment and Triennial February burn) had the highest canopy cover across three of the EBP's (Pretoriuskop (39.4% and 32.2%), Skukuza (16.8% and 18.5%), and Satara (4.3% and 6.4%)) with the Mopani EBP showing the highest canopy cover in the annual August burn (24.7%). The dominant growth form across all the treatments within the Pretoriuskop (16.4% No Burn Treatment; 12.1% Triennial February Burn; 9.9% Triennial August burn; and 7.8% Annual August Burn) and Skukuza (6.9% No Burn Treatment; 9.3% Triennial February Burn; 3.7% for the Triennial August burn; and 2.6% for the Annual August Burn) EBP's were trees. The Satara EBP displayed variable degrees of dominance of growth forms with shrubs being dominant in the less intense burns (2.1% No Burn Treatment and 3.3% Triennial February Burn), trees being dominant in the more intense Triennial August Burn (2.37%) and dwarf shrubs being dominant in the intense Annual August Burn (1.9%). The No Burn (12%) and Triennial February Burn (12.15%) treatment's in the Mopani EBP had trees as the dominant growth form. The less intense burns had a higher canopy cover compared to the more intense burns with trees being the dominant growth form across all EBP's. The frequent burns showed a lower canopy cover than the infrequent burns with shrubs and dwarf shrubs being the dominant growth form across all EBP's. Preliminary results suggests the less intense burns had a higher canopy cover and thus an increased potential browse.

Large tree dynamics in Lowveld protected areas: with emphasis on drought response

10:00 - 12:00

Presented by :

Mike Peel, Specialist Scientist, Agricultural Research Council – Animal Production Institute

It is now accepted that the aesthetic value of large trees is as an acceptable aspiration as the more 'concrete' objectives like preventing biodiversity loss. The potential decline in tall trees in protected areas has been variously ascribed to elephant and associated potential knock-on effects such as fire. Elephant can modify habitats rapidly and extensively, and as such may trigger a cascading effect through the ecosystem, affecting many co-existing plants and animals. It is contended that a manifestation of high elephant densities 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 vegetation is replaced by short closed woodland with an increasing number of species such as impala (mixed feeder) and kudu (browser). We examined two sets of data in a number of protected areas: 1) Marked trees-direct; 2) Tree densities measured in belt transects going back as far as 1992/93 in some instances. We focused on *Sclerocarya birrea* and *Acacia nigrescens* and try to determine whether the primary impact of elephant: 1) Leads to elevated large tree mortality through direct impact (e.g. elephant); and 2) Magnify the attributes that affect selection and the manner of utilisation which render the trees vulnerable to higher mortality rates (e.g., de-barking and susceptibility to fire).

The application of Tree Popper (TM) mechanical control of woody plant encroachment in savanna rangelands

10:00 - 12:00

Presented by :

Piet Monegi, Agricultural Research Council

The absence of disturbances such as herbivory and fire in savannas is associated with greater establishment success of seedlings of woody plants, leading to woody plant encroachment. Cost-effective strategies that may help control these seedlings are needed. This study tested the hypothesis that a Tree Popper® mechanical tool may be an effective way to mechanically uproot seedlings of woody plants in savannas. To conduct this study, seedlings of eight woody plant species were selected (i.e. *Vachellia* (*Acacia*) *karroo*, *V. nilotica*, *V. tortilis*, *Dichrostachys cinerea*, *Ziziphus mucronata*, *Euclea crispa*, *Ehretia rigida*, and *Gymnosporia buxifolia*) and grouped into three height classes (i.e. between 0–49 cm, 50–99 cm, and 100–150 cm) of 10 seedlings per species per height class. For each seedling, we measured plant height, canopy diameter in two perpendicular directions, and stem basal diameter. We also recorded whether the seedling was single- or multi-stemmed. Tree Popper® successfully uprooted 64.7% of the seedlings. The Tree Popper® uprooted 100% of *G. buxifolia*, 97% of *Z. mucronata*, 97% of *E. crispa*, 93% of *E. rigida*, 81% of *D. cinerea*, 16% of *V. karroo*, 15% of *V. nilotica*, and 3% of *V. tortilis* seedlings, respectively. The effectiveness of the Tree Popper® depends largely on plant species and not only on soil wetness. The Tree Popper® was more effective on broad-leaved trees such as *Z. mucronata*, *E. rigida*, *E. crispa*, and *G. buxifolia*. The instrument was also effective in removing seedlings of *D. cinerea*. Differences in the effectiveness of the instrument may be due to the differences in plant morphological structure, particularly of the root system, among fine-leaved trees and broad-leaved trees. Unfortunately, Tree Popper® is not an effective tool for controlling some of the major encroachment species in southern Africa.

Effect of warming on trade-offs between growth and defence of *Vachellia sieberiana* seedlings growing with or without grass

10:00 - 12:00

Presented by :

Lusanda Ncisana, Candidate Researcher, University Of KwaZulu-Natal / Agricultural Research Council

