

26 - 30 July 2021

56th Annual Congress

of the

Grassland Society of Southern Africa

Virtual
event

*Advancing rangeland ecology and
pasture management in Africa*



Proceedings edited by Janke van der Colf and graphics by Erica Joubert



INSTRUCTIONS TO DELEGATES

- It is essential that you are able to log in to your Dryfta user account. If you experience any issues, please contact the Administrator via info@grassland.org.za. **Do not create a duplicate user account!**
- Zoom session links will be shared via email, please check your emails regularly.
- The sessions can also be accessed via [Dryfta](#). Log in and go to Programme and open the relevant session - the link will be displayed or look for a JOIN LIVE/CHECK-IN button. **You must be logged in!**
- CPD points will be awarded based on actual time spent in sessions.
- Quiz questions will be posted by live poll during the Congress. The delegates who answer all the questions correctly will be entered into a lucky draw to win a prize.
- Adjudication of each presentation and poster can be done by all delegates via the Dryfta platform. Click on the [Adjudication menu tab](#) in Dryfta. The judging of presentations closes at 17h00 on Thursday, 29 July.
- There is an award for the most prolific adjudicator.
- The poster sessions will take place on [Twitter](#) during the tea and lunch breaks. Twitter is the place where all conversations related to Congress and the posters will take place. The Twitter handle for the Grassland Society is [@GrasslandSocSA](#). Use the [#GSSACongress56](#) to group all related congress posts together. Feel free to retweet posts, ask questions, and like the posts. Find your fellow delegates and presenters to engage with them.
- Posters for the day will be posted early on so that there is plenty of time to engage on the posters.
- There are live links in this document. To navigate to abstracts within a specific session, you can click on the session name in the Table of contents or the detailed programme. You can also access websites and social media sites by clicking on the icons at the bottom of the programme overview.
- Virtual tour videos will be streamed during the breaks.
- The organisers plan to make the session presentations available to delegates for 48 hours after each session. Hence if delegates experience connectivity problems or loadshedding, they will still be able to view or review the sessions. The link to access these will be sent following the end of each session via email.
- **Tip:** Any electronic devices near your microphone may cause interference. So, for instance, a cell phone near your laptop or even a fan in the room may cause interference. Make sure that as far as possible all unnecessary devices are switched off. Also, if you are logged into Zoom on more than one device this will cause feedback (awful screeching sound!), so do try to be connected with one device at a time.



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KEYNOTES

Keynote presenter

Sue Milton
RENUKAROO VELD RESTORATION CCKAROO RESEARCH –
CHALLENGES AND
OPPORTUNITIES

Dr Sue Milton is a plant ecologist specialising in Karoo ecosystems, veld restoration and plant propagation. She is the owner of Renu-Karoo Veld Restoration nursery which grows Karoo plants and seeds for restoration and landscaping. Dr Milton is a Research Associate SAEON Arid Lands Node.

Keynote presenter

Abel Ramoelo
UNIVERSITY OF PRETORIARANGELAND ASSESSMENTS
AND MONITORING IN EVER-
CHANGING ENVIRONMENTAL
CONDITIONS:
CURRENT EARTH
OBSERVATION AND
GEOINFORMATION SCIENCE
APPLICATIONS

Prof Abel Ramoelo is a Director of the Centre for Environmental Studies, and Associate Professor at the Department of Geography, Geoinformatics and Meteorology, University of Pretoria. He is a member of the Editorial Board for the ISPRS International Journal of Photogrammetry and Remote Sensing and he is an Associate Editor for the International Journal of Applied Earth Observation and Geo-Information Science. Prof Ramoelo was recently appointed as an Editor-in-Chief for SANParks' KOEDOE journal: African Protected Area Conservation and Science journal

Keynote presenter

Heidi Hawkins
UNIVERSITY OF CAPE TOWNANIMAL DIVERSITY AND
GRAZING PRESSURE MATTER
MORE THAN GRAZING
PATTERN OR DENSITY FOR
THE PRODUCTIVITY, CLIMATE
RESILIENCE AND
RESTORATION OF GLOBAL
RANGELANDS

Dr Heidi-Jayne Hawkins is the Science Director at Conservation South Africa and Honorary Research Associate at the University of Cape Town. She has a background in plant nutrient physiology and her current focus is understanding above- and belowground nutrient cycling and how this affects ecosystem function and global change. Her main interest is on how plants acquire nutrients within plant-soil-microbe and animal feedbacks, and how the various drivers (climate, land use, fire, herbivory and woody plant encroachment) affect this.

Keynote presenter

Igshaan Samuels
AGRICULTURAL RESEARCH COUNCILRE-HERDING
THE SOUTH AFRICAN
LANDSCAPE:
KEY LESSONS FROM
TRADITIONAL
PASTORALISM

Dr Igshaan Samuels is an arid rangeland scientist at the Agricultural Research Council in South Africa. Part of his current research involves investigating and mapping land-use patterns and vegetation communities, assessing diet selection and resource use amongst livestock species in herded and free-ranging herds in semi-arid rangelands and assessing indigenous knowledge systems and their application in climate change adaptation in Namaqualand.

Keynote presenter

Jacobus Bothma
UNIVERSITY OF PRETORIACOMMERCIAL WILDLIFE
PRODUCTION
IN SOUTH AFRICA:
HISTORY,
CURRENT STATUS AND
THE FUTURE

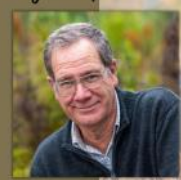
Prof Jacobus Bothma, Emeritus Professor at the University of Pretoria, is a wildlife writer and an international wildlife management consultant. He has published 24 books, including *Game Range Management*, *Written in the Sand*, and *Of Silk and Sand*. He has published 316 popular science papers and 104 papers in refereed scientific journals. Prof Bothma was the Director of the Centre for Wildlife Management at the University of Pretoria from 1989 until 2005.

Keynote presenter

Jacqueline Rowarth
LINCOLN UNIVERSITYFIT FOR PURPOSE
AGRICULTURAL
SYSTEMS

Prof Jacqueline Rowarth holds the role of Adjunct Professor at Lincoln University, New Zealand. She is currently a farmer-elected member of the Board of Directors for DairyNZ and of Ravensdown Co-operative Ltd. In 2010 she was selected as the Agricultural Communicator of the Year by the Guild of Agricultural Communicators and Journalists. Prof Rowarth is a frequent contributor to public debate in the media and remains committed to dispelling the myths that surround food production.

Keynote presenter

Ken Coetzee
CONSERVATION MANAGEMENT
SERVICESPRACTISING EFFECTIVE
HABITAT
CONSERVATION ON
COMMERCIAL GAME
RANCHES

Mr Ken Coetzee founded *Conservation Management Services* in 1996 after working for the Cape Department of Nature Conservation for 25 years. His company focuses on veld and wildlife management and management planning for conservation areas, game reserves and commercial game ranches. Ken is a practical field ecologist who is passionate about veld rehabilitation and the restoration of rangelands in Africa. He loves the Karoo and has an excellent working knowledge about its different landscapes, plants, wildlife and people. Mr Coetzee is a long-standing board member of the Gouritz Cluster Biosphere Reserve and an Honorary Senior Member of the Game Rangers Association of Africa.



56th Annual Congress

Virtual congress & workshops

Tuesday, 27 July 2021

8:00 to 10:00	Opening of the 56th Annual Congress of the Grassland Society of Southern Africa
10:00 to 10:15	Research Proposal Poster Session
10:15 to 12:30	Livestock and game management
12:30 to 13:30	Standard Poster Session
13:30 to 14:30	Combined Session: Fire ecology and climate change
14:30 to 16:45	SPECIAL SESSION I: Exploring the impacts of the climate variability and change on extensive livestock production systems in the Little Karoo and the Southern Nama Karoo

Wednesday, 28 July 2021

08:00 to 10:00	Planted pastures
10:00 to 10:15	Research Proposal Poster Session
10:15 to 12:15	SPECIAL SESSION II: Carbon in Grasslands – A pathway to climate mitigation?
12:15 to 13:15	Standard Poster Session
13:45 to 16:00	Rangeland ecology and management

Thursday, 29 July 2021

08:00 to 11:15	Conservation and restoration
11:15 to 11:30	Research Proposal Poster Session
11:30 to 13:00	Bush encroachment
13:00 to 14:00	Standard Poster Session
14:00 to 16:15	SPECIAL SESSION III: Herding into the future – key lessons for future range management and biodiversity

Monday, 26 July 2021

Research Skills Workshop: Scientific and popular science communication

Friday, 29 July 2021

Policy and Practice workshop: Towards a better understanding of the Biodiversity Stewardship Guideline in SA

Click on the icons below to access our the online program, website and social media sites:





Congress 56 Day 1 | Tuesday, 27 July 2021

OPENING OF THE 56TH ANNUAL CONGRESS OF THE GRASSLAND SOCIETY OF SOUTHERN AFRICA		8:00 to 10:00
8:00	Presidential Address	<i>Kevin P Kirkman</i>
8:30	Keynote: Karoo research – challenges and opportunities	<i>Sue Milton</i>
9:15	Tierberg LTER: a research gem in the Karoo	<i>Wynand Calitz</i>
9:30	Montane rangelands in a changing world: Summary of AJRFS Special Issue	<i>Vincent Clark</i>
9:45	Q & A Session	
TEA AND RESEARCH PROPOSAL POSTER SESSION		10:00 to 10:15
Research Proposal: the ecology and management of drought across South African rangelands		<i>Ngoako Letsoalo</i>
Assessing the agro-ecological knowledge requirements for livestock farmers on land reform farms in South Africa		<i>Khululiwe Ntombela</i>
Alternative uses of various plant parts of <i>Vachellia nilotica</i> as fodder for small ruminants: implications of woody plant encroachment		<i>Fortune Lindy Manganyi</i>
Comparing techniques for assessing rangeland health and factors affecting the adoption of science-based technologies among livestock farmers		<i>Kamogelo Malepe</i>
LIVESTOCK AND GAME MANAGEMENT		10:15 to 12:30
10:15	Keynote: Commercial wildlife production in South Africa: history, current status and the future	<i>Jacobus Bothma</i>
11:00	Keynote: Practising effective habitat conservation on commercial game ranches	<i>Ken Coetzee</i>
11:45	Population dynamics of ticks on and off bovine hosts grazing under different agro-ecological zones in the Eastern Cape Province	<i>Nkululeko Nyangiwe</i>
12:00	Development of a landscape level elephant management framework for the Great Limpopo Transfrontier Park and Conservation Area	<i>Mike Peel</i>
12:15	Q & A Session	
LUNCH AND STANDARD POSTER SESSION		12:30 to 13:30
Evidence of shrinking communal rangelands in the former Transkei: causes, implications and remedial actions		<i>Siphe Zantsi</i>
Evaluation of communal rangeland condition under the East Griqualand veld type of Eastern Cape Province, South Africa		<i>Sive Tokozwayo</i>
Climate change as a wicked problem: farmers' perceptions on livestock losses at Emalahleni local municipality in the Eastern Cape Province, South Africa		<i>Siza Mthi</i>
Utilisation of woody plants by the Cape porcupine in mesic savannas may ameliorate the effects of bush encroachment		<i>Unathi Kraai</i>
A paired tower approach to compare carbon dioxide and water vapour fluxes between two vegetation types representing Savanna and Nama-Karoo Biomes		<i>Amukelani Maluleke</i>
Soil moisture relationship with long-term variability of rainfall, temperature and humidity in		<i>Kudakwashe Musengi</i>



COMBINED SESSION: FIRE ECOLOGY AND CLIMATE CHANGE		13:30 to 14:30
13:30	Growth response of a Karoo shrub to imposed warming under field conditions	<i>Guy Midgley</i>
13:45	Investigating the impacts of different physiological drought responses in perennial, South African C4 grasses	<i>Londiwe Mokoena</i>
14:00	Fighting wildfire fire with prescribed fire: identifying and overcoming social	<i>Urs Kreuter</i>
14:15	Q&A Session	
AFTERNOON TEA		14:30 to 14:45
SPECIAL SESSION I: EXPLORING THE IMPACTS OF CLIMATE VARIABILITY AND CHANGE ON EXTENSIVE LIVESTOCK PRODUCTION SYSTEMS IN THE LITTLE KAROO AND THE SOUTHERN NAMA KAROO		14:45 to 16:45
14:45	Overview of climate variability and climate change in the Little Karoo and southern Nama Karoo	<i>Stephanie Midgley</i>
15:00	The impact of the drought on the vegetation of the Nama Karoo and Succulent Karoo	<i>Nelmarie Saayman</i>
15:15	Future climatic instability: Assessment of environmental stressors in sheep	<i>Schalk W. P. Cloete</i>
15:30	Extreme temperatures compromise male and female fertility in farmed ostriches in an arid region	<i>Zanell Brand</i>
15:45	Satellite imagery and open-access, online tools to support monitoring and decision-making in veld management	<i>Michael Wallace</i>
16:00	Koup 4: the gold standard in area wide planning	<i>Francis Steyn</i>
16:15	Determining the impacts of climate variability on vegetation and animal production in the Western Upper Karoo Shrublands	<i>Christiaan Harmse</i>
16:30	Q & A Session	
ANNUAL GENERAL MEETING OF THE GRASSLAND SOCIETY OF SOUTHERN AFRICA		17:30 to 19:00

**Congress 56 Day 2 | Wednesday, 28 July 2021**

PLANTED PASTURES		08:00 to 10:00
08:00	Keynote: Fit for purpose agricultural systems	<i>Jacqueline Rowarth</i>
8:45	A review: The value of grazing maize for sheep as overwintering alternative in the summer rainfall areas of South Africa	<i>Erika Van Zyl</i>
9:00	The effect of partial replacement of perennial ryegrass (<i>Lolium perenne</i>) with plantain (<i>Plantago lanceolata</i>) pasture and concentrate level on milk production and milk composition of Jersey cows in spring	<i>Robin Meeske</i>
9:15	Evaluation of <i>Brachiaria</i> grass accessions for adaptability and agronomic performance under rainfed conditions in the northern region of Gauteng province, South Africa	<i>Stephen Modiba</i>
09:30	Temporal changes in herbage yield and botanical composition in forage herb/grass binary mixtures	<i>Sigrun Ammann</i>
09:45	Q & A Session	
TEA AND RESEARCH PROPOSAL POSTER SESSION		10:00 to 10:15
Potential use of white clover (<i>Trifolium repens</i>) as a green manure in over-cultivated and nutrient poor agricultural soils in Eastern Cape, South Africa		<i>Unathi Gulwa</i>
Legacy effects of multi-species grassland mixtures in a crop rotation system		<i>Reon Marx</i>
Seed germination of <i>Brachiaria</i> grass species under different temperature and osmotic stress conditions		<i>Jabulile Leroko</i>
The effect of applying different nitrogen fertilizer types and levels for growth on grass-legume mixtures		<i>Amahle Sogoni</i>
The identification of the most suitable <i>Brachiaria</i> genotypes for improved livestock production in water-limited agro-ecological areas of South Africa		<i>Francuois Müller</i>
The incorporation of livestock into cash-cropping systems in the Western Cape to decrease its potential impact on climate change		<i>Lisa Matthews</i>
SPECIAL SESSION II: CARBON IN GRASSLANDS– A PATHWAY TO CLIMATE MITIGATION?		10:15 to 12:15
10:15	A high resolution (30m) soil organic carbon map for South Africa: A tool for research and carbon projects in grasslands.	<i>Zander Venter</i>
10:30	Fire and herbivory effects on soil organic C stocks and soil greenhouse gas emissions from South African grasslands and savannas: Implications for global change	<i>Farai Chikomba</i>
10:45	Modelling grazing and burning in communal rangelands helps farmers plan land use and assess feasibility of carbon finance projects	<i>Heidi Hawkins</i>
11:00	Negative effects of cattle on soil carbon and nutrient pools reversed by megaherbivores	<i>Duncan Kimuyu</i>
11:15	International carbon trading and carbon standards: new opportunities for rangeland restoration programmes to benefit from carbon income, a review of prospects.	<i>Leon-Jacques Theron</i>
11:30	Changes in fire frequencies influence soil organic carbon sinks in South African mesic grasslands	<i>Robyn Nicolay</i>
11:45	Effects of livestock grazing on ecosystem CO ₂ exchange in semi-arid Karoo ecosystems, South Africa	<i>Oksana Rybchak</i>
12:00	Q & A Session	



LUNCH AND STANDARD POSTER SESSION		12:15 to 13:15
Nutrient intake, digestibility, growth performance, and methane emission by Nguni steers fed <i>Seriphium plumosum</i> meal		Motswapo Phoko
Mineral concentration of perennial grass species cultivated in semi-arid areas of the North West province		Ntokozo Happy Msiza
Performance of Nguni goats supplemented with sweet potato vines, in KwaMthethwa area		Cynthia Fikile Luthuli
The performance of <i>Lolium multiflorum</i> varieties under irrigation on Cedara Research Station, KwaZulu-Natal in 2020		Derryn Nash
Estimating the composition of <i>Lespedeza cuneata</i> fodder samples using near-infrared spectroscopy		Erika Van Zyl
The impact of temperature and water-limitation on seed germination and early seedling establishment of annual forage legumes in the genera <i>Medicago</i> and <i>Trifolium</i>		Francuois Müller
Determine optimal dosage of ethyl methanesulphonate (EMS) mutagenesis in selected Teff varieties for dual purpose		Patrick Rakau
An evaluation of dry matter yields and production trends of 24 Lucerne cultivars in the northern region of the Gauteng province, South Africa		Francuois Müller
Productivity evaluation of four <i>Medicago</i> sativacultivars under two water regimes (irrigated and non-irrigated) and two soil types at B Bathurst Research Station in the Eastern Cape Province		Mhlangabezi Solontsi
RANGELAND ECOLOGY AND MANAGEMENT		13:15 to 16:00
13:15	Keynote: Rangeland assessments and monitoring in the ever-changing environmental conditions: current earth observation and geoinformation science applications	Abel Ramoelo
14:00	The impact of increasing woody vegetation on montane biodiversity in the Maloti-Drakensberg: a case study of <i>Leucosidea sericea</i> encroachment	Muxe Dlomu
14:15	The influence of drought on grass sward composition, structure and species interactions in mesic grassland	Yonela Maziko
14:30	Effect of proximity to highways on aboveground tissue surface pH of grazed savanna grass species	Mantsana Mathole
14:45	Value of remotely sensed vegetation indices and animal movement patterns for rangeland management in Karoo Shrublands	Christiaan Harmse
15:00	Perceptions of rangeland users on the ecology, socio-economic impacts and management of invasive plant species: a case of Mphaki in Quthing District, Lesotho	Moselantja Rahlao
15:15	Density effects of mature trees on grass production and tree seedling recruitment in a bush-encroached savanna	Piet Monegi
15:30	The diversity of poisonous plant patches in the arid rangelands of Namaqualand, South Africa	Clement Cupido
15:45	Q&A Session	



Congress 56 Day 3 | Thursday, 29 July 2021

CONSERVATION AND RESTORATION

08:00 to 11:15

08:00	Keynote: Animal diversity and grazing pressure matter more than grazing pattern or density for the productivity, climate resilience and restoration of global rangelands	<i>Heidi Hawkins</i>
08:45	South Africa is a hotspot for previously unknown grass stem-boring wasps (<i>Tetramesa</i> ; <i>Eurytomidae</i>)	<i>Guy Sutton</i>
09:00	Getting a grip on grasslands: assessing plant diversity in the under-sampled and threatened grasslands of South Africa	<i>Annerine Myburgh</i>
09:15	Sexual reproduction trait expression of eleven grassland species along a gradient of nitrogen: phosphorus stoichiometry in the Netherlands	<i>Shuqiong Wang</i>
09:30	<i>Verbesina encelioides</i> – next invasive alien species in the South African rangelands?	<i>Thulisile Jaca</i>
09:45	First quantification of plant endemics in the Manica Highlands (Zimbabwe–Mozambique), and circumscription of the Manica Highlands Centre of Floristic Endemism	<i>Vincent Clark</i>
10:00	The restoration of environment and people - Jobs for Carbon perspective	<i>Andre Britz</i>
10:15	The story of the Goukou Resilient River Project	<i>Rita Liebenberg</i>
10:30	The Limpopo–Mpumalanga–Eswathini Escarpment – extra-ordinary endemic plant richness and extinction risk in a summer rainfall montane region of southern Africa	<i>Vincent Clark</i>
10:45	Forbs first: forbs show consistently higher alpha and beta diversity than grasses in a	<i>Michelle Greve</i>
11:00	Q & A Session	

TEA AND RESEARCH PROPOSAL POSTER SESSION

11:15 to 11:30

Assessing the impacts of grazing lawns on plant and soil mite diversity in the Bontebok National Park	<i>Claire Grootboom</i>
Determining the optimum phenological stage for harvesting <i>Calobota sericea</i> fodders.	<i>Ethan Britz</i>
Investigating the impact of climate change and natural resources management on the Premium Beef Value Chain, in Eastern Cape, South Africa: NDVI Applications	<i>Nkwenkwezi Myeki</i>

BUSH ENCROACHMENT

11:30 to 13:00

11:30	Bush Expert Information Management System (BEIMS)	<i>Klaus Kellner</i>
11:45	Changes in herbaceous vegetation along a shrub encroachment intensity gradient in the montane rangelands of Sehlabathebe in the Qacha's Nek District of Lesotho	<i>Retselisitsoe Stephen</i>
12:00	Syndromes and symptoms: Traits of savanna seedlings linked to woody establishment	<i>Laura Milne</i>
12:15	Steal the rain: rainfall interception losses by encroaching fine-leaf and broad-leaf woody species in a South African semi-arid savanna.	<i>Felix Skhosana</i>
12:30	Some realities of the primary production and water use of semi-arid rangelands in the Eastern Cape: preliminary results from eddy covariance towers in the Great Fish Thicket, Bhisho Thornveld and Bedford Dry Grassland.	<i>Anthony Palmer</i>
12:45	Q & A Session	



LUNCH AND STANDARD POSTER SESSION		13:00 to 14:00
<i>Nassella neesiana</i> is an invader to watch in South African mountains		<i>Anthony Mapaura</i>
How does overgrazing kill a grassland forb?		<i>Craig Morris</i>
Characterizing woody vegetation around the EFTEON flux tower at Benfontein Nature Reserve (BNR), South Africa		<i>Buster Magonong</i>
Nitrogen-fixing gene found associated with the roots of mesic grasses in South Africa		<i>Craig Morris</i>
Chemical composition and dry matter degradability of some native woody species as influenced by season in different rangelands of South Africa		<i>Humbelani Silas Mudau</i>
Can livestock grazing on California rangelands reduce the potential for and severity of wildfires at the landscape scale?		<i>Theresa Becchetti</i>
Restoration potential of selected grass species on different slope gradients in Mesic highveld grassland.		<i>Modau Norman Magoro</i>
Faecal analysis: the use of N, P and Na as an adjunct to traditional range evaluation methods		<i>Mike Peel</i>
<u>SPECIAL SESSION III: HERDING INTO THE FUTURE – KEY LESSONS FOR FUTURE RANGE MANAGEMENT AND BIODIVERSITY</u>		14:00 to 16:00
14:00	Keynote: Re-herding the South African agricultural landscape - key lessons from traditional pastoralism	<i>Igshaan Samuels</i>
14:45	Wildlife-friendly livestock management promotes mammalian biodiversity recovery on a semi-arid Karoo farm in South Africa	<i>BHDV Smuts</i>
15:00	Recovery and compositional change of vegetation after high impact trampling events in the semi-arid Nama Karoo in South Africa	<i>Jeannine McManus</i>
15:15	Herding Academy	<i>Johan Bouwer</i>
15:30	Assessing the effect of herding on livestock grazing patterns in the Amakhuzeni communal rangelands, using GPS Trackers	<i>Andiswa Finca</i>
15:45	Agrisycretic knowledge production and applications of Namaqualand herders	<i>Clement Cupido</i>
16:00	Q & A Session	

**CONGRESS ORGANISING COMMITTEE**

Charne Viljoen	Stellenbosch University
Sigrun Ammann	Western Cape Department of Agriculture
Francuois Muller	Agricultural Research Council
Janke van der Colf	Western Cape Department of Agriculture
Malissa Murphy	Elsenburg Agricultural Training Institute
Melvin Swarts	Department of Rural Development and Land Reform
Nelmarie Saayman	Western Cape Department of Agriculture
Annelene Swanepoel	Western Cape Department of Agriculture
Clement Cupido	Agricultural Research Council / UWC
Erica Joubert	GSSA

Thank you to the following individuals for assisting with the checking of video presentations: Hanneke Augustyn, Reon Marx, Lisa Matthews and Malissa Murphy

SCIENTIFIC COMMITTEE:

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Erika Van Zyl	KwaZulu-Natal Department of Agriculture and Rural Development
Florence Nherera-Chokuda	Emerging Red Meat Producers Organization (NERPO)
Francuois Muller	Agricultural Research Council API
Igshaan Samuels	Research Council API
Janke Van Der Colf	Western Cape Department of Agriculture
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Rouxdene Deysel	Department of Agriculture and Rural Development
Sigrun Ammann	Western Cape Department of Agriculture
Solomon Tefera Beyene	University of Fort Hare
Tony Swemmer	SAEON
Wayne Twine	University of the Witwatersrand
Yvette Brits	North West Department of Agriculture and Rural Development



Grassland Society of Southern Africa: 2020/21 Council

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IMMEDIATE PAST PRESIDENT	Debbie Jewitt
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PUBLICATIONS EDITOR	Malissa Murphy
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ADDITIONAL MEMBER	Francuois Muller
ADDITIONAL MEMBER	Florence Nherera-Chokuda
ADDITIONAL MEMBER	Robyn Nicolay
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56th Annual Congress

27 - 29 July 2021



*Grassland Society
of Southern Africa*

OPENING SESSION

SESSION CHAIR: CHARNÉ VILJOEN

Tuesday 27 July 2021, 08:00 - 10:00

PRESIDENTIAL ADDRESS by *Kevin P Kirkman*

KEYNOTE ADDRESS: KAROO RESEARCH – CHALLENGES AND OPPORTUNITIES

Sue Milton

RenuKaroo Veld Restoration

Our present understanding of Karoo ecosystems and our ability to predict how these systems will change is limited to research carried out over the past century. Most of this research has focussed on vegetation mapping and responses of vegetation and soil to rainfall and grazing. However landuse in the Karoo is no longer confined to grazing, but now includes solar and wind-farm developments, lifestyle farms, extended protected areas and tourism developments and the vast Square Kilometer Array astronomy facility. Mining and hydraulic fracturing for natural gas resource development may well join this mix, and all these landuse changes are taking place during a period of human-driven climate change characterised by warning and altered rainfall patterns in the western and Northern Cape. I will discuss the need for multidisciplinary approaches to resource mapping, process studies, and trend detection in order to solve social and environmental problems generated by these changes in landuse. Among the priorities for research are veld restoration, erosion control, biocontrol, bird deflectors, predator friendly ranching, heat-tolerant livestock and crops, water-efficient crop production, recycling technology, extension approaches, improvements in recycling of effluents and solids, farming under solar panels, sustainable lifestyles and finding solutions to rapid human population growth and associated social and ecological problems. The future research on Karoo socio-ecological systems will probably often be multi-disciplinary as it will take place in an ecosystem influence not only by local landuse, soil, climate and economics but also influenced by global climate and economic change. Despite the complexity, future Karoo researchers will have many opportunities and facilities that previous researchers lacked. These include largescale semi-replicated disturbances created by renewable energy developments, a greater variety of protected areas for comparative studies, access to data archives (SAEON, Iziko, CSIR, SAWS), new technology (remote imagery, flux towers, loggers), internet connections in remote places, and a general acceptance of the benefits of interdisciplinary approaches to research. Moreover, it is likely that new sources of research funding will become available via the state (SAEON/EFTEON/SANParks), international agencies such as SKA, private industry (mining, renewables, tourism).

**PLATFORM PRESENTATION: TIERBERG LTER: A RESEARCH GEM IN THE KAROO***Wynand Calitz¹, Helga Van Der Merwe¹, Gregor Feig²*¹SAEON Arid Lands Node, ²SAEON Expanded Freshwater And Terrestrial Environmental Observation Network

Thirty kilometres from the small Karoo town of Prince Albert lies a 34-year-old research platform that has over the years hosted many of South Africa's top ecologists to conduct research in this portion of the Succulent Karoo. This 100-hectare enclosure was first established as the Tierberg Karoo Research Centre and was the start of many research projects, a number of which are still continuing thereby contributing to long-term datasets. In 2014, the land was donated to the National Research Foundation and is managed by the South African Environmental Observation Network's (SAEON) Arid Lands Node which actively visits the site to conduct research and maintain the infrastructure. The Tierberg Long Term Ecological Research (LTER) site is the focus of more than 180 research papers. SAEON encourages local and international research at the site. Since SAEON's involvement started, many students and interns have had the chance to study and work here and in turn produce environmental research. Baseline information in the form of archived vegetation and weather data are available to support new research. Weather data, now collected by an automated weather station with several sensors, allows for a comprehensive dataset of climatic variables. As seen throughout much of the Karoo, the area has recently been subject to an extensive drought with the effects measured through drought studies and captured in the phenological surveys. As a result of baseline data, the site has become a valuable resource for climate studies in the Succulent Karoo and the long-term records from the site will be useful for future studies in the area. Sue Milton and Richard Dean have been instrumental in the research success at the site, long before SAEON's involvement, and actively conduct research here and at the Wolwekraal Nature Reserve, situated on the outskirts of Prince Albert. Future development of research opportunities at Tierberg-LTER and Wolwekraal Nature Reserve will be facilitated by the Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) which has approved the Garden Route Gateway landscape. This landscape stretches from the coast, inland, into the Karoo and covers an area from Robertson in the west to the Gamtoos river in the east. The landscape is centred around the NMU George Campus with satellite sites at Prince Albert (including Tierberg and Wolwekraal Nature Reserve), Duivenhoeke Weir, Baviaanskloof and the Kromm. What makes this effort unique is the fact that it will not only cover an extensive area, but a very heterogenic landscape which includes various biomes and vegetation types. EFTEON aims to provide and operate a network of six heavily instrumented landscape-level research platforms across South Africa. SAEON and EFTEON would like to encourage researchers and students to develop new research studies or get involved in ongoing and/or planned studies and continue to build on the Tierberg-LTER long-term research legacy in this part of the Succulent Karoo.

PLATFORM PRESENTATION: MONTANE RANGELANDS IN A CHANGING WORLD: SUMMARY OF AJRFS SPECIAL ISSUE 2021*Vincent Clark^{1*}, Kyran Kunkel², Timothy O'Connor³, Debbie Jewitt⁴, Ntebohiseng Sekhele⁵, Kevin P Kirkman⁶*¹Afromontane Research Unit / University Of The Free State, ²Conservation Science Collaborative, University Of Montana, ³SAEON, ⁴Ezemvelo KZN Wildlife, ⁵University Of The Free State, ⁶University Of KwaZulu-Natal

With nine out of 12 contributions, the Maloti-Drakensberg is the strongest geographic focus of this Special Issue. Covering some 40,000 km², the Maloti-Drakensberg is the largest single mountain massif in southern Africa, and a complex transboundary massif from a management perspective. As the principal water tower for southern Africa, it is perhaps not surprising that the Maloti-Drakensberg has emerged as the dominant focus of this Special Issue. Contributions for this region cover Lesotho (three papers), and the South African provinces of KwaZulu-Natal (five papers), and the Free State (one paper), but none from the Eastern Cape. This Maloti-Drakensberg focus is rounded off by Hill's (2021) book review of Rodney Moffett's *A Scientific Bibliography of the Drakensberg, Maloti and Adjacent Lowlands* (2020), a useful contribution to consolidating the widely varied research conducted in these mountains over the decades. For the protected, lightly-grazed portions of the Maloti-Drakensberg in KwaZulu-Natal, the conclusions are that appropriate fire management (in this case biennially in the dormant/spring season) is critical to maintaining desired vegetation states for maximum ecosystem services benefits and biodiversity conservation. Inappropriate fire management can be detrimental to local *Protea roupelliae* savannas, and the entire mesic grassland system may be vulnerable to global warming and potential associated increased aridity. Poorly governed communal rangeland (rather than climate change) in the Maloti-Drakensberg drives dramatic degradation at the landscape/catchment scale, such degradation favouring mass shrub encroachment in such communal systems;



such degradation also poses substantial risks to wetland sustainability and their ecosystem services. In contrast, well-managed communal rangeland can support *in situ* biodiversity conservation outside protected areas. The Atlas Mountains, one of the highest and most extensive mountain systems in Africa, are represented in two vegetation-related papers. One emphasises the need for seasonal grazing in favour over continuous grazing in arid Tunisian grasslands to ensure that species diversity is maintained, whereas the other reports a general decline in species diversity and rangeland resilience in the Middle Atlas of Morocco. There is one paper from the Namaqualand Escarpment (South Africa), also an arid mountain system, and is the sole non-biophysical paper in this Special Issue; it highlights the need for more non-natural science and inter-disciplinary research on these complex issues. A key outcome of this Special Issue is the value of long-term monitoring in mountain rangelands: five contributions present valuable results from long-term observations that span 22 to 38 years. These results indicate that substantial ecological changes (and their social and political implications) are evident over these time periods. Whether these changes are from local rangeland governance (including grazing history and fire management), or climate change, or both, can often be difficult to interpret. Carefully planned surveillance is needed in order to tease out the relative influence of climate change impact versus land management changes, and not all changes should be assumed to be driven by climate change alone.

