

Congress 55

Virtual event

29 June - 2 July 2020

*Advancing
rangeland ecology
and pasture
management in
Africa*

Grassland Society of Southern Africa

1966 - 2020



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MONDAY, JUNE 29, 2020

R for biologists

VIRTUAL WORKSHOP
08h00 to 16h30 SAST (GMT+2)

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R for Biologists

R statistical software has become a popular tool for data storage, manipulation and particularly data analysis. It is open-source software, runs on all major operating systems and has many graphical and statistical capabilities built-in. The interactive workshop will cover the analysis of biological data using common statistical techniques and interpretation of the results.



Dr Victoria Goodall
<https://www.vlgstats.co.za/>

PROGRAMME

- | | | | |
|-----------|-----------------------------|-----------|-----------|
| 1 | Welcome | 2 | Practical |
| 3 | Estimation | 4 | Practical |
| 5 | Hypothesis testing | 6 | Practical |
| 7 | Correlation and regression | 8 | Practical |
| 9 | Multiple linear regression | 10 | Practical |
| 11 | Generalised linear models | 12 | Practical |
| 13 | Final questions and closing | | |

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30 JUNE - 2 JULY 2020

TUESDAY, JUNE 30, 2020

Opening Session

08h00 to 09h30 SAST (GMT+2)



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PRESENTERS

1

Paul Rencken

VIRTUAL CONGRESS ORIENTATION

2

Hon MEC Nomakhosazana Meth

OPENING ADDRESS

3

Debbie Jewitt

PRESIDENTIAL ADDRESS

4

Wiseman Goqwana

KEYNOTE ADDRESS: For a change, doing things differently: A look at the process of agricultural research for development to enhance adoption and solving complex rural development issues.

5

Rauri Alcock

KEYNOTE ADDRESS: Goats, grass and climate change - an unlikely entangled future.

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Keynote
SPEAKER



Wiseman Goqwana
EASTERN CAPE ORDRAR

FOR A CHANGE, DOING THINGS DIFFERENTLY: A LOOK AT THE PROCESS OF AGRICULTURAL RESEARCH FOR DEVELOPMENT TO ENHANCE ADOPTION AND SOLVING COMPLEX RURAL DEVELOPMENTAL ISSUES



Keynote
SPEAKER



Rauri Alcock
GOAT AGMBUSINESS PROJECT

GOATS, GRASS AND CLIMATE CHANGE - AN UNLIKELY ENTANGLED FUTURE



Twitter posters: Drought stressed rangelands - reflections and the future

09h30 to 10h00 SAST (GMT+2)
TUESDAY, JUNE 30, 2020

Impact of the drought
on the vegetation of the
Rainshadow Valley
Karoo bioregion in the
Western Cape Province

Nelmarie Saayman, Western Cape
Department of Agriculture



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Is a long
hygroscopic awn
an advantage to
Themeda triandra
in drier areas?

Craig Morris, ARC - Animal
Production

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Virtual Tours

09h30 to 10h00, 13h00 to 13h30 SAST (GMT+2)
TUESDAY, JUNE 30, 2020



THE ADVENTURE PROVINCE
eastern cape parks and tourism association



THE SUBTROPICAL THicket
a journey back in time



CHANGE IN THE NAMA-KAROO
where to from here? saeon arid lands node



HIGHLIGHTS AND MEMORIES
grassland society of southern africa



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TUESDAY, JUNE 30, 2020

Session 2: Drought stressed rangelands - reflections and the future

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PRESENTERS

1

Devan McGranahan

Patch-burning buffers forage resources and livestock performance to mitigate drought in the US Great Plains

2

Jeremy Perkins

KALARIVA: The key to wildlife conservation in a changing climate

3

Justin du Toit

Catastrophic collapses of sensitive species, including the quiver tree (*Aloidendron dichotomum*) following fire in the arid Nama-Karoo, South Africa

4

Theresa Ojo

Effects of warming and different rainfall regimes on plant community composition in a mesic grassland

5

Abel Ramoelo

Combining machine learning and remote sensing techniques for grass condition assessment and monitoring

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Comparing the visual assessment method to the norms for grazing capacities in Chris Hani and Western District, Eastern Cape, South Africa

Sive Tokozwayo, Eastern Cape Department of Rural Development and Agrarian Reform

Exploring veld fire management and policy directions in a Savanna biome undergoing land tenure changes. A case study in Matabeleland North Province of Zimbabwe

Onalenna Gwate, University of the Free State

Agro-ecological characterisation of smallholder livestock farming system in the Limpopo and Mpumalanga Provinces

Azwiangwisi Edward Nesamvuni, University of Free State

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Twitter posters: Communal rangeland dynamics, governance and restoration

11h00 to 11h30 SAST (GMT+2)

TUESDAY, JUNE 30, 2020

Which ruminant livestock to farm with in communal rangelands? Affordability, profitability and sustainability of communal ruminant livestock farming in the Eastern Cape, South Africa: A policy directed review

Siphe Zantzi, Stellenbosch University

Climate vulnerability and smallholder livestock water and fodder use analyses

Azwiangwisi Edward Nesamvuni, University of Free State

Smallholder farmers' perceptions on sustainable ruminant farming systems in the Eastern Cape Province, South Africa

Tawanda Marandure, Coventry University

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Virtual Tours

11h00 to 11h30, 13h30 to 14h00 SAST (GMT+2)

TUESDAY, JUNE 30, 2020



ON THE FRONT LINE - FARMERS living lands



RESTORING THE BAVIAANSKLOOF living lands



MIGRATORY PASTORALISTS survival on marginal lands



KGALAGADI TRANSFRONTIER PARK south african national parks



ADVENTURE IN THE EASTERN CAPE eastern cape parks and tourism association

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TUESDAY, JUNE 30, 2020

Session 3: Communal rangeland dynamics, governance and restoration

11h30 to 13h00 SAST (GMT+2)



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Keynote
SPEAKER

Nicky McLeod
ENVIRONMENTAL & RURAL SOLUTIONS

THE SURPRISING POTENTIAL OF LIVESTOCK TO RESTORE RURAL RANGELANDS AND VILLAGE ECONOMIES

PRESENTERS

1

Nicky McLeod

KEYNOTE ADDRESS: The surprising potential of livestock to restore rural rangelands & village economies

2

Igshaan Samuels

Long-term changes in pastoral mobility in a semi-arid montane region of SA: The role of policy and legislation

3

Toshpulot Rajabov

Impact of aspect on vegetation characteristics in the mountain grasslands of Tajikistan

4

Yvette Brits

Communal cultivated pastures: Successes and failures - lessons to be learned for a value-added future

5

Maud Sebelebele

"Ons Plante In Ons Manier": An ethnographic case-study of how herders in the Leliefontein Communal Area apply Indigenous Ecological Knowledge (IEK) to ascertain the "value" of fodder-plants

6

Clement Cupido

The vanishing herders of Namaqualand: Implications for indigenous knowledge and rangeland management

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30 JUNE - 2 JULY 2020

WEDNESDAY, JULY 1, 2020

Session 4: Dairy pastures of the future - resilience and productivity

08h00 to 09h30 SAST (GMT+2)



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Special
SESSION

DAIRY PASTURES OF THE FUTURE - RESILIENCE AND PRODUCTIVITY

In South Africa – as in many parts of the world – pasture-based dairy production has been mainly centred on *Lolium* species; viz. perennial, hybrid and Italian ryegrass. In recent years, pasture-based dairy farmers in South Africa have suffered through drought periods and other weather extremes, with the added pressure on the availability of water resources. These resources are not only affected by drought, but also by the increasing water needs for human and industrial uses. This has prompted the need to investigate options for dairy pastures that offer more resilience – yet are productive – and of suitable forage quality to sustain dairy production at an intensive level. This spans the breadth of what makes up a pastures system: from the soil, to the species, and the management of such systems; to attain the required resilience, productivity and quality, with reduced inputs, or with increased production efficiency – in terms of water use efficiency, but also nutrient use efficiency. Inevitably, this also relates to a reduced environmental impact. Incorporating different species into such systems makes the systems more complex, and requires different management of the pasture plants and the grazing animals than was the case before. In this Special Session, there will be presentations on alternative species that show potential for resilience and productivity, aspects of soil health and nutrient efficiency, as well as pasture management systems where alternative species, grazing animals and soil parameters are researched as an entity – both in a formal research environment and on farms.

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08H00 TO 09H30 SAST (GMT+2)

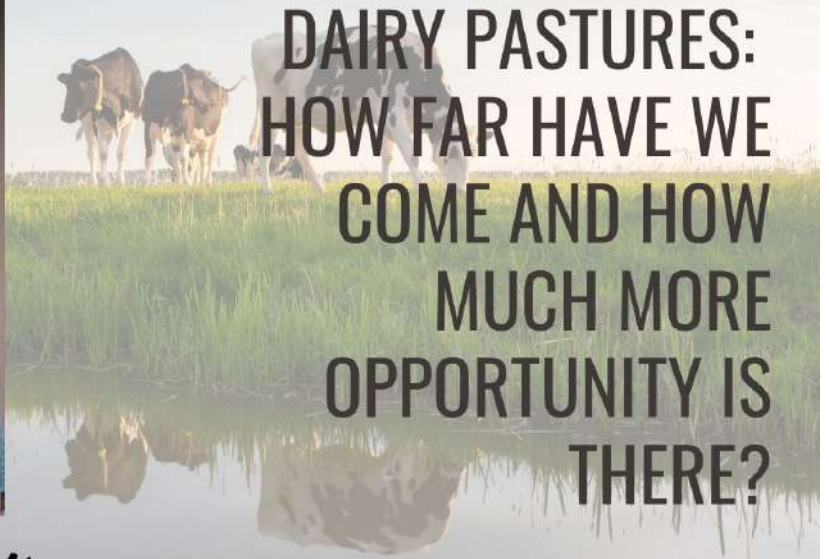




Keynote
SPEAKER



Craig Galloway
TRACE & SAVE



DAIRY PASTURES:
HOW FAR HAVE WE
COME AND HOW
MUCH MORE
OPPORTUNITY IS
THERE?



PRESENTERS

1

Craig Galloway

KEYNOTE ADDRESS: Dairy pastures:
How far have we come and how much
more opportunity is there?

2

Donna Berjak

Short, medium and long duration
cultivar characterisation of forage
cereals

3

Derryn Nash

The performance of Lucerne cultivars
(*Medicago sativa*) with different
dormancy classes over three years on
Cedara - quantity and quality data

4

Sigrun Ammann

Assessing the potential of alternative
species for intensive dairy pasture
production

5

Craig Galloway

Building soil carbon to improve water
holding capacity

6

Janke Van Der Colf

Pasture mixtures and monocultures for
milk production: First insights

7

Craig Galloway

Case study: Improving nitrogen fertiliser
efficiency on pasture-based dairy farms

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Wednesday, 1 July 2020 - Congress 55 Day 2

Twitter posters: Dairy, nutrition and cultivated pastures

09h30 to 10h00 SAST (GMT+2)

WEDNESDAY, JULY 1, 2020

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Effects of *Cajanus cajan* and *Mucuna pruriensis* forages on goat production in Southern zone - Madagascar

Arsene Randrianariveloseheno,
Laboratory of Animal Nutrition

Nutritional value and forages species typology in Southern Region at Madagascar

Arsene Randrianariveloseheno,
Laboratory of Animal Nutrition

Eragrostis curvula as future pasture for highveld of the Mpumalanga province, South Africa

Mobau Norman Magoro,
Mpumalanga Department of
Agriculture, Rural Development,
Land and Environmental Affairs

Chemical composition of different grass species under different soil types

Thabile Joyce Mkgakane, Mpumalanga
Department of Agriculture, Rural Development,
Land and Environmental Affairs

Understanding the utilisation of income from forage seed sales by smallholder farmers: A case of Beitbridge district, Zimbabwe

Irenie Chakoma, International
Livestock Research Institute (ILRI)

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WEDNESDAY, JULY 1, 2020



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GARDEN ROUTE NATIONAL PARK

south african national parks



TABLE MOUNTAIN NATIONAL PARK

south african national parks



SKYDIVE JEFFREYS BAY

eastern cape parks and tourism association



EXPERT TOURS SARDINE RUN 2020

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WEDNESDAY, JULY 1, 2020

Session 5: Nutrition and cultivated pastures

10h00 to 11h00 SAST (GMT+2)



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PRESENTERS

1

Xolile Nuse

Protein-energy supplement increases feed intake, nutrient digestibility and growth performance of Dohne Merino ewes

2

Gideon Jordaan

The effect of different levels of phosphorus fertilizer on the nutritional value of a mixed grass-legume pasture

3

Robin Nicolay

The effect of plant community rooting densities on soil health indicators

4

Erika van Zyl

In vivo effects of Bromelain enzyme, dried pineapple leaves and chicory grazing against gastro-intestinal nematodes of sheep: A comparative study

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Wednesday, 1 July 2020 - Congress 55 Day 2

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30 JUNE - 2 JULY 2020



Virtual Tours

11h00 to 11h30, 13h30 to 14h00 SAST (GMT+2)

WEDNESDAY, JULY 1, 2020



HALDON STATION NEW ZEALAND

nz on air irirangi te motu



I AM SANPARKS

south african national parks



HIGHLIGHTS AND MEMORIES

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WEDNESDAY, JULY 1, 2020

Session 6: 4th IR / Next generation advances in rangeland management

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Keynote
SPEAKER



Louise Jupp
TERREDO AVIATION (PTY) LTD

DRONE ON THE RANGE:
DRIVING BETTER
PASTURE AND
GRASSLAND
MANAGEMENT PRACTICES



PRESENTERS

1

Louise Jupp

KEYNOTE ADDRESS: Drone on the range: Driving better pasture and grassland management practices

2

Anthony Palmer

Recognising the structure and functionality of novel landscapes arising from abandoned arable lands: remote sensing in assessing Land Degradation Neutrality

3

Gregor Feig

The importance of integrated long term environmental research infrastructures for rangeland management: facilities and data for the 4IR

4

Anisha Dayaram

National Vegetation Map 2021: Our goals and an opportunity for the GSSA to contribute to the structure of the next version

5

Sawsan Hassan

Estimating carrying capacity using crowd sourcing & VegMeasure under Covid-19

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30 JUNE - 2 JULY 2020

THURSDAY, JULY 2, 2020

Session 7: Rangeland management for game farming, nature conservation and tourism I

08h00 to 09h30 SAST (GMT+2)



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Keynote
SPEAKER



Kyran Kunkel
UNIVERSITY OF MONTANA

NEW APPROACHES TO GLOBAL CONSERVATION OF GRASSLANDS



PRESENTERS

1

Kyran Kunkel

KEYNOTE ADDRESS: New approaches to global conservation of grasslands

2

Barbara Hutchinson

International Year of Rangelands and Pastoralists (IYRP): History, process, priority themes, & way forward

3

Nthuseng Kahlolo

Assessing wetland functionality using soil surface indicators in Letšeng-la-Letsie wetland in Quthing District, Lesotho

4

Wynand Calitz

Vegetation change along an altitudinal gradient across the Great Escarpment at Compassberg

5

Nkuebe Lerotholi

Impact of shrub encroachment and the efficacy of mechanical shrub removal in the montane rangelands of Lesotho

6

Siphathisiwe Moyo

Time budget and diet selection of semi-captive elephants (*Loxodonta africana*) at Jafuta Game Reserve, Victoria Falls, Zimbabwe

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Repeatable methods of classification of alien and native vegetation in the Montane Grasslands, Mpumalanga.

Keletso Moolwe, University of Cape Town / SAEON)

Twitter posters: Rangeland management for game farming, nature conservation and tourism

09h30 to 10h00 SAST (GMT+2)
THURSDAY, JULY 2, 2020

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Small-bodied browsers maintain the openness of savanna grazing lawns

Michael Voysey, University of Pretoria



Long-term herbivore population trends and spatial dynamics across Kruger National Park (South Africa) and the adjoining private game reserves

Mike Peel, ARC



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THURSDAY, JULY 2, 2020



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MOUNTAIN ZEBRA NATIONAL PARK
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RAGGY CHARTERS SARDINE RUN
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THURSDAY, JULY 2, 2020

Session 8: Rangeland management for game farming, nature conservation and tourism II

10h00 to 11h00 SAST (GMT+2)



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PRESENTERS

1

Ian Rushworth

KEYNOTE ADDRESS: Evolving, but in the right direction?
Commodification & domestication of wildlife as a threat to
biodiversity, rangelands and the broader biodiversity economy

2

Anthony Mapaura

The impact of the invasive grass *Nassella trichotoma* on the plant
species richness, diversity and composition in Karoo Escarpment
Grassland, Sneeuberg Centre of Floristic Endemism

3

Tebelelo Mashego

Determining the effects of fire suppression on grass biomass in confined
savannah rangeland of Mafikeng Game Reserve

4

Arend de Beer

Examining inter- and intra-specific leaf
trait variation in savanna grasses

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Ian Rushworth
EZEMVELO EZN WILDLIFE

EVOLVING, BUT IN THE RIGHT
DIRECTION?
COMMERCIALIZATION AND
DOMESTICATION OF WILDLIFE
AS A THREAT TO BIODIVERSITY,
RANGELANDS AND THE
BROADER BIODIVERSITY
ECONOMY



Community based rangeland rehabilitation for maintenance of ecosystem functions, services and goods

Solomon Tefera Bayene, University of Fort Hare

A review of the invasive genus *cotoneaster* Medik (Rosaceae) in southern Africa

Karabo Moloai, University of Free State

Contextualizing ecological infrastructure restoration frameworks for sustainable management in complex and dynamic catchment systems - a case in the Blyde Catchment

Silindile Mshali, UKZN / SANBI

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Research

Grazing for carbon: Investigating soil, plant and ruminant interactions on carbon sinks in extensive mesic grassland and improved kikuyu (*Pennisetum clandestinum*) pasture

Robyn Nicolay, University of KwaZulu-Natal

Implications of expansion of protected areas utilised by megaherbivores for carbon sequestration and land degradation neutrality: A case study of the South African Thicket Biome

Thokozane Mapegula, Stellenbosch University

The impacts on montane biodiversity of *Leucosidea sericea* encroachment in the Maloti-Drakensberg

Muxe Dlomu, University of Free State

Stodious investigation with the intention of discovering new facts and conclusions

Twitter posters: Research proposal posters

11h00 to 11h30 SAST (GMT+2)

THURSDAY, JULY 2, 2020



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11h00 to 11h30, 13h30 to 14h00 SAST (GMT+2)

THURSDAY, JULY 2, 2020



TSITSA PROJECT
rhodes university & deff sa



SUSTAINABLE RANGELANDS
iucn - drylands programme



WILD COAST SOUTH AFRICA
eastern cape parks and tourism association



TSITSIKAMMA CANOPY TOURS
eastern cape parks and tourism association

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THURSDAY, JULY 2, 2020

Session 9: Water production and fire management in rangelands

11h30 to 13h00 SAST (GMT+2)

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PRESENTERS

1

Ralph Clark

Beyond the tree-line: The C3-C4 'grass line' can track global change in the world's grassy mountain systems

2

Tsele Rantso

Effect of holistic grazing management on plant cover, plant diversity and biomass production in Mokhotlong District, Lesotho

3

Basanda Nondlazi

Using littoral vegetation, wetland edaphic factors and characteristics to sub-group depressional wetlands in southern Africa

4

Matthew Danckwerts

Post-hoc physical patterns & indicators of fire behaviour as an aid in wildfire investigations

5

Stephan Steyn

Decrease in total burned area despite increase in climatological fire danger over the Central Grassland Biome of South Africa

6

Kevin Kirkman

Mesic savanna grassland responses to 70 years of experimental fire

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CLOSING OF CONGRESS 55

1

Ralph Clark

Scientific Committee Chair programme synthesis

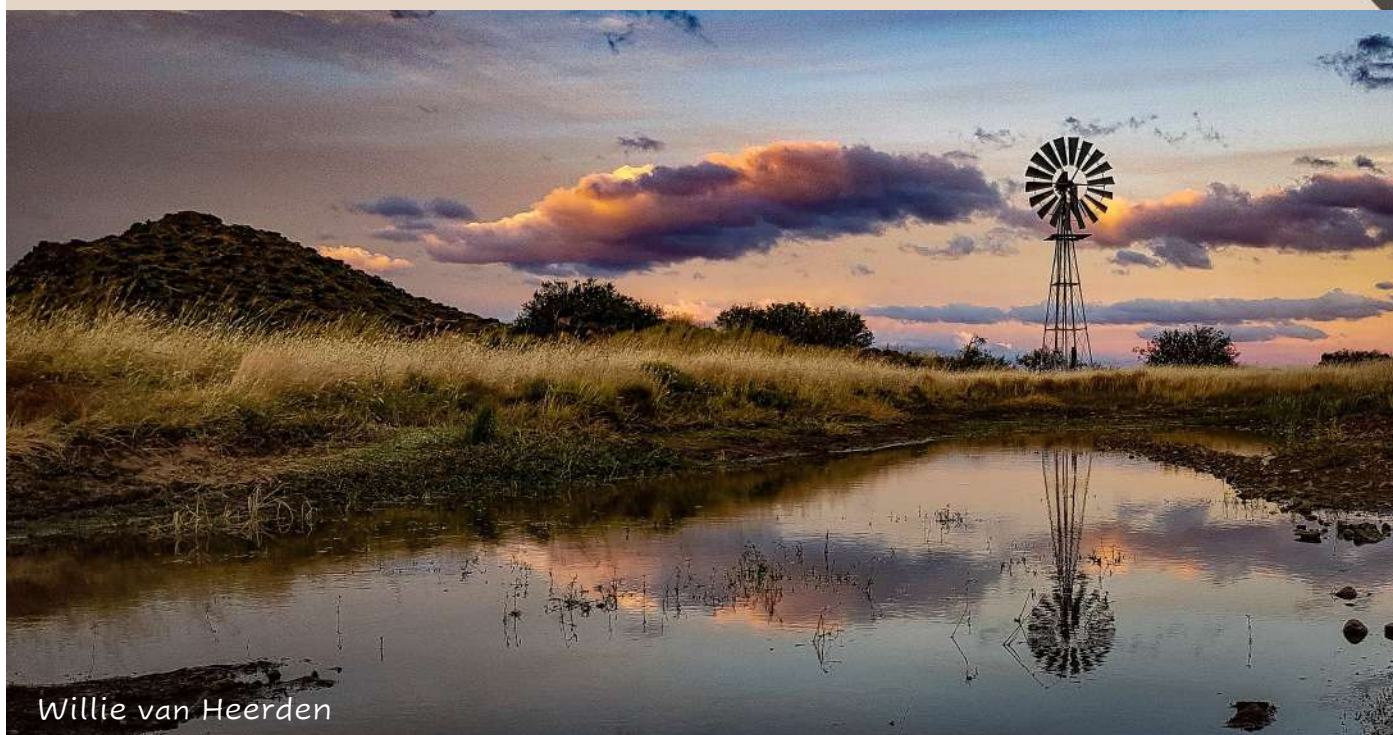
2

Debbie Jewitt

Closing of Congress 55

GSSA Congress 55

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Willie van Heerden

Friday, 3 July 2020 - Annual General Meeting

FRIDAY, JULY 3, 2020

GRASSLAND SOCIETY OF SOUTHERN AFRICA

*Advancing rangeland ecology and pasture
management in Africa*

VIRTUAL AGM

10h00 to 11h00 SAST (GMT+2)

