

Grassland Society of Southern Africa

57th Annual Congress

Aldam Resort & Conference Centre, Free State, South Africa

25 - 29 July 2022



PROCEEDINGS

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KEYNOTES



Nico Smit is a Professor in the Department of Animal, Wildlife and Grassland Sciences at the University of the Free State. His research involves bush thickening, savanna dynamics, rangeland management, ecological modelling and the game ranching industry. Prof Smit is a long-standing member of the GSSA, previously serving as an assistant scientific editor and president of the society. He also received several awards from the society. He published over 60 scientific papers and two books on the *Acacia* trees of South Africa. The development of the BECVOL-biomass quantification model gave him national and international recognition. Prof is officially retiring from the University of the Free State at the end of July 2022 to further pursue his career in consultations and his international photography business.



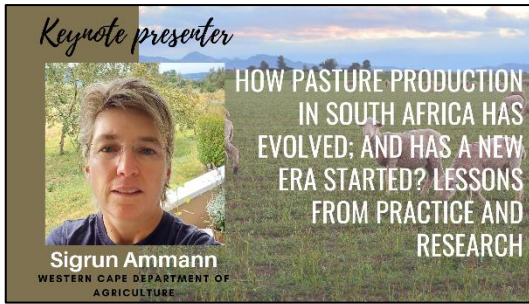
Michiel Scholtz is a Specialist Researcher in Applied Animal Breeding at the Agricultural Research Council - Animal Production and Affiliate Professor at the University of the Free State. Although he retired in 2018, he is continuing with his research and the mentoring of students. His current research focus is on climate-smart beef production systems and breeding objectives to mitigate global warming for sustainable food production.



Dr Mzileni completed a BSc Advanced Major in Biology at the University of St Francis Xavier, a BSc Honours and Masters degrees in Wildlife Management from the University of Pretoria and a DTech from Tshwane University of Technology. She specialises in large mammal behaviour and currently works as a Regional Ecologist for the Arid and Central Nodes of SANParks.



Professor Tally Palmer (BSc UKZN, Hons, MSc, PhD Rhodes University) has just retired from being Director of both the Institute for Water Research, Rhodes University; and the Water Centre of Excellence in the African Research Universities' Alliance. Along with Silver and Gold medals from the Southern African Society for Aquatic Scientists, and a Women in Water award, she is a pioneer of engaged, transdisciplinary, sustainability research in South Africa. Her Adaptive Systemic Approach is designed to support transformations towards fairness for society and ecosystems (social-ecological justice). Tally's passionate research and practice spans aquatic ecology, water pollution, water governance and water resources management.



Sigrun completed a BSc Agric in Grassland Science and an MSc Agric in Crop Science. She worked at the ARC Pasture Breeding division at Cedara from 1994 to 2013. Thereafter she joined the Grass and Forage Science division of KZNDARD at Cedara as a pasture scientist and in 2015 transferred to the Outeniqua Research Farm of the Western Cape Department of Agriculture near George. Much of the work is focussed on improving dairy pasture systems to be more productive and resilient by looking at amongst other things alternative, more resilient species which have the required forage quality to support dairy production. The Outeniqua Research Farm is well connected to dairy producers, the seed industry through SANSOR members amongst others, which gives valuable insights into the practical challenges for dairy farming in the southern Cape. The work also involves gaining a better understanding of the dynamics of mixed species pasture production.



Paul Avenant obtained a National Diploma in Pasture Science Pretoria Technicon and was employed as pasture science technician at the Roodeplaat Range and Forage Institute from 1988-1998. From 1998 to 2007 he was employed by the ARC Range and Forage division, situated in Bloemfontein at the University of the Free State. He obtained a B.Agric.(Hons.) in Pasture Science: Wildlife Management in 2002. In 2007, he accepted a position as Production Scientist at the National Department of Agriculture (D:LUSM) in the sub-division for Natural Resources Inventories and Assessments. Mr Avenant's responsibilities and achievements include: AGIS data assessment and systems development; Responsible for the assessment, and management of spatial natural resource data; Co-author of the book "Grasses of the Kalahari regions"; Responsible for the National Bankrupt bush survey and control strategy; and, he is responsible for the development of the new grazing capacity map of South-Africa for dairy farming in the southern Cape. The work also involves gaining a better understanding of the dynamics of mixed species pasture production.

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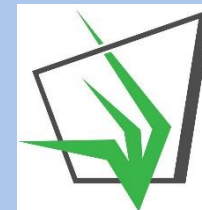


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SESSION 01 | CLIMATE CHANGE

SESSION CHAIR: FRANCOIS DEACON

Tuesday 26 July 2022, 08:00 - 10:15

KEYNOTE ADDRESS: AN UPDATED PERSPECTIVE ON THE CONTRIBUTION OF EXTENSIVE RUMINANT PRODUCTION TO GREENHOUSE GAS EMISSIONS IN SOUTHERN AFRICA

Michiel Scholtz

Agricultural Research Council - API / University Of The Free State

There is a general perception that ruminants produce large quantities of greenhouse gases (GHG), which contribute to global warming. Ruminant production is also in the spotlight as it is the world's largest user of land and Southern Africa is no exception. Only ruminants can utilise areas of non-arable land where the vegetation is rich in fibre and convert this fibre into high-quality nutrients for human consumption, which is often ignored. Recent estimates indicate that livestock are responsible for only 4% of the world's greenhouse gas emissions through methane production, compared to the initial estimate of 18% by the FAO. In addition, latest estimates indicate that the total GHG emissions directly related to livestock production in Southern Africa did not increase over a period of 20 years (1990 -2010), whereas the livestock production related GHG emissions intensity (carbon dioxide equivalent / kg animal product) in the Southern African region was reduced by 40% (from 123 to 62 gigagram CO₂ equivalent / kg animal product). It is speculated that most of this decrease in the GHG (mainly methane) intensity is the result of increased productivity and genetic selection. Three recent studies in South Africa indicated that: (1) The GHG intensity (methane) between beef breeds in South Africa can differ by up to 44%. In this case greenhouse gas intensity was estimated as the kg methane/kg live weight of cattle leaving the farm per annum. (2) The productivity in the cowherds of four South African landrace beef breeds increased by between 10% and 18% over a period of 25 – 30 years. This resulted in a decrease in the carbon footprint, as defined by the enteric methane emissions factor, of between 7% and 12%. (3) Crossbreeding between indigenous and exotic breeds can have small to moderate effects on the methane efficiency (kg calf weaned per kg methane produced) of weaner calf production under extensive conditions. Improved ruminant productivity can be achieved through the use of indigenous and adapted genotypes, alternative breeding objectives (to improve productivity and not merely production), alternative production systems (e.g. crossbreeding), as well as management. These interventions will be the key to sustainable production with a low environmental impact.

KEYNOTE ADDRESS: ADAPTIVE CHANGE FOR CLIMATE ADAPTATION

Nkabeng Mzileni

SANParks

Biodiversity carries a variety of values, some of which protected areas safeguard from various threats such as poaching, urbanization and mining. Some threats, such as climate change, carry more intense challenges than others. Protected areas are seldom fully intact ecosystems. Global environmental change-drivers influence biodiversity even within protected fenced areas containing large terrestrial animals. For large mammals, climate change which alters environmental conditions can lead to changes in distribution, reproductive success, foraging behaviour and even death. The implications of these changes can influence the long-term survivorship of species. Conservation authorities aim to manage, maintain, restore or mimic ecological processes when managing a gradient of largely intact to degraded protected areas. The restoration of dynamic ecological processes provides numerous opportunities that can contribute to conservation initiatives. Authorities therefore use enabling elements and benefit from embracing learning by doing through applying strategic adaptive management. Climate change creates a complexity and uncertainty that challenges our conservation strategies of large mammals. It is these uncertainties and complexities that need to be resolved to achieve management objectives even though the effects of the management action are in themselves an uncertainty. The use of adaptive management in the face of climate change can be addressed by the development of a framework using models that direct ecological management of wildlife. This framework uses an approach that combines models as simplified representations of real-world scenarios based on empirical data. This framework illustrates due diligence to climate change implications on biodiversity.

PLATFORM PRESENTATION: IMPACT OF CLIMATE CHANGE ON WIND (SPEED/DIRECTION) AND ITS EFFECT ON THE TRAVEL DIRECTIONS OF GIRAFFES (GIRAFFA CAMELOPARDALIS)

Rinae Mukwevho, Francois Deacon, Adriaan Van Der Walt*

There is limited research on climatic changes such as wind speed and direction influencing movement patterns of large mammals, e.g., zebras, buffalo, elephants, and particularly giraffes. Knowing these patterns and directions at high and low wind speed will help in the management and understanding complex functioning of these animals. In this research, we investigate whether the shift in the wind speed patterns and direction influences giraffes to travel upwind or downwind. Two male and two female giraffes were fitted with GPS collars, in the Rooipoort Nature Reserve, in the Northern Cape Province which allowed the collection of hourly data on their movement directions and patterns for 12 months, from October 2017 to November 2018. The climatic data extracted from the weather station located within the reserve was used to determine the occurring wind speed and direction computed using R software. The giraffes travelled upwind within each month (January, August, and October) when the average wind speed was between 6.63 m/s and 8.29 m/s towards the southward direction of the reserve. Therefore, the travel direction was predominantly upwind during high wind speeds. The average travel direction of giraffes was different each month, and about 30% of the time each month, giraffes travelled in the direction of low wind speed (0 – 1.66 m/s). It is concluded that wind speed and direction influence the complex movement and travel direction of giraffes and giraffes predominantly browse upwind.

PLATFORM PRESENTATION: FACTORS AFFECTING FINE-SCALE VARIATION IN GRASS OCCURRENCE PATTERNS IN A DRAKENSBERG GRASSLAND

Bridgette McMillan, Peter Le Roux*

Climate change is strongly altering the distribution of some, but not all, species. Forecasting how species ranges will shift under future conditions is key to efficient conservation planning and mitigation actions. Traditionally, these range shift predictions have been based on broad-scale (i.e. regional, national or continental) studies, but examining what drives fine-scale variation in distributions may provide additional, complementary insights. This study examined the relationship between the fine-scale (1 m²) occurrence patterns of dominant grass species and abiotic data collected from a Drakensberg grassland (at c. 2000 m a.s.l. in Golden Gate Highlands National Park). Specifically, the study tested if species occurrence patterns were related to several ecophysiologicaly-relevant abiotic variables. The occurrence of the ten most dominant grass species in the study area were related to a combination of microclimatic, topographic and edaphic variables. Soil moisture had a negative relationship with the probability of occurrence of five species and soil temperature was positively related to the probability of occurrence of five species, but also negatively related to the occurrence of another two species. Of the environmental variables not directly reflecting climate, mesotopography, soil texture, soil carbon and soil pH were also related to the occurrence of at least eight of the dominant grass species but showed inconsistent patterns, as they affected approximately an equal number of the species positively and negatively. Even after accounting for the influence of the eight predictor variables measured, grass occurrence patterns were strongly related to sampling grid identity. This suggests that there are still key unmeasured environmental conditions (including, e.g., potentially soil nutrient content) that need to be considered when modelling grass occurrence patterns. Therefore, these results highlight that grasses' responses to changing temperature and rainfall conditions may be species-specific and, potentially, constrained by non-climatic environmental conditions.

PLATFORM PRESENTATION: MODELLING THE CURRENT AND FUTURE SPATIAL DISTRIBUTION OF SUITABLE AREAS FOR VERNANOETHURA POLYANTHES USING MAXENT IN ZIMBABWE

Soul Washaya, Dorine D Washaya, Tawanda Manyangadze*

The changes in global climatic events have significantly resulted in the promulgation of invasive terrestrial species. The objective of this study was to predict the current and future distribution of *Vernanoethura polyanthes* and, determine the environmental and climatic factors that influence its distribution. The species has invaded Chimanimani, Mutare and Chipinge districts after it was introduced by cyclone Eline in 2000. It is believed to invade areas with high soil nitrogen and phosphorus, plantations and abandoned crop fields. Two climatic variables; temperature and precipitation were considered because temperature explains the spatial distribution whereas precipitation affects plant species distribution and population dynamics. The MaxEnt model which determines current and future potential distribution was used to estimate the relationship between species occurrences and, a set of climatic or environmental variables. The environmental layers used in this study were obtained from the Africlim portal. The 19 bio-climatic and environmental variables were chosen to determine plant species distribution. Various models were tried and the final model employed was quadratic, hinge, and linear feature types. The area under the curve (AUC) was used to measure model accuracy and the percentage contribution of each variable to the model output was used to show the significance of each variable in the model. The study used two methods to evaluate model performance. Firstly, the evaluation was done by assigning a subsection of the present record for training 75% and building the model and the

outstanding 25% records to test the resulting model. Secondly, the receiver operating characteristic (ROC) analysis was used to evaluate how well the MaxEnt model compared to a random prediction. A 90% sensitivity criterion was used to distinguish suitable from unsuitable habitats. A GPS was used to collect points with species (presence-only data). Results showed that moisture in the driest quarter, mean temperature in the coolest month, temperature seasonality and rainfall in the driest month were important predictors for presence-only data. Rainfall in the driest quarter, isothermality, annual temperature range, and rainfall wettest month had no significant effects on the presence data of *V. polyanthes*. The suitability area of approximately 3.6% in the study area was occupied by *V. polyanthes*. It is anticipated that invasion will continue up to 3.9% by 2085 and rainfall wettest month and mean temperature in the coolest month will cause this increase. Therefore, we conclude that the species is invasive with the capability to invade areas with high rainfall and cool temperatures.

POSTER SESSION 1

Climate
Change

Bush
encroachment
and alien
invasive plants

SESSION CHAIR: JAMIE PAULSE

Tuesday 26 July 2022, 10:15 – 10:45

Posters can be viewed on twitter @ <https://twitter.com/GrasslandSocSA>

STANDARD POSTER: FLUCTUATIONS IN ENTERIC METHANE PRODUCTION OF EXTENSIVE BEEF CATTLE GRAZING NATURAL RANGELAND OVER A FULL PRODUCTION CYCLE

Marsia Grobler, Michiel Scholtz*

Due to approximately 70% of agricultural land in South Africa not being suitable for crop production, extensive beef production, among others, plays a major role in the agricultural sector of South Africa. The largest contribution to greenhouse gases due to beef production comes from the enteric methane produced in the gastrointestinal tract, accounting for 16 percent of global methane emissions. Current methods used to estimate methane emissions from beef cattle are largely based on generic values not taking into account the differences in production systems between countries, regions, or climatic zones. Thus, it is important to obtain methane emission data under local farming conditions. The aim of the study was therefore to measure enteric methane emission of extensive Bonsmara cattle grazing Sourish Mixed Bushveld over a full production cycle at the ARC-Roodeplaat Research Station. A production cycle was defined as from the time a heifer was weaned until she weaned her first calf which also relates to different physiological stages (growth, pregnancy, lactation) over different seasons. Methane was measured with a non-invasive Laser Methane Detector. The 26 Bonsmara heifer weaners allocated to the study were divided into two uniform groups of 13 heifers each according to date of birth and weaning weight. Methane measurements commenced at weaning (July 2017) and continued until the heifers weaned their first calves (July 2019). Animals were mated over a 3 month mating season (January 2018 – March 2018). Calves were weaned at approximately 210 days of age (July 2019). Methane production was the lowest during spring 2017 (27.7 kg/heifer/year) when the heifers were still growing and highest during summer 2019 (54.4 kg/cow/year) when the cows were in early lactation. This difference can probably be linked



to both physiological state and season, which will be investigated. These results are lower compared to published results, i.e. based on the IPCC Tier 2 level. However, this is not unexpected since methane concentration measurements cannot be used interchangeably without identifying and correcting for the inherent variabilities, including different methods used for each study. The methane produced (kg ha⁻¹) per large stock unit (LSU) was 5.2 during summer 2018 when animals were not pregnant, which is much lower than the 9.5 (kg ha⁻¹ LSU⁻¹) obtained in summer 2019 when the animals were in early lactating. Although the study was too short to obtain long-term results, it seems that the methane production was the lowest when the animals were still growing and highest when nutritional needs related to intake were the highest during early lactation. Methane production started to decrease again during late lactation before calves were weaned.