**TUESDAY RESEARCH PROPOSAL POSTER SESSION**

Tuesday 27 July 2021, 10:00 - 10:15

Posters can be viewed on twitter [here](#)**RESEARCH PROPOSAL POSTER: THE ECOLOGY AND MANAGEMENT OF DROUGHT ACROSS SOUTH AFRICAN RANGELANDS***Ngoako Letsoalo^{1*}, Igshaan Samuels¹, Julius Tjelele¹ and Richard Knight²*¹Agricultural Research Council API, ²University Of The Western Cape

Drought frequency and intensity are likely to increase in many parts of the world and in the future, and its occurrence should not be dissociated from climate change. In South Africa, prolonged droughts affect commercial, emerging, and subsistence farmers across diverse rangelands. Farmers' vulnerability is often exacerbated by a lack of effective drought management. Studies investigating knowledge and skills used by farmers to respond to climate variability and change including drought in South Africa are lacking, although livestock farmers have been living and coping with extreme environmental conditions for centuries. The overall aim of the study will be to assess the ecological impact of drought across South African rangelands and the different management strategies livestock farmers implement to adapt and mitigate the impacts of drought on their production systems. A selection of 100 champion farmers in different rangelands in five biomes in South Africa will be studied using stratified random sampling. We define champion farmers as "livestock farmers that hold multi-generation knowledge of the social, economic and ecological ways of farming, and that has extensive personal experience in coping with drought". The study will attempt to answer the questions: How has drought-affected rangeland productivity in the different farming systems and biomes in South Africa in the past 20 years? How different are livestock production and rangeland management practices between the farming systems and biomes in South Africa? What are the drought adaptation and mitigation strategies employed by champion livestock farmers in South Africa? The selection of the study areas will be representative of five biomes (Grassland, Savanna, Nama-Karoo, Albany thicket, and Succulent Karoo) in the nine provinces of South Africa. The different farming enterprises (large stock, small stock, and game) will be represented, taking into account the dominant enterprise for a specific biome. Furthermore, the different land tenure systems; communal, private, tribal and state land will be represented for a specific biome. The findings of this study will assist farmers to adapt and mitigate drought impact but most importantly assist policymakers in formulating appropriate policy interventions to support livestock farmers against the peril of drought; which is threatening food security, economic growth, human survival, and livelihoods of farmers.

RESEARCH PROPOSAL POSTER: ASSESSING THE AGRO-ECOLOGICAL KNOWLEDGE REQUIREMENTS FOR LIVESTOCK FARMERS ON LAND REFORM FARMS IN SOUTH AFRICA*Khululiwe Ntombela^{1,2*}, Igshaan Samuels², Andiswa Finca², Adriaan Engelbrecht¹ and Clement Cupido²*University Of The Western Cape¹, Agricultural Research Council API²

The South African Land Reform programme aims to increase agricultural productivity and raise the country's economy through employment and raising rural income. Since 1994, a number of toolkits have been established and some phased out for the implementation of land reform in the country. However, the government has concluded that despite the establishment of these toolkits, many land reform farms are not producing according to expectation. Hence, there is a need to investigate the factors that might be responsible for such low productivity. One of the research areas, that is often neglected in studies concerning agricultural production on livestock farms is agro-ecological knowledge. The movement towards sustainable agricultural production is centred around an improved understanding of farmers' knowledge and learning processes. How a farmer understands their farming environment, captures horizontal knowledge transfers during farmer encounters and conservation knowledge are all crucial understandings required to inform farmers' decision-making processes. Therefore, this study aims to investigate the formal and informal knowledge economy of livestock farmers on land reform farms in South Africa in terms of knowledge production, access, sharing and use. The study will be conducted with individual beneficiaries on a total of 60 land reform farms in the Northern Cape Province and Eastern Cape Province representing arid and mesic rangelands. Methods will include structured questionnaires, semi-structured interviews, and focus groups. Qualitative data will be coded and analysed in SPSS and ATLAS.ti software. This study will be beneficial in providing the government with unseen or intangible factors that might be responsible for under-performing land reform farms, with an opportunity guideline for including agro-ecological knowledge requirements in the criteria used for beneficiary selection, beneficiary farm placement, and capacity development.



RESEARCH PROPOSAL POSTER: ALTERNATIVES USES OF VARIOUS PLANT PARTS OF *VACHELLIA NILOTICA* AS FODDER FOR SMALL RUMINANTS: IMPLICATIONS OF WOODY PLANT ENCROACHMENT

Fortune Lindy Manganyi^{1*}, Julius Tjelele¹, Francuois Müller¹, Ngoako Letsoalo¹, Hosia Pule¹, Stephen Modiba¹ and Khanyisile Mbatha²

¹Agricultural Research Council API, ²UNISA

Woody plant encroachment is a common problem throughout southern African savannas. It negatively affects rangeland productivity by reducing the carrying capacity, thus increasing costs associated with livestock management and production. However, in certain instances, farmers see these encroaching species as a source of feed for their livestock, especially during the dry season, or periods of drought. During the dry season, ruminants consume large amounts of woody plant pods, subsequently dispersing scarified seeds that may contribute to an increase in encroaching woody plants. It is therefore important to develop sustainable strategies of reducing the spread of the encroaching seed species and minimise dry season feed gaps. The objectives of this study are to determine the edibility of *Vachellia nilotica* to produce alternative feed sources to fill the dry season feed gap, explore the use of feed additives to improve the digestibility and explore the ensilability. The proposed study will be carried out at Agricultural Research Council, Animal Production (Roodeplaat and Irene Experimental farms), Pretoria, South Africa. The harvested shoots and seed pods will be chipped separately using a wood chipper (Tandem 6.5hp chipper / shredder). The raw chipped shoots will be mixed with or without different amounts of chipped seed pods and feed additive (Voermol LS33) to form the baseline fodder treatments. A total of twenty-four indigenous veld goats will be divided into four groups of 6 goats per group and will be fed seed pods with hay grass, seed pods with hay grass plus feed additive, chipped materials and chipped materials with feed additive. All the experimental animals will be fed with hay grass for maintenance for the duration of the trial. The experimental animals will be allowed to consume the experimental diet, and faecal collection will commence immediately. Seeds recovered from each animal for the day will be counted and stored for a germination trial. Furthermore, the chipped material with or without the feed additives will be ensiled using the company recommended concentrations of a biological additive, BioStabil Plus (Biomim®). The nutritional quality of *V. nilotica* fodders and silage will be analysed for crude protein, NDF, digestibility, energy, and the fermentative characteristics of the silage. The study is envisaged to contribute to the development of fodder programmes to minimise dry season feed gaps.

RESEARCH PROPOSAL POSTER: COMPARING TECHNIQUES FOR ASSESSING RANGELAND HEALTH AND FACTORS AFFECTING THE ADOPTION OF SCIENCE-BASED TECHNOLOGIES AMONG LIVESTOCK FARMERS

Kamogelo Malepe^{1*}, Hosia Pule¹, Ngoako Letsoalo¹, Julius Tjelele¹ and Khanyisile Mbatha²

¹Agricultural Research Council API, ²UNISA

Rangeland deterioration, reduced animal production and accelerated soil erosion are major challenges facing South African rangelands. The absence of appropriate, cost-effective techniques for determining rangeland condition may be one of the contributors to rangeland deterioration. Most techniques for assessing rangeland conditions can be costly and/or time-consuming. Furthermore, solving rangelands problems in the livestock sector requires developing and diffusing new science-based technologies and practices. Despite research results with an understanding of adoption, it is a challenge for policymakers to enforce farmers to adopt science-based technologies. The objectives of the study are to; 1) compare three rangeland health assessment techniques during dry and wet seasons on veld condition score (%) and grazing capacity (ha LSU⁻¹). 2) Determine the factors that discourage farmers in the high-value beef partnerships (HVBPs) from adopting science-based technologies and practices. Rangeland condition assessments will be conducted using three different techniques in three camps during the wet and dry season at Towoomba Research Station, Limpopo Province. The techniques will be used simultaneously on each of the three camps with each of the three techniques replicates three times per camp. The differences between rangeland condition assessment techniques on veld condition score (VCS (%)) and grazing capacity (GC (ha LSU⁻¹)) during different seasons and on different camps will be analyzed using the analysis of variance. Interviews using semi-structured questionnaires will be conducted with 25 farmers who will be randomly selected from HVBPs database. The questionnaires will contain both closed and open-ended questions and will be analyzed using appropriate software. The results from this study will assist with resolving some of the rangeland management challenges and in the dissemination of information and promotion of science-based technologies to HVBPs farmers in South Africa.



56th Annual Congress

27 - 29 July 2021



*Grassland Society
of Southern Africa*

SESSION 2 Livestock and game management

SESSION CHAIR: NELMARIE SAAYMAN

TUESDAY, 27 JULY 2021, 10:15 - 12:30

KEYNOTE ADDRESS: COMMERCIAL WILDLIFE PRODUCTION IN SOUTH AFRICA: HISTORY, CURRENT STATUS AND THE FUTURE

Jacobus Bothma

University Of Pretoria

The history, current status and future of commercial wildlife production in South Africa since its inception in 1991 are discussed. The rehabilitation and efficient management of the habitat is the basis of wildlife management. The various phases in the commercial wildlife industry in South Africa to date are discussed. Most of the wildlife ranches were once overgrazed livestock units. The greatest initial mistakes were not to rehabilitate the habitat before restocking the land with indigenous wildlife below the current grazing and browsing capacity of the habitat and aid the conservation of the natural biodiversity of each region. The wildlife industry has become too dependent on the lucrative markets involving international tourists and professional hunters and exotic wildlife which have all but ceased during the covid 19 pandemic. There also was a loss of interest in exotic wildlife in recent years by wildlife breeders and professional hunters which created a sharp drop in their value. It is suggested that the wildlife producers should increasingly market their own wildlife on internet auctions and use passive capture systems to separate the captured wildlife into different market segments such as for breeding stock, local hunters, meat production and tourism. As commercial wildlife production can provide food security and create sustainable economic development for millions of impoverished, rural people in Africa who suffer from a lack of space and food, rural populations could set up their own commercial wildlife production units to sustain the harvest of their wildlife with mobile abattoirs, cater for hunters and produce meat for food security for sustained economic development.



KEYNOTE ADDRESS: PRACTISING EFFECTIVE HABITAT CONSERVATION ON COMMERCIAL GAME RANCHES

Ken Coetzee

Conservation Management Services

This presentation is all about the rehabilitation of natural habitat on game ranches, none of it is new information and we are all very aware of the situation in our rangelands but very little is being done about it. Examples of habitat degradation are shown, most of it resulting in topsoil loss and general aridification of the landscape due to unsustainable grazing practices. Rehabilitation is possible and affordable, and examples of rehabilitation success on private game ranches are shown. The rehabilitation demonstrated represents a back-to-basics practical approach consisting of A) the removal of the causes of the degradation and B) the implementation of a rehabilitation management plan which consists of soil stabilization, vegetation cover improvement and sustainable wildlife management. The action plan is basically 1) slow down the rainwater runoff flow and 2) improve rainwater infiltration and 3) improve the natural plant cover. This is all done together with an appropriate (conservative) game stocking rate. This is all done by means of simple soil stabilization using site reshaping, erosion control geotextile fences, mulching and brush-packing, water collecting hollows and temporary exclusion from grazing. The spread of a variety of invasive alien cactus species, which increase rapidly in degraded rangelands, by means of the selective use of injection of systemic herbicides and promoting biocontrol in Laikipia Kenya and the Karoo are some of the treatments discussed. Examples of degraded wetlands and the means employed to rehabilitate them to improve water and carbon storage capacity are discussed as are the methods used to improve the fire management practices in the catchments of the wetlands. Cork oak forest rehabilitation on a game farm in Morocco by means of grazing reduction, ground cover rehabilitation and mass tree planting is shown and this illustrates that the habitat rehabilitation process, which is the theme of this presentation, has universal application potential in arid and semi-arid habitats. Similarly, the restoration of severely degraded Karoo rangeland to become a productive, and award-winning game reserve project, in less than ten years is discussed. The general message of the presentation is that the methodology for habitat rehabilitation is known, it is not overly complex or expensive and it takes little more than an ethical responsibility towards the sensitive management of natural habitats to make a significant difference and that some private game ranchers appear to be leading in this field.

PLATFORM PRESENTATION: POPULATION DYNAMICS OF TICKS ON AND OFF BOVINE HOSTS GRAZING UNDER DIFFERENT AGRO-ECOLOGICAL ZONES IN THE EASTERN CAPE PROVINCE

Nkululeko Nyangiwe^{1*}, Mandla Yawa², Voster Muchenje², Charles Kadzere¹, Conference Thando Mpendulo² and Chris Marufu³

¹Eastern Cape Department Of Agriculture, Rural Development And Agrarian Reform, ²University Of Fort Hare, ³University Of Pretoria

The seasonal dynamics and tick distribution are of significance in the epidemiology of tick-borne diseases. Tick abundance varies with time, habitat, agro-ecological zones and species to species due to variations in the daily duration of light and darkness to which an organism is exposed. The objective of this study was to determine the ecological preferences and seasonal dynamics of free-living and parasitic ticks from cattle and on vegetation in the Eastern Cape Province. A total of 31,425 ticks were collected from 10 cattle and also from six drag samples (samples from the vegetation) during the 12-month study period. Adult ticks were removed from the right-hand side of each animal and all instars of ticks were placed in containers filled with 70% ethanol. Based on morphological traits, 10 tick species were identified namely: *Rhipicephalus (Boophilus) decoloratus* (32.5%), *R. evertsi evertsi* (18.8%), *R. appendiculatus* (17.3%), *Amblyomma hebraeum* (16.3%), *R. simus* (7.7%), *Ixodes pilosus* (3.8%), *Hyalomma rufipes* (3.5%), *R. follis* (0.08%), *Haemaphysalis elliptica* (0.04%), *H. silacea* (0.02%). The southern African yellow dog tick, *H. elliptica*, was found only on vegetation. The agro-ecological zones differ significantly in tick species and their distribution. The *A. hebraeum* and *R. evertsi evertsi* counts were higher in Kowie Thicket (KT) during the summer season (2.05 ± 0.01 and 1.00 ± 0.09 , respectively) compared to Bedford Dry Grassland (BDG) and Bhisho Thornveld (BT) veld types. In all vegetation types, higher counts of *R. appendiculatus* than other tick species were recorded in KT in spring (0.91 ± 0.08), summer (0.78 ± 0.08) and winter (0.78 ± 0.08). *Rhipicephalus (Boophilus) decoloratus* was more abundant in the BT (1.78 ± 0.11) during the summer season. BDG had lower tick infestations with *R. evertsi evertsi* being the most abundant species in summer. No representatives of *H. rufipes* were collected in the KT. Of epidemiological interest, *R. (B.) microplus* was absent in the study area and this requires further investigation. Within the context of this study, we found agro-ecological differences and seasonal variations to influence the distributions of the tick species which were encountered.



PLATFORM PRESENTATION: DEVELOPMENT OF A LANDSCAPE LEVEL ELEPHANT MANAGEMENT FRAMEWORK FOR THE GREAT LIMPOPO TRANSFRONTIER PARK AND CONSERVATION AREA

Mike Peel^{1}, Greg Martindale², Jeremy Anderson³, Nicia Giva⁴, Graeme Wolfaard⁵ and David Cumming⁶*

¹Agricultural Research Council API, ²Conservation Outcomes, ³International Conservation Services, ⁴Universidade Eduardo Mondlane, ⁵Sustineri Ecological Consulting (Pty) Ltd, ⁶University Of Cape Town

In 2002 the presidents of South Africa, Mozambique and Zimbabwe signed the Great Limpopo Transfrontier Park (GLTP) Treaty, which allowed for the formal proclamation of the GLTP. It also provided a platform for the establishment of the Great Limpopo Transfrontier Conservation Area (GLTFCA), which includes land around core protected areas and is defined as "the area adjacent to the Transfrontier Park, comprising compatible conservation areas but not lending itself to formal integration with the Transfrontier Park". The open system of the GLTP constitutes a landscape-level biodiversity conservation initiative that incorporates land in South Africa, Mozambique and Zimbabwe. It encompasses several forms of land tenure, including state, private and communally-owned land. The GLTFCA is developing a Joint Strategic Management Plan to guide its implementation over the next 10-year period, beginning in 2020, and a number of lower level strategies are being developed to form part of the plan in support of the implementation of key GLTFCA programmes and initiatives. The Elephant Management Framework forms one of the supporting strategies and is being developed concurrently with the Joint Strategic Management Plan. In this presentation, we address the role that elephants play as a key driver of landscape change and their economic, social and aesthetic value within the GLTFCA. This presentation addresses the threats that elephants face including the illegal wildlife trade, habitat destruction, human-wildlife conflict and unethical hunting practices. The Elephant Management Framework also presents the movement of elephant populations, especially in relation to the establishment of wildlife dispersal corridors between protected areas within the GLTFCA.



TUESDAY POSTER SESSION

Tuesday 27 July 2021, 12:30 - 13:30

Posters can be viewed on twitter [here](#)**STANDARD POSTER PRESENTATION: EVIDENCE OF SHRINKING COMMUNAL RANGELANDS IN THE FORMER TRANSKEI: CAUSES, IMPLICATIONS AND REMEDIAL ACTIONS***Siphe Zantsi*

University Of Stellenbosch

Rangelands are an important component of rearing livestock especially for extensive production systems, which is normally practised by smallholder farmers. This study investigates the extent to which communal rangelands have shrunk since the introduction of the 1913 Land Act and the Betterment Schemes, where black African communities (reserves, homelands) were only given a mere 13% of South Africa's land for both residential and agricultural purposes. In the 1950s, the Tomlinson Commission found that these areas were overstocked because of insufficient land. Today one could only imagine how little land is still available in these areas, especially rangelands. Simple Google maps from Ndabakazi village in the Eastern Cape are analyzed together with household production data collected from 20 households in Ndabakazi village in 2014. This data is supplemented with recent surveys collected in 2018 from KwaZulu Natal to strengthen the discussion. Boundaries of the village were traced by elders in the village. Results clearly show the area of land which use to be allocated for grazing animals, which now has residential plots (homesteads). The residential land area of the village grew by almost 50% taking up a significant share of the rangeland area. The consequences of this decline are prominent in livestock rearing. Key informants alluded that the number of animals in the village dropped significantly after the dismantling of camps and cutting of the rangeland area. Households that have larger herds survive by supplementary feeding during winter. To deal with this problem the government elsewhere has implemented the 1Household-1Hectare (1Ha-1HH) policy under the land redistribution element of land reform. This case study of a Kokstad communal area formed on a land reform farm is used for discussing a possible solution to this problem in the study area. Based on the evidence found from Google maps illustrations and data analyses, it is concluded that indeed, some rural villages are overpopulated. Land reform policy should cater for rural households who want land for residential and small-scale farming as stated in one category of the many categories of the State Land Lease and Disposal Policy. However, evidence of implementation of this policy is very scant. This evidence might spike interest in policymakers to implement the 1Ha-1HH policy in other rural communities.

STANDARD POSTER PRESENTATION: EVALUATION OF COMMUNAL RANGELAND CONDITION UNDER THE EAST GRIQUALAND VELD TYPE OF EASTERN CAPE PROVINCE, SOUTH AFRICA*Sive Tokozwayo*

Eastern Cape Department Of Rural Development And Agrarian Reform

Rangeland condition is defined as the state of health of rangeland in terms of species diversity and the potential for producing good quality forage for livestock. However, these rangelands are gradually declining due to poor resource management, land degradation and climate change which poses a serious threat to the natural resources and economic development of South Africa. The aim of the study was to assess communal rangeland conditions in terms of species composition, to determine woody density, browsing unit (BU/ha) and tree equivalents of woody plants at Santombe communal grazing lands. The study was conducted in four sites that were selected based on similar land use. In each site 100m x 50m were demarcated, three parallel transects of 3m x 100m were measured per site. Within each belt transect, line transect of 100m was measured to determine grasses composition using the step point method. Woody plants occurring within a belt transect were identified, counted and recorded to evaluate woody plant species composition, density, browsing unit and tree equivalents. Fifteen grass species were identified, 80% were increasers, 13% decreasers and 7% exotic species. Fourteen woody species were identified, 64% were acceptable and 36% were unacceptable to goats. *Rhamnus prinoides* and *Scutia myrtina* were the most dominant species. Site 2 (2508 plants/ha) and site 1(2112 plants/ha) had the highest plant density, while site 4 (2310 BU/ha) had the highest browsing unit compared to sites 1,2 and 3. The abundance of increaser species was a clear indication of rangeland deterioration. A high percentage of acceptable wood plants showed great potential for sustainable goat production. It was recommended that farmers should establish a rangeland farmer's association which will assist in formulating rules and regulations for better utilisation of their feeding resources.



STANDARD POSTER PRESENTATION: CLIMATE CHANGE AS A WICKED PROBLEM: FARMERS' PERCEPTIONS ON LIVESTOCK LOSSES AT EMALAHLENI LOCAL MUNICIPALITY IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

Siza Mthi^{1*}, Tanki Thubela¹, Mandla Yawa², Hlumisa Ngqokomashe¹, Qeqeshwa Mzola¹, Nonzaliseko Edith Mhlwa¹ and Nobahle Mjamba¹

¹Eastern Cape Department Of Agriculture, Rural Development And Agrarian Reform, ²University Of Fort Hare

Climate change is seen as a major threat to the survival of many species, ecosystems and the sustainability of livestock production systems in many parts of the world. Climate change is a wicked problem due to issues that are highly complex, have immeasurable and unclear causes and are difficult to understand and frame. The study was conducted to investigate farmer perceptions on the impact of climate change on livestock production at Emalahleni local municipality in the Eastern Cape Province. Three communities (Buffesdorings, Tsembeyi and Bankies) and 160 farmers being livestock owners were purposively sampled with the assistance of extension personnel. Data was obtained through observations and interviewed using a pre-tested structured questionnaire. The interviews were conducted using the vernacular Xhosa language. The questionnaire included questions related to demographics and farm characterises, land/farm size, livestock numbers and classes, the impact of climate change on livestock production. Of the sampled farmers (n=160), male to female ratio was 0.7 to 0.3. Farmers perceived that climate change had an impact on livestock production due to a decline in forage quality and quantity, an outbreak of diseases caused by poisonous plants, drying of dams and rivers and a decline in livestock market prices. Climate change had a significant effect ($p < 0.05$) on breeding females and offspring (calves/lambs) than castrate and bulls/rams. There was a significant difference ($p, 0.05$) between communities, huge losses of livestock were observed in Buffesdorings followed by Tsembeyi and Bankies with 52%, 30% and 18%, respectively. These findings are in agreement with other studies where it was found that high losses of livestock were due to poor quality and quantity of feed, heat stress and livestock disease. Reducing livestock numbers, scoping of dams, the establishment of pasture in old lands and the use of drought-tolerant plants as alternative feed resources will minimise the challenges faced by farmers.

STANDARD POSTER PRESENTATION: UTILISATION OF WOODY PLANTS BY THE CAPE PORCUPINE IN MESIC SAVANNAS MAY AMELIORATE THE EFFECTS OF BUSH ENCROACHMENT

Unathi Kraai^{1*}, Zivanai Tsvuura¹, Manqhai Kraai¹, Ntuthuko Mkhize² and Julius Tjelele²

¹University Of KwaZulu-Natal, ²Agricultural Research Council API

Herbivory plays a fundamental role in determining the structure of savannas. The impacts of small herbivores on trees in savannas remain poorly understood because most research attention focuses on large herbivores such as elephants whose destructive effects on trees can be pervasive at landscape scales. Cape porcupines are generalist herbivores foraging on herbaceous as well as woody plants but their feeding activities on woody plants can lead to tree mortality. The study was aimed at investigating the utilisation of woody plants by the Cape porcupine in three mesic savanna sites in South Africa. We quantified the woody plant diet of the porcupine for the dry and wet season at Roodeplaat Farm in Gauteng Province and at Goss Game Farm and Bisley Valley Nature Reserve in KwaZulu-Natal Province. Twenty quadrats of 30 m × 30 m were laid at Roodeplaat and Goss while ten quadrats of 10 m × 10 m were laid at Bisley. The sizes of quadrats varied because porcupines fed on mature trees at Roodeplaat and Goss but tree seedlings and saplings at Bisley. Within the quadrat, we measured stem diameter for all trees and in cases where there was bark damage the length and width of bark scars made by porcupines were measured. We collected ten dung samples from each study site in the wet and dry seasons for the quantification of woody material in the porcupine diet. Porcupine foraging behaviour affected different tree species at each site: *Vachellia robusta* at Roodeplaat, *Spirostachys africana* at Goss and *Vachellia nilotica* at Bisley. Each of these species was dominant at each site. More scarring and tree mortality were recorded at Bisley with 70% tree sapling mortality occurring on the *V. nilotica* plants due to porcupine feeding activities. The mortality of trees at Bisley was evident because porcupines fed on saplings while at the two other sites, they fed on the bark and roots of mature trees. The size of bark scars was greater at Goss ($p < 0.01$) than at Roodeplaat and Bisley, which were similar. Damage on the bark of *S. africana* trees differed significantly by stem diameter size class ($p = 0.007$) and was greater for the smaller (stem diameter of 1.6-7 cm) than the larger size classes (8-14; 15-21 cm). For all the study sites dung samples revealed that woody material contributed over 80% of the porcupine diet during the dry season, which declined to 35% during the wet season for Roodeplaat and was still high for Bisley at 79%. Porcupine foraging activities substantially contributed to tree mortality at each site. We posit that porcupine induced mortality on dominant tree species at each site may contribute to structural heterogeneity in woody plant vegetation in mesic savannas.

**STANDARD POSTER: A PAIRED TOWER APPROACH TO COMPARE CARBON DIOXIDE AND WATER VAPOUR FLUXES BETWEEN TWO VEGETATION TYPES REPRESENTING SAVANNA AND NAMA-KAROO BIOMES**

Amukelani Maluleke^{1}, Gregor Feig², Christian Brümmer³, Kerneels Jaars², Tamryn Hamilton⁴ and Guy Midgley¹*

¹Stellenbosch University, ²SAEON, ³Thünen Institute For Climate Smart Agriculture, ⁴North-West University

African semi-arid ecosystems are subject to multiple anthropogenic stresses, such as climate change and increasing concentrations of atmospheric carbon dioxide, which potentially alter the ecosystem and biogeochemical processes. Recent studies indicate that semi-arid systems appear to respond more strongly to these drivers than expected. This study uses paired Eddy Covariance flux towers to improve the quantitative understanding of carbon, water and energy exchange in two distinct vegetation types representing distinct biomes namely, Savanna and Nama-Karoo. The towers are located within ~4 kilometres of each other at the Benfontein Nature Reserve, Free State Province. This spatial heterogeneity in biome occurrence over a short distance allows the study, under closely matched variations in climatic conditions during the wet and dry seasons, to (i) compare the phase and magnitude differences of carbon fluxes (Net Ecosystem Exchange, Gross Primary Production, and Ecosystem Respiration) and water vapour fluxes over diurnal and seasonal scales, (ii) to elucidate key the biophysical drivers (i.e. rainfall, soil moisture, incoming radiation) of carbon and water fluxes using multivariate correlations, (iii) to assess the controls and patterns of ecosystem water use efficiency (eWUE), and (iv) to describe and compare the partitioning of energy fluxes (Sensible and Latent Heat) between the two vegetation types. We hypothesise that the Nama-Karoo will show lower carbon and water flux rates and higher eWUE due to lower leaf area index and greater prevalence of arid-adapted growth forms than the Savanna, over diurnal and seasonal scales. Fluxes from both vegetation types will be primarily driven by water inputs rather than temperature and incoming radiation, at least over a seasonal temporal scale. The partitioning of energy fluxes will differ between wet and dry seasons but likely to remain similar between the vegetation types, with less energy dissipated as latent heat during the dry season. Data has been collected for approximately 16-months at the sites, here we share preliminary analyses of the diurnal and seasonal patterns of carbon and water exchange and their controls from selected biophysical inputs. In addition, an initial assessment of energy fluxes and eWUE patterns for largely the wet season and to a minimum extent of the dry season is provided. The preliminary results set to provide a platform to answer some of the major questions about how vast expanses of semi-arid ecosystems in Africa are functioning as sinks, and whether they have any future potential to respond positively to rising carbon dioxide concentrations against a backdrop of projected rainfall and temperature changes.

STANDARD POSTER: SOIL MOISTURE RELATIONSHIP WITH LONG-TERM VARIABILITY OF RAINFALL, TEMPERATURE AND HUMIDITY IN THE KAROO

Kudakwashe Musengi, Joh Henschel and Helga Van Der Merwe*

SAEON

Soil moisture plays a crucial role in many ecosystem processes. Hence, accurate measurement of soil moisture is important. Soil moisture regulates plant available moisture, which affects individual plants and eventually the vegetation across a landscape. Climate change is predicted to increase the frequency and intensity of drought in many areas of the world. In this study, we applied the European Space Agency's Climate Change Initiative (ESA CCI) to assess the soil moisture dynamics at a site in the Karoo (Tierberg Long-term Ecological Research site, i.e., Tierberg-LTER) and its relationship with annual rainfall, temperature and humidity from 1999 to 2013. The ESA, through the CCI is currently providing many decades of global satellite observed, fully homogenised soil moisture data representative of the first few centimetres of soil (~0-5 cm). Unfortunately, the ESA CCI data is generally poor as some of the data is not available in many parts of South Africa before 1998 and from 2014 the data for Tierberg is not available. Meteorological data were obtained from weather stations at the study site. Monthly mean values of soil moisture, rainfall, temperature and humidity were computed if at least 15 days of data are available in a monthly period. Variability analysis of the data was done and the relationship between soil moisture and meteorological data was also assessed. Tierberg-LTER in the Karoo was found to have soil moisture ranging from 0.045 to 0.087 m³/m³, with an average of 0.071 m³/m³. As expected, there was a significant positive correlation ($r = 0.3054$, $p > 0.01$) between rainfall. Our results show how much soil moisture has decreased due to decreasing rainfall and increasing temperatures in recent years. Estimating soil moisture is important in understanding the effects of drought and the spatial patterns of soil moisture. Remotely sensed ESA CCI data had enabled us to conduct these analyses during the COVID-19 pandemic when in situ monitoring was constrained.