With limited knowledge of trade-offs between growth and physical defense, it is not easy to understand the effect of warming on growth and physical defense, particularly thorn length. Thus, it is vital to improve the understanding of the trade-offs between plant growth and defense. This study tested the hypothesis that elevated temperatures would decrease thorn length and increase growth of *Vachellia sieberiana* seedlings growing without grass cover but not with grass cover. This was examined with *V. sieberiana* seedlings at the Ukulinga Experimental Farm of the University of KwaZulu-Natal, Pietermaritzburg using open-top warming chambers (OTC). About 200 seeds of *V. sieberiana* were collected in 2016 around Pietermaritzburg and were germinated using agar. These were then grown in pots with sandy soil in a greenhouse for three weeks before they were transplanted in the field. To test the hypothesis, 120 seedlings that were three weeks old were transplanted into 20 field plots. Ten plots were warmed with grass cover and no grass cover and other ten plots were not warmed with grass cover and no grass cover. This experiment was conducted in March 2018. Open-top warming chambers raised air temperature by 1.5 °C. Plant height, stem length, stem diameter and thorn length were measured after six weeks. To determine effects of warming and grass cover on the relationship between defense and growth, ratios of thorn length (a measure of defense) to plant height, stem length and stem diameter (measures of growth) were calculated. The hypothesis of the study was supported. Warming and grass cover significantly and independently reduced the thorn length: plant height ratio. Likewise, the thorn length: stem length ratio was significantly and independently reduced by both warming and grass cover. There was significant interaction effect between warming and grass on the thorn length: stem diameter ratio. Warming significantly reduced the thorn length: stem diameter ratio when grass cover was present, but not when grass cover was absent. Warming to a level expected in the next few decades clearly was more effective than grass cover removal for *V. sieberiana* seedlings growth and defense relationship. Therefore 1.5 °C temperature increase resulted in trade-offs between thorn length and growth of *V. sieberiana* seedling growing with grass cover.

The extreme Knysna fire event of June 2017: Causes and impacts as evidenced from content analysis of local media and government reports
10:00 - 12:00

Presented by :

Phila Ngwilikane, Intern, South African Environmental Observation Network (SAEON)

This paper examines the perceptions of residents about the causes of the 2017 Knysna fire. Furthermore, the social and economic impacts of the fire on the residents as well as the response strategies being implemented by the Western Cape government in collaboration with the Knysna Municipality are considered. The study examines whether such impacts can be prevented in the future and if the present response strategies will help the town adapt to ongoing environmental change. Content analysis was conducted on grey literature and a total of 78 newspaper articles published during and after the fire. The results show that residents perceive the causes to be the lack of institutional responses as well as perfect conditions resulting in the devastating fires. In terms of response strategies, there must be a radical rethink when it comes to rebuilding Knysna. This will require adaptive thinking and adaptive governance to rebuild a transformed and resilient town that can adapt to an ever-changing environment and climate. This study has a socio-ecological aspect that is in line with that of the Grassland Society of Southern Africa and reviewing the challenges and solutions brought up in other vegetation types might assist in planning for the future of rangelands.

The effect of fire, soil depth and *Seriphium plumosum* canopy cover on soil fertility in a South African semi-arid grassland community

10:00 - 12:00

Presented by :

Gilbert Pule, Researcher, Agricultural Research Council – Animal Production Institute

The causes of woody plant encroachment are many, and the encroachment effects on ecosystem processes and functioning have been limited in extent and confined largely to pastoral land uses or particular geographic regions. Consequently, hindering the trade-offs that need to be considered when controlling or managing encroaching woody species. The aim of this study was to investigate the interaction effect of fire, soil depth, and *Seriphium plumosum* canopy cover in the semi-arid grassland on components of soil fertility; potassium (K), phosphorous (P), magnesium (Mg), total nitrogen (TN), sodium (Na), calcium (Ca), soil organic carbon (SOC), and pH. Data were analysed as a complete randomised design with 3 × 1 factorial analysis of variance using GLM procedure. There was a significant interaction effect of fire x soil depth on K, P, Mg, TN, Ca, SOC, and pH ($p < 0.05$). Potassium content was the same as the subsurface soil after (79 ± 5.22 mg/kg) and before (74 ± 3.01 mg/kg) fire and significantly lower than at the surface soil before fire (115.04 ± 4.98 mg/kg), which was also significantly lower than at the surface soil after fire (152.83 ± 8.98 mg/kg). Phosphorus content was the same as the subsurface soil after (2.36 ± 0.20 mg/kg) and before fire (2.27 ± 0.16 mg/kg), but significantly lower than at the surface soil before fire (4.22 ± 0.18 mg/kg), which was also lower than after fire (6.50 ± 0.29 mg/kg). Magnesium content at the subsurface soils before (39.53 ± 2.19 mg/kg) and after (40.10 ± 3.09 mg/kg) fire were similar and significantly lower than at the surface soil before burning (53.44 ± 3.52 mg/kg), which was significantly lower than after burning (75.23 ± 5.28 mg/kg). Calcium content at subsurface soils before (97.43 ± 5.27 mg/kg) and after (94.29 ± 7.37 mg/kg) fire were similar and significantly lower than at the surface soil before fire (136.97 ± 8.16 mg/kg), which was also significantly lower than after fire (189.72 ± 11.31 mg/kg). Soil organic carbon (SOC) content at subsurface soils before (1.30 ± 0.03 mg/kg) and after (1.25 ± 0.02 mg/kg) fire were similar and significantly lower than at the surface soil before (1.50 ± 0.03 mg/kg) and after (1.61 ± 0.04 mg/kg) fire, which were similar. Soil pH level at subsurface soils before (4.70 ± 0.02 mg/kg) and after (4.74 ± 0.02 mg/kg) fire was similar and significantly lower than similar surface soil before (4.87 ± 0.03 mg/kg) and after burning (5.02 ± 0.03 mg/kg). The result suggests that *S. plumosum* encroachment has no effect on soil fertility, while fire may contribute to improving soil fertility, especially on the soil surface, thus improving conditions for *S. plumosum* seed germination and recruitment.

