

Grassland Society of Southern Africa

59th Annual Congress

Gariep Forever Resort, Gariep, Free State, South Africa

22 - 26 July 2024



PROCEEDINGS

COMPILED/EDITED BY JAMIE PAULSE-ROSS AND GRAPHICS BY MINETTE VAN LINGEN



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Keynote Speakers



**Prof. Guy
Midgley**



**Dr. Devan
McGranahan**



**Dr. Richard
Fynn**



Grassland Society of Southern Africa

• POLICY & PRACTICE WORKSHOP •
**RANGE-EXPANDING WOODY SPECIES IN
SOUTHERN AFRICAN MOUNTAINS**

• **26 JULY 2024** •

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Keynote Speaker

Emeritus Prof. William Bond

**Plenary on Bush Encroachment in
southern African mountains**



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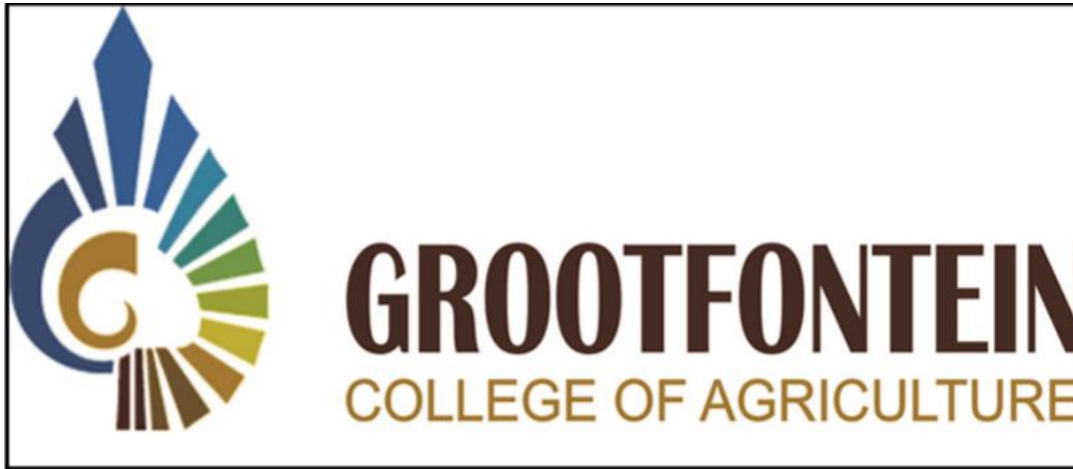


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SESSION 01 | CLIMATE CHANGE & CARBON

SESSION CHAIR: JUSTIN DU TOIT

Tuesday 23 July 2024, 08:15 - 10:30

**KEYNOTE ADDRESS: EARLY EVIDENCE OF THE IMPACTS OF CURRENT AND LEGACY LAND USE ON ARID ECOSYSTEM
CARBON BALANCE**

Guy Midgley, Amu Maluleke, Christian Brümmer, Oksana Rybchak, Gregor Feig*

While remote sensing trends have identified some evidence for recent decadal-scale "greening" in semi-arid regions globally, there are very few in situ measurements of ecosystem carbon balance in these systems in southern Africa to allow us to explore such effects at local scales, and in particular the effects of land use on their quantum and persistence. With a growing interest in how land use may affect carbon balance, such data would be vital in testing the credibility of claims of land use effects on carbon sequestration. In this paper, we present some early data for several years' worth of carbon balance dynamics measured using eddy-covariance, and how these may be affected by land use and land cover change. We will discuss the implications of the findings and the potential value of further work to support verifiable and material opportunities for carbon sequestration under different land management regimes.

**PLATFORM PRESENTATION: SOIL FLUX MEASUREMENTS, FIRE, AND WARMING EXPERIMENT AT THE BROTHERTON
PLATEAU, UKHAHLAMBA DRAKENSBURG PARK, SOUTH AFRICA**

Sibusiso Trevor Dlamini, Sivu Situngu, Mariska te Beest*

Fire is used as a management tool in grassland ecosystems, and it has top-down effects on above ground species composition. Amid Climate Change it is important to understand the potential effects of increased temperatures in grassland ecosystem. The aim of this study was to quantify the rates of respiration as affected by fire frequencies and warming in the ecosystem in summer and winter seasons of the year 2023. This research was conducted based on the hypothesis that soil respiration will differ seasonally, and it will be increased by warming. Where a randomised block design long term fire frequencies (Annual, Biennial, Quinquennial, No Burn) experiment was laid out in 1980 at Brotherton plateau at uKahlamba Drakensburg Park, South Africa. In January 2017, hexagonal open top chambers (OTC's) were laid out in the periphery of the spring fire plots resulting in a full-factorial randomised-block experiment. In January 2023 PVC collars and temperature-moisture sensors were installed on the chambers and their control plots. In summer and winter seasons, soil flux measurements were measured in the morning (9 - 11.30 am) for 14 consecutive days. Grass species composition consisted of *Themeda Triandra*, *Tristachya leucothrix*, *Harpocloa falx* and *Heteropogon contortus* as the dominant species. Results from a Kruskal-Willis analysis and Dunn test indicated that the warming treatment significantly increased soil respiration with seasonal differences observed. In summer the more frequently burned plots recorded significantly ($p < 0.00***$) higher respiration 42 and 58 $\mu\text{mol m}^{-2} \text{s}^{-1}$ respectively while in winter Biannual (14 $\mu\text{mol m}^{-2} \text{s}^{-1}$) and No Burn (12 $\mu\text{mol m}^{-2} \text{s}^{-1}$) plots were significantly higher ($p < 0.00**$). Soil temperature followed the same trend with different Q_{10} values recorded for fire frequencies and warming for both seasons. A liner mixed model indicated that warming was more of a controlling environmental factor than soil moisture in the ecosystem. To offset the increased soil respiration by warming, burning less frequently can be a possible option in future for the ecosystem amid Climate Change.

PLATFORM PRESENTATION: FIRE EXCLUSION AND ASPECT INFLUENCES SEASONAL DYNAMICS AND TEMPERATURE SENSITIVITY (Q₁₀) OF SOIL RESPIRATION IN AFROMONTANE GRASSLANDS, DRAKENSBURG, SOUTH AFRICA

Lindokuhle Xolani Dlamini, Elmarie Kotzé, Gregor T Feig, Olivier Mathieu, Mathieu Thevenot, Jean Lévêque*

Soil respiration (R_s), a crucial biogeochemical process, is a major pathway for CO_2 emission. Due to its temperature dependence, R_s is expected to increase with global warming, particularly in high-altitude mountainous regions. Afromontane grasslands in temperate high-rainfall regions of South Africa are huge reservoirs of soil organic carbon (SOC). These ecosystems evolved with fire, and fire-exclusion leads to native plant afforestation. With the recent global promotion of afforestation as a nature-based solution, understanding the impact of grassland afforestation on SOC dynamics and seasonal R_s is crucial for accurately predicting potential future changes in terrestrial C fluxes and to guide climate policy. This study investigated SOC stocks, seasonal dynamics and Q_{10} of R_s to understand the impact of fire-exclusion-driven afforestation and aspect on SOC dynamics. Using the Cathedral Peak Research Catchments initiated in the 1940s, this study compared an afforested fire-excluded site to a periodically burnt grassland within the same south-facing catchment (C-IX). Additionally, it compared the south-facing periodically burnt grassland (C-IX) to a north-facing biennially burnt grassland catchment (C-VI). Soil samples were collected at set intervals down to 1 m soil depth to determine SOC stocks and $\delta^{13}C$ isotopic signatures. Measurements of R_s were performed using an 8-chamber LI-8100A automated system (C-VI) and a monthly static chamber-based manual technique (all sites, approximately 3 years dataset). The periodically burnt grasslands had more topsoil SOC stocks than the afforested site, but similar subsoil stocks. The $\delta^{13}C$ values revealed that SOC in the periodically burnt grassland originated from C_4 grasses, while it mostly originated from C_3 plants in the afforested site. For the afforested site, the isotopic-mixing model indicated that in the subsoil, over 40% of SOC originated from C_4 grasses indicative of the legacy effect of past grassy vegetation. Linear Mixed-Effects Models showed that these two R_s methods were complementary and seasonal variability was higher during summer than in winter in all sites. This seasonal variability of R_s was influenced by fire, soil temperature, and moisture. The afforested site had more overall R_s and double the Q_{10} compared to the periodically burnt grassland. Therefore, Fire-exclusion-driven afforestation changed SOC input from fine roots to litter, thus altering both storage and biogeochemical cycling. While fire increased R_s in the first growing season, as expected the cooler and wetter south-facing grassland stored more SOC, released less CO_2 from soils, and had lower Q_{10} compared to the north-facing grassland. While often neglected, this indicates that cooler south-facing slopes are better reservoirs of SOC than north-facing slopes. This study suggests that aspect play a crucial role in biogeochemical cycling and Afromontane grassland shows greater potential for C sequestration than afforested systems.

STANDARD POSTER PRESENTATION: LONG TERM VEGETATION MONITORING USING SEOSAW PROTOCOLS AT EFTEON SITES IN KWAZULU-NATAL

Sachin Doarsamy, Corrina Naidoo, Kathleen Smart*

Woody Plant Encroachment (WPE) is a global phenomenon of increasing native woody plants with significant thickening occurring in grassland, tundra and savannah biomes. The change in savannahs is often attributed to changes in fire and herbivory management. However, elevated CO_2 and rainfall patterns cannot be ruled out as a primary driver. Therefore, understanding vegetation change over a long term in multiple locations will improve our understanding of the drivers of WPE. The Socio-Ecological Observatory for Studying African Woodlands (SEOSAW) is a network established to understand the response of African woodlands to global changes using standardized methodologies and linked protocols. SEOSAW aims to understand and quantify changes in African woodlands with repeated sampling and to understand relationships between growth, mortality and productivity. The Expanded Freshwater & Terrestrial Environmental Observation Network (EFTEON) research infrastructure aims to provide a platform for environmental research in South Africa, including the long-term assessments of key biodiversity components. We aim to investigate vegetation changes using SEOSAW protocols. The

vegetation sites in this study are centred around Eddy Covariance (EC) towers at two EFTEON landscapes: Northern Drakensberg and Maputaland Coastal Plain, KwaZulu-Natal, South Africa. In the Northern Drakensberg the site is within the Spioenkop Nature Reserve. This is a woody encroached area that was previously a grassland with a history of fire suppression and several large herbivores. In contrast, in the and Maputaland Coastal Plain, the Lake Sibaya grasslands is a communal rangeland under tribal authority exposed to water stress due to a decreasing water table. Each site consists of five permanent 1 ha plots to document changes in woody and herbaceous vegetation. Every woody tree stem with a diameter of 30 mm within the five permanent 1 ha plots was identified, height measured, and permanently tagged with a unique ID. In addition to this the Global Grassy Group (GGG) protocol was implemented to document changes in grasses and forbs consisting of 84 circular plots per ha. Northern Drakensberg site outcomes: A total of 1047 trees were sampled and 1879 stems tagged comprising of 13 species. *Vachellia* is the dominant genus with *Vachellia karroo* having a 90% occurrence. Woody sampling provided: species composition, age cohorts and distribution. The herbaceous component for the central plot comprised of 148 species and dominated by *Themeda triandra* and *Cymbopogon caesius*. Maputaland Coastal Plain site outcomes: 342 trees were measured comprising of 23 species. The area is dominated by *Dichrostachys cinerea*, *Psyrax obovata*, *Strychnos decussata* and *Hyphaene coriacea*. *D.cinerea* was highlighted as a major encroacher with 1987 immature plants counted. Future monitoring plans: the completion of the herbaceous plots at Spioenkop and profiling the herbaceous layer, specifically geoxylic suffrutices at Lake Sibaya. Long term conclusions will be drawn from repeat sampling between 2-5 years, comparing the difference in functional types and species across locations, detailed understanding of the processes of WPE relative to land use and management, rainfall patterns and atmospheric CO₂.

STANDARD POSTER PRESENTATION: EFFECT OF RAINFALL REDUCTION AND RESTING PERIOD ON RESIDUAL SOIL WATER CONTENT AND SELECTED SOIL CHEMICAL PROPERTIES OF SEMI-ARID GRASSLAND.

Thabo Magandana, Abubeker Hassen, Eyob Tesfamariam*

Water deficit is a recurring event expected to increase in intensity and frequency over the next few decades due to climate change. Changes in precipitation regimes have intensified the hydrological cycle because of climate change. The main plots are 49 m² (7 m x 7 m) in size and are covered by metal frame structures with V-shaped clear acrylic bands on top, without an ultraviolet filter. These plots are subdivided into two sub-plots to determine the effect of resting periods (70 and 90 days). Rainfall reduction was employed as the main plot treatment at four different levels (15%, 30%, 60%, and 0% (control/ambient)). The main plot treatments were each replicated five times using the rainout shelters arranged in a split-plot experimental design. Two soil samples were taken per sub-plot (70- and 90-day resting periods), and the two samples per sub-plot were bulked together. The soil samples were 8 cm in diameter and 20 cm in depth (1005 cm³). A neutron water meter was used to measure soil water content (SWC) at three soil depths (0–20 cm, 20–40 cm, and 40–60 cm) immediately before harvesting the vegetation at different rainfall reductions and resting periods. The soil was analyzed for pH, electrical conductance (EC), iron (Fe), chloride (Cl), nitrate (NO₃), nitrite (NO₂), sulfate (SO₄), potassium (K), and phosphate (PO₄). Our results showed that reduced rainfall, resting period, and soil depth have a significant effect on SWC. Reduced rainfall and longer resting periods lead to higher soil nutrient content.

STANDARD POSTER PRESENTATION: LIVESTOCK FARMERS' PERCEPTION ON CLIMATE CHANGE AND ADAPTATION PRACTICES: CASE OF CHRIS HANI DISTRICT, IN EASTERN CAPE PROVINCE, SOUTH AFRICA

Siza Mthi, Zuko Mpisana, Francisca Rumosa-Gwaze, Tanki Thubela, Sive Tokozwayo, Zimasa Dubeni, Nangamso Mlaza*

Livestock production stands as one of the key economic cornerstones for smallholder farmers in most rural areas of sub-Saharan Africa. Across the globe, livestock production systems are facing significant impacts from climate change. This study aimed to investigate the perceptions of livestock farmers regarding the impact of climate change and adaptation practices in the Chris Hani District of the Eastern Cape Province, South Africa. Eighty livestock farmers were randomly

selected from six communities and interviewed using a semi-structured questionnaire from June to September 2023. The data were analysed using the Statistical Package for Social Sciences (SPSS) version 27.0. A demographic analysis of the interviewed farmers reveals that a predominant proportion (55%) comprises youth with prior involvement in agricultural pursuits. A substantial majority (> 60%) of these respondents demonstrate awareness of climate change, notably through observations of seasonal climate change or shifts. The perceived consequences of climate change among these respondents include challenges such as feed scarcity (60%), the prevalence of novel diseases (30%), and poor animal performance (25%). Adaptation practices adopted by the respondents include cultivating water-efficient pasture varieties in backyard gardens (56%), selling non-reproductive livestock (34%), and purchasing disease-resistant livestock breeds (10%). The survey underscores the need for targeted interventions and policy frameworks to address climate change challenges in the agricultural sector. Youth farmers can leverage their knowledge for sustainable practices and resilience building. Policy initiatives should support adaptation strategies, education, and outreach programs. A collaborative approach among stakeholders can foster a more resilient and sustainable agricultural sector.

STANDARD POSTER PRESENTATION: GROWTH AND ADAPTIVE CHARACTERISTICS OF TAGASASTE (*CHAMAECYSTITIS PALMENSIS*) TREE SEEDLINGS IN RESPONSE TO VARYING WATER AVAILABILITY.

Siphelele Eleven Takata, Casper Ignocia Madakadze, Tlou Julius Tjelele, Francois Muller*

Climate change is an abiotic factor that threatens the agricultural sector as a whole globally. This results from erratic rainfall, increases in global average temperature, and drastic drought that has a pernicious impact on natural rangelands. Drought is the most critical and primary driver of rangeland patterns and biodiversity. Furthermore, this sequel in livestock feed scantiness is more aggravated in extensive communal livestock production systems where natural pastures are the primary source of feed. The marked seasonality in rainfall experienced in South Africa leads to periods of feed shortages, especially during dry periods. Additionally, the over-dependence on natural pastures during these periods often exacerbates the pressure on natural veld. Therefore, there is a need to close these gaps of feed shortages and simultaneously reduce the negative impacts of over-dependence on the natural veld. However, Identifying, adopting, and eventually upscaling the production of alternative fodder plant species like tagasaste to close these gaps may improve feed availability. Tree lucerne (*Chamaecystis palmensis*) is one of the most popular pasture species in the arid and semi-arid regions, playing a critical role in sustaining livestock production in many areas of the world. Tree lucerne has been proposed as a candidate species that can substantially reduce the dry season feed gaps in South Africa. Unfortunately, very little information is currently available on how the seedlings of tree lucerne respond to drought stress. The main aim of the study is to characterize the ability of tree lucerne seedlings to survive periods of water limitation and potentially identify morphological, physiological, and biochemical mechanisms that allow the seedlings to survive periods of drought. However, plants adopt several mechanisms to withstand drought. The increase in the production of osmoprotectants, redirecting resources towards roots, increasing roots in-depth to secure edaphic resources, and closing stomata to preserve water. To do this, 144 planting bags, each carrying 2 plants, three comparative ages (3, 4, and 5), four water-limited periods (7, 14, 21, and 28 days), and 28 water-limited. Within the trial, (1) a well-watered control (WWC) i.e. Seedlings will be watered 2 times a day in the morning and afternoon as an experiment zero, (2) a water-limited treatment (WL) i.e., Water will be withheld for 28 days, and (3) Re-watering (RW) i.e. Water will be withheld for different periods (28, 21, 14 and 7 days). At the end of each period, shoot morphology, root morphology, resource allocation, electrolyte leakage, and osmoprotectants will be measured. These results will help us to understand the response of tree lucerne to drought and assist in developing a foundation for the sustainable use of tree lucerne (*Chamaecystis palmensis*).



SESSION 02 | BIODIVERSITY & CONSERVATION

SESSION CHAIR: SUSI VETTER

Tuesday 23 July 2024, 11:00 - 13:00

PLATFORM PRESENTATION: NATIONAL VEGETATION MAP 2024: A SUMMARY OF UPDATES

Anisha Dayaram, Philip Desmet, Greer Hawley-McMaster, Richard Cowling, Adriaan Grobler, Sean Privett, Hayley Cawthra, Rebecca Dames, Erich van Wyk, Coert Geldenhuys, Taryn Riddin, Anesu Machite, Janine Adams, Kagiso Mogajane, Londiwe Mokoena, Anthony Rebelo, Andrew Skowno, Alastair Potts, Debbie Jewitt*

There have been three updates to the National Vegetation Map under the VEGMAP Project since the first release in 2006. We continue to collaborate with valued partners across South Africa to update areas as new information becomes available. We have just completed a beta version of the fourth update, NVM 2024, and we will share the changes to the map and classification system, invite you to implement the beta version and provide feedback. Changes include a full remapping of vegetation in the North-West Province (including many savanna and grassland types), a re-delineation of VhaVenda Miombo, small changes to the boundaries of Elim Ferricrete Fynbos and surrounding vegetation types, the addition of new Southern Afrotemperate Forest polygons in Langeberg, and the addition of four new strandveld types in the Fynbos Biome. We will also share some new thinking in terms of mapping the historical extent of some ecosystem types. We have used a combination of old literature and aerial photographs coupled with in field verification to approximate the pre-development extent of Mangroves as a test case. We also invite you to contribute data as we continue to collate information for the next iteration.