56th Annual Congress

27 - 29 July 2021



Grassland Society
of Southern Africa

SESSION 3 Combined session: fire ecology and climate change

SESSION CHAIR: DEBBIE JEWITT

TUESDAY 27 JULY 2021, 13:30 - 14:30

PLATFORM PRESENTATION: GROWTH RESPONSE OF A KAROO SHRUB TO IMPOSED WARMING UNDER FIELD CONDITIONS

Guy Midgley^{1*}, Amy Edwardes¹ and Nicola Stevens²

¹Stellenbosch University, ²University Of Oxford

Experimental studies globally have found variable effects of warming on plants, but relatively little is known about how warm, semi-arid ecosystems will respond to ongoing anthropogenic warming due to climate change in southern Africa. To determine warming impacts on the widespread karoo shrub *Eriocephalus ericoides*, 6x replicated pentagonal open-top chambers (OTC) with an internal area of 4.91 m² were set up in an experimental paddock historically managed at the recommended stocking rate at Grootfontein, Middelburg, in December 2016. Water-filled PVC pipes painted black were deployed at the base of the OTC as a thermal buffer to moderate extreme daytime temperature increase and passively raise night-time temperatures. Each OTC surrounded an individual shrub of *E. ericoides*, and 6 unchambered plots were chosen to represent controls, interspersed between the treatment chambers (i.e. treatment plots were not paired). The OTC system successfully raised temperatures during the day and night, with mean daytime increases of 0.89°C and night-time increases of 1.03°C during the treatment period. Shoot growth and shoot photosynthetic rates were measured monthly during a single growing season, on 3 replicate shoots per individual shrub. Shoot stem extension and stem thickness growth were measured using digital callipers and were converted to biomass values using an allometric relationship. An LI-6400XT portable photosynthesis system was used to measure photosynthetic rate (Reference CO₂ concentration was set at 400ppm, photosynthetic flux density at 1500m⁻²s⁻¹). Results showed that gravimetric soil water contents, measured monthly, were significantly lower in warmed plots ($F(1, 50) = 5.69, p < 0.05$). There was a significant positive effect of warming ($F(1, 50) = 14.251, p < 0.001$) and month ($F(4, 50) = 43.046, p < 0.001$) on shrub shoot biomass gain occurring during the growing season when soil moisture, gravimetrically determined, was greater than 3.5%. Above this soil moisture level, biomass gain was positively correlated with soil moisture content ($R = 0.47, p < 0.001$). Warming effects on shoot photosynthetic rates were not statistically significant. Post-hoc analysis revealed that a chamber effect may have enhanced the growth response of *E. ericoides* to warming to some degree. It, therefore, appears that *E. ericoides* growth is currently temperature limited at the Grootfontein site, and that future anthropogenic warming will increase its production here under current rainfall conditions at least. Shoot growth was sensitive to both ambient air temperature and soil moisture in this shrub species, with a surprisingly strong positive growth response to moderate warming of only around 1°C that was not negated by a reduction in soil moisture in the warmed treatments. Overall, we conclude that anthropogenic warming projected over the next few decades would tend to increase production in this shrub species, especially at its cooler range margins. Further work is required to expand these findings beyond this species and other sites.

**PLATFORM PRESENTATION: INVESTIGATING THE IMPACTS OF DIFFERENT PHYSIOLOGICAL DROUGHT RESPONSES IN PERENNIAL, SOUTH AFRICAN C₄ GRASSES***Londiwe Mokoena^{1*}, Sally Archibald¹, Caroline Lehmann² and Anabelle Cardoso³*¹University Of The Witwatersrand, ²Royal Botanic Garden Edinburgh, ³Yale University

Changes in temperature and rainfall that are linked to global climate change are predicted to cause an increase in the duration and severity of droughts. Global climate changes will possibly result in water becoming scarcer in some environments. Perennial grasses will face periods whereby water is limited in their lifespan, meaning that perennial grasses need to have some kind of drought strategies that aid them in dealing with droughts. The extent and severity of drought will affect the types of strategies used. C₄ grasses respond to periods of drought differently, some grasses will control water loss by closing stomata whilst others continue to photosynthesise and lose water. The aim of this study was to describe and quantify the range of drought strategies shown by some representative southern African C₄ grass species by describing and quantifying the different drought response strategies. We selected 13 perennial, tufted, C₄ grass species each replicated 25 times making a total of 325 individual pots. The grasses were placed under a drought using a pot experiment in a greenhouse for 6 months. Drought tolerance of grasses as the leaf water potential at which the stomatal conductance fell below an ecological threshold ($50\text{mmol/m}^2/\text{s}^{-1}$) for functioning was measured. The grasses showed variable responses to drought with water potentials at stomatal closure ranging from -1Mpa to -5Mpa. Different grass species had significantly different rates at which they closed their stomates (reached $50\text{mmol/m}^2/\text{s}^{-1}$) at different water potentials ($p=0.0002315$). Species such as *Panicum maximum* closed their stomates earlier in the drought as compared to *Aristida congesta* which kept its stomates open till the end of the drought. As expected, grass species regulate their stomata differently under water stress through ranges of eco-physiological regulations. Some plants can maintain stomatal conductance at lower soil water potentials than others, and when the atmospheric demand becomes greater than the supply of water from the soil they lower the water loss by closing their stomata. We conclude that the drought had an effect on the species and the strategies that grass species used varied between species, indicating that the grass species fall under different categories of drought strategies. There are variations on how grasses respond to drought stress and their specific thresholds of water loss that is representative of hydraulic failure.

PLATFORM PRESENTATION: FIGHTING WILDFIRE FIRE WITH PRESCRIBED FIRE: IDENTIFYING AND OVERCOMING SOCIAL BARRIERS*Urs Kreuter^{1*} and Carissa Wonkka²*¹Texas A&M University, ²Northern Plains Agricultural Research Lab

Elevated fuel loads together with hotter and drier climatic conditions are expected to produce more frequent catastrophic wildfires in the USA. This has led to calls for more widespread use of prescribed fire to reduce accumulated fuel loads resulting from long term fire suppression and increases in woody plant density. However, perceptions that prescribed fire can lead to substantial legal liability if fire escapes hinder its use by landowners. Therefore, the degree of liability incorporated in legal statutes pertaining to escaped fire can affect the use of this wildfire mitigation tool. In states with gross negligence standards for escaped fire, landowners were found to burn more frequently and more land than in states with simple negligence standards. By contrast, the enactment of burn bans by county officials can prevent the use of prescribed fire at times when invasive woody plants are most effectively controlled by fire. We present research findings about the perceptions of landowners, District Court Judges, and County Commissioners regarding the use of prescribed fire in the Southern Plains, USA. The likelihood that landowners would apply prescribed fire on their land was negatively correlated with their perception about the severity of legal liability of an escaped fire, and positively correlated with membership in a prescribed burning association. Judges indicated that about 1.5 times more of the undisputed facts would constitute evidence of a failure to exercise ordinary care (simple negligence) than would constitute evidence of failure to exercise even slight diligence (gross negligence). Therefore, landowners who apply prescribed fire are less likely to be found liable for an escaped fire under a gross negligence standard. However, most County Commissioners indicated that a change in the legal statute from simple to gross negligence would not affect the incidence of burn bans. Of those who indicated the opposite, about half thought it would lead to an increase in public pressure for more burn bans and, therefore, more burn bans would be enacted (more so in Texas), while the other half thought it would lead to less public pressure and fewer burn bans (mainly in Oklahoma). These differences indicated a stronger pro-fire culture in Oklahoma, which is correlated with greater clarity regarding legal liability in Oklahoma's simple negligence statutes. These findings highlight several foci for increasing the use of prescribed fire as a wildfire mitigation tool. These include reformulating legal statutes affecting the use of prescribed fire to clarify and reduce liability risks; better informing county officials about the wildfire mitigation benefits of using prescribed fire to reduce accumulated fuels; and the widespread establishment of prescribed burning associations to enhance the safe application of prescribed



Grassland Society of SA Congress 56

SPECIAL SESSION Exploring the impacts of climate variability and change on extensive livestock production systems in the Little Karoo and southern Nama Karoo

Western Cape Department
of Agriculture

SESSION CHAIR: STEPHANIE MIDGLEY

TUESDAY 27 JULY 2021, 14:45 - 16:45

This session will explore the recent climate trends, climate variability (including the current drought) and future climate projections for this region, impacts of these dynamics on agricultural production systems dependent on rangelands and pastures, and selected tools and projects that can offer practical solutions.

The overall aim is to explore the linkages between rangeland/pasture science and the science of arid zone livestock production systems, specifically in the Little Karoo and extending into adjacent parts of the Nama Karoo, in response to climate stress. The specific objectives are to:

1. Provide scientific background to climate stress in the region;
2. Explore the vegetation dynamics in response to climate stress;
3. Make the link to impacts on livestock production (sheep, ostrich);
4. Present two practical solutions to the challenge;
5. Formulate research needs.

PLATFORM PRESENTATION: OVERVIEW OF CLIMATE VARIABILITY AND CLIMATE CHANGE IN THE LITTLE KAROO AND SOUTHERN NAMA KAROO

Stephanie Midgley

Western Cape Department of Agriculture

Climate variability and climate change are key drivers of ecological, agricultural and social changes in the Karoo. The agricultural economy and livelihoods, based on livestock (sheep, goats, ostriches, and cattle), will be impacted by shifts in rainfall and temperature regimes. A better understanding of climate change in the Karoo is needed to inform on-farm management, adaptation, and sectoral planning. This paper provides an overview of current knowledge on past, present and future climate, as well as the current drought, in the south-eastern Succulent Karoo and the southern Nama Karoo. This informs a high-level assessment of likely risks and impacts on livestock farming. A literature review was conducted and supplemented with recently completed studies. Historical observations indicate statistically significant increases in temperature, with increases in the annual number of warm/hot nights/days and decreases in cold/cool nights/days. Several studies show statistically positive trends in annual rainfall totals, associated mostly with wetter summers. However, rainfall trends must be carefully interpreted owing to their cyclical behaviour, with periods of high rainfall alternating with periods of drought. Significant increasing trends in daily

rainfall extremes and rainfall intensity are evident. Projected climate futures show strong patterns of warming in most model projections, more so in the south-central interior (Nama Karoo) compared to the Little Karoo. By mid-century, the annual number of days $> 35^{\circ}\text{C}$ could increase by more than 30 in warmer regions, and days $< 6^{\circ}\text{C}$ could decrease by more than 30. Associated changes include a reduction in frost risk, increased heat units, and increased reference potential evaporation. Future projections of rainfall are highly complex and depend on the model, the scenario, and the time period. By mid-century, the majority of models show decreased rainfall, and this message strengthens towards the end of the century. In the first half of the century, and/or with a scenario of strong reductions of greenhouse gas emissions, some models show increasing rainfall in the region, with associated increases in runoff and streamflow. Analyses are emerging of the most recent drought (2015-2020, in some areas ongoing). This event must be interpreted in the context of historical drought patterns as well as the shifting climate. Rangelands and pastures are expected to respond to climate change in complex ways, driven by changes in rainfall amount, seasonality and variability; more very hot periods; reductions in frosts; and rising atmospheric CO_2 concentrations; in interaction with soil types; veld types and composition; the number and types of animals; the grazing intensity and seasonality; and land-use changes. Strong impacts will likely be event-driven. Temporary or permanent biome shifts are possible in the ecotonal areas of the Succulent Karoo, Nama Karoo and adjacent Grassland Biomes. A critical factor is likely to be the changing cover and biomass of annual and perennial grasses, with direct implications for livestock farming potential and drought resilience. The key parameters to monitor and study are changing grazing quantity and quality, drought dynamics, changing water resources, and animal resilience to excessive heat.

PLATFORM PRESENTATION: THE IMPACT OF THE DROUGHT ON THE VEGETATION OF THE NAMA KAROO AND SUCCULENT KAROO

Nelmarie Saayman^{1*}, Craig Morris² and Rudi Swart¹

¹Western Cape Department Of Agriculture , ²Agricultural Research Council API

The vegetation of the Nama Karoo (summer rainfall) and the biodiverse Succulent Karoo (winter rainfall) biomes in the arid western half of South Africa, has experienced prolonged drought since 2015, receiving 50% less than the average annual rainfall in some or most of the years. Our study aimed to assess the response and relative sensitivity of these two biomes to drought. The study was done in the Western Cape on 10 farms in the Succulent Karoo (Little Karoo area of the Rainshadow Valley Karoo Bioregion) and 14 farms in the Nama Karoo (Lower Karoo Bioregion = 8; Upper Karoo Bioregion = 6). Repeated plant surveys were done in the winter of 2016 and 2019 in the Succulent Karoo and late summer of 2017 and 2020/2021 in the Nama Karoo. Permanently marked 1000 m line transects were surveyed using the line-point method, identifying perennial species and ephemerals (as a group) at each point. In the absence of plants, the cover of plant litter, dung, rocks, or bare ground was recorded. Changes in the direction and magnitude of species composition change over time in each biome were assessed using partial CCA (for paired plots). Paired t-tests were used to assess change in growth forms, palatability classes, and cover components. Species composition changes significantly over time in both the Succulent Karoo ($p = 0.003$) and Nama Karoo ($p = 0.002$), with 15% species lost in the Succulent Karoo compared to the 3% species lost in the Nama Karoo. There was an increase in bare ground (12.6%; $p < 0.01$) and dead plants (4.64%, $p < 0.001$) in the drier Lower (Nama) Karoo and the Succulent Karoo, respectively, during the drought, while they showed no significant changes in the Upper (Nama) Karoo. In the Succulent Karoo, the cover of the dominant growth form, namely succulents (-4.95%; $p = 0.014$), and subshrubs (-5.43%; $p < 0.001$) declined. In the Nama Karoo, the cover of the dominant subshrubs decreased (-12.79%; $p < 0.001$), mainly because of a decline in *Pentzia incana* (-7.24%; $p < 0.01$) while grasses, particularly *Aristida adscensionis*, increased by 10.9% ($p > 0.05$). In the Nama Karoo, there was a shift from palatable to unpalatable species ($p < 0.05$) whereas highly palatable species declined in the Succulent Karoo ($p < 0.05$). The unpalatable subshrub *Chrysocoma ciliata* ($p < 0.05$) declined in abundance in both biomes during the drought. Both biomes showed changes in vegetation composition and it appears that succulents and certain subshrubs species are more sensitive to extended droughts and if the less valuable species are more adapted to survive droughts. Combined with lower plant cover the extended drought resulted in a decrease in the agricultural production potential of both biomes. The Succulent Karoo, where winter rainfall is predictable and prolonged droughts are very rare, was more negatively affected by a very severe drought. The vegetation of the Nama Karoo, where prolonged droughts are common, are more adapted to drought, especially the grasses such as *Aristida* species.

**PLATFORM PRESENTATION: FUTURE CLIMATIC INSTABILITY: ASSESSMENT OF ENVIRONMENTAL STRESSORS IN SHEEP***Schalk W P Cloete*, Cornelius Nel, Shannon Steyn and Tertius Brand*

Stellenbosch University

The climate of the Western Cape is expected to become more unstable, incorporating severe heat during the summer as well as more severe cold weather (cold snaps) during winter. Interventions assisting the farming community to cope with these events are thus needed. Animal-based records to guide breeding and management decisions for alleviating climate stress have not yet been quantified under local conditions. Research indicated that eye temperature from infrared imaging as well as respiration rate of mature ewes markedly increased from moderate temperatures in the morning to hot temperatures in the afternoon during early summer in the Swartland. Respiration rate in breaths/minute (bpm) of heat-adapted, indigenous Namaqua Afrikaner ewes increased by only 84% from morning recordings to those recorded during the hotter afternoons (58 vs. 32 bpm). Corresponding increases in bpm of commercial composite breeds with indigenous parentage, namely the Dorper (87 vs. 31 bpm) and Meatmaster (74 vs. 32 bpm) were more than twofold. Means for bpm for breeds from temperate regions increased by more than threefold; Merino (122 vs. 38 bpm), Dohne (94 vs. 31 bpm), SA Mutton Merino (112 vs. 34 bpm) and Dormer (121 vs. 32 bpm) ewes. Heat-adapted, indigenous genotypes should thus cope better with future increased summer temperatures than breeds from temperate regions. A temperature-humidity index (THI) elucidated the impact of tree shade relative to an unshaded control treatment on bpm of heat-susceptible neonatal Dormer and SA Mutton Merino lambs during autumn. Lamb bpm were unaffected by shade treatment at THI levels below 77, indicating that both groups of lambs could maintain homeothermy. The linear subsequent increase in bpm of lambs without shade was more than five-fold higher than in lambs with access to shade (26.8 vs. 5.2 bpm/unit THI). A simple intervention such as providing shade thus alleviated behavioural heat stress expressed as bpm in susceptible animals. Similarly, a cold-stress gradient (CSG) was assessed in Merino selection lines selected divergently for their ability to rear multiple lambs during winter lambing. Selection improved overall lamb survival in the line selected for an improved rearing performance (the High or H Line) relative to the line selected downwards (the Low or L Line) (respectively 86 vs. 74%). Survival to three days of H Line lambs was high and independent of the CSG for the ranges studied. In contrast, L Line lambs were more likely to succumb at increased CSG levels, indicating a greater susceptibility to cold stress. Selection for robustness in sheep may promote the ability of lambs to cope with more severe winter storms in future. In combination, all these results are encouraging, as it provides a foundation for future research on adapted breeding and management strategies for resilience to climatic instability.

PLATFORM PRESENTATION: EXTREME TEMPERATURES COMPROMISE MALE AND FEMALE FERTILITY IN FARMED OSTRICHES IN AN ARID REGION*Zanell Brand^{1*}, Mads F. Schou², Maud Bonato³, Anel Engelbrecht¹, Erik I. Svensson², Julian Melgar², Pfunzo T Muvhali¹, Schalk W P Cloete³ and Charlie K. Cornwallis²*¹Western Cape Department Of Agriculture, ²Lund University, ³Stellenbosch University

Although temperature has a crucial influence on defining where species can survive and reproduce, past research has primarily focused on survival. This has made it unclear whether temperature fluctuations constrain reproductive success, and if so, whether populations harbour the potential to respond to climatic shifts. We examine how temperature fluctuations over a 20-year period affect multiple fertility traits in the world's largest farmed bird, the ostrich (*Struthio camelus*). Data on the fertility of females and males were obtained by collecting eggs daily from captive pairs (n=1290 individuals), and by collecting natural ejaculates from captive solitary males. The data were then matched with onsite temperature records (ranging from -5 to 45 °C) to investigate: (1) how thermal fluctuations shape investment in gametic traits (number of eggs and sperm, egg mass and sperm viability) and reproductive success (hatching success and chick numbers), (2) individual variation in the resilience of fertility to temperature change, and (3) whether extreme temperatures cause trade-offs in investment across gametic traits. Ethical clearance was obtained from the Western Cape Department of Agriculture (project: AP/BR/O/SC14, Decra: R12/54). A reduction in reproductive success of up to 44% was observed with 5 °C deviations from the 20 °C thermal optimum of female ostriches. In contrast, measures of gamete quality (egg mass and sperm viability) were largely unaffected by temperature fluctuations. The effects of temperature were not immediate, but resulted from a critical thermal window 2–4 days before laying and ejaculation. Also, extreme temperatures did not expose trade-offs between gametic traits. Instead, some females appeared to invest more in reproducing at high temperatures, which may facilitate responses to climate change. These results show that the robustness of fertility to temperature fluctuations,



and not just temperature increases, is a critical aspect of species persistence in regions predicted to undergo the greatest change in climate volatility. In future reproductive strategies for ostriches may need to be revisited to ensure optimal production for a sustainable ostrich industry.

PLATFORM PRESENTATION: SATELLITE IMAGERY AND OPEN-ACCESS, ONLINE TOOLS TO SUPPORT MONITORING AND DECISION-MAKING IN VELD MANAGEMENT

Michael Wallace^{1}, FC Basson¹, Philip Desmet² and Zander Venter³*

¹Western Cape Department Of Agriculture, ²Nelson Mandela University, ³Norwegian Institute For Nature Research

Recent years have seen rapid developments in the online accessibility of free satellite imagery that can support research and decision-making in veld management and land-use planning and monitoring. This paper discusses two open-data approaches to facilitating simplified access to, and interaction with such data. The first is based on medium resolution data (10 m) with a relatively short historical archive, and the second, based on coarser data (30 m), suited to larger regional analysis, but with a much longer historical time-series, allowing longer-term assessment of veld condition and trajectories of change. Firstly, the Sentinel-2 Viewer App (<https://gis.elsenburg.com/apps/s2v/>) developed by the Western Cape Department of Agriculture (WCDoA) provides customised analytical tools and functionality to support field- or camp-scale veld monitoring and analysis, based mainly on the Sentinel-2 imagery provided by the European Space Agency, via the Sentinel Hub. The second approach, developed by researchers at the University of Cape Town and ZSV Consulting, utilizes the Landsat data archive to deliver insight on long-term (1984 to present) trend assessments in veld vegetation. Access is via an interactive Web application (<http://evitrend.zsv.co.za>) utilizing the Google Earth Engine API (Application Programming Interface) for data storage, processing and visualization based on linear trends in Landsat EVI (Enhanced Vegetation Index) for a user-defined period. Both approaches exploit cloud-based computation, removing much of the inherent complexity and "big data" management demands of conventional remote sensing workflows. Both implement statistical Feature Information Services (FIS) via their respective API's to perform statistical computations on the satellite data over specified time ranges upon specified wavebands of the respective satellite platforms, providing processed products such as the true colour imagery, NDVI (Normalised Difference Vegetation Index), EVI, as well as many other potentially useful vegetation indices. User requests facilitate display (mapping), provide values, or perform statistical analysis and comparisons either within, or between any images available since the commencement of the respective data time series. The ability to demarcate and interrogate user-defined zones, allows the user to analyse a specific area of interest, monitor it in near real-time, compare seasonal phenology, or look at long term trends, in the case of EVI-Trend-Inspector. User knowledge is required to discern and interpret the context-specific trends in both short and long-term assessments. These tools are the first generation of web-based applications that harness the enormity of freely available remote sensed imagery, putting this at the fingertips of researchers and land managers allowing them to assess and monitor landscapes and ecosystems in near real-time and at a spatial resolution appropriate to on the ground land use processes. These tools have the potential to radically shorten the information feedback loops between land use planning, decision-making and implementation, thereby improving the spatial focus of interventions such as land care programs, early detection of undesirable activities and, in the context of this special session, monitoring veld conditions to help support grazing and stocking recommendations and supporting drought relief management.

PLATFORM PRESENTATION: KOUP 4: THE GOLD STANDARD IN AREA WIDE PLANNING

Francis Steyn

Western Cape Department Of Agriculture

The LandCare model – to plan holistically and strategically, at an area-wide scale (as opposed to farm-scale), and together seek ways to protect natural resources and secure a viable farming business – has offered practical and vital solutions to a group of landowners farming in the arid central Karoo region, in the Western Cape of South Africa. These farmers sought to address threats around predation (with farmers losing more than half their lambs to predators every year), and the drought. The aim of area-wide planning is to enhance community-based conservation where the farmers take the lead and internalise the challenges and opportunities as a group instead of as individuals. The challenge is that many natural resource problems are far greater than one single farm and a holistic approach is required to solve the challenges and take the opportunities offered. The LandCare model caught the attention of a group of farmers in this region. And once this group realised the need to design, develop and implement the plan from the ground up, they officially launched the Koup Area Wide Planning Project. This project became known as a



"gold standard" for community-based natural resource management, and today serves as an example for any farming community around the world. In total 19 farmers formed this group and it comprised of 80 000ha of rangeland. As a group they planned projects, prioritized these projects, and together with their partners implemented these projects of which the following were examples: a) Fencing project of 238km to protect their stock and create employment; b) Rangeland assessment with the aim of improving the veld; c) International predator research projects to manage the resources; d) Biggest research camera trap in the world measuring the baseline against the Rooiberg conservation area; e) Scanning project to determine productivity of stock; and f) Economic research to identify areas of improvement in farming practices. Before the project started farmers were losing up to 60% of their stock due to predators and other factors. After project completion, the farmers have reported as little as 10% stock loss due to the improved management of stock and predators. In the arid central Karoo area of South Africa, a group of farmers have captured the essence of LandCare. Facing a set of extreme challenges – including drought and predation, these farmers set out to understand, repair and then enhance their agricultural and natural landscapes. This project has spread to 5 other areas in the Central Karoo and farmers are taking the lead in managing their challenges, including the threats of climate change. One of these areas is moving towards the formation of a Special Management Area status thereby protecting natural resources at the highest level.

PLATFORM PRESENTATION: DETERMINING THE IMPACTS OF CLIMATE VARIABILITY ON VEGETATION AND ANIMAL PRODUCTION IN THE WESTERN UPPER KAROO SHRUBLANDS

Christiaan Harmse and Hannes Gerber*

Northern Cape Department Of Agriculture, Environmental Affairs, Land Reform And Rural Development

The Western Upper Karoo cover approximately 17 150 km² land area with variable rainfall where the annual rainfall ranges from 220 mm in the east down to 120 mm in the west. Land use in this region is dominated by small stock production. Various studies have shown rainfall to be the key determining factor of forage production. Shifts in rainfall patterns and trends are important drivers of livestock production potential and therefore historical, long-term rainfall- (1933–2020) and temperature data (1966-2020) for Carnarvon were analysed. The climate data was compared to long-term vegetation and animal production data collected at the research station since 1988. Trends in seasonal and annual rainfall, as well as, maximum and minimum temperatures were calculated. The data were analysed in order to determine possible climatic shifts. Both rainfall and temperature were found to increase ($P < 0.05$) over the measured periods with a decrease in the average frost days. Historically, frost days were present from April to October, but the data indicated that more recently frost days only occur between May and September. Results emanating from this study support the school of thought that rising temperatures may be the driver for increased rainfall in the western Upper Karoo regions of the Northern Cape Province. During below average rainfall seasons with higher temperatures, vegetation and sheep performance was significantly impacted upon with lower animal performance and vegetation vigour. From this data, it is apparent that climatic variability including severe droughts is an intrinsic part of the Upper Karoo. It is therefore important for land users and -managers to take this into account in order to mitigate its effects. Also, to guide on management options such as adapted breeds, flexible stocking densities and sustainable grazing management systems.



56th Annual Congress

27 - 29 July 2021



Grassland Society
of Southern Africa

SESSION 5 Planted pastures

SESSION CHAIR: PIETER SWANEPOEL

WEDNESDAY, 28 JULY 2021, 08:00 - 10:00

KEYNOTE ADDRESS: FIT FOR PURPOSE AGRICULTURAL SYSTEMS

Jacqueline Rowarth^{1*}, Ants Roberts², Warren King³ and Mike Manning²

¹Lincoln University, New Zealand, ²Ravensdown, ³AgResearch

Regenerative agriculture (RA) is being embraced by some businesses globally to signal sustainable food production while mitigating the effects of climate change. In some areas, in some production systems, the principles embraced by RA can bring benefits, in others they might not. Context is vital and the starting point of whatever is being considered must be known. New Zealand agricultural scientists have examined the goals of RA, and while applauding the focus (building soil carbon while reducing chemical inputs) are concerned about recommendations for long rotation/lax grazing of hyper-diverse (say, >20 species) pastures. Considerable research on pasture management suggests that grazing at the three-leaf stage of a perennial ryegrass plant and grazing down to around 1500kg DM/ha maintains peak pasture quality while optimising regrowth potential. Quality is vital for animal performance and conversion of pasture to milk and meat with the least impact on the environment through nitrogen (N) loss and greenhouse gas (GHG) production. Maintaining pasture quality becomes increasingly difficult as the number of species in the sward increases. The current recommendation is to sow 3-4 species: a grass, a legume and a forb, species depending on geographical location and production system. On dairy farms, ryegrass and white clover are common with chicory (*Cichorium intybus*) because of its rooting capacity and quality in autumn. Plantain (*Plantago lanceolata*) might also be included because of N loss reduction potential. Although part of the concept with lax or long-rotation grazing is trampling material into the ground to build up soil carbon, New Zealand soil typically has considerable quantities of organic matter already, reflecting their relatively young origins as well as nutrient inputs to realise the potential of photosynthesis. Research on the interaction between grazing management and soil carbon began in the 1930s, and New Zealand pastures now have an average of approximately 90 tonnes of soil carbon per hectare to 30cm, three times as much as Australia and twice as much as the U.S. For some farmers, the concept of regenerative agriculture and doing better for the environment and animals have been attractive. The RA coaches are persuasive, and the farmers have enjoyed feeling part of a social movement. In this, RA has similarities to the organic movement but is without the premium prices that are enabled by quality assurance, audit and certification. The economics around RA are not positive and advocates are often associated with off-farm incomes. RA has the appearance of a business marketing ploy that has yet to reap benefits. Scientists and farmers working together have developed and will continue to refine, fit for purpose farming systems that produce high-quality protein with minimal environmental impact. Constant improvement is another RA tenet – and is also the founding principle of New Zealand farming.

PLATFORM PRESENTATION: A REVIEW: THE VALUE OF GRAZING MAIZE FOR SHEEP AS OVERWINTERING ALTERNATIVE IN THE SUMMER RAINFALL AREAS OF SOUTH AFRICA

Erika Van Zyl^{1*}, Chris Dannhauser², Peter Oosthuizen¹ and Phumzile Msunthsa¹

¹KZN Department Of Agriculture, Environmental Affairs And Rural Development , ²Rangeland & Pasture Consultant, Independent

Sheep farming in summer rainfall areas of South Africa is largely dependent on the veld as feed source. In the higher rainfall eastern areas, veld forms part of the broader sourveld areas in South Africa, characterized by its well documented poor winter quality, implying that sourveld cannot maintain small stock production for a full year. In a search for financially viable wintering feeding systems to combat this feed quality shortfall, the system of grazing maize, where unharvested, matured maize is used for grazing by sheep, was developed over years by several researchers. However, most of these results were published only in the popular media, however fragmented. The aim of this presentation is to review and summarize the available scientific research done on grazing maize for publication purposes. Several sheep management practices were found to be essential for the successful use of grazing maize as winterfeed for sheep. To combat mortality due to acidosis, the gradual adaptation of sheep to whole maize grain before grazing commences, as well as a buffer-containing lick provided to sheep throughout the grazing period, is essential. Grazing maize cannot supply all the protein requirements of lactating ewes or weaned lambs. The protein shortfall must be supplemented, either via lick or through a protein-rich companion crop, which is grazed together with the maize. Grazing capacity, strongly related to maize grain yields, was calculated as 1000 Small stock unit (SSU) grazing days ha⁻¹ per one ton maize grain available ha⁻¹. Pre-wean average daily gains for Merino-type lambs ranged between 180–250 g day⁻¹ lamb⁻¹, for lactating ewes between 50-100 g day⁻¹ ewe⁻¹ and for weaned lambs between 160-200 g day⁻¹ weaner⁻¹. The economic viability of this system depends on the ratio of mutton prices to maize prices, sheep performance and cultivation costs of maize. The work of several researchers concluded that grazing maize as winter-feed for lactating ewes or the finishing of lambs, is a viable alternative, but only if management requirements are fulfilled. The now adopted grazing maize wintering system, has proven to be a successful overwintering solution for sheep farmers, however, it still falls in the much-debated arena of food/feed competition between humans and animals.