The effect of *Solanum mauritianum* on plant abundance and soil properties in the Eastern Cape, South Africa

10:00 - 12:00

Presented by :

Feziwe Sibanda, Student, University Of Fort Hare

South Africa has been severely invaded by invasive alien plants and this has resulted in a growing concern worldwide about the increasingly negative effects of widespread invasions of alien plants on water resources, conservation areas, natural vegetation, and agricultural productivity. *Solanum mauritianum* (bugweed) has become a prominent and widespread invader and is listed as one of South Africa's worst ecological weeds, having been targeted for biological control efforts since 1984. This study was conducted in Butterworth, Eastern Cape province, and the objective was to determine the effect of *Solanum mauritianum* invasion on herbaceous plant abundance, and soil bulk density and porosity. We assessed soil structural properties, and herbaceous plant abundance beneath trees of three size classes (short, medium and tall). Grass species abundance differed significantly ($p < 0.05$) beneath and outside the tree canopy of the tree height classes. The results showed that the height of bugweed did have an effect on species composition, soil bulk density and soil porosity. This implies that although this weed is known to be a nursery plant to some grass

species some do not have the mechanisms that help them to grow under the canopy of this tree. Therefore farmers should be advised to control its invasion before it grows too tall. Develop biological methods and chemical methods of controlling its spread of this plant.

Peri-urban communal grazing and socio-economic challenges: Advancing small-scale livestock farming against all odds

10:00 - 12:00

Presented by :

Modau Norman Magoro, Scientist Production, Mpumalanga Department Of Agriculture, Rural Development, Land And Environmental Affairs

Loss of grazing lands in peri-urban areas of South Africa is of great concern to urban livestock farmers. It is caused by the expansion of urban settlements as a result of the rural migrants who are often attracted to urban areas by greater economic opportunities and better services. The mining boom in the Mpumalanga province, for example, has resulted in the migrant labour system and the associated urban expansion, particularly in the towns of Ermelo, Emalahleni and Middleburg. Peri-urban livestock farming undoubtedly contributes to national food security and economic stability. In recent years however, land tenure policies and land invasion have made livestock farming in peri-urban areas less economically viable due to limited grazing lands. In addition, there is no intent by peri-urban land owners, often the local municipalities, to regulate the stocking rate. This puts additional pressure on the viability of already limited peri-urban grazing lands. This study was conducted with the purpose of advancing small-scale livestock farming in peri-urban areas by assessing the condition of vegetation and urbanisation trends in and around Ermelo townships, Msukaligwa Local Municipality. Two communal livestock farmers groups with a combined allotted peri-urban grazing area of approximately 650 ha were chosen. Veld condition assessments were conducted annually during April to May months from 2008 to 2018 in order to quantify the stocking rate. A line transect survey method was used to gather plant species composition at every one metre interval of the transect, resulting in 300 survey points. Biomass production was estimated using a quadrat of 0.4×0.4 m and falling-plate pasture meter. In addition, the Likert Scale rating questionnaires were used to determine farmers' attitude towards their communal grazing lands. The results show an average long term stocking rate of the area to be approximately 0.277 LSU/ha during grazing season. Grazing area was reduced to 450 ha due to human settlement and mining activities, subsequently reducing the stocking rate to 0.14 LSU/ha per grazing season. The dominant grass species in the grazing areas were *Eragrostis chloromelas*, *E. plana*, *E. gummiflua* and *Hyparrhenia hirta* due to overgrazing. The results showed no significant changes on species composition throughout the study period, whereas biomass production showed a significant decrease from an average of 1,688 kg/ha to 953 kg/ha. The effect of human settlement on communal grazing was evident through visible illegal land invasions of neighbouring private properties. Farmers were generally dissatisfied with the continuous reduction of grazing lands. The outcome of the study was used as a guideline to transfer knowledge to local farmers on the significance of stocking rate. Continuous peri-urban population density and high levels of unemployment potentially threatens the sustainability of communal grazing resource use. Therefore, imperative peri-urban production technologies are needed to sustain continuous communal livestock production. These include adhering to recommended stocking rate and affordable fodder.

In a novel landscape, in the Eastern Cape, South Africa, what are the key vegetation resources that support livestock production?

10:00 - 12:00

Presented by :

William Liversage-Quinlan, Masters Student, Institute For Water Research, Rhodes University

In the Tsitsa River catchment, land degradation, the overstocking of livestock, and concentrated settlements show some of the environmental aftermath of Apartheid policies, and this altered state affects the future of proposed dams, the landscape condition, and communities impacted by these issues. Rapid and fundamental alterations to ecosystem functions and feedbacks, as well as species composition and diversity, have led to these recently emerged ecosystems to be described as 'novel'. Yet, these landscapes continue to sustain a large population of livestock, providing vital economic benefits in these rural areas. Primary areas of vegetation production have been shown to supply essential Ecosystem Services that support substantial livestock herds. Particular vegetation types are favoured over others, and so grazing habits are not uniform throughout the catchment. Hillslope seep wetlands, riparian meadows, contour banks and natural grasslands are examples of productive vegetation resources that have been recognised as common feeding areas. The Tsitsa Project has been established by the Department of Environmental Affairs to restore the ecological infrastructure of the catchment to an optimal condition. This research is situated within the context of this project, and will help to identify productive areas of vegetation that can be utilised by livestock. By identifying the most productive vegetation resources and determining their relative contributions, the limited resources for rehabilitation and management efforts can be focused on threatened, productive landscape elements. The MODIS Normalised Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), and Net Photosynthesis time series (PSNnet) were used to identify the locations of productive grazing patterns in altered landscapes. Landscape function analysis, biomass estimates, and spatial indices were used to define the attributes of these productive locations in a pilot area of 5 × 5 km² using very high-resolution (< 1 m/pixel) DigitalGlobe satellite imagery. Average condition and annual production of these vegetation types were measured, and these characteristics were used to identify similar vegetation types in a larger spatial area with lower resolution Sentinel imagery (25 × 25 km²).