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AGENDA

- | | | | |
|----------|--|-----------|---|
| 1 | <i>Welcome</i> | 2 | <i>Present and apologies</i> |
| 3 | <i>Additions to and
acceptance of agenda</i> | 4 | <i>Approval of previous
minutes</i> |
| 5 | <i>Matters arising</i> | 6 | <i>Council reports</i> |
| 7 | <i>Election of new office
bearers</i> | 8 | <i>General</i> |
| 9 | <i>Award ceremony</i> | 10 | <i>Vote of thanks</i> |

GSSA Congress 55

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Grassland Society of Southern Africa: 2019 / 2020 Council

PRESIDENT	Debbie Jewitt
IMMEDIATE PAST PRESIDENT	Tony Swemmer
VICE PRESIDENT	Kevin Kirkman
HONORARY SECRETARY	Heleen Els
HONORARY TREASURER	Linda Kleyn
SCIENTIFIC EDITOR	Pieter Swanepoel
PUBLICATIONS EDITOR	Janet Taylor
WEBSITE EDITOR	Charné Viljoen
PUBLIC RELATIONS OFFICER	Malissa Murphy
ADDITIONAL MEMBER (ASSISTANT PUBLICATIONS EDITOR)	Malissa Murphy
ADDITIONAL MEMBER (ASSISTANT PUBLICATIONS EDITOR)	Christiaan Harmse
ADDITIONAL MEMBER	Florence Nherera-Chokuda
ADDITIONAL MEMBER	Ntuthuko Mkhize
ADDITIONAL MEMBER	Marnus Smit
CHAIRPERSON OF TRUST	Nicky Allsopp

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SPONSORS



A research grant at the Centre of Environmental Management (CEM) at the University of the Free State (UFS)



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Congress 55 Organising Committee

Debbie Jewitt (CHAIR)	Freyne du Toit
Linda Kleyn	Heleen Els
Kevin Kirkman	Ralph Clark
Ntuthuko Mkhize	Charne Viljoen
Janet Taylor	Tanki Thubela
Malissa Murphy	Pieter Swanepoel
Marnus Smit	Christiaan Harmse
Unathi Gulwa	Nicky Allsopp
Erica Joubert	



Congress 55 Scientific Committee

Ralph Clark (CHAIR)	Afromontane Research Unit / University of the Free State
Ed Granger (VICE-CHAIR)	Themtek Environmental Consultancy
Anthony Palmer	Agricultural Research Council
Erika van Zyl	KwaZulu-Natal Department of Agriculture and Rural Development
Florence Nherera-Chokuda	National Emerging Red Meat Producers Organization (NERPO)
Francois Muller	Agricultural Research Council
Igshaan Samuels	Agricultural Research Council
Janke van der Colf	Western Cape Department of Agriculture
Joao de Deus Vidal	Afromontane Research Unit / University of the Free State
Josef van Wyngaard	Voermol
Justin du Toit	DAFF - Grootfontein ADI
Melvin Swarts	Department of Rural Development and Land Reform
Ntuthuko Mkhize	Agricultural Research Council
Pieter Swanepoel	Stellenbosch University
Rouxdene Deysel	Gauteng Department of Agriculture and Rural Development
Sigrun Ammann	Western Cape Department of Agriculture
Solomon Tefera Beyene	University of Fort Hare
Tony Swemmer	South African Environmental Observation Network (SAEON)
Wayne Twine	University of the Witwatersrand
Yvette Brits	North West Department of Agriculture and Rural Development

AWARDS

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

PLATFORM PRESENTATIONS

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

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

Congress delegates are asked to help in this process by judging the platform presentations. The primary objective of these awards is to encourage and promote the standard of presentation of papers at the Congress.

To qualify for the Best Presentation by a Young Scientist award and the Norman Rethman award, the presenter should meet the following criteria:

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

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

POSTER PRESENTATIONS

POSTERS CAN BE VIEWED DURING INTERVALS ON TWITTER. FOLLOW THE GSSA, @GRASSLANDSOCSA AND LOOK FOR #GSSACONGRESS55

An award is also given to the **Best Poster** on display during the Congress. Congress delegates are asked to assist in judging this award according to certain criteria which are given on the adjudication sheet. The **Best Research Proposal Poster** will be judged by an appointed panel of adjudicators.

Essentially a poster should convey its primary message concisely, preferably within a three minute reading time. Adjudicators give a value (1-10) to each of four questions relating to the physical poster and to one question relating to the oral presentation. Considerable guidance is provided here to try to reduce variation. Additionally, judges are asked to indicate whether the subject of the presentation

THE FAUX PAS AWARD

“Every village has its own idiot . . .

Every circus has its own clown . . .

But this trophy is dedicated

to our very own star . . .”

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

So make a note of all the hilarious moments, the embarrassing moments, the “oops” moments, and cast your vote for the winner of the Faux Pas award of the 55th Annual Congress of the Grassland Society of Southern Africa. Nominations should be received by Thursday, 1 July at 1pm via email to info@grassland.org.za.

PLATFORM PRESENTATION ADJUDICATION SHEET

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

POSTER PRESENTATION ADJUDICATION SHEET

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

PROCEEDINGS

55th Annual Congress
of the Grassland Society of Southern Africa
Virtual Event

30 June - 2 July 2020

08:00AM -
08:45AM

R for Biologists: Welcome

Zoom Webinar

08:45AM -
09:00AM

Practical

Zoom Webinar

09:00AM -
09:45AM

R for Biologists: Estimation

Zoom Webinar

09:45AM -
10:00AM

Practical

Zoom Webinar

10:00AM -
10:30AM

Break

10:30AM -
11:15AM

R for Biologists: Hypothesis testing

Zoom Webinar

11:15AM -
11:45AM

Practical

Zoom Webinar

11:45AM -
12:30PM

R for Biologists: Correlation and regression

Zoom Webinar

12:30PM -
01:00PM

Practical

Zoom Webinar

01:00PM -
01:45PM

Lunch break

01:45PM -
02:30PM

R for Biologists: Multiple linear regression

Zoom Webinar

02:30PM -
03:00PM

Practical

Zoom Webinar

03:00PM -
03:45PM

R for Biologists: Generalized linear models

Zoom Webinar

03:45PM -
04:15PM

Practical

Zoom Webinar

04:15PM -
04:30PM

R for Biologists: Final questions and closing

Zoom Webinar

08:00AM -
09:30AM

Zoom Webinar

Opening of the 55th Annual Congress of the Grassland Society of Southern Africa

Moderators

Debbie Jewitt, Conservation Scientist, Ezemvelo KZN Wildlife

Virtual congress orientation

08:00AM - 08:10AM

Presented by :

Debbie Jewitt, Conservation Scientist, Ezemvelo KZN Wildlife

Opening Address

08:10AM - 08:20AM

Presented by :

Nomakhosazana Meth, MEC, Eastern Cape Department: Rural Development And Agrarian Reform

Presidential Address

08:20AM - 08:30AM

Presented by :

Debbie Jewitt, Conservation Scientist, Ezemvelo KZN Wildlife

KEYNOTE ADDRESS: For a change, doing things differently for change: A look at the process of agricultural research for development to enhance adoption and solving complex rural developmental issues

08:30AM - 08:55AM

Presented by :

Wiseman Goqwana, Eastern Cape Department Of Rural Development And Agrarian Reform

Governments and donors have shown growing impatience with what they see as the lack of results from conventional agricultural research that has not addressed their main concerns: Poverty reduction, food security, sustainable natural resource use, competitiveness in international markets; the poor return on investment in agricultural research; the regional imbalances in agricultural development, with the most endowed zones/systems receiving all the benefits of agricultural research. Political and public perceptions of the role of agriculture in rural development have changed, from a narrow emphasis on agricultural production values; technical efficiency; specialisation and increase in scale to a broader emphasis on the multiple functions of rural areas: Social welfare and healthy food; non-agricultural production values and environmental values and landscape. There is a need for flexible approaches to promote innovation and for dealing with complex issues with processes that will effectively resolve complex problems and realise complex opportunities. It is also necessary to explore an alternative to traditional reductionism and linear approaches of technology generation, transfer and adoption and to achieve collective action and by encouraging interaction between multiple stakeholders. Agricultural research needs to enhance the performance of individuals and or organisations in tackling

complex issues because complex issues cannot usually be resolved/realised and positive change achieved by single persons/organisations acting alone. We need to strive to bring positive change that is acceptable across a broad range of stakeholders. The focus should not be to generate research products with the hope that they will be broadly adopted when transferred to end-users but collective exploitation of the opportunities involving stakeholder participation to enhance adoption.

KEYNOTE ADDRESS: Goats, grass and climate change—an unlikely entangled future

08:55AM - 09:20AM

Presented by :

Rauri Alcock, Director, Goat Agribusiness Project

Despite the size of the informal small-scale farming sector and its livestock holdings in South Africa, there has been little detailed work to assess how livestock populations are affected by drought. The KwaZulu-Natal Goat Agribusiness Project has been compiling a livestock census year by year for five years with some 20,000 farmers per year. This census collects information farmer by farmer on livestock that they own, sales, mortalities, as well as what farmers have been spending on the livestock. This census represents an area of approximately 55,000 km². South Africa experienced a major drought in 2015–2016. An analysis of goat and cattle census data from the Msinga-Weenen area in KwaZulu-Natal, which represent the livestock of some 3,000 households, shows that cattle farmers lost 43% of the herd, compared to 29% for goats in 2015–2016. Three years after the drought, cattle numbers remained depressed, whereas goat numbers had recovered. The analyses also showed that in 2015–2016, as in the drought of 2003, larger herds suffered lower mortality rates, suggesting that owners of larger herds had better means to support their herds. Support to reduce drought losses and aid recovery should thus take into consideration the different capabilities and needs of small and large herd owners. Effects of high stocking rates and resource condition on mortality and herd growth were apparent during the drought year of 2016 but not the other years. Most die-offs appear to have been concentrated in a short period once forage and water resources became too scarce and far to reach. Recognising when this threshold is imminent would be useful for targeting strategic interventions. To develop appropriate ways of supporting livestock owners, off-station research into the growing rural farming areas is critical to gain a better knowledge of livestock ownership patterns, how livestock are affected by resource availability, drought, veld condition and management practices, and what farmers' aspirations and constraints are. The methodology of livestock censuses in rural communities is described and it can be used by other researchers in the rest of the country. The state departments need to also process this information once it becomes available to create better extension systems. A cattle-free future may be on the horizon and instead, large numbers of drought-tolerant goats might be the only thing that will keep our grasslands and savannas intact and protected from bush encroachment. They will do this while feeding the growing population. What the countryside will look like in 20 years' time in terms of livestock numbers and types is an important question grassland scientists need to answer to continue to have the ear of both the state and farmers.

Q&A | Discussion: Opening session

09:20AM - 09:30AM

Presented by :

Debbie Jewitt, Conservation Scientist, Ezemvelo KZN Wildlife

09:30AM -
10:00AM

Interval | Virtual Tours

09:30AM -
10:00AM

Twitter poster session: Drought-stressed rangelands - reflections and the future

Twitter
@GrasslandSocSA

Moderators

Kevin P Kirkman, University Of KwaZulu-Natal

Impact of drought on the vegetation of the Rainshadow Valley Karoo bioregion in the Western Cape Province, South Africa

09:30AM - 09:40AM

Presented by :

Nelmarie Saayman, Scientist, Western Cape Department Of Agriculture

The Rainshadow Valley Karoo bioregion has high plant species diversity because it has a predictable winter rainfall with few extended droughts. However, the bioregion has experienced an extreme drought since 2015, receiving less than 50% of the mean annual rainfall, potentially degrading vegetation and its ability to economically support livestock. The objective of this study was to determine what possible impact the drought had on the plant species composition and cover of the Rainshadow Valley Karoo. The study was done on 14 farms where a permanently marked 1,000 m line transect were marked out and surveyed in the winters of 2016 and 2019, using the line-point method. Perennial species, identified to species level if possible, and ephemerals hit at each point, and bare ground where no plants were present, were recorded. Rainfall for each farm was recorded. A partial CCA was done to show changes over time in the species composition. Paired t-tests were done of the percentage cover of the different growth forms and palatability classes of the vegetation in each area as well as the percentage dead plants encountered and percentage plant cover. A partial canonical correspondence analysis (CCA) (accounting for spatial differences) showed changes ($p = 0.0001$) in species composition, and more than 15% of species were lost during the study period. The cover of dwarf shrubs (-32.44%), succulents (-27.47%), and shrubs (-27.14%) decreased ($p < 0.05$) over time. These growth forms accounted for 99% of the plant cover, with succulents the most dominant (53%). Another study found that succulents are much less affected by drought than dwarf shrubs. The succulents were mainly less palatable species; their decrease is thus most likely due to the drought rather than grazing. Cover of all palatability classes, especially highly palatable species (-67.24%), declined ($p < 0.01$), whereas dead plants increased (71.43%; $p < 0.001$) during

the drought. Overall, the condition of the veld declined but reduced vegetation cover might allow plant species to establish after the drought. With mainly less valuable species remaining the veld will be in a worse condition after the drought.

Is a long hygroscopic awn an advantage to *Themeda triandra* in drier areas?

09:40AM - 09:50AM

Presented by :

Craig Morris, Senior Researcher, ARC-AP

The seeds of *Themeda triandra* have a geniculate hygroscopic lemma seed awn that twists when hydrated and drying, moving the caryopsis across the soil surface into suitable microsites for germination (e.g. cracks, crevices, protrusions). In Australia, *T. triandra* plants in the dry interior have longer awns than those growing at the coast, possibly enabling diaspores in semi-arid grasslands to be transported further in search of scarce microsites. Therefore, the hypothesis was tested that in KwaZulu-Natal, awns would get longer along an increasing aridity gradient and that long awns would move faster and further than short awns. Awns ($n = 100$ per site) were collected from 16 sites across a mean annual precipitation gradient from 575–1,223 mm, ranging from 271–2,097 m above sea level. Awn length was regressed against mean annual precipitation (MAP), elevation, and various aridity indices (temperature, evaporation). The daily movement, after spraying with water, of ten long (70.1 ± 5.79 mm) and ten short (41.6 ± 5.22 mm) awns across blotting paper along separate tracks in two plastic trays were tracked over five days to compare their movement. Awn length varied considerably among (mean: 41.4–63.2 mm) and within (sd: 3.44–8.99) sites. Awn length did not decline with increasing aridity as predicted but tended to increase ($r = 0.426$), though not significantly ($p = 0.099$), with increasing MAP: awns in the wettest sites were seldom short. Awn length was unrelated to elevation, temperature variables, plant available water and annual evaporation ($p > 0.30$). Long awns compared to short awns moved twice as fast (46.3 vs 22.1 mm.day⁻¹) and much further in total (231.3 vs 110.4 mm) and maximum daily (82.1 vs 38.6 mm) distance ($p < 0.0001$). Measurements ($n = 50$) of the basal twisted segment and the passive tip (beyond the bent 'knee') of awns indicated that longer awns have a longer active region ($p < 0.001$) that is hygro-activated as well as a proportionally longer passive lever towards the tip ($p < 0.0001$) than short awns. The tendency for awn length to increase with rainfall suggests that resource availability might constrain awn length. However, awn variation towards the driest limit of the distribution of *T. triandra* needs to be examined and the influence of genotypic (particularly degree of polyploidy) and other local influences (such as fire intensity) should be considered. The particular internal cellular and macro-morphological features of the awns of *T. triandra* that make it responsive to changes in humidity and energise it to move across the ground remain to be described.

Moderators

Ralph Clark, Director, Afromontane Research Unit

Patch-burning buffers forage resources and livestock performance to mitigate drought in the United States Great Plains

10:00AM - 10:10AM

Presented by :

Devan McGranahan, Associate Professor: Range Science, North Dakota State University

Summer droughts in North America's northern Great Plains are expected to increase in frequency and duration as precipitation shifts toward spring and autumn. Two rangeland experimental stations in North Dakota experienced a summer drought relative to 25-year averages. The southwest location had a 170 mm deficit from the 360 mm normal rainfall and was grazed by cattle (*Bos taurus*) and sheep (*Ovis aries*); the south-central location had 109 mm below the 403 mm normal rainfall and was grazed by cattle. We evaluated patch-burn grazing as a drought resilient land management strategy in the northern Great Plains by comparing average daily gains, fecal density, available forage biomass, and forage crude protein content. At the southwest location, livestock performed better during the drought season compared with animals on the same pastures in the previous year, which had near-normal rainfall but no fire. At the central location, cows on patch-burned pastures performed better than cows on continuously-grazed, unburned pastures in the same year under drought conditions; all cows were nursing calves and calf gains did not vary between treatments. In both locations, the burned patches had higher fecal density and lower available forage biomass than patches not yet burned throughout the grazing season, indicating grazer attraction to burned areas. Despite drought, burned patches maintained grazer attraction and animal performance was maintained or even improved, which contrasts with the expected relationship between animal performance and precipitation. This study indicates that prescribed patch-burning can mitigate drought by buffering forage resources (crude protein content and availability) and maintaining animal performance (average daily gains).

KALARIVA: The key to wildlife conservation in a changing climate

10:10AM - 10:20AM

Presented by :

Jeremy Perkins, Associate Professor, University Of Botswana

Over fifty years ago the importance of the 'drought corridor' that connects the semi-arid savannas of the Sahel, eastern and southern Africa in explaining the current distribution of African fauna and flora and its central role in adapting to climate change was realised. In wetter periods the equatorial rainforests confined the 'drought corridor' to a narrow eastern band while during drier periods the corridor expanded and enabled movement and range shifts along with it. As southern Africa becomes drier and hotter throughout this century even Transfrontier Conservation Areas (TFCAs) such as the Kavango–Zambezi (KAZA) will be unable to support the large herds ungulates that it does today. Movement along the drought corridor north-eastwards to the relatively wetter climate of eastern Africa, will therefore once again be necessary. Unfortunately,

land-use/land cover change means that connectivity along the most promising wildlife corridors, such as the Chobe–Kariba–Ruaha–Rungwa and the Greater Limpopo–Selous–Niassa–Serengeti-Mara corridors, are not possible today. Malawi's high population density and Lake Malawi itself poses an absolute barrier to ungulate movement as increasingly does more extensive pastoralism and cropping in and around existing conservation landscapes. The broader drought corridor linkage with the Sahel–Ethiopia–Sudan has been lost to war and civil strife. The 'mega-droughts' and heat waves predicted to increasingly afflict southern Africa will expose the existing fatal flaws in conservation planning and funding within a system that largely excludes local people from the benefits that can accrue from the presence of wildlife and yet expects them to endure unprecedented levels of human-wildlife conflict. Instead of looking outwards to new models and innovative ways of adapting to climate change in a holistic way, many governments seem increasingly locked into often conflicting sectoral policies that promote short term economic gains over sustainable development. Protected areas follow five year plans that manage for the persistence of species populations rather than promote historically proven adaptive strategies such as movements between the Kalahari and the Rift Valley (KALARIVA) along the drought corridor. Botswana has adopted a 'water security for wildlife' policy based on widespread permanent artificial water provision in and around its Protected Areas, rather than one that recognises that the best way to manage its burgeoning elephant and other mobile populations will be to facilitate their movement north-eastwards out of the KAZA TFCA. Co-existence between livestock and wildlife populations over key landscapes between protected areas is required, and for this to occur in a sustainable way local communities must be seen as the true custodians of wildlife, and to benefit disproportionately from sharing the landscape with them. The value of maintaining existing economic models based on outdated subsidies that are driving unprecedented levels of biodiversity loss and rural poverty is likely to be ruthlessly exposed by climate change. Rather than radically change our ways of thinking and operating we seem destined to cling onto the wreckage of existing systems, rather than seek to reform them before it is too late.

Catastrophic collapses of sensitive species, including the quiver tree (*Aloidendron dichotomum*) following fire in the arid Nama-Karoo, South Africa

10:20AM - 10:30AM

Presented by :

Justin Du Toit, Production Scientist, DAFF- Grootfontein ADI

Fire is rare in desert ecosystems owing to low fuel loads, and local unadapted species face catastrophic population collapses if burnt. Slow-growing, rare species are particularly susceptible, especially if germination and establishment is uncommon. Increases in grassiness, plus drought-induced increases in flammability of normally non-flammable species, can increase the likelihood of available fuel and therefore fire in arid systems, and both are predicted to increase in occurrence with climate change. An accidental fire in the arid (Aridity Index = 0.08) northern Nama-Karoo, South Africa, occurred in a relatively dense stand of the iconic quiver tree (*Aloidendron dichotomum*), a succulent, at the eastern limit of its range, in 2017 during a severe drought. No fires are known of

there in historical time. Vegetation comprises an under-storey of herbaceous (mainly grass), succulent and woody species, and a sparse population of quiver trees, up to 3–4 m tall. Grass cover was likely low at the time of the fire owing to drought conditions. The fire was 4 ha in extent, occurring mainly on relatively steep slopes, which would have aided fire spread. Vegetation responses were recorded two years post-fire at twelve paired (burnt vs unburnt) sites along the fire boundary. A 4-state mixture model demonstrated that the quiver tree population had developed through pulsed recruitment in the past. Statistically significant fire-induced collapses in the abundance of shrubs, dwarf-shrubs, succulent shrubs, and succulent dwarf-shrubs occurred. Fire eliminated six species in the burnt area: four dwarf-shrubs, one succulent shrub, and one succulent dwarf-shrub. Fewer than 10% of quiver trees survived, and survival was positively related to tree size. Mortality appeared to be lower in trees exposed to locally-low fire intensities. Total canopy cover was significantly lower post-fire, with only micro-grasses increasing over time. Results indicate that several species, including the quiver tree, are highly vulnerable to fire. Because suitable climatic (rainfall) conditions for germination occur rarely, and because shaded micro-environments such as those provided by shrubs and dwarf-shrubs are required, it is predicted that the quiver tree population is unlikely to recover within any reasonable time-frame. Furthermore, owing to the likelihood of occasional increased grassiness as well as severe droughts, quiver-tree populations may face increased mortality risks in the future as climate change progresses.

Effects of warming and different rainfall regimes on plant community composition in a mesic grassland

10:30AM - 10:40AM

Presented by :

Theresa Ojo, PhD Student, University Of KwaZulu-Natal

Climate change has fundamental impacts on temperature and precipitation patterns worldwide. Future rises in temperature, caused by climate change, are predicted to increase the variability of precipitation regimes, which in turn are predicted to have significant effects on vegetation community composition and ecosystem functioning. In this study, the effect of combined rainfall (control, -50%, +50%) and temperature (warmed and control) manipulation on the plant community composition of a mesic grassland was conducted at the University of KwaZulu-Natal's Ukulinga Research Farm (URF), Pietermaritzburg, KwaZulu-Natal. The warming treatment plot was warmed by artificial warming chambers, and the treatment of combined rainfall (control, -50%, +50%), combined warming and rainfall (-50% + warmed and +50% + warmed) and the warmed plots were replicated in three resulting to six treatments per each of the three blocks. Data was collected over the growing periods of both early and late seasons on the 14th January 2020 and 2nd March 2020, respectively. In the first year of treatment application, species composition responses were examined under both single and combined treatments of the warming and rainfall experimental manipulation. In particular, plant community composition was examined to determine sensitivity to experimental warming and drought and whether shifts in plant community composition intensified or stabilized changes in productivity. First, the overall effects of warming and +50% rainfall were not statistically significant ($p = 0.42$) resulting to greater grass and forb abundance with the likes of *Tristachya*

leucothrix, *Themeda triandra*, *Cymbopogon caesius*, *Cephalaria pungens* and *Dyschoriste burchelli*, whereas drought (-50% rainfall) was highly statistically significant ($p < 0.001$) on species response, ($p < 0.001$ and $p < 0.001$) for single effect on grasses and forbs, respectively. The combined effect of warming and drought (-50% rainfall) significantly altered community composition leaving out forbs ($p = 0.13$) with a high abundance of *Eriosema cordatum* and *Tragia meyeriana*. Lastly, warming had no significant effect on both grasses and forbs composition ($p = 0.08$ and $p = 0.30$, respectively). Overall, this study showed how swiftly drought affected the species composition within a short period of the manipulative experiment.