PLATFORM PRESENTATION: THE EFFECT OF PARTIAL REPLACEMENT OF PERENNIAL RYEGRASS (*LOLIUM PERENNE*) WITH PLANTAIN (*PLANTAGO LANCEOLATA*) PASTURE AND CONCENTRATE LEVEL ON MILK PRODUCTION AND MILK COMPOSITION OF JERSEY COWS IN SPRING

Robin Meeske^{1,2*}, Bertus Myburgh¹ and Pieter Cronje¹

¹Western Cape Department Of Agriculture, ²Stellenbosch University

Kikuyu/ryegrass pasture under irrigation is commonly used as forage for dairy cows in the Southern Cape. Recently a forage herb, plantain (*Plantago lanceolata*) has become more popular and is planted in pure stands or as part of a pasture mix. The aim of the study was to determine the effect of partial replacement of ryegrass with plantain during spring on milk production and milk composition of Jersey cows fed a low or a high level of concentrate. The study was conducted during spring (October, November) 2020 at the Outeniqua Research Farm near George. Nine hectare kikuyu/ryegrass pasture under irrigation was over-sown in May 2020 with perennial ryegrass (*Lolium perenne*) cv. Base planted at 20kg/ha. Plantain (*Plantago lanceolata*) cv Agritonic was planted at 9kg/ha on five hectare under irrigation during April 2019 and another 3 ha was planted in March 2020. Fertilizer was applied at 42kg N after each grazing (150kg/ha limestone ammonium nitrate (LAN) containing 28% nitrogen). The pasture was irrigated using DFM soil moisture probes The grazing cycle was 21 to 25 days depending on the growth rate of the pasture. Ryegrass was grazed at the 3 leaf stage and plantain at a height of 20 cm. Sixty Jersey cows of the Outeniqua Research Farm were blocked according to milk production, days in milk and lactation number. Cows within blocks were randomly allocated to one of four treatments (n=15): Grazing ryegrass day and night supplemented with 3.5 or 7 kg dairy concentrate per day (RGRG 3.5, RGRG 7); Grazing ryegrass at night and plantain during the day supplemented with 3.5 or 7 kg dairy concentrate per day (RGPL 3.5, RGPL 7). The study consisted of an adaptation period of 14 days and a measurement period of 44 days. Milk production of cows grazing ryegrass or ryegrass and plantain was similar ($p = 0.19$) at 18.8 and 19.4 kg milk per day respectively. Four per cent fat corrected milk did not differ ($p = 0.69$) and was 21.4 and 21.7 kg per cow per day for RGRG and RGPL pasture treatments. Milk production and 4 % fat corrected milk (FCM) increased significantly due to higher concentrate feeding and was 18.4 and 19.8 kg milk/cow/day ($p = 0.001$) and 20.8 and 22.2 kg FCM/cow/day ($p = 0.01$) for cows

fed 3.5 or 7 kg/day. The response on concentrate feeding was low at only 0.40 kg milk per kg concentrate fed as concentrate feeding increased from 3.5 to 7 kg/cow/day. Milk composition was not significantly ($p > 0.05$) affected by pasture or concentrate treatments. It is concluded that partial replacement of ryegrass with plantain during spring did not increase milk production. Feeding lower levels of concentrate to cows grazing high-quality pasture is recommended as the response on concentrate feeding was poor at higher concentrate levels.

PLATFORM PRESENTATION: EVALUATION OF *BRACHIARIA* GRASS ACCESSIONS FOR ADAPTABILITY AND AGRONOMIC PERFORMANCE UNDER RAINFED CONDITIONS IN THE NORTHERN REGION OF GAUTENG PROVINCE, SOUTH AFRICA

Stephen Modiba^{1*}, Julius Tjelele¹, Jones Ng'ambi² and Francuois Müller¹

¹Agricultural Research Council API, ²University Of Limpopo

Livestock production contributes significantly to the socio-economic status of smallholder farmers in South Africa. However, feed shortage, especially during the dry season negatively affects livestock productivity, which subsequently leads to poor welfare status of the farmers. To address the problem of feed shortage, there is a need to evaluate high-yielding climate-smart grass species. Grass species from the genus *Brachiaria* have been identified as climate-smart tropical grasses that are high yielding in a variety of agro-ecological zones in east-African countries. Such information is limited under the climatic conditions that prevail in South Africa. The aim of this study was to determine the adaptability and agronomic performance of several *Brachiaria* accessions for their potential as alternative forage resources for livestock. The study was conducted at the Agricultural Research Council - Roodeplaat experimental farm - located in the northern region of Gauteng province, South Africa. A total of 11 grass accessions composed of two locally adapted species as controls and nine *Brachiaria* accessions were used. The *Brachiaria* accessions were composed of six breeding lines, and four commercial cultivars that were obtained from the International Centre for Tropical Agriculture genebank in Colombia, and the International Livestock Research Institute genebank in Kenya, respectively. Germinated seedlings were transplanted to individual field plots (2.0 m x 4.0 m). The accessions were arranged in randomized complete block design, three replicates per accession, and a spacing of 0.3 m within a row and 0.5 m between rows. Agronomic performance and biomass yield of the plants were measured at 50% flowering. Sub-samples of fresh biomass were weighed and oven-dried at 60 °C for 72 hours to determine dry matter (DM) yield. Results show that all grass accessions recovered after exposure to winter frost. All commercial *Brachiaria* accessions had high DM yield, with *Brachiaria decumbens* cv. Basilisk producing the highest ($p < 0.05$) DM yield at 12.16 ± 3.84 ton/ha/year. The highest DM yield for a breeding line *Brachiaria brizantha* CIAT 16320 was 8.6 ± 2.11 tons/ha/season, which was lower ($p < 0.05$) than the DM yield of 10.05 ± 3.26 ton/ha/season for *Panicum maximum*. *Brachiaria* accessions have shown signs of adapting by recovering satisfactorily after been exposed to the lowest winter temperatures of 1 - 5 °C at night. The high DM yield produced by *Brachiaria decumbens* cv. Basilisk can be attributed to the accession's regrowth rate, spread, and tiller number. In conclusion, *Brachiaria* grass accessions have the potential to provide adequate forage for small ruminants in South Africa. However, evaluation for two more growing seasons is needed to obtain conclusive results.

PLATFORM PRESENTATION: TEMPORAL CHANGES IN HERBAGE YIELD AND BOTANICAL COMPOSITION IN FORAGE HERB/GRASS BINARY MIXTURES

Sigrun Ammann*, Dalena Lombard, Lethukuthula Zulu and Janke Van Der Colf

Western Cape Department Of Agriculture

A trial to investigate the temporal changes in yield and botanical composition in binary forage herb and grass mixtures was established at the Outeniqua Research Farm on 5 October 2016 and completed end of February 2021. The forage herb species consisted of *Cichorium intybus* cv. Choice (Ci) and *Plantago lanceolata* cv. Tonic (Pl). The three grass species were *Dactylis glomerata* cv. Adremo (Dg), *Festuca arundinacea* cv. Baroptima (Fa) and *Lolium perenne* cv. Arrow (Lp). Annual yield for the Ci/Dg mix varied over the four years with the highest yield (21.1 ± 0.9 tDM ha⁻¹) in the first year, with a similar yield in Year 2 and 4 (16.4 ± 0.1 tDM ha⁻¹ and 16.0 ± 0.1 tDM ha⁻¹ respectively and intermediate in year 3 (18.7 ± 0.3 tDM ha⁻¹). Seasonal yield peaked in spring/summer each year with autumn variable ranging from 5.2 ± 0.3 to 2.4 ± 0.1 t DM ha⁻¹. The botanical composition for Ci/Dg was Ci-dominant in year 1 (85:15). After 2 ¼ years it reached the inflection point of 50:50 in the third autumn, after which Dg became dominant reaching a 70:30 % composition at the end of year 4 and sward density remaining at 100%. For the Ci/Fa mix the annual yield significantly declined after year 1 (20.0 ± 0.8 t DM ha⁻¹), with years 2 to 4 declining from 16.2 ± 0.8 to 13.4 ± 1.6 t DM ha⁻¹. The seasonal yield pattern of Ci/Fa was similar to Ci/Dg peaking in spring/summer.



Initially, Ci dominated with 95:5 and the 50:50 inflection point was reached after the third winter (2½ years) where after Fa dominated at the end of year 4 with 70:30, and remained at 100% sward density. The annual yield for Ci/Lp declined over years from 20.3±0.5 to 7.3±3.7 t DM ha⁻¹ and sward density declined to 50% with both Ci and Lp plants decreasing in number. Again in the first year Ci dominated (90:10) with Lp reaching a maximum in the third year (45:65). The annual yield for the PI mixes were all highest in year 1 and higher than the Ci mixes with PI/Dg 26.2±0.8, PI/Fa 25.6±1.3 and PI/Lp 24.5±0.3 t DM ha⁻¹. For all three PI mixes the annual yield showed a linear decline ($R^2 = 0.96, 0.95$ and 0.98 for PI/Dg, PI/Fa and PI/Lp respectively). The dominant component for the first two years was PI in all three mixes 90:10, 97:3 and 92:8 in year 1 for PI/Dg, PI/Fa and PI/Lp respectively and similar for year 2 (87:13, 91:9 and 85:15). Both PI/Dg and PI/Fa moved towards a 55:45 composition towards the end of the fourth year while the Lp increased to 23% maximum in year 3 and declined thereafter while PI increased to 87%. Sward density of all PI mixes remained at 100% with PI plants in the PI/Lp treatment increasing in size as Lp plant numbers decreased. In general, the Ch/Dg and Ch/Fa mixes changed from herb dominant to grass dominant whereas the PI/Dg and PI/Fa mixes changed from herb dominant towards a 50:50 mix.



WEDNESDAY RESEARCH PROPOSAL POSTER SESSION

Wednesday, 28 July 2021, 10:00 - 10:15

Posters can be viewed on twitter [here](#)**RESEARCH PROPOSAL POSTER: POTENTIAL USE OF WHITE CLOVER (*TRIFOLIUM REPENS*) AS A GREEN MANURE IN OVER-CULTIVATED AND NUTRIENT POOR AGRICULTURAL SOILS IN EASTERN CAPE, SOUTH AFRICA***Unathi Gulwa^{1*}, Andrew Magadla² and Alexander Valentine³*¹Eastern Cape Department Of Rural Development And Agrarian Reform, ²Agricultural Research Council, ³Stellenbosch University

Legume plants in association with rhizobia are able to fix atmospheric N in nutrient-poor soils, resulting in reduced synthetic N fertilizers use. In nutrient-limited soils, legumes are able to switch N source preference, minimizing atmospheric N fixation favouring soil N uptake via roots, this may be related to the carbon economy and energy availability. To date, carbon costs of these symbiotic interactions (rhizobia, arbuscular mycorrhizal (AM), moreover, the switch of N sources preference to reserve energy) have not been explored in *Trifolium repens* growing in Eastern Cape over-cultivated agricultural nutrient-poor soils. Therefore, it is pertinent to evaluate how nutrient acquisition rates in *T. repens* are affected by the symbiosis, with these symbionts during soil nutrient deficiencies and how the plant growth and productivity are influenced. The study is aimed at testing the potential use of white clover (*Trifolium repens*) as green manure in old cultivated nutrient-poor agricultural soils in Eastern Cape, South Africa. Soils used in the pot experiment will be collected from various nutrient-poor soils of the old arable lands from various agro-ecological areas of the Eastern Cape Province. Seeds of *Trifolium repens* (white clover) will be germinated and grown in these soils in a pot experiment in a glasshouse at the University of KwaZulu-Natal. Growth experiments will be conducted under ambient conditions in the glasshouse using 20cm diameter pots. Mycorrhizal fungi and rhizobial bacteria will be extracted and identified from these soils. In addition, the quantification of the phytohormones and phytochemicals and protein regulation in *T. repens* will be done. The effects of the different factors will be tested using analysis of variance (ANOVA) Kaleidagraph synergy software. In cases where ANOVA depicts significant differences, means will be separated using post – hoc Turkey's LSD (SuperAvona for Macintosh, Abacus Concepts, USA) ($P < 0.05$). The quantification of the phytohormones and phytochemicals and protein regulation in *T. repens* will provide a better understanding and physiological insights as influenced by AM fungi in nutrient-poor soils. These will collectively give insight on the potential use of *T. repens* as green manure in over-cultivated nutrient-poor Eastern Cape soils.

RESEARCH PROPOSAL POSTER: LEGACY EFFECTS OF MULTI-SPECIES GRASSLAND MIXTURES IN A CROP ROTATION SYSTEM*Reon Marx* and Pieter Swanepoel*

Stellenbosch University

Crop rotation is an important management practice among conservation agriculture farmers as it is a key factor in maintaining sustainable production and profitability. The benefits of incorporating diversity in cropping systems may include reduction of nitrogen fertiliser requirements, disruption of pest and disease cycles, enhanced weed control, improved soil health, increased carbon sequestration, increased yields, reduced risk, and higher profits. Apart from the direct benefits of grassland leys through the integration of livestock in cropping systems, grassland leys may have beneficial legacy effects on subsequent crop production phases. The objectives of this study are to determine i) the quantity and quality of herbage yield of grassland leys ii) the resource use efficiency and ecosystem services from grassland leys, and iii) the legacy effects of grassland leys in crop rotation systems. Although the focus of this contribution will be on an experiment on Welgevallen Experimental Farm of Stellenbosch University, 41 similar experiments will be established across the globe (see LegacyNet: (<https://legacynet.scss.tcd.ie/>)). Grasses (*Lolium multiflorum* x *L. boucheanum*; *Festuca arundinacea*), legumes (*Medicago sativa*; *Trifolium pratense*) and herbs (*Cichorium intybus*; *Plantago lanceolata*) will be planted as monocultures and various permutations of species in mixtures. The chosen species are based on complementary traits in the context of optimised forage production, forage quality and legacy effects. The first phase of the experiment is the grassland ley phase, during which no weeding will be conducted. These mixtures will be evaluated for their herbage productivity, botanical composition, forage quality and wider ecosystem service delivery potential. The second phase will commence when grassland leys are terminated with a herbicide. Wheat (*Triticum aestivum*) will be established. The focus of the second phase



will be on the effects of grassland mixtures on wheat and how the treatments reflect the legacy effect of the grassland composition therefore no fertiliser will be added in the establishment to avoid dilution of the ley effects. The experiment will demonstrate the benefits of multi-species mixtures for yield, weed suppression, nitrogen use efficiency and forage quality. The experiment will furthermore assist in designing multispecies pastures consisting of species with complementary outcomes and legacy effects.

RESEARCH PROPOSAL POSTER: SEED GERMINATION OF *BRACHIARIA* GRASS SPECIES UNDER DIFFERENT TEMPERATURE AND OSMOTIC STRESS CONDITIONS

Jabulile Leroko^{1}, Ethan Britz¹, Lilburne Cyster¹, Clement Cupido² and Francuois Müller²*

¹University Of The Western Cape, ²Agricultural Research Council API

Climate change has motivated the world to look for climate-smart forages that are adapted to extreme bioclimatic conditions and at the same time reduce greenhouse gas emissions from livestock production systems. *Brachiaria* grass, with most species native to Africa, has been identified as such a species, due to its successes as a pasture crop in other countries. To date, however, there has been no research published on the adaptation of *Brachiaria* grasses as pastures in South Africa. More specifically, no results are currently available on the seed germination ecology of *Brachiaria* grass species under drought conditions. This project, therefore, aims to determine how the seed germination ecology of different *Brachiaria* species will respond to different levels of, and combinations of, temperature and osmotic stress conditions. To achieve these aims, seeds of each *Brachiaria* species and cultivars within each species will be germinated at constant temperatures of 5 °C to 40 °C at increments of 5 °C, under continuous dark conditions. At each of these temperature treatments, five osmotic treatments (0 -MPa, - 0.1 -MPa, - 0.3 -MPa, - 0.5 -MPa, and - 0.7 -MPa) will be prepared using PEG6000. Seed germination will be recorded daily and at the end of the trial, the total number of germinated, imbibed, dormant and dead seeds will be quantified. With this project, we expect to identify the best-adapted genotypes that are adapted to germinate under drought conditions.

RESEARCH PROPOSAL POSTER: THE EFFECT OF APPLYING DIFFERENT NITROGEN FERTILIZER TYPES AND LEVELS FOR GROWTH ON GRASS-LEGUME MIXTURES

Amahle Sogoni^{1}, Unathi Gulwa¹, Bethwell Moyo² and Sive Tokozwayo¹*

¹Eastern Cape Department Of Rural Development And Agrarian Reform, ²Fort Cox Agriculture College

Nitrogen (N) is an essential macronutrient required for plant growth and is a major part of proteins and its presence is necessary for optimal plant growth. This study involves intercropping forage legumes (namely: *Lotus corniculatus* and *Trifolium vesiculosum*) and grasses (namely: *Eragrostis teff* and *Panicum maximum*) and applying different rates of fertiliser and types and assess their effect on pasture productivity. The experiment will be a pot experiment conducted at a nursery in Fort Cox College of Agriculture and Forestry. This study is aimed at determining the appropriate N fertilizer application type and rate for optimum pasture productivity on poor soils collected from Krwakrwa communal area in the Eastern Cape. Nitrogen in the form of urea and bio-slurry will be applied at different rates will be applied in grass-legume intercrops that are grown under rainfed conditions. The pots will be arranged in a randomised complete block design (RCBD) replicated four times. Prior to planting, legume seeds will be mixed with the appropriate inoculant by hand. Seasonal herbage production will be cut 5cm above the soil. All collected data will be analysed using two-way analysis of variance (ANOVA) of the Generalised linear model procedure of SAS (2010) statistical program where N fertiliser rate and type will be independent factors while forage quality and quantity parameters will dependent variables.

RESEARCH PROPOSAL POSTER: THE IDENTIFICATION OF THE MOST SUITABLE *BRACHIARIA* GENOTYPES FOR IMPROVED LIVESTOCK PRODUCTION IN WATER-LIMITED AGRO-ECOLOGICAL AREAS OF SOUTH AFRICA

Francuois Müller, Julius Tjelele, Ntuthuko Mkhize, Stephen Modiba, Marsia Grobler, Mokhele Moelets, Marike Trytsman, Letty Masemola, Isaac Kgonothi, Patrick Rakau and Lesedi Sere*

Agricultural Research Council API

Within South Africa, there is a lack of pasture species that are adapted to the water-limited agro-ecological areas of the country. *Brachiaria* grass, native to Africa, has recently been identified as highly productive forages, and has gained importance for its climate-smart qualities. Various *Brachiaria* grass hybrids are reputed to have a significantly

lower water footprint, high yield, and high protein content even under water-stress conditions. Apart from this, it has been proposed that these forages have the potential to reduce greenhouse gas emissions from livestock whose basal diets have been supplemented with the *Brachiaria* grass. Unfortunately, these evaluations have not been done in South Africa. Because large portions of available rangeland for livestock production in South Africa are located within year-round, or seasonal water-limited areas, it is important to identify specific *Brachiaria* genetic resources that can withstand these marginal agro-ecological conditions. To do this, this project aims to select the best performing, drought tolerant *Brachiaria* genetic resources for improved livestock production in South Africa. To achieve this, the following specific objectives will be pursued. 1. Collection of *Brachiaria* plant genetic resources from various seed distributors and genebanks, multiplying the seeds from genebanks, and subsequently including those into the ARC forage genebank collection. 2. Characterizing the *Brachiaria* genetic resources for agronomic traits (production, persistence, ensilability and quality) and selecting the best performing genetic resources for further evaluation. 3. Morphologically and physiologically screening selected *Brachiaria* plant genetic resources for their adaptation to drought/water-limited agro-ecological conditions and selecting only the most suitable genetic resources for further evaluation and characterization. The drought screening will look at: (a) the germination ecology of different *Brachiaria* genotypes under different temperatures and water-limited conditions; (b) seedling establishment abilities under different soil moisture conditions; (c) drought tolerance and the potential to recover under variable moisture conditions. 4. Characterizing the impacts of the selected drought tolerant *Brachiaria* genotypes on livestock performance (feed intake, average daily gain, feed conversion ratio, body condition score) and enteric methane production, measured with a laser methane detector. At the end of this study, we hope to identify the best performing *Brachiaria* genetic resources that can be implemented under water-limited agro-ecological conditions to improve livestock production (sheep, goat and cattle) within these water-limited areas, and at the same time, reduce greenhouse gas emissions from these livestock production systems.

RESEARCH PROPOSAL POSTER: THE INCORPORATION OF LIVESTOCK INTO CASH-CROPPING SYSTEMS IN THE WESTERN CAPE TO DECREASE ITS POTENTIAL IMPACT ON CLIMATE CHANGE

Lisa Matthews^{1*}, Pieter Swanepoel¹, Johann Strauss², Thorsten Reinsch³ and Friedhelm Taube³

¹Stellenbosch University, ²Western Cape Department Of Agriculture, ³Christian Albrechts University

Discourse on climate change and the emissions of greenhouse gases (GHG) is becoming increasingly topical. There is a worldwide push to decrease emissions and responsibility is being placed on emitters to make critical reductions. The agricultural sector is a major GHG emitter and thus a key player in this global effort. According to the Intergovernmental Panel on Climate Change (IPCC), the best place to make reductions is through better cropland and grazing management practices. In the Western Cape Province of South Africa, there is a need to develop context-specific practices. Identification of such practices requires an in-depth look at the entire system's lifecycle, its inputs and outputs, and quantification of direct and indirect GHG (carbon dioxide, methane, and nitrous oxide) emissions. Livestock are associated with large carbon footprints due to enteric GHG production. However, when livestock are considered within the context of the entire production system a different picture can emerge. In the Western Cape Province, where sheep are integrated in cropping systems through annual medics (*Medicago polymorpha* and *Medicago truncatula*), the system nitrogen fertiliser savings could offset the carbon cost of the livestock as annual medics fix nitrogen. Nitrogen fertiliser is the biggest contributor of emissions in cropping systems as its production and transport is energy intensive, and fertilisation is associated with spikes of nitrous oxide emissions. There is also a reduced fuel usage as annual medic pastures are self-regenerating. Planting and harvesting machine passes are therefore not required. Finally, a pasture phase between cropping phases in rotation systems reduces chemical inputs of herbicides and pesticides by disrupting pest and disease cycles. The aim of this project is to evaluate the effects of crop rotation systems with and without livestock integration on the carbon footprint of the entire production system. The experimental site will be situated in the Swartland on a long-term crop rotation trial that begun in 1996. Three rotation systems will be evaluated: Wheat-Wheat-Wheat-Canola (WWWC); Medic-Wheat-Medic-Canola (MWWC); and Wheat-Canola-Wheat-Cover crop mix (WCWc). The WWWC rotation is a cash-crop rotation system. Fifty percent of the MWWC rotation system is based on incorporation of livestock on a leguminous pasture. The WCWc features a mix of cover crop species which livestock will graze on. For the quantification of GHG emissions, nitrous oxide will be measured through weekly gas sampling using the closed chamber method. Methane will be estimated from animal stocking rate. Carbon sequestration will be quantified using soil carbon stocks, and emissions estimated for inputs (such as fertiliser and fuel) using carbon equivalence databases of the IPCC and historic records of the long-term experiment. This data will be combined into a Life Cycle Analysis of the different systems to compare carbon footprints. This research will contribute to a better understanding of how different systems and practices impact the environment and contribute towards climate change. It will provide a picture of the carbon footprint of agricultural systems, assisting the development of climate-smart agricultural strategies.



Grassland Society of SA Congress 56

SPECIAL SESSION Carbon in grasslands: a pathway to climate mitigation?

Conservation South Africa

SESSION CHAIR: HEIDI HAWKINS

WEDNESDAY, 28 JULY 2021, 10:15 - 12:15

The session will explore the spatial extent and drivers of ecosystem carbon, with a focus on soil carbon, and how re-wilding may influence climate mitigation. Carbon projects will be discussed, as well as contentious aspects thereof, e.g., the Bonn Challenge.

Researchers will present research showing the extent of soil organic carbon (SOC; a sink less vulnerable to loss compared to aboveground carbon), drivers of SOC such as grazing/browsing, herbivore type (livestock, wildlife grazers/browsers and megaherbivores) fire and woody plant encroachment. They will consider potential trade-offs between above and belowground carbon greenhouse gases, water, production and livelihoods using primary data as well as maps and models. Generally, we will consider the amount of ecosystem carbon in Southern African rangelands compared to e.g. European forests, and whether carbon projects are meaningful. Ending the talks, the experts will explain how verified carbon and similar standards work, South Africa's commitments to carbon, and where carbon projects have been implemented in Southern African rangelands to date.

The overall aim is to better understand the different components and drivers of ecosystem carbon and carbon equivalents in Southern African grasslands so that land use decisions are well-informed.

PLATFORM PRESENTATION: A HIGH RESOLUTION (30M) SOIL ORGANIC CARBON MAP FOR SOUTH AFRICA: A TOOL FOR RESEARCH AND CARBON PROJECTS IN GRASSLANDS

Zander Venter^{1}, Heidi Hawkins^{2,3}, Mike Cramer³ and Anthony Mills⁴*

¹Norwegian Institute For Nature Research, ²Conservation South Africa, ³University Of Cape Town, ⁴C4 EcoSolutions

Methods to monitor soil organic carbon (SOC) stocks that rely on in-situ soil sampling provide robust data, but are often time-consuming and expensive to reproduce at scale. The proliferation of high resolution satellite data provides a novel opportunity to interpolate point-based SOC measurements over large areas. Spatially explicit data on SOC are important for rangeland ecologists and land managers to work toward maintaining soil productivity and meeting climate change mitigation targets. Current global and national SOC maps do not provide enough detail for landscape-scale decision making, and do not allow for tracking carbon sequestration or loss over time. Using an optical satellite-driven machine learning workflow, we mapped SOC stocks (topsoil; 0 to 30 cm) under natural vegetation (86% of land area) over South Africa at 30 m spatial resolution between 1984 and 2019. We estimate a total topsoil SOC stock of 5.6 Pg C with a median SOC density of 6 kg C m⁻² (IQR: interquartile range 2.9 kg C m⁻²). Over 35 years, predicted SOC underwent a net increase of 0.3% (relative to the long-term mean) with the greatest net increases

(1.7%) and decreases (-0.6%) occurring in the Grassland and Nama Karoo biomes, respectively. At the landscape scale, SOC changes of up to 25% were evident in some locations, as evidenced from fence-line contrasts, and were likely due to local management effects (e.g. woody encroachment associated with increased SOC and overgrazing associated with decreased SOC). Our SOC mapping approach exhibited lower uncertainty ($R^2 = 0.64$; $RMSE = 2.5 \text{ kg C m}^{-2}$) and less bias compared to previous low-resolution (250-1000 m) national SOC mapping efforts (average $R^2 = 0.24$; $RMSE = 3.7 \text{ kg C m}^{-2}$). Our trend map remains an estimate, pending validation against repeated measures of soil samples in the same location (time-series); a global priority for tracking SOC changes. While high resolution SOC maps can inform land management decisions aimed at climate mitigation (natural climate solutions), potential increases in SOC are likely limited by local climate and soils. It is also important that climate mitigation efforts such as planting trees balance trade-offs between carbon, biodiversity and overall ecosystem function.

PLATFORM PRESENTATION: FIRE AND HERBIVORY EFFECTS ON SOIL ORGANIC C STOCKS AND SOIL GREENHOUSE GAS EMISSIONS FROM SOUTH AFRICAN GRASSLANDS AND SAVANNAS: IMPLICATIONS FOR GLOBAL CHANGE

Farai Chikomba^{1}, Heidi Hawkins^{1,2}, Mike Cramer¹ and Pieter Swanepoel³*

¹University Of Cape Town, ²Conservation South Africa, ³Stellenbosch University

Understanding drivers of soil organic C (SOC) stocks and soil greenhouse gas emissions in grassland and savanna ecosystems is critical considering that soils are large C reservoirs while functioning as sinks and sources of the principal soil greenhouse gases, carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). However, we have limited understanding of how wildlife herbivory, fire and pyric-herbivory influence SOC stocks and emissions of soil greenhouse gases. We hypothesised that, in low nutrient soils, wild herbivores would shift vegetation towards low quality (high C:N) foliage and litter that are resistant to microbial decomposition. This may contribute to the stable SOC pool, while reducing fluxes of all soil greenhouse gases. By contrast, fire was expected to reduce soil N pools by volatilisation, but to increase the stable SOC pool by addition of mostly recalcitrant pyrogenic organic C, thereby lowering CO₂ and N₂O fluxes. CH₄ fluxes would be increased by the fire-induced death of methanotrophic bacteria. To explore this, we examined SOC stocks, soil CO₂, CH₄ and N₂O fluxes including other soil and environmental variables from Long-Term Ecological Research sites within a South African grassland and savanna. Four fire treatments distinguished by fire frequency were used (annual, biennial, triennial and no fire) while the presence or absence of wild herbivores represented the two herbivory treatments. We found that grassland SOC stocks were highest with biennial fires ($20.47 \pm 2.04 \text{ g C m}^{-2}$, $p < 0.001$) compared to other treatments. In the same site, soil CO₂ fluxes were highest with herbivory plus annual fires ($2.28 \pm 0.72 \mu\text{mol m}^{-2} \text{ s}^{-1}$, $p < 0.001$). In the savanna, neither SOC stocks nor soil CO₂ fluxes were affected by treatments. Generally, lower frequency fires (biennial or triennial) increased soil CH₄ uptake while annual fires reduced soil CH₄ uptake. From this, we estimated that South African grassland and savanna soils could consume about 0.47% per m² of the CH₄ released by global wetlands. These native grassy sites with wildlife exhibited very low fluxes of N₂O whereas tropical grasslands and savannas that include livestock populated rangelands are thought to contribute about 16% to the global terrestrial N₂O emissions. Linear mixed-effects models for SOC stocks showed total soil N was the strongest predictor rather than plant detritus inputs. Thus we conclude that fire and herbivory drove SOC stocks via effects on soil N. After pooling the data for the grassland and savanna to compare with local and global figures, we conclude that South African grasslands and savannas have a small but significant potential for SOC sequestration and reduction of soil greenhouse emissions given that they constitute ca. 57% of the country's terrestrial ecosystems.

PLATFORM PRESENTATION: MODELLING GRAZING AND BURNING IN COMMUNAL RANGELANDS HELPS FARMERS PLAN LAND USE AND ASSESS FEASIBILITY OF CARBON FINANCE PROJECTS

Heidi Hawkins^{1,2}, Mostafa Moradzadeh³, Marie-Liesse Vermeire⁴, Farai Chikomba¹ and Lianhai Wu³*

¹University Of Cape Town, ²Conservation South Africa, ³Rothamsted Research, ⁴IRD-CIRAD-IPME

Grasslands and savanna (grassy biomes) cover more than 80% of South Africa's land area, providing critical ecosystem services, livelihoods and cultural values related to wildlife and rangelands. Communally owned rangelands in South Africa are often overgrazed and subject to runaway fires, but lack of data limits our understanding of how these threats impact production and how alternatives could increase climate adaptation and mitigation. Thus, we are using models to predict future scenarios as a planning tool for resource-poor communal farmers. We think that moderate grazing and fire regimes will increase overall primary production and carbon

sequestration with uncertain trade-offs for water and nutrient cycling. To test this, we trained two process-based biogeochemical models (DAYCENT and SPACSYS) with individual merits to simulate known fire returns and grazing pressures on a 40-year-old long-term ecological research site in high-altitude grasslands (Brotherton burning trial). We validated models with data from Mvenyane, a communally grazed area in similar grasslands. Both models accurately simulated herbaceous biomass at Brotherton for various grazing and fire treatments ($R^2 = 0.5-0.8$), and phenological patterns of grassland growth were also well simulated. Using the calibrated parameters from Brotherton with the climate and soil characteristics in Mvenyane, we found that measured and modelled herbaceous biomass was similar for unrested but not 'rested' areas, revealing that the latter was, in reality, frequently trespassed by grazing livestock belonging to the local and neighbouring communities, and biomass did not increase as expected. Supporting this, the NDVI time-series for non-woody areas in Mvenyane was near-identical for the unrested and 'rested' areas ($R^2 = 0.90$). This has prompted the community to address non-compliance within their land-use agreements, resulting in an approximately three times higher biomass in rested vs unrested areas to date in 2021. Soil organic carbon in measured and modelled data were similar for a single time point in 2018. Models projected that soil organic carbon could increase by about 1000 g C m^{-2} over ten years ($1 \text{ t C ha}^{-1} \text{ yr}^{-1}$) with moderate increases in biomass and no change in water fluxes when changing from continuous high pressure to moderate pressure grazing in a two-camp rotation, with or without fire. These and other scenarios, including future climate projections, are being used to evaluate biophysical and social trade-offs so that sustainable land use plans can be created in Mvenyane and the wider rangeland community. Given the small but meaningful carbon sequestration potential with improved land use, we conclude that carbon finance for rangeland farmers could contribute to both climate adaption and mitigation.