PLATFORM PRESENTATION: SPATIAL AND TEMPORAL CHANGES IN THE RIPARIAN VEGETATION OF THE OLIFANTS RIVER SYSTEM OVER A 25 YEAR PERIOD, MPUMALANGA

Peter Nyeko Mashaba, Willem Johannes Myburgh, Michael David Panagos*

Riparian vegetation is one of the most diverse and dynamic vegetation types on Earth's surface. However, the diversity and dynamic processes unique to this type of vegetation are under threat from a wide variety of disturbance regimes that interact synergistically. The riparian vegetation of the Olifants River's macro-channel is no exception. This study focused on investigating spatio-temporal changes in the riparian vegetation of the Grassland and Savanna Biome sections of the Olifants River's macro-channel over 25 years. We used an area-based variable belt transect to resurvey 61 sampling plots within the previously described and identified plant communities associated with the Grassland and Savanna Biome sections of the Olifants River system. We employed a forced phytosociological classification to analyse and compare the floristic data of two sampling periods (1995 vs 2020/2021). Over 25 years, there were notable temporal changes in species composition in both biomes. These changes were mainly attributed to the considerable influx of herbaceous species, which increased by 34% and 54% in the Grassland and Savanna Biome sections, respectively. As a result, overall species richness increases of 35% and 44% were observed along the longitudinal gradient of the Olifants River system, respectively. The distribution and cover of woody plants led by shrub and dwarf shrub growth forms, increased towards the upstream section of the Grassland Biome over 25 years, exhibiting evidence of spatial changes. In the Savanna Biome section, spatial changes in the resurveyed plant communities were variable across the macro-channel. The canopy cover of the dwarf shrubs and shrubs declined in both upstream and downstream plant communities, whereas the tree layer exhibited

stability in the upstream communities, while it increased in downstream plant communities. Therefore, the Savanna Biome section's riparian vegetation structure exhibits evidence of transitioning from a thicket to a woodland-type riparian vegetation. Additionally, the macro-channel of the Olifants River appeared to have provided a template for the establishment and increase of alien and invasive species during this period, with these species increasing by between 78% and 91% across the two respective biomes. The longitudinal extent of the Olifants River system is associated with various land uses. Therefore, as expected, the observed spatio-temporal changes and vegetation trajectories in the riparian vegetation can be attributed to integrated natural factors such as floods, as well as human-induced disturbances like agricultural practices, developments, river regulation, and mining, each uniquely influencing the macro-channel. Human-induced disturbances exacerbate the impacts of natural disturbances. Therefore, it is suggested that multiple land uses should include the maintenance and management of riparian systems as part of their management objectives to improve the system's functionality and resilience to disturbance regimes. This study demonstrates that the macro-channel of the Olifants River is a dynamic system and can be considered an area of constant change influenced by a range of disturbance regimes.

PLATFORM PRESENTATION: ESTIMATING FRACTION OF BARE GROUND FOR THE NAMA-KAROO BIOME IN SOUTH AFRICA

Wataru Tokura, Andrew Skowno, Timm Hoffman, Vernon Visser*

Effective ecological condition assessments are essential for evidence-based conservation, agriculture, and environmental management. However, in southern Africa, existing assessments are often conducted at local scales or suffer from infrequent updates, limiting their utility to support decision making at a larger spatial extent and at appropriate temporal frequencies. To address this gap, the SBAPP regional project (<https://science.uct.ac.za/seec/sbapp-ecological-condition>) aims to use remote sensing technology to enable regular, biome-wide mapping of ecological condition. As part of the SBAPP regional project, this study focuses on the spatial and temporal pattern of bare ground in the Nama-Karoo Biome. Within this biome bare ground is often perceived as a severe form of rangeland degradation. Specifically, this study uses ground photographs and satellite imagery to develop a predictive model for (1) estimating bare ground fraction within this biome and (2) analysing how this fraction has changed across the biome over time. The ultimate goal of the project is to be able to discern areas which have undergone an increase in the bare ground fraction over time and which might be of concern for all stakeholders with an interest in the long-term sustainability of the Nama-Karoo biome. To develop a model, a reference dataset was sourced from 852 ground photographs taken between 2014 and 2023. From these photos, the fraction of bare ground was manually estimated and subsequently divided into 70% training and 30% validation data. Monthly composite satellite images with 10 vegetation indices were derived from the Landsat series using Google Earth Engine. By integrating these data, we constructed two partial least squares models—one for the growing season and one for the non-growing season—to predict the fraction of bare ground at 30 m resolution. The models showed adequate predictive accuracy (growing season: $Q^2_{cum} = 0.72$, non-growing season $Q^2_{cum} = 0.63$, overall: RMSE = 17.8 MAE = 13.5). The map produced showed a general pattern of an east-west gradient in bare ground fraction corresponding to mean annual rainfall. The influence of local features such as saline pans or ephemeral streams on bare ground could also be distinguished on the map. These results demonstrate the potential of a remote sensing approach for use in large-scale, long-term monitoring of ecological condition of this biome, although the results still need to be validated against field measurements.

PLATFORM PRESENTATION: FINE-SCALE VARIATION IN MONTANE GRASS SPECIES COVER AND OCCURRENCE PATTERNS: ENVIRONMENTAL DRIVERS AND THEIR CONSISTENCY ACROSS A 1000 M ELEVATIONAL GRADIENT

Bridgette Mc Millan, Peter le Roux*

Forecasting how species ranges will shift under future climatic conditions is key to efficient conservation planning and mitigation actions, but this requires knowledge of species ecological niches. Understanding why plant species are located in particular niches and the resulting distribution patterns is essential for understanding the intricacies of ecosystem dynamics. Traditionally, these range shift predictions have been based on broad-scale studies, but examining fine-scale variation in distributions may provide additional, complementary insights. This study identified the factors related to the fine-scale cover and occurrence patterns of dominant grasses in Drakensberg grasslands, and tested if the factors (and/or the effect of the factors) influencing these patterns are consistent across elevation. Using data from three sites located along a 1000 m elevation gradient (c. 2000 - 3000 m a.s.l.) in the Maloti-Drakensberg mountain range, we modelled the occurrence and cover patterns of ten grass species. Mesotopography and soil depth consistently emerged as influential factors. However, the relationships between predictors and species varied, and the nature of the effect of some predictors differed across altitude, highlighting the site-specific nature of environmental influences on species fine-scale distributions. Variation in predictor importance was observed across the three sites, where mesotopography was the predominant factor at the highest elevation, and soil depth took precedence at the mid-elevation site. At the lowest elevation, both soil depth and soil moisture played the most important roles in shaping grass distributions. Our findings highlight the importance of non-climatic predictors in determining species distributions, suggesting that climate change may potentially not have an immediate impact on the distributions of these species, at least until some threshold values are exceeded. These results add to our understanding of how climate change might affect the grasslands of the Maloti-Drakensberg.

PLATFORM PRESENTATION: REHABILITATION OF OLD POTATO PRODUCTION CIRCLES IN THE LEIPOLDTVILLE SAND FYNBOS, SOUTH AFRICA - WHAT HAPPENED TO THE CHICKENS?

Nelmarié Saayman, Rudi Swart, Christie Rheeder*

Potato production is the main land use in the endangered Leipoldtville Sand Fynbos vegetation type on the west coast of South Africa. Many of these lands are abandoned and the rehabilitation thereof is important to improve the state of this vegetation type. The lands are not only subjected to wind erosion because of slow natural recovery in most cases, but also contain high phosphorous levels due to years of fertilising. The objective of this research was to rehabilitate the abandoned lands to a more semi-natural state that could improve ecosystem services through 1) lowering of the phosphorous levels, 2) establishing indigenous plant species, and 3) reducing the impact of wind erosion. The study was done at three sites in the Leipoldtville Sand Fynbos, all in sandy soils. Seven treatments were applied, namely 1) plant indigenous species (P), 2) initial rye mix (R); 3) brush packing (B), 4) initial rye mix; plant indigenous species (RP), 5) brush packing; plant indigenous species (BP), 6) brush packing; initial rye mix; plant indigenous species (BRP), and 7) control (C). A randomised block design with four replicates were followed. The initial rye mix was planted in June 2018 to improve the soil conditions. Branches were packed at 50-80% cover to lower wind erosion. Soil samples were collected in all treatments in May 2017 and October 2023 to determine any changes in phosphorous levels, organic carbon, and microbial diversity due to treatments. Cuttings from *Osteospermum moniliferum*, *Exomis microphylla* and *Manochlamys albicans*, all indigenous to the vegetation type, were planted in June 2021. Survival of the cuttings was monitored until October 2023. Due to the drought experienced from 2017-2020 the initial rye mix established poorly and had little impact on the soil-P levels. However, the phosphorous levels decreased over time at two of the sites, but increased significantly at the Eland's Bay site that is adjacent to active croplands ($p = 0.007$). The organic carbon increased over time at the Eland's Bay and Sandberg sites. At Redelinghuys, with the lowest natural plant cover on the abandoned land, the organic carbon only increased in the treatments that included brush packing. At all the sites there was a significant increase in soil microbial diversity ($p < 0.001$), indicating an

improvement in the overall soil health. Significantly more cuttings survived at Eland's Bay and Sandberg sites ($p = 0.002$) than at Redelinghuys, with *O. moniliferum* being the most successful ($p < 0.001$). By June 2022, the cuttings were well established at all the sites, but most plants died in the dry, hot summer at the Redelinghuys site. Here survival was better in the treatments with brush packing. Brush packing lowered the impact of wind erosion and provided a better microclimate for plant survival. Sufficient rainfall and protection from wind erosion are critical for the survival of young plants and the improvement of ecosystem services.

PLATFORM PRESENTATION: WAYS TO IMPROVE THE RED LIST OF ECOSYSTEMS IN THE GRASSLAND BIOME SOUTH AFRICA

Maphale Monyeki

Efforts to update the 2022 list of threatened terrestrial ecosystems will soon commence in preparation for the NBA 2025/26. Applying the full range of the IUCN RLE criteria on South Africa's terrestrial ecosystems has been challenging due to the poor availability of spatially explicit ecosystem condition data. This is a key data limitation that was acknowledged in the NBA 2018 and may have resulted in the threat status of many ecosystem types being underestimated. To navigate these challenges and strengthen the credibility of the RLE assessments, SANBI aims to establish an RLE community of biome experts motivated by their shared research interests and passion for seeing the best available information being used to improve the assessments. The majority (33%) of the ecosystems identified as threatened in the Grassland biome result from ongoing high rates of habitat loss. However, the risk of collapse in this region is likely to be underestimated due to the poor availability of ecosystem conditions. Though efforts are underway to improve this data availability, it is equally important to establish an RLE community that would add an important layer of expert knowledge to the assessments. For example, ecosystems collapse under Criteria C (abiotic environmental degradation) and D (disruption of biotic processes or interactions) are measured through the change or degradation that occurs in the identified ecosystem-specific indicators. Unlike Criteria A (reduction in geographic distribution) and B (restricted geographic distribution), which have pre-defined collapse values, the thresholds for collapse for Criteria C and D are defined by the assessors/experts for each indicator using expert knowledge, available data, and theory most relevant to measuring the change in defining features of the ecosystem type and its extent. Having such a community will move us closer to a comprehensive list of terrestrial ecosystems genuinely experiencing spatial and functional declines.



SESSION CHAIR: THULISILE JACA

Tuesday 23 July 2024, 14:00 - 16:00

PLATFORM PRESENTATION: MONITORING THE REESTABLISHMENT OF SERIPHIMUM PLUMOSUM POST HERBICIDE CONTROL USING MACHINE LEARNING AND UAV TECHNOLOGY

Debbie Jewitt, Erika Van Zyl, Michelle Keith*

Seriphium plumosum (now *S. vulgaris*) is an aggressive encroacher species and indicator of bush encroachment in South African grasslands. It is replacing natural grazing lands, and methods to control and monitor the spread of the species are required. Trials at the Dundee Research Station were initiated in 2018 to evaluate the effectiveness of a single herbicide treatment to control *S. plumosum*. We aimed to evaluate the reestablishment rates and assess the effectiveness of using drone technology to detect and map the species. Metsulfuron-methyl (500g/kg) herbicide was applied along 20 m strips. Twenty plots (2 m x 25 m) in both treated (n=10) and untreated (n=10) plots were assessed for density and plant size in 2024. Colour (1 cm resolution) and multispectral imagery (3 cm resolution) were obtained from DJI Phantom 4 and DJI Matrice 210 drones respectively flown at 40 m HAGL, and mosaiced using Pix4DMapper. Machine learning using neural networks from Picterra were used to train Detectors and applied to the mosaiced imagery to detect and map *S. plumosum* plants. The machine learning Detector accuracy for the colour imagery was 92% with an 8% omission and 80% identification accuracy when applied at scale. The Detector accuracy was 85% for the multispectral imagery. The area surveyed with the UAV was 4.2 ha and 1768 features were detected with higher *S. plumosum* density and plant size in untreated areas compared to treated areas. The multispectral imagery was useful to distinguish the visually similar grey coloured *Helichrysum* species from *S. plumosum*, due to their different spectral signatures when using the NIR, red and green bands. The results confirm significant reductions in number and size of *S. plumosum* plants in treated areas, six years after the initial treatment, however ground assessments will determine seedling numbers across the plots. The results obtained from the drone survey supported previous field assessments and thus offer an opportunity to accurately monitor *S. plumosum*, which can be scaled to larger areas. Future work should seek to improve the training algorithms to limit false positives and omissions, and scale to high resolution satellite imagery.

PLATFORM PRESENTATION: CAN SATELLITE REMOTE SENSING BE USED TO MEASURE THE WATER-USE IMPACTS OF INVASIVE ALIEN TREES IN THE GRASSLANDS OF SOUTHERN AFRICA?

Liam Cogill, Karen Esler, Alanna Rebelo*

Invasive alien trees are known for consuming significant quantities of water which can be linked to considerable ecological, economic, and societal impacts in southern Africa. To better understand and mitigate the water use impacts caused by invasive alien trees, it is essential to quantify their water use at landscape scales and compare them to relative indigenous vegetation types. Freely available evapotranspiration satellite products offer an opportunity to estimate and compare the water use of different vegetation types at broad scales. This study therefore aimed to use an ensemble of satellite-derived evapotranspiration products (NASA's PT-JPL, WaPOR, VIIRS, EEFLUX, and MOD16) to estimate the

evapotranspiration of invasive alien trees relative to native grasslands in the Tugela and uMzimvubu catchments in South Africa. Satellite-derived evapotranspiration results were validated using field-measured evapotranspiration data from 14 flux towers over a climate gradient in South Africa. Evapotranspiration estimates derived from the satellite products showed that restoring invasive alien tree infestations to grasslands could result in net gains of approximately 24 and 162 Mcm per annum in the Tugela and uMzimvubu catchments respectively. Alternatively, converting the infestations to agriculture in these catchments could result in net gains of approximately 11 and 114 Mcm per annum for the Tugela and uMzimvubu respectively, contributing to food security while making more water available. This demonstrates the significance of clearing invasive alien trees in grasslands to secure future water resources as well as other co-benefits, such as biodiversity gains. This study warrants further exploration of the potential of ensembles of satellite-derived evapotranspiration products to estimate the water use impacts of invasive alien trees across southern Africa. This can be particularly helpful in water-scarce nations, aiding in policy formulation and management strategies amidst growing demands on freshwater resources in grasslands and elsewhere.

PLATFORM PRESENTATION: TRADE-OFFS BETWEEN SPATIAL AND SPECTRAL RESOLUTION IN MAPPING WOODY INVASIVE ALIEN TREES IN THE GRASSLANDS OF THE UMZIMVUBU CATCHMENT, SOUTH AFRICA

Thandeka Skosana, Karen Esler, Alanna Rebelo*

The invasion of woody invasive alien trees in the grasslands of the uMzimvubu Catchment, South Africa, presents a significant challenge, as they impact ecosystem function and people. Remote sensing has been effective in mapping invasive alien trees in grasslands; however questions arise whether focussing on spatial or spectral resolution would provide higher accuracies. Trade-offs in different types of resolution, specifically: spectral, spatial, and temporal resolution, have been a topic of much discussion, but there is little resolution for grasslands. This study investigated the trade-off between spectral and spatial resolution in freely available remote sensing imagery, to determine which product, or combination of products, can most effectively map woody invasive alien plants in grasslands in the uMzimvubu Catchment. The methods involved a stakeholder workshop to identify the invasive alien plant taxa of concern, followed by fieldwork to gather training data in May to June 2023. This study compared imagery from five different sensors with different ranges of spatial and spectral resolutions, specifically multispectral satellite imagery like SPOT 6/7 (5 bands and 6 m) and Sentinel-2 (13 bands and 10 m), and hyperspectral satellite sensors like Environmental Monitoring and Analysis Program (EnMap: 246 bands and 30 m) and Earth Surface Mineral Dust Source Investigation (EMIT: 285 bands and 60 m), as well as airborne remotely sensed imagery, like aerial photographs (3 bands and 0.25 m). The Random Forest classifier, predetermined as the best performing machine learning algorithm, was applied to 70% of the training data, with 30% being retained for validation. Stakeholders identified Gum, Poplar, Silver Wattle, and Black Wattle as the most concerning invasive alien tree taxa in the grasslands of the uMzimvubu Catchment. Classifications with Sentinel-2, EnMAP and EMIT imagery (higher spectral resolution) performed better than that of the aerial photos and SPOT 6/7 (higher spatial resolution). This suggests that high spectral resolution might be more important than high spatial resolution for invasive alien tree discrimination in grasslands. Data fusion, i.e. combining different combinations of imagery, resulted in a marginal increase in accuracy, with a 3% improvement when fusing aerial photographs with Sentinel-2. Invasive alien trees were found to have invaded approximately 7% of the grasslands of the uMzimvubu Catchment in 2023. These research findings are novel in that the new freely available EnMap and EMIT imagery are shown to be able to be used to effectively map woody invasive alien plants in grasslands. This study concludes that for woody invasive alien plants in the grasslands of the uMzimvubu catchment, spectral resolution should be traded off against spatial resolution for best results. Interestingly, these are also the datasets that are free, easy to access, and have a high temporal resolution (between 8-21 days). To effectively manage and monitor the invasion of woody alien plants in grasslands, the use of sensors with high spectral resolution like EnMap and EMIT, and the Sentinel-2 multispectral sensor are advised.