Combining machine learning and remote sensing techniques for grass condition assessment and monitoring

10:40AM - 10:50AM

Presented by :

Abel Ramoelo, Regional Ecologist/ Remote Sensing Specialist, South African National Parks,

In the era of the fourth industrial revolution (4IR), the management and assessments of the grassland ecosystem shall never be the same. The 4IR enables the combination of artificial intelligence and data technology as a new solution to address industrial, environmental, and social problems across the globe, by integrating cyber, biological, and physical fields. Components of 4IR critical for assessing grassland ecosystems are the internet of thing (IoT), big data, and artificial intelligence techniques such as machine learning techniques. Grassland is one of the biomes threatened by global environmental changes. These changes are climatic and anthropogenic related. Climate change is predicted to increase the frequency of droughts in southern Africa. In addition to the climatic change, land-use changes threaten grasslands. Therefore, the Grassland Biome is the least conserved, and assessment of biodiversity is critical. For the proper management of the protected areas within this Biome constant observation of the ecosystem is required (i.e. species composition, condition, quality, and quantity). Again, the use of conventional techniques is time-consuming and expensive. Remote sensing is an option with a wealth of satellite data available at multiple scales (Landsat, Sentinel, and MODIS sensors). Integration of *in situ*, remote sensing data, and machine learning techniques is useful to model key essential biodiversity variables for assessing grassland ecosystems such as vegetation cover, biomass, nutrient concentrations, and land degradation levels. I explore the possibility of using remote sensing data and machine learning techniques to develop and model key essential biodiversity variables for understanding changes in grassland ecosystems. I present the results on vegetation condition assessment in protected areas using time-series of remotely derived vegetation condition index (VCI), land degradation risk mapping using spectral mixture analysis, biomass, and nutrient concentrations. These products are useful for developing frameworks of monitoring and managing grassland ecosystems, including deriving stocking rates, grazing carrying capacity, and prioritising land restoration and rehabilitation.

Q&A | Discussion: Drought-stressed rangelands - reflections and the future

10:50AM - 11:00AM

Presented by :
Ralph Clark

11:00AM -
11:30AM

Interval / Virtual Tours

11:00AM -
11:30AM

Twitter poster session: Communal rangeland dynamics, governance and restoration

Twitter
@GrasslandSocSA

Moderators

Kevin P Kirkman, University Of KwaZulu-Natal

Melvin Swarts, Project Coordinator, Department Of Rural Development And Land Reform

Agro-ecological characterisation of smallholder livestock farming system in the Limpopo and Mpumalanga Provinces, South Africa

11:00AM - 11:04AM

Presented by :

Azwihangwisi Edward Nesamvuni, Professor, University Of Free State

A study to characterise the Agro-ecological attributes of smallholder livestock farming areas was carried out in Limpopo and Mpumalanga Provinces. The aim of the investigation was to differentiate the geophysical and climatic variables that may have an effect on the smallholder livestock farmers' vulnerability to climate extremes such high temperatures, drought, and floods. For purposes of this study the geographic co-ordinates were collected to match the geographic location of each farmer to the agro-ecological area, village, municipality, towns and district. Thematic maps were developed to show major geophysical and climatic attributes in each village such as rainfall, temperature, aridity and water sources. Water resources were also mapped showing location of water sources and their types (springs, pans, dams, boreholes, wells and waterholes. The study adopted the Vulnerability Framework of Lindoso (2011). Classification of the study area was based on the Food and Agriculture Organisation (FAO) framework of 1978 of agro-ecological zones (AEZs), based on major climate zones, moisture zones (water availability) and highland-lowland (cool or warm based on elevation). The assumption was made to the effect that AEZs are said to be influenced by latitude, elevation, and temperature, seasonality, and rainfall and distribution during varying seasons. The factoring in of elevation provided more information to the local conditions and its usual zonation for the classification of the various livestock production system and determination of their likely climate-related risks, as well as vulnerability. The results showed that over 90% of the present study experiencing lower rainfall to the global average of 860 mm.annum⁻¹. There were localised micro-climate zones that were arranged in a north-south areas that experience in excess of 1000 mm.annum⁻¹. The temperatures within the study region were generally warmer with the temperatures in excess of 24 °C, especially in the north-eastern parts. The aridity index values in the study area were categorised into three discrete subsections; namely the arid, semi-arid, and

dry sub-humid. The arid areas in the Musina Municipality were found to be the hottest regions in the study area, while it is also among the driest regions with serious lack of water resources. Smallholder farmers suffered great losses during the drought years 1980s, 1990s, 2002, 2003, 2007 and recently 2013. The lowest mean annual rainfall and erratic precipitation pattern are the main factors that hinder farming, especially when natural grazing becomes scarce in the semi-arid regions. The dry sub-humid areas constituted about 5% of the entire study area. The study region was found to be a risk area, owing to changing environmental conditions, mostly as a result of the rain-fed and/or insecure source water upon which the livestock production systems are dependent. Based on the findings of the study, it was recommended that: (1) early warning system be enhanced to rapidly provide smallholder farmers with weekly, monthly weather forecasts and (2) smallholder farmers be encouraged in their mixed farming to grow fodder crops for their animals.

Climate vulnerability and smallholder livestock water and fodder use analyses

11:04AM - 11:08AM

Presented by :

Azwihangwisi Edward Nesamvuni, Professor, University Of Free State

Farmer understanding of the impact of climate variability and extremes on water supply and grazing production is critical for them to develop adaptive practices necessary for resilience against adverse climatic conditions. Small-holder farmers often make a critical contribution to food security and are more vulnerable to adverse climatic conditions. The purpose of this study was to investigate the perceptions of small-holder farmers on the impact of climatic variability and extremes on livestock water and fodder use in Limpopo and Mpumalanga Provinces. Based on the results, recommendations were made for adaptive management of the water and grazing resources by small-holder farmers for sustained livestock production. Data was collected through descriptive surveys using a semi-structured questionnaire for interview of individual farmers, while some data was obtained from observations and focus group discussions. Based on the semi-structured questionnaire, 366 small-scale livestock farmers were interviewed, each being asked a standard set of questions posed in the same way each time. Spatial mapping of the small-holder farmers indicated that they were located in agro-ecological zones where surface (rivers and dams) and groundwater was available. The main sources of water for small-holder farmers were perceived to be rivers (41%), municipal/piped water (40%) and boreholes (33%). Only 3% and 7% of the farmers were believed to have used wells and dams/ponds respectively as water sources for livestock. Adult women older than 18 years (47.3%) and teenage women between 10 and 18 years (25.4%) were thought to be the main carriers of water from the water sources. The main water uses by households were regarded to be cooking (84%), washing (46.7%), and drinking (44.1%). Municipal piped water to farmer's households was reported to be critical to supply sheep and goats within homesteads. Cattle were perceived to have obtained water from a distance of 1–10 km, mainly from rivers. Majority of small-holder livestock farmers (97%) was believed to have accessed fodder from communal grazing. Even with the use of crop residues (59%) and own crop harvest (35%), inadequate grazing was perceived to be the biggest challenge for

large stock (cattle) and small stock (sheep). Based on the findings of the study, it was recommended that (1) early warning information be interpreted and regularly presented to farmers for them to be timeously aware of pending weather patterns, (2) livestock reduction be encouraged for seasons when adverse climate is anticipated (especially droughts in which both water and grazing tend to be scarce), (3) earth dams be constructed to harvest flood water at strategic catchment points (accessible to livestock farming villages) for use in times of scarcity.

Comparing the visual assessment method to the norms for grazing capacities in Chris Hani and Western District, Eastern Cape, South Africa
11:08AM - 11:12AM

Presented by :

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

Grazing capacity is expressed as a specified number of hectares per large stock unit (LSU). The aim of this study was to compare estimated and national benchmarks grazing capacities in 10 emerging farms in Chris Hani and Western districts. Data for large stock units and farm size per farm were collected from farm owners using semi-structured questionnaires. Two camps per farm were randomly selected for visual assessment and each camp were scored using the following indicators; plant cover (1–25%), grass species diversity (1–15%), soil surface condition (1–10%) and encroachment/invasion (1–10%). Veld condition score (%) was determined by adding all indicators. Thereafter, the calculated veld condition score (%) and annexure for annual rainfall of an area were used to estimate grazing capacity per farm. Benchmark grazing capacities per farm were provided by the National Department of Agriculture. The estimated grazing capacity for Mzini and Draaihoek farms in Chris Hani District was 16 ha.LSU⁻¹, whereas figures for the benchmark (Mzini: 15 ha.LSU⁻¹; Draaihoek: 9 ha.LSU⁻¹) indicated that grazing capacities of these two farms have increased. This implies that grazing land in terms of hectarage which can support one large stock unit has increased. In the Western District the farms Cres (5 ha.LSU⁻¹), Lilly Bovids (7 ha.LSU⁻¹) and Happy Valley (9 ha.LSU⁻¹) showed a similar trend when compared to the benchmark of 3 ha/LSU for these three farms. These results showed that the demand for grazing lands in terms of hectarage for sustaining one large stock unit has increased. The main reasons for such similar trends in these farms were due to negligence or poor veld management practices such as overstocking, bush encroachment and climatic factors, which were observed and reported by farm owners during the visual assessment of these farms. This confirms that the difference between estimated and national benchmark grazing capacities should be reduced to avoid the need for more grazing land for one large stock unit. This can be achieved through the implementation of proper veld management practices.

Smallholder farmers' perceptions on sustainable ruminant farming systems in the Eastern Cape Province, South Africa
11:12AM - 11:16AM

Presented by :

Tawanda Marandure, Research Assistant, Coventry University

The disconnect in 'mental models' of experts and farmers have been linked to the development of inappropriate technologies by the former, supposedly, to assist the later. These 'mental models' can be synchronised through understanding the key factors driving farmers' perceptions of the intended technology prior to its introduction. Interviews were conducted with 160 farmers to evaluate their perceptions, determinants, barriers and opportunities for sustainable smallholder ruminant farming in Eastern Cape Province, South Africa. The majority (70%) of smallholder ruminant farmers lacked awareness of the sustainability concept. Farmers had positive perception indices of social (+0.21) and negative perception indices of ecological (-0.31) and economic (-0.30) ruminant farming practices. Ordered logit model results showed that the odds for negative perceptions on biomass supply, crop residues, security from theft, offtake rates, household food security and socio-cultural roles of ruminant livestock were influenced by age, gender, marital status, education level, livestock training and employment status of farmers ($p \leq 0.05$). Major barriers to sustainable ruminant farming were poor rangeland management (70% of the respondents), low livestock productivity (60%), livestock theft (70%), youth migration to cities (70%) and cultural exclusion of women from ruminant farming (50%). Improved animal and rangeland management were the prominent opportunities raised by the respondents. Overall, smallholder ruminant farmers' positive perception of social and negative perception of ecological and economic sustainability farming practices were influenced by their socio-economic factors.

Exploring veld fire management and policy directions in a Savanna Biome undergoing land tenure changes

11:16AM - 11:20AM

Presented by :

Onalenna Gwate, Postdoctoral Fellow, Afromontane Research Unit / University Of The Free State

In Zimbabwe, uncontrolled anthropogenic veld fires became prevalent since the year 2000 as government undertook the fast track land reform programme to resettle the landless. It is well established that fire is important in structuring ecosystems. However, the timing and high frequency of uncontrolled anthropogenic fires in Zimbabwe could adversely affect the ecosystem. Government has been implementing different strategies to contain the high frequency of these uncontrolled veld fires. Despite these efforts, veld fire incidents and attendant socio-economic and ecological damages continue unabated. The present study sought to explore veld fire management and appropriate policy options for sustainable management in Matabeleland North province of Zimbabwe. A cross-sectional survey design was adopted and it essentially relied on focus group discussions and key informant interviews to understand community perceptions on the recurrence of uncontrolled veld fires. Results showed that causes of veld fires included gold mining (both legal and illegal) activities, poaching, land clearing and bee smoking. Natural wildfires were uncommon across sites. Farmers that were not resident on the farms (absentee landlords) aggravated the veld fire problem as they over-delegated management responsibility to workers who often had no interest in judicious fire management. There were poor relations between government service providers, like the Forestry Commission and National Parks and Wildlife Authority, which exacerbated the veld fire problem. In some areas, inappropriate models of

resettlement were implemented, resulting in failure to recognise the long-standing buffer zones adjacent to protected forests, and this compounded the veld fire problem. Veld fire prosecution was cumbersome, with a consequence that offenders were let loose, even when law enforcement agents were convinced that an offence had been committed. With respect to the traditional judiciary system, we found that prosecutions were low due to lack of capacity. Most veld fire law enforcement agencies were not visible on the ground with a consequent that communities do not get to receive extension packages and were not prosecuted as frequently as they should. This has resulted in the relegation of environmental issues to the background. Therefore, lack of institutional capacity exacerbated the veld fire scourge in the study area. There is a need to develop a policy to encourage absentee property owners to improve farm management through making drastic interventions such as withdrawal of lease documents owing to poor environmental performance. The mining sector should also be targeted in terms of fire pre-suppression and suppression regulatory enforcement. In order to improve uncontrolled veld fire management, there is a need to capacitate institutions involved in veld fire management to improve pre-suppression, suppression and post-fire suppression activities.

Which ruminant livestock to farm with in communal rangelands?
Affordability, profitability and sustainability of communal ruminant
livestock farming in the Eastern Cape, South Africa: A policy directed
review

11:20AM - 11:24AM

Presented by :

Siphe Zantsi, PhD Student, University Of Stellenbosch

There are many challenges facing communal farming in South Africa. These include the slow pace of land reform; declining productivity; the confined area of communal rangelands; increasing human populations; the impact of climate change on rangelands and on other agricultural activities; low communal livestock off-takes (particularly cattle); and increasing livestock production costs. In light of the above factors, Vetter (2013) has raised a thought-provoking debate on the design of effective policies on communal rangeland and livestock farming. To add to this debate, the purpose of this review is to analyse the likelihood of affordability, profitability and sustainability of ruminant livestock in Eastern Cape's communal rangelands. This review is based on published scientific papers in accredited journals, government reports on policies, and statistics in the Eastern Cape province of South Africa, which holds one of the highest national livestock herds in South Africa. After a review of relevant literature and policy documents, the early mentioned points and rural development policies were critically discussed. The review found that degradation of communal rangelands cuts across many parts of the former homelands in the Eastern Cape. As a result, communal farmers manage to keep more stock by supplementary feeding, which implies an increment in the production cost. This was found to link with the emerging localised literature on declining livestock numbers on communal land particularly cattle as they are highly affected by a shortage of grazing compared to small ruminants due to feed requirements and grazing behaviour. Moreover, cattle off-take has been reported to be very low, while small ruminants off-takes tends to be slightly high. Further, wool production has seen growth and this could

be due to improved profitability due to demand from China. Further, climate change forecasts project a decline in rainfall and increase in temperature accompanied by more intensive and more frequent droughts. The share of the communal grazing area is further shrinking as some of the grazing land is used for residential plots. This reduces grazing capacity, which is further reduced by the invasion of alien invasive plants. It was also found that the rate of land redistribution, which is expected to ease the pressure of communal rangelands, is slow. Several rural development and land reform policies are discussed in line with the central argument of the study. Based on the reviewed literature, it can be concluded that keeping all other factors (i.e. those not discussed here) constant, small ruminants are likely to be the most affordable, profitable and sustainable livestock activity in communal areas for an average rural household. This will depend on a sustainable market for wool in China. The review ends with several policy recommendations and areas for future studies.

11:30AM -
01:00PM
Zoom Webinar

Tuesday Session 03: Communal rangeland dynamics, governance and restoration

Moderators

Melvin Swarts, Project Coordinator, Department Of Rural Development And Land Reform

KEYNOTE ADDRESS: The surprising potential of livestock to restore rural rangelands and village economies

11:30AM - 11:55AM

Presented by :

Nicky McLeod, Director, Environmental & Rural Solutions (ERS)

Central to traditional economies and constituting an important form of currency, livestock are an integral component of rural society across Africa. They are a fundamental part of agricultural production systems and rural households' security, and are inextricably and symbiotically linked with our vast grasslands. Effective and equitable stewardship of the communal rangelands, which play host to almost 50% of South Africa's national herd plus unknown small-stock numbers, provides one of the most challenging management contexts in southern Africa, yet also poses an immense potential for augmenting household security in the sub-region. At no other time in our known history has the potential of productive, well-managed communal rangelands been so starkly imperative than now, in the context of COVID-19-catalysed hunger and potentially catastrophic economic challenges. Cattle as a widget of wealth are often maligned as the cause of degradation, both in the rural Eastern Cape where we work, as well as in communal landscapes across Africa. In this paper, we posit that livestock have the potential to restore both landscapes as well as the lives of those who live there, through improved governance and an understanding of how they fit into a greater holistic living landscape system. Garret Hardin's 1968 discourse on the tragedy of the commons places 'collective action arrangement' as a possible solution to degradation, and it is within this context, plus the experience of 20 years work in the area, that this paper is presented. Several key components have been explored in a participatory, hands-on, action-research-oriented and

citizen-science-based approach in the upper uMzimvubu catchment near Matatiele. These include how traditional knowledge systems and practices, along with new democratic processes, have influenced landscape governance and natural resource management outcomes. The focus has been on identifying common incentives for enhanced and locally acceptable, scientifically defensible collective rangeland governance, which underpins household and water security in the local landscape. The requisite participation of South Africa's effectively disenfranchised rural poor in rebuilding local economies is indisputable: this needs to be founded on sound subsistence practices and natural resource management, feeding into regional markets through simple, equitable and appropriate mechanisms such as mobile village auctions and certified biomass products. This paper reviews a very practical process which has implemented and explored how to link appropriate incentives such as enhanced market access, with a positive feedback loop to improved actions, primarily the balanced stewardship of rangelands, including their restoration from infestation by alien invasive plants.

Long-term changes in pastoral mobility in a semi-arid montane region of South Africa: The role of policy and legislation

11:55AM - 12:05PM

Presented by :

Igshaan Samuels, Senior Researcher, Agricultural Research Council

Legislation and policy are key tools used by governments to change the socio-economic and political landscape of agrarian systems with consequences for mobile pastoralism. This study examined how pastoral mobility in the semi-arid, montane Leliefontein communal rangeland of Namaqualand adapted to the changing 20th century socio-political landscape imposed upon the inhabitants. It analysed the impact of apartheid and post-apartheid legislation and policies introduced in South Africa from 1948 onwards. Apartheid legislation promoted betterment planning and the privatisation of communal lands by awarding access to most of the grazing areas to a few wealthier pastoralists. This led to increased stocking densities and further restriction of herd mobility when the majority of herds were restricted to fewer grazing camps. Throughout this period, pastoralists have resisted agricultural modernisation and have adapted their mobile practices within the limitations determined by their spatial constraints. The new land reform policies that have been introduced after 1994 continue to advocate for the modernisation of pastoral practices. Although legislative and policies initiatives have generally failed to address the challenges facing mobile pastoralists, the persistence of mobility among livestock keepers suggests that this is a particularly resilient and necessary element of their practices. Legislation and policy that promotes herd mobility will potentially support the single most important adaptation strategy among these pastoralists to a variable and changing montane rangeland.

Impact of aspect on vegetation characteristics in the mountain grasslands of Tajikistan

12:05PM - 12:15PM

Presented by :

Toshpulot Rajabov, Dean Of The Faculty, Samarkand State University

Tajikistan grasslands are mostly mountainous and consist of high-elevated summer and low-elevated winter pastures traditionally managed through flock mobility. The vegetation structure and composition in these diverse landscapes is strongly influenced by several environmental factors, including topography, elevation, slope gradient and aspect. The current study investigates the influence of aspect on *Artemisia* species-dominated vegetation in summer and winter pastures in northern Sughd Province, Tajikistan. Two V-shaped dry valleys with north and south-facing aspects were selected in summer and winter pastures. In each valley, three monitoring sites were established along an elevational gradient with two contrasting aspects in each site. In total, 12 sites were selected. At each site, vegetation sampling was conducted during two peak biomass-accumulation periods of the year (May and November). Attributes of perennial vegetation (species composition, plant cover and density) were described using three 10 x 2 m quadrats at each sampling site. Green biomass of overstory vegetation was determined by randomly selecting and clipping of above-ground biomass of perennial shrubs. Standing-crop of annuals was identified within 1 x 1 m quadrats, randomly distributed with three replications. Effects of aspect were profound on species diversity and botanic composition of both pastures. North-facing aspects were dominated mostly by perennial semi-shrubs as *Artemisia persica* and a wide variety of annual species, whereas south-facing aspects were characterised by the monotonous and unpalatable annuals *Taeniatherum crinitum* and *Bromus tectorum* with perennial semi-shrubs being scarce. Perennial plant density was also higher on north-facing than on south-facing aspects for the winter pasture in November (130,700 and 22,000 plants.ha⁻¹) and in May (87,200 and 54,300 plants.ha⁻¹), while there were no significant differences in the summer pasture. For both pasture-types, and during both biomass-accumulation periods, the standing crop was higher ($p < 0.05$) on north-facing aspects in comparison to the south-facing aspects due to the specific dominant species with various life forms. In particular, the absence of annual species in November considerably increased the variability of herbage biomass between the two aspects this being very low on south-facing as compared to north-facing aspects. Thus, the difference in vegetation physiognomy was obvious at the end of the vegetation period when understory herbaceous species were senescent. Results from this study indicate higher seasonal vegetation diversity and carrying capacity in the north-facing compared to south-facing aspects, implying that aspect should be factored in when designing restoration and/or grazing management approaches. Due to higher resource availability in north-facing, the expectation is that vegetation will respond quicker when compared to south-facing slopes, which would allow for animals to spend relatively longer periods in these slopes. Finally, considering the aspect-driven vegetation dynamics in mountainous ecosystems will lead towards improved management of these increasingly utilised grasslands in Tajikistan and similar ecosystems.