PLATFORM PRESENTATION: NEGATIVE EFFECTS OF CATTLE ON SOIL CARBON AND NUTRIENT POOLS REVERSED BY MEGAHERBIVORES

Duncan Kimuyu^{1} and Judith Sitters²*

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Many savanna ecosystems in Africa are currently experiencing a rapid decline in populations of wild herbivores and a concurrent increase in livestock densities. The implications of these changes on soil carbon (C), nitrogen (N) and phosphorus (P) pools and cycling remain poorly understood. Yet these processes are important for the long-term functioning of savanna ecosystems. Using a series of herbivore exclosures, we studied the consequences of manipulating the presence and absence of large wild herbivores and cattle. Grazing by cattle resulted in a net decrease in total soil C, N and P pools, while the presence of megaherbivores (mainly elephants) increased these pools and even reversed the negative effects of cattle. The observed reduction in soil C, N and P pools by cattle is likely as a result of higher rates of nutrient offtake (through grass consumption) than replacement (through dung deposition) due to their management in nightly enclosures. Contrastingly, megaherbivores were responsible for a net gain in soil C, N and P, partly explained by indirectly suppressing cattle forage offtake and by facilitating mesoherbivores and increasing their dung deposition in shared plots. In addition, megaherbivores likely increased C, N and P fluxes from woody vegetation to the soil through the toppling of trees. The contrasting roles of domestic vs. wild herbivores on soil C and nutrients have implications for savanna management. Our results suggest that the conservation of the largest herbivores is important to simultaneously manage livestock production, ecosystem function, and biodiversity conservation.

PLATFORM PRESENTATION: INTERNATIONAL CARBON TRADING AND CARBON STANDARDS: NEW OPPORTUNITIES FOR RANGELAND RESTORATION PROGRAMMES TO BENEFIT FROM CARBON INCOME, A REVIEW OF PROSPECTS

Leon-Jacques Theron

Conservation International

Greenhouse Gas Emissions (GHG) trading, also known as carbon trading, is a tool that was developed in 1997 under the Kyoto Protocol to assist with getting atmospheric GHG concentrations below 1990 levels. An international cap and trade scheme was proposed to incentivise GHG emissions reductions and place a value on GHGs through trading of carbon credits (based on Greenhouse Warming Potential all GHG are converted to carbon dioxide equivalent - CO_2e and traded in tonne). GHG reduction pathways allowed under international trading schemes range from renewable energy through to no-till agriculture and manure management. All projects have to undergo regular third-party verification. The cap and trade scheme had limited regional success and a voluntary carbon market



nature-based climate solutions have been accepted by markets after permanence guarantees were developed, but it has been strongly forest focused due to the large contribution deforestation makes towards GHG emissions and also reduced carbon credit prices. The latter barring low carbon credit generating projects from the market due to high development and verification costs of projects. Therefore, large scale avoided deforestation and afforestation/reforestation projects have made up the bulk of land use sector carbon credit projects. Several large scale forest conservation projects have been funded through income from carbon credit sales. Rangelands have till recently not been seen as viable carbon credit projects due to generally lower standing biomass in rangelands making them not suitable for avoided land use change credit generation and no methodologies available to quantify other potential pathways such as restoration. Recent advances in rangeland carbon dynamics research have, however, shown that the soil organic carbon pool can under the right circumstances respond positively to restoration actions such as rotational grazing and sequester meaningful quantities of carbon. Coupled with a recent increase in demand for carbon credits due to renewed commitments to mitigate climate change, voluntary carbon market standards, particularly the Verified Carbon Standard of Verra has published new methodologies that now allows for the registration of rangeland and grassland projects that can show a net reduction or removal of GHGs. This paper will explore some of the key qualifying criteria for the registration of carbon credit projects and the applicability conditions of some of the methodologies and the opportunities and pitfalls that exist for rangeland projects.

PLATFORM PRESENTATION: CHANGES IN FIRE FREQUENCIES INFLUENCE SOIL ORGANIC CARBON SINKS IN SOUTH AFRICAN MESIC GRASSLANDS

Robyn Nicolay^{1}, Kevin P Kirkman¹, Michelle Tedder¹ and Ntuthuko Mkhize²*

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Grasslands cover a large portion of the earth's surface and have the potential to store substantial amounts of soil organic carbon (SOC), however, this potential is dependent on how grasslands are managed. Fire occurrence in global grassland ecosystems, both natural and anthropogenic, are known to influence both biophysical as well as biochemical processes at multiple levels. Whilst fire is used as an important management tool in many savanna and grassland agro-ecosystems to control bush encroachment and remove moribund material, previous research has recognised SOC as being sensitive to management. The frequency of defoliation events such as fire, could potentially influence the turnover and storage of SOC stocks and grasslands in that they change Net Primary Production (NPP) through altered canopy properties, species composition as well as root turnover. Considering the influence of fire as a primary disturbance mechanism in grassland systems, the quantification of SOC dynamics under prescribed fire frequencies, is necessary for decisions in managing Carbon offsets. A long-term grassland burning trial at Ukulinga, South Africa was used to evaluate the effect of varying seasonal burn frequencies on mesic grasslands potential as a carbon sink. Trial removal treatments consist of annual, biennial, and triennial burns, as well as no burn and annual mown treatments. Treatments are organised in a randomized block design and replicated three times. Established in 1948, Ukulinga burn trials were designed to test the effect of various combinations of mowing and burning, at different frequencies and in different seasons over a series of time. Soils and above-ground biomass was collected from the different burn frequency treatments and used to quantify Soil Organic Carbon (SOC) using LECO CN dry combustion methods. Results are modelled to determine SOC stock, SOC sequestration and determination of SOC turnover. What has been established is that soil C sequestration does not have unlimited potential to mitigate CO₂, with an accumulation of C reaching equilibriums by 20 to 30 years. We then assume Carbon stocks in undisturbed mesic grasslands in the fire trial at Ukulinga will demonstrate relatively stable carbon stocks, with land-use changes accounting for possible variation between treatments. Outcomes of this experiment would aid in developing the potential of anthropologically managed grasslands, to maintain carbon stocks and promote sequestration.

PLATFORM PRESENTATION: EFFECTS OF LIVESTOCK GRAZING ON ECOSYSTEM CO₂ EXCHANGE IN SEMI-ARID KAROO ECOSYSTEMS, SOUTH AFRICA

Oksana Rybchak^{1}, Justin Du Toit², Jean-Pierre Delorme¹, Jens-Kristian Jüdt¹, Mari Bier¹, Kanisios Mukwashi¹, Gregor Feig³ and Christian Brümmer¹*

¹Thünen Institute For Climate Smart Agriculture, ²Production Scientist, GADI/DALRRD, ³SAEON

Climatic and land management factors, such as water availability and grazing intensity, affect carbon ecosystem-atmosphere exchange in semi-arid ecosystems. However, the carbon dynamics remain understudied in South African semi-arid ecosystems. In the current study, we investigated the effect of two contrasting grazing regimes on

CO₂ fluxes. The hypothesis was that a heavy grazing regime reduces the ecosystem carbon sink potential by altering vegetation cover and composition, thereby decreasing gross primary production. To test this hypothesis, four years of measurements (November 2015–October 2019) from two eddy covariance towers in the Karoo, South Africa were collected, analysed, and compared. The two study sites represented lenient grazing (LG) vs experimental grazing (EG). The LG site comprised a diverse cover of dwarf shrubs and grasses such as *Digitaria eriantha*, *Pentzia globosa*, *Eriocephalus ericoides*, and *Sporobolus fimbriatus* with a species richness of 32 species and Shannon index of 2.12. The EG site had been degraded through heavy grazing in the past, but subsequently not grazed for 10 years between 2007 and 2017. It consisted mainly of unpalatable grasses such as *Aristida diffusa* and ephemeral species such as *Aristida congesta* with a species richness of 10 species and Shannon index of 1.15. A heavy grazing regime was reintroduced to the EG site for the two last years of measurement, i.e. 2018 & 2019. During the first two years of measurements, the difference in carbon fluxes between the sites was significant with cumulative NEE of $84 \pm 42 \text{ g C m}^{-2}$ and $-4 \pm 41 \text{ g C m}^{-2}$ for the LG and EG sites, respectively ($p = 0.0007$). After 10 years of no grazing the EG site was more efficient as a CO₂ sink thereby contradicting our hypothesis that the LG site was a stronger sink for atmospheric CO₂ due to the impacts of overgrazing at the EG site prior to 2007. However, during the last two years, the comparison between lenient with heavy grazing revealed no significant difference ($p = 0.39$) in carbon exchange ($-7 \pm 39 \text{ g C m}^{-2}$ and $-32 \pm 48 \text{ g C m}^{-2}$ for the LG and EG sites, respectively). The higher net carbon sequestration at the EG site in the first two years of measurements compared to the lower sequestration levels at the LG site indicated that a long resting period after overgrazing, together with the transition to unpalatable drought-tolerant grass species (*Aristida diffusa*, *Aristida congesta*, etc.), creates conditions that are favourable for carbon sequestration in such water-limited ecosystems. At the same time, the high proportion of unpalatable relative to palatable species made this site unproductive for its current use as Dorper sheep pasture. This may indicate that an optimally managed grazing site is not necessarily the most carbon-efficient ecosystem. A difference in carbon sequestration within the sites between the measurement years was likely due to different amounts and distribution of precipitation. This indicates that studied ecosystems are largely driven by water availability and can quickly switch from a carbon sink to a carbon source.



WEDNESDAY POSTER SESSION

Wednesday, 28 July 2021, 12:15 - 13:15

Posters can be viewed on twitter [here](#)**STANDARD POSTER: NUTRIENT INTAKE, DIGESTIBILITY, GROWTH PERFORMANCE, AND METHANE EMISSION BY NGUNI STEERS FED *SERIPHIMUM PLUMOSUM* MEAL**Motswapo Phoko¹*, Jones Ng'ambi² and Julius Tjelele¹¹Agricultural Research Council API, ²University Of Limpopo

One of the most limiting factors influencing livestock productivity under extensive production systems in South Africa is the quantity and, often, inadequate supply of nutritious feeds for livestock, especially during the dry season. This poses a threat to forage digestibility, increased susceptibility to diseases and ultimately poor animal performance. The increasing rate and extent of *Seriphium plumosum* in the semiarid grassland biomes provide an opportunity to explore its use as a feed ingredient for feed formulation, and thereby contribute to the management of bush encroachment. The objective of this study was to determine the optimal animal performance and reduce methane emission by Nguni cattle fed at different dietary *S. plumosum* meal inclusion levels. Twenty-eight Nguni steers with a mean body weight of 300 kg \pm 10 (SE) were used in the experiment. Animals were allocated into single pens at the feedlot facility and fed iso-energetic and iso-nitrogenous diets with 0 %, 10 %, 20 % and 30 % *S. plumosum* meal. Dry matter intake (DMI) was measured by weighing in feed intake andorts daily, live weight gain was measured by weighing animals' using a heavy-duty scale by weekly. Methane (CH₄) emission was measured using Laser methane detector (LMD) technique in the beginning and at the end of the experiment, and a digestibility trial was conducted following the total collection method to determine animal response on dry matter (DM), neutral detergent fibre (NDF), acidic detergent fibre (ADF), protein and fat ether extract (EE). The results showed that *S. plumosum* meal inclusion in diet had no significant difference on animal live weigh gain among all treatment diets ($p > 0.5035$), despite high nutrient intake ($p < 0.0001$). A 10 % *S. plumosum* (87.46 ppm) inclusion resulted in significantly low methane emission than a 30 % inclusion (103.45ppm) and control (98.72 ppm) diet. The inclusion levels of *S. plumosum* in diet on digestibility showed high fibre intake NDF ($p < 0.0001$) and ADF ($p < 0.0001$); similar trends were evident for protein level ($p < 0.001$), and fat ($p > 0.021$). However, no significant difference was observed in digestible dry matter among all the treatments. *Seriphium plumosum* meal has the potential to reduce CH₄ emission, improve live weight gain and thereby reduce the costs associated with livestock production. In conclusion, this study will contribute knowledge on the utilization of natural feed resources and management of woody plant encroachment.

STANDARD POSTER: MINERAL CONCENTRATION OF PERENNIAL GRASS SPECIES CULTIVATED IN SEMI-ARID AREAS OF THE NORTH WEST PROVINCE

Ntokozo Happy Msiza*, Khuliso Ravhuhali, Hilda Kwena Mokoboki, Sydney Mavengahama and Lebogang Ezra Motsei

North-West University

Season and growth stage are some of the common factors that influence the nutritional profile and mineral distribution in grasses. Despite the wide utilisation of perennial grass species, they are still generally undervalued due to a lack of knowledge on their potential feeding value at different growth stages. The characterisation of these grasses is necessary to fully understand their relative potential for efficient utilization at a particular growth stage. Knowledge on the chemical constituents of these grasses will assist in establishing baseline data to formulate ways of supplementing minerals to improve ruminant productivity. The study was conducted to assess the mineral concentration of selected grass species at different growth stages. The greenhouse study was conducted at the North-West University, Molelwane Farm, North West province. Perennial grass species identified around North West province were used for the experiment. *Antheophora pubescens*, *Cenchrus ciliaris*, *Chloris gayana*, *Dactylis glomerata*, *Digitaria eriantha*, *Eragrostis curvula*, *Festuca arundinacea*, *Panicum maximum* and *Themeda triandra* were harvested at different growth stages and were analysed for chlorophyll and minerals. *Eragrostis curvula* (47.3 \pm 1.3) had a higher ($p < 0.05$) chlorophyll content than all other grasses, while *F. arundinacea* (34.5 \pm 1.3) had a lower ($p > 0.05$) chlorophyll content when compared to all other grasses. At stem elongation stage, *P. maximum* had the highest ($p < 0.05$) Mg (3.3 g/kg) content, whereas *A. pubescens* and *F. arundinacea* had the lowest ($p < 0.05$) Mg concentration at the same stage. *Dactylis glomerata* had higher ($p < 0.05$) Ca concentration

than *A. pubescens*, *C. ciliaris*, *C. gayana*, *E. curvula*, *F. arundinacea*, *P. maximum* and *T. triandra* at elongation stage. The P content in species varied significantly, being particularly higher ($p < 0.05$) in *P. maximum* (6.9 g/kg) and lower ($p > 0.05$) in other species (*A. pubescens*, *C. ciliaris*, *D. glomerata*, *D. eriantha*, *E. curvula* and *F. arundinacea*) at the elongated growth stage. Within each species, *C. ciliaris*, *C. gayana*, *D. eriantha*, *E. curvula*, *F. arundinacea* and *P. maximum* had better N values at vegetative stage than elongation and maturity stages which did not differ significantly from each other. *Dactylis glomerata* (33.9 mg/kg) and *F. arundinacea* (32.3 mg/kg) had a higher ($p < 0.05$) Zn concentration when compared to all grass species at elongation stage. *Panicum maximum* (503 mg/kg) had a higher ($p < 0.05$) Fe concentration when compared to all grass species except for *E. curvula* at maturity stage. *Antheophora pubescens* (20.5 mg/kg), *C. ciliaris* (14.6 mg/kg) and *C. gayana* (14.5 mg/kg) had better ($p < 0.05$) Cu values at vegetative stage followed by elongation and maturity stages. It was concluded that even though these grass species cannot individually supply adequate minerals required by livestock type in different production stages, they can complement each other with sufficient nitrogen diet levels to meet the nutrient requirements for all livestock. Nitrogen favours the growth of fibrolytic bacteria and increases the ruminal degradation and voluntary intake of fibre and the energy extraction from forage material fed to animals.

STANDARD POSTER: PERFORMANCE OF NGUNI GOATS SUPPLEMENTED WITH SWEET POTATO VINES, IN KWAMTHETHWA AREA

Cynthia Fikile Luthuli¹*, Fabian Fon² and Msawenkosi Fano Msomi¹

¹KwaZulu-Natal Department Of Agriculture And Rural Development, ²University Of Zululand

The majority of the smallholder farmers in the KwaMthethwa area, under the Umfolozi local Municipality, KwaZulu-Natal, South Africa owns livestock with goats being the dominant ruminant. Goats' keeping is greatly hindered by forage shortages especially in winter where browsing materials are limited and supplements are expensive. Alternative crop residues with feed potential are not or less used, are available in this area. They can reduce feed costs and improve production. Sweet potato vines are one of those residues that are least exploited with the 1990 cultivar being the most popular in the area. The aim of this study was to measure the effects of supplementing the diet of goats with different levels of sweet potato vines (from *Ipomoea batatas* cv 1990) and measure the influence on feed intake, growth and anti-helminthic properties. Thirty-two yearling male Nguni goats, with a similar body weight of ± 21.84 kg goat⁻¹ were randomly allocated to four treatments with eight goats per treatment. Four levels of fresh *I. batatas* vines that had 17.80% DM, 48.52% NDF, 33.06% ADF and 17.02% CP in proximate, were included in diets. *Eragrostis curvula* hay formed the basic feed and was available *ad libitum*. Supplementation of *I. batatas* vines were as follows: T1 (0 kg goat⁻¹), T2 (1.5 kg goat⁻¹), T3 (2.0 kg goat⁻¹) and T4 (3.0 kg goat⁻¹). All goats were fed individually and had access to water *ad libitum*. The feeding trial lasted eight weeks. The results revealed that feed intake increases ($p < 0.05$) with increasing levels of *I. batatas* vines supplementation. Goats fed T4 had the highest ($p < 0.05$) final weight of 26.05 g per goat. The average daily gain of goats in T1 was 14.51 g goat⁻¹ day⁻¹, in T2 23.81 g goat⁻¹ day⁻¹, in T3, 45.09 g goat⁻¹ day⁻¹ and in T4, 74.56 g goat⁻¹ day⁻¹, respectively. The anti-helminthic properties for all treatments, measured as eggs g⁻¹ of fresh dung, revealed reduced levels of helminth egg production in all groups of goats fed *I. batatas* vines but not in the control group. In conclusion, supplementing the diet of Nguni goats with sweet potato vine has the potential to improve goats' weight per day and feed intake as well as reduced internal parasites infestation.

STANDARD POSTER: THE PERFORMANCE OF *LOLIUM MULTIFLORUM* VARIETIES UNDER IRRIGATION ON CEDARA RESEARCH STATION, KWAZULU-NATAL IN 2020

Derryn Nash* and Donna Berjak

KwaZulu-Natal Department Of Agriculture And Rural Development

A *Lolium multiflorum* (Italian ryegrass) trial is planted annually to assess the performance of new varieties coming onto the market. Twenty varieties, of both Italian and westerwolds types, were planted as a randomized block design with three replicates. Total dry matter yields (t DM/ha) ranged from less than 10 t/ha to over 15 t/ha. The top five varieties were not significantly different from each other ($p < 0.05$) whilst the lowest seven varieties were also not significantly different. Generally, as expected, the Italian types out yielded the westerwold types. However, the exceptions were the westerwolds type Zoom and Performer which had a longer growing season than expected, and the Italians Bolt, Bill Max and, to a lesser extent, Star had disappointing yields and went reproductive earlier than expected. The significant difference ($p < 0.05$) in total yields between the top-yielding Italian variety, Fox, and the bottom yielding Italian variety, Bolt, was 6.39t DM/ha. On a grazing platform of only 10 ha, this would translate into 63,9 more tons of feed over the season. The only difference in input costs would be the price of the seed. This figure



alone should indicate the value of these trials, however, the season when varieties are most productive and reproductive is also of value when planning a fodder flow or pasture mixture. The anomalies between the behaviour of Italian and westerwolds indicate an additional description of long westerwolds and short Italians may be required in future.

STANDARD POSTER: ESTIMATING THE COMPOSITION OF *LESPEDEZA CUNEATA* FODDER SAMPLES USING NEAR-INFRARED SPECTROSCOPY

Erika Van Zyl^{1*}, Mark Laing² and Richard Burgdorf³

¹KwaZulu-Natal Department Of Agriculture And Rural Development, ²University Of KwaZulu-Natal, ³ICFR

The feasibility of using near-infrared spectroscopy (NIRS) to predict the chemical and digestibility parameters for a legume pasture species, *Lespedeza cuneata*, was investigated. This technology potentially offers a fast and inexpensive alternative to the costly and laborious analytical procedures that are typically used in specialized "wet chemistry" laboratories. Samples (n = 32) were used to develop cross-validation models against wet chemistry results. A Bruker FT-NIR spectrometer was used to capture spectral data, which was then analyzed in the Bruker OPUS software environment. Preliminary R² correlation values for different quality parameters showed promising results and are as follows: acid detergent fibre (ADF) % (R² = 95.95), neutral detergent fibre (NDF) % (R² = 93.27), ash % (R² = 89.47), Ca % (R² = 90.1), crude protein (CP) % (R² = 90.04), Cu % (R² = 70.07), fat % (R² = 84.06), K % (R² = 95.95), Mg % (R² = 87.62), Na % (R² = 92.97), and P % (R² = 93.43). The research done so far suggests that NIRS, coupled with chemometric analysis, have the potential to be used to analyse quality parameters of *L. cuneata* samples. The study will be extended to other pastures crops to enable the rapid and low-cost estimation of rangeland pasture quality, which would allow for a more frequent and diverse sampling of rangeland pastures.

STANDARD POSTER: THE IMPACT OF TEMPERATURE AND WATER-LIMITATION ON SEED GERMINATION AND EARLY SEEDLING ESTABLISHMENT OF ANNUAL FORAGE LEGUMES IN THE GENERA *MEDICAGO* AND *TRIFOLIUM*

Francuois Müller¹, Ethan Britz², Lincoln Raitt², Lilburne Cyster², Igshaan Samuels¹, Clement Cupido¹ and Letty Masemola¹

¹Agricultural Research Council API, ²University Of The Western Cape

Annual *Medicago* and *Trifolium* species form important components of pasture-crop rotations in the Western Cape. However, the predicted climate change scenarios for these production areas can significantly affect the productivity of these cropping systems. This study was conducted to quantify seed germination responses of medics and clovers to temperature and osmotic stress conditions. Seeds of eight annual *Medicago* and *Trifolium* species were germinated under controlled conditions. Seed germination was recorded for 15 days at constant temperatures of 5 to 30°C, and five osmotic treatments (0 MPa, -0.1 MPa, -0.3 MPa, -0.5 MPa and -0.7 MPa) per temperature treatment. Results from this study indicate that seed germination of annual *Medicago* and *Trifolium* species differed significantly within germination temperatures and osmotic treatments, as well as between germination temperatures within an osmotic treatment and between osmotic treatments within a germination temperature. Because these species originate primarily from the Mediterranean basin, the optimum germination temperatures of 5 to 15 °C for most of the species was expected. However, species such as *T. vesiculosum*, *T. subterraneum* ssp. *subterraneum*, *M. polymorpha* and *M. littoralis* were able to germinate well (> 80 %) up to 30°C, 25°C, 25°C and 25°C respectively, under well-watered or slight water-limited conditions (-0.1 MPa). Only rarely were there species that could germinate optimally up to moderate water-limited conditions (-0.3 MPa). These species included *T. vesiculosum* at temperatures of 5 to 15°C, *M. polymorpha* and *M. littoralis* at 15 °C, and *M. truncatula* at 20 °C. From this work, it was clear that many of the species evaluated are able to cope with increasing temperatures as long as water availability is not a limiting factor. However, significant investment should be made to improve the adaptation of these species to water-limitation. Further research is needed into the seedling establishment, survival and production potential of these species under water-limited conditions.

**STANDARD POSTER: DETERMINE OPTIMAL DOSAGE OF ETHYL METHANESULPHONATE (EMS) MUTAGENESIS IN SELECTED TEFF VARIETIES FOR DUAL PURPOSE***Patrick Rakau¹*, Isaack Mathew², Shimelis Hussein² and Mark Laing²*¹Agricultural Research Council API, ²University Of KwaZulu-Natal

Crop improvement depends on the availability of genetic variation. However, recombination during sexual reproduction may be inadequate or slow for successful crop improvement. Ethylmethanesulphonate (EMS) is widely used to induce mutations and create new genetic variation in plants. The objective of this study was to determine optimum dosage and treatment conditions for EMS mutagenesis in teff (*Eragrostis tef*) to create a genetic variation for breeding. Seeds of three teff varieties (Emerson, Highveld and Ivory) were treated with four EMS dosages (0, 0.5, 1 and 1.5% v/v) at room temperature for three different periods (1, 1.5 and 2 hours). After mutagenesis, seeds were planted in trays using a 3 x 4 x 3 complete block design (CBD) with three replicates and raised under greenhouse conditions. Percentage seedling emergence, germination, seedling height and root length were recorded. Seedling height and root length were significantly ($p < 0.001$) affected by the three-way interaction involving variety, EMS dosage and duration. The estimated EMS dosages for effective mutagenesis with minimal biological damage for Ivory, Highveld and Emerson were 0.9%, 1.1% and 1.7% for 1 hour, respectively. The determined optimal dosages and treatment conditions will be used for initiating large-scale mutagenesis of teff to create a new genetic variation for breeding dual purpose varieties for feed and food production.

STANDARD POSTER: AN EVALUATION OF DRY MATTER YIELDS AND PRODUCTION TRENDS OF 24 LUCERNE CULTIVARS IN THE NORTHERN REGION OF THE GAUTENG PROVINCE, SOUTH AFRICA*Francois Müller*, Letty Masemola and Marike Trytsman*

Agricultural Research Council API

The selection of the most appropriate lucerne (*Medicago sativa*) cultivar is often complicated, but is the most important factor that will determine the production and persistence under specific agro-ecological conditions. In South Africa, only lucerne cultivars that are registered on the South African variety list may be sold, and the number of registered cultivars on this list regularly changes. Due to a large number of available lucerne cultivars and their respective winter dormancy classes, it is often difficult for farmers to select the most appropriate cultivar and dormancy class that will suit their specific agro-ecological requirements. The aim of the current study was to establish as many of the commercially available cultivars available in the Gauteng province at the ARC Roodeplaat research campus to evaluate their yield potential and production trends over a 5 year period. Prior to planting, an initial germination trial was conducted to determine the germination potential of the different cultivars received. At the same time, the thousand seed mass of each cultivar was determined in triplicate. Thereafter, four replicates of 24 lucerne cultivars (inoculated with a commercial Rhizobium inoculant) were established at 25 kg ha⁻¹ in 10 m² plots. The soil nutrient conditions within the plots were corrected prior to planting, and all plots were irrigated as needed. Two months after establishment, seedling counts were done within a 0.25 m² quadrant, and one month later the branching intensity of 5 randomly selected plants within each plot was done. The plots were harvested at a stubble height of 5 cm at 10 % flowering from a 0.25 m² sub-plot. All harvested materials were oven-dried at 65 °C and dry mass determined after one week. Production per cutting was expressed as kg dry mass per hectare, and total production over the growing period was done by adding the production from each harvesting time. Results presented here are data collected over the first two years of the trial. Results indicate that there are significant differences in biomass production between the different cultivars in both the first and second years of production, as well as the total production over the two years. Also, significant differences were observed within different cultivars between the two years. Even with only two years of data, it is possible to see that differences in biomass production between the different cultivars are becoming smaller. Biomass production data were correlated with winter dormancy class, seed mass, branching intensity and the number of seedlings establishing. Results indicate that winter dormancy, seed size, branching intensity and seedling establishment are significantly correlated to the production of the lucerne cultivars, and to each other. An additional three years of data collection will be done which will give a good indication as to the persistence of the different lucerne cultivars being evaluated. Additionally, further information regarding the morphological and nutritional properties of the cultivars being evaluated will be collected.



PRODUCTIVITY EVALUATION OF FOUR MEDICAGO SATIVA CULTIVARS UNDER TWO WATER REGIMES (IRRIGATED AND NON-IRRIGATED) AND TWO SOIL TYPES AT BATHURST RESEARCH STATION IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

Mhlangabezi Solontsi^{1}, Mfundo Maqubela¹, Jan Van Niekerk², Juan Swanepoel², Gideon Jordaan¹, Unathi Gulwa¹ and Nkululeko Nyangiwe¹*

¹Eastern Cape Department Of Rural Development And Agrarian Reform, ²University Of The Free State

Medicago sativa (lucerne) is a perennial and drought-tolerant fodder crop that is widely used as feed for livestock in South Africa. This study evaluated four lucerne cultivars under two water regimes and also determined the effect of soil type and different fertilizer (P) application rates on lucerne biomass production. Before planting, soil samples were collected at random points from irrigated plots and non-irrigated plots up to a depth of 15cm to determine both the chemical and physical properties of the soil. Data on four lucerne cultivars (WL 711, WL 525 HQ, KKS 9911 and SA Standard) under different fertiliser (P) application rates were collected on both irrigated and non-irrigated plots. Soil type (site) had a significant ($P < 0.05$) effect on the quantity of dry matter produced. Different levels of water application (moisture supplementation) affected the quantity of dry matter produced. Cultivar 3 (KKS 9911) was the least productive cultivar in site 1, while the same cultivar was the most productive cultivar in site 2. These findings show that soil type had a significant effect on the total dry matter production of Lucerne.



56th Annual Congress

27 - 29 July 2021



Grassland Society
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SESSION 7 Rangeland ecology and management

SESSION CHAIR: JULIUS TJELELE

WEDNESDAY, 28 JULY 2021, 13:15 - 16:00

KEYNOTE ADDRESS: RANGELAND ASSESSMENTS AND MONITORING IN THE EVER-CHANGING ENVIRONMENTAL CONDITIONS: CURRENT EARTH OBSERVATION AND GEOINFORMATION SCIENCE APPLICATIONS

Abel Ramoelo

University Of Pretoria

Rangelands are faced with unprecedented challenges throughout the world. Global environmental change is one of the key challenges affecting the quality, state and condition of the rangelands. These environmental changes threaten livelihoods and the resilience of rangeland ecosystems services, i.e. livestock production and biodiversity conservation. For example, the Grassland Biome is one of the threatened Biomes in South Africa, yet with extremely high biodiversity. Specifically, anthropogenic factors leading to these changes are caused by the settlement expansions or urbanization, agricultural intensification both for crops and livestock production, the proliferation of invasive species, unsustainable land-use practices (e.g. overgrazing) and over-exploitation of natural resources. Furthermore, climate change causes erratic rainfall and induces a high frequency of droughts. Due to this, there is a need for constant monitoring of rangelands to improve their resilience and associated ecosystem services. Monitoring and assessing essential variables on the quality, state and condition of the rangelands are crucial for planning and management. Combining field and remote sensing data provide opportunities for rangeland monitoring and assessments. The objective of this talk is to showcase results from various remote sensing studies to assess and monitor rangeland essential variables such as grass quality (leaf nutrient concentrations, species composition, richness and diversity), and quantity (biomass, leaf area index, productivity). In addition, the presentation will also focus on the use of remote sensing-based vegetation indices to assess the extent to which drought and land degradation are affecting our rangelands. Results for the rangeland products within and around protected areas derived using a suite of remote sensing data at multiple scales for Savanna and Grassland Biome will be presented. Remote sensing provides avenues to map and monitor these essential variables for rangelands using the optical (Landsat, Sentinel-2 and MODIS) and active (Sentinel-1) domain effectively and efficiently. These successes were realized, when remote sensing data is combined with the suite of parametric and non-parametric modelling tools, from classical regression to machine learning techniques. Rangeland quality and quantity information can be integrated into the monitoring tool. It will provide actionable information to inform decision-making by farmers, planners, managers and policymakers.



PLATFORM PRESENTATION: THE IMPACT OF INCREASING WOODY VEGETATION ON MONTANE BIODIVERSITY IN THE MALOTI-DRAKENSBERG: A CASE STUDY OF *LEUCOSIDEA SERICEA* ENCROACHMENT

Muxe Dlomu¹*, Peter Le Roux², Michelle Toucher¹ and Vincent Clark³

¹SAEON, ²University Of Pretoria, ³University Of The Free State

Globally, there is a trend of indigenous woody species converting grassland systems into woody systems through the process of bush encroachment. Along southern Africa's eastern Great Escarpment, there is a potential for the endemic shrub/small tree *Leucosidea sericea* (Cheche (Sotho), Umtshitshi (Zulu), Ouhout (Afrikaans), and Oldwood (English)) to dominate biodiversity-rich mesic montane grassland, impacting negatively on water production, grassland conservation, and rangeland-based livelihoods. The aim of the study was to determine the impact of *L. sericea* on plant diversity in the Maloti-Drakensberg (MD). We hypothesize that *L. sericea* encroachment replaces rich grassland diversity with depauperate proto-forest diversity. Vegetation sampling was conducted at three sites in the MD: Cathedral Peak Research Catchments (Catchment IX) (CPK), Golden Gate Highlands National Park (GGHNP), and Witsieshoek (Batlokwa Tribal Authority) (WB), during mid-summer (December 2020–January 2021) and in late-summer (March–April 2021). At each site, the number of species, the number of individuals per species, and percent coverage per species were recorded in 30 paired 1 x 1 m quadrats, one set in *L. sericea* thickets, and one set in adjacent grassland. Plots in each pair were placed 3 m apart, and pairs were separated by 10 m. The effect of *L. sericea* on species composition and species diversity was analyzed using non-metric multidimensional scaling and t-tests comparing Shannon diversity indices. The species composition in CPK ($P=0.001$) and WB ($P=0.004$) was significant, albeit weakly ($R^2 < 10\%$, PERMANOVA), affected by the occurrence of *L. sericea*, which may be due to old mature *L. sericea* riparian forest supporting a greater proportion of shade-tolerant and nutrient-demanding species. There was no significant difference in species diversity in CPK ($P=0.27$) and GGHNP ($P=0.98$) between *L. sericea* and grassland plots. However, there was a statistical difference in species diversity in *L. sericea* plots in WB ($P=0.04$). This suggests that *L. sericea* encroachment does not have an overall negative impact on plant diversity. However, the type of species occurring in these sites may be impacted by *L. sericea* encroachment, and therefore a comparison of the threat status of the species associated with *Leucosidea* or open grassland habitats may still provide additional insights into the conservation implications of woody encroachment in this system.