PLATFORM PRESENTATION: CONTROLLING INVASIVE ALIEN EUROPEAN RABBITS (*ORYCTOLAGUS CUNICULUS*): LIMITED RECOVERY OF NATURAL VEGETATION ON A SMALL, ECOLOGICALLY DEGRADED SOUTH AFRICAN OFFSHORE ISLAND INDICATES A SHIFT TO AN ALTERNATIVE STABLE STATE DUE TO PROLONGED HERBIVORY

*Thabisani Ndhlovu**, *Zivanai Tsvuura*, *Karen J. Esler*

Biological invasions by non-native species, such as the European rabbit (*Oryctolagus cuniculus*), significantly threaten biodiversity by altering native ecosystems. Introduced to 13 of South Africa's 24 offshore islands in the 17th century, European rabbits have substantially altered and depleted vegetation communities through selective grazing and browsing. Now naturally extinct on seven islands, they persist on six. This study investigated vegetation changes on Robben Island (33°48'S, 18°22'E), the most ecologically impacted of these islands, over four years (2010–2013) following rabbit eradication attempts in 2008–2009. Utilising fixed transects and line-point intercepts, the study assessed changes in species cover at various sites—strand (n=3), eucalyptus (n=3), and inland dune (n=3)—across the island. Significant differences ($p \leq 0.05$) between years were determined using one-way Analysis of Similarities (ANOSIM), with the Similarity Percentage (SIMPER) identifying the species driving compositional change. Correlative statistical analysis accounted for interannual rainfall variation. Vegetation composition changed significantly at strand ($R = 0.51$, $p = 0.001$) and inland dune sites ($R = 0.21$, $p = 0.012$), but not at eucalyptus sites ($R = 0.15$, $p = 0.104$). Contrary to expectations, rabbit removal did not lead to the re-establishment of desirable, late-successional species. Instead, there was an exclusive increase and decrease in the cover of early-successional species. Changes at the strand and inland dune sites included the re-establishment and increased prevalence of the early-successional palatable woody shrub *Tetragonia fruticosa*, along with perennial grasses *Ehrharta longiflora*, *Cynodon dactylon*, and *Ehrharta villosa*. These changes coincided with reductions in the abundance of the early-successional unpalatable annual grass *Bromus diandrus* and perennial herbs *Oncosiphon suffruticosum* and *Conicosia pugioniformis*. These results suggest that prolonged rabbit herbivory has pushed Robben Island's vegetation past a critical ecological threshold. This threshold marks a point where the loss of late-successional native plant species is so severe that it undermines the ecosystem's ability to self-regenerate. Consequently, the vegetation has shifted to an alternative stable state dominated by early successional species more resistant to rabbit grazing. Therefore, merely removing the rabbits is insufficient for restoring the original vegetation; this new stable state lacks seed banks with late-successional native plant species necessary for natural re-establishment. Unchanged species composition at eucalyptus sites was likely due to the inhibitory effects of alien *Eucalyptus* trees on understory vegetation dynamics. These findings highlight the complexities of ecological restoration on islands with long-established invasive species. Effective restoration on Robben Island and similar invaded islands may require comprehensive strategies that include both invasive species eradication and the active reintroduction of native flora to overcome altered ecological conditions and facilitate recovery towards a pre-invasion state.

PLATFORM PRESENTATION: IMPACT OF INVASIVE ROSACEAE ON PLANT DIVERSITY ALONG ELEVATION GRADIENTS IN THE MALOTI-DRAKENSBERG

*Lesego Malekana**, *Vincent Clark*, *Sandy-Lynn Steenhuisen*, *Grant Martin*

In mountainous regions worldwide, woody plant species, including both native and non-native Rosaceae species, are expanding their elevational ranges due to factors such as global warming and human activity. This phenomenon is also seen in the Maloti-Drakensberg mountains of southern Africa. This study aimed to assess the impact of specific Rosaceae species, including the invasive alien species *Cotoneaster pannosus* Franch, *Pyracantha angustifolia* (Franch.) C.K. Schneid, *Rosa rubiginosa* L., and the native species *Leucosidea sericea* Eckl. & Zeyh, on native biodiversity at different elevations in the Maloti-Drakensberg area. Additionally, this study investigated the efficacy of active control measures in managing these invasive species. To achieve this, six sets of three treatments were implemented—cleared, uncleared, and natural control—at three distinct sites with varying elevations (1730, 1842, and 1985 meters above sea level). The impact of invasive Rosaceae species was investigated by analysing plant species diversity in invaded treatments compared to



uninvaded treatments (open grassland controls) Furthermore, the management of woody Rosaceae species was monitored by clearing a set of plots at each site and measuring recovery of plant communities seasonally, including recording the change in plant diversity and grass cover. In addition, microclimatic conditions with regards to temperature and light intensity, and various chemical and physical soil properties, were compared between invaded and cleared treatments. Results revealed significant impacts of invasive Rosaceae species on native vegetation, including reduced native grass diversity in invaded treatments and alterations in soil properties at higher elevations. Upon clearance, significant differences in temperature and light intensity between cleared and uncleared treatments were observed, which are expected to facilitate vegetation recovery in previously invaded areas. Despite experiencing unintended secondary invasion by resident alien species, native vegetation recovery was observed, along with an increase in species diversity and abundance. However, recovery was slower at higher elevations. Overall, this study highlighted the negative impact of Rosaceae species' invasion on native species diversity and points out the importance of active management efforts. A contingency plan that includes monitoring and continued removal of alien plant seedlings and regrowth is essential for managing these alien Rosaceae species, to rehabilitate invaded high elevation grasslands in the Maloti-Drakensberg to a near-natural, pre-invaded community structure.

PLATFORM PRESENTATION: FLESHY-FRUITED INVASIVE ALIEN SHRUBS POPULATION CHANGE OVER TIME ALONG ROADSIDES OF SOUTH AFRICAN GRASSLANDS

Lehlohonolo Adams, Grant Martin, Sandy-Lynn Steenhuisen, Colleen Downs*

The increasing spread of invasive fleshy-fruited shrubs and trees in South African grasslands presents a significant ecological challenge. Understanding the factors driving this invasion is crucial for developing effective management strategies. In this study, we used repeat photography initially to track vegetation changes over time in South African grasslands. However, as historical images were limited, we used Google Street View (GSV), leveraging its extensive data coverage and accessibility. A total of 123 points were sampled over 12-year period. We downloaded historical images that were taken in 2010 from GSV and took in-person images using digital camera in 2022 from the same GPS points. We only selected points that had populations of fleshy-fruited plants. Roads sampled included R56 along towns Aliwal North in Eastern Cape to Kokstad in KwaZulu-Natal, and R26 in Free State from Clarens to Zastron towns in Free State. We used descriptive statistics to assess population change. Plant species recorded included *Cotoneaster pannosus* Franch. (Rosaceae) (n = 15 points), *Lantana camara* (Verbanaceae) (n = 1), *Ligustrum lucidum* (Oleaceae) (n = 1), *Melia azedarach* (Meliaceae) (n = 6), *Opuntia ficus-indica* (Cactaceae) (n = 35), *Prunus persica* (Rosaceae) (n = 18), *Pyracantha angustifolia* (Franch.) C.K.Schneid. (Rosaceae) (n = 74), *Pyracantha crenulata* (Rosaceae) (n = 3), *Rosa rubiginosa* L. (Rosaceae) (n = 28), *Schinus molle* L. (Anacardiaceae) (n = 2), and *Solanum mauritianum* (Solanaceae) (n = 9). Most populations (Mean \pm SE, n = number of populations recorded) had increased with time. Population assessments over time revealed increases in several species, while successful management strategies, potentially biological control measures, led to decreases in others. Species' populations that increased over 12 years included *P. angustifolia* (9.0 ± 1.96), *S. mauritianum* (4.0 ± 2.88), *P. crenulata* (4.0 ± 2.33), *M. azedarach* (2.0 ± 0.92) and *C. pannosus* (2.0 ± 0.72), and *R. rubiginosa* (2.0 ± 0.66). *Prunus persica* (0.3 ± 0.15) and *S. molle* (0) populations were unchanged, while *O. ficus-indica* (-6 ± 5.87) populations decreased in numbers. *L. camara* (-1) and *L. lucidum* (0) were only observed at one point each; thus, population growth over time was inconclusive. Challenges associated with GSV sampling, including limited coverage, temporal limitations, and resolution of image issues, were identified. Despite challenges, GSV analyses provided valuable insights and highlighted the potential of GSV for long-term monitoring of plant populations in anthropogenic landscapes.



PLATFORM PRESENTATION: CACTUS INVASIONS IN THE NORTH WEST PARKS AND NATURE RESERVES.

Thulisile Jaca, Mpho Sekgarametso, Wilfred Seithamo, Khumoetsile Phala*

Cacti are among the most widespread and dominant groups of invasive plants in South Africa as a result of their long history of introduction and utilisation for agriculture and ornamental horticulture. The impacts of cacti species are related to biodiversity losses, ecological functioning, and loss of agricultural productivity. South Africa's arid interior (e.g. North West, Northern Cape) offers favourable conditions for the establishment of drought-adapted species, such as cacti. In the North West alone, there are about 23 species recorded as having become naturalised, of which some species occur in the Nature Reserves where they threaten natural vegetation and the well-being of game animals. The North West Parks and Tourism Board (NWPTB) Nature Reserves are the most important pristine and natural areas in the province as they support an outstanding abundance of biodiversity, and provide critical resources for local landowners. In this study, we documented patterns of cactus invasion in the NWPTB Nature Reserves. We collected data through stratified random sampling. Identified strata were disturbed sites, areas adjacent to the staff houses, abandoned houses and reserve/park boundaries. We observed nine species from 12 nature reserves, of which seven were NEM: BA category 1b, one category 1a and 2 respectively. Of the 13 reserves surveyed, we did not record any cactus species in Kgaswane Mountain Nature Reserve. The most abundant genera were *Opuntia* (50%) and *Trichocereus* (20%). The findings all contribute to the development of management or eradication plans for cacti species and other invasive plants, especially those that are emerging in the reserves.

STANDARD POSTER PRESENTATION: ALIEN AND INVASIVE PLANTS: DISTRIBUTION AND CHANGES IN THE OLIFANTS RIVER SYSTEM IN 25 YEARS, MPUMALANGA

Peter Nyeko Mashaba, Willem Johannes Myburgh, Michael David Panagos*

Invasion by non-native plants is a global phenomenon, and it is a major threat to biodiversity and ecosystem functioning. To better understand the impacts of alien plants and thus formulate control programmes, knowledge on the distribution and extent of alien plants is crucial. This study aimed at assessing changes in the distribution, species richness, and canopy cover of alien plants in the macro-channel of the Olifants River system over a 25-year period in the Grassland and Savanna Biome sections of the river system. An area-based variable belt transect was used to resurvey 61 sampling plots within the plant communities associated with the macro-channel of the Olifants River. A forced phytosociological classification was used to analyse the data and extract alien and invasive species per plant community. There was a high influx of new alien and invasive species post-1995, resulting in increased alien plant species richness across the longitudinal gradient of the Olifants River. Specifically, alien species richness increased by 78% and 91% in the Grassland and Savanna Biome sections, respectively. The new invasions were predominantly herbaceous with notable establishments within the dwarf shrub and shrub growth forms. Both naturalised and invasive species' distribution increases were multidirectional, with noteworthy invasions of woody invasive species such as *Solanum sisymbriifolium* and *Cotoneaster pannosus* in the upstream section of the Grassland Biome's macro-channel. *Sesbania punicea* and *Verbena bonariensis* exhibited the widest increase in distribution in both biomes, while the woody species *Melia azedarach*, *Morus alba* var. *alba*, and *Lantana camara* showed notable increases in the Savanna Biome section. The observed increases in alien and invasive species can be related to multiple land uses, such as development and agricultural practices, and their associated disturbances. These disturbances acting synergistically with natural disturbances such as floods in concomitant with increased atmospheric CO₂ and climate change might explain the observed increases in alien and invasive plants. The Olifants River can be considered as an agent of propagule dispersal as there was a notable increase of alien plants over 25 years. However, these increases were not isolated and were augmented by disturbance regimes as well as independent factors such as increased atmospheric CO₂ and climate change. The documented increases threaten the

riparian system's phytodiversity, productivity, and functionality, with potential negative impacts including the thickening of riparian vegetation, channel narrowing, reduced stream flow, and subsequent reductions in ecosystem services. Therefore, land use management should be cognizant of both aspects of drivers change and the impacts of alien plants when developing management programmes.

STANDARD POSTER PRESENTATION: BEYOND ORNAMENTAL: UNVEILING THE ECONOMIC SIGNIFICANCE AND ECOLOGICAL IMPACT OF CORTADERIA SPECIES WORLDWIDE

Moleseng Claude Moshobane, Lesibana Maema*

Cortaderia is a small genus of tall grasses comprising 19 species. *Cortaderia selloana* and *C. jubata*, both native to South America, have been introduced to several parts worldwide, including South Africa (SA) for ornamental and landscaping purposes and in mine rehabilitation. In SA, and in other counties, these and other *Cortaderia* species have become naturalized. In New Zealand *C. selloana* is wide-spread but it is illegal to use it under the Biosecurity Act. In Spain, it is an opportunistic invader of industrial sites and has also become one of the most aggressive invasive species in southern Europe. However, the continued introduction of some *Cortaderia* species in some countries suggests that there may be economic benefits associated with this genus. Hence we have reviewed the existing scientific literature for information on the economic importance of *Cortaderia*. The Economic Botany Data Collection Standard (EBDCS) was utilized to collate information on the economic botany of *Cortaderia*. We found evidence for uses in nine categories, with some species used across multiple categories. In scientific literature, *Cortaderia selloana* has uses in seven categories while *C. speciosa* and *C. jubata* have uses in six categories. As regards social uses, the inflorescences of *C. speciosa* are offered at grave sites and those of *C. selloana* are used for decoration in religious assemblies. Five *Cortaderia* species are used in female health problems such as abortion, menstrual haemorrhage, parturition haemorrhage, and postpartum pain. The *Cortaderia selloana* & *C. jubata* are reported to host over 20 microorganisms. *Cortaderia rudiuscula*, *C. speciosa* and *C. selloana* are reported to possess properties that inhibit the germination of crops such as *Lactuca sativa*, while *C. speciosa* acts as herbicide. Under in-vitro conditions, *C. selloana* reportedly inhibits growth in the bacterium *Escherichia coli* and growth in the yeast *Saccharomyces cerevisiae*. In both their native and alien distribution ranges *Cortaderia spp.* are used for ornamental purposes. *Cortaderia Jubata* is used as animal food in Australia and California. However, in southern Australia it has been recognized to have the potential to become a serious weed in wetlands and disturbed areas while in California, it has spread widely across the state, threatening native plants and the animals that rely on them. . There is a paucity of studies on the uses of *Cortaderia* species such as *C. atacamensis*, *C. boliviensis*, *C. echinate* and *C. egmontiana*. More research on these species is required especially those which do or may have microbial inhibitory properties.



SESSION 04 | RANGELAND ECOLOGY & MANAGEMENT I

SESSION CHAIR: LORAINÉ VAN DEN BERG

Wednesday 24 July 2024, 08:30 - 10:30

KEYNOTE ADDRESS: FLEXIBLE GRAZING MANAGEMENT TO BALANCE THE NUTRITION NEEDS OF LIVESTOCK AND SUSTAINED RANGELAND PRODUCTION - EVALUATING THE EVIDENCE

Richard Fynn, Kevin Kirkman, Craig Morris, Peter Zacharias*

Maintaining the long-term health and productivity of rangeland on commercial cattle ranches, while ensuring optimal cattle production and profits, requires a delicate balancing act. Ranchers must strive to achieve excellent rangeland condition through appropriate stocking rates and resting regimes to ensure ecological sustainability, yet this may conflict with animal production objectives if grazing management strategies are poorly conceptualized. The results of numerous experimental studies suggest that grazing management plays little role in determining rangeland condition and cattle performance, with stocking rate being the most important variable. While managing at correct stocking rates is no doubt essential for sustainable rangeland management because it determines the ability to implement appropriate recovery periods after grazing, we contend that cattle management also plays an important role. An inability to detect grazing management effects may stem from lumping fundamentally different approaches to grazing management in a single bucket category, termed rotational grazing, which will mask the effects of any strategy that does work. Another possible reason is that effects of grazing management may interact with grassland productivity, having neutral or negative effects at low productivity and positive effects at higher productivity, yet experimental designs do not consider this. We present data from two ranch-scale studies and two paddock-scale experimental studies in South Africa and Botswana, which demonstrate that when management is based on conceptually robust principles (facilitation of immature and digestible/nutritious grazing during the growing season and minimizing of selective grazing) that both livestock weight gain and rangeland condition is improved. Paddock-scale experimental studies at Athol and Dohne Research Stations clearly demonstrate that in Sourveld grasslands where grasses lose quality rapidly as they mature, both cattle and sheep gained weight significantly faster on shorter, higher quality forage, specifically where they had access to grassland immediately after fire compared with those animals that gained access only once the grass had matured for several weeks prior to grazing. The results of these paddock-scale studies were supported by a farm scale study in sourveld grasslands at Stratherne Ranch, Dundee, which uses a season-long resting and grazing strategy, maintaining short immature grass with non-selective grazing in a priority paddock (SLRG). This study showed that keeping grassland in a short, high-quality state by focussed grazing (1) reduced selective grazing, thereby improving the abundance of shorter, high-quality grasses (*Themeda triandra*), while reducing the abundance of taller grasses (*Hyparrhenia hirta*) and (2) improved cattle weight gains and the percentage of animals reaching market weight by two and a half years of age. Prior to the implementation of the SLRG approach at Stratherne, a fixed period four paddock rotational grazing system was used, which clearly demonstrates that not all grazing systems are created equal. Finally, several ranch-scale studies in Botswana demonstrated that selective grazing prevented an increase in short, high-quality grasses, despite stocking rates being set conservatively. Thus, the data demonstrates that, at least in southern African grasslands, merely maintaining correct stocking rates is not sufficient to achieve optimal livestock performance, nor improved rangeland condition.

PLATFORM PRESENTATION: STOCKING INTENSITY: THE FORGOTTEN PARAMETER IN GRAZING MANAGEMENT

Kevin Kirkman, Jaco Erasmus*

The ongoing debate around the relative impact of stocking rate (SR) and stocking density (SD) on ecological sustainability and livestock performance is missing a key grazing management parameter. SR refers to the relationship between the number of animals and the total area of the land utilised over a specified time, i.e. an animal-to-land relationship over time with the time usually taken to be a year. The units are usually in the form of Animal Units (AU) hectare⁻¹ (ha) year⁻¹. SR is often linked to carrying capacity, following the notion of there being a maximum stocking rate that will achieve a target animal performance level without resource deterioration. SR also reflects the long-term balance between forage production and consumption. SD refers to the relationship between the number of animals and the specific unit of land being grazed at any one time, i.e. an instantaneous measurement of the animal-to-land area relationship, with units typically AU ha⁻¹. SD has no relationship to SR, and there is no time component in the definition of SD. In single paddock systems, SR is generally regarded as the single most important parameter influencing livestock performance and resource health. With intensification and an increase in paddock numbers, management intensifies, and SD is commonly regarded as more important than SR. With increasingly intensive management with increasing paddock numbers, the potential for error increases with reference to both animal performance and resource health, and this is exacerbated by the focus on SD as the principal parameter, bearing in mind that SD is independent of time. While the term “rotational grazing” is somewhat nebulous, animal performance in rotational systems is influenced by paddock size, herd size, and period of stay. Stocking intensity (SI) is a parameter that accounts for these three variables, being defined as AU grazing days in a paddock (AU gd ha⁻¹). SI differs from SD in that it includes a measure of time, which is important in time-controlled rotational grazing systems. Research focused on the relationship between stocking intensity and animal performance shows that period of stay and herd size are inversely related to animal performance, while paddock size is directly related to animal performance. The three variables making up the SI parameter allow for formal calculations of forage consumption and forage supply, and the time available before consumption becomes greater than supply. By way of example, for a 1 ha paddock with 2000 kg dry matter (DM) forage available, 200 AU gd ha⁻¹ are available (1 AU consumes 10 kg DM day⁻¹). For a SD of 100 AU ha⁻¹ for a 5-day “in” period, SI is 500 AU gd ha⁻¹, which exceeds the 200 AU gd available. For a 2-day period “in”, stocking intensity is 200, which equals the 200 available. For a 1-day period “in”, stocking intensity is 100 AU gd ha⁻¹, which is less than the 200 available. As SI can be measured and is directly related to animal performance, it should replace SD as the basis for planning grazing strategies within rotational grazing systems.