Communal cultivated pastures: Successes and failures – lessons to be learned for a value-added future

12:15PM - 12:25PM

Presented by :

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

Grazing systems have been popular dialogue topics amongst pastoralist for quite some time. Whether it is a continuous, rotational, or the ultra-high density grazing system, depending on the school of thought and in some instances on recent relevant science, commercial producers adhered and relied on either one of these practices. The application of any, however, is lacking in the communal landscape, and grazing capacity is at an all-time low within the communal producer arena in South Africa, especially within the North-West Province, as uncontrolled grazing takes the upper hand. Veld is overgrazed and the natural resources are pushed to the limited. Within their social and cultural systems, producers in the communal setup don't want to follow the standard practice of reducing animal numbers, even though the land can't sustain these numbers. For the producers it is a matter of numbers equals status, but even more so for some, the animals are their only possession and can be turned into cash when needed. This differs from province to province. As government departments, officials are confronted on a daily basis with the question of how to increase the grazing capacity in communal areas, without reducing animal numbers. That being said, many efforts to introduce grazing systems of any kind, have also failed in most instances. However, the producers within these landscapes are desperate for solutions. Routine farm planning practices dictate the incorporation of cultivated pastures, but as the communal landscape has many constraints pertaining to large cultivations, alternative methods of cultivation and stockpiling of fodder needs to be investigated. Can these methods aid in erosion control and topsoil loss? What other clever plans have some of the communal land users come up with to breach the feeding gap? Surely some success stories are lurking around in our communal lands. It is an open question of which we might not have a straight-shooting answer, as the human factor, natural environmental occurrences, as well as long term climate change, are responsible for these. The aim of this presentation will be to start a conversation on how we can improve the grazing capacity of the surrounding landscape without reducing animal numbers by introducing cultivated pastures in the narrative. Furthermore, to engage the wider audience on success stories within other provinces, or countries, alternative crop production and alternative grazing systems to suit the communal/informal settlement setup.

“Ons plante in ons maniere”: An ethnographic case-study of how herders in the Leliefontein Communal Area (South Africa) apply indigenous ecological knowledge (IEK) to ascertain the “value” of fodder-plants

12:25PM - 12:35PM

Presented by :

Maud Sebelebele, Master's Student, University Of The Western Cape

Mainstream valuations studies and publications related to how pastoralists use their Indigenous Economic Knowledge (IEK) to assign value to grazing plants tend to be either quantitative or qualitative studies, analysed through mixed methods. Most natural resources valuation studies conducted alongside pastoral communities consistently assess the value of fodder-plants based on conventional classifications such as sustainability (endangered or not), fungibility (economically exchangeable or not), and palatability, for instance. Moreover, in the analysis, emic (knowledge according to local perspective) IEK is consistently

instrumentalised and reflected through conventional and pre-developed scientific frameworks that are etic (reflected according to researcher knowledge) and abstract in their description, therefore leaving *in situ* qualitative knowledge gaps as to how local people are assigning value to their local grazing plants. Consequently, the interests of this study were to observe, and through a qualitative approach, reflect on the valuation processes that exist in three villages in the Leliefontein Communal Area according to indigenous concepts, to find out (1) how do herders and community members categorise and value fodder-plants? (2) Additionally, what goes into the dynamics and processes involved in considering and thus declaring grazing fodder plants to be valuable? Twelve herders (four per village) were sampled using purposeful and snowball sampling, and the data was collected through 16 walking-ethnographies, in the veld alongside grazing animals. The data was collected through an ethnographic multi-species approach where the veld, fodder-plants, grazing livestock, and the herders were interviewed using an assortment of qualitative research methods which included observation, photographs, voice-recording, semi-structured open-ended questions, journaling, and the deep-hanging out technique. The data was analysed using reflexive thematic analysis whereby common phrases, descriptions and observations, and meanings, were coded and interpreted using a grounded theory approach. This paper gives a summary of the ethnographic trajectory as well as the different value indicators and value categories found while conducting the study.

The vanishing herders of Namaqualand: Implications for indigenous knowledge and rangeland management

12:35PM - 12:45PM

Presented by :

Clement Cupido, Researcher, Agricultural Research Council ? Animal Production Institute

Traditional pastoralism has been practised for millennia in numerous ecosystems across the world. Despite agricultural advancement in livestock production in the developed world, pastoral systems still persist in many variations. Transhumance movements are still the order of the day in such pastoral systems where the herder plays a pivotal role as herd and rangeland manager. They are therefore central in such pastoral communities, but this role is often looked down upon by the modern world and disregarded as trivial work. Published literature, however, indicates that herding does offer many benefits over commercial paddock systems e.g. improving rural livelihoods, reducing stock theft, reducing predation and improving biodiversity management. The Agricultural Research Council has for the past two decades been working with Nama communities in the Kamiesberg, Steinkopf, and Richtersveld regions on ecological, as well as anthropological studies. This paper (in the form of a photo essay) is an attempt not only to give a human face to herders through a series of photographic images, but to highlight particular activities of herders in the semi-arid Namaqualand region of South Africa. The images show the complexity of herding, portraying herders in their daily activities as ecologists (e.g. reading the land in terms of plant and soil degradation), and as botanists (e.g. their understanding of taxonomy, phytochemistry, nutritional value and plant toxicity). It also depicts herders as midwives during lambing season, practising nursing, as animal capital investors, and shows the interaction with their guarding dogs which are vital in

effective low-cost predation control. It also shows the interaction between herders at communal water point which acts as the gathering point for the exchange of knowledge. Furthermore, the images illustrate the role of women as shepherdesses. The art of herding is, unfortunately, a slow dying art as cultural regression is a reality and since the younger generation do not see it feasible to embrace the labour-intensive aspects of herding. These results show that the value of herders, as knowledge holders in a community of practice, in dryland farming systems deserve more recognition and they should be key players in policy development.

Q&A | Discussion: Communal rangeland dynamics, governance and restoration

12:45PM - 01:00PM

Presented by :

Melvin Swarts, Project Coordinator, Department Of Rural Development And Land Reform

08:00AM -
09:30AM

Zoom Webinar

Wednesday Session 04: Special Session: Dairy pastures of the future – resilience and productivity

Moderators

Sigrun Ammann, Pasture Scientist, Western Cape Department Of Agriculture

KEYNOTE ADDRESS: Dairy pastures: How far have we come and how much more opportunity is there?

08:00AM - 08:25AM

Presented by :

Craig Galloway, Trace & Save

The premise of pasture-based dairy systems is that milk production is supported predominantly by pastures grown on the farm, with minimal roughage supplementation and adequate provision of concentrates to meet additional nutritional requirements. This combination should result in the most cost-effective production of milk. The pursuit of this ideal has led farmers, consultants and researchers to continually adapt and adjust pasture types, grazing management practices and fertilisation strategies. The tools with which to do this and the level of detail involved has changed significantly in the past years. Kikuyu grass (*Pennisetum clandestinum*) became popular in South Africa on dairy farms as early as the 1930's. Since then it has been the basis of dairy pastures. Although kikuyu has many benefits, it is low in digestible energy, and therefore dairy farms relied on concentrates to achieve optimal milk production. Cool-season grasses, most notably ryegrass (*Lolium* spp.), have been oversown into kikuyu to provide forage throughout the year. More recently clover (*Trifolium repens* and *T. pratense*), chicory (*Cichorium intybus*) and plantain (*Plantago lanceolata*) have been included into pasture mixtures, with kikuyu-ryegrass as a base. Annual pastures have included annual ryegrass (*L. multiflorum*) with oats (*Avena sativa*) or triticale (*Triticosecale*). The shift towards multi-species pastures has been driven by a desire for better quality, higher resilience, greater dry-matter production and improved soil health. A shift away from kikuyu-based pastures, to higher quality warm-season perennials (e.g. lucerne *Medicago sativa*), has led to a smaller reliance on high concentrate inputs. Further improving pasture quality through better cultivars, selecting the correct multi-species mixtures, better fertiliser management and improved soil health has the potential to decrease the reliance on external feed sources. Another opportunity, which has started to be more widely adopted, is perennial dryland pastures. Although this is a challenge in many contexts because of dry summers (Southern Cape) or cold winters (KwaZulu-Natal), new cultivars and multi-species pastures have made this a greater possibility. The use of plate-meters to measure pastures, and the associated tools to accurately allocate pastures has made significant differences in pasture utilisation. When looking to the future, there is further opportunity to refine this process to not only prioritise pasture quality, but to also manage grazing to improve soil health. The use of chemical inputs has also changed greatly over the years. There was a big increase in fertiliser inputs, especially

nitrogen, in the early 2000s to a point where over 1,000 kg of N.ha.year⁻¹ was being applied. This has gradually decreased to an average of around 350 kg N.ha.year⁻¹ in recent years, which is still currently widely recommended. Future opportunity, especially when considering the push towards soil health, is to decrease fertiliser inputs significantly. This is an imperative for more sustainable, regenerative pasture-based dairy farming. There have been many changes in dairy pastures, but the general commitment from farmers to greater productivity has not changed. Farmers have been the drivers of innovation and change and will continue to be.

Short, medium and long duration cultivar characterisation of forage cereals

08:25AM - 08:35AM

Presented by :

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

Forage cereals can be used in diverse manners and by farmers of any scale. Cereals can be planted dryland for livestock feed or as a cover crop after silage maize in the autumn. These versatile species can be used as direct grazing or as a once-off silage harvest, thus increasing land productivity and filling a feed gap in winter and early spring months. However, farmers need to know where cultivars fall within the short, medium and long-duration scale in order to know when to plant and for which purpose each cultivar is best suited. Short duration types (spring-types with no vernalisation requirements) can be planted later and used for a single silage harvest or one or two grazings. Medium and long-duration types (winter-types, which require vernalisation to varying degrees) can be planted earlier in autumn and grazed several times. In autumn 2019, two trials were planted, whereby 12 short-duration cereal cultivars were planted in one trial and 27 medium and long duration cultivars planted in another trial. The following cereal species were used: barley (*Hordeum vulgare*); white oats (*Avena sativa*); black oats (*A. strigosa*); red oats (*A. byzantina*); stooling rye (*Secale cereale*); and triticale (\times *Triticosecale*). Supplementary irrigation was applied sparingly. A space planted nursery was established to determine days to flowering. The short-duration trial was harvested once as a silage cut when seed heads were at the soft-dough stage. These yields were highly significant for cultivars at $p < 0.001$ at 5% level of significance. The highest yielding cultivar was Overberg oats at 6.98 t DM.ha⁻¹ with a mean of 5.84 t DM.ha⁻¹, which is considered a good yield. The earliest flowering cultivar was KM 10 triticale at 75 days and the short duration trial had a mean 122 days to flowering. The medium to long-duration trial was harvested four times to simulate grazing. These yields were highly significant for cultivars at $p < 0.001$ at 5% level of significance. The highest yielding cultivar was Southern Blue stooling rye at 5.58 t DM.ha⁻¹ with a mean of 4.16 t DM.ha⁻¹. In general, the white and black oats were quick to establish. Cultivars that had a high yield in the medium to long-duration trial tended to be characterised as long duration as they still had good yields in the third and fourth cuts where other cultivars had already died off. Some cultivars fit clearly into the short, medium or long duration characterisation, however, there does seem to be some variation in days to flowering depending on the year or season, hence repeating the study would be recommended.

The performance of lucerne (*Medicago sativa*) cultivars with different dormancy classes over three years on Cedara—quantity and quality data

08:35AM - 08:45AM

Presented by :

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

Lucerne (*Medicago sativa*) is a perennial legume of excellent quality, which is used as an intensive pasture or to make hay. Lucerne cultivars have been bred with a range of dormancy classes. Cultivars with a rating of 1 (most dormant) to 8 are winter dormant, whilst those rated 9 to 11 are winter active. Winter dormant cultivars tend to be dormant in winter with their crown below ground. Due to this growth habit, they tend to be more persistent and are more adapted to grazing. Winter active cultivars have a smaller elevated crown, which can be damaged by grazing, are better for hay production and tend to be less persistent. These attributes make dormancy class an important factor during cultivar selection. In 2014, an irrigated lucerne cultivar trial was planted on Cedara Research Station, in KwaZulu-Natal. Harvesting was done when basal shoots were 3 to 5 cm in length or most cultivars were starting to flower. The cultivars were planted in two adjacent blocks, separated according to dormancy class. One block had 18 cultivars with dormancy class < 9 (WD-winter dormant) and the second had 14 cultivars with dormancy class ≥ 9 (WA-winter active). Over three years (2014 to 2017) of the trial the WA block had one more cut than the WD block and a total mean yield of 42.11 t DM.ha⁻¹ and 41.99 t DM.ha⁻¹, respectively. The bulk of the dry matter (DM) yield was grown in spring and summer, ranging from 4.16 to 7.32 t DM.ha⁻¹ for WD and 3.39 to 6.9 t DM.ha⁻¹ for WA cultivars. Winter yields from WA were higher (2.2 to 2.78 t DM.ha⁻¹) than WD (1.23 to 1.49 t DM.ha⁻¹) signifying that the dormancy class system is valid, since the WD cultivars are to varying degrees dormant during winter. Quality data showed generally high crude protein (CP) (20 to 35%) figures and low non-structural carbohydrates (NSC) (3.0 to 7.8%) for all varieties, as expected for a legume species. However, there were significant differences between seasons ($p < 0.001$) at 5% level of significance, which is assumed to be connected to growth and stage of reproduction. The relative feed value (RFV) is calculated from neutral detergent fibre (NDF) and acid detergent fibre (ADF) and is a method used to compare forages. All RFV values are compared with lucerne in full bloom being rated at 100; values higher than 100 indicate superior quality. WA cultivars were all above 100 in all seasons (108 to 168), indicating good quality. Alternatively, five WD cultivars had a value lower than 100 in summer (97 to 99). Differences in yield were not as great as anticipated between dormancy classes, however, the trial did not have any dormancy classes lower than five. Choice of cultivar is dependent on management ability and preference. Winter dormant cultivars are more forgiving to stresses such as heavy grazing and drought, and winter active cultivars are more productive and persistent over a longer period.

Assessing the potential of alternative species for intensive dairy pasture production

08:45AM - 08:55AM

Presented by :

Sigrun Ammann, Pasture Scientist, Western Cape Department Of Agriculture

The temperate species most commonly used for intensive pasture production are *Lolium multiflorum* (annual ryegrass) and *L. perenne* (perennial ryegrass), which are productive under intensive systems and have good forage quality required for milk production. In South Africa, the ryegrass species have also formed the basis of intensive dairy pastures. However more recently there has been an ever-increasing realisation that dairy pastures require more resilience and robustness. Contributing factors are drought and reduced irrigation water availability, as are overall changes in climate. The objective was to compare yield and forage quality of alternative species with perennial ryegrass to determine their potential for use as dairy pastures. The data is taken from cultivar evaluation trials conducted on the Outeniqua Research Farm. The species considered as possible alternatives are *Festuca arundinacea* (tall fescue) and forage herbs, being *Cichorium intybus* (chicory) and *Plantago lanceolata* (plantain). Defoliation was determined according to the requirements for each species being leaf stage for the grasses and height for the forage herbs. The data are compared on a seasonal and annual basis. The total dry matter (DM) yield for fall fescue, forage herbs and perennial ryegrass are 13.8, 21.9 and 13.2 t DM.ha⁻¹ respectively for the first year and 13.4, 19.2 and 12.8 t DM.ha⁻¹ for the second year. Within the forage herbs, chicory yielded 22.6 and plantain 25.8 t DM.ha⁻¹. The annual yield clearly shows that the alternative species not only have potential but are higher-yielding than ryegrass. For the first autumn, forage herbs are significantly superior with 5.56 t DM.ha⁻¹ ($p < 0.05$) with perennial ryegrass at 2.78 and tall fescue at 1.36 t DM.ha⁻¹. This is, however, the establishment month for grasses while the forage herbs are established in spring already. In the second autumn, the forage herbs are significantly higher yielding than the grasses ($p < 0.05$), while there are no differences ($p < 0.05$) in the third autumn. In winter perennial ryegrass (3.2 t DM.ha⁻¹) is higher-yielding ($p < 0.05$) than the other species however on a cultivar level there are differences with plantain at 4.1 and the forage herb mean for all cultivars at 2.1 t DM.ha⁻¹. Similarly, for summer, the forage herbs are significantly superior ($p < 0.05$) over all three years. Crude protein (CP) levels are comparable between perennial ryegrass (20 to 28%) and tall fescue (16 to 28%) with a strong seasonal variation, while the forage herbs maintain a more constant level above 20% peaking at 26%. The fibre content (NDF) in tall fescue ranges from 40 to 54%, for forage herbs 30 to 38% and perennial ryegrass 42 to 48%, season dependent. This data confirms that the alternative species do have potential for intensive dairy pasture systems. The seasonal yield distribution is different to perennial ryegrass and thus suitable pasture systems have to be developed to take advantage of these deeper rooted and more resilient species with improved production potential.

Building soil carbon to improve water holding capacity

08:55AM - 09:05AM

Presented by :

Craig Galloway, Trace & Save

Water has become one of, if not the most important, limiting factor in dairy farming. The recent drought has placed a much stronger focus on the vulnerability of farms to water scarcity. It has also shown that future focus in pastures should be on improving the resilience of pasture systems to extreme

weather conditions. Total water holding capacity and carbon are some of the soil parameters that can provide information about a soil's water use efficiency. The study aimed to establish the correlation between soil carbon and water holding capacity in pasture soils. It also focused on the broader role that soil carbon plays in improving soil health. In addition to this, the study explored practices that farmers have implemented which improved soil carbon, and therefore soil health-including water holding capacity, and how the integration of these practices lead to greater water use efficiency on dairy farms. Soil core samples from 31 pasture-based dairy farms in the Eastern Cape, South Africa, were used to determine the relationship between soil carbon and soil structure indicators (water holding capacity, porosity), soil life indicators (active carbon, mould, yeast), and soil fertility indicators (pH, calcium, magnesium, potassium and sodium). Each core sample is a composite of four cores and are taken at depths of 0–15 cm, 15–30 cm, 30–45 cm, and 45–60 cm. A total of 1,226 core samples were included in the analysis. A correlation was done in order to determine the relationship between the soil parameters. To further explore the relationship between carbon and water holding capacity, a linear regression was used to determine the corresponding increase in water storage ability with a 1% increase in soil carbon levels. Anecdotal evidence from consultations with farmers was used to provide insight on practices which improved soil carbon levels. Soil carbon and water holding capacity were positively correlated ($R = 0.41$; $p < 0.001$; $n = 1,226$). Each 1% increase in soil carbon corresponds with an increase in water holding capacity of 3.20%. This is the equivalent increase of 8,315,522 litres.ha⁻¹ in a 0.6 m soil profile, the maximum depth to which the soil samples were taken. Water holding capacity and total carbon were negatively correlated to depth-both decrease with greater depth in the soil. All the other soil parameters included were positively correlated to soil carbon. Carbon is therefore integral to soil health from a structure, life and fertility perspective. The importance of implementing practices which improve soil carbon levels is highlighted through this study. Producers who have implemented an integrated approach of no-till practices, multi-species pastures, improving each aspect of soil health and managing grazing rotation effectively, have been able to increase soil carbon levels. Further research needs to prioritise how to take better advantage of increased soil water holding capacity through improved irrigation management.

Pasture mixtures and monocultures for milk production: First insights

09:05AM - 09:15AM

Presented by :

Janke Van Der Colf, Pasture Scientist, Western Cape Department Of Agriculture

The sustainability of pasture systems in the Southern Cape is being put at risk due to high stocking rates, poor persistence of pastures, weed ingress of no-till pastures, and increasing input costs associated with irrigation, fertilisation, and concentrate feeding. The inclusion of alternative pasture species, such as plantain (*Plantago lanceolata*) and tall fescue (*Festuca arundinacea*) has been hypothesised to be a pasture-based approach whereby to improve sustainability, due to the improved rooting depth, high forage quality and high-yielding ability of these species. A project was initiated in 2019 to investigate how to integrate alternative pasture species into pasture systems in order to increase forage quality, pasture yield, pasture persistence, milk yield, and overall efficiency. The

study consists of three 5 ha un-replicated farmlets based on (1) a combination of two monoculture pastures of plantain and tall fescue (MC), (2) a pasture mixture made up of tall fescue/plantain/red clover (*Trifolium pratense*) (MIX), and (3) kikuyu-ryegrass (*Pennisetum clandestinum-Lolium* spp.) (KIK) pasture. The former two pastures were established by complete renovation with herbicides, while the latter was over-sown using traditional no-till methods. Each system was grazed by a 'mini-herd' of twenty cows selected to achieve an even distribution of lactation number, maintain days in milk (DIM) at approximately 150 and provide a constant flow of animals into and out of the system. Due to lack of replication associated with the farmlets, preliminary systems data were compared by means of non-weighted normalised index values for pasture parameters (dry matter yield.ha⁻¹, cows.ha⁻¹, sown component contribution), fodder flow parameters (cow days on conserved/bought forage, % area cut for feed conservation, number of silage bales cut, area re-established in autumn), and animal production (milk yield, kg milk components). These indexes were combined into a 'whole system index'. When totalled from June 2019 to April 2020, MIX had a higher whole system index (68) than MC (63) and KIK (64). The higher whole system index in MIX was also associated with a higher pasture, milk, and fodder flow index. The MIX system achieved the highest pasture index from winter to summer and the highest fodder flow index during spring and autumn. This trend could indicate that pasture supply and overall fodder flow in this system are more favourable than in KIK and MC. Due to a combination of low pasture yield and a low sown component in KIK it had the lowest pasture index during winter, spring, and summer. The milk index was more variable than the pasture index in all systems, with no clear trend discernible over seasons. Once more factors, particularly forage quality, are included in the data, relationships can be identified to explain these trends. Although preliminary indexes can indicate how systems perform comparatively over seasons at this early stage in the project, a weighted index based on a broader range of parameters such as nutrient and water use efficiency, forage quality and economic parameters, could give a more accurate representation of how systems will perform over time.

Case study: Improving nitrogen fertiliser efficiency on pasture-based dairy farms

09:15AM - 09:25AM

Presented by :

Craig Galloway, Trace & Save

Nitrogen is imperative to pasture growth. Conventional agriculture has become increasingly reliant on inorganic nitrogen fertiliser to achieve productive pasture growth. This is costly to farmers and has associated negative environmental impacts. Improving the efficiency of nitrogen fertiliser will result in more profit, and more importantly, limit the environmental impact of pasture growth. This case study aimed to examine how pasture-based dairy farmers have improved nitrogen fertiliser efficiency over the past four years, a period over which these farmers aimed to improve the nitrogen use efficiency (NUE) of their farms. It is an observation of how effectively the farmers were able to do so. The farms included in this study are where farmers purposefully worked to improve their NUE, and did so effectively. Included in the case study are three farms in the Tsitsikamma, one in George and one in Cookhouse. The three Tsitsikamma farms are mixed

irrigation and dryland, whereas the other two farms only have data for irrigated pastures. All five farms have multi-species pastures predominantly containing various mixtures of kikuyu-ryegrass or lucerne-ryegrass with chicory, white clover, red clover and plantain. In order to improve NUE, all five of these farmers shifted the overall balance of pasture compositions on their farms from predominantly kikuyu-ryegrass pastures to predominantly lucerne-ryegrass pastures. Farmer-recorded organic and inorganic nitrogen fertiliser application rates and pasture growth per camp were examined for each farm. In 2016, a mean of 342 kg N.ha⁻¹ ($n = 141$) was applied on irrigated pastures, and 318 kg N.ha⁻¹ ($n = 21$) on drylands. These application rates reduced to 176 ($n = 239$) and 149 ($n = 78$) kg N.ha⁻¹ on irrigation and drylands respectively in 2019. Under irrigation, the pastures produced a mean of 18.5 t DM.ha⁻¹ in 2016, which decreased in 2017, recorded the severest drought. Even though the drought continued in 2018, production increased, and peak production was reached in 2019, at 19.4 t DM.ha⁻¹. The drylands, surprisingly, showed a steady increase from 2016, at 8.2 t.ha⁻¹, to 2019, at 16.4 t.ha⁻¹. The mean fertiliser efficiency improved on irrigation from 19.6 kg N.t⁻¹ DM in 2016 to 10.0 kg N.t⁻¹ DM in 2019. On drylands this improvement was from 38.0 kg N.t⁻¹ DM in 2016 to 9.7 kg.t⁻¹ DM in 2019. It is clear from the results that these five farms have drastically improved the efficiency with which they convert nitrogen fertiliser into pasture. They have done this by using a lot less fertiliser while improving the tons dry matter produced. The keys to this improvement in efficiency, as observed from anecdotal evidence, are an integrated approach of improved soil health, the inclusion of legumes in pastures and optimal grazing management. Reduced fertiliser not only saves farmers money, but it reduces the negative environmental impact of growing pastures. More efficient nitrogen use means less excess nitrogen results in pollution of the atmosphere and water sources.