PLATFORM PRESENTATION: THE INFLUENCE OF DROUGHT ON GRASS SWARD COMPOSITION, STRUCTURE AND SPECIES INTERACTIONS IN MESIC GRASSLAND

Yonela Maziko*, Michelle Tedder, Kevin P Kirkman and Terry Everson

University Of KwaZulu-Natal

A significant percentage of Southern African grasslands have undergone deteriorative transformation due to climate change-related impacts. This study seeks to probe the impacts of drought on species composition under different burning management regimes. The long-term veld burning trial which was established in 1950 was resurveyed to compare any vegetative changes that might have occurred after the single drought event that occurred in 2014. The trial consists of different treatments that are burnt at different frequencies namely the unburnt, annually burnt and triennially burnt treatments at Ukulinga Research Farm, University of KwaZulu Natal. Species composition in the abovementioned treatments was surveyed in the early and late season annually for five years (Kirkman et al., 2014). During this period, the mean annual rainfall was 677mm then a decline in rainfall was noted from 2014 to 2015 whereby the site received 540mm and 514mm of rain respectively. Given that Kirkman et al. (2014) found no effect of year on species composition but a significant effect of burning frequency, the annual and triennial spring burning treatments and the undefoliated control were resurveyed in 2019 to determine any change in species composition since the previous survey. Three treatments are replicated three times in a blocked design to account for changes in soil depth. The field survey methods used by Kirkman et al. (2014) were replicated for this survey. Two 4m² quadrats were relocated and divided into four 1m² quadrats then used for species composition surveys. The survey procedure is modified from Daubenmire (1959) where the aerial cover of each species rooted within the quadrat is identified and recorded. The maximum cover of each species during early and late season surveys is then averaged across the four 1m² quadrats and used to estimate total abundance for the plot. Differences in species composition were assessed using the Canonical Correspondence Analysis (CCA). Variations in species richness and biodiversity were analyzed with a two-way ANOVA. Further analysis was done to determine variations between treatments using a Tukey's test. The total number of species was higher (209) before the severe short-term drought than after (80).



There is a significant main effect of year on species diversity whereby it was significantly higher following drought. Specifically, annual burning has a significantly higher species diversity. The annually burnt treatment had a greater concentration of grass species with the control dominated by woody plants. Burning treatments were significantly affected by drought but there was no interactive effect between burning treatments and drought. Concurrently with the previous research paper by Kirkman et al., (2014), frequent burning significantly favours a higher diversity and richness of species. More frequent fire influenced a more diverse grassland, dominated by grasses such as *Themeda triandra*, whereas unburnt areas had more forbs and woody species. The results of this study shed light on plant responses to different drought may potentially provide mitigation strategies against drought implications.

PLATFORM PRESENTATION: EFFECT OF PROXIMITY TO HIGHWAYS ON ABOVEGROUND TISSUE SURFACE PH OF GRAZED SAVANNA GRASS SPECIES

Mantsana Mathole and Chris Munyati*

North-West University

Many savanna rangelands are in close proximity to roads. This exposes the grasses and grazers to the detrimental effects of motor vehicle sourced emissions and particulate matter, including changes in the surface pH of the plant tissue. In this study, the change in surface pH of the aboveground tissue with distance from the road verge was investigated. The study sites were grass expanses along highways in Pretoria and Mahikeng, South Africa, that represented high and low traffic volumes, respectively. Three grass species were studied: *Digitaria eriantha*, *Brachiaria nigropedata*, and *Eragrostis lehmanniana*, which represented grasses of very high, high and average grazer nutrition value, respectively. Transects that were perpendicular to the highways were used during sampling in March, at the end of the growing season. Along the transects, tissue (leaf, stem and flower) samples of each grass species were collected at various distances from the road verge and up to 100 m away. In the laboratory, tissue from the respective grass samples was immersed in distilled water, and the pH of the distilled water with the washed-off material was then measured. Trends in the pH against distance were established using Microsoft Excel. Despite rainfall events prior to the sampling period, the general trends were that pH was lower close to the road verge, and higher farther away. This was interpreted to be due to the acidity caused by sulphuric and nitric acids that result from the reaction of water with the sulphur dioxide (SO₂) and nitrogen oxides (NO_x) in motor vehicle exhaust fumes. The trend varied with traffic volume and was quite pronounced in the case of *B. nigropedata* and *D. eriantha*. Leaf size appeared to determine the size of the surface area onto which the acid-forming fumes collected. Therefore, in the case of the small-leaf *E. lehmanniana*, the trend was less pronounced. Rainfall also seemed to affect the results in that it washed away the acid-bearing material from the tissue surfaces. There was evidence of morphological disturbance to the grass leaves, and negative effects on leaf stomatal frequency. Low grass surface pH can, therefore, potentially result in reductions in the growth of grazing grass, slight alterations to the taste of the palatable grasses, as well as reduced mineral metabolism by the grazers. Given the expanding road networks on savanna rangelands in conservation and agricultural areas, the results indicate that the quality of the grazing grass can be affected negatively by proximity to roads.

PLATFORM PRESENTATION: VALUE OF REMOTELY SENSED VEGETATION INDICES AND ANIMAL MOVEMENT PATTERNS FOR RANGELAND MANAGEMENT IN KAROO SHRUBLANDS

Christiaan Harmse and Hannes Gerber*

Northern Cape Department Of Agriculture, Environmental Affairs, Land Reform And Rural Development

The objective of rangeland monitoring is to determine if grazing management strategies meet sustainable resource utilization goals to prevent rangeland degradation. The advancement of sustainable management strategies requires an understanding of rangeland dynamics in relation to the manner in which grazing livestock utilize available fodder. Remote sensing techniques have been successfully applied to assess vegetation vigour and to provide valuable insights for agricultural applications. The availability of high spatial and temporal satellite imagery has opened up many new possibilities in rangeland research with regards to landscape dynamics. Sentinel-2 imagery was used in this study for rangeland scale observations on the vegetation conditions. The aim was to better understand the spatial relationships between vegetation composition, -activity, and the movement patterns of sheep within and between different grazing camps. Using these technologies, the impact of drainage lines which is characteristic of these camps could be determined. The hypothesis was that sheep at lower stocking rates graze more selectively and this would result in localized overgrazing to take place and that this grazing effect can be quantified using remotely sensed vegetation data. It was assumed that the resolution of the remotely sensed images will be critical and that localised overgrazing effects will be best described by making use of higher resolution images. The results showed



that sheep spend significantly ($p < 0.05$) more time in the grazing areas within drainage lines. Soils were found to be significantly deeper in drainage lines and vegetation assessments confirmed higher species richness and -evenness here, as compared to shallower soils outside. Species such as *Pentzia incana*, *Rosenia humilis* and grass species such as *Stipagrostis ciliata* and *S. obtusa*, were more dominant within the drainage lines and not commonly associated on the shallower soils outside. Plant density was also found to be significantly higher within drainage lines. The spatial resolution with the strongest correlation for NDVI and grazing hot spots were established using a pixel comparison analyses. Pixel-size were compared at 100 m², 400 m², 900 m², 2 500 m², 10 000 m², 62 500 m², 250 000 m² and 1 000 000 m². The strongest correlation was found to be at 10 000 m² pixel size. The drainage lines with higher NDVI scores were clearly visible at the higher spatial resolution, but less detectable at resolutions above 62 500 m². Historically understanding of, and measuring livestock movement patterns in the semi-arid rangelands of the Upper Karoo region was time-consuming and costly. This study has demonstrated the effectiveness of remotely sensed vegetation condition data as a grazing management tool. Understanding the spatial variation of plants within camps can be used in the planning of farm infrastructures such as fencing and water reticulation in order to better manage and prevent over utilization.

PLATFORM PRESENTATION: PERCEPTIONS OF RANGELAND USERS ON THE ECOLOGY, SOCIO-ECONOMIC IMPACTS AND MANAGEMENT OF INVASIVE PLANT SPECIES: A CASE OF MPHAKI IN QUTHING DISTRICT, LESOTHO

Moselantja Rahlao*, Lerato Seleteng-Kose, Peter Chatanga, Botle Mapeshoane, Makoala Marake

National University Of Lesotho

Rangeland condition is deteriorating in some parts of the world due to various anthropogenic factors that include amongst others, over-utilization of resources compounded by climate change and plant invasion. Lesotho's rangelands are mostly threatened by plant invasion, and this is evidenced by various ecological impacts such as soil erosion, a decline in indigenous plant species diversity and depletion of water resources. A number of studies with a focus on invasive plant species have been conducted in the country. However, they did not focus on invasion ecology or socio-economic impacts of invasive plants. The current study was conducted in four villages in the Mphaki constituency in Quthing District of Lesotho to assess perceptions of the local community on: (1) possible introduction pathways of invasive plant species and their methods of spread; (2) their effects on rangeland condition; (3) the socio-economic impacts of these species; and (4) existing and/or potential management interventions regarding invasive plant species. Data were collected from 182 respondents and analysed using descriptive statistics. Many respondents (90.7%) reported that there is a deterioration in rangeland productivity, mainly due to plant invasion, coupled with overgrazing and drought (a proxy for climate change). The most common invasive plants cited by respondents include *Rosa rubiginosa* (79.1%), *Xanthium strumarium* (56%), and *Chrysocoma ciliata* (53.8%). Surprisingly, *Artemisia afra* (55.2%) and *Leucosidea sericea* (40.7%) were also reported as invaders, although they were not previously classified as invasive species in Lesotho. The respondents indicated that the invasive plants were introduced from urban areas and their spread is facilitated mainly by: (1) human activities (*Relbania dieterlenii* and *Rosa rubiginosa*); (2) livestock (*X. strumarium*) and (3) wind (*X. strumarium*). The negative impacts of these invasive plants were reported as mainly reduced rangeland size, low income and fodder production, reduced quantity and quality of wool and mohair, as well as reduced cropland. Plant invasion has mostly affected sheep (81.8%) and goats (11.5%) production. Uprooting invasive species (such as *C. ciliata*, *R. dieterlenii* and *Stachys rugosa*) is a common control method in the area. Even though some invasive plants have negative impacts on rangeland productivity, they also have positive socio-economic benefits to communities, such as being a source of food and generating income. Therefore, their control and /or eradication have conflicting challenges within the communities. Thus, the management of invasive plant species should focus on the interface of both ecological impacts and socio-economic benefits, particularly in communities with limited resources.

PLATFORM PRESENTATION: DENSITY EFFECTS OF MATURE TREES ON GRASS PRODUCTION AND TREE SEEDLING RECRUITMENT IN A BUSH-ENCROACHED SAVANNA

Piet Monegi^{1*}, Ntuthuko Mkhize¹, Julius Tjelele¹, David Ward² and Zivanai Tsvuura³

¹Agricultural Research Council API, ²Kent State University, ³University Of KwaZulu-Natal

The removal of trees in rangelands may create gaps that are associated with increased grass production, tree seedling recruitment and growth of remaining trees and seedlings. We conducted a field experiment at two savanna sites that receive relatively similar rainfall but differ in soil texture and woody species composition in South Africa.



We used 24 plots (30 m × 30 m) in each site to determine the effects of different tree removal-intensities (0%, 10%, 20%, 50%, 75% and 100%) on grass production, tree seedling establishment and growth, and the growth of the remaining mature trees. Site 1 was on clay-dominated soils characterized by severe soil erosion and was encroached by a monospecific stand of *Vachellia tortilis*. Site 2 was on sandy soils with several woody plants. In site 1, the high removal treatments (i.e. 75% and 100%) significantly reduced grass biomass production after the first growing season, with no differences after the second season. In site 2, tree removal significantly increased grass biomass production. We found no significant effect of tree removal on tree seedling establishment in site 1. In site 2, tree removal had a significantly negative effect on overall tree seedling establishment. In both sites, there were no significant differences in tree seedling growth. Moderate (50%) to high (75%) removal of trees had a positive effect on the growth of the remaining mature trees in both study sites. We found that increased and/or diminished grass biomass production plays a vital role in tree seedling recruitment. In addition, we found that reduced tree competition may facilitate the growth of the remaining mature trees. We attributed the diminished grass biomass in site 1 to the inability of *V. tortilis* trees to facilitate herbaceous biomass outside their canopies. In addition, the level of soil erosion, which may have negatively affected the soil seedbank that is necessary for vegetation development, could have contributed to the diminished grass production. The implication of these findings is that regardless of the substantial costs of woody plant control; the recovery of key ecosystem services such as an increase in forage production may be absent. However, this may be system-specific and therefore, in other systems, the absence of management interventions such as tree removal may compromise ecosystem services and function.

PLATFORM PRESENTATION: THE DIVERSITY OF POISONOUS PLANT PATCHES IN THE ARID RANGELANDS OF NAMAQUALAND, SOUTH AFRICA

Clement Cupido^{1*}, *Tauriq Jamalie*², *Igshaan Samuels*¹, *Francuois Müller*¹ and *Richard Knight*²

¹Agricultural Research Council API, ²University Of The Western Cape

The Namaqualand region in South Africa is part of the richest arid biodiversity hotspot in the world. Plant distribution and diversity here are impacted by various biophysical and anthropogenic factors. In these landscapes, poisonous plant patches, which pose serious threats to livestock, are widespread but their contribution to the region's biodiversity are not fully understood. This study assessed their plant diversity and compared its matrix. This study was conducted in the semi-arid to arid Steinkopf pastoral area located in Namaqualand where livestock is still herded daily. Twenty-five paired sites were selected based on the dominance of poisonous plants within the genera *Tylecodon*, *Euphorbia* and *Adromischus*. Within these sites, the number and abundance of different plant species were recorded and categorised into different plant functional types. Results showed a significant difference in Shannon Wiener plant diversity where poisonous plant patches displayed a greater diversity compared to sites sampled in the matrix. We interpret these findings as a consequence of herding in the region, where herders do not allow their animals to graze on or near poisonous plant patches. As such, palatable plants, which are absent or low in abundance in the surrounding landscape have a refuge where they can survive and set seed. This study provides evidence that the ethnobotanical knowledge of herders and palette of livestock are also major contributors to the spatial distribution and diversity of plant species in the arid biodiversity hotspot.



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SESSION 8 Conservation and restoration

SESSION CHAIR: CLINTON CARBUTT

THURSDAY, 29 JULY 2021, 08:00 - 11:15

KEYNOTE ADDRESS: ANIMAL DIVERSITY AND GRAZING PRESSURE MATTER MORE THAN GRAZING PATTERN OR DENSITY FOR THE PRODUCTIVITY, CLIMATE RESILIENCE AND RESTORATION OF GLOBAL RANGELANDS

Heidi Hawkins^{1,2}

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Globally and historically grazing is equal to cropping in causing soil organic carbon (SOC) losses to the atmosphere and livestock are net contributors to greenhouse gas emissions. Southern Africa, Argentina and Australia have been hotspots of SOC loss over the last 12,000 years and are targets for restoration efforts or 'natural climate solutions'. The Savory Institute claims that "we can take enough CO₂ out of the atmosphere on half the world's grasslands to take us back to pre-industrial levels" (using a multi-camp method which increases animal density and sometimes stocking rate as part of Holistic Management (HM)). Peer-review studies have found no support for the claim that HM increases production or SOC under all conditions in all habitats, while several studies report social benefits. Proponents of HM have criticized the small scale of some studies, stating that production and climate benefits only emerge on large working farms. Here, the conclusions from 20 key, peer-reviewed farm-scale, social and soil carbon studies from across the globe have been synthesized diagrammatically to show how grazing pattern / density, stocking rate and animal type influence biology, climate resilience, economics and society. The synthesis confirms that excessive grazing pressure decreases productivity while HM has either no effect or reduces primary and secondary production as evidenced from three farm-scale studies. This is not surprising given that HM does not change animal behaviour (1 study; South Africa). Application of HM could include reduction in livestock parasites but was not more effective than four-camps ($p > 0.05$). Increased animal density can reduce vegetation heterogeneity at the patch scale (-0.001 vs 0.001 Normalized Difference Vegetation Index units yr^{-1} for two-camp vs HM). In combination with fire (commonly used in the four-camp approach and pyric-herbivory), increased diversity of grazers and vegetation can increase floral and faunal biodiversity. Alternatively, managers wishing to homogenize an area can consider HM. Seven peer-reviewed studies and one review conclude that rates of carbon sequestration are substantially less than the $0.3\text{--}0.9 \text{ kg m}^{-2} \text{ yr}^{-1}$ estimates from non-peer-review HM literature, which also does not account for the increases in faunal emissions of methane and soil emission of nitrous oxide with increased livestock numbers. Interestingly, the negative effects of livestock on SOC can be reversed by wild mega-herbivores, according to a novel study in Kenya (2.5 vs 1.5 kg C m^{-2}). Five studies show that HM provides a support framework for land users by increasing social learning, agency and peer-peer support. This framework could be adopted by any farming community without accepting the unfounded HM rhetoric, and governments could allocate funds to train extension



agents accordingly. Importantly, it is hoped that future rangeland management and restoration programmes can now turn attention away from groundless claims, and focus on established, effective grazing approaches while exploring the potential of varied animal diversity (including wildlife) and pyric-herbivory for increasing productivity, biodiversity, climate resilience and human well-being on rangelands.

PLATFORM PRESENTATION: SOUTH AFRICA IS A HOTSPOT FOR PREVIOUSLY UNKNOWN GRASS STEM-BORING WASPS (TETRAMESA; EURYTOMIDAE)

Guy Sutton*, Kim Canavan, Iain Paterson, Clarke Van Steenderen and Liam Yell

Rhodes University

The stem-boring wasp genus *Tetramesa* (Hymenoptera: Eurytomidae) comprises 203 species that feed exclusively on grasses. The wasps are highly host-specific, typically feeding on a single or a few closely-related grass species, and can cause significant damage to their host grass (e.g. reducing seed production, increasing tiller mortality). These attributes often result in *Tetramesa* being serious grain pests, but it also makes them ideal biological control agent candidates for controlling invasive grasses. Very little is known about the Afrotropical Hymenoptera in general, and to date, almost all the sampling effort in collecting and describing *Tetramesa* species has taken place in the northern hemisphere. Only four African species have been described, none of which are from South Africa. The Centre for Biological Control (CBC) at Rhodes University has been investigating biological control options for several African grasses that have become invasive in Australia and the Americas, and have been collecting *Tetramesa* specimens across South Africa since 2017. The insect communities associated with more than 60 different native grasses have been surveyed over this period. The uniform morphology of adult and larval *Tetramesa* has, however, made it impossible to determine whether these wasps are a single polyphagous species, or multiple oligophagous and/or monophagous species. We are currently using genetic barcoding tools (mitochondrial *COI* and nuclear *ITS2* regions) and species delimitation methods to solve this problem. Our preliminary results have identified at least six potentially undescribed *Tetramesa* species from South Africa. Each novel *Tetramesa* species was highly specific, with five of the six potential species feeding and completing their development on a single host grass species (e.g. *Sporobolus pyramidalis*, *Eragrostis curvula*, *Hyparrhenia hirta*). This work will facilitate using biological control techniques to manage invasive alien grass species and highlights a previously unknown diversity of *Tetramesa* species associated with South African grasses. It is likely that we will uncover many more undescribed *Tetramesa* species in the region as our sampling effort escalates.

PLATFORM PRESENTATION: GETTING A GRIP ON GRASSLANDS: ASSESSING PLANT DIVERSITY IN THE UNDER-SAMPLED AND THREATENED GRASSLANDS OF SOUTH AFRICA

Annerine Myburgh^{1*}, Caroline Lehmann², Thami Shezi^{3,4} and Michelle Greve¹

¹University Of Pretoria, ²Royal Botanic Garden Edinburgh, ³Wits University, ⁴SAEON

The South African grassland biome boasts exceptional floristic diversity. Its diversity can largely be attributed to the vast range of forb species found in this biome. The grassland forb diversity has historically been underestimated and understudied. This is problematic as diversity is known to be one of the key drivers of ecosystem functioning, which in turn translates into the provision of ecosystem services. Furthermore, grasslands are arguably the most transformed and least protected of all nine South African biomes. Therefore, understanding forb diversity patterns is essential for conservation planning and management of grasslands, not only on a landscape scale but also on a regional scale. The objective of this research was to describe patterns and drivers of alpha and beta diversity of grassland forbs at different spatial scales (1.5 m, 50 m and > 100 km) in under-sampled grasslands of Northern KwaZulu-Natal and Mpumalanga. Forty-two undisturbed grassland sites, each consisting of 21 plots were surveyed for forb species. In each plot, all forb species were identified and recorded, and environmental parameters (e.g. soil, climate, fire history) were collected for each site. The drivers of alpha and beta diversity were assessed with generalized linear models, and the respective contribution of alpha and beta diversity to landscape (gamma) diversity was assessed. 492 forb species were identified across all sites, while mean forb richness per site and plot were 33 and 6 respectively. Only fire return interval had a marginally significant effect on alpha diversity at site level ($p = 0.05$). None of the environmental parameters had a significant effect on the mean beta diversity between sites. The mean similarity in species composition between sites was 8.6%, and between plots within sites 22.4%. This indicates a high turnover of forb species exists between sites, but even within sites situated only 50 m apart. The mean similarity within sites was 22.4%, indicating that the overall turnover within sites (local scales) is still high, but not as high as the turnover between sites (regional scales). Therefore, local and regional beta diversity was a major



contributor to species richness at the site- and landscape-level respectively. The results indicate the importance of evaluating grassland diversity at different spatial scales to conduct effective environmental impact assessments. Historical phytosociological studies from the grassland biome have not provided us with the fine-scale diversity data needed to promote an active grassland biome conservation programme. Our study shows that many parts of our Grassland Biome need to be revisited with a fine-scale biodiversity mapping focus.

PLATFORM PRESENTATION: SEXUAL REPRODUCTION TRAIT EXPRESSION OF ELEVEN GRASSLAND SPECIES ALONG A GRADIENT OF NITROGEN: PHOSPHORUS STOICHIOMETRY IN THE NETHERLANDS

Shuqiong Wang*, Jerry Van Dijk, Sanne Poppeliers, Ineke Roeling, Mohamed Ghoneim and Martin Wassen

Utrecht University

Plant investment in sexual reproduction is affected by nitrogen (N) : phosphorus (P) stoichiometry. It has been suggested that an important adaptation to strong P limitation is reduced investment in sexual reproduction. In a field survey we aimed to investigate the influence of N:P on sexual reproduction performance within and between grassland species. Eleven grassland species were selected in ten plots covering all three types of nutrient limitation (N limitation, N and P co-limitation, and P limitation) distributed over three sites in the Netherlands. Nutrients in soil and above-ground biomass were determined, plus two environmental variables (soil pH and soil moisture). A range of sexual reproduction traits were measured as a proxy for investment in sexual reproduction. At the intraspecific level, we found significant patterns of reproduction traits for 4 species: compared with N-limited plots, in P-limited/co-limited plots, flowering period in individuals was shorter in *Lythrum salicaria* (36.5 ± 3.5 days vs. 15 days), flowering time was later in *Plantago lanceolata* (38.5 ± 4.9 vs. 66.5), *Lotus uliginosus* (87.2 ± 0.6 vs. 96.5 ± 1.7), and *Anthoxanthum odoratum* (22.5 vs. 37.5 ± 3.4), and *Anthoxanthum odoratum* had fewer inflorescences (2.5 vs. 1.3 ± 0.3). At the interspecific level, along with the increasing N:P ratio (higher N:P ratio indicates more P-limited condition), species flowering time was significantly earlier ($R^2_{\text{flowering time-plant N:P}}=0.591\sim0.692$; $R^2_{\text{flowering time-soil N:P}}=0.307\sim0.445$), and seed stalk and seed panicle were significantly longer ($R^2_{\text{seed stalk length-soil N:P}}=0.262$; $R^2_{\text{seed panicle length-soil N:P}}=0.382$). Furthermore, flowering period was shorter and number of inflorescences was less ($R^2_{\text{flowering period in the population-plant N:P}}=0.394$; $R^2_{\text{flowering period in the population-soil N:P}}=0.167$; $R^2_{\text{flowering period in individuals-plant N:P}}=0.578$; $R^2_{\text{flowering period in individuals-soil N:P}}=0.436$; $R^2_{\text{number of flowers (inflorescences) per individual-plant N:P}}=0.265$). Moreover, soil pH and soil moisture were found significantly correlated with sexual reproduction performance of the selected grassland species. Along with the decreasing soil pH (the acid condition coincided with P limitation in our survey), flowering time was earlier ($R^2_{\text{flowering time-soil pH}}=0.456\sim0.650$), seed stalk and panicle were longer ($R^2_{\text{seed stalk length-soil pH}}=0.333$; $R^2_{\text{seed panicle length-soil pH}}=0.451$), but flowering period was shorter ($R^2_{\text{flowering time in the population-soil pH}}=0.229$; $R^2_{\text{flowering period in individuals-soil pH}}=0.611$). Along with the increasing soil moisture, flowering time was earlier ($R^2_{\text{flowering time-soil moisture}}=0.291\sim0.505$), while flowering period was shorter and number of inflorescences was less ($R^2_{\text{flowering period in the population-soil moisture}}=0.164$; $R^2_{\text{flowering period in individuals-soil moisture}}=0.469$; $R^2_{\text{number of flowers (inflorescences) per individual-soil moisture}}=0.181$). Our results show that P limitation/co-limitation restrict the sexual reproduction of grassland species, which may hamper their dispersal capacity. However, we recommend that future studies further analyze the relationship between soil pH and N:P stoichiometry and the influence of soil pH, as well as soil moisture on sexual reproduction performance of grassland species in addition to analyzing N:P stoichiometry.

PLATFORM PRESENTATION: VERBESINA ENCELIODES – NEXT INVASIVE ALIEN SPECIES IN THE SOUTH AFRICAN RANGELANDS?

Thulisile Jaca* and Gordon Ringani

SANBI

Verbesina encelioides (Golden crownbeard) is an annual herb growing up to 1.5 m high, native to United States and Mexico. It is naturalised in many parts of the world including Europe, Asia, Australia, and New Zealand. It is considered invasive in the northern Hawaiian Islands due to the displacement of native plant species and the negative impacts it has on breeding colonies of marine birds. The plant spreads through the production of numerous seeds (up to 2,000) per plant, which are produced throughout summer. This species demonstrates an efficient ability for both self and cross-pollination and is very fecund, producing ample winged seeds for local dispersal. In South Africa, *V. encelioides* was first observed naturalised in the Northern Cape Province around Van Zylsrus and has since been recorded in areas around southern-western Free State, Limpopo, and North West where it is more abundant. The species is not yet listed as invasive in South Africa, but rather a candidate for surveillance and evaluation. The



aim of this study was to assess the invasiveness of *V. enceliodes* in South Africa. Australian/New Zealand weed risk assessment was used to assess the potential invasiveness of the species and Southern African Plant Invaders Atlas for locality data and data collected by the authors from 2018 to 2021. To determine the potential distribution of *enceliodes* we developed a species distribution model using MaxEnt 3.3.3e. The distribution map and habitat records indicated that the species has managed to establish in natural areas. Risk assessment results and the species distribution model indicate that the species has a high potential of being invasive in South Africa. *Verbesina enceliodes* is a pioneer species and can thrive in a variety of habitats including natural grasslands, disturbed areas, roadsides and pastures. Although widespread in distribution, populations are still small and therefore needs to be regulated and managed before it becomes a major problem

PLATFORM PRESENTATION: FIRST QUANTIFICATION OF PLANT ENDEMICS IN THE MANICA HIGHLANDS (ZIMBABWE–MOZAMBIQUE), AND CIRCUMSCRIPTION OF THE MANICA HIGHLANDS CENTRE OF FLORISTIC ENDEMISM

Vincent Clark^{1*} and Jonathan Timberlake²

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The 8,200 km² Manica Highlands (MH) are defined as the montane massifs and upland areas between the Zambezi and Limpopo Rivers associated with the Zimbabwe–Mozambique borderlands; it also includes important associated inselbergs such as Serra Mocuta and Mount Gorongosa. The majority of the area lies above 1,200 m elevation, but extends down to 350 m on the Chimanimani foot-slopes and to 800–900 m along the south-eastern margins. The highest elevations are 2,440 m (Mt Binga; the highest mountain in Mozambique) and 2,592 m (Mt Nyangani; the highest mountain in Zimbabwe). Although the MH has been well-botanised from the late 19th to early 21st centuries, a comprehensive list of endemic plant species has never been compiled, nor have patterns of endemism been quantitatively determined. Using *Flora Zambesiaca*, the Flora of Zimbabwe and Flora of Mozambique websites, and "ground-truthing" using herbarium vouchers (K, SRGH), we present the first comprehensive treatment of plant endemics in the MH. The MH has 222 strict endemic taxa, and 11 near-endemic taxa; being the second-smallest component of southern Africa's Great Escarpment, this is one the richest concentrations of endemics/km² in the region (cf. Great Winterberg–Amatholes: 7,400 km², only 35 endemics). The strict endemics comprises 54 Monocotyledons, 167 Dicotyledons and one Gymnosperm (cycad). Five taxa are still to be formally described. The most endemic-rich families are Fabaceae *sensu lato* (12%), Rubiaceae (10%), and Asteraceae (9%). Despite having the highest species richness in southern Africa, there are no endemic Pteridophytes in the MH. Spatial patterns of endemism are complex: 67 (30%) of the endemics occur across the MH – suggesting it is a unified montane Centre of Floristic Endemism – while 88 (40%) are confined solely to the southernmost portion (i.e. south of the Bvumba). Within this southern portion, and with 79 (36%) strict endemics, the Chimanimani Mountains are the strongest local sub-centre of endemism and have the highest local endemic richness, driven by the unique quartzite substrate; the Nyanga area (Nyanga–Rukotso–Serra Choa) forms a second sub-centre, with 21 (10%) strict endemics. Mount Gorongosa has only two endemics, but shares 25 (11%) endemics with the rest of the MH, suggesting that the 125 km-wide topographic interval between them is as negligible biogeographically as the two narrow (c.10 km-wide) topographic intervals within the MH itself. Similarly, Serra Mocuta has one strict endemic, and shares one endemic with the rest of the MH. Open montane habitats are the most important for endemism, hosting 171 (77%) of the endemics, compared to 51 (23%) in forested and wooded habitats. It is not surprising then that the dominant life form is the perennial herb, with 144 taxa (65%). The dominance of open habitat endemics supports the idea of montane grasslands in southern Africa being palaeo-systems that have facilitated rich speciation, and highlights the need for more proactive conservation efforts to protect this habitat in particular; major threats are woody invasive species, mining, poorly managed seasonal fires, and expansion of arable agriculture.

PLATFORM PRESENTATION: THE RESTORATION OF ENVIRONMENT AND PEOPLE - JOBS FOR CARBON PERSPECTIVE

Andre Britz^{1,2}

¹Jobs For Carbon Project, ²Gouritz Cluster Biosphere Reserve

'Jobs 4 Carbon' (J4C) has been the 'Gouritz Cluster Biosphere Reserve' (GCBR)'s flagship initiative for developing "carbon farming" in the Little Karoo. This has been an ongoing programme since 2015, based on the habitat rehabilitation qualities of the spekboom plant (*Portulacaria afra*). A major benefit for the rural communities is that both the J4C and GCBR initiatives create jobs, and therefore, better livelihoods for the residents. The GCBR's J4C programme aims to rehabilitate degraded, arid landscapes by planting spekboom where they used to naturally occur.