The nutritional value of grass species in different communal rangelands within the soil type in Msukaligwa municipality, South Africa

10:00 - 12:00

Presented by :

Thabile Joyce Mokgakane, Scientific Technician, Mpumalanga Department Of Agriculture ,Rural Development, Land And Environmental Affairs

The productivity of ruminants is influenced by the quantity and quality of available forage. Environmental factors such as soil physicochemical composition play a vital role in determining the production of particular grazing land. The main objective of this study was to determine the nutritional value of the grass species from three selected communal rangelands in Msukaligwa municipality. These communal rangelands include Breyten, Davel, and Wesselton with Hutton, Avalon, and Clovelly as dominating soil types. Grass species were collected between March and April 2015 towards the end of the rainy season. The grass species were towards the end of their growing cycle and were measured from transects at 20 m interval using a falling plate meter and oven dried at 60 °C for a period of 24 h for nutritional value and in vitro ruminal fermentation. Data were subjected to two-way factorial analysis of variance under a complete randomised design. Across all sites, a total number of 31 different grass species were identified, but only common and dominant species were considered for chemical analysis. The nutritional composition of *Digitaria eriantha* (106.5 g/kg dry matter, DM) and *E. gammiflua* (65.4 g/kg DM) in Hutton soil type had higher crude protein (CP) content when compared to the same species in Avalon and Clovelly soil types which did not differ significantly from each other. *Aristida congesta* and *E. chloromelas* had the same CP content within all soil types. *Eragrostis chloromelas* in Avalon soil type had the same acid detergent lignin (ADL) content as *A. congesta* and *E.plana* species. *Eragrostis chloromelas* in Clovelly soil type had the same ADL content as all other species from the same soil type. *Aristida congesta*, *D. eriantha*, *E.*

curvula, *E. gammiflora*, and *E. plana* had the same ($p > 0.05$) acid detergent fibre (ADF) content within all the three soil types. *Digitaria eriantha* in Hutton soil type had the same 36 h (36 h) dry matter degradability (DMD) value as all other species from the same soil type. *Eragrostis chloromelas* in Avalon soil type had the highest 36 h DMD value (334.5 g/kg DM) when compared to *E. plana* (158.9 g/kg DM) species from the same soil type. *Eragrostis chloromelas* in Clovelly soil type had the highest 36 h DMD value (649.3 g/kg DM) when compared to *A. congesta* (229.1 g/kg DM) and *D. eriantha* (381.0 g/kg DM) species from the same soil type. *Eragrostis chloromelas* in Clovelly soil type had the highest 48 h DMD value (623.6 g/kg DM) when compared to same species in other soil types which did not differ significantly from each other. All the species in Hutton soil type had the same in vitro degradability values at 48 h. The results imply that the soil type has an influence on grass species degradability and CP content; therefore feed supplement will be required as per daily livestock diet requirement for all soil type. Further studies on feed supplementation on communal rangeland are suggested to improve communal livestock productivity.

Long-term effects of a two-camp 'blaze and graze' system on selected soil physico-chemical properties in the East Griqualand Grassland

10:00 - 12:00

Presented by :

William Diko, Scientific Technician, KwaZulu-Natal Department Of Agriculture And Rural Development

Due to the lack of data on the impact of this management type on soil physico-chemistry, a long-term grazing trial was started in 1992 to examine the effect of a two-camp 'blaze and graze' trial (i.e. graze one half continuously and rest the other for the season) on animal performance, veld condition and soil loss. A preliminary study data was conducted at Kokstad Research Station to determine the effect of a two-camp blaze and graze system on physicochemical properties of soil in the East Griqualand grassland of KwaZulu-Natal. The objective of the study was to determine the effect a blaze and graze system using as grazers on, soil total nitrogen (N), carbon (C), soil particle size distribution (PSD), and bulk density (BD). The treatment included four stocking rates (SR): 1) high SR (1.0 livestock units (LU)/ha); 2) medium SR (0.7 LU/ha); 3) low SR (0.5 LU/ha); and 4) ungrazed (0.0 LU/ha) applied at two different landscape positions, i.e. steep and flat slopes. Treatments prolonged for 27 years. Soil samples were collected at depth of 0-15 cm using soil core rings samplers and analysed for standard soil properties. Data was analysed using GenStat 18th Edition for an unbalanced analysis of variance. Stocking rates did not affect soil N content: 2.35 ± 0.10 g/kg, $(2.25 \pm 0.10$ g/kg, 2.56 ± 0.13 g/kg, $(2.78 \pm 0.13$ g/kg) for the High SR, Medium SR, Low SR and Ungrazed treatment, respectively. However, the flat landscape had a lower ($p = 0.001$) N content (1.79 ± 0.10 g/kg) compared with the steep landscape (2.59 ± 0.10 g/kg). The interaction between the stocking rate and the landscape showed a significant ($p = 0.029$) effect on N content. Soil C content was also not affected by SR, while the flat landscape consisted of a lower ($p = 0.001$) soil C content (30.7 ± 1.5 g/kg) than that of steep landscape (37.2 ± 1.2 g/kg). Moreover, there was no treatment interaction effect between the SR and the landscape on soil C content. Bulk density did not differ among stocking rates and landscapes. Particle size distribution was unaffected by SR treatment. The flatter landscape had a higher ($p = 0.001$) sand percentage than that of the steeper landscape ($37.9 \pm 1.6\%$ vs. $30.9 \pm 1.2\%$). The steeper landscape had a higher ($p = 0.037$) fine silt content compared with flatter landscape ($27.8 \pm 1.0\%$ vs. $24.1 \pm 1.0\%$). These preliminary results suggest that different SR has had little effect on soil parameters after 27 years of sheep grazing, although there are indications that long-term effects of high stocking rates on steep slopes have a negative effect on total N content.