PLATFORM PRESENTATION: AMBIGUITY ABOUT GRAZING INTENSITY: A NOVEL INDEX FOR QUANTIFYING THIS METRIC TO ADDRESS CONFLICTING OUTCOMES OF GRAZING SYSTEMS COMPARISONS

Jenna Likins, Urs Kreuter, Jason Sawyer*

The debate about the efficacy of alternative grazing management approaches has persisted ever since managed grazing systems were introduced in the 1950s and it has intensified since the advent of adaptive multi-paddock (AMP) grazing management. Some researchers have concluded that there is no evidence that rotational grazing is generically superior to continuous year-round grazing in terms of forage productivity and animal performance. Many of these researchers also concluded that stocking rate adjustment is the only meaningful grazing management tool to sustain forage supply and individual animal performance. By contrast, numerous leading rangeland managers around the world have reported that AMP grazing has produced dramatic improvements in soil health and water holding capacity parameters and, therefore, forage production, other ecosystem services, and carrying capacity at the whole ranch scale. A primary reason for these seeming contradictions appears to be the inadequacy of the parameters used to differentiate alternative grazing management strategies and the lack of a rigorous standard approach for quantifying grazing intensity. These deficiencies have confounded the grazing intensity effects of alternative grazing approaches on the forage base for livestock



production. This paper presents a weighted composite index to serve as a standardized approach for more accurately quantifying grazing intensity. The Grazing Intensity Index is comprised of six traditional indicators and two novel indicators of grazing intensity that comprehensively account for the complex management parameters involved in such systems. To gather data on grazing intensity metrics, 870 ranchers in North Dakota, South Dakota, and Texas were surveyed during January-March 2022. Based on a principal components analysis, the eight grazing intensity indicators converged into three factors that describe the grazing systems effects on rest (*Paddock/Herd Ratio, Effective Resting Rate/Effective Stocking Rate, Rest Period Length*), grazing (*Grazing Event Length, Re-grazing Frequency, Effective Stocking Rate/Stocking Rate*), and the animal/land relationship (*Stocking Rate/Carrying Capacity, Stock Density*). Together, the factors explained 89% of the variation across grazing systems studied; the rest factor explained 36%, the grazing effect factor explained 30%, and the animal/land relationship factor explained 23%. Applying the Grazing Intensity Index to previous grazing management studies showed less disparity among systems where no ecological differences were reported than studies where significant ecological differences were found between grazing management practices. Importantly, these findings did not neatly align with traditionally defined continuous, rotational and more intensive AMP grazing systems. These findings explain, at least in part, the discrepancies of conclusions reached by previous grazing system comparison studies.

PLATFORM PRESENTATION: SPATIAL AND SOCIAL ATTRIBUTES ARE USUALLY NEGLECTED IN GRAZING RESEARCH AND DOCUMENTATION OF COMMERCIAL PRACTICE, BUT THEY CAN MAKE A DIFFERENCE TO THE ACCURACY OF ASSESSMENT OF GRAZING IMPACTS

*Brien Norton**

Grazing studies have a long history of examining the influence of stocking rate and frequency of defoliation (timing of grazing and rest periods) on rangeland vegetation and livestock production. However, there is little consensus among published research reports on the ability to manipulate frequency of grazing to achieve increases in forage and/or animal production. Primary producers, on the other hand, have adopted rotational grazing practices across many countries and consistently found improved productivity and better financial returns. A key difference between the two categories of research and commercial practice is one of scale: grazing trials tend to employ relatively small paddocks and small numbers of experimental animals, whereas commercial producers require extensive areas of rangeland grazed by hundreds or even thousands of animals to reach economic viability. In research trials, assumptions of spatial homogeneity for both available forage and its utilization create distortions when measuring the impacts and inferring the application of specific grazing treatments. Routinely, these studies report no adverse ecological effects from both the continuous and rotational grazing treatments. In extensive landscape-level continuous livestock grazing, on the other hand, animals cannot access all the available forage equally and patch grazing occurs with concomitant patch degradation. This presentation will illustrate the source of these distortions caused by the social consequences of grazing treatments allocated to adjoining small research paddocks, or of ignoring the varying topography in research paddocks. For example, a grazing trial in Iran employed small paddocks that were set up in adjacent ranks and contained small experimental flocks. The sheep gathered at the corners where they were close to neighbouring flocks and grazed those corner areas heavily, while vegetation sampling was spread evenly across the paddock. A grazing trial at Chiswick Research Station near Armidale, NSW, employed sheep grazing small paddocks that incorporated a topographical slope. The sheep spent most of their time at the higher end of the paddock while instruments recording the effects of the grazing treatment were placed at the other end on the flat close to the access road. In both cases there was a disconnect between the grazing distribution and the sampling array measuring grazing impacts. In contrast, the differential social and spatial behaviour of 300 sheep confined in a large paddock for a year at low stocking rate is compared to their behaviour when a large herd of 5,000 head grazes the same paddock for short spells as part of a grazing rotation. In the latter case, animal behaviour is affiliated with the large flock rather than local territories that are heavily patch-grazed and leave most of the paddock neglected. A large pastoral station in Western Australia serves to illustrate the social and spatial changes

associated with converting grazing management from continuous use to a rotation. The result is more area of the paddock being grazed and more social interaction. In conclusion: spatial and social aspects of grazing treatments should be acknowledged in research designs and the assessment of treatment impacts.

STANDARD POSTER PRESENTATION: THE EXPANDED FRESHWATER AND TERRESTRIAL ENVIRONMENTAL OBSERVATION NETWORK (EFTEON) – AN ENVIRONMENTAL RESEARCH INFRASTRUCTURE IN SOUTH AFRICA

Helga Knoetze, Abri De Buys, Sachin Doarsamy, Gregor Feig, Isaac Gura, Warren Joubert, Amukelani Maluleke, Jeremy Moonsamy, Nolusindiso Ndara, Marc Pienaar, Sylvester Selala, Kathleen Smart*

The South African Research Infrastructure Roadmap (SARIR) was launched in 2016 by the Department of Science and Technology. SARIR is a strategic and systematic intervention to provide research infrastructures (RIs) across the entire public research system. The Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) is currently one of the RIs managed by the National Research Foundation (NRF). Being hosted by the NRF, and SAEON – the South African Environmental Observation Network – EFTEON strives to build upon the vision of both these organisations, which is expressed as ‘research for a better society’, and ‘world-class environmental research platforms for a sustainable society’. EFTEON’s mission, therefore, is to offer public value through the provisioning of long-term, multidisciplinary observation platforms that are designed to clarify earth system dynamics, changes over multiple scales, and to distinguish between natural and anthropogenic environmental change. EFTEON develops open-access data systems and tools, whilst striving for excellence, data sharing, capacity development, stakeholder consultation, collaboration, and a natural environment conducive to sustained life on earth. EFTEON’s design is based on the development of six landscapes distributed across South Africa, each representing important ecosystem-human networks, and the aquatic systems within them. Each landscape will have standardised sets of automated instruments measuring the carbon and water cycles, meteorology, and air quality, along with a range of standard repeated measurements to cover biodiversity, productivity, ecosystem condition, and ecosystem service provision and use. Landscapes will have secondary sites with elementary standard automated instruments for monitoring climate and freshwater systems, as well as repeated measurements such as socio-ecological survey data collection in the surrounding communities. The six EFTEON landscapes stretch across various biomes and vegetation types of South Africa including arid shrubland, tropical savanna, semi-arid savanna, tropical grassland, high altitude mesic grassland, Afromontane forest, Nama-Karoo, and Fynbos. These landscapes are representative of various land use types, for example protected areas and rangelands, and tenure systems. Within these different land uses and tenure systems (i.e., heavily utilised grasslands, conservation areas, and communal grazing areas), EFTEON aims to support and promote long-term environmental observations, research, and data collection in the rangelands of South Africa by following a transdisciplinary approach, distributing landscape-scale research infrastructure, facilitating research at different scales within and between landscapes, linking various science themes such as ecohydrology, carbon/nutrient cycles, soils and sediments, biodiversity, disturbance regimes and their outcomes, climate/atmosphere, and social-ecological systems. To enhance transdisciplinarity, EFTEON further supports the inclusion of local/indigenous land users and their knowledge through relevant Indigenous Knowledge Systems (IKS). Other aims of EFTEON include training students, developing technical skills, collaborating with other international research initiatives, and welcoming opportunities for joint projects with both national and international partners. EFTEON as a research infrastructure supports studies on coupled ecological and social systems in South Africa.



STANDARD POSTER PRESENTATION: AGRONOMIC AND MORPHOLOGICAL CHARACTERISTICS OF FIVE GRASS SPECIES AT DIFFERENT GROWTH STAGES UNDER TILLAGE AND NO-TILL IN THE SOURISH MIXED BUSHVELD

Mantji Tshenolo Mirriam, Ntsoane Tumisho*

Inadequate forage quantity and quality are significant threats to livestock production, leading to ruminants failing to meet their minimum dry matter and nutritional requirements (Moyo et al., 2013). Establishing complementary native grass species may address the forage shortages in pastures. This study evaluated the effects of tillage and no-till management on the agronomic performance and morphological traits of five grass species at different growth stages. The grass species studied were *Eragrostis curvula*, *Anthephora pubescens*, *Cenchrus ciliaris*, *Chloris gayana*, and a mixture of different grass species referred to as Bush Mix. The study was conducted as a 2 x 5 factorial structured under RCBD. Data collected included, germination percentage, flowering percentage, plant height (cm), number of leaves, leaf width (cm), number of tillers, root turf diameter (cm), crown diameter, and biomass yield. A two-way ANOVA was used to analyze the data. At the germination stage, *C. gayana* had the highest germination percentage ($P < 0.05$) under both tillage and no-tillage conditions, while *E. curvula* had the lowest ($P < 0.05$). Similar results were observed for flowering percentage under tillage management. *C. gayana*, *C. ciliaris*, and *A. pubescens* had significantly higher tiller numbers ($P < 0.05$) compared to Bush Mix and *E. curvula*. At the elongation stage, *C. gayana* had the highest root number (69.36 cm, $P < 0.05$), while *E. curvula* had the lowest (37.64 cm, $P < 0.05$). At maturity and elongation stages, *A. pubescens* (6688 g/plot), Bush Mix (6616 g/plot), and *C. ciliaris* (6440 g/plot) produced significantly more biomass ($P < 0.05$) than *C. gayana* (3848 g/plot) and *E. curvula* (3016 g/plot). All species reached maturity within 4–6 months. The findings indicate that *C. ciliaris*, *C. gayana*, and *A. pubescens* are the most suitable species due to their superior morphological traits at all growing stages compared to the *E. curvula* and Bush mix. However, the Bush Mix performed less effectively, likely due to water stress. No significant differences were found between tillage and no-till treatment for each grass species across all developmental stages. These results suggest that complementary grass species such as *C. ciliaris*, *C. gayana*, and *A. pubescens* could enhance forage availability during the dry season.

STANDARD POSTER PRESENTATION: ASSESSING DIFFERENT FODDER PROCESSING METHODS AND SEED RECOVERY AFTER INGESTION OF VARIOUS ENCROACHING TREE SPECIES

Nelson Maila, Francois Müller, Julius Tjelele, Abubeker Hassen*

Livestock production is an integral part of the communal farming system. The use of browse species as fodder for ruminants are increasingly becoming more important in many parts of the world, especially in extensive livestock production systems. The problem of animal feed supply and quality is aggravated in arid, semi-arid and tropical regions with scarce and erratic rainfall that limits the growth of herbaceous species and biomass yield in rangelands. Thus, livestock in such regions have to survive on recurrent feed shortages or poor quality feed for most part of the year. However, the availability of leguminous trees could be exploited to improve the nutritional status of goats during the dry season. Tree fruits and seeds of these trees are especially valuable as many ripen and fall well into the dry season when there are few alternative sources of dietary protein. Goats have access to dry and mature fruits as they fall from trees at the beginning of the dry season. Tree fruits are a potential source of protein, but more information on their nutritional quality, different processing and storage techniques, and potential distribution through endozoochory needs to be investigated if their utilisation is to be improved. This study therefore aims to evaluate the nutritional quality of *Vachellia nilotica*, *Vachellia tortilis*, *Vachellia karoo* and *Dichrostachys cinerea* at different phenological stages. Thereafter we aim to determine how different processing and storage techniques will influence its nutritional quality followed by evaluating the risk associated with seed recovery after ingestion on the potential dispersal leading to increased encroachment. The edible parts (thin branches, leaves twigs and seed pods) of these tree species will be harvested using the tree pruner. After harvesting the plant material for each tree species, the plant material will then be processed using two different

techniques namely chipping and pelleting and thereafter chemical analyses will be made to all samples.



SESSION CHAIR: NTUTHUKO MKHIZE

Wednesday 24 July 2024, 11:00 - 13:00

PLATFORM PRESENTATION: SWARD STATE AND NUTRITIONAL CHARACTERISTICS OF ROTATIONALLY GRAZED PASTURES SUPPORTING BEEF CATTLE IN AGROFORESTRY AND SILVOPASTORAL SYSTEMS IN JAMAICA VARIES WITH FARM AND SEASON

Martin Hughes, Paul Jennings, Cicero Lallo*

Beef cattle is predominantly managed under rotational grazing systems in open pastures or agroforestry and silvopastoral systems in Jamaica. However, the nutritional characteristics of the pastures grazed by beef cattle in agroforestry and silvopastoral systems are unknown. The aim of this study was to determine the nutritive value and sward state of pastures on five (5) beef cattle farms in different geographic locations (Minard Estate, FM Jones beef farm, Allied Farms, Bengal Estate and Lanrumney Estate) dominated by *Cynadon nlemfuensis* or *Brachiaria decumbens* Cv. Basilisk under agroforestry and silvopastoral systems in Jamaica. Grass samples were collected in three (3) paddocks per farm during the dry (January – April) and wet (August – November) seasons at 4 - 6 weeks interval depending on the normal grazing cycle of the farm. To estimate the nutritive value of the “grazable” herbage, samples were collected by hand-plucking the upper half of the sward. Ground level sampling within a 0.5 m² rectangular quadrat was done to determine herbage mass. Herbage mass ($p = 0.020$) and sward height ($p = 0.000$) were influenced by the interaction of farm and season. Herbage mass was highest at FM Jones beef farm in the dry season (8,702 kg DM ha⁻¹) and lowest at Minard Estate in the wet season (3,256 kg DM ha⁻¹). Pre-graze sward height was highest at Allied Farms (41.6 cm) and lowest at Minard Estate (7.5 cm) in the wet season. Sward bulk density varied between farm (205 – 404 kg DM/cm). The concentration of crude protein differed between farm ($p = 0.000$) and season ($p = 0.035$). Crude protein was highest at Minard Estate in the dry season (132 g/kg DM) and lowest at Lanrumney Estate in the wet season (82.8 g/kg DM). Neutral detergent fiber (587 – 720 g/kg DM), in vitro organic matter digestibility (548 – 673 g/kg) and estimated metabolizable energy (7.7 - 10.0 MJ/kg DM) were unaffected by season and farm. We concluded that sward state and nutritional characteristics of pastures supporting beef cattle in agroforestry and silvopastoral varies with farm and season.

PLATFORM PRESENTATION: ETHYL METHANESULPHONATE INDUCED GENETIC VARIATION IN SELECTED TEF (ERAGROSTIS TEF) GENOTYPES

Patrick Rakau, Hussein Shimelis, Francuois Muller, Jacob Mashilo, Maliata Wanga*

Tef [*Eragrostis tef* (Zucc.) Trotter] is an underutilized multi-purpose crop indigenous to Africa. The gluten-free grain is used for food, and the straw for livestock feed. Genetic enhancement and gene discovery are critical to developing climate-smart tef varieties with enhanced grain and straw nutrition qualities for breeding and cultivation in water-limited agroecologies, including South Africa. Ethyl methanesulphonate (EMS) is an established mutagenic agent that induces genetic variation in crop breeding programs. After mutation induction of seed-bearing crops, high phenotypic variation is expressed in M₂ generation due to the genetic segregation of recessive alleles. Also, dominant mutations are expressed



in the M₁ generation rarely. The objective of the present study was to assess the genetic variation of the mutants of tef in the M₁ and M₂ generations for agro-morphological and quality traits to guide selection and large-scale mutagenesis. The seed of three tef cultivars Ivory, Highveld and Emerson were treated with two EMS doses (0 and 2.11% v/v). The EMS-treated seeds (M₁ seed) were planted as M₁ plants to phenotype them and harvest M₂ seeds. The M₂ plants were established under a field experiment at the Agricultural Research Station, Cedara-Kwa-Zulu-Natal, South Africa using a split-plot design where the EMS doses were assigned as the main plot factor, while the genotypes were a sub-plot. A total of 2880 M₂ individual plants were assessed from 24 families to appraise genetic variation and only 120 were selected for agronomic evaluation. Data were collected from 120 randomly selected and marked plants per family. There were marked genetic variation ($p < 0.05$) in the M₁ and M₂ generations for agronomic traits, including days to 50% emergence, plant height, shoot height and seed yield, revealing the effect of the EMS for genetic mutation and selection in the subsequent generations. The genotype \times EMS, dose interaction effect, was significant ($p < 0.05$) for mineral nutrients, including crude protein, copper, and aluminium, in both generations, suggesting adequate segregation for the selection of potential novel and useful mutant plants in the M₂ generation. The identified mutants with unique agronomic traits and nutrition qualities are recommended for simultaneous selection and the development new cultivars.

PLATFORM PRESENTATION: NUTRITIONAL QUALITY OF FODDER AND SEEDS FROM VARIOUS ENCROACHING TREE SPECIES

Nelson Maila, Francoois Muller, Julius Tjelele, Abubeker Hassen*

Livestock production is an integral part of the communal farming system. Communal farmers rely mainly on natural pastures, hence the search for inexpensive, yet convenient feedstuffs continues in order to minimize costs while maintaining or improving livestock production. Therefore, this study aimed to determine whether the nutritional quality of various encroaching tree species (*Vachellia nilotica*, *Vachellia tortilis*, *Vachellia karoo*, and *Dichrostachys cinerea*) differs when harvested at different phenological stages. Edible parts (thin branches, leaves, and seed pods) of each species were harvested at different phenological stages (vegetative, full flower, early seed pod formation, and mature seed pods) at the ARC Roodeplaat experimental farm. The material was air-dried and milled, and samples were sent for analysis to determine CP, ADF, NDF, mineral nutrients, and IVOMD. Results from this work show large variations in the nutritional quality between different harvesting times/phenological stages. Furthermore, the best time to harvest these species also differed, with certain species having the highest overall nutritional quality and digestibility at the vegetative stage, while others were at the mature seed pod stage. However, in general, crude protein content ranged between 8.75% for *V. nilotica* and 13.60% for *D. cinerea*, both harvested at the early seed formation stage, suggesting that even at the lowest concentrations, CP is sufficient to meet the minimum requirements of 7–8% for ruminants. All mineral nutrients were at concentrations sufficient for livestock production, with the exception of P, which was below the recommended level. From this work, recommendations are made as to which phenological stages to harvest these species. Furthermore, recommendations for future studies on the evaluation of different fodder processing techniques are provided, as well as recommendations for evaluating the potential of endozoochorous dispersal of seeds from fodders fed to livestock with intact seeds.

PLATFORM PRESENTATION: GERMINATION AND EARLY SEEDLING GROWTH RESPONSES OF LUCERNE (*MEDICAGO SATIVA L.*) GENOTYPES TO ALUMINIUM TOXICITY AND ACIDIC SOILS.