Spekboom is an iconic plant that historically dominated large parts of the arid Little Karoo. Hundreds of years of overgrazing have resulted in erosion, reduced water infiltration, loss of ecosystem productivity, and loss of biodiversity. We present a case in which approximately 484 hectares of private land between 16 private landowners was planted with 476,000 spekboom cuttings, for which a 10 to 50-year Memorandum of Understanding (MoA) was signed. These private landowners have also committed an additional 4,080 hectares to passive conservation. Component activities include implementation of fine-scale mapping of potential restoration sites and landscape carbon assessments, training of 72 previously unemployed community members as employees, harvesting and planting of spekboom cuttings, and excluding livestock from planted sites through the use of fences. In the 6 years since its inception, the programme has yielded several major benefits. Firstly, unemployed and unskilled local community members have experienced a boost in their self-confidence and found themselves economically empowered, proud, and upskilled. This has resulted in positive, tangible benefits for the local village, which will perpetuate for generations. Examples include the construction of a new primary school, and improved water and food security through new water reservoirs and vegetable gardens to promote self-sufficiency. Secondly, the spekboom plant sequesters carbon into the soil, thereby improving water infiltration which facilitates the germination and survival of other plant species. This would not occur in similar arid conditions on degraded land. Mature spekboom plants are surrounded by a variety of other mature trees and plants which together provide shelter, food, essential nutrients, and micro-habitats for a variety of micro-organisms, insects, birds, and other animals. It is therefore hoped that a restored ecosystem will emerge from the once eroded, overgrazed and degraded land.

PLATFORM PRESENTATION: THE STORY OF THE GOUKOU RESILIENT RIVER PROJECT

Rita Liebenberg

Goukou Resilient River Project

The objective of this pilot project is to reverse biodiversity loss and connect fragmented habitats of the Goukou River system through wetland rehabilitation and clearing of invasive alien plants. The project involves the river system from catchment to coast which is largely located on private land, with limited to no systematic alien eradication programme being implemented. Alien infestations are increasing rapidly and have a severe impact on the water supply to downstream communities and on biodiversity. The Goukou River system has a number of palmiet wetlands which consist of a very hardy plant *Prionium serratum* and below the surface is a peat layer of approximately 8 – 10 metres in depth. The peat layers act as a sponge and store and release water throughout the year. Seventy per cent of all palmiet wetlands in the Cape Floristic Region have already been destroyed. This project represents the first phase of what is expected to grow into a flagship resilient rivers programme. The first phase of the project is being implemented from 2019-2021 and will need to meet the following milestones: (a) 700 ha mountain catchment and 350 ha lowland riverine habitat (including Palmiet wetlands) cleared of invasive alien plants. By the end of May 2021, the project has completed the initial clearing of 384 ha of lowland riverine habitat and 598 ha of mountain catchment. Follow-up work has been done on 45 ha in the mountain catchment. (b) Active rehabilitation of disturbed Palmiet wetlands; Demonstrable improvement of wetland functioning in the Goukou River system and increased water run-off released into river and estuary. We have done initial clearing covered with a mulch layer of chips where possible of 23 ha of wetland, river course and wetland periphery. We have also implemented a Palmiet rescue and replant trial to re-establish Palmiet within a watercourse. Our indigenous plant nursery is currently growing a variety of local species which will be planted in spring 2021. (c) Training and employment in ecosystem restoration of forty currently unemployed people through independent contractor teams. We have provided contract work for four independent contractor teams consisting of twelve members per team from the local community. We have also established an additional specialised chipper and restoration team (four members) with one of the contractors and we employ two nursery workers. We have also managed to obtain YES programme funding for twelve youth who are placed under the supervision of the contractors. Training has been provided in essential skills for alien species management. (d) Strengthened network of partners mandated to sustainably manage the Goukou River system; Demonstrable progress towards a comprehensive ecological reserve determination of the Goukou River, wetlands and estuary system. To this end, we have established an indigenous plant nursery. We are also creating demonstration sites to showcase indigenous cluster enlargement, selective clearing methodology, creation of mulch layers, erosion repair, and soil stabilisation. This will enable us to determine a set of best practices, provide skills development and a platform for knowledge sharing between stakeholders.



PLATFORM PRESENTATION: THE LIMPOPO–MPUMALANGA–ESWATHINI ESCARPMENT – EXTRA-ORDINARY ENDEMIC PLANT RICHNESS AND EXTINCTION RISK IN A SUMMER RAINFALL MONTANE REGION OF SOUTHERN AFRICA

Vincent Clark^{1*}, John Burrows², Barbara Turpin², Mervyn Lotter³, Kevin Balkwill⁴ and Stefan Siebert⁵

¹University Of The Free State, ²Buffelskloof Herbarium, ³Mpumalanga Tourism & Parks Agency, ⁴University Of The Witwatersrand, ⁵North-West University

Conservation of mountains is key to successful biodiversity conservation. Despite this, the biological diversity of many mountain systems globally – and especially those in southern Africa – remains inadequately documented. Lack of accurate biodiversity data has resulted from: (i) a general decline in baseline taxonomic collecting effort – especially for difficult-to-access mountains; (ii) a predominant focus on phytosociological methods, that by nature do not record fine-scale diversity; and (iii) digital herbarium records only becoming available recently. The Limpopo–Mpumalanga–Eswathini (LME) Escarpment (South Africa–Eswathini) – formerly known as the 'North-eastern Transvaal Drakensberg' – is one of the largest components of southern Africa's Great Escarpment. Covering c.40,000 km², it forms a contiguous highland area from the KwaZulu-Natal–Mpumalanga provincial border in the south, north to the Woodbush area (Limpopo province), and includes rugged western Eswathini. It is characterized by a dramatic, rugged scarp on the eastern side, while the western side merges with the South African Highveld / 'Bushveld' hinterland. Compared to many other southern African mountains, it has been relatively well-botanised over some 150 years, work which is ongoing. Despite this effort, there has never been a comprehensive synthesis of plant endemics data for the LME. Using exhaustive literature mining, coupled with combined decades of fieldwork by the authors, and up-to-date taxonomic assessments of the 46 undescribed species, we provide the first robust list of plant endemics for the LME. The LME has 460 endemic taxa, comprising 9.9% of the provisional flora (of 4,657 taxa). This is more than double the endemic angiosperm species in the Drakensberg Mountain Centre (DCM), and may be the richest concentration of montane endemics in southern Africa outside of the Core of the Greater Cape Floristic Region. This extra-ordinary endemism is represented by 55 families and 148 genera. The top ten endemic-rich families are Asteraceae (11.3%), Lamiaceae (9.8%), Apocynaceae and Iridaceae (7.8% each), Asphodelaceae (7.4%), Fabaceae (5%), Hyacinthaceae (4.3%), Orchidaceae (4.1%), Gesneriaceae (3.5%), Anacardiaceae (3%), and Scrophulariaceae (2.8%). Twenty-seven genera have ≥5 endemic species, the richest genera being *Aloe* (6.1%), *Helichrysum* (5.4%), *Syncolostemon* (4.6%), *Ledebouria* (3.7%), *Gladiolus* and *Streptocarpus* (3.5% each), *Brachystelma* (3.3%), *Asapargus* and *Encephalartos* (2% each), and *Disa*, *Euphorbia*, *Ocimum*, *Searsia*, and *Selago* (1.7% each). Despite the high endemism, there are major conservation concerns for the LME: endemic extinction risk is being accelerated through widespread landscape transformation (especially from mesic montane grassland to commercial forestry); the rampant spread of alien invasive species; poaching of wild plant populations for horticulture; mining; and bush encroachment by indigenous woody species. The charismatic cycads represent this concern most effectively: of the nine endemic *Encephalartos* species – perhaps the richest concentration of montane cycads in southern Africa – two are Extinct in the Wild, five are Critically Endangered, and two are Vulnerable. Our results for plant endemism, combined with parallel local extinctions and increasingly threatened populations of endemic fauna, suggest that the LME should become a major focus of conservation effort between South Africa and Eswathini as a matter of urgency.

PLATFORM PRESENTATION: FORBS FIRST: FORBS SHOW CONSISTENTLY HIGHER ALPHA AND BETA DIVERSITY THAN GRASSES IN A NATURAL GRASSLANDS

Michelle Greve*, Jolani Bezuidenhout, Xavier Brits, Arend De Beer, Joscelyn Howard, Lesego Malekana, Nompilo Mazibuko, Bridgette McMillan, Laura Milne, Megan Roberts and Annerine Myburgh

University Of Pretoria

While grasslands are physiognomically characterised by grasses, they also support a substantial forb flora. However, our understanding of the contributions of grasses vs forbs to the diversity of grasslands has been insufficiently explored. A particular knowledge gap is the contribution of grass vs forb species to total plant diversity differs, and how this changes with spatial grain and scale. Here, we quantify both local richness (alpha diversity) and species turnover (beta diversity) of grasses and forbs of grassland at different spatial grains and two spatial scales. Grassland vegetation plots were surveyed in 48 plots spread across approximately 7 km in Buffelskloof Nature Reserve, Mpumalanga. The richness of grasses was consistently lower than that of alpha diversity of forbs. The difference between grassland and forb richness increased as spatial grain increased because forbs showed higher species turnover between plots. Species turnover of forbs was substantial even at small (< 12 m), and even more



pronounced at a larger (> 2 km) spatial scale. These findings have major implications for the conservation of South African grasslands which are experiencing extensive habitat loss and increasing threats. Our findings suggest that, in order to accurately assess the forb diversity of grasslands, it is essential that grasslands are surveyed intensively across extensive areas. Additionally, the loss of even relatively small areas of land can lead to the local extinction of forb species, though grasses are less threatened by localised habitat loss. This highlights the need for the protection of grasslands.



THURSDAY RESEARCH PROPOSAL POSTER SESSION

Thursday, 29 July 2021, 11:15 - 11:30

Posters can be viewed on twitter [here](#)**RESEARCH PROPOSAL POSTER: ASSESSING THE IMPACTS OF GRAZING LAWNS ON PLANT AND SOIL MITE DIVERSITY IN THE BONTEBOK NATIONAL PARK***Claire Grootboom^{1,2*}, Igshaan Samuels², Adriaan Engelbrecht¹ and Mmoto Masubelele³*¹University Of The Western Cape, ²Agricultural Research Council API, ³SANParks

Herbivores have both positive and negative impacts on natural environments, such as seed dispersal and overgrazing of palatable plants respectively. Herbivore are known to also create grazing lawns, which are nutritious food sources for them, especially during times of drought. However, we do not understand the implications these grazing lawns potentially have for the plant diversity as well as the soil mite diversity in the Fynbos biome. The aim of this study will be to determine how the extent and distribution of grazing lawns have changed over the years in the Bontebok National Park. This study also aims to investigate how grazing lawns affect plant species diversity as well as the soil mite diversity in the park. Furthermore, the study will assess the relationship between the soil mite and plant diversity in the park. The study will analyse whether any changes in the soil nutrient status lead to changes in the soil mite distribution and diversity. Vegetation plots of 10 x 10 m in size will be placed in various grazing lawns within the park, and paired plots with intact Fynbos vegetation will be surveyed for plant diversity at each site. Species will be organized into plant functional types and growth forms for further statistical analysis. The line intercept method will be used for vegetation cover assessment along a 100 m transect adjacent to each plot and plant density will be measured using the step-point method. The changes in sizes of the grazing lawns will be measured by using monitoring data that the Bontebok National Park records on the lawns and also GIS. Four soil cores will be taken at each plot and corresponding plant species will be recorded. The mites will be extracted from the soil and identified by means of a light microscope. Soil pH, texture, bulk density, organic carbon and water holding capacity will be estimated. Soil N, P and K of these soil samples will be assessed using verified laboratory techniques. This study is important as it will give insight and information on the impacts of herbivores on plant and soil mite diversity when creating, maintaining and spreading grazing lawns.

RESEARCH PROPOSAL POSTER: DETERMINING THE OPTIMUM PHENOLOGICAL STAGE FOR HARVESTING *CALOBOTA SERICEA* FODDERS*Ethan Britz^{1*}, Francois Müller², Clement Cupido², Igshaan Samuels² and Lilburne Cyster¹*¹University Of The Western Cape, ²Agricultural Research Council API

Calobota sericea has been identified as an alternative fodder species for the semi-arid agro-ecosystems of Namaqualand in the Northern Cape Province of South Africa. In these Namaqualand rangelands, *C. sericea* was shown to form an important part of the fodder flow plan of communal farmers within the Leliefontein communal rangelands of South Africa. It was subsequently suggested that *C. sericea* could have the potential to significantly reduce dry season feed gaps within these areas. However, little is currently known about the nutritional quality of the species. Therefore, this project aims to evaluate the effect of the phenological stage on the nutritional quality of *C. sericea*. Five collection sites within the Leliefontein communal rangeland will be used within which three replicates (consisting of a composite sample of five individual plants) per phenological stage will be collected. The plant samples will be oven-dried at 60 °C for five days. The dry samples will be milled using a stainless steel laboratory blender. Thereafter, a 0.1 - 0.2 g sample of the dry milled plant material will be digested using 10 mL hydrogen peroxide digestion mixture in a microwave digestion unit. The resulting aqueous solution will be filtered and diluted to volume (100 ml) using deionized water. Total Ca, K, Mg, Cu, Mo, Fe, Zn, Mn and Na concentrations will be determined from the digested samples solution using an atomic absorption spectrophotometer by means of certified standards for these elements. Phosphate content in the digest will be determined using a spectroquant pharo spectrophotometer. Total N concentration in the digest will be determined by direct titration with 0.01 M HCl after Kjeldahl distillation using Büchi Nitrogen Distillation unit. The N content (%) in the samples obtained will be multiplied by a factor of 6.25 to obtain the crude protein (CP) content (%). A sub-sample of the dry plant material will be sent for Fibre (ADF and NDF) analyses at the ARC Animal Production analytical laboratories. Secondary metabolite screening will be done by extracting half of the mass of the sample of the plant material with an 80% methanol and 20% deionized water solution. The solvent will be evaporated from the extract at 35 °C using a Buchi Rotor vapor.



The secondary metabolites will then be isolated based on polarities, using a solvent-solvent extraction method to separate metabolites from the least polar to most polar. The outcome of the study would be to know how the phenological stage influences the nutritional quality of the *C. sericea* fodders in order to inform farmers as to the best time to harvest the materials for their livestock.

INVESTIGATING THE IMPACT OF CLIMATE CHANGE AND NATURAL RESOURCES MANAGEMENT ON THE PREMIUM BEEF VALUE CHAIN, IN THE EASTERN CAPE, SOUTH AFRICA: NDVI APPLICATIONS

Nkwenkwezi Myeki^{1}, Anthony Palmer^{1,2}, Retief Celliers³ and Bukho Gusha²*

¹Agricultural Research Council API, ²Rhodes University, ³Nelson Mandela University

Currently, the premium beef livestock production sector plays an important role in food security in the Eastern Cape. The predicted climate changes for the region (increased aridity and increased temperature) is a concern for this production system which is wholly dependent upon rangeland. Climate change is also a threat to livestock production because of the impact on the quality of feed crop and forage, water availability, milk production, livestock diseases, animal reproduction, and biodiversity. An improved understanding of the likely impact of climate change on value chains in livestock marketing is necessary. This study focuses on beef produced from cattle raised on rangeland where they are free-ranging for their entire lifecycle or finished on a grass-based diet, without antibiotics, pain, injuries, diseases or fear. The premium value of the beef produced is applied to free-range products that certify 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 assessment. There is a concern whether these farmers will be able to comply with the certification and meet specifications of the premium market while constrained by climate change and factors that affect the rangeland condition of their farms. In addition, the natural resources to sustain the growing demand for Premium Beef Value Chain are strained. This study aims to assess the impact of climate change on the rangeland's condition of the farms that are participating in a Premium Beef Value Chain Project using earth observation (mainly Sentinel 2 Normalised Difference Vegetation Index (NDVI)). Following an initial veld condition assessment, a benchmark NDVI site will be established on each property which will be explored annually using Google Earth Engine (GEE). We hypothesize that the NDVI will be a reliable forecaster of rangeland health, and there will be a correlation between the degraded veld and veld in good condition. Data will be obtained from Sentinel 2 SR image collection using Javascript in the GEE Code Editor. This study is expected to help farmers understand the importance of improving rangeland management, taking into consideration of climate change. The study will also help the commercial-orientated smallholder farmers to be aware of the importance of natural resource protection, to know the veld condition of veld on their farms, and to ensure that certification requirements are met.



56th Annual Congress

27 - 29 July 2021



Grassland Society
of Southern Africa

SESSION 9 Bush encroachment

SESSION CHAIR: RALPH CLARK

THURSDAY, 29 JULY 2021, 11:30 - 13:00

PLATFORM PRESENTATION: BUSH EXPERT INFORMATION MANAGEMENT SYSTEM (BEIMS)

Klaus Kellner^{1}, Dirk Pretorius² and Reletile Mangani¹*

¹North-West University, ²SMC Synergy

Land degradation as a result of bush encroachment/thickening is a major challenge in Southern Africa. In order to curb this problem, the government initiated bush clearing projects through the Natural Resource Management (NRM) programme driven by the Department of Forestry, Fisheries and Environment (DFFE) in different parts of the country. The Terrestrial Ecology Section in the School of Biological Sciences and Unit for Environmental Sciences and Management (UESM) of the Faculty of Natural and Agricultural Sciences (FNAS) at the North-West University (NWU) focus their research on land degradation and restoration/rehabilitation ecology of arid- and semi-arid rangelands. The research mainly focuses on Sustainable Land Management (SLM) and the impacts on Ecosystem Services (ES) but also includes research on impacts of desertification, land degradation and drought on rangelands, especially after bush encroachment. This led the research team to initiate the development of the Bush Expert Information Management System (BEIMS) in collaboration with SMC Synergy. BEIMS consists of the EcoRestore Decision Support System (DSS) containing guidelines on restoration after bush control and the Bushmon database that contain information (including spatial location) of bush encroachment restoration research projects. This system will help land users to make scientifically sound decisions regarding the restoration/rehabilitation and sustainable management of their degraded land. Furthermore, the system will also give expert assistance on how to implement technologies of bush control. BEIMS is an easily accessible online system that can also be linked to a stand-alone Global Information System (GIS) through a spatial database link. Future development of BEIMS will include an updated data capturing module, illustrated manual on bush control and information regarding the problem of bush encroachment and restoration/rehabilitation activities that can be implemented.



PLATFORM PRESENTATION: CHANGES IN HERBACEOUS VEGETATION ALONG A SHRUB ENCROACHMENT INTENSITY GRADIENT IN THE MONTANE RANGELANDS OF SEHLABATHEBE IN THE QACHA'S NEK DISTRICT OF LESOTHO

Retselisitsoe Stephen*, Peter Chatanga, Lerato Seleteng-Kose, Botle Mapeshoane and Makoala Marake

National University Of Lesotho

Rangelands cover approximately 45% of the earth's land surface and provide various ecosystem services. However, these ecosystems are facing a problem of shrub encroachment, attributable to overgrazing, among other factors. Lesotho's rangelands (grassland and wetlands) cover approximately 50.7% of the country's land surface and underpin livestock production. Although these rangelands are currently experiencing widespread shrub encroachment, estimated at 19.1% of the country's land area, information on the effect of encroachment on plant diversity is scarce. Therefore, the aim of this study is to assess how an increase in shrub encroachment intensity in the montane rangelands of Sehlabathebe in the Qacha's Neck District of Lesotho may be correlated with changes in herbaceous species abundance and diversity. Fifty 4 m × 4 m vegetation plots were randomly selected on a shrub-encroached rangeland area. In each plot, shrub species data, including canopy cover, richness, density, and height were recorded. The Braun-Blanquet method was used to assess herbaceous vegetation. Data on environmental variables were collected using standard methods. All the data were analysed using regression analysis, correlation analysis, and ordination. In total, 92 herbaceous and 15 shrub species were recorded. The most frequently occurring shrubs ($n = 50$) were *Chrysocoma ciliata* (98%), *Inulathera thodei* (88%), *Helichrysum trilineatum* (84%), *Selago flanaganii* (64%), and *Selago melliodora* (24%). Shrub density had a significant positive correlation with herbaceous species richness and Shannon-Wiener diversity ($p < 0.05$). While a significant negative correlation was found between shrub canopy cover and graminoid species richness ($p < 0.05$), shrub density had a significant positive correlation with forb species richness ($p < 0.05$). Redundancy analysis revealed that *Carex* sp, *Festuca caprina*, *Melica decumbens*, *Agrostis lachnantha*, and *Kniphofia caulescens* were positively associated with *S. melliodora* canopy cover. The ordination further revealed that shrub species richness was negatively related with the abundance of *Cynoglossum austro-africanum*, *Gazania krebsiana*, *Nemesia rupicola*, *Sebea sedoides*, *Senecio asperulus*, and *Wahlenbergia appressifolia*, while shrub species Shannon-Wiener diversity was negatively correlated with the abundance of *Cineraria lyrata* and *Selaginella imbricata*. Shrub species density was also found to be negatively correlated with the abundance of *Bulbostylis humilis*, *Cynodon hirsutus*, *N. rupicola*, and *Pseudognaphalium luteo-album*, while shrub species evenness was negatively correlated with the abundance of *Argyrobolus sericosemium*, *B. humilis*, *Catalepis gracilis*, *C. hirsutus*, *Pennisetum sphacelatum*, and *P. luteo-album*. The correlation analysis of edaphic properties and shrub attributes indicated that shrub density decreased significantly with an increase in clay content ($p < 0.05$) and increased significantly with increasing sand content ($p < 0.05$). The findings of this study suggest that increase in shrub encroachment intensity may reduce the richness, diversity, and evenness of graminoids, while increasing the diversity and evenness of forbs. This implies that shrub encroachment compromises the condition of montane rangelands because grazable forage in these ecosystems comprises primarily graminoids and not forbs. The current study, therefore, recommends that effective shrub control methods should be investigated and employed for the sustainable provision of rangeland ecosystem services.

PLATFORM PRESENTATION: SYNDROMES AND SYMPTOMS: TRAITS OF SAVANNA SEEDLINGS LINKED TO WOODY ESTABLISHMENT

Laura Milne^{1*}, Michelle Greve¹, Nicola Stevens², Monique Botha¹, Joscelyn Howard¹ and Kenneth Oberlander¹

¹University Of Pretoria, ²University Of Oxford

The establishment of woody seedlings is one of the major bottlenecks in the establishment of trees. African trees must not only adapt to abiotic stresses such as drought, but also to disturbances such as fires and herbivory, which are widespread across the continent. Understanding the adaptive role of seedling traits in surviving abiotic stresses and disturbances is important for the management of woody communities in rangelands. Therefore, the aim of this study was to identify potential syndromes in woody seedlings exposed to different environmental and disturbance gradients in African savannas. The objectives were to characterise morphological and anatomical traits of several mimosoid species and to investigate the trade-offs between various resource allocation strategies. We expected plant investment trade-offs between desiccation avoidance and herbivory and fire tolerance. Twelve mimosoid species were planted in an experimental setting and several aboveground and belowground traits were quantified at the age of 60 days. Additionally, average water stress, herbivore exposure and fire intensity experienced across the range of each species were quantified from GBIF records and GIS maps. Phylogenetically weighted linear models



were used to investigate trade-offs and correlations between traits. A constrained ordination analysis and linear models were used to investigate the relationships between trait complexes and environmental factors. Seed size correlated with several traits indicating early seedling vigour, e.g. height, diameter and cotyledon mass. Additionally, species that invested strongly in rapid growth, linked to escape strategies, invested less in traits linked to persistence strategies. Arid species prioritised root expansion at greater depths than mesic species. Species exposed to high levels of herbivory invested less in stem biomass. Fire-prone species invested more in stem insulation (such as stem conicity, wood density and outer bark thickness). Species exposed to high-intensity fires invested in recovery strategies (such as shorter, thicker roots for storage and buds located close to the soil surface). Our results suggest that tree species exposed to different pressures display different adaptive traits, even from the seedling stage. Species either invest in strategies to avoid stem death or to recover after biomass loss. Understanding the adaptations of trees to abiotic and disturbance pressures from a young age can aid in the management of these species in areas of different climates, and in areas undergoing woody encroachment.

PLATFORM PRESENTATION: STEAL THE RAIN: RAINFALL INTERCEPTION LOSSES BY ENCROACHING FINE-LEAF AND BROAD-LEAF WOODY SPECIES IN A SOUTH AFRICAN SEMI-ARID SAVANNAH

Felix Skhosana^{1}, Nicola Stevens², Graham Von Maltitz³, Mohau Mateyisi⁴ and Guy Midgley⁵*

¹Council For Scientific And Industrial Research, ²University Of Oxford, ³Independent Researcher, ⁴CSIR, ⁵Stellenbosch University

Woody encroachment is one of the most complex phenomena impacting ecosystem functioning and services in arid and semi-arid savannas. Due to a growing concern that woody encroachment may result in less water availability for herbaceous plants and groundwater recharge, we aimed at investigating the impact of woody encroachment on rainfall partitioning into throughfall, stemflow and interception across a gradient of encroachment by *Terminalia sericea* (a broadleaf species) and *Dichrostachys cinerea* (a fine-leaf species) at Wits Rural Facility in the Limpopo Province. We quantified gross precipitation (the amount of rain falling in the open), throughfall (the amount of rain falling through the tree canopy to the ground) and stemflow (the amount of rain falling through tree stems) at plot level. Interception was then calculated by subtracting throughfall and stemflow from gross precipitation. The sampled 25m² plots were chosen from low (1-2 trees), medium (5-6 trees) to high (> 10 trees) densities (stems/m²) to represent the gradient of woody encroachment. Canopy cover and tree basal area (TBA) was also quantified at plot level to represent the encroachment gradient. Using a generalized linear mixed-effects model the preliminary results show that, throughfall significantly ($p < 0.05$) decreased with increase in TBA from about 90% and 80% at 2m²/ha to about 70% and 50% at 30m²/ha for *T. sericea* and *D. cinerea*, respectively. *T. sericea* had a significantly ($p < 0.05$) higher average throughfall (83%) compared to *D. cinerea* (68%). *D. cinerea*, however, had a slightly but non-significantly higher average stemflow (1%) per average TBA compared to *T. sericea* (1.5%) and the model also predicted an increase in stemflow from about 0.1% to 5% with an increase in canopy cover from 2m²/ha to 30m²/ha for both species, respectively. In terms of "stealing the rain", *D. cinerea* significantly ($p < 0.05$) intercepted more rain (29%) on average compared to *T. sericea* (16%) per average TBA which can be attributed to it being a fine leaf species with relatively high surface area to volume ratio, which aids in water capture. The model predicted a significant ($p < 0.05$) increase in interception losses from 20% and 10% at 2m²/ha to 50% and 30% at 30m²/ha for *D. cinerea* and *T. sericea*, respectively. These high interception losses by these encroaching species in a semi-arid system that received more than 70% of the recorded rainfall events comprising of small events of less than 10mm raise serious ecological concerns in aggravating the dryness as some of these small events can be completely captured by the canopies and evaporated back into the atmosphere. The impact can even be worse for much drier and water-scarce systems.

PLATFORM PRESENTATION: SOME REALITIES OF THE PRIMARY PRODUCTION AND WATER USE OF SEMI-ARID RANGELANDS IN THE EASTERN CAPE: PRELIMINARY RESULTS FROM EDDY COVARIANCE TOWERS IN THE GREAT FISH THICKET, BHISHO THORNVELD AND BEDFORD DRY GRASSLAND

Anthony Palmer^{1,2}, Kathleen Smart², Craig Weideman², Carolyn Palmer²*

¹Agricultural Research Council API, ²Rhodes University

The efficiency with which native rangelands sequester carbon and evaporate water during the process in semi-arid natural rangelands has been a long-standing debate. Policy implementation by the government has been built on unsubstantiated claims of greater efficiency of certain ecosystems to exceptional carbon sequestration ability. In addition, the presence of high above-ground biomass has misled policymakers into believing that the presence of



woody shrubs and trees is an indication of ecosystem efficiency at sequestering carbon. One of the most trustworthy ways of assessing the true performance of an ecosystem's ability to capture carbon is to install an eddy covariance flux tower over the canopy. Not only does the tower provide a true reflection of the quantum of the mass (carbon) and energy (water) fluxes over the vegetation, but it also provides a measure of the water use efficiency of the process. The quantum has relevance to the amount of carbon that can be stored above and below the ground, and that provides concrete evidence for farmers and land managers to claim carbon credits in the global effort to remove CO₂ from the atmosphere. We installed eddy covariance flux towers in the Great Fish Thicket (28 months) and in a paired-tower experiment in the Bhisho Thornveld and Bedford Dry Grassland. We report in detail on the results from the Great Fish Thicket and present preliminary results from the paired experiment. Several studies point to Succulent Thicket being able to achieve exceptional levels of carbon sequestration. Unfortunately, two years of eddy covariance data from the Great Fish Thicket does not support these claims. Similarly, the woody encroachment associated with Bhisho Thornveld into the grasslands of the Bedford Dry Grassland indicates very small differences in carbon sequestration rates between the two sites. Our results point towards the need for an improved understanding of the role of respiration (soil, whole plant and stem), as this process appears to play a very important role in reducing the net carbon gain of these ecosystems.



THURSDAY STANDARD POSTER SESSION

Thursday, 29 July 2021, 13:00 - 14:00

Posters can be viewed on twitter [here](#)**STANDARD POSTER: NASSELLA NEESIANA IS AN INVADER TO WATCH IN SOUTH AFRICAN MOUNTAINS**Anthony Mapaura^{1*}, Kim Canavan², David M. Richardson³, Vincent Clark¹ and Sandy-Lynn Steenhuisen¹¹University Of The Free State, ²Rhodes University, ³University Of Stellenbosch

Nassella neesiana was accidentally introduced as a "stowaway" in hay from Argentina in the early 1900s, together with *N. tenuissima* and *N. trichotoma*. While *N. neesiana* is currently not a listed invader in South Africa, it is an invader of major concern in Australia and New Zealand, countries with similar socio-ecological systems to South Africa. Consequently, it may still have a negative impact in South(ern) Africa, despite its long "lag phase". Very little is known about *N. neesiana* distribution in South(ern) Africa, and it may be posing as a "cryptic invader" as evidenced by recent locality records and detailed population assessments undertaken at one of these new localities. Recently, in 2020, incidental records of *N. neesiana* have been confirmed in the Eastern Cape, Western Cape, and Free State. Considering records for the period 2007–2016 in the Somerset East area (Eastern Cape), it appears that *N. neesiana* is much more common and widespread than post-2017 records show. At one of the new localities – "Platberg Stream" (1621–1725 m asl) at which the species was recently recorded – a detailed population mapping exercise was done in March 2021. This study investigated two questions: (1) How widespread is *N. neesiana* in the Harrismith district? and, (2) What is the impact of *N. neesiana* on the environment? For (1), sub-populations were located visually by visiting a selection of open areas on the north-eastern side of the Harrismith urban area together with, a systematic search for sub-populations along "Platberg Stream". For (2), 14 pairs of 2 x 2 m plots (total 28 plots) were sampled from all identified sub-populations, each pair comprising an invaded and a non-invaded site within 3 m of each other. In each plot, all vascular plant species were recorded, and the cover-abundance of each species was visually estimated. The number of *N. neesiana* plants in each invaded plot was counted. A total of seven *N. neesiana* sub-populations were recorded, four being along "Platberg Stream", and three in other open spaces. The total area invaded by *N. neesiana* was 19534 m², with sub-populations ranging from 30 m² to over a hectare and all in disturbed areas. Tuft densities ranged from 3–21.5 tufts per square metre; tuft basal diameter from 2–130 cm and between 2–3 culms to many culms per tuft. The smaller tufts were recorded where the combined density of other plants was high. Species composition, diversity, and evenness did not differ significantly between invaded and uninvaded areas, but invaded areas had a slightly lower indigenous plant diversity ($p < 0.02$). Thirty-five species representing 12 families were recorded. Nineteen species are indigenous, six are naturalised invaders and 10 are naturalised non-indigenous and non-invasive species. *N. neesiana* appears to gradually infiltrate vegetation in disturbed and riparian contexts, however, its overall impact on native diversity remains unknown. The possible more extensive presence of *N. neesiana* in eastern and southern South Africa requires investigation and further quantitative population and environmental impact studies be conducted.