Q&A | Discussion: Dairy pastures of the future – resilience and productivity

09:25AM - 09:30AM

Presented by :

Sigrun Ammann, Pasture Scientist, Western Cape Department Of Agriculture

09:30AM -
10:00AM

Interval | Virtual Tours

09:30AM -
10:00AM

Twitter poster session: Dairy, nutrition and cultivated pastures

Moderators

Twitter
@GrasslandSocSA

Kevin P Kirkman, University Of KwaZulu-Natal

Janke Van Der Colf, Pasture Scientist, Western Cape Department Of Agriculture

Effects of *Cajanus cajan* and *Mucuna pruriensis* forages on goat production in the southern zone, Madagascar

09:30AM - 09:35AM

Presented by :

Arsène Randrianariveloheheno, Laboratory Of Animal Nutrition

In the sub-arid Southern Rangelands of Madagascar, shrubs and herbaceous forage species are available for goats. This research aims to compare the production of twenty goats (four females and sixteen males) in two groups with an average live weight (13.87 ± 1.29 kg and 13.97 ± 1.57 kg), confined in individual sheds. The study was carried out at the experimental station GRET NGO Ambovombe ($25^{\circ}09'55.3''S$, $46^{\circ}06'04.2''E$). One group (lot 1) were fed with native forages (*Flacourtia indica*, *Tamarindus indica*, *Operculicarpa hyphenoides*, *Solanum* sp., *Euphorbia stenoclada*, *Opuntia ficus-indica*), while the second group (lot 2) were fed with introduced forage species (*Brachiaria ruziziensis*, *Mucuna pruriens utilis*, *Cajanus cajan* and by-products such as *Vigna unguiculata*, *Ipomea batata* and *Zea mays*). Both lots were fed for 105 days (in five phases of 21 days each). Feeding was done twice a day, at 08h00 and 15h30. The following parameters were recorded: live weight, average daily weight gain, food intake, chemical composition, and apparent digestibility. It was found that *Mucuna pruriensis* and *Cajanus cajan* significantly increased the live-weight of lot 2 (18.33 ± 2.58 kg) and for lot 1 ($p < 0.05$). These legume forages increased average daily gain with 57.00 ± 13.36 g.d⁻¹ in lot 1 against 54.80 ± 21.44 g.d⁻¹ in lot 2. Dry matter (DM) intake was higher in Lot 2 (866.60 ± 47.38 g.d⁻¹) in comparison to lot 1 (785.40 ± 139.70 g.d⁻¹) ($p = 0.05$). Chemical composition between two feeding lots was characterized: dry matter Lot 1 ($85.94 \pm 14.41\%$) and lot 2 ($86.00 \pm 10.24\%$); crude protein lot 1 ($9.59 \pm 7.75\%$ DM) and lot 2 ($8.26 \pm 2.70\%$ DM); crude fibre lot 1 ($22.78 \pm 7.64\%$ DM) and lot 2 ($29.34 \pm 4.10\%$ DM). Consequently, crude protein digestibility apparently is significantly different between the two lots with $84.24 \pm 0.50\%$ in the case of lot 1 and $84.30 \pm 0.33\%$ in the case of lot 2 ($p = 0.05$). In fact, the nutritional value of these forage species determines the lower level of the goat production. *Mucuna pruriensis* and *Cajanus cajan* apparently increase crude protein digestibility. Thus inclusion of legume forages is implied in the improvement of forage bio-availability and for a sustainable agro-ecological zone.

Nutritional value and forages species typology in the Southern Region of Madagascar

09:35AM - 09:40AM

Presented by :

Arsène Randrianariveloheheno, Laboratory Of Animal Nutrition

Although the rangelands of southern Madagascar are dominated by vegetation adapted to sub-arid conditions, they are still extensively used by ruminants. With the collaboration of smallholder farmers at Ambovombe (Androy Region; $25^{\circ}09'55.3''S$, $46^{\circ}06'04.2''E$), the nutritional value of species used for forage was tested in order to classify forage species according to chemical composition. The sampled forage species were analysed following the methods of the Association of Official Analytical Chemists, and included dry matter, crude protein, crude fibre, lignin, organic matter digestibility, net energy, calcium and phosphorus. The data were treated with Principal Components Analysis (PCA) for typology analysis. A total of 166 collected plants were collected, 48 species (23 families) of which were identified and categorised as forage species. Of these, 39.9% were shrubs,

31.3% trees, and 29.2% herbaceous species; Fabaceae is the dominant family (22.9%), followed by Poaceae (20.8%), and Euphorbiaceae comprised 2.1%. With significant difference ($p < 0.05$), these rangelands have been characterised by average chemical composition such as: dry matter (DM) ($34.83 \pm 8.57\%$); crude protein ($13.38 \pm 5.15\%$ DM); crude fiber ($24.15 \pm 7.81\%$ DM); lignin ($27.82 \pm 15.82\%$ DM); organic matter digestibility ($72.00 \pm 1.00\%$); net energy (0.69 ± 0.02 Forage Unity); calcium (1.37% DM); and phosphorus ($0.37 \pm 0.19\%$ DM). With PCA, three typology groups have been established. The first group was determined by crude protein content and organic matter digestibility (e.g. *Azima tetracantha*, *Boerhavia diffusa*, *Clerodendrum arenarium*, *Cordia caffra*, *Leptadenia madagascariensis*, *Macroptilium atropurpureum*, *Mollugo decandra*, *Opuntia dillenii*, *O. inermis*, *Poupartia caffra*, *Salvadora angustifolia*, *Tridax procumbens*). The second group was characterised by dry matter and crude fibre content (e.g. *Brachiaria brizantha*, *B. humidicola*, *Cenchrus ciliaris*, *Combretum collinum*, *Dactyloctenium aegyptium*, *Diospyros sclerophylla*, *Flacourtia indica*, *Heteropogon contortus*, *Indigofera compressa*, *Panicum mahafalense*, *Pennisetum purpureum*, *Plectaneia stenophylla*, *Pycnus polystachyos*, *Senecio madagascariensis*, *Stylosanthes guianensis*). The third group was determined by lignin, calcium and phosphorus contents (e.g. *Allophylus decaryi*, *Alysicarpus ovalifolius*, *Andropogon eucomus*, *Caesalpinia decapetala*, *Capurodendron mandrarensis*, *Croton mahafaliensis*, *Cynodon dactylon*, *Delonix regia*, *Dichrostachys tenuifolia*, *Indigofera astragalina*, *Leucaena leucocephala*, *Melia azedarach*, *Mucuna pruriens*, *Operculicarya decaryi*, *Panicum pseudovoeltzkowii*, *Pentopetia grevei*, *Pithecellobium dulce*, *Secamonopsis madagascariensis*, *Solanum hippophaeoides*, *Tamarindus indica*, *Thilachium sumangui*). These Malagasy rangelands provide significant variety for ruminants, but quantifying forage availability for sustainable management should be an important next research step.

Eragrostis curvula as future pasture for highveld of the Mpumalanga Province, South Africa

09:40AM - 09:45AM

Presented by :

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

Eragrostis curvula is one of the intensively studied planted pasture species in South Africa and other parts of the world. Current pasture production is no longer reliant on only superior production, but also needs to be tolerant to variable climatic conditions and have competitive abilities. Recently, South Africa experienced variable weather patterns where drought and flooding were common scenarios in different parts of the country. A different weather pattern, especially drought, contributed to awareness on how best pastures can be selected for national drought emergencies. Mpumalanga Province Highveld Region produces 89% of *E. curvula* hay in the province, therefore conservation and development strategies of *E. curvula* is a provincial priority. Data on production potential of *E. curvula* were collected annually, including biomass, resilience after fire and recently recovery of species after medium-term drought. The purpose of the study was to highlight biomass production trends in correlation with local annual mean precipitation during different growing seasons. Biomass data were collected by clipping the material beneath the disc of a disc pasture meter which was then

oven-dried to constant dry weight. A metric rain-gauge tool was used to measure mean annual precipitation (MAP). Fertilization application of 100 kg N.ha⁻¹ was applied in two consecutive spreads on each plot after defoliation. The statistical package R-studio version 3.6.0 was used to analyse the data. When MAP was adequate the biomass production was greater between seasons ($p < 0.05$) in all plots at 4,000 kg.ha⁻¹, and following season with lower MAP the production at minimum production at 2,500 kg.ha⁻¹ as compared to other seasons. Results showed a strong positive correlation of inter-dependency between MAP and biomass production ($p < 0.05$). Therefore, *E. curvula* was able to produce acceptable biomass when moisture conditions were below the long-term MAP. Numerous under-resourced pasture farmers can consider planting *E. curvula* pasture and expect acceptable production when rainfall is less than the mean annual value.

Chemical composition of different grass species under different soil types

09:45AM - 09:50AM

Presented by :

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

The chemical composition of grass species, as indicated by the crude protein, mineral and fibre content is considered as one of the major factors for ruminants' optimum productivity. The effect of soil type on these chemical composition indicators was studied. Grass species sampling was done on different soil types; a 100 m permanent line point method was used. The permanent lines were replicated three times, 50 m apart within each site. Grass species at 1 m marked point intervals and within a 10 cm radius were identified at each site. The sampling sites, geo-referenced using a GPS, including the Hutton, Clovelly, and Avalon soil types. All grass species in each site were identified and their abundance was recorded. Topsoil samples at a depth of 200 mm were collected from each of the transects per site resulting in 9 samples per site. A sample per species per site was oven-dried 60 °C for a period of 24 hours, later grounded to pass through a 2 mm sieve and were kept in a tight plastic container until further use for soil physical and chemical constituents. Soil texture was determined by means of standard Bouyoucos (hydrometer) method, soil pH measured in a 1:2.5 soil-water relation extraction method. Organic carbon (OC) was analysed using a colorimetric method. Macro- and micro-minerals were also analysed. The chemical analyses were done at the Animal Health Centre Laboratory (North-West University, Mahikeng campus) following the guidelines provided by the Agri-Laboratory Association of Southern Africa. Analysis of variance was used to test the effect of site on soil chemical constituents, grass species composition, and species occurrence using General Linear Model (GLM) procedures of SAS in a completely randomised design. Least Significant Differences (LSD) were used to separate the means SAS 2010. LSD was calculated at 5% level. Results from this study showed that the following grass species were present: *Eragrostis planiculmis* (0.05, 0.08, 3.1 g.kg⁻¹ DM), *E. micrantha* (0.06, 0.07, 2.5 g.kg⁻¹ DM), *Elionurus muticus* (0.06, 0.012, 3.3 g.kg⁻¹ DM), *Monocymbium ceresiiforme* (0.05, 0.05, 2.3 g.kg⁻¹ DM), and *Paspalum dilatatum* (0.08, 0.01, 3.1 g.kg⁻¹ DM) commonly found growing in the areas had similar ($p > 0.05$) values for

phosphorus (P), magnesium (Mg), and calcium (Ca), respectively. These grass species were found to be deficient in P and Mg across the different soil types, however, there was sufficient amount of Ca content available for ruminant consumption and were able to meet the minimum requirement for ruminant feed. The soil nutrient status such as carbon was lower ($p < 0.05$) in Avalon (0.5%) compared to Clovelly (1.3%) and Hutton (1.6%) soil types, all the areas had an acidic soil pH Avalon (4.5), Hutton (3.6), and Clovelly (3.5). Most of the common grass species harvested from this study indicated that the different soil types showed little variation in terms of chemical composition, therefore nutrition imbalances may occur and need to be monitored and corrected where needed. In order to balance the nutrition, mineral licks and supplementation may be required to balance the animal's growth potential.

Understanding the utilisation of income from forage seed sales by smallholder farmers: A case of Beitbridge District, Zimbabwe

09:50AM - 09:55AM

Presented by :

Irenie Chakoma, Research Associate, International Livestock Research Institute (ILRI)

There is increasing recognition of the importance of forage production activities for improved livestock productivity. However, such initiatives are hampered by the limited availability of adequate and quality feed to meet the nutritional requirements of livestock. A survey was conducted involving 21 farmer households selected through a purposive sampling of households that produced and sold forage seed in 2018. The main objective of the study was to examine how farmers utilise income from the sale of forage seed. Results indicated that the area planted to forage crop ranged from 0.10 ha to 2.00 ha. In 2018, forage seed harvested varied from a 65 kg to 7,000 kg, and of this 97.7% was sold to a contracting seed company. Income from forage seed sales increased by about 60.8% in 2018 from that received in 2017. Fodder seed sales were the third highest contributor (18%) to total household income after livestock (22.5%) and remittances (19.4%) in 2018. Other increases were from livestock sales, casual labour and remittances. Expenditure on household food items constituted the largest component, accounting for 27.8% of total household expenditure. School fees accounted for 20%, whilst non-food items constituted 6.7% of total household expenditures. There was a strong reinvestment in agriculture as evidenced by expenditure in farming of close to USD400. Major challenges encountered during fodder crop production and marketing included high transport costs, unstable economic environment (currency changes), limited knowledge on fodder production, and delayed payment to farmers that had an early harvested crop. Suggested improvements were information on producer prices in line with price fluctuations, stabilisation of input prices, payments to be made in foreign currency, synchronisation of seed crop establishment, reduction of seed delivery distances to collection centres, and improvement of irrigation infrastructure. In conclusion, income from forage seed was found to contribute significantly to household income among smallholder farmers in Beitbridge. Major expenditures were on food items and school fees. There is a need to standardise input prices, reduce distances to seed delivery points and improve irrigation infrastructure.

10:00AM -
10:20AM

Zoom Webinar

Q&A | Discussion: Dairy pastures of the future – resilience and productivity

Moderators

Sigrun Ammann, Pasture Scientist, Western Cape Department Of Agriculture

10:20AM -
11:00AM

Zoom Webinar

Wednesday Session 05: Nutrition and cultivated pastures

Moderators

Janke Van Der Colf, Pasture Scientist, Western Cape Department Of Agriculture

Protein-energy supplement increases feed intake, nutrient digestibility and growth performance of Dohne Merino ewes

10:15AM - 10:25AM

Presented by :

Xolile Nuse, STUDENT, University Of Fort Hare

Good quality nutrition is a crucial factor for sheep production, as feed accounts for about 70% variable cost in livestock production. Dietary protein improves muscle accumulation which promotes growth performance and economic returns in livestock production. The objective of the study was to determine the influence of varying levels of a protein-energy supplement (Master 20[®] supplementation containing 200 g.kg⁻¹ crude protein and 8.7 MJ.kg⁻¹ metabolisable energy as fed; 85% dry matter content) on feed intake, nutrient digestibility and growth performance of Dohne Merino sheep. Twenty-four Dohne Merino maiden ewes of approximately 18 months of age and 40 ± 3.58 kg average body weight were used. Sheep were randomly assigned to four complete diets containing grass hay (*Eragrostis tef*: protein = 5.15%, energy = 3.04 MJ.kg⁻¹, NDF = 65.33%) as a basal component of the diets and varying levels of Master 20[®] supplement [T1 = 0% (14.16% protein), T2 = 12.5% (14.83% protein), T3 = 25% (15.87% protein) and T4 = 37.5% (14.08% protein)], respectively. A ten-day adaptation period was applied before the collection of data was initiated. Average daily feed intake (ADFI), average daily gain (ADG), feed conversion efficiency (FCE) and feed conversion ratio (FCR) were determined weekly. Nutrient digestibility was determined on the last seven days of feeding trial. Inclusion level of Master 20[®] increased the ADFI of sheep across the treatments ($p < 0.001$). There was a linear increase ($p < 0.001$) in ADFI with increasing weeks of feeding for sheep subjected to T1 (1,195 g.d⁻¹) and T2 (1,286 g.d⁻¹), and quadratic increase ($p < 0.001$) in ADFI on T3 (1,302 g.d⁻¹) and T4 (1,125 g.d⁻¹), respectively. There was a quadratic increase ($p < 0.001$) in ADG with increased weeks of feeding for sheep in T2 and T3. Higher ADG values ($p < 0.005$) were found in T3 (0.24 kg.d⁻¹) compared to T2 (0.19 kg.d⁻¹). There was a quadratic increase ($p < 0.05$) in FCE with increase in weeks of feeding for sheep in T2 and T3. There was a positive quadratic relationship ($p < 0.05$) between treatments and digestibility of dry matter and crude protein. Digestibility of dry matter and crude protein increased with increasing levels of Master 20[®] supplement. There was a linear relationship ($p < 0.05$) between treatments and digestibility of NDF and ADF. As expected, sheep on 25% Master 20[®] inclusion performed better than other

treatments in terms of feed intake, weight gain and feed conversion efficiency. Lower nutrient digestibility in T4 indicated that Master 20[®] supplement should not be included in sheep diets at 37.5% inclusion level. We conclude that, for best sheep productivity, Master 20[®] supplement should be included at 25% to sheep diets, since inclusion levels beyond 25% do not seem to significantly improve productivity of Dohne Merino sheep.

The effect of different levels of phosphorus fertiliser on the nutritional value of a mixed grass-legume pasture

10:25AM - 10:35AM

Presented by :

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

Old lands in the Eastern Cape Province (ECP) suffer from low pasture quality brought about by a lack of palatable grass species with good grazing value. Previous trial work identified promising annual and perennial legume pastures to fill the winter feed gap and increase animal production. This work also aimed to develop an intercropping system that could utilise any excess nitrogen produced by the pasture legumes for maize production, while affording the legumes an opportunity to continue to survive. To ensure that the introduced legumes survive in the long run and continue to productively fix atmospheric nitrogen (N), the low levels of phosphorus (P) in the soils need to be addressed. The study was conducted at Kubedlana community, ECP, where legume pastures have been successfully established for the last ten years. During May 2017 four P treatments were applied in a randomised block design with four replicates. Herbage production was determined by cutting 1 m² quadrats during May of each year (2017 and 2018). A 250 g grab-sample was collected per plot for quality analysis purposes. The only parameter tested which showed a positive linear response to the applied P was the crude protein content of the sward ($r^2 = 0.9227$) the increase in crude protein content ranged from 0.04% at the 10 kg P.ha⁻¹ treatment to 3.55% at the 40 kg P.ha⁻¹ treatment. Total D detectable N ranged from 76.54% to 76.89% while the P content was 0.12% for all the treatments except for the 10 kg P.ha⁻¹ where it was 0.09%. These results indicate that, when planting legumes on these old lands to improve pasture quality and for future maize production, one will have to correct the soil phosphorus content to at least recommended levels for maize production.

The effect of plant community rooting densities on soil health indicators

10:35AM - 10:45AM

Presented by :

Robyn Nicolay, PhD Candidate, University Of KwaZulu-Natal

In this study, we aimed to address how rooting densities of different plant community compositions affect soil health, quantified by soil water infiltration, soil organic matter (SOM) content and collembola community data. Data were collected from an existing long-term field trial planted to either forb-dominated composition, grass-dominated composition or a multipurpose mixture of forb and grass species. Treatments included plant-trait combinations linked with target ecosystem services. The site is located in Shropshire, England (52.7795° N,

2.4271° W), on sandy loam soils. Experimental plots were planted in 4 x 4 m randomised block designs with five replicates and separated by 1 m grass buffer-strips. Perennial grass (including *Festuca* sp., *Agrostis capillaris*, *Dactylis* sp., *Cynosurus cristatus*, *Alopecurus pratensis* and *Phleum pratense*) and forb species (including *Trifolium* sp., *Hypochaeris radicata*, *Taraxacum* sp. and *Vicia cracca*) were chosen based on traits supporting water quality protection (WQP), pollinator support (PS), a mix of species suited to local soil types (sandy loam soil; SLS) and a mix suited to all soil types (AST). A commercially available seed mix (CM) was included that is representative of a mixture currently available to farmers and growers. Data collected from sites included root structural density, soil collembola community using QBS-c methods. Falling-head water infiltration was measured, indicating field saturated hydraulic conductivity (Kfs) and SOM was measured as loss on ignition (LOI). Data were analysed in R Studio using the FactoMineR package. Micro-arthropod abundances were described using generalised linear models, with Poisson regression. ANOVA models were used in describing soil chemical properties and Kfs. Principal Component Analysis was used to explore the variables associated with observed discrimination between the samples. Forb-dominated PS treatment showed a significantly higher water infiltration ($p = 0.017$) and Epigeic collembola abundances ($p < 0.01$) above other treatments. Significance was observed between Epigeic collembola abundances and CM treatments, with rooting density interactions ($p = 0.015$). Euedaphic collembola indicated the greatest significance across all treatments with root interactions ($p < 0.01$). Results showed that forb-dominated vegetative communities planted for pollinator support showed most significance in terms of contribution to soil quality, particularly regarding water infiltration and soil health. This suggests that by planting multifunctional buffer-strips, plant species composition can be designed that is both beneficial for pollinators, improved on-farm edaphic ecosystem structure and functioning as well as catchment level hydrology management. Furthermore, bio-indicators suggest commercial mixes support soil health development and maintenance. High abundances of Euedaphic collembola across all treatments are indicative of high levels of soil health. The results presented here add further evidence that plant communities can be specifically tailored to support the provision of different soil functions and support soil health development and maintenance.

In vivo effects of Bromelain enzyme, dried pineapple leaves and chicory grazing against gastro-intestinal nematodes of sheep: A comparative study

10:45AM - 10:55AM

Presented by :

Erika Van Zyl, KwaZulu-Natal Department Of Agriculture And Rural Development

Gastrointestinal nematodes (GIN) infections have serious negative consequences on the production of domestic small stock globally. Current control relies on synthetic anthelmintics, but the development of GIN resistance to most of these products has driven a search for alternative control methods, including a range of botanical products and extracts with anthelmintic activity. The cysteine proteinases from pineapple (*Ananas comosus*), have shown strong anthelmintic activity with Bromelain enzyme found in pineapple juice, stems and leaves, a common source of cysteine proteinases. Another strategy to control GIN, is

prophylactic strategies, such as grazing strategies and the use of bioactive forages, e.g. grazing chicory (*Cichorium intybus*), the efficacy of milled *A. comosus* leaves, bromelain powder and grazing of forage chicory on the development of GIN infections in sheep. Treatments included full-time chicory grazing compared to supplementing kikuyu grazing sheep individually three times per week with bromelain (80 mg.kg⁻¹ bodyweight), milled pineapple leaves (1.7 g.kg⁻¹ body weight), and restricted access to chicory grazing. Full-time chicory grazing was able to prevent GIN egg-counts in sheep from reaching a critical level where treatment would have been a necessity. Bromelain was the second most effective. The results of the other treatments, namely pineapple leaves and partly grazing on chicory, clustered with the control. The only significant difference ($p < 0.05$) was between the lower level of FEC in sheep on the chicory, compared to the partly grazed chicory. Partial grazing on chicory, as well as bromelain and pineapple-leaf treatments, did not control GIN levels effectively in this experiment, compared to full-time chicory grazing, where control was sufficient. Given that the literature reports trials in which the anthelmintic properties of bromelain and pineapple leaves were confirmed, the rate of inclusion in the diets could have played a role in their lack of efficacy but further research is needed on the rates and frequencies of dosage of these products. Only full-time chicory grazing was able to prevent GIN egg-counts in weaner lambs from reaching a critical level where treatment would have been necessary, and delivered good fodder performance in terms of animal ADG. This provides a promising option for small stock farmers for GIN control.