Sesethu Sokoko, Francois Muller, Julia Sibiya, Letty Masemola*

Metal toxicity is a major limiting factor in crop production in various areas around the world and in South Africa. Some metals available in the soil are not essential but rather toxic when present in certain forms. These toxic metals are mostly found in acidic soils (soil pH <5.5) and amongst others, aluminium (Al) toxicity is the most widespread metal inhibiting root growth in many crops. When the soil pH is above 5.5, Al becomes non-toxic, and it solubilizes once the pH drops, and it becomes toxic. Many parts in South Africa have acidic soils with an estimate of approximately 5 million hectares of soils that are severely acidic and about 11 million hectares moderately acidic. This implies that most soils in South Africa have solubilized form of Al which is then toxic to the plants. Aluminium stress is a serious impediment in crop growth and yield of many crops grown in acidic soils throughout the world. Many studies have reported that Lucerne (*Medicago sativa L.*) is one of the widely grown forage crops in the world however lucerne varieties cannot tolerate acidic soils, but there is little information on how the Al toxicity affects the lucerne varieties, especially those in South Africa. This project therefore aims to characterize agronomic and morphological traits of various acid tolerant lucerne lines and commercial lucerne cultivars. To achieve this, the following objectives will be pursued: (i) investigate germination responses of various lucerne lines to Al toxicity, (ii) to characterize the early morphological responses of different lucerne genotypes to soil acidity, (iii) to assess the effect of Al toxicity on lucerne root growth and development, (iv) to assess the impacts of soil acidity and Al toxicity on lucerne growth, biomass production and resource allocation, (v) To determine the effects of soil acidity and Al toxicity on the nutritional quality (ADF, NDF, CP, ME, mineral nutrients) of various lucerne genotypes, (v) To select genotypes with improved acid tolerance for inclusion in further lucerne improvement programs. To acquire this, a germination test will be conducted at to screen the lucerne lines in aluminium chloride to check their response to Al toxicity at germination stage. The lucerne lines will be further screened in a glass house using pots with acidic soils and data will be collected for physiological and morphological traits.

PLATFORM PRESENTATION: BIOMASS PRODUCTION OF SELECTED PERENNIAL C4 GRASSES HARVESTED AT DIFFERENT PHENOLOGICAL STAGES – POTENTIAL FOR CLIMATE-SMART FODDER BANKS FOR EXTENSIVE LIVESTOCK FARMERS

Lesego Motshekga, Thabiso Komane, Edward Nesamvuni, Baldwin Nengovhela, Kedibone Chueu*

The livestock sector is critical for both the economic development and food security of South Africa, but the scarcity and poor quality of fodder to meet livestock feed demands reduces ruminant productivity, promotes rangeland degradation and puts the most vulnerable population at risk. Perennial C4-grasses such as *Chloris gayana*, *Digitaria eriantha*, *Panicum maximum*, 4 Grazer are an alternative for enhancing the sustainability of the sector. The objective of the trial was to measure biomass production of selected tropical grasses as influenced by pasture species and harvest day. The field experiment is being carried out at the University of Limpopo experimental farm. The experiment was laid in randomised complete block design replicated three times. Treatments included four pasture species, *C. gayana*, *D. eriantha*, *P. maximum* and 4 grazer mixture (*Brachiaria brizantha* cv MG-5, *C. gayana*, *D. eriantha*, *P. maximum* cv Mombasa) and three harvest days (63, 77 and 98 days after planting). Biomass production in a form of aboveground phytomass was harvested at 63, 77 and 98 days after planting representing the vegetative stage, boot stage and 50% flowering respectively. A measured parameter was subjected to analysis of variance (ANOVA) and the mean separation was done using Duncan's multiple range test at 5% probability. Pasture species and harvest day had a highly significant effect ($p < 0.001$) on biomass production while the pasture species * harvest day interaction had no significant effect ($p < 0.05$). Biomass production during the first year of growth ranged from 9300 kg/ha to 5200 kg/ha with *Panicum maximum* as significantly the highest producer, followed by 4 grazer mixture and *Chloris gayana*. *Digitaria eriantha* was significantly the lowest producer. The highest dry matter was attained at 77 days after planting when the pastures were at boot stage.



Significantly lower dry matter production was recorded from pastures harvested 63 days after planting at vegetative phase. Biomass production at 98 days after planting was significantly lower than at 77 days but higher than at 63 days after planting. Harvesting post flowering is not recommended to prevent loss of biomass production due to increased amount of senescent leaves.

STANDARD POSTER PRESENTATION: THE DIFFERENT ROLES PLAYED BY ITALIAN AND WESTERWOLDS TYPES IN LOLIUM MULTIFLORUM PASTURES ON CEDARA RESEARCH STATION, KWAZULU-NATAL

Donna Berjak, Derryn Nash*

Lolium multiflorum (Italian ryegrass) is an annual temperate pasture planted under irrigation, generally for dairy production. There are two types of Italian ryegrass, one called Westerwolds and the other Italian. The Westerwolds type is generally known for quick germination and early yields, it responds to increasing daylength to go reproductive and is normally dead by summer. Italian types are known to respond to cold vernalization and should persist into summer. There are two periods of dietary challenge for dairy farmers during the year, the first is in autumn, the so called “autumn slump”, when milk production drops due to pastures flowering or becoming moribund, which makes them less palatable, reducing intake and pasture quality. The second period of dietary challenge is during summer, when high environmental temperatures challenge intensive pasture production in terms of quality. Simultaneously, the dairy cow can become heat stressed, which negatively affects milk production. In fodder flow, farmers need to consider different pastures to fulfill different needs throughout the year. Traditionally, Westerwolds would be planted for quick autumn growth and Italians for persistence into summer. The cultivar evaluation trials planted on Cedara in March 2023 had equal numbers of Italian and Westerwolds types planted. Seasonal yield data showed that while Westerwolds types were quick with good autumn yields, some Italian types were just as fast. The top 13 cultivars in autumn were not significantly different from one another ($p < 0.05$), of these nine were Westerwolds and four were Italian types. In summer all but one Westerwolds type were dead with Italian types persisting to various degrees. Reviewing the total yields, the top 11 cultivars were not significantly different from one another ($p < 0.05$), of these nine were Italian, one a Westerwold type and one a hybrid cultivar. Total yield still favoured the Italians due to their summer production. The conclusion would be that certain Italian types can be planted for both good autumn growth and summer yield, thus serving both purposes. While Westerwolds could be planted for autumn growth they could also be followed in late spring by a quick “maize for silage” crop.

RESEARCH POSTER PRESENTATION: PLANTING DATE AND VARIETAL EFFECT ON MORPHOLOGY, AGRONOMY, NUTRITIVE VALUE AND RUMINAL FERMENTATION OF SELECTED LUPIN VARIETIES

Kgomotso Lekgetho, Hilda Kwena Mokoboki, Khuliso Emmanuel Ravhuhali*

Degraded rangelands in South Africa limit livestock productivity in mixed crop-livestock systems. Tropical forage legumes like lupins offer potential for improving forage quality and production. This study aims to assess the effects of planting date and varietal selection on the production potential of lupins. We hypothesize that both planting date and variety will influence the production efficiency and nutritive value of selected lupin varieties. The study will evaluate two lupin varieties (sweet and bitter lupin) planted on two dates across two growing seasons (2024 and 2025) following recommended agronomic practices. Specific agronomic and morphological attributes (e.g., plant height, leaf area) will be measured for two months (weekly basis) post-planting. Plants will be harvested before flowering stage and the plant leaves will be dried and analyzed for chemical composition (e.g., protein, fiber), phytochemicals, rumen- degradable protein (buffer nitrogen solubility), and *in-vitro* ruminal fermentation characteristics. A two-way analysis of variance will be used to assess the effects of planting date and variety on lupin production and quality parameters. The project is expected to yield an informed recommendation for farmers regarding optimal lupin variety and planting date selection. This research has the potential to improve forage production in South African rangelands and contribute to the economic

well-being of farmers.

STANDARD POSTER PRESENTATION: DETERMINING THE IMPACTS OF INCREASED TEMPERATURES AND REDUCED WATER-AVAILABILITY ON THE AGRONOMIC PERFORMANCE AND NUTRITIVE VALUE OF DIFFERENT INDIGENOUS FORAGE GRASS ECOTYPES

Nothando Ngcobo, Francois Muller*

Water limitation and adverse temperatures are abiotic factors that negatively influence plant production by negatively impacting root and shoot growth, nutrient and water uptake, as well as plant physiological processes such as photosynthesis, transpiration and respiration. In forage crops specifically, limited water availability and high temperatures can cause a decrease of forage yield by 30%, resulting in significant feed shortages. Indigenous South African grasses has contributed significantly to global pasture production. However, there is a large diversity of unexploited grass and legumes genetics that are well adapted to water-limited conditions. Species such as *Digitaria eriantha*, *Eragrostis curvula*, *Panicum maximum*, *Cenchrus ciliaris*, *Chloris gayana* have already made significant impacts on global livestock production systems. Studies which focused exclusively on forages in Southern Africa, revealed that in order to maintain a successful pasture economy in South Africa, it is necessary to identify and breed grass species that can adapt to challenging climates. The proposed study aims to evaluate agronomic performance and nutritional quality of various commercial forage grasses in comparison to indigenous ecotypes of these grasses grown under water-limited conditions. This study will be carried out at the Agricultural Research Council's Roodeplaat Experimental Farm in Gauteng. This research farm holds the National Forage Genebank, from which seeds will be gathered for research. Four replicates of 50 seeds of each species *P. maximum* and *D. eriantha*, from both commercial varieties and collections made from indigenous populations, breaking seed dormancy and germination will be done according to International Rules for Seed Testing in seed germination chambers. Germination will be recorded daily for 7 days. Thereafter 4 replicates of 20 germinated seedlings will be planted in 10 x 15 cm pots watered to 70, 50 and 40% of soil moisture holding capacity. A further 4 replicates will be planted under 100% soil moisture holding capacity. All pots will be placed in the plant growth chambers calibrated to constant temperatures of 20, 25 and 30 °C and a 10h/14h day/night cycle for 30 - 45 days. Seedling emergence and survival will be recorded daily, after 30 and 45 days morphological characteristics plant height, leaf width, date to first, 50 % and full flowering duration, leafiness and branching intensity will be recorded. At 30 days half of the surviving plants will be harvested, the shoots will be clipped at 10 cm above the soil level and divided into root and shoots and the remaining will be harvested after 45 days. Nutritional quality such as mineral nutrients, crude protein, NDF, ADF, energy and digestibility will be determined from oven dried biomass samples. The evaluation of different grass species for their ability to overcome drought stress is crucial since the results of these experiments will inform future breeding initiatives aimed at improving drought tolerance in these forage grass species.

STANDARD POSTER PRESENTATION: EVALUATION OF COVER CROPS IN SELECTED LAND CARE AREAS OF SOUTH AFRICA

Fortune Manganyi, Julius Tjelele, Patrick Rakau, Francois Muller, Ntuthuko Mkhize, Martha Khwene, Klaas Mampholo, Kwabena Ayisi*

Climate change has resulted in marginal bioclimatic conditions, which have serious implications for sustainable crop and livestock production, especially for smallholder and emerging farmers. Conservation agriculture is a farming system used to mitigate the impacts of climate change by maintaining and improving soil health with minimal soil disturbance, diversifying of crop species, and maintaining soil cover. This system assists in using soil health as a tool for soil physical and biological properties to verify which respond to the soil use and management. Along with these benefits, the use of cover crops allows farmers to diversify their agricultural practices with the addition of livestock, which leads to improved resilience to climate change. This project aims to introduce farmers to cover cropping using forages as a means to assist



farmers in identifying the most suitable forage options (i.e. grasses, broadleaves, and legumes) that are better adapted and resilient to different climatic conditions and explore cover crops that will improve soil physical, chemical and biological properties. To do this, ten on-farm and five on-station cover crop demonstration sites will be established in seven provinces (KwaZulu-Natal, Eastern Cape, Mpumalanga, Gauteng, Limpopo, Free State and North West). Thereafter, 100 smallholder farmers and twenty departmental officials will be trained on how to implement cover cropping systems using climate-smart forage technologies. Furthermore, we plan to map out the forage seed value chain in the identified provinces/regions, identifying key actors and their roles, analyzing constraints in the value chain and identifying opportunities to enhance effectiveness and competitiveness of the value chain. Lastly, we aim to characterize the growth, yields and impacts on soil health of different cover crop species and combinations of species over contracting seasons. The information produced from this study will be used to develop training manuals and simplified information packages custom-made for small-holder producers in their home languages.

STANDARD POSTER PRESENTATION: MORPHOLOGICAL, PHYSIOLOGICAL, BIOMASS YIELD AND NUTRITIONAL QUALITY RESPONSES OF CHAMAECYTISUS PALMENSIS PLANTS WHEN SUBJECTED TO HEAT STRESS TREATMENTS

*Phumlani Mhlongo**

Climate change poses a significant threat to crop and livestock production due to increased occurrences of heatwaves and prolonged periods of drought. Tree lucerne has the ability to survive dry periods and is often used in Australia as a livestock supplement, and therefore has been proposed as a potential supplementary fodder resource for livestock during the dry season in South Africa. However, there is a need to understand the influence of increased heatwave occurrence in South Africa on the establishment and growth of tree lucerne and subsequently its nutritional quality. Thus, this study aims to characterize the morphological, physiological, and biochemical responses of tree lucerne exposed to different degrees of heat stress conditions. Additionally, this study will determine how heat stress impacts the nutritional quality of tree lucerne and investigate the in vitro fermentation parameters (IVOMD, total gas production and methane emissions). The study will be conducted at ARC-AP campus in Roodeplaat, where the plant will be established for 2, and 3 months before being placed into growth chambers calibrated 4 different temperatures (20°C, 27 °C, 32°C, and 40 °C). Four replicates of each age per temperature treatment will be removed on 3, 6, 9, and 12 days after exposure to heat treatment. Morphological measurements will include shoot length, root length, stem thickness, mid-leaflet length, petiole length, and shoot fresh and dry mass. Leaves will be used for electrolyte leakage determination which will be used as an indication of stress. Thereafter the dried milled sample will be used for chemical analysis where NDF, ADF, ME, CP, IVOMD, and total gas production will be determined.

SESSION 06

LIVESTOCK AND GAME MANAGEMENT

SESSION CHAIR: PERCY SEKWADI

Wednesday 24 July 2024, 14:00 – 14:40

**PLATFORM PRESENTATION: THE ECOLOGICAL IMPACT OF NATIVE HERBIVORES ON VEGETATION OF RIETKUIL
WILDLIFE CONSERVATION FARM, PARYS, FREE STATE SOUTH AFRICA**

*Makoshane Seloana**

Rietkuil Wildlife Conservation Farm plays a role in wildlife preservation to date under Johannesburg City Parks and Zoo (JCPZ) management, the custodians of greening and nature conservation in the city. The farm breeds fauna as feed for Johannesburg Zoo and serves as a sanctuary for animals in need of space for rehabilitation. The study aimed at investigating the status of the vegetation; assess the extent of veld condition and grazing capacity of the herbaceous layer for the conservation farm. Two methods were used for the study: Braun-Blanquet phytosociological method and Veld Condition Index (VCI). Braun-Blanquet assessment procedures of the herbaceous and woody vegetation condition were tested in the different vegetation communities. The two phases, namely the analytical and the synthetic phase, with plot sizes of 20 x 20 m (400m²) for the vegetation units were sampled. For the VCI method, the botanical composition of the grass sward in comparison to a reference benchmark site was measured. A total of 16 plots were sampled. Each plant species present in a plot was noted and assigned a cover abundance value. The detailed vegetation survey consisted of recording all the identifiable trees, shrubs, grasses, sedges, ferns, forbs, geophytes, succulents and alien (exotic) plant species within each sample plot. An estimate of the total vegetation cover (%) was made for different strata: tall trees (>6 m), small trees (3 m – 6 m), shrubs (<3 m), dwarf shrubs as well as the herbaceous layers (grasses and forbs). A step point-survey (50 points per sample plot) of the herbaceous layer (grasses and forbs) was made in the grassland communities to determine the frequency (%) of grass species. This point survey provides an indication of the dominance or importance of each grass species. Data analysis was through the Ecological Index Method to determine VCI of each site. An average of 15 different plant species recorded per sample plot. The vegetation was found to be dominated by unpalatable grass *Eragrostis chloromelas*. Grass species recorded include *Cynodon dactylon*, *Eragrostis curvula*, *Aristida congesta* subsp. *congesta*, *Melinis repens*, *Setaria sphacelata*, and *Calochortus excavatus*. Scores showed that 19% of the sampled site were categorized as very poor, with 57% as poor, while 24% as moderate in terms of veld condition status. The results indicate that generally, veld condition had diminished by an estimation of 50 - 77% from its potential condition. This observed current condition is due to veld management issues (e.g., stocking rate, lack of rotational grazing, type of animal within the camp etc.). It can be concluded that the stocking rate management plan, which entails the matching of grazing livestock numbers to forage production is crucial.

PLATFORM PRESENTATION: DIET MIXING AND SUPPLEMENTATION INCREASED CONSUMPTION OF THE ENCROACHING WOODY PLANTS BY GOATS

Piet Monegi, Ntuthuko Raphael Mkhize, Purity Thobekile Masondo, Khanyisile Rebecca Mbatha, Dibungi Luseba, Tlou Julius Tjelele*

The expansion of woody plants at the expense of grassy layers, coupled with the rising societal demand for animal protein and livestock products, necessitates concerted efforts by land users, ecologists, and animal scientists to enhance the utilisation of trees and shrubs as forage. Without such efforts, meeting future demand for meat and meat products will be challenging. This study aimed to investigate strategies to increase the intake of condensed tannin-rich woody plants by goats through two short-term pen experiments. Experiment 1 evaluated the effects of supplementation with polyethylene glycol (PEG), a high-protein source (soybean meal), and a high-energy source (yellow maize grain) on the intake of *Euclea crispa*. Experiment 2 assessed the impact of diet mixing (single-species vs. multispecies diets) on the intake of *Searsia lancea*, *S. pyroides*, and *E. crispa*. In Experiment 1, supplementation with energy- and protein-rich sources significantly increased the intake of *E. crispa* ($p < 0.05$), with intakes of $713.4 \text{ g} \pm 13.5$ and $760 \text{ g} \pm 28.9$, respectively, compared to $540.32 \text{ g} \pm 11.2$ for the control diet. Although PEG tended to increase *E. crispa* consumption, the increase was not statistically significant ($p > 0.05$) compared to other treatments. In Experiment 2, goats offered a combination of all three-forage species achieved substantially higher dry matter intakes compared to goats offered these species individually ($p < 0.05$). This suggests that diet mixing can enhance the intake of tannin-rich woody plants. These findings indicate that management strategies incorporating (1) a variety of forage species in the diet rather than monocultures and (2) a combination of nutrient-rich and tannin-rich species may improve goats' ability to consume chemically defended woody plants. While longer-term field experiments are needed in African savannas, the current results provide a basis for developing feeding strategies that leverage diet mixing and supplementation to increase the utilisation of woody plants by goats. These results have important implications for managing woody plant encroachment and improving forage utilisation in pastoral systems, thereby contributing to sustainable livestock production in the face of changing ecological and economic landscapes.