STANDARD POSTER: HOW DOES OVERGRAZING KILL A GRASSLAND FORB?

Craig Morris

Agricultural Research Council API

Many of the numerous herbaceous forbs that make up most (> 80%) of the species diversity of mesic grasslands in South Africa (> 650 mm a⁻¹) are fire-adapted but grazing intolerant. These forbs can survive having all their exposed growth repeatedly removed by dry season fires or mowing because they have growth reserves buried in underground storage organs (USOs) such as thickened rootstocks, rhizomes, bulbs, root tubers, or corms. These USOs provide the resources (non-structural carbohydrates, minerals, and water) required for resprouting in spring and enable forbs to tolerate severe frost and drought. However, despite having a high proportion of their biomass protected underground, mesic grassland forbs can be killed by chronic heavy livestock grazing, which can severely deplete plant populations as well as species richness and diversity. This study examined whether frequent, severe clipping during the growing season – to simulate the extensive leaf damage and removal by herbivores that forbs can experience – would reduce the growth and vigour of a grassland forb by negatively affecting its USO. In plot trial, five replicate plants of *Hypoxis hemerocallidea*, a common grassland forb with a corm, were clipped (to 80 mm) six times during the growing season and allowed to resprout in the following spring in full or restricted light to measure the



contribution of store reserves to regrowth compared to undefoliated controls. Defoliated plants were resilient to defoliation during the growing season, producing the same total amount of biomass (including offcuts) as unclipped plants. In the following spring, plants growing in the dark were able to draw upon reserves stored in corms to match the growth of plants growing in full light, confirming the importance of USOs. However, the negative effects of defoliation were carried over to spring when previously clipped plants produced a third less growth and 40% fewer inflorescences than unclipped plants. Surprisingly, and importantly, clipping more than halved the mass of corms. Above-ground spring regrowth was also positively correlated with corm mass, indicating the importance of maintaining large reserve pools in USOs. These results indicate that geophytic forbs are sensitive to herbivory because recurrent damage to their aerial parts can diminish their underground storage organs, reducing potential regrowth. Under sustained overgrazing, plants would therefore likely be progressively weakened and eventually die. Moderate stocking densities and regular burning, coupled with regular full-season rests to enable forbs to replenish their USOs, are recommended to maintain the vigour and longevity of mesic grassland forbs. Trampling by dense herds or flocks should be avoided.

STANDARD POSTER: CHARACTERIZING WOODY VEGETATION AROUND THE EFTEON FLUX TOWER AT BENFONTEIN NATURE RESERVE (BNR), SOUTH AFRICA

Buster Magonong^{1*}, Helga Van Der Merwe², Tshililo Ramaswiela², Amukelani Maluleke³ and Gregor Feig⁴

¹Wits University, ²SAEON, ³Stellenbosch University

Size class distribution (SCD) methods have been widely used to describe woody vegetation population structure. Furthermore, population characteristics such as health and direction (i.e. growing or declining) can also be explained by SCD analysis. These methods use stem diameter and/or height classes to categorize the woody vegetation. We sought to apply the SCD methods (using height) to describe the woody vegetation around an EFTEON (Expanded Freshwater and Terrestrial Environmental Observation Network) flux tower at the Benfontein Nature Reserve, Kimberley, South Africa. We used height classes due to a lack of circumference data for the recruits. We surveyed woody vegetation in five 1 ha plots following the SEOSAW (Socio-Ecological Observatory for Southern African Woodlands) protocol for woody vegetation. We recorded each individual of woody species to obtain information on the diversity and abundance. Tree height and stem circumference for the large trees (ranging between 1.2 to 9.5 m in height) were measured, while only tree height was measured for the recruits (tree individuals between 0 and 1 m in height). We found a total of 1007 tree individuals belonging to five species in the plots. The most dominant species present was *Vachellia erioloba* which accounted for 51.6% of the total number of trees. Recruits constituted 95.9% of the overall woody vegetation abundance in the landscape, while only 4.1% were large trees. The population structure of the woody vegetation yielded a Type IIIa curve i.e. a population that is missing one or more height size classes, for all tree species except for *Ziziphus mucronata* which yielded a Type IIIb curve representing a population structure that is missing small-sized trees. The results indicate that the sampled tree species populations are healthy and have a high number of recruits. Long term monitoring in this reserve is needed to capture the dynamics (e.g. recruits and adult growth rates, mortality etc.) of the woody vegetation, including the keystone species *V. erioloba*.

STANDARD POSTER: NITROGEN-FIXING GENE FOUND ASSOCIATED WITH THE ROOTS OF MESIC GRASSES IN SOUTH AFRICA

Craig Morris^{1*}, Richard Burgdorf², Tinta Morris³, Steven O'Connor⁴, Michael Relihan⁴, Heather Tredgold⁵ and Matthew Van Wyngaard⁵

¹Agricultural Research Council API, ²ICFR, ³Stellenbosch University, ⁴KZN Department Of Agriculture And Rural Development, ⁵University Of KwaZulu-Natal

Nitrogen, a key element in all ecosystems including grasslands, is typically made available to plants through microbial decomposition of soil organic matter or by fixation of gaseous N by *Rhizobium* bacteria symbionts of legumes. Grasses are believed to obtain N primarily by the former pathway, less commonly via free-living N-fixing soil bacteria (diazotrophs) associated with a few cereal and tropical grass species, or from endophytes in roots, shoots, or stems, such as in some varieties of sugarcane (*Saccharum officinarum*). Recently (2016), the roots of *Themeda triandra* in the Serengeti were found to harbour diazotrophs that fix large amounts of N, contributing substantially to ecosystem productivity. Our study aimed to discover whether N-fixing bacteria associate with local mesic grasses and on which types of grasses they are most prevalent. We searched for the presence of the nitrogenase gene, *nifH*, occurring on or inside the roots of four mesic grassland species ranging in applied mineral N-responsiveness from *Eragrostis curvula* > > *Themeda triandra* > *Tristachya leucothrix* > > *Aristida junciformis*, with

the strongest association expected for grasses dominant on dystrophic soils (esp. *A. junciformis*). DNA extracted from roots (shaken clean of soil and then milled) from 20 individuals of each species growing in a species-rich suburban mesic grassland was amplified by polymerase chain reaction (PCR) using a *nifH* gene-specific primer and DNA of *Bradyrhizobium japonicum* from soyabean as a positive control. Results were visualised by electrophoresis. The N-fixing gene was found in 43 of the 80 root samples (53.75%). Species varied in the likelihood of occurrence of *nifH* ($\chi^2_{6 \text{ df}, n=80} = 47.677$, $p < .0001$) with the highest proportion of absences for *T. triandra* (75%) and *T. leucothrix* (65%) and with the highest likelihood of occurrence (based on gels and degree of amplification) for *E. curvula* (85% highly likely) followed by *A. junciformis* (25% likely, 45% highly likely). This result was surprising, indicating that low-N tolerant and nitrophilous species could depend on N fixation, perhaps enabling the former to at least survive and the latter to thrive on low-N soils. Diazotrophs, though occasionally present, might not be as important for *T. triandra* and *T. leucothrix*, which are abundant in good-condition mesic grasslands. Further work on these samples will aim to sequence and quantify the *nifH* gene abundance found on each species. This first discovery of the potential for N-fixation by root-associate bacteria in a South African grassland indicates that grass-diazotroph associations need to be considered when understanding the N economy of grasslands. Further research is required to, inter alia, culture and identify N-fixing bacteria species, ascertain whether they are endophytic or rhizoplane specialists, and quantify seasonal variation and the influence of soils, environment, and fertilizer N on their fixation and provision of nitrogen to the grass plants.

STANDARD POSTER: CHEMICAL COMPOSITION AND DRY MATTER DEGRADABILITY OF SOME NATIVE WOODY SPECIES AS INFLUENCED BY SEASON IN DIFFERENT RANGELANDS OF SOUTH AFRICA

Humbelani Silas Mudau* and Khuliso Ravhuhali

North-West University

Exploring the use of native browse species for animal nutrition can be a vital force towards enhancing livestock production in semi-arid areas. Native browse trees contribute to the bulk diet of forage material available to most ruminants and wild animals. Browse trees are the cheapest and most accessible animal feed during the drier months of the year and are the most common alternative feed resource for financially constrained communal farmers. The research was conducted to assess the browse species variation in chemical composition, predicted chemical estimates and *in vitro* dry matter degradability as influenced by seasonal (summer and winter) changes. The study was carried out at Thulamela Local Municipality (Limpopo) with a very high number of ruminants that do rely entirely on the rangeland. The tree species were harvested in communal areas (Makuya and Lamvi) of Thulamela Municipality around Vhembe District in Limpopo province. The communal areas are located within 40 to 50 km from Kruger National Park. Fresh leaves (ten trees per species) from randomly selected sixteen trees species (*Acacia karoo*, *Acacia nigrescens*, *Acacia nilotica*, *Balanites maughamii*, *Berchemia discolor*, *Berchemia zyheri*, *Bridelia mollis* Hutch, *Combretum collinum*, *Combretum imberbe*, *Dalbergia melanoxylon*, *Dichrostachys cinerea*, *Grewia monticola*, *Grewia occidentalis*, *Melia azedarach*, *Ziziphus mucronata* and *Ormocarpum kirkii*) were harvested green from the site by hand in two seasons (summer and winter) and dried at room temperature and then ground for analysis. Chemical composition and *in vitro* ruminal degradability data were analysed based on a two-way factorial treatment design in a completely randomised design. *Melia azedarach* (343.7 g/kg DM) had the highest ($p < 0.05$) CP content in summer. In winter, *B. maughamii* (210.3 g/kg DM) had the highest ($p < 0.05$) CP content. With an exception to *D. cinerea*, *G. occidentalis*, *A. karoo* and *M. azedarach* all other browse species had higher ($P < 0.05$) NDF in summer when compared to the same species in winter. In the summer season, *Bridelia mollis* H, (502.3 g/kg DM); *A. nigrescens* (321.0 g/kg DM), *A. nilotica* (325.2 g/kg DM) the highest ($p < 0.05$) ADL content and while in winter *D. cinerea* (355.8 g/kg DM) had the highest ($p < 0.05$) ADL content. *Combretum collinum* (2.90 Mcal/kg) had a highest ($p < 0.05$) ME value in summer. Within each species, *B. mollis* H, *B. maughamii*, *B. discolor*, *C. collinum*, *C. imberbe*, *O. kirkii*, *A. nigrescens*, *A. nilotica*, *G. occidentalis* and *B. zyheri* had the same ($p > 0.05$) DMD48 values across two seasons. We can conclude that in the winter and summer seasons, a majority of the studied browse species are an ideal protein supplement to low-quality natural grasses so as to meet the nutritional requirements of ruminants. Further studies can be made to investigate the bioactive compounds in these browse trees for amelioration.

**STANDARD POSTER: CAN LIVESTOCK GRAZING ON CALIFORNIA RANGELANDS REDUCE THE POTENTIAL FOR AND SEVERITY OF WILDFIRES AT THE LANDSCAPE SCALE?**

Theresa Becchetti*, Katherine Siegel, Stephanie Larson, Matthew Shapero, Fadzayi Mashiri, Lulu Waks, Luke Macauley and Van Butsic

University Of California

Livestock grazing has been removed from many rangelands due to concerns grazing negatively impacts ecosystems. Historically grazing pressure was one of the greatest tools for reducing fine fuels that carry wildfires on a landscape scale. The past decade in California has seen a rise in the amount and size of wildfires and the 2020 fire season alone saw five of the top six largest fires in the state's history. Mega-fires and unprecedented expenditures on fire suppression have resulted in a renewed focus on pre-suppression management. Data suggests that grazing may reduce fire severity and size, however, there is little research into the effects of grazing on fire at the landscape scale. We ask if livestock grazing on California rangelands can reduce the potential for and severity of wildfires in California at the landscape scale. Using past data of wildfires, climate, vegetation type, land ownership and biophysical variables we determined if grazed areas burned less frequently and/or with less severity than non-grazed areas. In addition, we seek to identify trade-offs and synergies between grazing and wildfire management. Grazing by livestock is likely the most cost-effective and practical treatment to apply across large landscapes to manage herbaceous fuels over the long term.

STANDARD POSTER: RESTORATION POTENTIAL OF SELECTED GRASS SPECIES ON DIFFERENT SLOPE GRADIENTS IN MESIC HIGHVELD GRASSLAND

Modau Norman Magoro*, Thabile Mokgakane, Ontiretse Keromecwe and Matome Collen Rabothata

Mpumalanga Department Of Agriculture, Rural Development, Land And Environmental Affairs

Mesic Highveld grassland is listed as threatened, the main threats being the expansion of activities such as coal mining, commercial agriculture and unplanned urban development. Prospecting activities and railroad development are ongoing advances to meet National Development Plan goal. The success of restoration plans depends not only on the adaptability of individual grass plants used but also on the ability of grass species to thrive on different slope gradients. Continuing research efforts on the restoration of this fragmented ecosystem are consequently essential. Most grass species offer acceptable and optimum restoration ability at slope gradient between 5% -25%. This study was conducted to evaluate restoration abilities of grass species along railroad different slope gradients along a railroad that was recently restored in 2015. The following mixed grass seeds were used to target the areas to be restored. Experimental mixed grass seeds used were *Digitaria eriantha*, *Cynodon dactylon*, *Cenchrus ciliaris*, *Eragrostis chloromelas* and *Hyperhennia hirta*. Mixed seeds were planted at twice their sowing rate to limit poor germination and survival ability of grass species. Slope gradients were measured on four different restoration sites and categorised in five scales (5%-10%, 11%-17%, 18%-25%, 26%-34% and > 35%) respectively, where 5% slope gradient scale was classified as near footslope and > 35% scale as being the highest slope of the study area. Braun-Blanquet method of botanical surveys was used (1m² relevé) to quantify the composition and densities of individual experimental grass species. Grass composition and density of different species varied along slope gradient. *Digitaria eriantha* and *C. dactylon* had a relatively similar density of 4-6 plants per 1m² at slope gradient > 26%, but the density and composition of *D. eriantha* declined to < 2 plants per 1m² at slope gradient < 10%. *Cynodon dactylon*, *E. chloromelas* and *H. hirta* density increased as the slope gradient decreased below 10%. *Cenchrus ciliaris* had an optimal germination rate, but with a low survival rate across all relevé on the study site and had an insignificant role in the restoration process of the study area. *Cynodon dactylon* and *E. chloromelas* were expected to withstand high slope gradient due to their localised natural ability of early establishment and competing ability during the early growing stage and can both withstand competition. *Digitaria eriantha* is not a common native grass of the study area, but it survived at a relatively higher slope gradient of the study area. The study showed an adaptive ability of *D. eriantha* to grow on different slope gradients as compared to other grasses used in the experiment, and also showed to have optimum ability to be used as reliable restoration grass across all slope gradients. The study will continue to provide appropriate guidelines on suitable restoration grass species and management technologies to use in mesic highveld grassland prior to establishment.



STANDARD POSTER: FAECAL ANALYSIS: THE USE OF N, P AND NA AS AN ADJUNCT TO TRADITIONAL RANGE EVALUATION METHODS

Mike Peel^{1}, Rina Grant^{2,3}, Lucas Manaka¹, Sweetness Myeni¹ and Dalton Masia¹*

¹Agricultural Research Council API, ²Nelson Mandela University, ³Rhodes University

Long term grass and tree trends are looked at as response variables driven by climate (in particular rainfall) and management actions (in particular animal number and type as influenced by water provision, fire and fencing). We contend that in addition to vegetation as the main indicator of system health, animal condition can be used as an important adjunct to determining appropriate or 'safe' stocking rates at the ranch and protected area scale. We look at how the nutrient status of animals may be used to assist in the setting of appropriate management guidelines under varying environmental and management regimes. By comparing faecal N (fN) concentrations over time we propose thresholds that indicate dietary deficiencies in drought, normal and above-average rainfall seasons. Looking at faecal P data over a long period of time, we further propose thresholds that indicate deficiencies that may result in lower reproductive and weaning success. In conjunction with vegetation monitoring, faecal analysis is used to assess whether applied stocking rates allow the full spectrum of grazers, mixed feeders and browsers in African savannas to select for a diet of sufficient quality to maintain them in a healthy nutritional and reproductive condition. We illustrate the usefulness of this approach where we examine for example fN content versus Grass Standing Crop (GSC) in a fenced protected area. At the onset of the drought in 2014/15 it became apparent that the selective feeders (in this instance blue wildebeest) condition declined as the grass layer became stressed and a feeding programme was implemented which carried these animals through the drought as illustrated in 2015/16 through 2019/20 fN levels all the while ensuring 'safe' stocking rates were maintained.



56th Annual Congress

27 - 29 July 2021

Agricultural Research Council

*Grassland Society
of Southern Africa*

SESSION 10

SPECIAL SESSION

Herding into the future: key lessons for future range management and biodiversity

SESSION CHAIR: CLEMENT CUPIDO

THURSDAY, 29 JULY 2021, 14:00 - 16:15

The special session will focus on the complexity of herding and offer key lessons for future range management and biodiversity. It aims to showcase the recent research done on herding as a rangeland management tool.

Objectives:

- To illustrate the complexity of herding and how ancient skill impacts (a) biodiversity recovery and (b) livestock performance within communal and commercial systems;
- To illustrate the complexity of herder knowledge production in Namaqualand;
- To demonstrate how herding is incorporated into holistic and regenerative farming 'systems'

KEYNOTE ADDRESS: RE-HERDING THE SOUTH AFRICAN AGRICULTURAL LANDSCAPE - KEY LESSONS FROM TRADITIONAL PASTORALISM

Igshaan Samuels

Agricultural Research Council API

Herding is a management strategy largely used to ensure that livestock has sufficient quality and quantity of food and water to meet their nutritional demands for maintenance, growth and reproduction and sometimes survival. A herding strategy is largely adapted to the local context, thereby, herding takes different shapes and forms and is applied in various farming systems. Studies have shown that herding of livestock has many other multiple benefits including the ability to distribute grazing pressure more uniformly across a landscape, managing livestock mobility to access key resource areas or intentionally applying high-density grazing pressure to the rangeland. Others have successfully used herding as a predator management strategy, job creation, practising cultural lifestyles, knowledge generation and sharing. In South Africa, most extensive livestock systems operate without herders and use technology such as fencing as a substitute to manage grazing distribution and density. Studies have shown that in the absence of herding, predation on commercial livestock farms remains a problem despite the various advanced technologies and control methods used. The paddocking system also takes great strain during drought periods as it limits livestock's access to rangeland resources such as forage, water and shelter, which are often distributed unevenly across the rangeland. Recent changes in the South African livestock industry also include land reform that affects farm ownership, access and management. South Africa's conservation estate is also expanding, thus encroaching on former livestock farms. With many recent changes and challenges facing the livestock industry in the



country and an increase in the interest in high-density grazing and holistic management, herding has become increasingly used on both commercial and land reform farms. We have also seen the emergence of formal herding schools and courses in the country to train herders and farm owners. However, herding, which some have described as an art and a science, cannot be loosely applied. We have also learned from traditional pastoral systems, is that herding is often a "calling" and pastoralists saying that some are born to do it. As such, there are several considerations when herding is introduced and/or expanded in rangelands. Almost two decades of research on herding in the traditional pastoral systems in Namaqualand have provided us with a few key lessons for using herding as a rangeland and livestock management strategy. In this presentation, a comprehensive overview of the benefits and disadvantages of herding will be outlined. An overview of South Africa's extensive livestock farming industry and the current challenges it faces will be given. Thereafter, this presentation will highlight and discuss the requirements for the successful implementation of herding on farms (communal, private and land reform) and how these requirements could be achieved.

PLATFORM PRESENTATION: WILDLIFE-FRIENDLY LIVESTOCK MANAGEMENT PROMOTES MAMMALIAN BIODIVERSITY RECOVERY ON A SEMI-ARID KAROO FARM IN SOUTH AFRICA

BHDV Smuts^{1}, Matthew Schurch^{1,2}, Jeannine McManus^{1,2}, Stefan Goets¹, Lain Pardo³, David Gaynor⁴, Igshaan Samuels⁵, Clement Cupido⁵ and Vanessa Couldridge²*

¹Landmark Foundation, ²University Of The Western Cape, ³Nelson Mandela University, ⁴University Of Pretoria, ⁵Agricultural Research Council API

Agriculture is an essential production system used to feed the growing human population, but at the same time has become a major driver of biodiversity loss and environmental degradation. Employing production methods that restore degraded landscapes can have a positive impact on biodiversity, whilst improving food production. We assessed how mammalian biodiversity, specifically richness and their relative abundances varied on five Karoo farms in South Africa that have been amalgamated and subjected to a transition from traditional livestock grazing. Past sporadic rotational grazing and lethal predator control were changed to wildlife-friendly non-lethal predator management, using human shepherding of livestock under a high-density short-duration grazing regime. We used camera trap data collected over a 4-year period, to determine mammalian species richness and distribution, and relative abundance to investigate temporal changes throughout the conversion from traditional commercial farming practices. In the last year of the study (2019) additional cameras were used to undertake a spatial comparison between the mammalian species on the wildlife-friendly farm and two neighbouring farms, one of which is a traditional livestock farm on which lethal predator controls and rotational grazing was employed, and the other a game farm where no predator control was practised but wildlife was hunted or traded. On the wildlife-friendly farm, we found that mammalian species richness increased by 24% over the duration of the study, with yearly increments. Herbivores showed an increase of 33% in the number of species detected over the four years, while predator species increased by 8%. The relative abundance and distribution of most species also showed increases as the conversion process took place. For example, 73% of the herbivore species detected throughout the study increased in relative abundance on the experimental farm. Similarly, 67% of all species showed an increase in the number of sites occupied over the four years. In the final year of the study, the wildlife-friendly farm had more mammalian species compared to the game farm and the traditional livestock farm, with the latter two farms having a similar number of species when compared to the commencement of the conversion of the wildlife-friendly site. These broad improvements in mammalian biodiversity on the wildlife-friendly farm demonstrate that livestock production can benefit local mammalian biodiversity through a combination of herder grazing management and wildlife-friendly farming.

PLATFORM PRESENTATION: RECOVERY AND COMPOSITIONAL CHANGE OF VEGETATION AFTER HIGH IMPACT TRAMPLING EVENTS IN THE SEMI-ARID NAMA KAROO IN SOUTH AFRICA

Jeannine McManus^{1,2}, Stefan Goets¹, Helga Van Der Merwe³, Igshaan Samuels⁴, Justin Du Toit⁵, Clement Cupido⁴ and BHDV Smuts¹*

¹Landmark Foundation, ²University Of The Western Cape, ³SAEON, ⁴Agricultural Research Council API, ⁵GADI/DALRRD

The semi-arid Karoo is important for livestock production. It is known to have degraded landscapes and slow vegetation recovery rates. With vast areas degraded, employing production practices that promote rangeland restoration has value for both production, and achieving conservation goals. The return of palatable cover with an increased grazing capacity is considered a primary goal of rangeland restoration. We investigated the trampling effect of a sheep herd (~1600 - 2100) kraaled at night, in one location for seven nights. After a kraal was abandoned,



plants were completely grazed or pulverised, leaving exposed, mulched soil. To assess the effect of trampling and regeneration rates of various growth forms we compared vegetation composition, cover and density inside kraals to adjacent areas with low once-off grazing impact, between 12 – 40 months after the trampling event. We predicted that vegetation cover and density would be higher inside kraals and that vegetation would respond more quickly to rainfall events. We predicted that annuals would be replaced by perennial plants resulting in increased perennials inside kraals. To test these hypotheses each plant species was assigned a growth form category of shrub, dwarf shrub, succulent, grass, geophyte, or herb and plant species were assigned a grazing index value (GIV) based on Botha et al. (2009). Additionally, each species was assigned a lifecycle as either annual or perennial. To further test the hypothesis of vegetation responding more rapidly to rainfall in kraaled sites, we tested the relationship between plant cover, density, lifecycles to -rainfall (mm), and -post kraaling age (months), using polynomial regression with a Gaussian link. To disentangle the correlation of time and the quantity of rainfall since kraaling, the effect of rainfall was tested based on five timeframes: first, total rainfall since kraaling; then rainfall over 12, six, three- and one-month rainfall post kraaling event. These same five timeframes were used to test the effect recent rainfall had since the data collection event (i.e. rainfall one-, three-, six-, 12 months since data collection in May 2020). The paired *t*-statistic was used to test for differences in vegetation cover and density of lifecycles, growth forms and GIV of these categories inside and outside kraal sites. We found that vegetation cover ($t = 3.08$, $df = 9$, $p = 0.013$) and perennial plants ($t = 6.57$, $df = 9$, $p = 0.002$) inside the kraal site was significantly higher than outside. The number of dwarf shrubs ($t = -2.63$, $df = 8$, $p = 0.043$) was higher outside of kraals. The GIV was significantly higher inside of kraals ($t = 2.97$, $df = 9$, $p = 0.009$). Only grass density inside kraals had a significant correlation to recent rainfall events with the previous three-month rainfall tally ($R^2 = 0.674$, $p = 0.033$). Intensive trampling events appear to promote rapid recovery of vegetation, improve forage quantity and grazing value, and respond to rain more efficiently. Therefore, trampling can be used to regenerate landscapes for the benefit of both livestock and conservation.

PLATFORM PRESENTATION: HERDING ACADEMY

Johan Bouwer

Herding Academy

The Herding Academy is the first accredited professional land management course for herders, and is pioneering this ancient skill to regenerate landscape functions in order to bridge human-wildlife conflict and improve socio-economic welfare. Founded in 2017 in Graaff Reinet, the Herding Academy is bringing to life the lost art of herding animals by trained professionals and herders, by using livestock to mimic natural migrations through the herd effect that was once seen in the ancient wild herds roaming our ecosystems. Training is aimed at three different levels to support the landowner, decision-maker, professional herder and the introductory herder. The Executive Land Management Course teaches the principles of holistic land management and regenerative mindset for decision-makers, executives and policymakers. This is a corporate leadership experience in the Karoo enabling decision-makers to experience and apply holistic and regenerative thinking. The Professional Herders Course is the first CATHSSETA accredited Land Management Course that trains communal farmers and corporate herders and equips them with intensive land and animal care knowledge as part of their regenerative decision-making framework. A mentorship programme takes the knowledge home and assists students within their implementation strategies and challenges. The Introductory Course trains principles and the application of holistic land management. Trainers will be sent to interested groups, organisations or cooperations where on-site practical training will be offered. As of 2021, 34 professional herders have been trained in the Professional Herders Course and there is a 100% employment rate. Students have come from the Northern Cape, Matatiele, Bushbuck Ridge and even as far as Botswana and Zambia. These trained herders are working in their communities and are establishing grazing plans, monitoring landscape functioning, working with local veterinary programmes and training other students in regenerative agriculture.

PLATFORM PRESENTATION: ASSESSING THE EFFECT OF HERDING ON LIVESTOCK GRAZING PATTERNS IN THE AMAKHUZENI COMMUNAL RANGELANDS, USING GPS TRACKERS

Andiswa Finca^{1*}, Thantaswa Currinta Zondani¹, Mpumzi Protous Mavuso², Julius Tjelele¹

¹Agricultural Research Council API, ²University Of Fort Hare

Communal rangelands in parts of the former Ciskei, in the Eastern Cape, are described as severely degraded owing to the absence of a livestock and rangeland management strategy. This has resulted in continuous unregulated grazing in most villages where livestock is only lead to communal grazing in the mornings, and collect in the



evenings or late afternoon. Thus, leaving the cattle to free-range which promotes overgrazing of certain areas. Hence, there is a need to explore a rangeland management strategy that will ensure that the communal grazing is optimally utilised. This study was aimed at assessing the impact of herding on livestock grazing patterns using Livestock GPS Trackers within three sub-villages namely, Guquka, Gilton and Sompondo forming part of the Amakhuzeni Tribal Authority. This was motivated by the fact that herders usually have knowledge of where the potentially good grazing areas are located and can lead livestock to areas that on their own are less likely to visit/utilize. This was achieved by fitting cattle from ten households (one per household representing the herd) with GPS Tracker collars in the wet season of 2017. Five of these households had agreed to herd for eight weeks, while the other five were asked to continue with standard management practice which was allowing their cattle to free-range. After eight weeks the collars were removed from the livestock and data was downloaded using the CatLog software and R statistic package and stored in comma-delimited ASCII text format (*.csv) and Google Earth Keyhole Markup Language (kml) files. The kml files were then displayed on Google Earth Pro to assess the livestock grazing patterns. Areas with dense points were viewed as frequently visited areas. These areas were marked, and herbaceous species composition data were collected from them. Results showed that the grazing patterns of both the herded and free-ranging cattle were focused on areas close to the homesteads, arable fields and foothills. Only cattle from three households (two herded) in Gilton, were shown to have grazed up the slope. None of the animals went further up to the mountains where good grazing was perceived to be in abundance. Grazing animals closer to the homestead can be attributed to fear of stock theft for free-ranging cattle, while for herded livestock, it could be the lack of herding knowledge from the herder's side since they are used to unregulated grazing practice. Herbaceous species composition results showed that the frequently grazed areas were dominated by *Eragrostis plana*, *Cynodon dactylon*, *Themeda triandra*, *Sporobolus africanus*, *Sporobolus fimbriatus*. The types of species encountered in areas frequently grazed by herded and free-ranging cattle did not differ much. These findings can be an indicator of the long term grazing pressure on areas both the herded and free-ranging animals frequently visited during the eight week period they had the GPS collars on. Owing to the factors mentioned above, it can be deduced that in this case, herding did not influence livestock grazing patterns in all three sub-villages.

PLATFORM PRESENTATION: AGRISYNCRETIC KNOWLEDGE PRODUCTION AND APPLICATIONS OF NAMAQUALAND HERDERS

Clement Cupido^{1*} and William Ellis²

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Historically, Khoekhoe speaking pastoralists at the southern tip of Africa adopted a transhumance strategy with their fat-tailed sheep breeds and cattle within the reaches of grazing and water resources. After colonisation, Nama pastoralists, who are one of the Khoekhoe groupings, became spatially constrained and were confined to mission stations and later the coloured reserves. These areas became melting pots for the weaving of indigenous African knowledge with Western knowledge on land management. In this study, we used an agrisyncretic approach by giving attention to the syncretic, which is used as a concept in social science to describe a fusion of beliefs, ideas, knowledge, rituals and practices that produce novel systems, social groups or forms. We also considered how this knowledge weaving aspect of the farming system makes it an adaptive strategy for livestock production in the Karoo. We will argue that the weaving of elements that form the agrisyncretic can be traced across five broad themes. These are the traditional, indigenous, commercial, scientific and idiosyncratic. Agrisyncretic thus suggests that in certain traditional farming systems, farmers weave multiple ways of knowing and doing that produces a knowledge system and framework that is unique to the region. We will further argue that this amalgam of knowing and doing ensures that the system remains open to new ways, is able to adjust to shifts in social, economic, cultural, political and ecological conditions and is suited to place and conditions. Within this paper, we illustrate how herders in Namaqualand utilise different knowledge systems in their daily tasks, such as (1) veld utilisation and management where they act as ethnobotanists and para-ecologists, (2) in livestock management as ethno-veterinarians and in predator control, (3) other forms of knowledge concerned with herd management which relates to animal behaviour, animal condition and midwifery, and (4) climate and weather prediction and adaptation. We will discuss that the knowledge system of herders is complex and the diversity of elements that characterise it should be recognised by agricultural practitioners. Moreover, this knowledge pool could be used by herding schools as a rich source of information and herders could be important co-producers and disseminators of knowledge that connects isolated academic disciplines such as the social, economic and natural sciences that relate to livestock production. Given the value that herding provides in terms of knowledge creation, we recommend that herding strongly be considered in future policies concerned with the management of rangelands in variable arid and semi-arid environments.