Veld condition status of selected Land Redistribution for Agricultural Development (LRAD) farms at Amathole region in the Eastern Cape province

10:00 - 12:00

Presented by :

Sindisile Goni, Grade B: Production Scientist, Dohne Agricultural Development Institute

Veld monitoring is an important aspect of determining whether animal stocking rates are optimal for achieving management goals. Grass species composition and abundance, grass basal cover (or the average tuft to point distance) and bare ground, grass fuel load, and the abundance of non-grassy forbs are all important aspects that form part of veld monitoring. Other aspects that are essential to monitor routinely include rainfall, livestock numbers, animal distribution and herd composition. The previously disadvantaged black farmers of the Eastern Cape province applied for the Land Redistribution for Agricultural Development (LRAD) farms before 2001 and were granted to them between years 2002 and 2012 in order to access land specifically for agricultural purposes. This was done as an approach of contributing to the redistribution of the country's agricultural land; improving nutrition and incomes of the rural poor who want to farm on any scale; de-congesting overcrowded former homeland areas; and expanding opportunities for women and young people who stay in rural areas. It was necessary therefore to assess the veld condition of these farms to determine the economic carrying capacity. The aim of this project was to assess the veld condition and determine the economic carrying capacity for grazers and browsers in order to understand the range condition status of LRAD farms in Amathole region. A vegetation survey was conducted in ten selected farms. Selected farms represented at least three biomes (Grassland, Savanna and Albany Thicket) of those which occur in Amathole region and six veld types (2–3 farms from each veld type). Farms were acquired between year 2002 and 2013 and were randomly selected without following any sequence. Six of the ten farms were properly fenced and four of them had broken old fences. All the beneficiaries of the farms were family related and used the farm as a unit with consensus decisions. Survey consisted of recording all identifiable plant species and allocating a percentage cover value to each species. A point survey of the grass layer was made to determine the frequency of grass species to calculate veld condition and the carrying capacity. The veld condition and carrying capacity of the different farms were assessed and the present carrying capacity for the each farm area was calculated based on the grazing capacity map of South Africa as a benchmark. On the assessed farms only one had a poor veld condition and two were moderate while the rest indicated a good condition. All the farms with good veld condition were understocked and those with either poor or moderate condition were highly overstocked. The poor condition could not only be attributed to overstocking but also poor management and extent of bush encroachment on the farms. However, the long term effects of underutilisation on these farms with good veld condition were evident on their status.

Understanding the language of ecosystem resilience by conceptualising soil formation using hydrogeology: Discovering the biological separation zone
10:00 - 12:00

Presented by :

Martin Tinnefeld, Managing Director, Hydro Pedo Pty Ltd

Soil is a primary ecosystem controller, determining the temporal and spatial supply of water and nutrients to vegetation. Soil and vegetation are not randomly distributed but follow chemo-physical properties and trends. The study of interactions between soil and water, comprising the soils formation processes across space and time, defines the novel field of hydrogeology. The aim is to identify conspicuous soil morphological trends that describe the spatial and temporal vegetation expressions across climatic and geological variation. Two sample sets of 200 observations each, are from the Archean Halfway House Granite Basement Complex and surrounding geology of the Gauteng province, and from aeolian sands with dolerite outcrops from the Douglas area, Northern Cape province. Soil observations were classified according to the Soil Classification Working Group (2018) and interpreted for their hydrogeology

applying the Hydrology of South African Soils and Hillslopes (WRC Report No. 2021/1/15). Semi-quantification of select chemical and physical soil properties were performed by a commercial laboratory. Vegetation was photographed along with soil augur observations and visually analysed. The two soil suites were identified to be mutually exclusive in their chemo-physical properties. Hydropedological physical properties show a good relationship with hydrological chemical properties. Hydrological connectivity between hydropedological response units was observed as continuous soil morphological gradient down hillslope landform units. Lignin content was observed to be associated with a root contact in shallow precipitate rich lateral flow. Vegetative physiological responses in morphology are observed upon flowpath activation and hydropedological red-ox processes. Discernible similarities in apparent plant systematics are associated with hydropedological response units. Vegetation morphology and species composition evolution within vegetation communities are directly imposable on to hydropedological response units. The continuous processes forming precipitate layers found within soil profiles continuing down a hillslope, splits rainwater into waters of different temporality, spatiality, and quality. The temporal, spatial, and qualitative hydrological difference are observed as limiting factor for possible vegetation kingdoms to occur. This splitting of rainwater within the soil profile into waters of different qualities is introduced as the Biological Separation Zone (BSZ). Conspicuous soil morphological trends are observed across climatic and geological regions due to hydropedological processes. Vegetation expressions are directly relatable to hydropedological response units across geological and climatic regions.