STANDARD POSTER: THE EFFECTS OF DROUGHT STRESS ON FLOWERING PHENOLOGY AND GROWTH OF THREE GRASSLAND FORB SPECIES

*Thandwayo Mbambo**, Michelle Tedder, Sandy-Lynn Steenhuisen

Forbs make up a large proportion of the total species and functional richness in grassland ecosystems. Climate change has been shown to affect grasslands by increasing graminoid and shrub above-ground productivity and decreasing forb density. Moreover, an increase in frequency and severity of droughts is also projected as a result of climate change. Little is known about the role of drought on the growth and flowering phenology of forb species. This study aimed to assess the impacts of drought on plant height, leaf production, flowering phenology and plant density. A field experiment was conducted from the 19th of October 2021 to the 4th of March 2022 on the University of KwaZulu Natal's research farm Ukulinga, Pietermaritzburg. Three common grassland forb species (*Thunbergia atriplicifolia*, *Cephalaria pungens* and *Senecio coronatus*) were investigated under three drought levels: a) Drought (50% rain); b) Added rain (150%) and c) Control (100%) when the total rainfall recorded for the period of the experiment was 821.45mm. Drought was simulated using rain shelters, and the added rain treatment was established by collecting and channelling run-off from the drought treatment into the added rain treatment. Each treatment was replicated three times. The experiment was arranged in a randomized block design. Four individuals of each species were evaluated in each plot. Our results show that in the drought treatment, the flowering stage of *C. pungens* was extended by one week. In the case of *T. atriplicifolia*, flowering was advanced by a week in the added rain treatment. And, although flowering started at the same time between the drought and the control, it extended for an extra week in the drought treatment. *Senecio coronatus* did not flower throughout the sampling period in any of the plots. Plant density, the total number of flowers in a plot and number of flowering plants per plot was lowest in the drought treatment for all the species. The response of plant height and number of leaves was modelled by fitting separate generalized mixed-effect models (GLMM) to each species, assuming a Gaussian and Poisson error distribution respectively. The results show that drought had the greatest reducing effect on plant height for all species. This was strongest for *C. pungens* (N= 99, est. = -28.756, std. error = 2.995, p< 0.0001) in comparison to *T. atriplicifolia* (N= 124, est. = -14.151, std error = 0.905, p< 0.001) and *S. coronatus* (N= 120, est. =-11.232, std error = 1.11, p< 0.0001). Drought (N= 124, est. -0.865, p< 0.0001) and rain treatment (N= 128, est. -0.212, p< 0.0001) significantly reduced the number of leaves for *T. atriplicifolia*. In contrast, these treatments significantly increased the number of leaves for *S. coronatus*; drought (N=120, est. 0.345, p< 0.0001) and rain (N=116, est. = 0.270, p< 0.0001). The drought and rain treatments had no effect on number of leaves for *C. pungens*. These results suggest that 25% rain for the 137 days between 19 October 2021 and 4 March 2022 could affect plant-pollinator interactions and possibly reduce reproductive success.

STANDARD POSTER: AN ANALYSIS OF RANGELAND DATA COLLECTED DURING VELD CONDITION ASSESSMENTS IN MPUMALANGA

Matome Collen Rabothata, Theunis Morgenthal, Oupa Keromecwe*

A regular task of rangeland scientists within Government institutions comprises of veld condition assessments. Such assessments are used to support regulatory function and administrative decision-making or are used for baseline information to support planning of projects. The results from these surveys often remain in reports and their broader value for regional assessment is overlooked. The aim of the study was to explore relationships among grass species data and environmental variables to improve the prediction of veld condition and grazing capacity estimation and monitoring. The study evaluates survey data collected during routine veld condition requests in the Mpumalanga Province. The data comprises of grass species frequency data, basic site observations, and an estimation of the grazing capacity, based on a visual assessment method collected in the Mpumalanga Province from 2015 until 2021. Veld condition scores were calculated for each site and compared with grazing capacity data from a visual assessment. The abundances for dominant grass species were compared amongst vegetation types, using frequency distribution tables. Natural resource information was related to species data using multivariate analysis techniques. Grazing capacity values estimated using the visual assessment method varied between 3.1 ha/LSU and 13.8 ha/LSU for the 311 sites. The dominant grass species within the database were *Themeda triandra*, *Eragrostis plana*, *Heteropogon contortus*, *Eragrostis curvula* and *Megathyrsus maximus* (*Panicum maximum*).

STANDARD POSTER: EFFECTS OF BUSH ENCROACHMENT INTENSITY ON HERBACEOUS VEGETATION IN SEMI-ARID SAVANNA RANGELANDS OF THE EASTERN CAPE PROVINCE, SOUTH AFRICA

Inga Mgushelo, Conference Thando Mpendulo, Andiswa Finca, Julius Tjelele*

Bush encroachment (BE) is a global phenomenon that is recognized as a contributing factor to poor and unproductive rangelands. Increasing bush densities in semi-arid Savanna rangelands reduces the growth of herbaceous vegetation, causing a decline in the grazing capacity of the rangelands and subsequently leading to rangeland degradation. This study explored the responses of the herbaceous vegetation to different bush encroachment levels (BELs) made through a selective thinning method using chainsaws. The study was conducted between December 2019 and March 2020 on a bush encroachment trial located at the University of Fort Hare's Honeydale Farm, in Alice, Eastern Cape. The trial comprised a total of fifteen plots of equal size (800 m²), made up of five treatments referred to as bush encroachment levels in this study, namely 12%, 25%, 50%, 75%, and 100%, randomly laid on three rows and each replicated three times. The 100% bush encroachment level represents the condition of the site prior to bush thinning. Parameters that were measured within each plot included herbaceous species composition, grass biomass production, tuft density, and mean point-to-tuft distance. The data were analyzed using the General linear model of Statistical Analysis Software, 2010. Grass biomass production was significantly ($p < .0001$) affected by bush encroachment levels, and it decreased linearly ($r^2 = 0.83$) with increasing bush encroachment levels. Grass biomass production was significantly higher at 12% bush encroachment level (1533.33 kg/ha) than in other bush encroachment levels, with 25% (955.56 kg/ha), 50% (973.33 kg/ha), and 75% (875.56 kg/ha) bush encroachment levels exhibiting similar grass biomass production. While 100% (568.89 kg/ha) bush encroachment level had the least grass biomass production. Mean point-to-tuft distance was affected ($p = 0.0027$) by treatments and increased ($r^2 = 0.96$) as bush encroachment levels increased, with mean point-



to-tuft distance ranging from 2.3, 3.0, 4.0, 4.2 and 4.7 cm at 12, 25, 50, 75 and 100% bush encroachment levels, respectively. The bush encroachment levels had a significant effect on tuft density ($p = 0.0077$) and it decreased ($r^2 = 0.75$) with increasing bush encroachment levels, with 12% (51.56 tufts/m²) and 25% (54.56 tuft/m²) bush encroachment levels having the highest tuft densities. The Decreaser and Increaser species exhibited differential responses to bush encroachment levels. Decreasers increased from 37, 47, 58, 64, and 64% relative abundance (under 12, 25, 50, 75, and 100% BELs) as bush encroachment levels increased, while Increasers decreased from 63, 53, 42, 36, and 36% relative abundance (under 12, 25, 50, 75, and 100% BELs) as bush encroachment levels increased. The most dominant, highly nutritious species were *Panicum maximum* and *Panicum stafianum*. We concluded that bush encroachment levels of $\geq 50\%$ have detrimental effects on grass biomass production, tuft density, species richness, and amplifies soil bareness, while those $< 50\%$ (12% and 25% BELs) show the opposite. This signifies that thinning to 12% and 25% bush encroachment levels is necessary to restore herbaceous vegetation in the semi-arid Savannas of the Eastern Cape Province, South Africa.

STANDARD POSTER: THE EFFECTS OF HERBICIDE APPLICATION AND STEM SIZE ON THE RESPROUTING ABILITY OF WOODY PLANTS

*Piet Monegi**, *Ntuthuko Mkhize*, *Julius Tjelele*, *David Ward*, *Zivanai Tsvuura*

While mechanical and chemical methods are widely used to control woody plant encroachment in many African countries, very little is known about the effectiveness of these control methods among woody species of different ages. We conducted a field experiment to determine (1) the effects of different tree removal treatments (10%, 20%, 50%, 75% and 100%), and herbicide application on resprouting ability and vigour of 12 woody plant species. We examined 20 plots (30 m x 30 m) each subjected to tree removal by cutting stems at 0.25 m height from the ground surface, followed by herbicide application on half of the stems for each species in each plot. All the tree species in this study resprouted after cutting. There were significant differences among species with respect to shoot production, the most sprouts being for *Ehretia rigida* and the least for *Vachellia robusta*. Herbicide application significantly reduced the resprouting ability of *Dichrostachys cinerea*, *E. rigida*, *V. robusta* and *Ziziphus mucronata*. The diameter of stems was an important factor in determining resprouting ability, with shoot production decreasing with increasing stem diameter. We found that woody plants are more likely to resprout and survive as juveniles than as adults after cutting and that herbicide only affected four of the 12 species. These findings could help land managers regarding more effective strategies aimed at controlling encroaching tree species in savannas.

STANDARD POSTER: PROGRESS IN DETECTION OF ALIEN AND INVASIVE PLANT SPECIES IN NORTHERN CAPE, FREE STATE AND EASTERN CAPE PROVINCES

*Thembelihle Mbele**, *Thabiso Mokotjomela*, *Vukeya Loyd Rodney*

The South African National Biodiversity Institute has an obligation to report on the status of invasive species to the Minister in terms of the National Environmental Management Biodiversity Act 10 of 2004. We compiled a list of alien species list to update the national status report. We searched for the presence of alien species in high-risk sites in 74 towns spread across the Free State, Northern, and Eastern Cape provinces. Systematic surveys and drive-by surveys were used to document alien species. Species were classified into life-forms, NEM:BA-AIS-regulations' categories, and native home range. We obtained 1782 records and identified 454 plant species dominated by woody life forms. The



majority of plants originated from the Americas. Significant numbers of plants were recorded along roadsides and in retail nurseries. Overall, plant species listed for management in the NEM:BA-AIS-regulations' categories were not significantly different from the species that are not unlisted for control. The results suggest a need to strengthen cross-border biosecurity between South Africa and the Americas, improve law reinforcement, and the urgent risk for assessment of unlisted species.

STANDARD POSTER: SUPPORTING LIVELIHOODS THROUGH CLEARING OF EMERGING ALIEN SPECIES: A CASE STUDY OF NORTHERN CAPE, FREE STATE & EASTERN CAPE PROVINCES

*Thabiso Cele**, *Thabiso Mokotjomela*, *Thembehle Mbele*, *Ramahladi Mokoena*

The South African National Biodiversity Institute has a responsibility of championing the conservation of South Africa's biodiversity and protecting it from threats, such as biological invasions. However, there are few studies focusing on SANBI's impact on human livelihoods. The National Strategic Development Goals aim to reduce poverty and inequality by 2030 and SANBI as a state organ is also obligated to make significant contribution. We aimed to provide evidence on how SANBI is contributing to the improvement of livelihoods through creation of employment during clearing of emerging AIS and documentation of alien species provide evidence for decision-making for their management. We have created more than 295 jobs across three provinces (Free State, Northern and Eastern Cape) in 21 local municipalities in the fight against unemployment during financial year, 2021-22. Our emerging alien species' clearing programme covering 1582.3 ha created 95 jobs while the Presidential Youth Unemployment Intervention Programme created 200 jobs in Eastern Cape (i.e., over space of 579 854 ha) for the detection of alien species to facilitate decision-making for species' management planning. The inclusion of other provinces with similar may increase the reported impact by a magnitude of six.

STANDARD POSTER: ALIEN INVASIVE LEUCAENA LEUCOCEPHALA SUCCESSFULLY ACQUIRES NUTRIENTS BY INVESTING IN BELOW GROUND BIOMASS COMPARED TO NATIVE VACHELLIA NILOTICA IN NUTRIENT AMENDED SOILS IN SOUTH AFRICA

*Khululwa Ndabankulu**, *Anathi Magadlela*, *Zivanai Tsvuura*

Soils in grasslands and savannas of southern Africa are acidic and nutrient-poor. Legumes, such as *Vachellia nilotica* and alien invasive *Leucaena leucocephala*, are major components of the vegetation in these biomes. *Vachellia nilotica* can establish in drought-prone environments. *Leucaena leucocephala* is an emerging invasive in South Africa and is ranked among the world's 100 most invasive alien species. Alien plants can invade native habitats through their adaptability to flourish on low-resource soils, and can thus out-compete and displace native vegetation. We investigated the effects of phosphorus (P) deficiency and soil acidity on legume-microbe symbiosis, nitrogen (N) nutrition, and carbon (C) growth-costs of these two legumes in grassland soils. We used soils as inoculum and growth substrate for seedlings of *V. nilotica* and *L. leucocephala*. The soils were collected from a long-term (> 65 years) nutrient and lime addition trial known as the Veld Fertilizer Trial (VFT) which is located on the University of KwaZulu-Natal's Ukulinga Research Farm near Pietermaritzburg in South Africa. We used soils from three VFT treatments namely: (i) soils fertilized with superphosphate (336 kg. ha⁻¹) applied once per year (+P), (ii) soils fertilized with superphosphate (336 kg. ha⁻¹) applied once per year with dolomitic lime (2250 kg. ha⁻¹) applied once every 5 years (P+L), and (iii) soils with no superphosphate and no dolomitic lime applications (control). Seeds of *V. nilotica* and *L. leucocephala* were germinated and grown

independently in these soils in a green-house and harvested after 125 days for measurement of growth, legume-microbe symbiosis, N nutrition and C growth-costs. Results showed that the two legumes had different growth adaptations. *Vachellia nilotica* grown in control soils and +P soils nodulated with various *Burkholderia spp.* bacteria while *L. leucocephala* did not nodulate in all soil treatments. Both legumes utilised both atmospheric and soil derived N for growth across all treatments thereby decreasing C growth-costs. *Vachellia nilotica* grown in +P soils accumulated the most biomass and N nutrition. *Leuceana leucocephala* maximised specific N assimilation rates by investing in below ground biomass accumulation in control soils. This shows that *L. leucocephala* possesses traits that are successful in acquiring nutrients by investing in below ground biomass and relying on utilisation of N from both the soil and the atmosphere.

STANDARD POSTER: ECONOMIC BOTANY OF GENUS CORTADERIA: A REVIEW

*Moleseng Claude Moshobane**, *Lesibana Moshobane*

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, for ornamental and landscaping purposes and in mine rehabilitation. In RSA, 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 rudiusscula*, *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 02 | BUSH ENCROACHMENT AND ALIEN INVASIVE PLANTS

SESSION CHAIR: PAUL MALAN

Tuesday 26 July 2022, 10:45 - 12:15

PLATFORM PRESENTATION: THE EFFECT OF FEED ADDITIVE ON SEED RECOVERY AND GERMINATION OF VACHELLIA NILOTICA SEED PODS FED SMALL RUMINANTS (GOATS)

Fortune Lindy Manganyi, Julius Tjelele, Francoois Müller, Ngoako Letsoalo, Khanyisile Mbatha*

The cost of feed is a major constraint in animal production and several efforts have been made to utilize locally available materials to supplement livestock diets when rangeland conditions deteriorate. This study aimed to determine the possibility of using the encroaching species *Vachellia nilotica* as an alternative fodder for resource-poor farmers. Specifically, we wanted to determine whether including *V. nilotica* seeds in livestock diets could reduce the spread of viable seeds in the rangelands. *Vachellia nilotica* shoots and seed pods were harvested separately at the ARC Roodeplaat experimental farm and were analyzed for fiber, protein and mineral nutrients at different seed pods inclusion rates, with and without a feed additive, Voermol LS33. From the results of the nutritional quality analyses, six diets, each representing an experimental treatment were selected. Thereafter a feeding and seed recovery trial was carried out at ARC Irene experimental farm. A total of twenty-four indigenous goats of approximately two years of age, with an average body weight of 29.6 ± 1.33 kg was used in the study. Twenty-four goats were divided into four groups, with six goats per group, each representing a replicate. The experiment consisted of six treatments of experimental diets which was whole seed pods, whole seed pods with LS33, chipped seed pods, chipped seed pods with LS33, *V. nilotica* chipped shoots with seed pods and chipped *V. nilotica* shoots with seed pods and LS33. Each group was fed the experimental diet at 3% of their body weight and supplemented by grass hay as a basal diet for maintenance. Results from the study showed that seeds ingested from the chipped seed pods with LS33 ($91 \pm 6.8\%$) was significantly higher than when whole seed pods ($59 \pm 9.7\%$) were fed to the goats. However, seed recovered was significantly higher in whole seed pods diets (4 – 6%) compared to chipped seed pods diets with LS33 (1 – 2%). Germination potential of *V. nilotica* seeds recovered from the faeces of animals in the six feed treatments, as well as three control treatments (scarified, chipped and untreated) seeds was also determined. The germination percentage of *V. nilotica* seeds that passed through the digestive system in all six feed treatments ranged between 9 and 17% and was significantly higher than the germination potential of un-scarified seeds (3%). The reduced recovery of seeds from chipped diets with LS33 suggests that a large portion of the seeds were completely digested by the livestock but those seeds that were recovered only had a germination potential of below 20% and high dormancy percentage in seeds that did not germinate (88%) with 3 to 8% dead seeds. The results suggest that chipping the seeds pods and adding a feed additive could reduce the spread of *V. nilotica* seeds in the rangeland. Further research is needed to determine whether dormant seeds may germinate after the first dry season after passing through the digestive tract of the livestock.