STANDARD POSTER PRESENTATION: EFFECT OF SUPPLEMENTING BARLEY FODDER SPROUT ON RUMINAL MODULATION AND METABOLIC FUNCTION OF MEAT-MASTER LAMBS

Thamsanqa Mpanza, Sinalo Mani, Francois Muller*

Hydroponic sprout is green, nutritious fodder that is produced without the use of soil. Forage production under hydroponic technology is less susceptible to drought and not seasonal bound like conventional forage production systems. The technology is applicable to smallholder farmers who has no private land with no irrigation; this is because the technology demands less space, less water with no necessity for fertilizer. The study was conducted to determine the effect of supplementing meat-master lambs with barley fodder sprout on ruminal fermentation, microbial composition and their metabolic functions. It was hypothesized that fodder sprout will modulate rumen fermentation, microbial composition and their metabolic functions. In this study, twelve meat-master growing lambs at an age of about 3 to 4 months old with an initial body weight of $23.09 \pm 0.69 \text{ kg}$ were used. The animals were randomly assigned into three dietary treatments, with four animals per treatment. Treatments were *Eragrostis curvula* (hereafter referred as grass hay) as basal diet (T1), Grass hay plus 25% barley sprouts (T2) and Grass hay plus 50% barley sprouts (T3). Each animal was offered 300 g of concentrates. Barley sprout was produced in a room without fluorescent light. Animals were housed individually, fed twice a day at 8h00 and 15h00, and had free access to clean water. At the end of growth study that lasted for 70 days, excluding 15 days for adaptation, rumen fluid was collected from animals per treatment using a stomach tube. The rumen fluid was used for ruminal fermentation analysis (i.e., VFA and $\text{NH}_3\text{-N}$) and to extract DNA for metagenomic analysis. Barley fodder sprout supplementation to lambs modulates rumen fermentation by significantly reducing $\text{NH}_3\text{-N}$ production and the Acetic:Propionic acid ratio. This study showed a shift in microbial composition from



the phylum *Proteobacteria* to the phylum *Firmicutes* in meat-master lambs supplemented with barley fodder sprout. Metagenomic analysis showed that genes encoding nitrite reductase, responsible for ammonium formation, were most abundant and were assigned to *Selenomonas* and *Prevotella* genera in animals that were consuming control diet. In addition, *Heterodisulfide* reductase-encoding genes that plays a key role in the energy metabolism of methanogenic archaea were observed. Therefore, barley fodder sprout supplementation modulates rumen microbial composition and thus metabolic function related to methane and ammonia formation.

STANDARD POSTER PRESENTATION: ECOLOGICAL PREFERENCES AND SEASONAL DYNAMICS OF TICKS (ACARI: IXODIDAE) FROM BOVINE HOSTS IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

Mandla Yawa, Nkululeko Nyangiwe*

Globally, ticks transmit a variety of pathogenic micro-organisms to livestock and wild animals more than any other arthropods. This is a challenge to cattle farming in tropical and sub-tropical regions worldwide. About 80% of the world's cattle population are affected by ticks and tick-borne diseases. The study aimed to investigate the ecological preferences and seasonal dynamics of free-living and parasitic ticks from cattle and on vegetation in the Eastern Cape Province. A total of 31,425 ticks were collected from 10 cattle and from six drag-samples during a 12-month study period. Adult ticks were removed from the right hand side of each animal and all instars of ticks were placed in containers filled with 70% ethanol. Based on morphological traits, 10 tick species were identified: *Rhipicephalus (Boophilus) decoloratus* (32.5%), *R. evertsi evertsi* (18.8%), *R. appendiculatus* (17.3%), *Amblyomma hebraeum* (16.3%), *R. simus* (7.7%), *Ixodes pilosus* (3.8%), *Hyalomma rufipes* (3.5%), *R. follis* (0.08%), *Haemaphysalis elliptica* (0.04%), *H. silacea* (0.02%). The southern African yellow dog tick, *H. elliptica*, was only found on vegetation. The agro-ecological zones differ significantly in tick species and their distribution. The *A. hebraeum* and *R. evertsi evertsi* counts were higher in Kowie Thicket (KT) during summer season (2.05 ± 0.01 and 1.00 ± 0.09 , respectively) compared to Bedford Dry Grassland (BDG) and Bhisho Thornveld (BT) veld types. In all vegetation types, *R. appendiculatus* had higher counts in KT in spring (0.91 ± 0.08), summer (0.78 ± 0.08) and winter (0.78 ± 0.08). *Rhipicephalus (Boophilus) decoloratus* was more frequent in the BT (1.78 ± 0.11) during the summer season. BDG had lower tick infestation with *R. evertsi evertsi* being the most frequent species in summer. No *H. rufipes* was collected in the KT. Of epidemiological interest, *R. (B.) microplus* was absent in the study area which needs further investigation. Within the context of this study, we found agro-ecological differences and seasonal variations to have influence on tick species distribution.



SESSION 07 | COMMUNAL RANGELANDS

SESSION CHAIR: PHILLIP NENGWENANI

Wednesday 24 July 2024, 14:45 – 16:00

PLATFORM PRESENTATION: RANGELANDS SUPPORTING PEOPLE: A REVIEW OF THE CONTRIBUTION OF THE AFRICAN JOURNAL OF RANGE AND FORAGE SCIENCE TO ADVANCING KNOWLEDGE ON THE HUMAN DIMENSIONS OF AFRICAN RANGELANDS

*Wayne Twine**

The social dimensions of rangeland systems have gained increasing attention in international rangelands literature. To evaluate the African Journal of Range and Forage Science's contribution in this area, a systematic review of socially relevant papers published from 1966 to 2023 was conducted. Total and annual frequency of papers, search terms, author key words, tenure context, and main focus were calculated and assessed quantitatively. A qualitative assessment of journal special issues' contributions, and a synthesis of recurring themes and emergent insights was conducted with the assistance of ChatGPT-4 AI, which was used to summarise meta-themes from paper conclusions. A total of 73 articles met the screening criteria. The number of papers with a social dimension have increased substantially over time, especially since 2003, with spikes corresponding to journal special issues. Most of the work has focused on management, practices/behaviour, knowledge, and livelihoods in communal areas. Emergent insights span a range of themes with practical applications. The journal has advanced the understanding of African rangelands as socio-ecological systems and has helped normalize the inclusion of social dimensions in rangeland management research, practice, and policy in South Africa. Suggested future research directions build on the existing work as well as addressing understudied themes.

PLATFORM PRESENTATION: EXPLORING SUSTAINABLE GRASSLAND MANAGEMENT IN THE UMHLABUYALINGANA AREA: A COMMUNITY-CENTRED APPROACH

*Sue Janse van Rensburg, Sulinkundla Maseko, Michele Toucher, Londiwe Gule**

Umhlabuyalingana is situated within the Indian Ocean Coastal Belt, an area characterised by its wooded grasslands, a distinctive ecosystem that blends elements of traditional grasslands with those of woodlands. It is groundwater-driven, and it depends on local rainfall for recharge. Lake Sibaya, South Africa's largest natural freshwater lake, is located within the Umhlabuyalingana area and serves as a great indicator of the groundwater levels of the area. The Umhlabuyalingana area falls within the tropical to subtropical climate transition zone and is considered a climate-sensitive region. It is predominantly rural, with high levels of unemployment, limited economic opportunities, poor infrastructure development and low literacy levels. The local economy primarily relies on agriculture, fishing, and small-scale tourism. The communities in the area are also engaged in traditional crafts and subsistence farming. The wooded grasslands within the Umhlabuyalingana region are experiencing significant threats from climate change and the expansion of commercial timber forestry. The area covered by commercial forestry plantations within the Umhlabuyalingana Local Municipality (ULM) doubled between 1986 and 2019, now exceeding 40,000 hectares. The expansion of commercial forestry plantations, combined with decreased rainfall due to climate change, has significantly diminished hydrological inputs crucial for the hygrophilous grasses in the region. As a result, Lake Sibayi has dropped by more than 1.5 meters during this time. As a result, the ecosystem is approaching a state of collapse. To understand and mitigate these effects, a



comprehensive project was initiated to model how different vegetation types and climatic factors influence the hydrological response of Lake Sibayi. This was achieved using a MODFLOW groundwater model using the Groundwater Vistas graphical user interface(GUI). Furthermore, to identify sustainable land management approaches that support community resilience, 223 household surveys were conducted to gather insights into local needs and preferences. The more sustainable alternatives identified through discussions with the communities include commercialising cattle, cultivating dryland crops, and growing irrigated crops. The study revealed that the indigenous Indian Ocean Coastal Belt (IOCB) grassland is the most effective land cover for promoting optimal groundwater recharge. However, responses from household surveys highlighted concerns about water scarcity and emphasised the grasslands' importance for crafts and livestock. Despite this, these grasslands are becoming less suitable for livestock due to the reduced availability of open freshwater bodies, which impacts cattle rearing. A critical recommendation from this project is that efforts must be made to preserve the remaining grassland areas within Umhlabuyalingana. Achieving this goal requires ensuring these grasslands deliver tangible benefits to their communities. Continuous engagement with local communities is vital to ensure that research remains relevant and is informed by local knowledge and needs. This includes a deeper understanding of the dynamics of the whole system in this transition zone and how they might evolve over time. By fostering interdisciplinary collaboration, maintaining active communication with relevant stakeholders, and prioritising sustainable practices, achieving the conservation of this critical ecosystem and enhancing the well-being of the local communities is possible.

PLATFORM PRESENTATION: HYDROPONIC BARLEY FODDER: BRIDGING THE FODDER GAP IN ARID RANGELANDS OF SOUTH AFRICA

Imanathi Kekaya, Igshaan Samuels, Francois Müller, Clement Cupido, Adriaan Engelbrecht*

Climate change in Namaqualand has led to prolonged droughts, water shortages, and feed gaps, compromising the quality and quantity of forage. The livestock farmers face challenges in producing green fodder, prompting exploration of alternative methods like hydroponics fodder production. However, the potential of this system in South Africa's drylands remains uncertain and needs evaluation due to water quality and availability. Therefore, this study aimed to evaluate the potential of implementing a hydroponic fodder production system in Namaqualand and assessed the effects of irrigating barley with borehole, municipal, nutrient solution and distilled water on its quantity and nutritional quality for green forage production. The seeds were sprouted and grown in plastic containers in a glasshouse with natural day/night cycles and were irrigated manually with 200 ml of the designated water treatment using a pressure sprayer three times daily for 10 days. Morphological and biochemical measurements including sprout height and mass, as well as nutrient composition (dry matter, crude protein, fibre, and mineral nutrients), were done at the end of the 10 days. The study found that municipal water had a higher pH (8.6) and was less saline (243.5 mS/m) than borehole water (8.5). Fresh fodder yields ranged from 956 to 1404 g, while dry matter yield was highest in barley irrigated with distilled water. Crude protein content was highest in fodder irrigated with nutrient solution (18.75%), however, all the fodder had better crude protein content (14.18 - 18.75%) compared to natural veld forages (4.8 - 6.9%). Acid detergent fibre concentrations varied significantly between the water sources ($p < 0.05$), while neutral detergent fibre concentrations were not significantly different. Overall, the fodder energy concentrations were insufficient to meet the energy requirements of lambs, dry ewes, and other animals. However, the study found that hydroponic green barley fodder can be safely irrigated with borehole and municipal water from Namaqualand, resulting in high yields without any adverse effects. This, along with the fact that the Barley fodder showed improved nutritional quality in terms of crude protein and specific mineral components means that hydroponic fodder can be used as supplementary feed for extensively grown livestock during the dry season. Furthermore, research is necessary to assess the effect of temperature on these fodders.

STANDARD PLATFORM PRESENTATION: EVALUATION OF COMMUNAL RANGELAND CONDITION: CASE STUDY OF SANTOMBE VILLAGE IN MOUNT AYLIFF, UMZIMVUBU LOCAL MUNICIPALITY, EASTERN CAPE PROVINCE

*Sive Tokozwayo**

Rangeland condition is defined as the state of health of rangeland in terms of species diversity and the potential for producing good quality forage for livestock. The aim of the study was to assess the condition of Santombe communal grazing lands. Four study sites were selected and marked based on similar land use. In each site, a 100m x 50m area was demarcated, and three parallel transects of 3m x 80m were measured per site. Within each belt transect, a line transect of 80m was measured to determine grass composition using the step point method. Woody plants occurring within a belt transect were identified, counted, and recorded to evaluate woody plant species composition, density, and browsing capacity. Fifteen grass species were identified, with 80% being increasers and 13% decreasers. Fourteen woody species were identified, 64% of which were acceptable to goats, while 36% were unacceptable. *Rhamnus prinoides* and *Scutia myrtina* were the most dominant species. Site 2 (2508 plants/ha) and Site 1 (2112 plants/ha) had the highest plant density, while Site 4 (2310 BU/ha) had the highest browsing capacity compared to Sites 1, 2, and 3. The abundance of increaser species was a clear indication of rangeland deterioration. In conclusion, the high percentage of acceptable woody plants showed great potential for sustainable goat production. It was recommended that farmers establish a rangeland farmer's association, which will assist in formulating rules and regulations for better utilization of their feeding resources.



SESSION 08 | FIRE ECOLOGY

SESSION CHAIR: KEVIN KIRKMAN

Thursday 25 July 2024, 08:30 – 10:30

KEYNOTE ADDRESS: OOPS, I LIT IT AGAIN: EFFECTS OF WILDFIRE VS INTENTIONAL BURNS ON GRAZED GRASSLAND

*Devan McGranahan**

Whether lit intentionally or not, fire has affected grasslands around the world for millennia, and fire frequency is increasing for many regions in the modern era. As such, it is critically important that managers understand the opportunity to sustainably graze grassland soon after burning. But limited understanding of grassland ecosystem responses to grazing after fire—especially wildfire—contributes to a culture of reticence to graze burned areas, despite several lines of evidence suggesting that not only are forage resources in prime condition for grazing shortly after fire, but also that grazing does not have negative impacts on soil health or plant communities. This talk combines experiences with livestock grazing after both prescribed fire and wildfire in the US northern Great Plains. Information is drawn from data on soil nutrients and microbes; vegetation; and pollinator communities and their resources. Across studies, there is little evidence that either wildfire itself, or grazing in the season after wildfire, compromised ecosystem integrity, and in many cases prescribed fire increased the grazing value of these grasslands. Overall, these dynamics suggest that fire has many benefits to livestock production and biodiversity conservation in grasslands of the US Great Plains, Southern Africa, and beyond.



PLATFORM PRESENTATION: AN INTRODUCTION TO VELDFIRE INVESTIGATIONS, CONDUCTED, *INTER ALIA*, IN PREPARATION FOR LITIGATION

*Matthew Danckwerts**

Wildland fires are an intrinsic feature of seasonal grassland and savanna ecosystems, and are thus guaranteed to occur at some frequency in these systems. In addition, fire managers and practitioners in southern Africa use fire as a management tool in these rangeland systems to achieve an array of management goals for ecological, agricultural, and safety purposes. The occurrence of uncontrolled fires, potentially attributable to human agency, is an inevitable outcome in these wildland fire systems. After wildfires, damages are often incurred, and fire investigations may be commissioned. The purpose of veldfire/wildfire investigations is usually to claim on one's own insurance, or to claim against a third party. In the latter case, somebody must be liable (negligent). Veldfire investigations may also be commissioned in order to contest against a claim. If liability is contested, the outcome will depend on: Eyewitness evidence, scientific fact, and legal argument. A fire investigator's role is strictly limited to the science, although they may use eyewitness evidence for context. Wildfire investigation is a specialist topic requiring specialist expertise (most fire investigations relate to structural fires). The theory of wildfire investigation is grounded in the science of combustion and science of fire behaviour in natural vegetation. There are three main aspects of wildfire investigation: where and how did the fire start, how did it spread (behaviour), and what was its extent?; could anything reasonable have been done by the landowners (not only the landowner where it started) to prevent its spread?; and what was the quantum of damage? *Post-hoc* physical indicators of wildfire pattern and spread, as well as fire behaviour prediction models, are used by experts to determine the origin, spread, and behaviour of fires in forensic wildland fire investigations conducted in contemplation of litigation. The fields of fire forensics are under-developed for wildfire systems; however, there has been increased academic interest of late, with several peer reviewed studies recently published. This presentation aims to introduce the field of forensic veldfire investigations, discuss its purpose and application, and use practical and technical real-life examples of burn scar analysis as demonstrations. Other issues that will be covered include: firebreaks, in terms of legislation and application; liability in a legal context; and quantum of loss.

PLATFORM PRESENTATION: THE EFFECT OF TIME OF DAY ON FACTORS THAT AFFECT FIRE INTENSITY IN SOUTHERN AFRICAN SAVANNA

Nothando Ngobeni, Ann Carla Staver, Sally Archibald, Navashni Govender*

The time of day affects fire behavior through changes in environmental factors, including relative humidity, temperature, wind speed, and fuel moisture. There is a gap in our understanding of fire behavior at different times of the day within African savanna ecosystems. Previous studies have not measured fire intensity throughout the day, focusing instead on variations across seasons. Therefore, this study aimed to explore how burning at different times of the day influences fire intensity. We investigated the impact of fuel characteristics and weather conditions on fire intensity for fires set at varying times. Additionally, we compared the intensity of fires occurring during the day to those in the early morning and late afternoon. This study was conducted at the basaltic supersites of the Lower Sabie section in the Kruger National Park (KNP). Grass biomass, fuel moisture content, weather conditions, and fire spread rate were recorded. Among these factors, relative humidity was found to significantly influence fire intensity, (r^2 of 0.48, $d.f.$ = 18, p < 0.001. Other measured factors, including wind speed, air temperature, and fuel moisture content, did not influence fire intensity (p > 0.05). The results suggests that variations in relative humidity play an important role in shaping fire behavior, potentially influencing the availability of fuel moisture and the rate of fire spread. These findings highlight the importance of considering diurnal variations in environmental conditions when assessing fire behavior in Southern African savannas.

PLATFORM PRESENTATION: LIFE AND DEATH IN AN ARID SAVANNA: EFFECTS OF RAINFALL VARIATION AND FIRE ON ACACIA DEMOGRAPHICS IN TSWALU KALAHARI RESERVE

Susanne Vetter, Tiffany Pillay, Michelle Greve*

Climate change will impact the woody vegetation of arid savannas directly and via altered fire regimes. High rainfall episodes drive woody plant recruitment and woody encroachment in arid savannas, but also promote the build-up of grassy biomass that can fuel extensive fires. Severe droughts can cause mortality and die-back of adult trees, while wet conditions can stimulate recruitment pulses, potentially increasing woody cover, while high grass biomass in wet years may also constrain tree recruitment and growth through interspecific competition and increased likelihood of fires. *Senegalia mellifera*, *Vachellia erioloba* and *V. haematoxylon* are dominant species in the Kalahari with contrasting ecologies: *V. erioloba* is slow-growing and long-lived, *S. mellifera* is fast-growing, short-lived and a common encroacher, and *V. haematoxylon* is a long-lived resprouter with very rare recruitment from seed. Using three years' data tracking individually marked individuals, we used matrix population models to assess the effects of rainfall variation and fire on seedling establishment, size-specific survival, and population growth rate of these three species. We combined this with additional data on topkill, sapling mortality and post-fire resprouting in an area burned in a wildfire. *Senegalia mellifera* produced large numbers of seedlings after the 2021-2022 wet summer season, of which a large proportion survived the following year in the absence of fire, while few survived where fire had occurred. *Vachellia erioloba* had low seedling recruitment and survival, while no seedlings of *V. haematoxylon* were recorded. All species had high adult survival with or without fire and were found to resprout from the base and/or from higher branches. Topkill probability decreased with tree size and size-specific topkill probability differed between species. *Vachellia haematoxylon* had an almost 100% topkill rate even among the tallest individuals, while some 50% of *V. erioloba* could resist topkill once a height of 3 m had been reached. Modelling suggests stable populations of *V. erioloba* and *V. haematoxylon* under the conditions sampled, including a single fire, but *S. mellifera* is predicted to increase in population size without fire because of its high recruitment and seedling survival during periods of high rainfall. Long-term monitoring of the tagged individuals through future wet and dry periods and with experimental fires will provide increasingly realistic predictions of population trajectories of these three key species in response to rainfall variation and fire.