Q&A | Discussion: Nutrition and cultivated pastures

10:55AM - 11:00AM

Presented by :

Janke Van Der Colf, Pasture Scientist, Western Cape Department Of Agriculture

11:00AM -
11:30AM

Interval | Virtual Tours

11:30AM -
01:00PM

Zoom Webinar

Wednesday Session 06: Next Generation / 4th Industrial Revolution advances in rangeland management

Moderators

Anthony Palmer, Reseach Professor, Agricultural Research Council-Animal Production Institute

KEYNOTE ADDRESS: Drone on the range: Driving better pasture and grassland management practices

11:30AM - 11:55AM

Presented by :

Louise Jupp, Owner , Terreco Aviation (Pty) Ltd

The application of drone systems in agriculture is proving to be a powerful tool especially in terms of driving greater efficiency and productivity as well as sustainability. Globally, agricultural applications have generally featured as one of the largest sectors along with construction/infrastructure and mining. The use of drone systems in agriculture has focused on crop and yield management in one form or another, whether targeting grapes, grains, vegetables, fruits or nut orchards. To date, their widespread use for animal husbandry or pasture management has been relatively small in comparison. However, it is a feature of drone system applications that the advancement of drone use in one sector and the advantages gained tends to inspire their adaptation and use in another sector. This is especially true of agricultural applications inspiring their use in habitat and biodiversity management, conservation, wildlife management and rehabilitation. It follows that the same applies to grassland management and domestic animal husbandry, as demonstrated by available case studies. The purpose of my presentation is to summarise the current direction of development and growth of the drone industry within the context of agriculture and its advantages for pasture and grassland management and rehabilitation. My presentation will include case studies, lessons being learned in terms of the reality of drone applications (as opposed to the hype) and the trends that will benefit future applications in grassland management and rehabilitation.

Recognising the structure and functionality of novel landscapes arising from abandoned arable lands: remote sensing in assessing land degradation neutrality

11:55AM - 12:07PM

Presented by :

Anthony Palmer, Research Professor, Agricultural Research Council-Animal Production Institute

After the Tomlinson Commission and the resultant Betterment Planning, millions of hectares of rangelands in the former Transkei were converted to potentially arable land. Many of these areas were seldom, if ever, planted to crops, and have since been classified as abandoned arable lands. The development of lands for cropping results in several important physical changes to the landscape, and has a direct bearing on the grass species likely to successfully colonize these landscapes. The first obvious change is in the local micro-hydrology, where the natural flow of water is regulated by the construction of contour banks. This results in run-on and run-off areas, with the run-on areas being colonized by grasses tolerant of mesic conditions such as *Paspalum dilitatum*, *Sporobolus africanus*, *Eragrostis plana* and *Pennisetum clandestinum*. The run-off areas are more xeric and are dominated by stoloniferous species (*Cynodon dactylon*) and forbs. Another change is the reduction of soil organic carbon, which is a consequence of the repeated stimulation of soil microbes during preparation for cultivation. Following abandonment, landscape engineers such as termites, earthworms and mole-rats, begin to play a role in re-engineering landscape function. In addition, woody species (mainly *Vachellia karroo*) become established, creating islands of nutrient hotspots. This re-engineering does not follow the expected trajectory to native grassland, but rather towards a novel landscape comprising a different suite of species and patches, which are further encouraged by the attention of domestic herbivores. Sheep and cattle are both known to

favour the run-on areas along contour banks, thereby further concentrating nutrients along the contour banks, and facilitating the creation of small nutrient islands. All these perturbations facilitate the formation of new landscape patterns, comprising hotspots of plant photosynthetic activity. These hot-spots are clearly visible from high-resolution near-infrared imagery. We used high resolution (10 m) Sentinel-2 and very high resolution (< 0,5 m) Digital Globe data to explore the nature of this spatial diversity across landscapes in the Tsitsa River catchment, and to use this understanding to define sites of degradation that can be rehabilitated to help achieve Land Degradation Neutrality. Exploration of NDVI time series using Google Earth Engine application also shows that many of these 'degraded' areas are highly productive, and remain resilient in the face of constant herbivory and frequent droughts.

The importance of integrated long-term environmental research infrastructures for rangeland management: Facilities and data for the 4th Industrial Revolution

12:07PM - 12:17PM

Presented by :

Gregor Feig, Manager, SAEON Expanded Freshwater And Terrestrial Environmental Observation Network

The advances being made through activities in the 4th industrial revolution present an opportunity to develop unique and detailed understandings of ecosystem processes. Long-term research infrastructures (RI) such as those being developed through the Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON), provide an opportunity to develop large integrated datasets well suited for the techniques being developed in the 4IR. The EFTEON RI is a long-term infrastructure that is being funded by the Department of Science and Innovation (DSI) through the South African Research Infrastructure Roadmap (SARIR) program and is run by SAEON. The EFTEON program is preparing to install six research landscapes across South Africa and will provide long-term open access datasets and research platforms for the broader research community, including measurements of the exchange of carbon, energy and water using the Eddy-covariance technique, measurements of hydrological properties (flow and chemistry) and long-term repeated biodiversity observations. An example of a long term research infrastructure that has been operational in a South African rangeland ecosystem is the Skukuza flux tower, which has been in operation since 2000. Approximately 30 research papers have been produced using the Skukuza flux tower data in a number of different fields, from ecology, remote sensing, climate modelling to micrometeorology and biogeochemistry. In addition, 1632 unique downloads of the data have occurred through the Fluxnet portal. This presentation will provide an example of how long-term integrated research infrastructures can act as a hotspot for facilitating inter and multidisciplinary research.

National Vegetation Map 2021: Our goals and an opportunity for the GSSA to contribute to the structure of the next version

12:17PM - 12:27PM

Presented by :

Anisha Dayaram, Vegetation Scientist, South African National Biodiversity Institute

The National Vegetation Map (VEGMAP) forms the foundation of many national and provincial data-sets and analyses including national red list assessments, prioritisation for conservation, and natural resource management. The first version was developed in 2006 and highlighted areas needing further refinement. Hence the authors of the 2006 version established the VEGMAP Project with the goal of refining the map further as better data-sets emerged. Since 2006, the VEGMAP Project team has released three subsequent versions i.e. 2009, 2012, and 2018. These versions have contributed to the refinement of approximately 8% of the total map area. The VEGMAP Project team is currently working towards the next version with a goal to refine the data-set both spatially and structurally. Although the structure has been slightly modified in the past (i.e. additional fields added), we are working to improve the richness of information associated with the spatial data. One of the ways in which we hope to achieve this is by sharing a link table with additional descriptive information about each vegetation type such as MAR, elevation, and geology. This table will be shared separately as a geo-database table, or csv which can be linked to the spatial map through the map code field. Other information that could be included in this linked table could include the latest IUCN Red List status and Protection level for each vegetation type. Therefore, there is an opportunity for GSSA conference attendees to help select which of these descriptive fields may be most useful to them so that we may consider them for inclusion in the accompanying table that describes the characteristics of the vegetation types. I will present a suite of field options and some constraints regarding the inclusion of fields. Other goals for the 2021 National Vegetation Map include reducing the file size as the map currently poses problems for memory intensive national-level analyses such as ecosystem accounting calculations. In addition, the dataset seems to work well in ArcMap, the platform used to develop and maintain the map, but we are aware that many users on other platforms such as Google Earth, R, and QGIS, sometimes encounter problems when processing the dataset for more complex analyses as the software is more sensitive to geometry rules. Therefore, our objective with the next version is to increase versatility across multiple platforms. We hope to achieve this goal by targeting known sources of error such as reducing the nodes in very large polygons and eliminating self-intersecting polygons. In addition, spatial changes may include the new forest polygons that are not currently captured in the 2018 version, and possibly a few small changes to fynbos vegetation types. The VEGMAP team strives to manage the product through transparent and collaborative processes in our pursuit to improve this user-driven, but scientifically defensible product. Therefore, we will appreciate your willingness to participate in this exercise so that we can all contribute to a better version in 2021.

Estimating rangeland carrying capacity using crowd-sourcing and VegMeasure under Covid-19

12:27PM - 12:37PM

Presented by :

Sawsan Hassan, Research Associate, Coordinator - Forage Systems, ICARDA

Rangelands represent the largest land cover in Jordan, comprising more than 80% of the total land area. They are the main rural livelihood, contributing to economic growth, poverty reduction, as well as holding cultural significance. However, these fragile ecosystems have been on a steady decline. To alleviate degradation several sustainable rangeland interventions have been undertaken. One of the key interventions is the implementation of a rotational grazing system. Unfortunately, with the prolonged confinement and widespread restrictions on mobility, scientists were not able to get to the site and conduct necessary fieldwork. Thus, the aim of this study was to explore innovative ways for estimating carrying capacity respecting the containment efforts involving quarantines due to Covid-19. The target site is called Majidya which is located 40 km south-east of Amman and has an average annual precipitation of 150 mm. In mid-March of 2020, the Government of Jordan imposed total lockdown where travel was banned. Thus, all field visits scheduled during the peak growing season were cancelled. To overcome this barrier, available technologies based on remote sensing, and crowd-sourcing, coupled with ground-truthing data, were explored. Targeting the youth among the community, members who were familiar with modern technology (such as smart phones) were asked to take straight down images across the landscape while respecting social distancing. Each image covers a surface area of approximately 1 m². After taking each image a 1 m² quadrat was placed and the vegetation was clipped and weighted. Digital images were sent to scientists for image processing. The colours recorded by the digital camera were interpreted using VegMeasure[®] software to create meaningful classes in order to measure the percentage cover of foliage, leaf litter, and bare ground. Close-up images of the dominant plants along with local plant name were also used to identify the species composition. Since each image was geotagged, we were able to overlay these points on a map and perform inverse distance weighing interpolation giving us a general view (map) of the natural vegetation across the landscape. Vegetation cover and biomass were positively correlated ($p < 0.05$) with R-squared 0.85. Considering the estimated grazable biomass and the number of livestock owned by the community the carrying capacity was determined. During a crisis, networking and exchange of good practices and procedures with pastoral communities, especially youth, is essential so that real-time rangeland condition can be brought to the attention of the local authority. The proposed protocols offer a rapid, cost-effective and easy to use technique for sampling vegetation while maintaining the needed social distancing and hygiene requirements. Monitored areas can be revisited each season or year to assess the spatial and temporal effect of natural and human-induced factors. At the same time, additional income could be generated through engaging of community youth. Moreover, encouraging dialogue with decision makers can help in addressing the specific needs of the agro-pastoralists. This, in turn, will ensure gaining more trust and achieving sustainable restoration objectives.

Q&A | Discussion: Next generation / 4th Industrial Revolution advances in rangeland management

12:37PM - 12:47PM

Presented by :

Anthony Palmer, Research Professor, Agricultural Research Council-Animal Production Institute

08:00AM -
09:30AM

Zoom Webinar

Thursday Session 07: Rangeland management for game farming, nature conservation and tourism I

Moderators

Rouxdene Deysel, Scientific Technician, Gauteng Department Of Agriculture And Rural Development

KEYNOTE ADDRESS: New approaches to global conservation of grasslands

08:00AM - 08:25AM

Presented by :

Kyran Kunkel, Director And Affiliate Professor, Conservation Science Collaborative, University Of Montana

Most cattle production in the western United States (US) grasslands is currently not ecologically or economically sustainable. Biodiversity is significantly imperilled on grasslands and much of that is an effect of current approaches to livestock production and management. New management models are urgently needed to turn wildlife losses around. Globally since the 1970s, wildlife populations have declined by over half. More species have been extirpated from at least part of the grasslands than any North American biome; 74% of 39 obligate species are imperilled. A global evaluation of grassland ecosystems recognised the North American Great Plains as one of the largest remaining but least adequately conserved grasslands in the world. New approaches are needed for large scale conservation as our current models are not working. We are creating and testing an innovative model in the grasslands of central Montana with a conservation objective focused on biodiversity, maintaining ecosystem functions and providing societal goods and services. We are creating the largest new wildlife reserve in the US of over 1.3 million ha. We are doing this by purchasing large ranches that are for sale and using them to connect already existing public lands. We are using economic incentives in the buffer and connectivity zones of private working lands to make them more sustainable. We designed this as a business and NGO model raising money from donors. We are creating a refuge for people and wildlife conserved forever as part of America's heritage. We have developed and published a measurable scale, the Freese Scale, for assessing our progress of moving the reserve from commodity based toward biodiversity based. We follow the science of that scale to instruct us in conservation, management and restoration. We focus on a flagship, keystone, and umbrella species for restoration, starting with bison (*Bison bison*). Our goal is to create the largest bison herd in the world with a minimum of 10,000 animals. Bison are considered ecosystem engineers, supporting landscape heterogeneity and providing abundant prey biomass, which influences the diversity and abundance of hundreds of species. We collaborate with science partners to research and monitor these impacts and adaptively manage. The reserve is designed to add economic diversity to a region with a declining economy. We are developing harvest, recreation, and tourism programs and infrastructure. For the buffer and connectivity working lands zones, we have built a successful program of "wildlife friendly beef," Wild Sky Beef. We created a market, developed rancher

partnerships and thus far implemented it on nearly 50,000 hectares. We developed a science framework for third party certification. We have measured increases in wildlife on all these ranches via our direct conservation payment for performance using camera traps. We have increased wildlife including large carnivore diversity and abundance on these ranches. The ranchers like the program and have signed contracts annually for over 5 years. Additionally, investors support the program and continue investments. We believe this model can be readily modified for other large scale grasslands conservation efforts globally. It, of course, is not without significant cost and controversy.

International Year of Rangelands and Pastoralists (IYRP): History, process, priority themes, and way forward

08:25AM - 08:35AM

Presented by :

Barbara Hutchinson, Project Manager, University Of Arizona

The road toward the declaration of an International Year of Rangelands and Pastoralists (IYRP) by the United Nations (UN) has been long and rocky, perhaps mirroring the relative lack of understanding by some governments of the importance of rangelands and pastoralists for a sustainable world, compared to the focus on other sectors such as forest or cropland sustainability. The idea was first discussed at the International Rangeland (IRC) and Grassland (IGC) Congress held in Hohhot, China in 2008. The creation of an IYRP Support Group (ISG) in 2015 helped to provide a stronger rationale and the integration of social dimensions. This has led to a growing partnership of national, regional, and international organisations. Numerous events were conducted at international meetings between 2015 and 2020 to solicit support for the IYRP. In 2018, the UN Environment Programme published a gap analysis of knowledge about rangelands and pastoralism that helped to further highlight the significant neglect of these issues in both academic and development circles. Under the leadership of the Government of Mongolia, the proposal for designation of an IYRP was officially presented in 2019 to the Committee on Agricultural Secretariat (COAG) of the Food and Agriculture Organisation of the United Nations (FAO). Current efforts are focused on gaining letters of support from governmental agencies and non-governmental organisations as well as holding side events at regional and international meetings to increase the visibility of the effort. This historical background provides instructive lessons on how global perceptions can change through strong partnerships. At the same time, in anticipation of obtaining this designation, a comprehensive list of monthly themes has been developed by the ISG to guide countries on outreach and educational activities to take place prior to and during the IYRP. This guidance provides a vision of multi-disciplinary and multi-stakeholder approaches towards integrating the social, economic, environmental, and political aspects of sustainability in rangelands and pastoralism. The themes were selected based on the criteria: (1) expanding awareness on the diversity of rangelands and pastoralists, (2) highlighting new insights, and (3) issues of concern to pastoralists. Relevant to the multiple themes of the GSSA Congress 55, the IYRP themes are (1) importance of rangelands, grasslands, and pastoralists, and how they help shape the world, (2) pastoralists' connections to rangelands and securing their access, services and resources for pastoralists, (3) rangelands, pastoralism, and climate change, (4) rangeland

biodiversity, ecosystem services, and pastoralism, (5) rangelands, pastoralists, soils, water, and land use, (6) sustainable consumption of livestock products, (7) pastoralist indigenous and local knowledge, culture, and innovation, (8) sustainable livestock production, (9) pastoralist women, and (10) pastoralist youth. Also included in the guide are example activities that could be undertaken during an IYRP. To this end, countries and regions are being called on to convene coordinating committees to begin planning outreach actions and acquiring the funding necessary to implement them.

Assessing wetland functionality using soil surface indicators in Letšeng-la-Letsie wetland in Quthing District, Lesotho

08:35AM - 08:45AM

Presented by :

Nthuseng Kahlolo, M.Sc. Student, National University Of Lesotho

Lesotho ratified the Ramsar Convention in 2004 and has observed the Convention's requirement of declaring at least one wetland as a Ramsar site. Letšeng-la-Letsie is the country's sole Ramsar site, which was declared in 2004. The wetland is regarded rich in biodiversity. However, despite the protection and conservation requirement under the Ramsar Convention, the greater catchment, including the wetland is an open grazing commons for the surrounding communities. The catchment is characterised by uncontrolled transhumant outposts (*Metebo*). Consequently, the area is experiencing overgrazing and is showing signs of severe degradation, such as soil erosion, reduced vegetation cover and loss of biodiversity. This has negatively affected the ecosystem service provision. The purpose of this study was to assess the extent of degradation in the wetland ecosystem functioning using soil quality indicators and Landscape Functional Analysis (LFA). Nine 30 m LFA transects were randomly placed on the landscape where the physical landscape was characterised and soil surface indicators assessed. Eleven soil surface indicators were assessed from three query zones in each patch (graminoids and forbs) and inter-patch zone (bare soil) along the established transects to obtain three functional indices (soil stability, water infiltration, and nutrient cycling). While graminoids and forbs covered an average of 36% and 39% of the transect, respectively, inter-patches covered 24%. The LFA indices and thresholds were used to benchmark wetland functional status and predict its response to disturbances that include grazing. In addition, a total of 80 soil samples were collected from the top 5 cm soil layer in all ecological patch types and inter-patches along the LFA transects for physical and chemical soil analysis. Results show that the landscape has a water infiltration capacity of 35%, a surface stability of 63% and a nutrient cycling potential of only 22%. The soils in the wetland were found to be stable against erosive rains. However, reduced vegetation cover due to overgrazing enhanced runoff and the system is less efficient in organic matter recycling. The accuracy of the LFA indices was tested by correlating them with soil quality indicators. The soil quality indicators revealed similar trends among the different transects, which indicates that soil organic carbon (SOC) and macronutrients are higher in transects with less signs of degradation. Water infiltration rate had a negative significant ($p < 0.01$) correlation with soil clay content. Moreover, water entry into the soil significantly ($p < 0.05$) enhances nutrient recycling, which may be due to the indirect effect of addition of organic matter into the soil by the growing vegetation. Similarly, SOC

was significantly ($p < 0.05$) related with LFA nutrient cycling index. The results also highlighted the importance of SOC and soil texture in predicting aggregate stability. This indicates that degraded wetlands require a substantial input of SOC to achieve an appropriate level of soil quality. The current findings reveal that LFA and soil quality indices are important in assessing wetland functioning, and this highlights the importance of conserving natural ecosystems. Thus, holistic land management is essential to conserve natural ecosystems, including preventing land degradation.

Vegetation change along an altitudinal gradient across the Great Escarpment at Compassberg (Eastern Cape, South Africa)

08:45AM - 08:55AM

Presented by :

Wynand Calitz, Field Technician, SAEON Arid Lands Node

With the growing concern of climate change and how it will impact the distribution of natural vegetation, it becomes essential to monitor vegetation change. The use of gradients is a useful way to identify patterns of species distribution, with one such gradient being elevation. Altitudinal gradients can serve as case studies, as many variables, including temperature, moisture availability and wind, change with elevation. The Compassberg mountain serves as an ideal study site as it is the highest peak west of the Drakensberg mountain range at ~2,504 m above sea level, and forms part of the Sneeuwberg mountain range, which forms part of the Great Escarpment. Here we investigate the change in vegetation along four transects, each serving to a particular aspect, and comparing our findings to climate among other factors. The transects were set as close as possible to the major aspects (north, east, south, and west) with only a slight deviation in cases of steep inclines. Seventy-two cover-abundance plots were used for vegetation analysis, including comparisons across slope aspects and different elevations. These plots were set at 50 m elevation-increments along the transects. The lowest plot was at 1,700 m and the highest near the peak at 2,450 m. Climate data were obtained from sixteen iButton temperature loggers at various elevations, two weather stations (one on and one off the mountain), and rainfall data received from local farmers. There was a clear decrease in temperature as elevation increases. The minimum temperatures recorded during winter were -6.5 °C and -9.9 °C for the lowest and highest elevation iButtons respectively, while the maximums in summer were 42.5 °C and 27.6 °C. Rainfall measures on the mountain proved insufficient due to the strong wind conditions and will be supplemented in future data collection by other moisture capturing instruments. Using Ward's method of classification, we identified patterns in the distribution of species, with few groupings based on aspect and others by altitude. Species diversity closely resembled a normal distribution with the highest number of species (100) occurring mid-way up the slope. The northern aspect had the highest alpha diversity (105) with the southern aspect representing the lowest diversity (53). The highest beta diversity, however, occurred between the north and west transects (95). Growth form cover did not greatly change between classes with the exception of herbs being much higher along the western transect (42%) as opposed to the southern aspect (26%). Further analysis using Canonical Correspondence Analysis supplement the findings from the classification, and the groupings based on altitude and aspect are often clearly

distinct. Statistical and graphical exercises using grass species diversity illustrate that the distribution of C₃ and C₄ species change with elevation, which in turn reflects the influence of temperature on the different photosynthetic pathways. The average number of species occupying lower elevation were three for the C₄ grasses compared to one for C₃ grasses, while at higher elevation the result is completely opposite. Interestingly, however, the cumulative percentage cover for both pathways stayed relatively the same (20%).