12:00 - 13:00

**Bella Roma
Restaurant**

Lunch

13:00 - 15:20

Vestibulo 2

Plenary: Methods & monitoring in rangelands

Moderators

Anthony Palmer, Principal Researcher, Agricultural Research Council - AP

A case study of drought affecting Tierberg-LTER to understand observed shrub dieback

13:00 - 13:20

Presented by :

Mthokozisi Moyo, Intern, SAEON Arid Lands Node

One of the challenges that we face in the 21st century is climate change. It is predicted that there will be an increase in the temperature as well as evapotranspiration. Rainfall patterns are likely to also change and that could lead to more droughts. In the last few years, the Karoo, like most parts of South Africa has experienced drought conditions. The aim of this study was to understand the effect of this drought on the vegetation in the area. We also compared the severity of this drought to previous droughts. A long term climate study was carried out using the towns of Beaufort West and Prince Albert. Daily data from these two stations was analysed. We looked for trends in the temperature and rainfall from 1941 to 2018. We also looked at other indices such as the number of warm days, the number of cold days and the number of rainfall events. We found that there has been an increase in the temperature as well as warm indices such as the number of hot days as well as a decrease in the number of cold days. There was an increase in the evapotranspiration while the rainfall decreased. This led

to an increase in the frequency of droughts in the area. These observed changes are consistent with what is expected from climate change. Our studies at Tierberg-LTER show that many shrub species in that area died as a result of this drought and that the dieback differs between different historical land uses. The drought had an impact on the vegetation in that area.

Parameterisation and evaluation of the Sustainable Grazing Systems pasture simulation model for predicting native grass growth in a southern African savanna

13:20 - 13:40

Presented by :

Walter Svinurai, PhD Student, University Of Pretoria

Pasture simulation modelling has gained much attention as a tool for near real-time estimation of herbage growth in extensive animal production systems in the last two decades. However, simulation models have rarely been applied in the Lowveld rangelands of Zimbabwe due to lack of data for parameterising and evaluating these models. To build confidence in using these models under data-limited conditions, there is a need to quantify errors associated with simulated outputs using independent data. This study was conducted to parameterise the Sustainable Grazing Systems (SGS) pasture simulation model and to assess the accuracy of simulated herbaceous biomass in predicting measured- and remotely sensed- herbaceous biomass. General parameter sets for three land types and two grass species namely, *Urochloa mosambicensis* and *Eragrostis curvula*, were developed by integrating spatial data layers with soil survey data collected in 2003 and 2007, and extensive reviews of published experiments. The SGS model predicted measured herbaceous aboveground biomass (AGB) production at low average errors of 820 kgDMha⁻¹. Modelled AGB (mean = 1674 kgDMha⁻¹) underestimated remotely sensed AGB (mean = 3644 kgDMha⁻¹) by 51% across all land types but the predictions were significantly correlated AGB ($p < 0.05$) ($r^2 = 0.63$; root mean square error = 981 kgDMha⁻¹). These results indicate that the integrated approach of combining different data sources adequately represent the key processes that influence grass growth under local soil and plant types defined for Nuanetsi ranch. Given the large difference between model and remotely-sensed biomass predictions, more field measurements for model calibration are required to improve the performance of simulation models.

AfriCultuReS Livestock Service: An operational effort towards monitoring the status and productivity of grasslands in arid and semi-arid regions of sub-Saharan Africa

13:40 - 14:00

Presented by :

Mahlatshe Kganyago, Remote Sensing Scientist, South African National Space Agency (SANSA)

Grasslands are the major source of feed for grazing livestock, thus their sustainability is a prerequisite in the changing climatic conditions. This is needed in order to increase livestock production in order to meet the increased demand of the rapidly growing populations and support national food security imperatives. The management of grasslands should be in a sustainable manner to maintain their agro-ecological integrity for current and future use. However, their management is challenging amidst climate-related phenomena such as bush encroachment, the proliferation of invasive alien plants, wildfires and droughts, which are all too frequent and widespread in the sub-Saharan African region. To tackle these phenomena, land managers and decision-makers have to be more effective in their implementation of land use management approaches and plan ahead of time to avoid the pitfall of a forage shortage and reduce degradation of grasslands. Spatially-explicit, objective and actionable information such as recommendations on carrying capacity and stocking rates, and early warning during extreme events are needed by various stakeholders such as national government,

disaster relief agencies, insurance companies, and farmers. Such tools should provide actionable information about the grassland productivity, status and risks, with sufficient lead-time to allow for timely intervention. The challenge is that currently available Earth observation (EO)-based products have coarse spatial resolution and there is currently no comprehensive high-resolution operational effort for monitoring the status and productivity of grasslands in Africa. Through a funded project, namely; Enhancing Food Security in African Agricultural Systems with the Support of Remote Sensing (AfriCultuReS) project [774652], seven (7) African and eight (8) European organisations are currently working collaboratively to design, implement and demonstrate an integrated agricultural monitoring and early warning system that will enrich multi-level decision-making and risk assessment for tackling food insecurity challenges in Africa. The project will deliver a broad range of climatic, production, biophysical and economic information, for various regions in Africa characterised by different agro-climatic zones and agricultural production systems, through the exploitation and integration of free and open, multi-sensor EO data and other geospatial technologies. A number of satellite-based products will be developed categorised into five (5) services, i.e. weather, water, livestock, land and drought. In particular, AfriCultuReS Livestock Service will provide grazing and rangeland maps, grazing and browsing capacity assessments, stocking rates assessments, and bush encroachment maps according to users' needs. We aim to present the status in the implementation of AfriCultuReS Livestock Service, including presenting the results of users' needs assessments workshops and surveys, and preliminary products from South African test sites.