PLATFORM PRESENTATION: EFFECT OF ANNUAL BURNING ON DIVERSITY AND VEGETATION COMPOSITION OF GOLDEN GATE HIGHLANDS NATIONAL PARK

Andri C. van Aardt, J.C. Linde de Jager, Johan J. van Tol*

Grasslands are known for high biodiversity and various ecosystem services, however, habitat loss, fragmentation, climate change, and anthropogenic activities threaten this biome. As South Africa's only national park in the grassland biome, and an important water resource area in southern Africa, Golden Gate Highlands National Park needs to implement firebreaks as a management tool to protect the park against uncontrolled fires. Firebreaks made by Park management occur along some of the roads located inside the Park as well as on the northern border of the Park. Although fire plays an important part in maintaining the structure of the biome, too frequent fires can be detrimental to vegetation. We attempted to determine the effect of consecutive annual burning on vegetation in the firebreaks and how it compared to the adjacent grassland. Paired plots (n=24) were set out along the firebreaks and in the adjacent grassland where vegetation data were collected using the Braun-Blanquet cover abundance scale. Alpha diversity of firebreaks and adjacent grasslands were determined using three measures, namely species richness (the number of species per site (S), the Shannon-Wiener index (H') and the Simpson index (D). Soil samples were also collected from these plots to assess the impact of fire on the below-ground carbon (C) and nitrogen (N) stocks and ratios. No statistical differences were found between the resultant plant communities of the adjacent grassland and the firebreaks, however, certain species favour either the firebreaks or adjacent grassland. *Hyparrhenia tamba*, *Hyparrhenia hirta*, *Eragrostis curvula*, *Richardia*



brasiliensis and *Ipomoea oblongata* prefer firebreaks while *Tristachya leucothrix*, *Heteropogon contortus*, *Helictotrichon turgidulum*, *Helichrysum aureonitens* and *Helichrysum callicomum* prefer the adjacent grassland. The diversity indices do not indicate a difference in diversity. Soil analysis also showed no significant difference in the carbon and nitrogen stocks and C:N ratios between the firebreaks and adjacent grassland, however, trends indicate a decline in both carbon and nitrogen with repeated burning. We, therefore, suggest that the vegetation of the Eastern Free State Sandy Grassland (Gm 4) vegetation type is relatively resilient against annual fires from the data of one season. It is however, recommended that more long term studies (more growing seasons) and the effect of fire on geophytes, parasites and shrubs be researched in future.

PLATFORM PRESENTATION: INVESTIGATING THE RESPONSE OF FORB AND GRASS BELOWGROUND REGENERATION TRAITS TO DISTURBANCE IN A SEMI-ARID SAVANNA

*Tsumbedzo Ramalevha**, Dave Thompson, Frances Siebert

African savannas are ecosystems driven by fire and herbivory and the absence of these drivers can lead to loss of plant diversity. These ecosystems are characterized by herbaceous layer co-dominated by forbs and grasses. Post-disturbance regeneration of the herbaceous layer occurs mostly by resprouting from the belowground bud bank. Assessing the response of belowground bud bank density and bud-bearing organs composition and density to disturbance can assist in predicting plant community response and resilience. This study aimed to assess the responses of the herbaceous belowground regeneration traits (bud bank and bud-bearing organs) at a community level to different fire frequencies with and without herbivores. The hypothesis was that forb and grass belowground bud bank density and bud-bearing organs composition and density would respond differently. To assess how forb and grass belowground regeneration traits respond to fire and herbivore treatments, we measured the density of forb and grass belowground bud bank and bud-bearing organ proportion in each of 10 0.5x0.5 m quadrats at seven sites. Six of the sites experienced burning for >65 years (annual burn, triennial burn and unburn) and had herbivore exclosures for >15 years. Grass bud bank density did not change significantly across fire treatments with and without herbivores, while forbs bud bank density increased when herbivores were excluded. Non-woody rhizome, root crown, stolon, bulb, woody rhizome, and root tuber were the main belowground structures on which buds were identified across the fire treatment. Triennial fire frequency (particularly without herbivores) had high bud-bearing organ diversity and high bud bank density. While the exclusion of fire (Unburn) in the presence of herbivores had the lowest bud bank density. The results indicate the importance of triennial fire frequency without herbivores to the preservation of forb and grass belowground bud-bearing organ, ensuring herbaceous layer resilience. We conclude that assessing belowground regeneration traits response to disturbance can provide insightful understanding on how herbaceous plant community cope with disturbance.



SESSION 09 | RANGELAND ECOLOGY AND MANAGEMENT II

SESSION CHAIR: RICHARD FYNN

Thursday 25 July 2024, 11:00 – 12:30

PLATFORM PRESENTATION: EXPLORING THREATS AND OPPORTUNITIES TO THE MAPUTALAND WOODED GRASSLAND: A COMMUNITY-CENTRED APPROACH

Susan Janse van Rensburg, Londiwe Gule, Sulinkhundla Maseko, Michele Toucher*

Umhlabuyalingana Local Municipality (ULM), in north-eastern KwaZulu Natal, lies within the Indian Ocean Coastal Belt, with Maputaland Wooded Grassland (MWG) as its primary vegetation. This groundwater-dependent area sustains abundant wetlands, including Lake Sibaya, South Africa's largest freshwater lake. Unlike other regions, the aquifer and associated wetlands rely solely on local rainfall for recharge. ULM falls within the tropical to subtropical climate transition zone and is considered a climate-sensitive region. The ULM, primarily rural, faces high unemployment, limited economic opportunities, inadequate infrastructure, and low literacy rates. Forestry and tourism form the primary formal sectors. Communities depend on natural resources for livelihoods, such as crafts, and subsistence farming. Ecosystem degradation caused by land use and land cover change (LULCC) threaten the already fragile livelihoods and water security. A notable decline in groundwater levels, approximately 4 meters since 2001, resulted in increased water insecurity prompting calls to remove *Eucalyptus* plantations, which are perceived as economically important. Insufficient understanding of the relative impacts of climate and plantations compared to other LULCC hinders effective action. To address this gap, a three-year study integrating climate, hydrology, LULCC, and economic dynamics was conducted with community participation. A primary aim was to identify alternatives to enhance community resilience while addressing key challenges identified by communities. While water security emerged as the most pressing issue, concerns over the loss of grasslands and bush encroachment were repeatedly raised. Household data and general engagements highlighted the importance of grasslands for livelihoods, food production, crafts and livestock and how the water table decline has negatively impacted these. Paradoxically, some grassland areas were no longer perceived as valuable. It emerged that, despite being in good condition, the reduced availability of open freshwater bodies in these grasslands made them unsuitable for livestock. Other areas are experiencing bush encroachment. Both issues are frustrating ambition to commercialise cattle as an alternative. Analysis revealed significant LULCC over time, with notable increases in developed areas and *Eucalyptus* plantations, while open water and wetland areas decreased alongside grasslands, confirming community observations. Of concern therefore is that hydrological results demonstrated that grasslands are the most effective land cover for optimal groundwater recharge following rainfall. A key recommendation is to prioritise the management and protection of the remaining grassland areas within ULM. Achieving this requires ensuring these grasslands deliver tangible benefits to the communities. Interdisciplinary collaboration with continued engagement with communities is needed to explore and implement management strategies that optimise financial benefits and ecosystem integrity, concurrent with implementing alternative land uses to plantations. Integrating results indicate that potential alternatives, based on community preferences, may provide greater and more holistic benefits (water security, employment/economic security, ecological integrity) than *Eucalyptus* plantations. A major outcome is that traditional councils have sent a plea for those interested to work with them on addressing challenges. By growing a collaborator value chain, from research to implementation, achieving the conservation of this critical ecosystem leading to the



enhanced well-being of the local communities, is tangible and urgently required in the face of climate change.

PLATFORM PRESENTATION: EVALUATING THE CAPABILITY AND USE OF RANGELANDS ON SOUTH AFRICA'S LAND REDISTRIBUTION (PLAS) FARMS

*Aart-Jan Verschoor, Siphe Zantsi**

A lion's share (approximately 69%) of South Africa's agricultural land is only suitable for grazing, by domesticated or wild herbivores. This makes livestock production the dominant agricultural production enterprise in the country. Therefore, rangelands are a critical natural agricultural resource, and rangeland management is key to a successful agricultural sector in South Africa. Since 1997, the Government embarked on a policy of land reform to address historical injustices in access, through three tiers, namely, land restitution, land tenure, and land redistribution. This article focuses on redistribution, specifically using the Pro-Active Land Acquisition Strategy (PLAS). Our objective was to evaluate the rangeland capability of 1,762 PLAS farms across our nine provinces, to evaluate their use. Rangelands were evaluated based on their capability to support livestock sustainably over the long term compared to current usage, with livestock grazing these rangelands. The base information used for this assessment was the long-term grazing capacity norms for South Africa. Grazing capacity was measured in Large Livestock Units (LSU). The rangeland of each PLAS farm was rated using a simple scoring system, as good (score 3) when the grazing capacity was better than 7 Ha/LSU, medium (score 2) when the grazing capacity was between 7 Ha/LSU and 14 Ha/LSU, and poor (score 1) when grazing capacity was lower than 14 Ha/LSU. Using recent satellite imagery from Google Earth, an expert panel from the Agricultural Research Council, comprised of a multi-disciplinary team of scientists, evaluated the rangeland potential carrying capacity and compared these numbers with the livestock actually kept on the rangeland. On average, the age of the PLAS beneficiaries included in this survey was approximately 53 years old, with a vast majority being male, comprising approximately 78% of the overall beneficiary pool. Further, most beneficiaries (41.31%) have secondary levels of education, while 35.29% have tertiary education. PLAS beneficiaries have, on average, 21 years of farming experience. However, only 7% of PLAS farms are currently producing at a commercial scale level. Only 4.1% of beneficiaries have high potential (adequate skill set) of becoming commercial farmers. The more productive rangelands are in the eastern parts of the country where the rainfall is higher. In the drier western parts of the country where Karoo vegetation dominates, mainly mutton, marketable as a product of a unique geographical region of origin, is produced. However, with regards to rangeland and use, about 85% of PLAS farm rangelands are used below their potential capacity. This level of rangeland under-performance varies by province, with the Western Cape farms doing better. We also note that poor rangeland performance and management are related to the general trend of the overall PLAS farm performance, beneficiary skills, and post-settlement support. Improving the disbursement of post-settlement support could increase PLAS farm performance and, in turn, farm incomes, which will improve beneficiary welfare.

PLATFORM PRESENTATION: GRASS SPECIES COMPOSITION AND DISTRIBUTION PATTERNS ACROSS THE THREE ECOLOGICAL ZONES OF MPUMALANGA PROVINCE

Matome Collen Rabothata, Ndifelani Mararakanye, Norman Magoro, Oupa Keromecwe, Thabile Mokgakane*

Grasslands play a crucial role in providing a wide range of ecosystem services, such as micro-climate regulation, habitat maintenance, carbon sequestration, erosion control, and feed for livestock. However, grasslands are under severe threat of degradation due to low and variable rainfall, fire, overgrazing, and bush encroachment, undermining their capacity to support biodiversity and the provision of ecosystem services. Understanding the composition, distribution, and abundance of grass species is key to determining the veld condition and the management of grassland resources. The study aimed to determine the grass species diversity in the three ecological zones of the Mpumalanga Province, namely the Highveld, Lowveld, and Midveld. The objectives were to (a) identify the dominant grass species, (b) develop a



georeferenced database of the grass species, and (c) compare the diversity of grass species between the three ecological zones. Data collection took place from June 2023 to December 2023 using the Survey 123 mobile application for ArcGIS Online. This method allowed for the integration of the collected data with other ArcGIS platforms for storage, visualisation, and analysis. For each site, grass species data was collected on a 100 m line transect at 1 m intervals with Global Positioning System (GPS) readings taken at the start point. Thus, the more abundant grass species occurs on a site, the higher the chances of that species being recorded. The Non-metric Multidimensional Scaling (NMDS) ordination was performed using the function metaMDS in the *vegan* package of R software to explore the variation of grass species across the ecological zones. In addition, the Analysis of Similarities (ANOSIM) (R: *vegan*) with 9999 permutations of the dissimilarity matrix was performed to test statistically whether there is any significant difference between the grass species across two or more ecological zones. A total of 48 genera and 83 species were found in 172 sites distributed across the three ecological zones. The largest genus was *Eragrostis*, with 13 species, followed by *Aristida*, with nine species. The most dominant grass species were *Cynodon dactylon* (n = 974), *Heteropogon contortus* (n = 961), *Eragrostis curvula* (n = 929), *Themeda triandra* (n = 851), *Eragrostis plana* (n = 749), *Eragrostis chloromelas* (n = 705), *Hyparrhenia hirta* (n = 584), *Hyperthelia dissoluta* (n = 577), *Melinis repens* (n = 485), and *Urochloa mosambicensis* (n = 449). The NMDS plot illustrated the compositional similarity among the grass species from the Lowveld and Highveld ecological zones. The distance between some points in an NMDS for the Midveld zone reflects the dissimilarity of the grass species with other ecological zones. The ANOSIM results confirmed that dissimilarity in the grass species across the three ecological zones exists, with a significant $p < 0.05$. However, the R-value of 0.06 suggests that the effect of ecological zones on grass species occurrence is minimal, although we cannot overrule that some species are driven by their ambient environment. The results from this exercise will however give the farmers a guide as to how they should manage their grazing going forward!

PLATFORM PRESENTATION: MEGACARCASSES: A UNIQUE DISTURBANCE TYPE ADDING TO THE SPATIAL COMPLEXITY OF SEMI-ARID RANGELANDS

*Helga Knoetze**, Michelle Budney, Deron Burkepile, Johan Du Toit, Ryan Helcoski, Nate Lemoine, Courtney Reed, Joshua Schimel, Izak Smit, Tercia Strydom, Aimee Tallian, Dave Thompson

Despite the well-known ecosystem engineering impacts of living elephants on savanna ecosystems, we know little about how their carcasses impact savanna ecology. Similar to the megacarcasses of whales that create communities of productivity, and functioning in the deep ocean, the nutrient pulses from elephant megacarcasses may play a similar role in African savannas by being a localised source of nutrient enrichment, impacting ecosystem biogeochemistry, and the community dynamics of vegetation, vertebrates, invertebrates, and microbes. These carcass-derived nutrients have been shown to create distinct plant communities. Our ongoing research in the Kruger National Park (KNP) provides an opportunity to better understand how megacarcasses can drive heterogeneity in semi-arid savannas. Here, we compare plant communities of ten elephant megacarcass sites (< 2.5 m from centre) with those of the surrounding matrix (> 10 m). We found that plant communities at megacarcasses were significantly floristically distinct from the matrix, with this variation being driven primarily by grasses. Additionally, all grass species occurring at carcass sites were palatable. Surprisingly, 71 % of species found at matrix sites were also palatable, suggesting that these carcass sites become zones of fertility, hosting high-quality forage. Nevertheless, the nutritional value of grasses at carcass and matrix sites also differed, with the former being higher in macro- (e.g. N, K) and microminerals (e.g. Cu, Na, Mg) important for grazers. Although 40 % of forb and grass species at carcass sites were prostrate, making them less susceptible to herbivory by ungulates, graze frequency, and intensity here was still higher than in the matrix, which was associated with tufted graminoids. Megacarcasses represent a unique disturbance type which adds to the spatial complexity of semi-arid rangelands by creating hotspots with distinct floristics, and increased forage potential. This study contributes to a growing recognition that megacarcasses have significant effects on terrestrial ecosystems, however, native large mammal



herbivore populations have been altered globally, with particularly the large-bodied species, such as elephants, becoming widely extinct, and anthropogenic pressures, such as the widespread establishment of livestock farming devastating the remaining populations. There has been considerable past research studying the effects of the absence of live elephants in rangelands, such as increased bush encroachment. However, there has been little to no research on the effects of the absence of dead elephants. Our research begins to fill this knowledge gap by exploring the implications of the lack of elephant carcasses (or other large carcasses) on processes such as nutrient cycling, hotspot formation, and grazing quality, which are critical for rangeland functioning and productivity.

PLATFORM PRESENTATION: AN APPLICATION OF MULTI-SCALE REMOTE SENSING IN ESTIMATING GRASS NUTRIENT LIMITATION AS MEASURED BY A RATIO OF NITROGEN AND PHOSPHORUS IN A SAVANNA ECOSYSTEM

Nasiphi Ngcoliso

Nutrient limitations may impact the ecosystem services the savanna biome provides. It may lead to degradation and, consequently, reduce the grazing capacity and the ecological security of the savannas if the necessary control measures are not implemented in time. The key indicator of the growth-limiting nutrients is the Nitrogen to Phosphorus (N:P) ratio. Grass foliar phosphorus content had rarely been investigated in African savannas, especially with remote sensing. Hence, information on the distribution of nutrient limitation is very limited. This study aimed to develop a Sentinel-2-based N:P predicting model and map the spatiotemporal variations of the N:P ratio in the Kruger National Park (KNP) area in the Northern part of the South African savanna biome. This was achieved by simulating the Analytical Spectral Device (ASD) reflectance data from 49 sampling points to Sentinel-2 MultiSpectral Instrument (MSI) configuration dataset. Laboratory-based chemical analysis was conducted to extract the concentrations of N and P from the grass samples. Partial least squares regression (PLSR) and random forest regression (RFR) techniques were used to develop the N:P prediction models from the simulated Sentinel-2 datasets. Results show that the best predicting RFR model explained over 80% of N:P variability with the lowest relative root mean square error (RRMSE) of 14%, with a p-value of less than 0.05. The optimal-predicting model was used to map the distribution of nutrient limitation using Sentinel-2 images across KNP and surroundings. Different parts of the KNP area are either N-limited or co-limited. The observed variations may result from varying environmental factors and anthropogenic activities. The Sentinel-2 N:P ratio estimation accuracies were then compared to the ratio of N:P of data from commercial multispectral (RapidEye and WorldView-2) and hyperspectral (Hyperion and EnMap) sensors. There is no vast difference between the estimation accuracy of these commercial sensors and that of the freely available Sentinel-2 when using RFR. However, when using PLSR, Sentinel-2 produced improved N:P ratio estimation accuracy than the commercial sensors with the highest R^2 value of 0.66 and an RRMSE of 20.696%. This makes Sentinel-2 a cost-effective means for estimating nutrient limitation in a heterogeneous savanna landscape. This study provides decision-makers with a cost-effective tool for managing, sustaining, and restoring the savanna biome which is a crucial step toward retaining the country's ecological security

POSTER SESSION

POSTERS AND RESEARCH PROPOSAL POSTERS

ECOLOGICAL CONDITION MAPPING IN SOUTH AFRICA: HELP US TO ASSESS ECOLOGICAL CONDITION IN THE GRASSLAND BIOME

Stephni van der Merwe Vernon Visser, Curtley Tonkin, Timm Hoffman, Colleen Seymour, Graham von Maltitz, Wataru Tokura, Andrew Skowno*

Assessing and mapping the ecological condition of ecosystems is a key research gap globally, due to the difficulty in detecting changes to ecological structure, function and composition at broad scales. Land cover maps are able to detect changes in the distribution of ecosystems resulting from the major environmental pressures in South Africa, such as urban development, croplands and mining. However, no product exists thus far to assess the decline in ecosystem processes and function to discern the true state of ecological condition. For example, in grasslands in South Africa, the land cover maps cannot distinguish between natural and degraded grasslands, with both lumped broadly as “Natural Grassland”, even though there are fundamental ecological differences between the two categories. With the rapid advancement in technology, we may now be able to detect environmental degradation and disruption to biotic processes. To do this, we use an approach guided by the IUCN Red List of Ecosystems which assesses changes in ecological conditions using key indicators adapted to each ecosystem. To prioritise which aspects of ecological condition are mapped, key pressures, as proxies for ecological condition, were identified for each biome of which disruption of grazing and fire regimes, bush encroachment and invasive alien woody species were ranked as the highest impact pressures for grasslands in South Africa. We are planning on using a combination of methods and metrics to map ecological condition of grasslands and changes therein, such as remote sensing metrics to detect changes in vegetation cover and fire regimes, species distributions as indicators of degradation and changes in species composition. This research forms a part of the SBAPP project (Spatial Biodiversity Assessment Planning and Prioritisation) which aims to develop national and regional spatial databases on ecological condition as an outcome. While some data products will be developed for the entire grassland biome, it is critical that the ecological interpretations thereof are done at the bioregion and/or ecosystem-level, and thus require expert opinion, as well as the perspectives of those who utilise and manage the land, from the outset of the project.