Impact of shrub encroachment and the efficacy of mechanical shrub removal in the montane rangelands of Lesotho

08:55AM - 09:05AM

Presented by :

Nkuebe Lerotholi, M.Sc. Student, National University Of Lesotho

Although rangelands are among the most socio-economically valuable ecosystems, their degradation remains a worldwide problem, especially in sub-Saharan Africa. Lesotho montane rangelands are no exception and are characterised by shrub encroachment and poor condition. The dominant encroaching species include *Chrysocoma ciliata* and *Inulathera thodei*. The encroachment has adversely impacted livestock farming, a sector that contributes about 5% of the country's gross domestic product. Several studies have assessed the effect of shrub encroachment on these rangelands, and the Lesotho Government has invested heavily on a programme to uproot shrubs (irrespective of species and height) across the country. However, after a decade of implementing the programme, no scientific studies have assessed the ecological benefits of this approach. Therefore, the current study evaluated the impact of mechanical removal of shrubs on rangeland condition in the Motšeremeli watershed in Mokhotlong District, Lesotho. Stratified random sampling was employed where the Metric Belt Transect-Quadrat method was used to assess the effect of uprooting shrubs on encroached rangeland. This was achieved by comparing herbaceous species diversity (Shannon-Weiner index, evenness and Simpson index of dominance) and standing biomass across four areas that had previously been subjected to different periods post shrub removal; one year, two years, three years and the control (no shrub removal). The structure (height, density and canopy size) and diversity of shrubs were also compared across the same treatment periods. The results reveal that the Shannon-Weiner index (H') and evenness of herbaceous plants increased significantly ($p < 0.05$), while dominance decreased significantly with time post shrub removal. The control displayed significantly lower ($p < 0.05$) herbaceous species diversity than all the treatments. Standing herbaceous plant biomass increased significantly ($p < 0.05$) with time post shrub removal and was also significantly higher in all the treatments than in the control. While the diversity of shrubs did not show significant variation with time post shrub removal, it varied significantly ($p < 0.05$) from the control. Shrub density and height increased significantly ($p < 0.05$) with time post shrub removal and varied significantly from the control. This increase indicates that shrubs can reoccur after removal, and the pre-removal density and height can be attained after three years. While shrub canopy size did not show significant variation with time post shrub removal, it differed significantly between the control and all treatments. It is therefore evident from these findings that herbaceous plant diversity and standing biomass improve following shrub

removal, as well as with time post shrub removal. Furthermore, although shrubs can reoccur after manual removal, their density and height can be reduced significantly, which enhances herbaceous plant growth. Nevertheless, some grass species such as *Eragrostis curvula* and *Pentaschistis oreodoxa* were found to be associated more with encroached areas than areas under shrub removal. This is probably because they are common in disturbed areas as they can withstand heavy grazing. The current study demonstrates that manual removal of shrubs improves rangeland condition, and this approach can be used as a rangeland management tool. However, repeated shrub removal at two-year intervals is recommended.

Time budget and diet selection of semi-captive elephants (*Loxodonta africana*) at Jafuta Game Reserve, Victoria Falls, Zimbabwe

09:05AM - 09:15AM

Presented by :

Siphathisiwe Immaculate Moyo, Sales And Administration Officer, Feedrite Animal Nutrition Pvt Ltd

Animal welfare has always been of concern especially in captive animals, the fear being that the animals are not able to exert normal behaviour like their wild counterparts. This study was done to determine if the elephants' confinement and the provision of food at night affect their foraging behaviour during the day when they are foraging freely in the bush. The aim of this study was to determine the foraging behaviour of semi-captive elephants at Jafuta Game Reserve in Victoria Falls, north-western Zimbabwe, by looking at the time budget and diet selection of elephants. Ten elephants, four females and six males, were studied using lead animal technique, where elephants were followed at a safe distance whilst they were foraging in the bush. The study was conducted for 10 days and the elephants were recorded between 9 am–12 noon, in three half-hour sessions. This was the time when there were no tourists as the main activities that were done were elephant rides and interaction. Four elephants were observed in a day, two males and two females. The study involved the recording of all elephant activities to determine time budget. The elephants spent most of their time feeding, walking and standing and less time doing other activities like swaying trunks and swimming. Diet selection of elephants was also recorded which involved plant species selected and the plant parts consumed. Continuous focal sampling was used to observe the plant species that were selected by the elephants. The observers were standing about 20 m from the elephants in order to easily identify the plant species that were selected and plant part. Nine out of ninety-three plant species were selected by the elephants, *Dactyloctenium aegyptium* being the most selected plant species as it contributed 32% of the total diet and it was still in its vegetative stage; *Piliostigma thonningii* being the least. Plant parts that were selected the most were leaves and stem and the least were branches and bark. The data obtained were analysed using SAS version 9.4. Elephants have very varied wide variety of diet as they incorporated grass, woody shrubs and trees into their diet. These results are in support with literature because these elephants ate more leaves and grass just like the elephants in the wild during the rainy season. It was also concluded that the semi-captive elephants of Jafuta Game reserve spent most of their time feeding rather than on

social activities such as swaying their trunks or swimming. In conclusion, even though these elephants were supplemented with feed in the evening their foraging behaviour was not affected.

Q&A | Discussion: Rangeland management for game farming, nature conservation and tourism I

09:15AM - 09:30AM

Presented by :

Rouxdene Deysel, Scientific Technician, Gauteng Department Of Agriculture And Rural Development

09:30AM -
10:00AM

Interval | Virtual Tours

09:30AM -
10:00AM

Twitter poster session: Rangeland management for game farming, nature conservation and tourism

Twitter

@GrasslandSocSA

Moderators

Kevin P Kirkman, University Of KwaZulu-Natal

Rouxdene Deysel, Scientific Technician, Gauteng Department Of Agriculture And Rural Development

Repeatable methods of classification of alien and native vegetation in the montane grasslands of Mpumalanga, South Africa

09:30AM - 09:35AM

Presented by :

Keletso Moilwe, Student, University Of Cape Town ,Center For Statistics In Ecology, Environment And Conservation (SEEC), South African Environmental Observation Network (SAEON)

Strategic water source areas (SWSA) supply South Africa with 50% of its surface water but only 13% of these crucial areas are protected. Rapidly expanding alien plant invasions occurring in the vicinity of SWSAs threaten the country's water security as they consume 37% of surface runoff. The Blyde Catchment falls within the Mpumalanga Drakensberg SWSA node, and is home to numerous wetlands and ecosystems which contain a variety of endemic plant species, and the hydrology of the catchments sustain water security and economic activities in the region. The study area comprises the Mariepskop State Forest, Mariepskop Nature Reserve and the Blyde River Canyon Nature Reserve, in the Montane Grasslands which lie within the Blyde catchment area. The Grassland Biome is particularly vulnerable to alien plant invasion due to the prevalence of commercial plantations of pines and eucalypts in mesic escarpment areas. Agriculture, tourism, and mining are key economic activities in the Grassland Biome which utilise large quantities of water. Measures aimed at protecting and monitoring South Africa's water security are under strain and advanced and repeatable techniques are required to alleviate the problem. Remote sensing and Geographic Information Systems (GIS) offer a cost-effective solution to accurately detect and produce near real-time updates to develop vegetation maps of alien and native plant abundance, enabling managers to improve the effectiveness of alien plant control methods and monitoring of impacts. Free open source

programmes (R, QGIS and Google Earth Engine) and high-resolution data from the Sentinel-2 satellite data, were used to detect, classify and map alien and native vegetation for an extent of 1,450 km² of the former Transvaal Drakensberg. Change detection by time-series from the year 2016 to 2020 will be done to assess the extent of invasion within the area, and the repercussion it has on biodiversity and groundwater. The assessment is based on the data available since the launch of Sentinel-2 satellite and vegetation data from the involved stakeholders. Random Forests classifier was used to categorise vegetation into several classes including pines, eucalyptus, grasslands, wattle, indigenous forest, bracken, wetlands, buildings and recently cleared plantations, based on their spectral signatures. Classes were selected based on a similar past study conducted in the vicinity of the study area and from data acquired from the involved stakeholders. The proportions of land cover types are yet to be determined after numerous iterations of classifications. This resulted in a Sentinel-2 based land cover map for 2016. Building the approach using free and open source programs and public data, allows the rapid and cost-effective reproduction of land cover and alien plant invasion maps for subsequent years. This repeatable methodology is ideal for monitoring of vegetation change and environmental degradation when resources are limited.

Small-bodied browsers maintain the openness of savanna grazing lawns
09:35AM - 09:40AM

Presented by :

Michael Voysey, Student, University Of Pretoria

In savannas, ruminant herbivores can have divergent impacts on tree recruitment and resulting woody cover. Whereas heavy grazing by cattle results in woody thickening, intensive grazing by wildlife instead tends to be associated with lower woody cover. To disentangle why woody cover is low in areas heavily grazed by wildlife, we tested (i) whether short-grass environments attract indigenous mammalian browsers; (ii) whether preference for short grass decreases with browser body mass because of differences in predator susceptibility; and (iii) whether these translate into suppression of seedlings and saplings on grazing lawns, thus maintaining their openness. In Kruger National Park, South Africa, the effect of grass height on browser abundance (dung counts), and on the utilisation of woody plants by browsers (bite-score approach) was tested. An enclosure experiment (enclosure dimensions: 1 m wide and 1.5 m high) tested the effect of grass height and browser removal on seedling survival and sapling growth of a dominant woody plant species in a short- and tall-grass mosaic. Finally, in Hluhluwe-iMfolozi Park, the effect of grass height and browser removal was tested on the growth rates of a range of woody species, monitored over ten years, across ten sites using large herbivore enclosures (dimensions: 40 m x 40 m). Steenbok ($p = 0.015$) and impala ($p = 0.001$) selected short- over tall-grass as preferred browsing sites, while elephant ($p = 0.010$) preferred tall grass. Browser abundance on short grass decreased with browser body mass ($p = 0.011$), indicating that predator avoidance might be a key factor driving small-bodied browsers to utilise grazing lawns. Grass height did not explain variation in the utilisation of woody plants by browsers. Seedling survival was lowest in short grass and when browsers were present ($p = 0.098$), with mortality occurring in two out of every three seedlings. Sapling growth was lowest in short grass ($p =$

0.003), although browser removal had no effect. Evidence for increased browser impact on grazing lawns was clearest from our long-term herbivore enclosure experiment in HiP, which demonstrated that the effect of browsers on *Dichrostachys cinerea* ($p = 0.005$), fine-leaved ($p = 0.031$) and broad-leaved ($p = 0.043$) sapling growth rates was strongly modified by the presence of short grass. These results provide support for the hypothesis that browsers, particularly small-bodied browsers and mixed feeders, are attracted to short-grass habitats, and that in turn, they help maintain grazing lawn openness by suppressing woody seedling survival and sapling growth where grass is kept short by grazers.

Long-term herbivore population trends and spatial dynamics across Kruger National Park (South Africa) and the adjoining private game reserves

09:40AM - 09:45AM

Presented by :

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

Landscape fragmentation is a major threat to herbivore populations globally, reducing the potential for species to use movement as a response to variable environmental conditions. While landscape fragmentation often entails conversion of natural habitats to land uses unsuitable for wild herbivores, such as croplands or urban development, in the greater Kruger National Park (KNP) system fragmentation was often imposed by the erection of fencing with only limited habitat transformation. Over the last two decades, however, there have been concerted efforts to remove fencing and thereby link conservation areas across the Lowveld, in an attempt to restore historical ecosystem functionality, including herbivore movement patterns. The removal of fences between the 18,984 km² KNP system, and part of the adjacent privately and state-owned protected areas, has increased the conservation estate by 14,332 km² to 33,316 km². We use two remarkable, but under-utilised, long-term herbivore count datasets for the KNP (sampling and with sporadic changes in count methods) and adjacent private protected areas to the west ('ARC' dataset using standardised total area counts and consistent teams) to explore herbivore population trends and spatial dynamics over the last 25- to 35-years in the Lowveld. The study period includes shifts in fire, water provisioning and elephant management policies, multiple droughts, and the periodic removal of fences separating KNP and the private protected areas. Within this context, we provide an initial assessment of the broad spatio-temporal dynamics of some herbivores at species- and herbivore functional type-levels, as landscape fragmentation is gradually reduced in the wider ecosystem. An additional objective of this research is to address these challenges and to provide a dataset that realises more of the value of this resource to the research community. Overall, the objective is to move towards a broader perspective on ecosystem dynamics across conservation areas in the Lowveld, in order to facilitate development of a more integrated management approach across the region.

Farming, Nature Conservation and Tourism II

Moderators

Igshaan Samuels, Senior Researcher, Agricultural Research Council

KEYNOTE ADDRESS: Evolving, but in the right direction?

Commodification and domestication of wildlife as a threat to biodiversity, rangelands, and the broader biodiversity economy

10:00AM - 10:25AM

Presented by :

Ian Rushworth, Manager Ecological Advice West, Conservation Services, Ezemvelo KwaZulu-Natal Wildlife

Africa is well known for its diversity and abundance of large mammals in wild places, and which forms the basis of consumptive and non-consumptive elements of the wildlife economy. Recently, almost all species of indigenous wild mammals in South Africa were listed under provisions of the Animal Improvement Act equivalent to farm animals, with Breed Societies established to define 'breed standards' and 'improve' the genetics of species. The listing took place without appropriate public consultation and is therefore seen to be an illegal act, currently being challenged in the courts. The listing is further unusual in that it lists entire indigenous species, not just breeds thereof: this would be akin to having breed standards and societies for 'cattle' and 'goats' as opposed to for 'Nguni' or 'Boer goat' breeds. The rationale for the listing can be explained in the context of the ongoing commodification of wildlife and attempts to acquire regulatory control over elements of biodiversity so as to remove wildlife ranching out of the perceived 'restrictive' control of conservation authorities. This presentation will provide an overview of the range of risks that the listing poses to biodiversity, rangelands and the broader biodiversity economy, including to the tourism and hunting industries. While the listing has been recent and the full impacts are yet to be realised, insights into the eventual outcomes may, however, be gained from a review of existing practices and impacts of intensive and selective breeding of wildlife. Some of the risks related to rangeland management include habitat fragmentation, habitat degradation, development of resistance to stock remedies and veterinary medicines, and disruption of the process of host-parasite evolution. The unclear distinction between wild and farmed game in the hunting sector and in relation to venison production may contribute to reputational damage and consequent negative economic impacts on other aspects of the wildlife industry and economy as a whole. The objective of conferring a 'high degree of genetic stability' in indigenous animals is, of course, the antithesis of conservation and climate change principles. Because it is not possible to isolate these impacts and risks from natural ecosystems and the broader socio-economic environment, far from accepting the demands for reduced government regulation and oversight, the need for clear policy, regulation and controls to achieve a balanced and sustainable growth path is now greater than ever. Concurrent regulatory control over species by both Agriculture and Environment, together with ongoing misleading statements by industry leaders, is already causing confusion and conflict. It is conceivable that the Registrar of Animal Improvement may attempt to interfere with legitimate conservation activities relating to the listed species. A case is made for removing indigenous mammals from the listing, and

for a more holistic assessment of the contribution and future role of wildlife in the broader biodiversity economy, before travelling further down a road from which it will be difficult to return.

The impact of the invasive grass *Nassella trichotoma* on the plant species richness, diversity, and composition in Karoo Escarpment Grassland, Sneeuberg Centre of Floristic Endemism (South Africa)

10:25AM - 10:35AM

Presented by :

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

Nassella trichotoma is a highly invasive South American grass invading montane grasslands in the Cape Midlands Escarpment (CME; comprising the Sneeuberg, Great Winterberg–Amatholes and Stormberg; Eastern, Northern and Western Cape Provinces, South Africa). Although *N. trichotoma* has been a recognised major problem in these mountains for decades, the primary focus and concern have been on impacts on rangeland productivity and management, while the impacts of invasions on plant biodiversity has not been considered. Given that some 92 plant species are endemic to the CME, > 90% of them being localised grassland species at high risk of extinction from alien invasion, this is an important topic for research. As a starting point to understanding *N. trichotoma* impact on local biodiversity, 39 pairs of 2 m x 2 m plots (total 78 plots) were laid out in Karoo Escarpment Grassland at Asante Sana Private Game Reserve, Pearston, in March 2020 at altitudes from 1,511 m to 1,855 m. Paired plots were chosen so that they had similar environmental conditions (aspect, elevation, rockiness, etc.), with one plot being invaded by *N. trichotoma* and the other not; paired plots were located no further than 30 m apart. A total of 12 *N. trichotoma* patches were sampled with two to four plot-pairs per patch. In each plot, all vascular plant species were recorded, and the cover abundance of each species was visually estimated using the modified 7-point Braun-Blanquet scale. Shannon and Simpson's diversity indices showed significant differences ($p < 0.01$) between invaded and uninvaded plots when tested using paired t-tests. The invaded and uninvaded plots shared 54% of the recorded species, but *N. trichotoma* dominated the invaded areas while the uninvaded areas had a more even species distribution. Uninvaded areas had more species diversity and fewer exotic species than invaded areas. Eight of the twelve South African endemic plant species recorded during this research occurred in invaded areas. The results indicate that *N. trichotoma* is a powerful driver in reducing the richness of indigenous grassland floral diversity in the Sneeuberg mountains (a Centre of Floristic Endemism), and should be cause for major concern by landowners and government.

Determining the effects of fire suppression on grass biomass in the confined savanna rangeland of Mafikeng Game Reserve, South Africa

10:35AM - 10:45AM

Presented by :

Tebelelo Mashego, Student, North-West University

Naturally induced fire has historically been a periodic event on savannah rangelands. Following the fragmentation of the savannahs due to agriculture and urbanisation, fenced reserves have been a pivotal nature conservation measure. An associated management practice in the fenced reserves is fire suppression through fire breaks and the implementation of fire extinguishing efforts in the event of accidental fires. In this study, the effects of such fire-suppression on grass biomass in Mafikeng Game Reserve were investigated. Indicative data on grass biomass was obtained in 90 cm quadrats towards the end of the 2019/2020 rainy season, at widely-spread sampling sites. The grass in each quadrat was harvested and weighed. Being at the end of the growing season, the grass was fully grown at the time of collecting the field data. MODIS (MODerate resolution Imaging Spectroradiometer) monthly images at 500 m resolution (MCD45A1 data) of burnt-areas showed that no fires penetrated the game reserve to its centre in the preceding 19 years. However, sections close to the boundary of the reserve experienced fire events in the period of analysis. The sections close to the boundary experience low grazing intensity, partly because they are avoided by the reserve's ungulate grazers due to the disturbance from motor-vehicle traffic on the two highways that run along large sections of the boundary. Heavily grazed and low fire-frequency sites, such as in the vicinity of water holes, had low grass biomass. Lightly grazed and low fire frequency sections, on the other hand, had high grass biomass. Grass leaf and stem material from previous growing seasons contributed to the high biomass. Such litter can serve as fire-fuel in the event of an accidental fire. The study concludes that the role of fire needs to be considered as part of rangeland management in protected savannah areas.

Examining inter- and intra-specific leaf trait variation in savanna grasses
10:45AM - 10:55AM

Presented by :

Arend De Beer, MSc Student, University Of Pretoria

Functional traits provide the opportunity to investigate how environmental variables drive variation in plants and can be interpreted as proxies of important ecological functions. Functional traits vary both inter-specifically (BTV) and intra-specifically (ITV), with the greatest proportion of variation being accounted for by BTV (i.e. up to 75%). Nonetheless, ITV also contributes considerably to community-level variation and is important for phenotypic plasticity and the adaptability of a species. I investigated leaf traits of savanna grasses (Poaceae) to address three issues that are poorly understood in a southern African context: (1) do savanna grass species differ in their leaf functional traits, (2) are leaf functional traits related to grass species life-histories, and (3) can intra-specific leaf functional trait variation be explained by environmental conditions (i.e. biotic, topographic or edaphic variables) in this system? Across Lapalala Wilderness Reserve 111 plots were sampled, with 1,147 individuals of 49 grass species being sampled and various environmental variables being measured for each plot. Specific leaf area (SLA) and leaf dry matter content (LDMC) were measured for each individual collected. Grass leaf traits differed between species, and life-history categories were only weakly correlated with leaf traits ($r^2 = < 0.1$ to 0.31). The strongest relationship between life-history categories and functional traits was grazing status, with decreaser species generally displaying low LDMC and

high SLA values. Intra-specific trait variation in leaf traits was correlated with some environmental variables, with moisture-related variables being the most important driver for both leaf traits. Considering the potential for variation in functional traits to have an impact on the grazing value of grasses, a more complete understanding of the underlying relationships between environmental conditions, functional traits and grazing value may be useful in guiding the management of our grasslands.

Q&A | Discussion: Rangeland management for game farming, nature conservation and tourism II

10:55AM - 11:00AM

Presented by :

11:00AM -
11:30AM

Interval / Virtual Tours

11:00AM -
11:30AM

Twitter poster session: Research proposal posters

Moderators

Kevin P Kirkman, University Of KwaZulu-Natal

Twitter
@GrasslandSocSA

Contextualising ecological infrastructure restoration frameworks for sustainable management in complex and dynamic catchment systems—a case in the Blyde Catchment, South Africa

11:24AM - 11:28AM

Presented by :

Silindile Mtshali, Student, UKZN-SANBI

Human livelihoods depend on healthy landscapes for natural resources and ecosystem services such as provisioning, regulating, cultural, and supporting services. The degradation of Ecological Infrastructure (EI) from poor land management hinders the delivery of these ecosystem services. Restoring EI to improve ecosystem functioning is critical for sustainable socio-economic benefits. This research aims to explore how participatory learning approaches and models can facilitate collaborative decision-making for effective EI restoration frameworks in the Blyde Catchment, a strategic water source area in Mpumalanga Province. The study seeks to transcend beyond scientific disciplines, guided by the socio-ecological systems methodology, to develop a learning-oriented and context-sensitive framework to inform the applicability, resilience, and sustainability of EI restoration initiatives. The study will answer a range of questions on how local communities depend on EI for ecosystem services? How socio-cultural factors influence decision-making in EI restoration to sustain these services? And how these decisions impact the overall socio-economy of communities? The study will use a participatory learning and action research approaches with a group of 20 participants who will go through a series of six workshops. These focus group workshops will be facilitated using a participatory mapping method for co-inquiry,

co-learning, and co-generation of knowledge. This methodology will seek to evaluate the dynamics of human-nature relationships through understanding the dependency, value, attitudes, and decision-making perceptions on EI restoration initiatives. The workshops will be facilitated using participatory mapping exercises, and open-ended questionnaires to identify vital ecosystem services and threats as defined by the participants, to develop a dependency map. The study will also evaluate the relevance of social-cultural dynamics that influence the restoration of EI. The next phase will be to assess the impact of restoring EI on ecosystem services delivered, and subsequently on livelihoods through collaborative system dynamics modelling. This process will include the co-developing of causal loop diagrams to establish a model using the Vensim software. In the preliminary assessment, the study has partially explored livelihood dependency through collaborative evaluation of demand and supply of ecosystem services and other benefits from the Blyde Catchment. The preliminary findings show a need for effective management actions and intensive EI restoration interventions to unlock the ecotourism. That will generate more sustainable EI restoration job opportunities, improving infrastructure and access, and the development of the small, medium and micro enterprises to support livelihood resilience. Low social capital, lack of financial resources, and technical capacity were highlighted as the main factors constraining long-term EI restoration initiatives. Governance and institutional arrangement issues relating to land reform were highlighted amongst the constraining factors. The preliminary assessment emphasises the importance of collaborative, context-sensitivity, and learning-oriented approaches as guiding decision-making processes for effective and sustainable EI restoration interventions. This work is part of the Living Catchment Project by the South African National Biodiversity Institute.

Community-based rangeland rehabilitation for maintenance of ecosystem functions, services and goods

11:04AM - 11:08AM

Presented by :

Solomon Tefera Beyene, Associate Professor, University Of Fort Hare

Globally, land degradation has affected more than a billion hectares of land and the people who depend on it. In South Africa, rangelands cover above 50% of the land surface and provide many ecosystem functions, goods and services. However, vast communally used rangelands, have suffered degradation, driven mainly by climate change, population growth and livestock overgrazing. Rangeland degradation and restoration should remain a foremost policy concern and subject of scientific study in order to make urgent and comprehensive action to halt the degradation. The Eastern Cape is the second-largest province comprising about 14% of the country's land area and a population of over 8.5 million. Native pastures are the major source of feed for ruminants raised for multiple drives including food consumption, income generation, manure and socio-cultural reasons. In the province, rangeland degradation is now a major social, ecological and economical challenge. This concern continues because the extent and severity of degradation are growing rapidly. Hitherto, no adequate scientific studies have determined the state rangeland degradation detailing the needs, and subsequently, evaluated the success of restoration practices that increase nutrient and moisture inputs to the soil and improve micro-climates.