PLATFORM PRESENTATION: RESTORATION AFTER BUSH CONTROL AND SOCIOECONOMICS OF RURAL COMMUNITIES IN TAUNG, NORTH WEST PROVINCE, SOUTH AFRICA

Tshegofatso Sebitloane, Klaus Kellner, Pieter Malan, Hendri Coetzee*

The structure and function of savanna ecosystems in southern Africa are altered by bush encroachment and the thickening of indigenous and alien woody species in savanna rangelands. Bush encroachment is a form of land degradation and leads to a decrease in grass productivity, a loss in biodiversity, and reduced grazing capacity. This study aimed to investigate brush-packing as a restoration treatment after woody species near Manthestad (a village in the Taung region of the North West Province, South Africa) had been cleared. The objectives of this research were to (1) assess the effectiveness of the brush-packing restoration treatment in bush-cleared areas, (2) determine grass species diversity in response to the restoration methods after the application of the brush-packing, and (3) document the perceptions of the community members regarding bush encroachment, bush control, and socio-economic factors before and after the restoration activities were implemented. Brush-packing (BP) entails covering the soil surface with organic material such as woody branches and leaves to promote grass growth and above-ground biomass production, increase plant species diversity, and protect the restoration plots from grazers. Eighteen sample plots were developed, measuring 400 m² (20 m x 20 m). The plots consisted of six different restoration treatments, replicated three times. Apart from a control group (no clearing (UC), the treatments encompassed clearing only (C); clearing and re-seeding (CRS); clearing and brush-packing (CBP); clearing, brush-packing, and re-seeding (CRSBP); and clearing, soil disturbance, brush-packing, and re-seeding (CSORSBP). The impact of the restoration treatments was monitored over three years (2018–2020). The diversity index results show highly significant ($p < 0.001$) differences in grass species diversity over the years according to the Simpson index and Shannon index. Grass species richness was significantly ($p < 0.05$) different over the three years. The most considerable biomass accumulation was recorded after the CSOSBP treatment, followed by the CRSBP and CBP treatments, while the lowest grass biomass was measured after the C restoration treatment. Results from the socio-economic survey show that bush encroachment has a significant negative impact on the socio-economic status of livestock owners and households. The implementation of the BP treatments also contributed to job creation initiatives and poverty alleviation, thereby improving the livelihoods and well-being of the Manthestad community. Effective restoration of encroached and degraded regions should be viewed as a long-term commitment rather than a one-time action.

PLATFORM PRESENTATION: SERIPHIMUM PLUMOSUM (BANKRUPT BUSH): WHAT HAPPENS AFTER A SINGLE HERBICIDE TREATMENT?

Michelle Keith, Erika Van Zyl*

Seriphium plumosum, commonly known as Bankrupt bush, was declared an indicator of bush encroachment in all provinces of South Africa under the Conservation of Agricultural Resources Act, Act 43 of 1983 (CARA) on March 2019. The name "Bankrupt bush" describes the way dense encroachment can "bankrupt" the farm by outcompeting existing grasses resulting in a useless "green desert". *S. plumosum* can be successfully controlled by herbicides or manual means, both are expensive. Due to the large and long-lived soil seed bank and highly effective wind seed dispersal mechanism of *S. plumosum*, re-encroachment is inevitable. The importance of monitoring the veld biomass and population dynamics of a specific population of *S. plumosum* post herbicide control and over a period of time was thus identified. A trial was done on a densely encroached site of *S. plumosum* at Dundee Research Station in KZN. Google Earth was

used to assess whether it was possible to quantify and monitor visible evidence of the encroachment, effective control and re-encroachment of *S. plumosum* of the site. Imagery in 2009 showed little visible evidence of encroachment but from 2011 the ground-based observed encroachment was clearly visible on the imagery. The site was burnt in spring 2017. In January 2018, metsulfuron-methyl (600 g / kg) herbicide was applied in 20 m strips to young regrowth, at the recommended rate, forming alternate treated and untreated strips across the site. The imagery from 2020 clearly shows these treated and untreated strips. In 2021, ten plots (2 m x 25 m) were randomly selected in both treated and untreated strips where grass biomass, *Seriphium* density and size data were collected. The mean standing grass biomass on treated plots was 2.48 t/ha compared to 1.58 t/ha on untreated plots which is a 36% loss of biomass. The mean number of *S. plumosum* plants for untreated plots was 44 plants / 50 m² compared to 10 plants / 50 m² in treated plots. The mean *Seriphium* plant density was 8 860 plants / ha on untreated plots; of which 25% were seedlings, and 2 060 plants / ha on treated plots; of which 59% were seedlings. The *Seriphium* mean canopy cover for untreated plots was 4 900 m² / ha and 80 m² / ha on treated plots. The results of the study illustrate how effective herbicide control of *Seriphium* can be, but also how within three years, the treated areas had a new cohort of encroaching seedlings emerging. Evaluation will continue annually. This study demonstrates the futility of many projects in attempting to control *Seriphium* with a single herbicide application and no follow-up treatments.

PLATFORM PRESENTATION: HOST SUITABILITY OF THREE OPUNTIA TAXA FOR THE DACTYLOPIUS OPUNTIAE (HEMIPTERA: DACTYLOPIIDAE) 'STRICTA' LINEAGE

Kudakwashe Musengi, Siphon Mbonani, Marcus Byrne*

The 'stricta' lineage of the cochineal *Dactylopius opuntiae* was released more than 20 years ago in South Africa where it has successfully controlled *Opuntia stricta*. However, its host preference has not been tested against all invasive cacti in South Africa. Therefore, the possibility exists that it might successfully control other invasive cacti. We compared the performance of the 'stricta' lineage on *Opuntia stricta*, *Opuntia humifusa* and two lineages of *Opuntia engelmannii*. Additionally, we assessed if morphology of these *Opuntia* taxa could be used as an indicator of host selection by the cochineal. Acceptability and suitability of the host taxa were measured using *D. opuntiae* life history parameters such as crawler development time and female weight. Principal component analysis of six morphometric characters of the *Opuntia* taxa revealed that *O. stricta* is morphologically more similar to the *O. engelmannii* lineages than to *O. humifusa*, which showed little similarity to any of the other taxa. Additionally, the two *O. engelmannii* lineages showed some morphological similarity to each other. The 'stricta' lineage completed its development on *O. humifusa* such that the cochineal could be considered as a potential biological control agent for *O. humifusa*. Conversely, *D. opuntiae* 'stricta' was not able to complete development on *O. engelmannii*. Consequently, it would not be a suitable biological control agent for either lineage of *O. engelmannii*. The results show that *O. humifusa* is a suitable host for *D. opuntiae* 'stricta' and that *Opuntia* morphology is not an obvious indicator of host suitability.

PLATFORM PRESENTATION: AN ASSESSMENT OF THE INVASIVE POTENTIAL OF VERBASCUM THAPSUS (GREAT MULLEIN) IN SOUTH AFRICA

Thulisile Jaka, Gordon Ringani*

The genus *Verbascum* L. comprises over 360 species and is the largest genus in the Figwort family (Scrophulariaceae). The genus is native to parts of Europe, Asia and Northern Africa. Some species are known to be naturalised and have



become invasive in other parts of the world such as North America and Hawaii. Three species of *Verbascum* are cultivated in South Africa; *V. blattaria* L., *V. thapsus* L., and *V. virgatum* Stokes. These species are found mostly in the inland areas of South Africa, although *V. thapsus* and *V. virgatum* are also reported in the Eastern Cape and Western Cape respectively. *Verbascum thapsus* is a hairy biennial herb with rosette leaves in the first year. It is native to Europe, North Africa, Asia, and naturalized in temperate areas of the world, including North America, Hawaii, Australia, and New Zealand. The plant spreads through production of numerous seeds (up to 180,000) per plant, which are produced during the second year of growth. In South Africa, *V. thapsus* was first observed naturalised in Gauteng Province at Rietfontein, Bronberg Conservancy and has since been recorded in areas around northern Free State and Northern Cape Province. The species is not yet listed as invasive in South Africa; it is listed as a suspect candidate that needs evaluation. The aim of this study was to assess the potential invasiveness of *V. thapsus* in South Africa. We gathered ecological data through surveys conducted from 2010 to 2021 supplemented by locality data from Southern African Plant Invaders Atlas and iNaturalist. Potential invasiveness was assessed using the Risk Analysis for Alien Taxa (RAAT) framework and species distribution models using Wallace. Seed germination studies were also conducted where the influence of three variables (soil type, light, pre-exposure to fire) on the germination of *V. thapsus* seeds will be investigated. The distribution map and habitat records indicated that the species has managed to establish in natural areas. RAAT results and the species distribution model indicate that the species has a high potential of being invasive in South Africa, as more than 10,000 grid cells (resolution: 2.5 arc minutes) are climatically suitable. Seed germination studies indicated no significant difference between soil types and light. However, fire seems to stimulate the seed germination. *V. thapsus* thrives in a variety of habitats, including natural grasslands, disturbed areas, roadsides, pastures and forest margins, posing a high invasion risk in South Africa. Regulation and management are essential before the species become a major problem.

PLATFORM PRESENTATION: THE DIVERSITY OF ALIEN PLANT SPECIES IN SOUTH AFRICA'S NATIONAL BOTANICAL AND ZOOLOGICAL GARDENS

*Thabiso Mokotjomela**, *Vukeya Loyd Rodney*

The management of biological invasions, which pose a growing threat to natural resources and human wellbeing, is critical for reducing associated negative impacts. As part of the process of developing a strategy for the management of biological invasions in the South African National Biodiversity Institute's (SANBI) gardens, we developed a list of alien species from 13 gardens as part of a situational analysis. We sent out a request for lists of alien plant species recorded in each of the SANBI's gardens. Of a total of 380 records, there were 225 alien plant species belonging to 73 families. Different plant species' life forms included woody and herbaceous plants, grasses, succulents and ferns. Herbaceous (42.7%; N = 225), and woody plants (3.8%) were the most common life forms. The Walter Sisulu National Botanical Garden had the highest number of alien species (88 species), followed by the Kirstenbosch (61 species) and Pretoria National Botanical Gardens (46 species), with herbaceous species constituting the largest number in all gardens (47, 19, and 27 species, respectively). The number of species listed in the National Environmental Management: Biodiversity Act (NEM: BA) (Act No. 10 of 2004): Alien and Invasive Species Regulations' categories were not significantly different from the number of unlisted species (58.2% vs 42.8%). The number of species listed in the different categories varied significantly across the different gardens. There was a significantly higher number of unlisted species and of species in category 1b in the Walter Sisulu, Kirstenbosch, and Pretoria National Botanical Gardens than in other gardens. The significant number of alien species were originating from South America points to the need to improve biosecurity controls on existing relations. The results of this study provided a baseline database to help comparison between successive surveys in future.



SESSION 03 | ADVANCES IN METHODOLOGY

SESSION CHAIR: ABEL RAMOELO

Tuesday 26 July 2022, 12:15 – 13:00

PLATFORM PRESENTATION: THE LIVING DEAD: ON THE TRAIL OF A FEMALE

Debbie Jewitt, Laura Cinti*

Cycads are the most endangered species in the world. They are worth millions of dollars annually in illegal markets, being in demand for traditional medicine and as ornamental plants in gardens. *Encephalartos woodii* Sander is considered Extinct in the Wild, making it one of the rarest cycads in the world. Wood's cycad was discovered 127 years ago in the Ongoye Forest in KwaZulu-Natal, South Africa. The only specimen ever discovered was removed to the Durban Botanical garden and suckers propagated in other botanical gardens around the world. However, these specimens are all genetically identical and they are all males. Hence unless a female partner can be found, it may never naturally reproduce again. Over the years, many expeditions have sought to find another specimen and specifically a female, so that the species can be brought back from the brink of extinction, but so far without success. Many sections of the forest are relatively inaccessible however, making the search difficult. Hence there is a possibility that a specimen may exist in the more remote parts of the forest. We conducted an aerial survey of sections of the forest using a DJI Matrice 210 drone and Micasense Rededge MX multispectral sensor. The search area for the drone was refined after a manned aerial survey. Two gridded surveys (15ha) were conducted on sections of the forest. The drones were flown at 80m above the takeoff point yielding an average of 8cm pixel resolution. The resulting multispectral imagery was stitched together using Pix4DMapper. The mosaiced imagery was inspected for signs of cycads using various spectral combinations and plant structure. Whilst a partner cycad has not yet been found, the search continues. Drone technology is providing useful information that can be used to enhance and streamline the search and could also be used for other conservation initiatives.

PLATFORM PRESENTATION: THE EVALUATION OF VARIOUS TECHNIQUES USED TO COMPARE HISTORICAL INTEGRATED DEFOLIATION MECHANISMS' EFFECT ON THE SEASONAL PRODUCTION POTENTIAL AND QUALITY OF SOURVELD

Alexis Oosthuizen, Emma Archer, Wayne Truter*

Sourveld rangelands are stable, productive areas that are an important resource for livestock production in South Africa. However, sourveld experiences a reduction in the quality and quantity of vegetation production over winter, which leads to a decline in animal performance. Veld condition assessment methodologies are used to quantify the quality parameters of natural veld and evaluate the effect of management regimes on these parameters. However, these

methodologies are often based on subjective techniques and are thus inconsistent over a wide range of veld types and climatic zones. This study aimed to evaluate the seasonal variation in above-ground standing biomass production (AGSB), forage quality and the ability of other quantifiable veld condition parameters (canopy cover, basal cover and the quadrat method) to predict AGBS and forage quality using different devices (Canopeo, bridge-point meter, rising plate meter (RPM) and Near Infrared Spectroscopy (NIRS)). Additionally, the study aimed to determine the effect of various defoliation mechanisms (cutting and burning) and historical land management regimes (grazing intensities and burning) on these parameters. Each site varied in its historical land management systems, species composition and topographical characteristics. The results indicated that historical land management has an effect on species composition and consequently forage quality. The results showed no correlation between AGBS and Canopeo readings but a correlation between AGBS and RPM ($R^2=0.540$) and Bridge meter ($R^2 = 0.560$) readings was obtained. Overall, this study indicates that Canopeo is an ineffective technique to estimate AGBS, whereas RPM may yield more accurate predictions. Forage quality effects are evident between historical land management regimes and should be considered when deciding on a particular land management system.

PLATFORM PRESENTATION: SEASONAL EVALUATION AND MAPPING OF BIOPHYSICAL PARAMETERS OF NATURAL RANGELANDS USING SENTINEL-1 AND SENTINEL-2 REMOTE SENSING DATA

Monde Rapiya, Abel Ramoelo, Wayne Truter*

Rangelands play an important role in the conservation of biodiversity and economic growth in developing countries. The condition of rangelands directly affects forage production, livestock production, and regional grassland resources. In this regard, we monitored the seasonal dynamics of biophysical parameters i.e. leaf area index (LAI) and aboveground biomass of natural rangelands using synthetic aperture radar-SAR (Sentinel-1) and optical remote sensing (Sentinel-2) data. The study was conducted in two game reserves, Hoogland and Welgevonden, in the Waterberg region, Limpopo province. A total of six sites were selected, three from each game reserve with homogenous vegetation. Eighty percent of the grasses were characterised for the sites, with each area subdivided into 10 plots of 30 x 30 m each to provide 60 plots. The fieldwork was undertaken in December 2020 (for early-hot-wet season), July 2021 (Cold-dry season) and March 2022 (late-hot-wet season) to measure LAI and aboveground biomass. The seasonal variation of LAI and aboveground biomass was assessed using Sentinel-1 (S1) and Sentinel-2 (S2) data, both individually and integrally, applying three extensively used Machine Learning algorithms: Multiple Linear Regression (MLR), Support Vector Machine (SVM), and Random Forest (RF). Results indicated that the models based on biophysical parameters (LAI and aboveground biomass) derived from Sentinel-2 ($R^2 = 0.79-0.81$) were more precise in predicting the seasonal variations in rangelands compared to ($R^2 = 0.33-0.36$) from S1. While the synergistic use of Sentinel-1 and Sentinel-2 yielded the highest accuracy ($R^2 = 0.84-0.85$). Therefore, integration of S1 and S2 data provided satisfactory data to capture the seasonal dynamics of rangelands at a 10–30-m spatial resolution and enhanced assessments of critical phenology stages.



SESSION 04 | CONSERVATION & RESTORATION

SESSION CHAIR: LORAINE VAN DEN BERG

Tuesday 26 July 2022, 14:00 – 16:00

KEYNOTE ADDRESS: WHY IS TRANSDISCIPLINARITY RELEVANT FOR THE FUTURE OF GRASSLAND ECOSYSTEMS?

Carolyn Palmer

Institute For Water Research And African Research Universities Alliance (ARUA) Water Centre Of Excellence,
Rhodes University

What is transdisciplinarity? Transdisciplinary research and practice – or praxis – has emerged from a range of thinking and understanding. Transdisciplinarity has three distinguishing features: i) it addresses the complex and so-called “wicked” problems of the Anthropocene; ii) it respects and includes knowledge from a wide range of sources: from different academic disciplines; from local, cultural and indigenous contexts; and from practice or practical experience; and iii) it is undertaken collaboratively with and for society. In contrast, interdisciplinary and multidisciplinary activities involve knowledge across academic disciplines. Multidisciplinary approaches bring different disciplinary knowledge to bear independently, and interdisciplinary approaches integrate knowledge across academic disciplines. Contemporary grasslands all exist as part of complex systems – whether these are in protected areas, or are part of private or communal agricultural landscapes. These systems are subject to the current planetary condition, that includes rapidly escalating human populations and demand for natural products, the widespread use of pollutants, strong trajectories towards urbanisation and climate change. All complex systems have characteristics in common - they comprise multiple elements, which interact, the multiple interactions cause intersecting feedback loops. As a result a current system condition reflects its history, future condition is difficult to predict, and interventions have unpredictable outcomes – some positive others negative. The system itself produces emergent properties – new characteristics - through time, out of the multiple element interactions. Grasslands are specifically complex social-ecological systems, with all the interactive complexity of both society and ecosystems. This paper uses the example of a landscape restoration project in the grasslands in the Tsitsa River catchment, Eastern Cape to showcase the pitfalls and positives of transdisciplinary praxis.