IMPALA SEASONAL HABITAT UTILISATION AND MOVEMENT PATTERNS IN SOURISH MIXED BUSHVELD

Boitumelo Mongale, Alan Barrett, Sellina Nkosi, Leslie Brown*

Impala (*Aepyceros melampus*) populations are abundant in South Africa, spanning state- and privately-owned property. These animals play an important role in nature conservation, the game farming industry and hold economic value for their meat. Seasonality influences the habitat utilisation patterns of Impala, subsequently affecting the utilisation of plant communities in their home ranges. This study examines Impala habitat utilisation at the Loskop Dam Nature Reserve. Braun-Blanquet and TWINSPAN methodologies were used to classify plant communities within Impala seasonal home ranges. Movement and environmental data were collected using a GPS collar fitted on a dominant Impala ram to record Impala movements with high temporal frequency provides information on their behaviour and how they interact with



their environment. Ivlev's Electivity Index was used to determine seasonal habitat preferences and utilisation. Vegetation maps were produced to visualise available plant communities, while home range maps depicted home range sizes. The phytosociological analysis showed six major plant communities identified and classified. There were three structural vegetation units identified, the woodlands, shrublands and grasslands. Vegetation was heterogenous and comprised of 94 different plant species. The selection of the *Euclea crispa-Vachellia karroo* closed woodland plant community by the Impala all year round is a clear indication that this community is a key habitat for the Impala at LDNR. This plant community provided available browse including *Combretum mole*, *Faurea saligna*, *Vachellia karroo*, *Euclea crispa*, *Terminalia sericea*, and *Burkea africana* trees, and grazing such as *Digitaria eriantha*, *Themeda triandra*, and *Setaria sphacelata* var. *sphacelata*. Impala daily average distance travelled varied seasonally with longer distances covered during the dry season ($x = 1,094.35\text{m}$) when resources are scarce, compared to the wet season ($x = 933.38\text{m}$) when resources are abundant. The difference between wet and dry season daily distances travelled by the Impala were not statistically significant (paired t-test: $t = 0.55, p > 0.05 = 0.55$). Woody vegetation density should be monitored in all communities to ensure that the threshold whereafter veld condition declines, is not exceeded. Consistent monitoring measures should be undertaken to guarantee woody species densities persist below 1800 ind/ha, if this increases, suitable management action such as bush encroachment/densification control be implemented. Vegetation monitoring assessments such as burning, measures of grazing and browsing should be performed annually to determine variability reactions. The daily distance travelled indicate that Impala movement patterns were associated with the availability of resources as expected. The tested environmental variables reveal that photoperiod was the main variable which had an effect on the daily distances travelled in the dry season. In the wet season, temperature was the main variable that had an impact on daily distances travelled. Results confirmed predictions that Impala are able to utilise a wide range of habitats, being mixed feeders. Due to differences in vegetation characteristics that determine forage quality and quantity, Impala responded well towards the selection of preferred habitats in different seasons. This research sheds light on the habitat preferences and movements of Impala, contributing to a better understanding of their ecological role and conservation needs.

HOW TO USE INATURALIST AND CARRYMAP AS TOOLS FOR FIELD VEGETATION DATA

*Kagiso Mogajane**

Since 2018 we have leveraged the wealth of data and contributors from iNaturalist to enhance the VEGMAP through the VEGMAPhoto (s Afr) project. iNaturalist's extensive database, supported by a community-driven approach, ensures that information is continuously updated and verified, offering reliable real-time data about vegetation types' species and plant assemblages, among other things. Meanwhile, the CarryMap app is an invaluable tool for VEGMAP users. It provides offline and mobile access to the National Vegetation Map. The application's GPS functionality enables users to pinpoint their exact location and cross-reference it with the vegetation types mapped in the National Vegetation Map, facilitating accurate field identification of vegetation types. Using the CarryMap for vegetation type identification and iNaturalist for vegetation type data collection, the VEGMAPhoto project can achieve higher accuracy and efficiency in the visual representation of vegetation types across South Africa, contributing to the better understanding of vegetation patterns and the field condition of vegetation types.



THE EVALUATION OF DIGESTATE VALORIZATION AS BIOFERTILIZER ON GROWTH PERFORMANCE OF PHASEOLUS VULGARIS (SUGAR BEAN LEGUME) AS COMPARED TO CHEMICAL FERTILIZER

Dikonketso Matjuda, Walter Matjie, Mosotho Rebeccah Sekgwele, Mammiikele Tsatsimpe, Pulane Sebothoma, Lerato Bame Tsalaemang Matsaunyane*

Exploring environmentally eco-friendly approaches to enhance crop growth and productivity are essential for sustainable agriculture and food security in South Africa. This is because the use of synthetic fertilizers in agricultural production over a long period of time result in soil health deterioration. Digestate prepared from anaerobic digestion can be used as a biofertilizer in replacement of synthetic fertilizer, as it contains ample amounts of plant nutrients, mainly nitrogen, phosphorous, and potassium. The objective of this study was to determine the impact of digestates valorization as biofertilizer on the growth performance of *Phaseolus vulgaris* (Sugar bean legume) in a pot experiment. Digestate was collected from a smallholder biogas digester treating pig farm waste at Ondesterpoort. Some elemental digestate composition was as follows: NH₄⁺ (61.22 % TKN), Ca (10.3 g/Kg), Mg (1.43 g/Kg), K (28.6 g/Kg), Na (8.32g/Kg), S (362.33g/Kg), P (13.5 g/Kg), Fe (3.86.g/Kg), Mn (123.14 mg/Kg), Cu (2.69 mg/Kg), Zn (26.13mg/Kg), B (12.8 mg/Kg), Mo (0.62 mg/Kg), TKN (57.00 g/Kg), Al (209.33 mg/Kg), Ni (3.08 mg/Kg), pH (7.72), EC (1459 micS/cm), moisture (95.66%), Total solids (4.34%), Volatile solids (53.72 %DM), *Salmonella* sp. (0 cfu/25g), coliforms (6.64 × 10²). The experiment was performed in a greenhouse in 5L plant pots using the following treatments: digestate, NPK 1:1:1 (31) (positive control), pig manure (positive control) and no fertilizer (negative control). To compare the biomass yield of digestate as compared to NPK 1:1:1 (31) both treatments were applied at a rate of 6 t/ha, 12 t/ha, 24 t/ha and 36 t/h and each treatment had 10 repetitions. The following parameters were recorded: physical (plant height, stem width, nodes, internodes, and number of leaves) and physiological (total chlorophyll content, stomatal conductance, and biomass yield). Preliminary results revealed that a digestate application rate of 12 t/ha promoted early plant germination as compared to other treatments where plant height 5 days after germination was observed to range from 6.9 - 7.3 cm. It was also observed that digestate did not have any negative impact on seed germination at all application rates. In conclusion, it appears that digestate may have potential to be used as biofertilizer as an alternative to synthetic fertilizer. However, optimal rates of application are still being investigated.

THE COMPOSITION OF ANAEROBICALLY DIGESTED CATTLE MANURE FROM SMALLHOLDER BIOGAS DIGESTERS IN NORTH-WEST PROVINCE, AND ITS QUALITY AS A POTENTIAL BIOFERTILIZER

Dikonketso Matjuda, Philippus Steyn, Lerato Bame Tsalaemang Matsaunyane*

Anaerobic digestion (AD) is considered a most suitable technology in manure treatment due to the amounts of biogas produced and its economic relevance. In addition, it has the potential to solve the problem of manure waste utilization and environmental pollution at the same time. Digestate as a by-product of AD is currently regarded as waste in South Africa, despite its nutritional value for soil and plants which can be harnessed if digestate is utilized as a biofertilizer to enhance plant growth and yield. This study investigated the physicochemical and microbial characteristics and biofertilizer potential of digestate produced from 10 biogas digesters installed in smallholder cattle farms in Lehurutshe, Voordonker, and Vrede2, Northwest Province. The pH, total solids, volatile solids, chemical oxygen demand, electrical conductivity, total volatile fatty acids and chemical composition were determined using standard methods for water and wastewater. Microbial analyses were done according to the serial dilution method (10⁻¹- 10¹⁰). The results were benchmarked with Public Available Specifications (PAS) 110 standards (United Kingdom) for quality control of digestate intended to be used as biofertilizer for agricultural purposes. Results for pH, total solids, electrical conductivity, chemical oxygen demand, and total volatile fatty acid in all digestate samples fell within the required PAS110 standard which requires standard limits of 6.5 to 9, 30% to 50 %, <1,500 mg/L, <3,000 μS/cm, and 0.43 COD/g VS respectively. Moisture content in all digestate ranged from 82.05±0.5 % to 95.49±0.38% and did not meet the required limit of <35%. *E. coli* in digestate from 7 digesters out of 10 were 1023±35 cfu/mL to 1068±51 cfu/mL and exceeded the required standard limit



of <1,000 cfu/mL. The *E. coli* concentration marginally exceeded the PAS 110 requirement and may be attributed to the less hydraulic retention time (15 -17 days) the feedstock was retained in the bio-digester in 7 analyzed biodigesters as compared to 20 - 30 days hydraulic retention time observed from the 3 biodigesters. *Salmonella* and *Listeria* were not detected in all digestates and fell within the limit of PAS110 standards which requires 0 cfu/mL in 25g of fresh digestate sample. Heavy metal concentrations in all digestate samples fell within the PAS 110 limits. Ammonia concentrations were present in mineral form in all analyzed digestate which ranged from 50.09±2.19 to 67.09±2.94 % Total Kjeldahl Nitrogen (TKN), while TKN ranged from 47.32±2.03 g/Kg to 57.33±2.36 g/Kg. In conclusion, digestate produced from installed smallholder cattle farms biogas digesters met most of the required EU PAS110 standard for utilization as biofertilizer marginally exceeded *E. coli* and moisture limits. Longer hydraulic retention time may be recommended to enhance *E. coli* reduction wherever possible or post-treatment of digestate that will enhance its sanitary quality and not compromise the available digestate nutrient contents needs to be investigated. Quality management of digestate in South Africa may necessitate policy development that will ensure its high-quality safety standards so as to maximize its marketability, promote a waste-energy circular economy and prevent environmental pollution.

DROUGHT TOLERANCE IN BRACHIARIA HYBRID CULTIVARS MULATO II AND SABIA

Francois Müller, Julius Tjelele, Letty Masemola, Nothando Ngcobo, Fortune Manganyi-Valoyi*

The current unpredictability and variability in temporal and spatial rainfall distribution in South Africa will likely increase with climate change. This has motivated scientists to look for forages that are adapted to extreme bioclimatic conditions. Grasses within the genus *Brachiaria* has been identified as a suitable candidate, with the recent developments of hybrid species that are said to be superior to current commercially available cultivars. However, information about drought tolerance at different stages of development of these hybrids is generally lacking. This study therefore aimed to determine the impacts of drought on two hybrid *Brachiaria* cultivars SABIA and Mulato II in early seedling growth and as mature plants. Pre-germinated *Brachiaria* seeds of each cultivar were transplanted into pots containing a commercial potting soil mix. After planting the pots were watered as needed and the first water-limitation trial was imposed on the plants 1 month after establishment and the second 4 months after establishment. At one month, water-limitation was imposed for 4, 8, 12, 16, 20 and 24 days. At 4 months, water-limitation was imposed for 7, 15 and 30 days. By the end of the experimental periods, the plants were uprooted, and morphological measurements were done. Results from this study show that both *Brachiaria* hybrid cultivars can be regarded as moderately drought tolerant as most negative effects were generally observed only after several days of water-limitation in both seedling and mature plants. Much of the drought tolerance of these *Brachiaria* cultivars could be attributed to their root growth, which is either not influenced by moisture stress or only after 12 to 15 days of water-limitation, when negative effects were observed. This attribute allows the plants to take up available moisture for longer periods without compromising the allocation of resources to shoot growth, which in this study resulted in little to no influences on crown growth in mature plants, or only negatively influencing seedling crown growth after 12 days of water-limitation. Furthermore, although leaf number in seedlings of both cultivars and mature Mulato II plants were not influenced by water-limitation, leaf length and width in seedlings and leaf width in mature plants were significantly reduced by water-limitation. This, in turn, could significantly influence total biomass yield and the nutritional quality of the fodders produced. Therefore, although these *Brachiaria* hybrid cultivars display several adaptations in morphological traits to help them survive under water-limited conditions, further research is needed to determine how moisture limitation may influence the nutritional quality of these hybrid *Brachiaria* cultivars.

TEMPORAL CHANGES IN PLANTAIN FORAGE QUALITY DURING REGROWTH

Maria Lombard, Sigrun Ammann*

The grazing cycle of intensively used dairy pastures is important in the overall productivity and efficiency of the pasture system. The criterion mostly used to decide on the grazing cycle, is physiological stage of the plant, in an effort to optimize yield and persistence. Forage quality is also an important criterion, and for species like ryegrass, for instance, it is known that the forage quality and the three-leaf stage are closely linked. In the case of plantain (*Plantago lanceolata*) the physiological stage is less important in terms of persistence and yield. In this study, a sequence of samples was taken following defoliation to determine the forage quality of plantain as the regrowth phase progresses and ascertain the optimal timing of grazing in terms of forage quality. Plantain was defoliated and sampled on a weekly basis for 6 weeks. Approximately 400 g of pasture was cut at 50 mm height and weighed wet, dried at 70 °C and weighed dry. Samples were then milled with a hammer mill, using a 1 mm sieve. It was analysed using NIRS (Dairyland Laboratories, Inc.) Crude protein (CP) and water soluble carbohydrate (WSC) values followed the expected trends, i.e. CP decreasing over time and WSC initially decreasing and then increasing to a peak, and then decreasing thereafter. CP stayed within a reasonable range from week 1 to 5, peaking at week 2 with 22.6% (SE = 0.61). Week 6 tended towards being too low but was still reasonable at 16.9% (SE = 0.41). Weeks 5 and 6 were significantly lower than weeks 1 to 4, with weeks 4 and 5 at 20.7% (SE = 0.63) and 18.3% (SE = 0.45), respectively. WSC increased from week 3 at 10.6% (SE = 0.55), peaking at week 5 with 14.3% (SE = 0.88). There was no significant difference between weeks 4 and 5, with week 4 at 12.4% (SE = 1.27). WSC decreased from 13.2% (SE = 0.70) at week 6, and onwards. The WSC:CP ratio follows the S-curve. The ratio peaked at week 5 at 0.8% (SE = 0.07) and then levels off. Neutral detergent fibre (NDF) content followed a quadratic function. The lowest value, 30.8% (SE = 0.99) is at week 4, but all NDF values are highly favourable. Lignin decreases linearly. The data shows that the main quality parameters informing decision making for defoliation interval to be WSC and CP, with the most favourable ratio (according to this dataset) at week 5 (thus a 35 day rotation). Initial nitrogen (N) fertilization was done 4 days after defoliation. An earlier application may have led to an earlier peak in the WSC:CP ratio. But how flexible is the grazing window? From a CP and NDF perspective, this pasture can be grazed from a 21 to 35 day interval, with no negative effects. However, when taking WSC into account, a 28 to 35 day cycle would be favourable. This trial should be repeated in spring/summer.

ARBUSCULAR MYCORRHIZAL FUNGI AND RAW CATTLE SLURRY DETERMINE THE GROWTH, FORAGE YIELD AND NUTRITIVE VALUE OF PERENNIAL RYE GRASS (LOLIUM PERENNE)

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In addition to inorganic nitrogen fertilizers, most pasture-based dairy farms use slurry to fertilize their pastures. The benefits include reduced fertilization costs and amelioration of the negative effects of excessive inorganic fertilizer use, such as increased soil acidity and reduced soil microbiota. Varying levels of sole slurry and slurry plus inorganic fertilizer applications have been used to fertilize pastures with contrasting results. The efficiency of organic fertilizer utilization can be improved by the use of beneficial soil microorganisms such as arbuscular mycorrhizal fungi (AMF), which can acquire nitrogen from decomposing organic patches and transfer some of it to the host plant. To test the effect of AMF inoculation and N slurry level on the growth, yield, and herbage quality of perennial ryegrass, a two-factorial (2 x 4) greenhouse pot experiment was conducted. The slurry N levels were 0 kg ha⁻¹ (N0); 60 kg ha⁻¹ (N1); 150 kg ha⁻¹ (N2); and 250 kg ha⁻¹ (N3), with two levels of AMF inoculation: inoculated and uninoculated. There were three replicates, resulting in eight treatment combinations randomly assigned to 24 pots. A two-way ANOVA was used to evaluate the effect of N slurry levels, AMF, and their interaction on shoot and root biomass, chlorophyll, leaf area, leaf length, and plant height.



Chemical nutrients evaluated were crude protein, ash, organic matter, crude fiber, NDF, ADF, and ADL. Increasing levels of N in cattle slurry and inoculation with AMF had no significant effect on leaf chlorophyll, root biomass, shoot biomass, leaf length, and plant height. Inoculation significantly increased leaf area with an increase in slurry N. A significant interaction of slurry N and AMF resulted in higher levels of N decreasing shoot biomass, organic matter, and crude protein of inoculated grass, while root biomass, ash, NDF, and ADF increased in inoculated grasses with an increase in slurry N. Most of the nitrogen from slurry was used to grow the roots of AMF at the expense of the shoots. Higher levels of slurry N (250 kg ha⁻¹) have a detrimental effect on the fiber qualities of grasses, while slurry levels of 150 kg ha⁻¹ result in the highest crude protein and organic matter. At lower levels of slurry N, AMF does not promote the growth of ryegrass; hence, AMF should be used with 150 kg ha⁻¹ slurry levels for optimum growth and nutritional quality.

COMPARATIVE GRAZING CAPACITY AND VELD CONDITION STATUS OF LRAD BENEFICIARIES' FARMS IN THE EASTERN CAPE PROVINCE

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Grazing capacity, also known as carrying capacity, is defined as the average number of livestock and/or wildlife that may be sustained on a grassland that fits the management goals. However, Land Redistribution Agricultural Development (LRAD) farming systems have shown to have agricultural practices lacking of adequate monitoring system that controls the availability of grazing resources. Additionally, there has been different perceptions regarding deterioration of veld condition and land capability of the farms acquired through these programmes with some attributed to previous occupants while there is also blame to current owners. The aim of this work was to assess the veld condition and determine the carrying capacity for grazers and browsers in order to understand the range condition status of LRAD farms in Amathole & Alfred Nzo district municipalities (DM). These regions have different vegetation and climatic conditions. Alfred Nzo is characterised by high precipitation, including snowfalls on the mountains in winter and high summer rainfall while Amathole enjoy mild temperate conditions ranging between 14 and 23°C. Of the two participating DMs, veld condition assessments were conducted to show rangeland productivity between 10 randomly selected farms per district. At each site, three 100m parallel transects were laid out 25m apart. Botanical composition and basal cover of the herbaceous layer were assessed using the step point method and within 100m parallel belt transects with woody plant species identified and counted to evaluate their composition. From the surveyed farms per district, we observed a marginally higher proportion of increaser II grass species in Alfred Nzo (55.6%) when compared to Amathole (53.9%) DM. On the other hand, the decreaser grass species were slightly fewer in Amathole (13.8%) by 2.7% when compared to Alfred Nzo's 16.5%. The greater abundance of increaser species in Alfred Nzo were a clear indication of grazing land deterioration and observations that numerous farms were overstocked during the survey. Fewer farms in Alfred Nzo had relatively good veld condition indicated by the presents of decreaser species. Implications from the data show the need for the application of appropriate grazing management practices and controls of available grazing resources.