Comparison of holistic planned, traditional continuous and rotational grazing in the Lowveld regions of the Eastern Cape: Effects on grass species composition and biomass yield

14:00 - 14:20

Presented by :

Silas Mudyjiwa, Student, University Of Fort Hare

Despite the increased attention that holistic planned grazing (HPG) has received over the last decades, we still have little understanding about the factors and processes that contribute to its perceived success, particularly compared with widely known conventional grazing management practices. A study was therefore conducted to examine the effect of communal-HPG, commercial-rotational, and communal continuous grazing on botanical composition and biomass yield in the Lowveld regions of the Eastern Cape located in Enock Mgijima Local Municipality, characterised by Dry Highveld Sand Grassland and Valley Thicket. Three HPG-communal, three continuous communal camps in Mceula communal lands and two adjacent commercial farms were selected for this study. Mceula has been practising HPG since 2013 to address degradation problems. Each camp and farm was divided into three major landscape positions (upper, middle and lower slope). Two 100 m transects were marked in each landscape to record vegetation data. A step point method was used to estimate grass species composition on 100 step points from each transect. Identification of grass species was done in the field. Specimens were sent for further identification at the SANBI Herbarium (Pretoria) for confirmation and those species not identified. Net primary aboveground biomass was estimated from two 1 m² exclosures established in each landscape position. All standing live vegetation in one 0.25 m² quadrat was harvested at 5 cm within each exclosure and dried to a constant weight in an oven at 75 °C for 48 h and weighed to determine dry matter yield. Results showed that a total of 25 herbaceous species were identified in all study sites. Continuous and HPG were dominated by *Eragrostis chloromelas* and *Aristida congesta*, with more productive species such as *Themeda triandra* and *Digitaria eriantha* being more abundant at HPG compared to the continuous grazing lands. Mean values for biomass yield in the dry season showed the following order: commercial-rotational (910 kg/ha) > HPG (261 kg/ha) > continuous (109 kg/ha). There was no significant difference ($p > 0.05$) in net primary aboveground productivity among grazing management methods although a

slightly greater value was recorded for the commercial-rotational followed by HPG and continuous-communal. The current study showed that holistic grazing can enhance vegetation conditions in communal degraded lands and improve rangeland productivity for sustainable livestock production.

Effect of rainfall interception, resting and season on rangeland productivity in the semi-arid grasslands of South Africa

14:20 - 14:40

Presented by :

Thabo Magandana, Student, University Of Pretoria

The aim of this study was to evaluate the effect of different levels of rainfall interception and resting period on aboveground biomass yield in semi-arid grassland. A split plot experimental design was used for the study. Different levels of rainfall interception (0%, 15%, 30% and 60%) were observed as the main plot treatments while resting periods (70 and 90 days) were observed as sub-plot treatment. The main plots were 7 × 7 m, while the sub-plots were 3.5 × 7 m in size. The plots were harvested at three different seasons (spring, summer and autumn) over a period of two years (2016/17 and 2017/18). Four 0.5 × 0.5 m (0.25 m²) quadrats were harvested from each sub-plot to determine aboveground biomass production and rainwater use efficiency. Herbaceous vegetation was separated into grasses and forbs. Grasses were further categorized as increaser or decreaser species. The rainfall interception had a significant effect on aboveground biomass yield, with the lowest biomass yield observed at 60% rainfall interception in all seasons in both years. The resting period had a significant effect on aboveground biomass production in spring for both years, with 70 days having the lowest biomass yield. Grasses were the most affected by rainfall interception as the aboveground biomass yield of the grass decreased with the increasing level of rainfall interception, while that of forbs increased as rainfall interception level increased. The overall aboveground biomass yield was higher in summer than in spring and autumn harvest for both years. This study revealed that the occurrence of drought will shift the herbaceous vegetation to more forbs than grasses as the former are more resistant to drought than the latter. Drought favours increaser grass species over decreasers, as decreasers decreased with the increase in rainfall interception while the opposite is true for increasers.

Impacts of cattle grazing (*Bos taurus*) pressure on vegetation and soil characteristics in an arid grassland of South Africa

14:40 - 15:00

Presented by :

Gert Botha, Postgraduate Student, Nelson Mandela University

Natural rangelands are often degraded due to the implementation of incorrect grazing systems. One potential solution is the use of short duration, high-intensity grazing. The impacts of this grazing system on, inter alia, vegetation and soil properties have not yet been properly tested within the arid rangelands of South Africa. This study aimed to determine the impacts of grazing intensity on vegetation composition, forage quantity, and quality, and soil compaction, infiltration rates and soil chemical properties in arid South African grasslands. Three treatments differing in grazing intensity were evaluated: (1) high grazing intensity for a short duration (90 cattle per plot for five days, rested for 360 days); (2) moderate grazing intensity for a longer duration (six cattle per plot for 14 days, rested for 60 days and repeated throughout the study); and (3) zero grazing. A total of 18 plots (six replicates per treatment), each 4 ha in size, were surveyed pre-grazing, directly after grazing, and again three, six and 12 months post-grazing. Available forage quantity (using a disc pasture meter), grass diversity and forage quality (using the step-point method) were measured along with soil compaction (Eijkelkamp hand penetrometer), soil infiltration (Mini Disk infiltrometer), and soil properties (15 cm top layer and 25–30 cm sub-soil). Soil properties analysed included pH, NH₄⁺, organic carbon, P₃⁻, Na⁺, Ca²⁺, Mg²⁺, and K⁺. Results indicated