PLATFORM PRESENTATION: THE VEGETATION COVER DYNAMICS AND POTENTIAL DRIVERS OF HABITAT CHANGE OVER 30 YEARS IN THE FREE STATE NATIONAL BOTANICAL GARDEN, SOUTH AFRICA

Vukeya Loyd Rodney, Thabiso Mokotjomela*

As a conservation strategy, the South African National Biodiversity Institute (SANBI) establishes biodiversity gardens in areas with unique vegetation types that are vulnerable to extinction. This is the first study to assess long-term changes in vegetation cover and to determine the conservation threats to national priority conservation vegetation

types in SANBI gardens. We aimed to: 1) determine the vegetation cover dynamics of the Free State National Botanical Garden (FSNBG) using 10-year intervals over a 30-year period (1987-2017), focusing on different vegetation classes, and test the prediction that vegetation would decline because of climate change-induced stress; 2) evaluate ecological integrity of the Critical Biodiversity Area 1 (CBA1) vegetation by determining the presence/absence of flagship plant species; and 3) quantify potential conservation threats that may be drivers of vegetation cover changes. Contrary to the study prediction, the “moderate vegetation cover” had increased by 25.1 ha and the “dense vegetation cover” had also increased by 8.6 ha in the FSNBG. Woody vegetation cover increased significantly over the past 30-year period, suggesting “bush” encroachment. Although vegetation cover of the CBA1 vegetation type was healthy ($79.6 \pm 15.9\%$), 50 plant species had disappeared, suggesting reduced functional intactness. Major conservation threats included the presence of 27 alien and invasive plant species interspersed within different vegetation patches, and habitat fragmentation in the past 19 years due to increasing human settlements (i.e., covering ~18% of the buffer zone). We conclude that increased vegetation cover is associated with bush encroachment, and we recommend interventions to reduce population density of woody plants, as well as the establishment of permanent vegetation monitoring plots.

PLATFORM PRESENTATION: COMPARING SEEDLING ESTABLISHMENT AMONG MICROSITES IN REHABILITATED AND UNTREATED LITTLE KAROO RANGELANDS

Rogan Bryce, Sue Milton, Willem Matthee, Ken Coetzee*

This study investigates the efficacy of rehabilitation methods in establishing vegetation cover of various plant growth forms, at two research sites in the semi-arid Little Karoo. We sampled the number of seedlings of all plant species on two farms in rangeland that received or did not receive rehabilitation, and recorded the microsites in which each seedling established. Microsites recorded were bare ground, hollows, sites covered by bushes or mulch, and microsites which were in hollows and covered. Chi Squared tests for independence were used to test for dependence between types of microsites and seedlings of different functional groups. Data from both study sites of Rooiberg ($chi-square = 342; df = 9; p < 0.001$) and Rietkraal ($chi-square = 3704; df = 6; p < 0.001$) showed that microsite preferences for germination microsites differed among plant functional groups. The abundance of seedlings per growth form was compared among germination sites (1) for each of the two independent study sites, and (2) for rehabilitated and control areas separately within each study site. On Rooiberg, both forbs and shrubs germinated more frequently than expected on bare ground, and less frequently than expected in covered microsites. Succulents germinated less frequently than expected on bare ground whereas graminoids germinated less within hollowed microsites than expected. Conversely, on Rietkraal, forbs and succulents germinated less in covered hollows than expected, whereas shrub seedlings were three times more abundant than expected in covered hollows. On Rooiberg, germination of all functional groups in hollows was more frequent than on control areas where germination in covered sites predominated. Similarly on rehabilitated areas at Rietkraal, forbs and succulents germinated mainly under covered microsites and shrubs germinated in microsites that combined cover and hollows. On the control areas, where hollows were absent, 91% of shrub seedlings germinated under covered microsites and the majority of succulent seedlings germinated on bare soil. In conclusion, seedling abundance within available microsites differs among growth forms. Vegetation development over time is therefore likely to vary with the types of microsites generated by various rehabilitation techniques.

PLATFORM PRESENTATION: ANALYSIS OF VEGETATION AND MICROBE BIODIVERSITY RECOVERY IN ABANDONED AGRICULTURAL FIELD CHRONOSEQUENCE USING DNA METABARCODING

Heike Oosthuysen, Riël Coetzer, Thabang Madisha, Kayleigh Coetzer*

Biodiversity refers to the variability among living organisms from all sources, including diversity within species, between species and of ecosystems. Biodiversity is traditionally measured by the number of species found in an environment, with higher numbers of species generally indicating a more stable and robust ecosystem. Farming practices are known to disrupt these ecosystems, altering not only the landscape but also the associated biodiversity. It has thus become crucial to focus on restoration treatments to combat this biodiversity loss. The main aim of our study is to assess the pace of natural recovery for a chronosequence of formerly planted fields in a grassland habitat. This study was conducted on a commercial livestock farm near Cradock, in the Eastern Cape, South Africa. The extent of recovery was evaluated by considering both the bacterial and vegetation biodiversity levels in the old fields as well as the functionality of the present species compared to the adjacent natural habitats. The sampling sites included old fields that were last planted in 1989, 1997, and 2009 as well as the natural grassland that surrounds these fields. Vegetation data were collected through species counts using the step point method, while the soil bacterial community was assessed through High Throughput Sequencing (HTS) of the 16s rRNA gene using metabarcoding techniques. Alpha diversity measures (observed richness, Shannon's diversity index and Simpson's diversity index) were used to determine the diversity within the communities. These indices showed high levels of diversity within the groups (Bacterial: Shannon diversity index = 6.75 - 7.18, Simpson's diversity index = 0.9985 – 0.9987; Vegetation: Shannon's diversity index = 1.69 - 1.97, Simpson's diversity index = 0.68 – 0.75). However, we found no significant differences in alpha diversity between the different age groups ($p > 0,05$) for both the vegetation and bacterial communities. Principle coordinate analysis (PCoA) based on the Bray-Curtis similarity matrix was used to visualize the dissimilarities of both the bacterial and vegetation communities. For both the bacteria and vegetation, the 2009 and Natural age groups were distinct, while the 1989 and 1997 age groups showed overlap. A correlation analysis based on Spearman's rank correlation showed significant positive and negative correlations between the different plant and bacterial families. We conclude that grassland restoration through passive techniques, such as abandonment, offers a viable solution for restoring species diversity after cultivation, which correlates with what has been found in other studies. Studying diversity levels in old fields allows us to identify the patterns and functions of these organisms, which can help society regulate and conserve biodiversity, specifically in the agricultural sector.

PLATFORM PRESENTATION: EVALUATING THE INSECT ABUNDANCE AND RICHNESS WITHIN A VALLEY IN THE WINTERBERG MOUNTAINS, EASTERN CAPE

Mart-Mari Myburgh, Thabang Madisha, Riël Coetzer*

Insects play a key role in the sustainability of biodiversity in ecosystems. Information concerning species occurrences and the movement of species could aid in the detection, monitoring, and measurement of biodiversity. The Eastern Cape Province situated in South Africa is known for its high biodiversity as this province contains two of the three biodiversity hotspots (the Maputoland-Pondoland hotspot and part of the Cape Floristic hotspot) as well as eight of the nine biomes. However, very few in-depth biodiversity studies have been conducted in this region. This is evident as the Eastern Cape Province only holds 2.85% ($n = 1,607$) of the South African barcoding records ($n = 56,382$). This

study therefore aims to assess the insect species abundance and richness between the eastern and western sides of a valley situated in the central Winterberg Mountains of the Eastern Cape and to highlight the important correlations observed between insect diversity and the observed vegetation diversity. In addition to determining species richness, insect specimens will also be barcoded and loaded onto the Barcode of Life Database (BOLD). Insects were collected with sweep nets and pitfall traps within 12 transects of 100 m length. Samples were collected in two seasons; the one collection was conducted at the end of the dry season (September 2020) and the other at the end of the wet season (April 2021). From both seasons 8,968 insect specimens were collected and sorted into 755 morphospecies. Of these morphospecies, 147 morphospecies have thus far been classified to family level (representing 70 insect families). These families were used for the analysis. The results of the alpha diversity indices yielded an average Simpson diversity index of 0.526 and an average Shannon's index of 1.131. Furthermore, Whittaker's beta-diversity estimates varied between 0.333 and 0.917 amongst the sampling sites. Non-metric Multi-dimensional Scaling (NMDS) analysis showed no specific grouping between the eastern and western sides of the valley. These are, however, preliminary results. Following the completion of the study, we expect to identify some ecological structuring between the eastern and western sides of the valley. We also expect altitude and vegetation type to determine species occurrences as several positive correlations according to the Pearson's correlation coefficient were already observed. One such correlation being a significant positive correlation ($p = 0.015$) between Sphecidae and bare ground. This positive correlation is supported by various studies which reveal that certain Sphecidae species commonly burrow into the ground to store prey for their larvae. This study will provide information concerning the richness and distribution of insect taxa in this understudied region. It will also serve as a foundation for future studies in which the changes of biodiversity over time can be identified, monitored, and protected.

PLATFORM PRESENTATION: RECONSTRUCTING DYNAMICS OF LARGE MAMMAL HERBIVORES IN AFRICAN SEMI-ARID ECOSYSTEMS USING FOSSIL DUNG FUNGAL SPORES: LESSONS, CHALLENGES, AND IMPLICATIONS FOR BIODIVERSITY CONSERVATION

Abraham Dabengwa, Sally Archibald, Marion Bamford*

Large herd-forming mammal herbivores vital for maintaining biodiversity patterns and ecosystem functioning have declined worldwide, even in Africa where assemblages are considered intact. Yet, establishing reliable historical baselines of herbivore abundances or biomass to guide evidence-based conservation remains a major challenge. Written records, anecdotes, and monitoring studies cover short timescales and suffer from taxonomic bias in favour of charismatic species. By contrast, continuous long-term prehistorical micro-fossil records providing insights into aggregate herbivore dynamics using dung fungal spore abundances from sedimentary environments but lack key taxonomic information. Furthermore, these sedimentary records are undermined by poor spore preservation, strong influence of wetland hydrology, and idiosyncratic interpretations. Semi-arid ecosystems are regions where we could improve our understanding of herbivore dynamics because animals there are more closely coupled to catchment environments that maintain soil moisture and vegetation productivity. Thus, establishing realistic prehistorical herbivore biomass or past grazing pressure is crucial in semi-arid ecosystems where indigenous or domestic herds could degrade vegetation and soils. In this study we analyse palaeo-ecological records from southern African semi-arid ecosystems of Botswana, Mozambique, Namibia, and South Africa. Our goal is to assess whether microscopic dung fungal spore and charcoal patterns from sedimentary basins associated with herbivore biomass and fire activity are consistent with expected dynamical interactions among climate, herbivory, fire, and vegetation. To achieve this goal, we compare two ecological hypotheses to examine palaeo-herbivore dynamics, i.e., the habitat compression

and key resource area non-equilibrium. The former leads to an expectation of higher grazing pressure or herbivore biomass with increasing human activity or climate stress; the latter postulates that some wetland grassland states may persist in the presence or absence of climatic stress due to strong local herbivore control or resistance to grazing. Distinguishing between two contrasting ideas is helpful for establishing qualitative baselines of ecosystem health. In this study, patchiness of indicator dung spore and charcoal data was reduced by contrasting ordination-based interpretation of these data according to inferred dominant local wetland grass heights. Specifically, short and tall grasses linked with vegetation functional responses to herbivores and fire, yet mediated by soil moisture. Our findings suggest a re-examination of the use of baselines obtained from dung fungal spores as they shift in response to climate and human activity, closely resembling changing landscape foraging resources. Last, we discuss how our findings could be extended with newer paleo-ecological methods that track herbivore dynamics at higher taxonomic resolution to improve biodiversity conservation.

POSTER SESSION 2

Conservation
&
restoration



SESSION CHAIR: SINDISO NKUNA

Tuesday 26 July 2022, 16:00 – 16:30

Posters can be viewed on twitter @ <https://twitter.com/GrasslandSocSA>

STANDARD POSTER: ENCEPHALARTOS NATALENSIS-MICROBE SYMBIOSIS, SOIL NUTRIENT INPUTS, AND SOIL ENZYMATIC STUDIES IN NUTRIENT-DEPRIVED ECOSYSTEM SOILS

Siphelele Ndlovu, Anathi Magadlela*

Preliminary studies have demonstrated that cycads develop coralloid roots that form symbioses with nitrogen-fixing cyanobacteria. The *Encephalartos* genus is widely distributed in Africa however, presently, its illegal harvesting in South Africa and widespread use in traditional medicine have led to its drastic decline in the wild. Despite the mutualistic relationship between *Encephalartos* and endophytic bacteria, the diversity of endophytic bacteria and their contribution to determining soil fertility is not well understood. The scantily of such information presents challenges in constructing comprehensive cycad conservation and management plans. This study focused on the symbiotic association between soil microbes and *Encephalartos natalensis* and the role that these microbes play in determining soil nutrition. The objectives of this study were to investigate the endophytic bacterial community within the coralloid roots, rhizosphere, and surrounding soils of wild species of *E. natalensis*. Furthermore, the nitrate reductase, nitrogen, and phosphorus cycling enzymes present in the rhizosphere and surrounding soils of this cycad were assayed. The coralloid roots, rhizosphere, and surrounding soils of *E. natalensis* were collected for bacterial extraction and identification. Thereafter the cycad soils were sent in for nutrient and geochemical analysis. Furthermore, soil enzymatic studies were conducted to test for the presence of nitrogen cycling, phosphorus cycling, and nitrate reductase activity in the cycad's rhizosphere and surrounding soils. The results of the nutrient analyses revealed that there were significant differences in the concentrations of nitrogen, potassium, calcium, zinc, and copper found in the rhizosphere and

surrounding soils of *E. natalensis*; however, there were no significant differences between the concentrations of phosphorus, magnesium, and manganese found in the rhizosphere and surrounding soils of this species. There were no significant differences in the nitrate reductase, glucosaminidase, acid phosphatase, and alkaline phosphatase activity of the rhizosphere and surrounding soils. Phosphate solubilising bacteria belonging to the *Paenibacillus*, *Caballeronia*, *Lysinibacillus* and *Phyllobacterium* genera were found in the coralloid roots, rhizosphere, and surrounding soils of *E. natalensis*. Additionally, nitrogen-fixing bacteria belonging to the *Bacillus*, *Rhizobium*, *Burkholderia*, *Paraburkholderia*, and *Pseudomonas* genera were found in the coralloid roots, rhizosphere, and surrounding soils of *E. natalensis*. The findings of this study contribute to the knowledge of the diversity of the endophytic bacteria that prevail on the coralloid roots, rhizosphere, and surrounding soils of *E. natalensis* and further elucidate the contribution of this threatened plant to ecosystem functioning and soil nutrition. This project raises awareness and provides more knowledge on the role of *E. natalensis* in restoring soil nutrition in nutrient-deficient soils. Therefore, the main impact of this research study was to highlight the importance of conserving cycads for their essential ecosystem services which include carbon sequestration, biodiversity maintenance, and nutrient cycling.

STANDARD POSTER: REHABILITATION OF OLD POTATO PRODUCTION CIRCLES IN THE LEIPOLDTVILLE SAND FYNBOS, SOUTH AFRICA - EARLY SUCCESSES - DON'T COUNT YOUR CHICKENS BEFORE THEY HATCH

*Nelmarie Saayman**, Rudi Swart, Christie Rheeder

The Leipoldtville Sand Fynbos on the west coast of South Africa is an endangered vegetation type of which less than 45% remains, the rest is cultivated, mainly for potato production. It is important to rehabilitate any abandoned lands to improve the state of this vegetation type. The lands are not only subject to high phosphorous levels due to years of fertilizing, but also wind erosion because of slow natural recovery in most instances. The objective of this research was to rehabilitate the abandoned lands with indigenous plant species to a more semi-natural state that will improve ecosystem services. The study is done at three sites in the Leipoldtville Sand Fynbos, all in sandy soils. Four treatments were applied namely 1) plant indigenous species (P), 2) initial rye mix; plant indigenous species (RP), 3) brush packing; plant indigenous species (BP), 4) brush packing, initial rye mix, plant indigenous species (BRP). A randomised block design with four replicates were followed. Initial rye mix was planted in 2018 to improve the soil conditions. Seed of *Ehrharta calycina* and *Eriocephalus racemosus* was sown in 2020 with no success. Cuttings from *Osteospermum moniliferum*, *Exomis microphylla* and *Manochlamys albicans*, all indigenous to the vegetation type, was planted on 1 June 2021. Each cutting received 1-2 litres of water after planting. *Lebeckia sepiaria* (Fabaceae) was transplanted from adjacent areas to improve the soil nitrogen levels. *Willdenowia incurvata* was transplanted along the southwestern corner of the plots to serve as wind breaks. Survival of the cuttings were monitored on 29 September 2021. Almost 80% of the cuttings survived, with significant less ($p < 0.05$) survival at Site 1 where the plants are more exposed to harsh environmental conditions. *Osteospermum moniliferum* had the best survival of the three species at all the sites followed by *M. albicans*. None of the transplanted *L. sepiaria* survived. There was no significant differences between treatments, but significantly ($p < 0.05$) more *E. microphylla* did survive in all the treatments at Site 2 and Site 3 than at Site 1. Significantly more *O. moniliferum* survived in the P-treatment at Site 2 and Site 3 than at Site 1 ($p < 0.01$). Ecosystem services should recover faster at Site 2 and Site 3. Good and regular winter rain ensured the survival of the cuttings through the winter, but will it survive the dry and hot summer months?