Designing sound restoration strategies starts with a rapid and reliable assessment of the extent and levels of degradation to a diagnosis of the 'cause-impact' and set up classification criteria. In this process, understanding the communal people's perception of their environment and degradation is imperative to contribute inputs to understand the historical perspectives and lead the rehabilitation process. The aims of the project are 1) document communal farmers' perceptions of the rangeland's resources and degradation, 2) assess the status of degradation levels 3) evaluate the success of some restoration practices with regard to changes in vegetation, and denuded soil patches in a semi-arid area of South Africa, and 4) explain the potential implication on ecosystem functions, goods and services. The project aims to generate information and evidence to contribute to decision making of a land user or policymakers needed for sustainable rangeland use and management in order to improve the production of ecosystems goods and services and livelihoods of resource limited farmers.

A review of the invasive genus *Cotoneaster* (Rosaceae) in southern Africa
11:08AM - 11:12AM

Presented by :

Karabo Moloi, MSc Student, University Of Free State

Cotoneaster (Rosaceae) comprises popular ornamental plants which originate from Sichuan and Yunnan provinces in the south-western regions of China. *Cotoneaster* grows into a wide range of various sized shrubs. These range from creepers to almost tree-like forms which produce abundant red-coloured pomes with two to three seeds, depending on the species, which are then dispersed by fruit-eating birds. In southern Africa, *Cotoneaster* has become widely naturalised in the moist, cooler eastern montane regions of South Africa, Lesotho, Eswatini and Zimbabwe. In South Africa, *Cotoneaster* species have been located in the montane foothills of KwaZulu-Natal along the Drakensberg, the eastern parts of the Free State, and in the Eastern Cape. These plants usually invade grasslands, shrublands, riverbanks, roadsides, rocky outcrops as well as forest margins. Invaded areas include both disturbed and pristine environments. The most problematic species are *C. pannosus*, *C. franchetti* and *C. glaucophyllus* with all three listed as Category 1b invaders in the National Environmental Management: Biodiversity Act. *Cotoneaster* presents a major potential risk to rangeland quality and associated livelihoods, water provision in strategic water source areas, and local biodiversity. They have been observed to form mono-specific stands in eastern Free State and KwaZulu-Natal in the higher mountain regions and along watercourses. At an ecosystem level, little is understood with regards to the consequences of *Cotoneaster* species on indigenous flora. This highlights the need to undertake studies that focus on the interactions of *Cotoneaster* species with indigenous flora and to explore reproductive output, pollination systems, seed dispersal mechanism, soil seed bank and factors affecting the germination of these species to fill this knowledge gap. In addition, early detection will aid in the addressing the localised infestations (e.g. Tugela Gorge, Royal Natal National Park) and of large infestations of such naturalised plants and other potentially harmful ornamental plants, especially in natural environments such as national parks.

The impacts on montane biodiversity of *Leucosidea sericea* (Rosaceae) encroachment in the Maloti-Drakensberg

11:12AM - 11:16AM

Presented by :

Muxe Dlomu, MSC Student, University Of Free State

Leucosidea sericea (Rosaceae; ouhout, oldwood) is a common indigenous shrub or small tree that is near-endemic to the eastern parts of South Africa (and also in Lesotho, Eswatini and Zimbabwe). It is recognised as a bush encroacher species, which negatively impacts rangeland use and hydrology. It is anticipated that understanding the spatial and temporal distribution patterns of *L. sericea* in the Maloti-Drakensberg (MD) region can offer a better understanding of the species' role in the local ecology. Although *L. sericea* is recognised as the premier montane bush encroachment species in the MD region, little is known on its impact on montane biodiversity. The current study intends to explore the impact of *L. sericea* on local biodiversity, with the hypothesis that *L. sericea* encroachment replaces grass-rich diversity with depauperate proto-forest diversity. An extensive dataset of ecological biodiversity in non-encroached, partially encroached, and fully encroached habitats at the Cathedral Peak Research Catchments (Catchment IX), Golden Gate Highlands National Park, and Witsieshoek (Batlokwa) area will be compiled through e.g. paired plots and standard quadrant sampling methods. Also, the historical spatial distribution of *L. sericea* will be quantified using aerial photographs and ground survey, as we postulate that *L. sericea* is a species that sees major expansions and contractions in the montane areas through a combination of climatic cycles, fire frequency, and (since the colonial era) major land-use changes and extirpation of indigenous mega-fauna. The elevated carbon dioxide (CO₂) and a C₃ photosynthetic pathway connection to *L. sericea* expansion in the montane landscape will also be explored through the use of a Simple Interactive Vegetation Model combined with GENESIS General Circulation Model. The results will contribute to policy recommendations on *L. sericea* management in the MD.

Grazing for carbon: Investigating soil, plant and ruminant interactions on carbon sinks in extensive mesic grassland and improved kikuyu (*Pennisetum clandestinum*) pasture

11:16AM - 11:20AM

Presented by :

Robyn Nicolay, PhD Candidate, University Of KwaZulu-Natal

Grasslands have the ability to store more carbon (C) than arable soils due to a greater root turnover contributing to soil organic matter. This potential is however undermined by intensive land use, with the potential for regeneration largely depending on how grasslands are managed for large mammal grazing. Whilst fire is used as an important management tool in African savanna and grassland systems, the combination of fire and grazing are seen as primary disturbance mechanisms, influencing C accumulation through effects on vegetation structure and composition. This project aims to evaluate soil organic carbon dynamics along a vertical gradient, under varying management or environmental scenarios; long-term burning and mowing regimes within mesic grasslands, extensive ruminant grazing in mesic grasslands and improved kikuyu (*Pennisetum*

clandestinum) pasture under grazing. The research site is located at the University of KwaZulu-Natal's research farm, Ukulinga, Pietermaritzburg. Long-term rangeland burning and mowing trials at Ukulinga will be investigated, with treatments consisting of annual, biennial and triennial burns, as well as no burn and annual mown treatments. Treatments are organised in a randomised block design and replicated three times. Targeted grazing experiments will be conducted at Ukulinga utilising grasslands managed under spring annual burns with a low stocking density. A further research site at the Agricultural Research Council (ARC), Cedara, will investigate existing kikuyu pastures stitched with white clover (*Trifolium repens*), grazed under recommended ruminant stocking densities. Composite soil core samples will be taken from random quadrats within treatments in 5 cm increments to a depth of 10 cm. Above-ground biomass samples will be collected either as cut vegetative biomass after mowing or vacuumed pyrogenic carbon material remaining after fire treatments. Total Organic Carbon, Total Nitrogen (N) and Labile Organic C and N fractions will be processed and analysed using LECO TruMac Methodology. Additional greenhouse pot-trials using oats (*Avena sativa*) will be conducted as a measure of Potentially Mineralisable N. Aboveground and belowground biomass collected determined using a LECO CNS analyser. Data collected will be analysed using R statistical software. Based on previous studies and understanding, we hypothesise the following: (i) mesic grasslands have a greater ability to sequester Soil Carbon under conservative fire application as a management tool, (ii) targeted grazing and conservative burn management enhance mesic grasslands potential for stabilising soil Carbon balances and (iii) perennial kikuyu pastures ability to retain stable Carbon stocks under conservative grazing, are complemented by legume intercropping. Implications resulting from this research aim at supporting land users in appropriate grassland fire and grazing management for land restoration, ultimately enabling carbon sequestration and supporting sustainable ruminant grazing systems.

Implications of expansion of protected areas utilised by megaherbivores for carbon sequestration and land degradation neutrality: A case study of the South African Thicket Biome

11:20AM - 11:24AM

Presented by :

Thokozane Magagula, Student, Stellenbosch University

Addo Elephant National Park is situated in the Eastern Cape Province of South Africa, in a semi-arid region which experiences severe droughts, high winds, and extreme temperatures. Vegetation that is severely affected by degradation needs to be restored as it is important for carbon sequestration and is the food for large grazers, especially African elephants. Various land-degradation types, created by a plethora of land-uses, have led to habitat fragmentation within and beyond the park boundaries. Within a park, overgrazing by large herbivores such as elephants and smaller herbivores, such as goats, in potential expansion areas, or abandoned land previously cultivated may be responsible for a decline in stocks in the region. Outside of a protected area, numerous other factors could play a role in degradation, which may curtail the future expansion of a protected area due to low conservation potential. The aim of the study is to identify the carbon sequestration status of the park and potential expansion areas in the sub-tropical

Thicket Biome, Eastern Cape Province. To fulfill the aim of the study, all carbon stocks within the park will be identified and assess the carbon sequestration rate (non-destructive using the allometric model) within the park and potential expansion areas. Remote sensing will be used to map long term vegetation change for a period of 35 years over the park and potential expansion areas and identify all the drivers of change in carbon sequestration within the park and potential expansion areas. This project will, therefore, be able to quantify all the degraded land across and beyond the park for proposed land degradation neutrality priority measures over the year 2000 to 2015 and then 2015 to 2020 periods. In addition, this study will contribute to the development of site-specific allometric equations, adding to those that are already existing in subtropical thicket vegetation developed by previous researchers on carbon sequestration.

11:30AM -
12:40PM

Zoom Webinar

Thursday Session 09: Water production and fire management in rangelands

Moderators

Theresa Ojo, PhD Student, University Of KwaZulu-Natal

Beyond the tree-line: The C₃-C₄ 'grass-line' can track global change in the world's grassy mountain systems

11:30AM - 11:40AM

Presented by :

Ralph Clark, Director, Afromontane Research Unit

Von Humboldt's tree-line concept has dominated mountain ecology for almost two hundred years, and is considered a key indicator for monitoring change in biome boundaries and biodiversity shifts under climate change. Despite being useful in many regions, this approach has little value in the widespread tree-sparse, grassy systems that comprise a third of the World's mountain systems. Among grasses (Poaceae), temperature is linked to variation in photosynthetic performance and community dominance for C₃ and C₄ metabolic groups, due to its role in limiting photorespiration in the C₃ photosynthesis process. Using data for grassy mountains globally, we show that C₃-C₄ grass genera exhibit clear elevational and latitudinal patterns correlating to von Humboldt's elevational habitat layering. Consequently, this C₃-C₄ 'grass-line' is as ecologically significant as the tree-line, and more practical for monitoring climate change impacts in grassy mountains. Our results raise the possibility that warming temperatures will cause C₃ genera occurring in sub-tropical mountains to undergo range retractions, shifting the grass-line upslope. Under higher temperatures, temperate mountains-previously characterized by a greater presence of C₃ grasses are likely to be increasingly colonised and/or dominated by C₄ grasses. These C₃-C₄ grass community shifts will likely have major implications for fire frequency and severity, rangeland productivity and livelihoods, food security, and water budgets in these mountain systems.

Effect of holistic grazing management on plant cover, plant diversity, and biomass production in Mokhotlong District, Lesotho

11:40AM - 11:50AM

Presented by :

Tsele Rantso, National University Of Lesotho

Rangelands grow primarily native vegetation consisting of grasses and other herbaceous plants (e.g. forbs) and shrubs managed as natural ecosystems. They are essential for maintaining biodiversity and are sources of livelihood for most of the rural communities. Nonetheless, rangeland ecosystems are increasingly under threat from weeds, both exotic and native. There has been an increase in native shrubs in many rangeland ecosystems of Lesotho as a result of overgrazing and recurrent droughts. As a result, rangeland productivity has been deteriorating in quality and quantity. Climate change has exacerbated the decline in resource use as evidenced in the negative effects of fluctuating temperature and precipitation. Holistic grazing management (HGM) is designed in a way that mimics natural grazing of wild herbivores which move in large animal flocks across large areas as they try to escape predators. This system ensures that grazed areas get enough recovery time before the next grazing. The Government of Lesotho, through the Department of Range Resources Management, is currently implementing HGM in Mokhotlong District, however, there is little empirical evidence about its appropriateness in improving rangeland productivity. A number of scholars have claimed that HGM can increase productivity through the impact of densely packed animals on primary production. However, this theory remains debatable. A cross-sectional study was therefore conducted in February 2020 to determine the effect of HGM on biomass production, plant species diversity, and plant cover in the high-altitude rangelands in Mokhotlong District. Four blocks (20 m x 20 m) were set in Holistic Grazing Area (HGA) and Traditional Grazing Area (TGA) where animals graze continuously throughout the year. Metric belt transect method was used to determine vegetation cover, species composition and abundance. Disc Pasture Meter was used to determine biomass production. The equation used was: $Y = -3,019 + 2,260\sqrt{x}$, where Y = standing biomass ($\text{kg}\cdot\text{ha}^{-1}$), x = mean compressed vegetation height (cm). Biomass production was found to be higher ($p < 0.05$) in HGM ($2,224 \pm 311.6 \text{ kg}\cdot\text{ha}^{-1}$) than in the TGA ($634 \pm 95.7 \text{ kg}\cdot\text{ha}^{-1}$). Plant diversity was found to be higher ($p < 0.05$) in HGM (2.1 ± 0.4) than in the TGA (1.9 ± 0.04). However, there was no significant difference in plant cover. These results indicate that HGM enhances biomass production and plant diversity, which are indicators of rangeland productivity. However, longer studies would be necessary in order to confirm the reported results.

Using littoral vegetation, wetland edaphic factors and characteristics to sub-group depressional wetlands in southern Africa

11:50AM - 12:00 Noon

Presented by :

Basanda Nondlazi, PhD Research Associate, Council For Scientific And Industrial Research And University Of KwaZulu-Natal

Vegetation on the littoral zones of depressional wetlands is an important feature for efficient wetland function because it is heavily involved in the provision of wetland ecosystem services incorporating many biogeochemical processes and biodiversity. Current global increases in land surface temperature and change in

rainfall may effect changes in the spatial patterns of wetland edaphic factors *i.e.* soil moisture content, salinity, and bulk-density. Therefore, depressional wetland vegetation might be highly vulnerable to climate variability and change. However, the effects of these edaphic shifts on the population dynamics of depressional littoral vegetation are less understood. Hence the study aims to understand whether depressional wetlands can be grouped using similarities in their littoral vegetation variables *viz.* species composition, abundance, growth-form functional types, species richness, diversity and edaphic factors. Paired samples of these vegetation and edaphic variables were collected along 14 belt transects in eight representative depressional wetlands situated in grazing camps in a managed grassland rangeland in Lake Banagher Farm, Mpumalanga Lake District, Mpumalanga Province, South Africa and used to investigate four objectives: (1) Whether depressional wetlands can be grouped using similarities in their littoral vegetation; (2) whether littoral vegetation dynamics can be used to explain the potential groupings of depressional wetlands; (3) how wetland characteristics and wetland edaphic factors might be driving the potential groupings; 4) whether the response of species richness increases with increase in the distance from the wetland water body in response to changes in edaphic factors. Using statistical differences from R-software v 3.5.3, among the eight sampled wetlands at Bonferroni adjusted $p < 0.001$. The results show compelling evidence that wetlands can be objectively grouped into three general groups *i.e.* herb, grass and sedge wetlands. Generally, wetland grouping was driven by differences in wetland edaphic factors and wetland characteristics, which in turn, drive vegetation population dynamics including spatial changes in species richness and growth form functional types. Species richness increases with an increase in the distance from the wetland water body accompanied by changes in growth form functional types; from dominance by aquatics to sedges, then herbs, and grass. From richness data, thresholds were observed at 30, 70 and 100 m from the wetland water body associating to permanently, seasonally and intermittently saturated zones, respectively. We conclude that this new understanding of the effects of edaphic factors in these semi-arid wetland ecosystems enhances monitoring, management and protection of depressional wetlands in the era of climate change. We recommend the results of this study as a proof of concept for the incorporation of climate change monitoring variables and the objective implementation of the vegetation descriptors, for advanced classification beyond the subjective level of Hydro-geomorphic Units in the National and International Wetland Classification Systems.

Post-hoc physical patterns and indicators of fire behaviour as an aid in wildfire investigations

12:00 Noon - 12:10PM

Presented by :

Matthew Danckwerts, MSc Student, Stellenbosch University

That fire plays an important role in shaping and maintaining ecosystems has been well documented. Notwithstanding, an inevitable consequence of anthropogenic settlement, accompanied by infrastructural development, is damage to property after uncontrolled fires. The result is numerous claims for losses incurred as a result of runaway fires, many of which lead to litigation. Legal teams rely on experts in wildland fire behaviour to investigate the origin, cause, spread and

other pertinent aspects of fire behaviour. Investigations are conducted on a *post-hoc* basis and rely on physical evidence. Wildfire pattern indicators are the physical objects or visual remains persisting after a fire's passage. They reveal the progress, action and pattern of the fire and rely on changes caused to partially burned fuels and incombustible objects when exposed to fire. There are few, if any, quantitative studies on *post-hoc* indicators determining wildfire behaviour. Knowledge on the topic is essentially anecdotal. The purpose of this study is to quantitatively assess the reliability and accuracy of *post-hoc* wildfire pattern and spread indicators in Eastern Cape montane grasslands. *Post-hoc* wildfire pattern indicators were quantifiably assessed on seven controlled burn sites across the Eastern Cape. There were 20 recording sites within each fire. Indicators tested were chosen for their relevance within grassland vegetation as well as for their ease of analysis. These included: Leaside charring on pole type fuels; leaf freeze; consumption depth (by combustion) of grass tussocks; undercutting (presence of unburnt culms on burnt veld) and unburnt plant litter. Wind direction, fire spread type (head, back, and flank), direction of fire spread, fire intensity and fire severity were recorded for each of the 20 replicates at the burn sites, during fire spread. Real-time recorded fire behaviour characteristics were then compared with those inferred from *post-hoc* wildfire pattern indicators. Residual unburnt plant litter differed significantly between fire spread types ($p = 0.001$); with headfires leaving more residual litter (mean = 198.938 g.m^{-2}) than backfires (mean = 116.745 g.m^{-2}). Leaside charring and leaf freeze indicated direction of wind at the time of fire passage (as opposed to direction of fire spread), but not unequivocally so. Consumption depth of grass tussocks was greater in backfires than in headfires. The number of unburnt culms lying on burnt veld differed significantly between fire spread types ($p = 1.87\text{E-}11$). Backfire scars had more unburnt culms (mean = 126.33) than headfire scars (mean = 1.85). Residual undercut culms were almost invariably present after backfires had passed. Instances of undercutting were rare in headfires. Importantly, the absence of unburnt culms on burnt veld is not indicative of a headfire, as culms may not have been present in the sward prior to the fire. To conclude, leaside charring on pole type fuels, leaf freeze, consumption depth of grass tussocks, and unburnt plant litter are reliable *post-hoc* wildfire pattern indicators, but are not necessarily conclusive on their own. In conjunction with each other, however, they may be used reliably to determine the point of origin and other fire behaviour characteristics. Moreover, undercutting was shown to be an almost unequivocal diagnostic feature of backfires.

Decrease in total burned area despite increase in climatological fire danger over the central Grassland Biome of South Africa

12:10PM - 12:20PM

Presented by :

Stephan Steyn, Lecturer, University Of The Free State

The grasslands of the South African interior plateau are subject to seasonal wildfires that occasionally inflict serious damage to livestock production systems and infrastructure. Recent changes in the climate imply changes in the fire regime, which can pose challenges to fire managers and exceed the current suppression capacity. The aim of this study was thus to assess recent changes in fire danger across the central Grassland Biome of South Africa. Both total burned area and climatological fire danger were considered. Total burned area data was

obtained through satellite remote sensing for the period 2002–2017 using MODIS MCD64A1.006 burned area data. This burned area data has an original resolution of 500 m, but was accumulated for each month at municipal district level and provided by the Council for Scientific and Industrial Research (CSIR) – Meraka Institute. Various fire danger indices (e.g. Canadian Fire Weather Index, Lowveld Fire Danger Index, and McArthur Forest Fire Danger Index) were calculated from ERA5 reanalysis climate data for the period 1979–2018. The ERA5 reanalysis data has a spatial resolution of $0.25^\circ \times 0.25^\circ$ and was downloaded from the Copernicus Climate Change Service Climate Data Store (C3S). The perceived increase in wildland fire activity in various world regions does not apply to the central grassland biome of South Africa. A statistically significant ($p = 0.017$) negative trend in annual total burned area was observed over the study area, corresponding to a decline of about 34,000 ha per annum over the period 2002–2017. This occurred during a time that the climatological fire danger increased. Climatological fire danger was shown to be considerably higher in the south-western part of the central grassland, where extreme days occurred on 5–9 days during the fire season. The incongruity between burned area and climatological fire danger can probably be ascribed to veld management practices including fire suppression and avoidance techniques, as well as fuel continuity and availability. The last decade has been marked by prolonged droughts, particularly over the southern and western parts of the central grassland region, which also resulted in reduced fuel loads and hence a reduction in observed burned area at a time when the climatological fire danger increased.

Mesic savanna grassland responses to 70 years of experimental fire

12:20PM - 12:30PM

Presented by :

Kevin P Kirkman, University Of KwaZulu-Natal

Fire occurrence in mesic grassland and savanna impacts species composition, richness and diversity, forage quality and quantity for livestock and wildlife, bush encroachment and greenhouse gas levels. The use of fire in grassland and savanna management in agricultural and conservation areas remains controversial, with approaches varying between countries and regions. Ukulinga Research Farm in KwaZulu-Natal, South Africa is the site of an ongoing fire experiment initiated in 1950. Treatments range from annual burn to total fire exclusion, in combination with varying summer defoliation treatments, from no defoliation to biannual defoliation. Burn treatments are burnt in winter, spring or autumn and annual burn treatments also have a mow substitution treatment. During 2019 full botanical analyses were carried out on all treatments, using eight 1 x 1 m quadrats per plot. Fire exclusion and reduced fire frequency (triennial burns) without summer defoliation leads to dominance by tall, robust, rapidly tillering species with low grazing value and disappearance of shorter, slower growing, less dominant species, with consequent reduction in species richness and diversity, and reduction in basal cover. Grazing value of the infrequently and unburned treatments is reduced. In the presence of summer defoliation, species composition converges with that of frequent burn treatments, characterised by short species of high grazing value. In addition, the absence of tall, dominant species results in greater species richness and diversity, and greater basal cover. Directly substituting annual fire with mowing reduced richness and diversity, and

facilitated encroachment by taller, lower-quality species. Defoliation in the form of mowing is thus not equivalent to fire. Encroachment of woody species is directly related to decreasing fire frequency, with fire exclusion plots dominated by alien and some native trees, with few grass species remaining, indicating an almost total loss of grazing value. The results reinforce the positive role of fire on vegetation richness and diversity in mesic grasslands. These long-term impacts of fire and defoliation treatments highlight the positive role of fire in mesic savanna grasslands. The Ukulinga Grassland Fire Experiment demonstrates the value of long-term ecological experiments, and forms an outdoor laboratory suitable for addressing ecological research questions far beyond the original envisaged scope of the experiment.

Q&A | Discussion: Water production and fire management in rangelands

12:30PM - 12:40PM

Presented by :

Theresa Ojo, PhD Student, University Of KwaZulu-Natal

12:40PM -
01:00PM

Zoom Webinar

Closing of Congress 55

Scientific Chair programme synthesis

12:40PM - 12:50PM

Presented by :

Ralph Clark

Closing of Congress 55

12:50PM - 01:00PM

Presented by :

Debbie Jewitt, Conservation Scientist, Ezemvelo KZN Wildlife

10:00AM -

11:30AM

**Annual General Meeting of the Grassland Society of
Southern Africa**

Zoom Webinar