that under high-intensity grazing, an increase in soil NH_4^+ ($P \leq 0.05$) and organic carbon ($p \leq 0.05$) increased in the top layer post-grazing compared with the top layer pre-grazing, $151 \pm 30.2\%$ vs. $133 \pm 23.4\%$ and $1.09 \pm 0.46\%$ vs. $0.89 \pm 0.24\%$, respectively. No change in grass species diversity was recorded among treatments across seasons ($p = 0.42$). Forage quantity differed among treatments across seasons, where zero grazing had a higher forage quantity than both the grazing systems throughout the study post-grazing ($p \leq 0.001$). Soil compaction differed among seasons but not among treatments, with summer having the lowest soil compaction compared with winter months that had a higher ($p \leq 0.001$) soil compaction. As anticipated, a high-intensity grazing system did improve soil nutrients as a result of the high amount of urine and manure deposited over a short duration. Unsurprisingly, post-grazing forage quantity was the lowest ($p \leq 0.001$) for the high stocking rate plots compared with the other treatments. However, this increased after the 360 day rest period. Forage quantity in the moderate intensity grazing plots stayed constant during the study as the sites where grazed every 60 days. We concluded that grazing intensity impacts might be site-specific and that there is a need for longer-term follow on studies to evaluate the impacts further.

The impact of climate variation on plant flammability

15:00 - 15:20

Presented by :

Wynand Calitz, Intern, SAEON Arid Lands Node

Plants adapt to the natural environment they are frequently exposed to. Climate, as temperature and precipitation, can greatly influence how a species evolves over long periods of time. Certain species have been documented to develop traits associated with fire regimes, which in many cases are linked to the environment. In this study, I focus on comparing flammability of species across seasons and hypothesise that plants will be more flammable in the summer than winter, due to the warm and dry conditions. I also hypothesise that flammability will be similar between the same season in different years. Five biomes, namely Fynbos, Grassland, Thicket, Forest, and Nama-Karoo, were sampled for species and their flammability tested using the standardized protocol proposed by Jaurequiberry et al., 2011. A minimum of twenty species from each of the biomes, resulting in ninety-nine distinct species, were selected based on their cover in their environment. The flammability index scores of species were compared between seasons, and these indicated that climate only accounts for significant differences when drastic events such as drought or high precipitation occurred. Similar seasons also proved to have different flammabilities as drought and annual rainfall were strong drivers. Looking at biome-scale comparisons, I find that the inherent properties of species that are unlikely fire-driven may influence the results. These properties include moisture retention, leaf density, and retention of dead material among others. From this, I can infer that species-level responses vary considerably between and among communities. The results also hint at the importance of weather conditions in regards to fire, and how climate shifts may influence the flammability of both fire-driven and non-driven systems. To elaborate on this, I tested the moisture content of a select few species, chosen based on their representation in a biome or across multiple biomes, and found that there is no consistent response to prevailing weather conditions. In terms of flammability, few studies have attempted such variety, and even less so in South Africa. Subsequent studies will need to focus on measuring a range of functional traits over temporal and spatial scales as well as to derive a method for standardizing the flammability index on a global scale.

15:20 - 15:45

Conference
Rooms Stoep

Afternoon Tea

15:45 - 16:45

Vestibulo 1

Closing Plenary

Moderators

Ralph Clark, Afromontane Research Unit / University Of The Free State

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

15:45 - 16:45

Presented by :

Timm Hoffman, Professor, University Of Cape Town

Riemvasmaak is a 74,000 ha hyper-arid region in the Northern Cape province of South Africa which receives about 128 mm of rain per year. In 1974 all of the inhabitants of the area were forcibly removed and the region declared a conservation area. However, following South Africa's first democratic elections in 1994, people were resettled in the region. Together with their livestock, many individuals and families established their farming enterprises once more. A long-term monitoring programme was established in 1995 to assess the influence that the change in land use might have on the environment. This programme was based on repeat photography and transect surveys at 29 core sites in the region. All sites were rephotographed and resurveyed in 2005, and again ten years later in 2015. The cover of grasses and shrubs in three different landforms (slopes, plains and ephemeral streams) was estimated at each time step from a visual inspection of the repeat photographs and from species cover estimates recorded during the transect surveys. The size class distributions of *Acacia erioloba* individuals were also recorded along fixed transects at four localities in 1995 and again in 2015. Results from a linear mixed-effects model showed that grass cover decreased significantly ($p < 0.001$) between 1995 and 2005 but increased significantly ($p < 0.001$) between 2005 and 2015. There was no significant difference ($p = 0.20$) in grass cover between 1995 and 2015. The cover of woody plants in the landscape had not changed significantly ($p > 0.05$) over the 20 years since resettlement. Trends in total cover, grass cover and woody cover were consistent between landforms. The total number of individuals of *Acacia erioloba* along the four transects which were surveyed had declined since 1995, particularly within the smaller size classes (< 2 m), and little or no new recruitment of this species had occurred since the initial survey. It is difficult to disaggregate the relative impact of rainfall and herbivory on the composition and cover of vegetation especially when sampling periods are ten years apart, and when detailed rainfall and livestock data are not available. Large numbers of animals clearly do have an impact on grass cover and also on the long-term population dynamics of key woody species, such as *Acacia erioloba*. However, drought and high rainfall events are also important drivers of the cover and dynamics of species within both of these growth forms. Even though there were significant fluctuations in grass cover between sampling periods, Riemvasmaak's rangelands did not look fundamentally different in 2015 from what they looked like in 1995, apart from a few areas which had been cleared for agriculture. The area has not become desertified since resettlement and continues to provide for the needs of many households which have derived a livelihood from the region's resources over the last 25 years.

**LIST OF REGISTERED CONGRESS DELEGATES AS AT 25 JUNE 2019**

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