STANDARD POSTER: A SURVEY OF FODDER TREES AND SHRUBS INDIGENOUS TO SOUTHERN AFRICAN

Marike Trytsman, Francois Müller, Igshaan Samuels, Clement Cupido, Braam Van Wyk*

Woody plants are important sources of food for livestock and game in semi-arid to arid regions as well as a vital source of highly nutritious feed in many other parts of southern Africa. The SA-National Forage Genebank, mandated to collect and conserve valuable forage seed, initiated an inventory study of known indigenous fodder trees and shrubs. The collection records of the botanical database of the South African National Biodiversity Institute and descriptive data were added to the recorded list of browsed species. A total of 675 species and infraspecific taxa from 74 families with 40,154 occurrence records were documented. A multivariate agglomerative hierarchical clustering was applied to determine biogeographical patterns. This resulted in four distinct clusters, namely the Northern Semi-arid, Eastern Subtropical, Western Arid and Southern Temperate clusters. The Northern Semi-arid cluster represented the highest number of browsed tree species and the Southern Temperate cluster the highest number of browsed dwarf/shrub to shrub species. For the Northern Semi-arid cluster, the highest occurring species were *Diospyros lycioides* and *Dichrostachys cinerea*, for the Eastern Subtropical cluster *Mystroxydon aethiopicum* and *Searsia pyroides*, for the Western Arid cluster *Ballota africana* and *Didelta carnosus* and for the Southern Temperate cluster *Dicerotheramnium rhinocerotis* and *Felicia filifolia*. The highest intensity of browsed species is present in the Northern Semi-arid cluster, followed by the Eastern Subtropical cluster. The Bushveld Bioregion (2528CA) was identified as a hot spot for browseable species in the Northern Semi-arid cluster. For the Eastern Subtropical cluster, high intensity of browsed species was recorded in the Lowveld Bioregion (2832AA), for the Western Arid cluster the Namaqualand Hardeveld Bioregion (2917DB) and for the Southern Temperate cluster the Albany Thicket Bioregion (3326BC), signifying key regions to consider for future collection efforts. More than half of the browsed species are deciduous, with the majority of species producing fleshy fruits (74%), represented mostly by *Searsia* and *Ficus* spp. The lesser pod and dehiscent fruit-bearing species (26%) are mainly members of *Vachellia* and *Indigofera*. For the majority of browsed species, the leaves and fruits are the only plant part utilised, with the exception of e.g. *Adansonia digitata*, *Senegalia mellifera* and *Berchemia discolor*, where most plant parts are utilised. There are three endangered browsed species, for whom the collection and conservation of viable seeds should be prioritised, i.e. *Warburgia salutaris*, *Rhynchosia emarginata* and *Eriocephalus microphyllus* var. *carnosus*. The value of Leguminosae and Asteraceae containing the most sought-after browse species are confirmed.

STANDARD POSTER: CORALLOID ROOT AND SOIL MICROBE DIVERSITY, ASSOCIATED ENZYME ACTIVITIES AND THE ROLE OF MICROBES ON SOIL NUTRITION: A STUDY ON ENCEPHALARTOS VILLOSUS GROWING IN NUTRIENT-DEFICIENT SOILS IN EASTERN CAPE, SOUTH AFRICA

Nqobile Motsomane, Anathi Magadlela*

Cycads have been identified as a flagship species for conservation. Prioritising cycad conservation is essential because they offer valuable ecosystem services such as nutrient cycling. Cycads are currently the only known gymnosperms that are associated with nitrogen fixing bacteria. Cycad-microbe symbiosis, soil microbes, and extracellular enzymes play a significant role in nutrient cycling and soil nutrient inputs. This study investigated the diversity of bacteria found in *Encephalartos villosus* endosphere, rhizosphere, and surrounding soils in Rwebu and Oceanview, Eastern cape.

Furthermore, this study investigated the role of cycad-microbe symbiosis and associated soil enzyme activities on soil nutrition. *Encephalartos villosus* coralloid roots were collected from adult individuals growing in Oceanview and Rhebu for bacterial extraction and identification. Soil samples from *E. villosus* rhizosphere and surrounding soils were collected for bacterial identification, analysis of extracellular enzyme activities, and geochemical properties (nutrient concentrations, pH, total cation, and exchange acidity). The bacteria isolated from *E. villosus* endosphere, rhizosphere, and surrounding soils were nitrogen-fixing, nitrogen cycling, and phosphorus solubilising. The isolates from the endosphere belonged to the *Bacillus*, *Lysinibacillus*, *Stenotrophomonas*, *Rhizobium*, and *Paenibacillus* genera. In Rhebu, the bacteria isolated from the rhizosphere and surrounding soils belonged to the *Pseudomonas*, *Paraburkholderia*, *Burkholderia*, *Variovorax*, and *Bacillus* genera. The bacteria isolated from the rhizosphere and surrounding soils in Oceanview belonged to the *Lysobacter*, *Pseudomonas*, *Bacillus*, *Bradyrhizobium*, *Paraburkholderia*, *Variovorax*, and *Burkholderia* genera. In Rhebu and Oceanview, there were no significant differences in the concentrations of primary nutrients (N, P, K), alkaline phosphatase, acid phosphatase, glucosaminidase, and nitrate reductase activity. The bacterial diversity in *E. villosus* endosphere, rhizosphere, and surrounding soils and associated enzyme activities enable *E. villosus* to improve soil nutrition and overall ecosystem health in the rhizosphere and surrounding soils. Highlighting the role of cycads in ecosystems will aid in finding effective conservation strategies and encourage their conservation.

STANDARD POSTER: CONTROL OF INVASIVE ALIEN EUROPEAN RABBITS (ORYCTOLAGUS CUNICULUS) INCREASES GRAZING CAPACITY ON A SMALL MEDITERRANEAN-TYPE SOUTH AFRICAN OFFSHORE ISLAND; DOES IT LEAD TO COMPLETE RECOVERY?

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

Invasive alien species (IAS) are the most critical factor driving extinction rates worldwide. Among the IAS, the impacts of introduced mammals on native biodiversity are the most severe, with the European rabbit being the most problematic. European rabbits, which originate from the Iberian Peninsula in south-western Europe, have been introduced to at least 800 islands worldwide, where they have had devastating consequences for native flora and fauna and agricultural systems. The impacts of European rabbits on biodiversity and human livelihoods have been extensively studied across the globe. However, some world regions such as the offshore islands along Africa's southern coast have been sparsely studied. In this study, we monitored change in grazing capacity on a South African offshore island, Robben Island, over four years (2010-2013) following an attempt to eradicate invasive alien European rabbits between 2008 and 2009. Our aim was to determine grazing capacity response on the island to the removal of alien invasive rabbits. Plant species cover at nine sites on the island (strand (n=3), eucalyptus (n=3) and inland dune (n=3)) was determined annually using 100 m fixed-line point intercepts. Grazing capacity at the sites was evaluated using the Bayer method of rangeland condition assessment. Following rabbit control measures; grazing capacity increased from ~8 to ~16 and ~8 to ~19 Large Stock Units (LSU) 100 ha⁻¹y⁻¹ at strand and inland dune sites, respectively. These changes were driven by the re-establishment of a highly palatable shrub, *Tetragonia fruticosa*, and palatable grasses, *Ehrharta villosa*, *Ehrharta longiflora* and the alien *Avena fatua*. There was no change in grazing capacity (~3 LSU 100 ha⁻¹y⁻¹) at eucalyptus sites, most likely because of the inhibitory effects of the alien trees on understory vegetation dynamics. The plant species which drove the grazing capacity increase, which are resilient to heavy rabbit herbivory, are most likely to be a subset of the full complement of palatable species that occurred on the island before the introduction of rabbit herbivory. There is, therefore, a need for further monitoring of vegetation change on the island to determine if additional palatable species will return to the study sites in later years. Such information could clarify whether the removal of European

rabbits can be regarded as sufficient to facilitate full recovery of grazing capacity on the island or inadequate due to irreversible vegetation degradation. In the latter case, eradication of rabbits would need to be coupled with other restoration actions, such as the replanting or reseedling of missing native palatable species to ensure the complete recovery of grazing capacity.

STANDARD POSTER: WETLAND GRASSLANDS THROUGH TIME: USING THE PAST TO SHAPE FUTURE ECOSYSTEM RESTORATION AND MANAGEMENT

Abraham Dabengwa

Wetlands grasslands in Africa provide key ecosystem services for wildlife and human populations. Also, the immense capacities of wetlands to store carbon is now considered a boon for climate change mitigation. However, wetland ecosystems are threatened by climate change, habitat transformation, and land use intensification. Despite suggestions that some are resilient, not much is known about patterns and interactions of disturbances brought by drought, fires, and settled agro-pastoralism influence their ability to store carbon and remain useful to wildlife and humans. Here, I review a handful of prehistorical multiple-proxy records from rainfall, fire, and temporal land-use intensification gradients in South Africa's grassy biomes. I discuss how ecosystem services change over millennia, and why it is challenging to set benchmarks for ecosystem restoration based on these sparse and localized records in heterogeneous landscapes.



SESSION 05

SPECIAL SESSION: RANGELANDS & LOCUSTS

SESSION CHAIR: JAMIE PAULSE

Tuesday 26 July 2022, 16:30 – 17:30

PLATFORM PRESENTATION: WHY IS TRANSDISCIPLINARITY RELEVANT FOR THE FUTURE OF GRASSLAND ECOSYSTEMS?

Joh Henschel, Izak Gous, Igshaan Samuels*

A century of research on the periodically swarming Karoo brown locust (*Locustana pardalina*) has yielded hundreds of publications, but many important knowledge gaps remain, most tellingly, the lack of cost-benefit analyses of outbreaks. The causes and effects, positive and negative, short- and long-term, direct and indirect impacts of locust swarms have never been properly examined, quantified and evaluated, not even their economic significance, notwithstanding a plethora of assumptions and perceptions. There is, therefore, no sound justification for the recurring, costly, large-scale applications of insecticides that are not target-specific and probably incur considerable collateral damage to Karoo biodiversity, ecosystems and rangelands. The brown locust is endemic to the Karoo and, as such, is a component of the veld affected by and affecting rangeland management. The grasshopper-like solitary phase is cryptic with a specialised

diet and deposits 'smart' eggs in egg-banks. Large-scale synchronous hatching leads to crowding, and the gregarious phase develops involving complex physiological and genetic factors. Upon maturity, large swarms of gregarious locusts disperse to new feeding and breeding grounds across the Karoo and beyond. Notwithstanding numerous anecdotal reports, the actual diet of gregarious locusts, their feeding effects on the veld, behaviour, movements, predation on locusts, the associated food webs and effects on nutrient mobilisation, concentration and recycling await detailed study to determine their role in Karoo ecosystem functioning and impacts on agriculture. Research on outbreak control has focused on reducing the direct collateral damage of poisoning, although the effects of toxins on locust predators, ecosystem processes and rangeland products have scarcely been touched on. Surprisingly, little research has focused on protecting crops from approaching locust swarms. Even more surprisingly, income losses to farmers are not quantified. The only documented information on economics concerns the costs of insecticides and the payment stream by government to field teams to distribute these. Poisoning counters the potential of modernising prehistoric practices of harvesting locusts as protein-rich food for people and domestic animals. Furthermore, there could be ecotourism potential for experiencing locust swarms or attendant bird flocks as dramatic mega-events. Despite the deep-seated cultural entrenchment of locusts as plagues by default engendering orthopterophobic panic due to perceptions of being under attack by masses of insects and widespread perceptions that locusts rob people of livelihoods, anthropogenic relations with locusts beg study. On the reverse side, orthopterophilic, artistic, culinary and academic appreciation of locust swarms as extant, great natural phenomena in arid regions also warrants attention. We recognise four priority areas for research that should inform an overarching cost-benefit analysis: 1. the underlying agroecological processes and conditions, population drivers and effects of solitary and gregarious locusts as grazers and nutrient-recyclers; 2. the conditions, triggers and mechanisms of phase change in relation to (1); 3. cost-effective management of outbreaks without collateral damage; 4. developing positive space for locusts in the anthropogenic world. This research should work towards a government-stakeholder led management strategy on locusts where everyone works together in a coordinated manner.

PLATFORM PRESENTATION: LOGISTICAL PROBLEMS ENCOUNTERED BY FARMING COMMUNITIES IN THE NORTHERN CAPE PROVINCE IN DEALING WITH THE RECENT LOCUST PROBLEM

Izak Gous

Farmers in the Northern Cape Province have recently come to know that locusts and grasshoppers are among the most harmful of agricultural pests and pose a major threat to their grassland ecosystems. Their control is critical to food security in South Africa but unfortunately remains the task of the farming communities to deal with the situation hands-on with little governmental involvement. Sporadic outbreaks have to some extent been controlled by shortening the duration and reducing the extent of larger outbreaks. It must be noted that while some locust and grasshopper control systems are still curative, the recognition of the damage caused by these pests has major socioeconomic consequences which have led to an increasing paradigm shift from rangeland protection to preventive management. We will discuss our experiences and recent results in using chemical control techniques and various preventative measures. We will also propose the possibilities of implementing precautionary management strategies which we believe will be effective in dealing with future outbreaks. A possible question could be if we should be using any insecticides at all, especially looking at the impact on other insects and organisms. Hopefully our experiences will lead to discussions on more efficient monitoring and control techniques for the farming community.

PLATFORM PRESENTATION: THE PERCEPTIONS OF KAROO FARMERS ON THE EFFECTS OF LOCUSTS ON THEIR RANGELANDS AND THE KNOWLEDGE THEY REQUIRE TO PREVENT AND CONTROL OUTBREAKS

Igshaan Samuels, Clement Cupido*

The Karoo region in South Africa has been experiencing unusually large locust outbreaks and it is perceived to impact on livestock farming in the region. With the Karoo being the source of swarms of the brown locust, *Locustana pardalina*, its sink includes areas adjacent to the Karoo where cultivated agriculture is common. This suggests that the locusts pose a threat to the food security of the country. We conducted an online survey using structured questions with livestock farmers who raise their animals on natural veld and to a lesser extent, planted pastures. There were 126 commercial farmers who completed the survey and they are distributed within 23 local municipalities in South Africa. These farmers keep mainly sheep but goats, cattle and game were also present on the farms. The respondents had an average of 28 years of farming experience in landscapes dominated by a shrub-grass mixture (66%), but their farms also contained grasslands (4%), shrublands (4%), planted pastures (13%) and those who depend on both veld and planted pastures (13%). About 77% mentioned that locusts grazed both their veld and pastures, whereas others mentioned that locust herbivory was only impacting on their grasses (12%), shrubs (4%) or planted pastures (8%). Specific impacts reported as a result of high intensity herbivory when locust swarms move across their farms included a temporary reduction in the carrying capacity for livestock, damage to the winter grazing reserves, delayed recovery of the vegetation from the prolonged drought and overall impact on the finances of their business. Due to the lack of forage reserves, farmers are inclined to protect their grazing lands and 97% of respondents mentioned that they use chemical spraying to control and sometimes prevent locust swarming. When the results of the online survey were reported back during a farmer's day in the Karoo, farmers were made aware of non-chemical preventative methods to control locusts. However, farmers mentioned that they would need more information on the lifecycles of locusts, location of egg banks, ideal conditions and timing of locust outbreaks and movement patterns of swarms to improve the efficacy of their control methods including using their livestock to eradicate egg banks and hoppers on their land. The outcome from our interaction with farmers indicate that they see the role that good rangeland management could play in control locusts outbreaks in the country. However, they require rangeland scientists to fill the knowledge gaps to reduce their reliance in insecticides.



SESSION CHAIR: PIETER SWANEPOEL

Wednesday 27 July 2022, 08:00 - 10:00

KEYNOTE ADDRESS: HOW PASTURE PRODUCTION IN SOUTH AFRICA HAS EVOLVED; AND HAS A NEW ERA STARTED? LESSONS FROM PRACTICE AND RESEARCH.

Sigrun Ammann

Western Cape Department Of Agriculture

Intensive pasture production in South Africa was for decades based on the various ryegrass species, starting with the release of cv. Midmar in the 1970's. Ryegrass is mainly used in monocultures or oversown into a kikuyu base. Ryegrass breeding globally is very prolific and in South Africa nowadays seed of mainly imported cultivars is used. In recent years changes to these traditional ryegrass systems have been gaining momentum both through research work and driven by droughts, changing rainfall patterns and ever increasing pressure on irrigation resources. Changes have also been motivated by the need for greater resilience, better forage quality year-round and increasing costs of fertilizers, electricity and fuel. More recently, lowering environmental impact has also come into focus. In some dairy production areas the need for change has been greater than others, most notably the southern Cape areas, with recent droughts and unpredictable rainfall. It is essential to improve the forage quality of the pasture grown especially in the marginal seasons of summer and autumn, while also reducing the need for annual pasture renovation on the whole farm. Weed ingress is another important aspect that influences pasture quality and is related to long-term no-till practices. This requires as one option either broad-leaved or grass monoculture pastures for a certain period to allow for effective weed control. All this has resulted in intensive pasture production moving from ryegrass dominated systems to alternative species and mixed swards, including legumes. Mixed swards come with their own challenges scoring high on resilience, but lower on predictability than monocultures do. Ryegrass based monocultures are predictable both the good and the bad seasons, their use is backed by vast amounts of research, accumulated knowledge and on-farm experience. Mixed swards have a host of advantages but require adaptive management which is often farm specific since it depends on the soil, climate, grazing management and irrigation resources. It requires that mixtures might be paddock specific and each farm developing its own best mixture and alternative monoculture composition and management thereof. It requires that research develops principles by which farms can "design" their pasture requirements. Research needs to provide guidelines on complementarity and pasture renewal options and the associated decision support systems. What are the future needs for pasture production? There are increasingly sustainability requirements in terms of water management, nutrient losses, carbon footprint and generally the impact on the environment. All this requires that inputs are lowered, but productivity and forage quality maintained or even improved. Species that are suitable for future pasture systems need more in-depth research and determination of suitable management practices, mostly in mixed swards. Cultivars need to be evaluated for adaptability and complementarity. Pasture system options will need refining with the inevitable need for more data collection on farm with user friendly decision support systems. There should be a willingness to critically assess current practices for possible improvement.

PLATFORM PRESENTATION: CAN PASTURE SYSTEMS BASED ON FORAGE HERBS AND MIXTURES COMPETE WITH KIKUYU-RYEGRASS PASTURES IN TERMS OF PASTURE YIELD IN THE SOUTHERN CAPE?

Janke Van Der Colf

The long-term sustainability of pastures in the southern Cape based on kikuyu (*Cenchrus clandestinus*) and ryegrass (*Lolium* spp) is at risk due to the poor persistence of ryegrass over years, the ingress of long-term minimum till pastures by weeds and high fertiliser and irrigation costs required to maintain high pasture yields. Results from variety trials conducted in the area have shown that the pasture yield of Tall Fescue (*Festuca arundinacea*) and forage herbs like plantain (*Plantago lanceolata*) and chicory (*Chicorium intybus*), compares favourably to that of perennial ryegrass (*Lolium perenne*) and Kikuyu-ryegrass. However, the pasture production potential of these species has not been evaluated under grazing or when established on areas under long-term minimum till pastures. A farmlet study was undertaken from June 2019 to May 2022 (3 years) to evaluate four pasture systems viz. 1) KIKRYE: kikuyu-ryegrass system 2) MONOC: two separate areas allocated to a monoculture sward of Tall Fescue or plantain, respectively, but grazed as one system 3)

FESC_PL.MIX: mixture with Tall Fescue, plantain and red clover and 4) LUC_HERB.MIX: mixture consisting of Lucerne, chicory, plantain and ryegrass. Each farmlet was managed as a self-sustaining, closed system, to which a mini-herd of approximately 25 dairy cows was allocated and used to graze each system throughout the year. Pasture yield was estimated pre-grazing on 0.2 ha plots using a rising plate meter. During both year 1 and 2, the two pasture systems based on alternative species (MONOC and FESC_PL.MIX) achieved similar growth rates to the traditional KIKRYE system during winter. The trend in spring growth rates was more variable over years, with different systems achieving the highest growth rates and seasonal yields viz. FESC_PL.MIX in year 1 and the LUC_HERB.MIX in year 2 and year 3. The typical pattern of high summer and autumn growth rates of kikuyu, particularly from December to March, was also evident during this study for the KIKRYE system throughout. However, during year 1 these growth rates were matched by that of MONOC_Fescue and the FESC_PL.MIX. Botanical composition was estimated by cutting samples on a third of the plots pre-grazing and separating it into different species that were dried and weighed. The major weed component in pastures in the southern Cape appears to be grasses (*Paspalum* spp. *Sporobolus africanus*, *Eragrostis plana* and *Bromus catharticus*), rather than broadleaf species. Grass monocultures such as KIKRYE and FESC had a higher proportion volunteer grasses during year 1 and 2 than MONO_PL and forage herb mixtures (FESC_PL.MIX and LUC_HERB.MIX). This indicates that forage herbs can compete to a degree with these species after establishment by use of herbicides. However, this competitive advantage seems to decline after year 2, resulting in the eventual ingress of weeds during year 3. Preliminary data indicates that alternative species such as tall fescue and forage herbs can yield at a similar rate as ryegrass, while also holding the potential to be used to manage weed ingress in long term no-till pastures.

PLATFORM PRESENTATION: THE USE OF INTERSEEDED COVER CROP SPECIES TO IMPROVE THE YIELD AND NUTRITIONAL QUALITY OF NATURAL VELD AND PLANTED PASTURES FOR RUMINANT LIVESTOCK PRODUCTION

Likhona Cele, Khanyisile Mbatha, Wayne Truter

Evidence on forage quality could benefit rangeland managers in selecting suitable grazing methods to achieve higher animal performance without damage to vegetation. Integrating cropping systems into livestock production offers a means to intensify agriculture sustainably and improve economic returns. Integrated crop-livestock systems (ICLS) can unite livestock and cash crops at the farm level, where crops and their by-products in ICLS are used to feed livestock. In turn, these livestock return excreta that is used to fertilise crops. This study aimed to evaluate cover crops as an alternative to preserved fodder. A completely randomised block design replicated three times was conducted at the University of Pretoria experimental farm during the 2020-2021 growing season. Biomass yields and forage quality (predicted moisture, crude protein (CP), neutral detergent fibre (NDF), acid Detergent Fibre (ADF), fibre, calcium, phosphorus and ash) using NIRS (Near-infrared Reflectance Spectroscopy) technology were measured for fresh forage and dry matter. Duplicated samples containing *Cichorium intybus* (Chicory commander), *Chloris gayana* (Rhodes grass), *Sorghum bicolor* (Forage sorghum), *Medicago sativa* (Lucerne), *Raphanus sativus* (Forage radish) were dried, milled and analysed for forage quality parameters. *Medicago sativa* exhibited a high protein percentage (24.05%) and a significantly low NDF (23.1%) when compared to a mixture containing *R. sativus* and *S.bicolor*. *Chloris gayana* contained the lowest percentage of protein (8.99%) and the highest NDF percentage (56.54%). This may be due to the planting combinations, planting methods, and stages of harvest. These different forage quality levels offer different functions in animal diets affecting animal performance. It can be concluded that incorporating cover crops in either degraded natural pasture or planted pastures can offer additional nutritional value to grazing animals.

PLATFORM PRESENTATION: CLIMATE-SMART BRACHIARIA GRASS ACCESSIONS HAVE THE POTENTIAL TO SERVE AS ALTERNATIVE FORAGE RESOURCES FOR RUMINANTS IN SOUTH AFRICA

Stephen Modiba, Julius Tjelele, Francois Müller, Jones Ng'ambi*

Ruminant livestock are economically, nutritionally, and culturally very important in South Africa (SA), particularly in rural communities where they contribute significantly to the food security of farmers. However, the productivity of livestock is negatively affected by feed shortages, which subsequently leads to poor welfare status of the farmers. To help fill the gap in feed shortages, there is a need to evaluate climate-smart grass species from the genus *Brachiaria*, which have shown potential in drought tolerance and high biomass yield in a variety of agro-ecological zones in east-African countries. Such information is limited under the climatic conditions that prevail in South Africa. The aim of this study was to determine the adaptability and agronomic performance of several *Brachiaria* accessions for their potential as alternative forage resources for livestock. The study was conducted at the Agricultural Research Council - Roodeplaat experimental farm - located in the northern region of Gauteng province, South Africa. A total of 11 grass accessions composed of two locally adapted species as controls and nine *Brachiaria* accessions were evaluated for two consecutive years. The *Brachiaria* accessions were composed of six breeding lines, and four commercial accessions that were obtained from the International Centre for Tropical Agriculture genebank in Colombia, and the International Livestock Research Institute genebank in Kenya, respectively. Germinated seedlings were transplanted to individual field plots (2.0 m x 4.0 m). The accessions were arranged in a randomized complete block design, replicated three times with 0.3 m intra-row spacing and 0.5 m inter-row spacing. Agronomic performance and biomass yield of the plants were measured at 50% flowering. Sub-samples of fresh biomass were oven-dried at 60 °C for 72 hours to determine dry matter (DM) yield. Results show that all grass accessions are adapted with a plant survival greater than 90% except for *B. brizantha* CIAT 16483. Commercial accession, *Brachiaria decumbens* cv. Basilisk produced the highest ($p < 0.05$) DM yield at 13.79 ± 0.59 ton/ha/year in the first year, while *B. brizantha* cv. Marandu produced the highest ($p < 0.05$) DM yield at 26.74 ± 4.34 ton/ha/year, and had the highest ($p < 0.05$) average DM yield at 16.58 ± 3.87 ton/ha/year compared to controls and breeding lines. There was an apparent increase in the DM yield from year one to year two, and this can be attributed to nutrient enrichment of the crown of the roots in the first year for aggressive growth in the second year. In conclusion, *Brachiaria* grass accessions have the potential to serve as alternative forage resources in SA, but an animal feeding study is needed to determine their potential in feeding value.

PLATFORM PRESENTATION: POTENTIAL FOR CONYZA BONARIENSIS AS A NEW FORAGE SPECIES WITH A SUBSTANTIAL FORAGE QUALITY FOR INCLUSION IN RUMINANT DIETS

Jamie Young, Charlie Reinhardt, Wayne Truter*

Global warming has emphasised, more than ever, the need for innovation for sustainable agricultural practices. The use of non-conventional feedstuffs for livestock production can prove beneficial to thriving under climate change. *Conyza bonariensis* is a prolific weed found throughout the sub-tropics, both in and outside cultivated lands. It is a prodigious seed producing plant, found in the Asteraceae family. Preliminary control methods have led to resistance of the weed to glyphosate and unintentional consumption of the plant by livestock. If *C. bonariensis* were to be classified as a forage species, with a potential forage quality, the need for herbicidal control of the weed would be mitigated, whilst introducing a hardy, cost-effective, and potentially nutritious feedstuff to the market. Little, if any research on the nutritive value of *C. bonariensis* and its chemical composition is available at this point. This study assessed how the

quality parameters of the weed change when water-stressed and nutrient deprived. *Conyza bonariensis* shows a mean protein content between 18-22%, which was maintained between 20.5% and 20.2% when water and nutrients were stressed, respectively. Because *C. bonariensis* is consumed by grazing livestock, an evaluation was conducted into the plant's sugar content utilising BRIX readings to quantify the plant's sugar content and correlate this to the palatability of the weed. We added a glyphosate treatment at 0.5 times the recommended dosage as a secondary study. The control treatments exhibited a mean BRIX reading of 8.0%, which is classified as good. When water and nutrients were stressed, the plants maintained their sugar content of 8.82% and 8.02%, respectively. These stable results are promising when looking at the potential success of *C. bonariensis* as a robust and adaptable forage species. Although the chemical qualities of the plant, such as protein %, fat %, and fiber %, managed to remain steady amongst the treatments, the biomass of plant material declined by 37.0% and 35.5% for water-stressed treatment and nutrient-deprived treatment, respectively, when compared with the control treatment (non-limiting water and nutrients). Such a decline was postulated, unlike the unforeseen protein content, which did not decline as expected. These results prove a step in the right direction for promoting *Conyza bonariensis* from weed to forage species if expected yields are acceptable and no anti-quality factors are present.

PLATFORM PRESENTATION: THE INFLUENCE AEROBIC STABILITY HAS ON SILAGE FERMENTATION CHARACTERISTICS OF GRASS AND LEGUME SILAGE

Wayne Sanders, Quenton Kritzingler, Wayne Truter*

Southern Africa has a wide diversity of endemic grasses, each with unique capabilities that enable them to survive in a range of climatic conditions. Research predominantly highlights maize silage and its potential, yet grass silage is not that well researched. The combination of grasses' adaptive qualities and the high-moisture content of silage material makes grass silage a good addition to any farmer's fodder flow system. Laboratory scale vacuum-sealed silage samples provide a fast and cost-effective practice used to simulate several storage conditions for a variety of forage crops. Microorganisms have a significant role in all the phases throughout the ensilage process, and their occurrence can act as a simple quality indicator. This study aimed to investigate how the silage quality of grass and legume silage is dependent on the absence of oxygen in the stored material by analysing the preservation efficiency of the stored silage material and identifying any fungal cultures and their potential mycotoxins. Pasture species used included a cool-season grass and legume (*Avena sativa* and *Medicago sativa*), warm-season grasses (*Chloris gayana*, *Panicum maximum*, *Pennisetum glaucum*, *Sorghum bicolor* and *Urochloa brizantha*) and a tropical herb (*Plantago lanceolata*). Species were grown and harvested from a randomised block design with five replicates, then stored at three different storage conditions over three months as 400g laboratory scale vacuum-sealed silage samples. Quality parameters such as crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF) and pH were measured. Physiological differences, such as perenniality and cultivar, will correspondingly influence silage quality, yet these differences make grasses so abundantly widespread. Fungal cultures indicated that the inadequately stored silage samples contained a variety of mycotoxins. This displays the negative health and performance consequences resulting from unsatisfactory ensilage practices. There is an inverse relationship between silage preservation technique and pH. Well sealed silage samples show pH values around 4.5, while poorly stored silage had a higher pH of 5.8. Variations in pH will suggest the level of fermentation that took place and the possible by-products produced in the silage. To improve an animal's performance, the farmer should aim to enhance the quality of the diet. The beneficial characteristics of grass and longevity of silage make grass silage an appealing forage to include in a ruminant feeding program.

POSTER SESSION 3

Planted pastures



SESSION CHAIR: PAUL MALAN

Tuesday 26 July 2022, 10:00 – 10:30

Posters can be viewed on twitter @ <https://twitter.com/GrasslandSocSA>

STANDARD POSTER: THE PERFORMANCE OF DACTYLIS GLOMERATA (COCKSFOOT) AND FESTUCA ARUNDINACEAE (TALL FESCUE) CULTIVARS IN THEIR FIRST YEAR ON CEDARA RESEARCH STATION, KWAZULU-NATAL

Donna Berjak, Derryn Nash*

New trials of cocksfoot (*Dactylis glomerata*) and tall fescue (*Festuca arundinaceae*) cultivars were planted next to one another in March 2021 to assess the performance of new cultivars coming onto the market in terms of yield, measured as tonnes Dry Matter per hectare (t DM/ha) and quality parameters (disease resistance and reproduction ratings). These species as well as a bromus (*Bromus catharticus*) cultivar are being tested as alternative perennial pastures that are more resilient in terms of adaptation to higher temperatures and possibly better water use efficiency, to accommodate climate change, than a popular pasture grass like perennial ryegrass. These trials will be carried out for at least three years in order to evaluate persistence and yield over time. The tall fescue trial consists of 16 cultivars including one bromus and one tall fescue/socksfoot mixture, and the socksfoot trial consists of 13 cultivars including the same bromus cultivar as is in the tall fescue trial. Both trials were planted as a randomised block design with three replicates. The mean total dry matter yield for the tall fescue trial was 14.52 t DM/ha ranging from 11.3 to 17.0 t DM/ha for the first year of the trial (March 2021 to February 2022). The highest yielding nine tall fescue cultivars were not significantly different from one another ($p < 0.05$), whilst the lowest yielding four cultivars were not significantly different from one another. The mean total dry matter yield for the socksfoot trial was 12.64 t DM/ha ranging from 8.4 to 15.4 t DM/ha for the first year of the trial. The highest yielding six socksfoot cultivars were not significantly different from one other ($p < 0.05$). Some of the cultivars that had lower total yields in the first year were due to a slow start in terms of establishment and having a low yield in the autumn and winter after planting, such as 'Ninkoko' and 'Greendale' tall fescues and 'Inavale', 'Pizza' and 'Echelon' socksfoots. Rust and reproduction (flowering) are estimated on a visual 9 point scale, which can be an indication of feed quality. The quality of the pasture is lower if rust and flowering is high. Rust infestation was not severe in the 2021/22 year, but was the most severe in the summer months (December, January and February) for both trials, particularly for the 'Bareno' (bromus) cultivar. The tall fescue trial was more reproductive than the socksfoot trial with many tall fescue cultivars reproductive in October, November and December 2021. The socksfoot had many cultivars that were reproductive in December 2021. Both trials were cut seven times during the first year, but overall, the tall fescue cultivars produced a greater yield than the socksfoot cultivars by two tonnes DM/ha. During the second and third years of the trial, it will be interesting to see if the trends continue.

STANDARD POSTER: THE USE OF LABLAB AS CLIMATE SMART FODDER LEGUME FOR SMALL SCALE FARMING SYSTEMS IN DRY LAND CONDITIONS

Amahle Sogoni, Unathi Gulwa, Sive Tokozwayo*

Lablab is an herbaceous tropical legume that can be used as standing forage or for making silage for ruminant animals. *Lablab* is a drought tolerant species with high nutritive value, palatability, and excellent forage yield. The species is adapted to diverse environmental conditions. This forage legume is drought tolerant, highly palatable, and nutritive. It also assists with soil erosion control and ecological restoration. This poster provides practical guidelines on how and when *lablab* as a climate smart fodder legume can be incorporated to improve livestock productivity.

STANDARD POSTER: GROWTH PERFORMANCE AND BIOMASS YIELD OF SORGHUM BICOLOR AS INFLUENCED BY BIOGAS DIGESTATE COMPARED WITH INORGANIC FERTILIZER

Thato Moloi, Thabiso Teffo, Thamsanqa Mpanza, Mary-Jane Thaela-Chimuka, Pillemon Ramalepe, Ida Risenga, Dikonketso Matjuda*

The study was conducted to determine the effects of digestate when valorized as a biofertilizer on the growth performance of *S. bicolor*. Digestate was collected from a Commercial biogas plant in Gauteng that co-digest fruit, vegetable, feedlot, abattoir waste and cattle manure. Digestate was collected once at secondary digester tank and was used throughout the trial period. Some elemental digestate composition was as follows: P (0.7 g/Kg), N (5.7 g/Kg), C (31.1%). The experiment was performed in a greenhouse on 5L pot plant and the following three treatments: foliar digestate, soil digestate application and inorganic fertiliser (positive control) and no fertilizer (negative control). Each treatment was replicated fifteen times, hence 60 pot plants were used. The experiment lasted for three months. The following parameters were recorded: physical (plant height, stem width, nodes, internodes and number of leaves) and physiological (total chlorophyll content and stomatal conductance, biomass and seeds yield). Physical parameters were collected fortnightly, whereas physiological were collected at plant maturity. Treatments had a significant ($p < 0.05$) effects on physical parameters. Plant height was 28.7 cm, 80.8 cm, 73.9 cm, and 50.2 cm for negative control, inorganic fertiliser, soil applied digestate and foliar applied digestate, respectively. Stem width was 4.2 mm, 6.7 mm, 4.0 mm and 3.5 mm for negative control, inorganic fertiliser, soil applied digestate, and foliar applied digestate, respectively. Mean internodes number were 1.7, 4.2, 4.0, and 3.5 per treatment for control, inorganic fertiliser, soil applied digestate and foliar applied digestate, respectively. Mean leaves number were 4.7, 4.6, 5.9, and 4.9 for control, inorganic fertiliser, soil applied digestate, and foliar applied digestate, respectively. The soil applied digestate significantly ($p < 0.05$) improved the total chlorophyll content (32.4 mmol/cm^2 ; $p < 0.05$) as compared to other treatments. The stomatal conductance for both abaxial and adaxial leaves surfaces showed no significant ($p > 0.05$) differences in all treatments. It could be because in this study only one concentration level was used. Biomass yield varied significantly ($p < 0.05$) across treatments with highest values observed in inorganic fertilizer treated *S. bicolor* (408.9 kg/ha) followed by soil digestate application (177.8 kg/ha). It can be concluded that soil applied digestate treatment had a positive effect on the physical and physiological growth parameter measured in this study compared to foliar applied digestate. It is withstanding to note the applying digestate fertilizer on soil after planting resulted in 47% plant mortality; hence, the survival rate was 53% as compared to 100% survival rate on other treatments. This could have attributed to no statistical

improvement of the biomass yield of plant that was subject to this treatment as compared to negative control. However, the treatment performed better on physical parameters. In conclusion, application of digestate directly to soil could have improved the growth performance and biomass yield of *S. bicolor* plants. Nevertheless, application after planting could have been a problem. Hence, there is a need for further study where different application levels before planting will be evaluated.

STANDARD POSTER: EVALUATING DRY MATTER YIELD AND NUTRITIONAL QUALITY BETWEEN TETRAPLOID AND DIPLOID VARIETIES OF ITALIAN RYEGRASS (*LOLIUM MULTIFLORUM*)

Patrick Rakau, Francois Müller, Mpho Nzeru*

Globally, ryegrass (*Lolium multiflorum*) is an important forage species to the dairy industry. Due to its importance, constant improvement of the species is needed to produce better varieties for implementation under specific agro-ecological conditions. Often however, improvements in one area (crude protein content), leads to deficiencies in other areas (dry matter content), necessitating the constant evaluation of new varieties entering the market. This study therefore aimed to compare new Italian ryegrass varieties (Tetraploid ARC-214 and Diploid ARC-148) with existing high producing varieties (Tetraploid SuperCharge and Diploid Supreme-Q) in terms of their biomass production, and nutritive value (non-structural carbohydrates, crude protein, and fibre). The ryegrass varieties were evaluated for two consecutive years (2018 to 2019) at the Cedara research station in the KwaZulu-Natal province of South Africa. The ryegrass varieties were planted in rows which were 150 mm apart in 12 m² plots, 30 kg/ha for Diploid and 36 kg/ha seeding density. Each trial were replicated three times. In 2018, the plots were harvested 7 times over the production period, and in 2019, 10 times. Biomass production and non-structured carbohydrates were determined from each cut. Total biomass production over the growing period was calculated as the sum of the biomass produced per cut. At the end of the trial, biomass samples for each year were grouped and homogenised, from where a sub-sample was used to determine the crude protein and fibre (ADF and NDF) content. The ADF and NDF values were used to calculate the dry matter digestibility (DMD), dry matter intake (DMI), metabolizable energy (ME), total digestible nutrients (TDN), digestible forage energy (DFE), digestible organic matter (DOM), net energy for lactation (NE_L), net energy for maintenance (NE_M), and net energy for gain (NE_G). Results from the trials showed significant variation in biomass production and TNC content between different cuts as well as between sampling seasons (winter, spring and summer). Total biomass production ranged between 4.6 and 6.4 t DM ha⁻¹ and 11.4 and 14.2 t DM ha⁻¹ in 2018 and 2019, respectively, and average TNC ranged between 15.08 and 23.2%, and 12.2 and 16.9%, in 2018 and 2019, respectively. Crude protein content were generally high in all varieties evaluated, ranging between 17.6 and 21.6%, and 16.5 and 20.9% in 2018 and 2019, respectively. The DMD for each of the varieties exceeded 60% suggesting that these are all high energy forages, which were confirmed by ME content of the varieties ranging between 10.6 and 11.4 MJ and 11.2 and 11.5 MJ and NE_L ranging between 2.9 and 3.2 MJ and 3.1 and 3.2 MJ in 2018 and 2019, respectively. These results indicate that the new varieties are comparing well with existing varieties in terms of their production potentials and nutritional quality. Additional morphological, physiological and biochemical characterisation is needed to determine in more detail whether the new varieties differ from the existing commercial varieties.

STANDARD POSTER: COMPARISON OF YIELD PERFORMANCE OF ITALIAN RYEGRASS CULTIVARS, AT TWO DIFFERENT LOCATIONS, CEDARA AND OUTENIQUA AND ACROSS TWO YEARS

Derryn Nash, Sigrun Ammann, Donna Berjak*

Similar cultivar evaluation trials on Italian ryegrass (*Lolium multiflorum*) are carried out at Cedara Research Station in KwaZulu-Natal and at Outeniqua Research Farm in the Western Cape. The same operating procedure is followed at both locations. Cultivars common to both trials in 2020 and 2021 were compared for yield. In 2020 and 2021 all cultivars did better for yield over 12 months at Cedara than at Outeniqua, except for the cultivars Barmultra II, Jeanne and Teanna in 2021, which when taking the standard error (SE) values into account had similar yields. Seasonally autumn and winter yields were higher at Cedara while summer yields were higher at Outeniqua in both years. Common cultivars in successive trials on Cedara were also compared for yield considering SE values as measure of variation. In 2021 yields were better than 2020 yields except for the cultivar Teanna, and the cultivars Green Spirit and Jackpot had similar yields over the two years. Generally, the 2020 autumn season was better than 2021, however, thereafter the 2021 winter, spring and summer was better for yield. The Westerwolds types Ribeye and Maximus and the Italian Enhancer had a longer growth period in 2021 with some growth into summer, where they had died out in spring 2020. Common cultivars at Outeniqua showed five cultivars producing higher in 2021 than 2020. During winter all cultivars had a higher yield in 2021 than in 2020, while the autumn and summer yield of 2021 was generally lower than 2020 with two cultivars significantly lower in autumn and five also lower in summer. Three cultivars were amongst the highest yielding group for both years, Fox, Barmultra II and Bond. These comparisons show that time (years and seasons) and location have an effect on yield performance of the same Italian ryegrass cultivars and data should not necessarily be extrapolated. This indicates environmental differences and thus genotype x environmental interactions, which should be investigated with more targeted statistical methods.

STANDARD POSTER: NITROGEN FERTILIZATION INCREASES THE GROWTH AND NUTRITIONAL QUALITY OF CALOBOTA SERICEA FODDERS

Francois Müller, Ethan Britz, Lilburne Cyster, Igshaan Samuels, Clement Cupido, Letty Masemola, Nothando Ngcobo*

A consistent fodder flow in water-limited rangelands remains a challenge for resource-poor farmers. *Calobota sericea* is currently being evaluated as an alternative drought tolerant fodder resource for these areas. The nutritional quality of *C. sericea* fodders from native populations are poor and this is believed to be due to poor soil fertility. To test this hypothesis, a complete randomized block pot trial was established to determine the impact of N-fertilization, applied at rates of 0, 25, 50, 75, and 100 kg/Ha N, on the growth and nutritional quality of *C. sericea* plants. Three-month-old plants were uprooted and the root and shoot length, roots, leaves and stems fresh mass and number of branches on each plant were determined. Thereafter, the various plant parts were oven dried and the dry mass determined and dried shoots were milled for nutrient determination. Results from the trial indicated that N-fertilization significantly ($p < 0.05$) improved plant growth at each of the fertilization application levels, with increases of 1.2–2.3 and 1.1–2.2 times in leaf mass and total shoot mass, respectively. Similarly, mineral nutrient uptake increased significantly ($p < 0.05$) under all the N-fertilization treatments and crude protein content increased by 1.4 to 1.9 times from the control, ranging from 9.6% (control) to 18.6% at the highest fertilization level. Therefore, fertilized *C. sericea* grown in monocultures can

be harvested as green material in winter and stored for use as a protein and nutrient source to supplement dry season feed-gaps in extensive livestock production systems.

STANDARD POSTER: COST-BENEFIT ANALYSIS OF ON-FARM MANAGEMENT OF PLANTED IMPROVED FORAGE VARIETIES IN WESTERN KENYA

Peggy Karimi, Stefan Burkart, Joseph Ugbede*

Livestock is a major source of livelihood for many households in sub-Saharan Africa. In Kenya, the dairy sector contributes with 14% of the agricultural gross domestic product. The sector is, however, heavily dependent on the quality of fodder, both forage- and legume-based, which is the key for the success of livestock keeping enterprises. Against this background, research and development programs over the years have put emphasis on developing and implementing superior forage species in Kenya, above all *Brachiaria* and *Panicum maximum* species, that have high biomass production, nutritional quality, and tolerance to biotic and abiotic stresses, increasing the overall feed availability throughout the year. In addition to the introduction of new forage species, improvements on agronomic forage management (e.g., weeding, manuring, fertilizing), have assisted in improving forage yields and feed availability. Even though the agronomic and productive benefits of introducing both forage varieties and management practices are well-documented, economic analyses that help producers and other stakeholders decision-making on adopting forages are scarce. The aim of this research was to determine the economic benefits of various on-farm agronomic management practices of improved forage grasses among farmers in western Kenya. Based on field measurements with 162 randomly selected farmers in four counties (Busia, Kakamega, Bungoma, and Siaya), expert consultation, and literature review, we evaluated the economic viability of introducing weeding, fertilizing, and manuring in dairy production systems that use different improved forage varieties of *P. maximum* and *Brachiaria* spp. We applied a discounted free cash flow model for the estimation of the economic indicators Net Present Value (NPV), Internal Rate of Return (IRR), and Return on Investment (ROI). Our results show that the economic indicators vary among the different forage varieties, management practices, and counties (agro-ecological zones). Moreover, the forage varieties and management practices were adopted to different extents by the farmers. The profitability especially depends on the soil and climatic conditions present in the counties. For instance, the lowest IRR, ROI, and NPV are obtained in Siaya county, resulting from the low yields of most forage varieties, whereas Busia county has soils with higher carbon and nitrogen levels, which positively impact forage yields and thus profitability. The highest NPV (1,260,692 Kenyan Shillings) and ROI (431%) were obtained for the *Brachiaria* hybrid cv. Cayman in Bungoma county, the highest IRR (39%) for *P. maximum* cv. Mombasa in Busia county, respectively. The application of management practices increases the profitability in all sites and for all forage varieties. The economic indicators are better for forage dry matter (hay) than for fresh forage, resulting from lower market prices for the latter. For most farmers, fresh forage sales are not sufficient to cover the financial investments incurred in forage establishment and management practices, despite high biomass production of the evaluated materials. We thus conclude that adoption decisions regarding planting improved forages and applying management practices should be supported by the site-specific economic indicators so that the risk of economic failure can be reduced.

STANDARD POSTER: CARBON SEQUESTRATION AND GREENHOUSE GAS EMISSIONS IN CROP SYSTEMS CONTAINING A PASTURE-LIVESTOCK PHASE VS CASH CROP ONLY ROTATION SYSTEMS

Lisa Matthews, Pieter Swanepoel, Johann Strauss, Thorsten Reinsch, Friedhelm Taube, Arne Poyda*

Agriculture has reformed the natural landscape, and with increasing climate change effects, it is critical to assess their contribution to global emissions of greenhouse gases (GHG). Within an agricultural system, emissions occur throughout the lifecycle, from tillage actions to the manufacture and transport of agrochemicals. GHG, particularly nitrous oxide (N₂O), are emitted directly from agricultural soils. Soils emit GHGs as products of biochemical processes; these are influenced by environmental factors, biological interactions, and agrochemical inputs. The choice of a rotation system, due to associated management practices (soil preparation, fertiliser requirements and agrochemical inputs), and plant-soil-livestock dynamics (crop type, livestock excreta and symbiotic plant-microbe relationships), could affect the emission balance of the system. This study investigates the difference in soil GHG emissions between cash crop and mixed crop-livestock rotation systems. The experimental site is a long-term rotation trial situated at Langgewens Research Farm near Moorreesburg, South Africa. The study evaluated three four-year crop rotation systems: Wheat-Wheat-Wheat-Canola (WWWC); Medic-Wheat-Medic-Canola (MWMC) where sheep grazed the annual medic (*Medicago* spp.) pastures; and Wheat-Canola-Wheat-Cover crop (WCWL). Annual medics are legumes that fix nitrogen, reducing the fertiliser requirement in the following cash crop by up to 70%. N₂O and CH₄ fluxes were sampled weekly, via the closed chamber method, over thirteen weeks, from 30 days after planting until stem elongation. Carbon sequestration was estimated using soil organic carbon (SOC) values from 2002 – 2020. Gas fluxes and SOC responses to rotation system were analysed with mixed model ANOVAs in R. Protein contents of the harvested wheat kernels, from 2002 – 2020, were compared using a Kruskal-Wallis test in R. No significant differences in SOC, or gas fluxes between rotations occurred. SOC values were around 1.3%, gradually increasing over the period. CH₄ fluxes were negligible and negative due to aerobic soil conditions. N₂O fluxes were very inconsistent over the period. WWWC, unlike the other systems, showed periods of negative fluxes. It is possible that the lower N₂O emissions resulted from periods of momentary N immobilisation as cash crops entered an N-hungry bolting growth stage, and microbes decomposed high C:N ratio residues. The long-term protein content of wheat in all rotations differed significantly ($p < 0.05$) from each other. MWMC had the highest long-term protein content, despite having the lowest N fertiliser application of typically 26 kg ha⁻¹ (relying on biological fixation). WWWC, receiving the highest fertiliser application of typically 87 kg ha⁻¹ had the lowest protein content. Legume inclusion may lead to higher levels of soil N, especially later in the season due to the build-up of residues with a low C:N ratio, leading to slightly higher levels of N₂O emissions and significantly higher protein contents in the wheat kernels. A clearer picture will emerge with continuation of measurements and a complete life cycle analysis. Being able to evaluate the environmental sustainability of different rotation systems contributes to the development of climate smart agricultural practices.



SESSION 07 | PLANTED PASTURES II

SESSION CHAIR: JANKE VAN DER COLF
Wednesday 27 July 2022, 10:30 - 11:45

**PLATFORM PRESENTATION: THE IMPACT OF ALTERNATIVE PASTURE SPECIES ON THE MILK PRODUCTION
POTENTIAL AND FODDERFLOW DYNAMICS OF PASTURE SYSTEMS IN THE SOUTHERN CAPE**

Janke Van Der Colf

Until recently, a large proportion of pastures for dairy production in the southern Cape have been allocated to minimum-till kikuyu-ryegrass (*Cenchrus clandestinus-Lolium* spp.) systems. Although high yielding in terms of pasture yield and grazing capacity, challenges within these systems include poor forage quality during summer and autumn, which in turn often leads to the "autumn slump" in milk production of cows grazing these systems, poor persistence of the temperate ryegrass component, poor resilience to adverse environmental conditions and the ingress of pastures by weeds. A potential solution to some of these challenges is the incorporation of alternative species such as Tall Fescue (*Festuca arundinacea*), chicory (*Chicorium intybus*) and plantain (*Plantago lanceolata*). The study thus aimed to determine whether the inclusion of these species in pastures could improve the milk production potential and fodderflow dynamics of pastures systems in the southern Cape over a three year period. Four 5.0 ha farmlets were established, with each farmlet allocated a different combination of species or mixtures viz. 1) KIKRYE: kikuyu-ryegrass pastures 2) MONOC: Half of the farmlet allocated to a plantain monoculture and the rest to a Fescue monoculture 3) FESC_PL.MIX: Tall fescue, plantain and red clover (*Trifolium pretense*) mixture 4) LUC_HERB.MIX: Lucerne (*Medicago sativa*), chicory, plantain and ryegrass mixture. A group of 25 Jersey cows grazed each system throughout the year, with animals blocked into groups based on days in milk (DIM), lactation number and milk yield and composition for previous lactation. Each system was managed as a closed and self-sustaining, with surplus pasture ensiled and pasture shortfalls supplemented with this cut silage or Lucerne hay. All systems showed low, but similar, grazing capacities during the winter, necessitating animals to be fed conserved forage during this period. Throughout the study the KIKRYE system had a higher grazing capacity from late spring to early autumn. However, these higher grazing capacities were also accompanied by lower milk yield per cow and total seasonal milk yield per ha for the KIKRYE system than the other three systems. In terms of average annual grazing capacity, it was higher for the MONOC and FESC_PL.MIX systems than the KIKRYE system during year 1, with total annual milk also higher for the two systems that had a forage herb component. During year 2 and 3, the KIKRYE system had a higher average annual grazing capacity, but this did not equate to a notably higher milk yield per hectare (< 1000 L/ha/annum) than the other systems. Results from the study are still preliminary, but indicate that the inclusion of forage herbs and legumes, whether in monocultures or mixtures, hold the potential to yield similar or higher than kikuyu-ryegrass in terms of milk per ha on a seasonal and annual basis, driven by a combination of grazing capacity and milk yield per cow.

PLATFORM PRESENTATION: EXCESSIVE NITROGEN FERTILIZATION IS A LIMITATION TO HERBAGE YIELD AND NITROGEN USE EFFICIENCY OF DAIRY PASTURES IN SOUTH AFRICA

Portia Phohlo, Pieter Swanepoel, Stefan Hinck*

Dairy-pasture producers in South Africa are accustomed to high nitrogen (N) fertiliser application rates. In fact, instead of using N as a management tool, farmers use N fertiliser as means to increase herbage yield. A large dataset (n = 153 fields) was evaluated over 5 years and was examined to determine the effect of N fertilizer on herbage yield and nitrogen use efficiency (NUE) in the Eastern Cape province of South Africa. Fertiliser application rates were grouped into three treatments viz., < 200, 200–350 and >350 kg N ha⁻¹. Herbage yield response over the years was analysed with mixed models while NUE was expressed as N applied (kg) per ton of pasture produced. There were no differences found in treatment yields over years. High N fertilizer rates did not correspond with a higher herbage yield of pastures, thus N application rates on pastures should not exceed 200 kg N ha⁻¹ per year. The N rate had a weak but significant negative correlation with the total annual yield and only explained 6% of the yield variation. Pasture NUE improved with reduced N application rates. Pasture yield varies through different seasons. Spring and summer account for the highest pasture herbage yield, coinciding with warm and moist conditions favourable for N mineralisation in the soil. Mineralisation adds a significant amount of N to plant-available N. Farmers need to consider the time of the year and plan their monthly or seasonal fertiliser application accordingly to account for peak N mineralisation rates.

PLATFORM PRESENTATION: MORE BENEFITS IN KIKUYU-RYEGRASS PASTURES FROM USING LOWER NITROGEN FERTILISER RATES

Charné Viljoen, Pieter Swanepoel, Henk Smit, Janke Van Der Colf*

Dairy-pastures in South Africa often receive nitrogen (N) fertilisation rates more than 500 kg ha⁻¹ year⁻¹. Legumes, with the benefit of biological N fixation, have been incorporated into these grass pasture systems with limited success due to the competitiveness of the grasses. Nitrogen application in grass-dominated systems are needed to ensure that productivity is maintained but can be expensive. With current high fertilizer prices, economic feasibility is at risk. Apart from fertiliser costs, excess N could be damaging to environmental health. Leaching and Nitrous oxide (N₂O) emissions are serious polluting pathways associated with injudicious N fertilisation practices. The current fertiliser guidelines of dairy pasture systems must be reconsidered. This study aimed to determine the efficiencies of N fertilisation through quantifying the herbage production and quality responses to various N rates of intensive pasture-based dairy systems in South Africa. Furthermore, the soil N dynamics and N₂O emissions were measured and investigated under the different fertilizer regimes. Nitrogen fertiliser rates (0, 20, 40, 60 and 80 kg ha⁻¹, applied after grazing) were assessed. Dairy cows grazed a pasture approximately 11 times per year. The pastures were managed according to typical pasture management practices in the region, which involves no-tillage of a permanent kikuyu (*Cenchrus clandestinus*) base oversown with ryegrass (*Lolium* spp.). In these pastures, the soil carbon content is high (>2%), which also supports N cycling through mineralisation. Herbage production showed little or no response to fertilisation within different seasons, however, crude protein content, soil mineral N content and urease activity responded to the different treatments. Reduced microbial activity was observed when more than 40 kg N ha⁻¹ was applied. When considering the soil total mineral N content, N is used inefficiently at rates above 40 kg N ha⁻¹. Accumulated N₂O emissions ranged between 2.45 and 15.5 kg N₂O-N ha⁻¹ year⁻¹. The relationship between N balance and annual N₂O emissions was exponential, which indicates that excessive N fertilisation will add directly to N₂O emissions from these pastures. The



soil became saturated with N when more than 40 kg N ha⁻¹ was applied after every grazing, however, there was no significant beneficial effect observed when more than 20 kg N ha⁻¹ (i.e. approximately 220 kg N ha⁻¹ year⁻¹) was applied. This study provides a rationale for reducing N fertiliser rates in pasture-based dairy systems.

PLATFORM PRESENTATION: SELECTION OF STABLE AND HOMOZYGOUS WHEAT MUTANT LINES BASED ON DROUGHT TOLERANCE, AGRONOMIC PERFORMANCE AND BIOMASS ALLOCATION

Athenkosi Makebe, Shimelis Hussein*

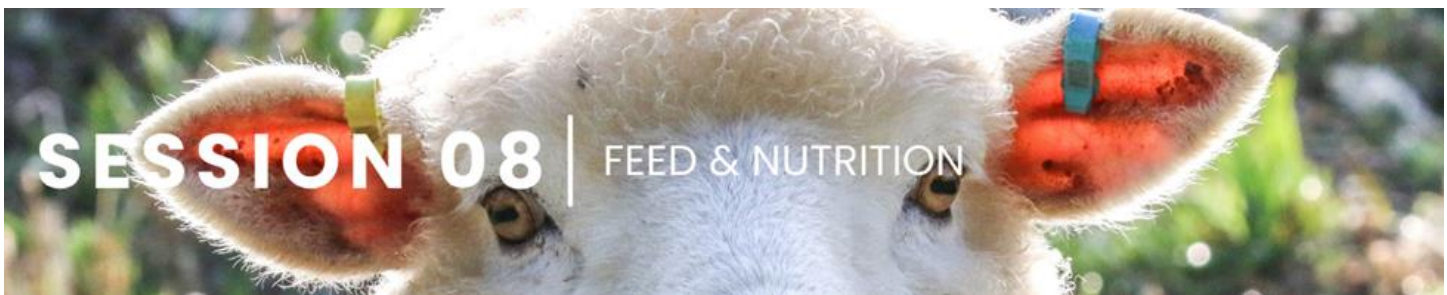
Drought stress is one of the leading constraints to wheat (*Triticum aestivum* L.) production globally. Narrow genetic diversity in wheat for drought adaptive traits and biomass allocation hinders wheat breeding for drought tolerance. Induced mutation can enhance genetic variation and counterparts compliments traditional breeding for drought tolerance. The aim of this study was to select stable and homozygous wheat mutant lines based on agronomic performance, drought tolerance, and biomass allocation. Sixty genotypes, including 53 mutant lines and seven local check varieties, were evaluated in field and glasshouse conditions during the 2020/2021 growing season. The experiments were set up with an alpha lattice design with two replications. The following 11 traits were recorded under well-watered, and water-stressed conditions: (i) days to 50% heading, (ii) plant height, (iii) number of reproductive tillers, (iv) panicle weight, (v) shoot biomass, (vi) root biomass, (vii) root– shoot ratio, (viii) spike length, (ix) spikelets per spike, (x) one thousand seed weight, and (xi) grain yield were collected. There was significant ($p < 0.05$) variation in grain yield and biomass production among the genotypes used. Mutants lines with high yield performance under stressed and optimum conditions maintained high values for yield components. From the principal components analysis, the first three PCs showed significant genetic variation under both conditions. The first three PCs showed 83.84% and 88.4% cumulative genetic variation under well-watered and drought conditions, respectively. Sixteen mutant lines with unique biomass allocation, drought tolerance, and superior agronomic performance were selected and recommended for yield stability trials.

PLATFORM PRESENTATION: DIVERSIFYING LUCERNE PASTURES WITH COOL SEASON FORAGES CAN MAINTAIN YIELD WHILE AVOIDING HERBICIDE USE

Pieter Swanepoel, Chloe MacLaren, Johan Labuschagne, Annemarie Van Der Merwe*

Lucerne (*Medicago sativa*) pastures are an important element of Western Cape crop rotations, supporting wool and meat production while fixing nitrogen and helping to suppress weeds, pests, and diseases for subsequent arable crops. Lucerne is typically sown and maintained as a perennial monoculture for 4-7 years, but there may be opportunities to enhance the functionality of lucerne pastures through diversification. In particular, semi-winter dormant lucerne cultivars are tolerant to grazing, but are less productive in winter than summer, and so crops that are more active in winter may complement lucerne to increase overall production. Cool season crops may also better suppress cool season weeds, which are problematic during the cereal and canola phases of the rotations. In this study, we investigated whether over-sowing different cool season crops into an established lucerne pasture increased annual pasture productivity and improve weed suppression. A field experiment was conducted at Tygerhoek Research Farm near Riversonderend from 2018 to 2021. Lucerne was oversown during May of each year with either single forage species or mixes. Single species treatments included black oat (*Avena strigosa*), forage barley (*Hordeum vulgare*), stooling rye (*Secale cereale*), Westerwolds ryegrass (*Lolium multiflorum*), forage radish (*Raphanus sativus*) and canola

(*Brassica napus*). Mixes consisted of various combinations of hybrid ryegrass (*L. x boucheanum*), Italian ryegrass (*L. multiflorum*), forage barley, black oat, various annual *Medicago* spp. and clovers (*Trifolium* spp.), vetch (*Vicia villosa*) and forage radish. The monoculture control ("business-as-usual") was a pure lucerne sward kept clean from grassy weeds through use of selective herbicides. No herbicides were used on the oversown treatment plots. Our results indicated that oversowing with cereal species or Westerwolds ryegrass achieved the same productivity and same levels of weed suppression as the monoculture lucerne control ($P > 0.05$). In contrast, oversowing lucerne with canola, forage radish, or a mixture of clovers and annual medics tended to reduce overall productivity and lead to higher weed biomass ($P < 0.05$). It seems that over-sowing other species suppressed lucerne, possibly through crown damage induced by the seed drill. The cereals and ryegrass were sufficiently productive to counter this fall in lucerne production, while the brassicas and legumes were not. Overall, this study demonstrated that oversowing lucerne with cereals or ryegrass can avoid the need for herbicide use in a lucerne crop while maintaining productivity and weed suppression. This would benefit farmers by reducing costs for herbicides, and a diverse crop would also reduce the risk of ruminants to bloat through diluting the lucerne on offer. Health hazards through exposure to herbicides may also exist. However, other aspects of the oversown crops also need to be taken into account, such as their potential to bridge diseases between arable cash crops. Future research exploring a wider range of costs and benefits of different over-sown crops would help Western Cape farmers to optimise the pasture phase of their rotations.



SESSION CHAIR: NTUTHUKO MKHIZE

Wednesday 27 July 2022, 11:45 – 13:15

PLATFORM PRESENTATION: FORAGE QUALITY OF FORAGE HERBS AND PERENNIAL GRASSES IN LATER SUMMER OF PURE STANDS AND BINARY MIXTURES

Sigrun Ammann, Dalena Lombard, Lethukuthula Zulu*

A trial of binary forage herb and grass mixtures and their pure stand components was established at the Outeniqua Research Farm on 5 October 2016. Summer and autumn are marginal seasons for dairy pasture production especially in terms of forage quality. Samples from this trial were analysed using the AMTS method from Dairyland Laboratories which is NIRS based. The main parameters considered are CP, NDF, NFC and ME which was calculated from the TDN values. The late summer harvest for 2017, 2019 and 2020 was used. The species were *Plantago lanceolata* cv. Tonic (PI), *Cichorium intybus* cv. Commander (Ch), *Festuca arundinacea* cv. Baroptima (TF), *Lolium perenne* cv. Arrow (PR) and *Dactylis glomerata* cv. Adremo (CF). For CP% plantain is significantly lower ($p < 0.05$) than chicory, perennial ryegrass and tall fescue but not lot lower than cocksfoot. This was similar for 2017, 2019 and 2020. The mixtures in 2017 and 2019 were dominated by forage herbs. In 2019 Ch/PR and TF had the highest CP values ($p < 0.05$), although the PR component was only 7% and thus the value mostly related to Ch. In 2020 CF and PR were significantly lower in CP% than TF. The pure grass stands had significantly higher NDF values throughout ($p < 0.05$). In 2017 CF (49.4%), TF (51.2%

and PR (52.2%). Forage herbs and mixes ranged from 30.5% to 38.3% with the best values being 30.5 to 33.4 % ($p < 0.05$) for treatments PI/TF, PI/PR, Ch/PR and Ch although the PR content was minor. In 2019 the mixes with CF and TF had higher NDF values ($p < 0.05$) than other mixes. In 2020 the NDF values overall were general higher. The grasses had the highest values (CF 56.4%) and PR (53.9%). The best values were 35.8 to 39.9 % ($p < 0.05$) for Ch, PI and Ch/PI. NDF % is very important as it affects intake and should preferably be < 40 for dairy pastures but also not < 30 . In all three years the NFC % was lowest in the pure stand grasses with CF significantly lowest ($p < 0.05$) in all three years (27.9, 22.0 and 21.2%). The forage herbs and forage herb dominated mixtures were highest. In 2017 PI/TF and PI/PR had 49.0 and 47.9% NFC with the grass component less than 10%. ME (MJ/kg) values were highest for PI/TF and PI/PR in 2017 (11.03 and 11.05%) ($p < 0.05$) with a minor grass component and PR had the lowest value with 10.07% ($P < 0.05$). The values for 2020 were lower than preceding years with PR the lowest at 9.83 ($p < 0.05$). The results show that plantain and chicory can improve the forage quality of pastures in late summer and that tall fescue is a viable option as the grass component. The forage quality values for the mixed swards depended on the composition initially dominated by forage herbs and by 2020 a greater grass component was present.

PLATFORM PRESENTATION: EFFECT OF SOIL TYPE ON TOTAL DIGESTIBLE NUTRIENTS (TDN) AND CRUDE PROTEIN (CP) CONTENT OF FOUR LUCERNE (MEDICAGO SATIVA) CULTIVARS PLANTED IN BATHURST RESEARCH STATION, EASTERN CAPE, SOUTH AFRICA

*Unathi Gulwa**

Medicago sativa (lucerne) is a perennial and drought tolerant fodder crop that is widely used as feed for livestock in South Africa. This study evaluated four lucerne cultivars under two water regimes and soil types on lucerne biomass quality (i.e. Total Digestible Nutrients (TDN%) and Crude Protein (CP%). Before planting, soil samples were collected at random points from irrigated and non-irrigated plots to a depth of 15cm to determine both chemical and physical properties of the soil. Nutritive value data on four lucerne cultivars belonging to different dormancy groupings under different soil types on both irrigated and non-irrigated plots were collected. Data collection was done by separating harvested biomass for each cultivar using clean packs, weighing and drying samples at 70 °C for 48 hours. A laboratory test was done to determine biomass quality (i.e. TDN % and CP %) and other essential micro and macro nutrient content of the pasture. In soil 1 (S1) the overall CP content was 11.48 % while it was 19.03% in soil 2 (S2). Soil type also had an effect ($P < 0.01$) on the overall total digestible nutrient (TDN %) content of different lucerne cultivars. In S1 C4 (WL 525) had the highest ($P < 0.01$) TDN content in comparison to the rest of the cultivars while, in the same soil type C1 (SA Std.) had the least TDN content. The four tested lucerne cultivars produced highly nutritive lucerne in S2 while they produced less nutritive lucerne in relation to both CP and TDN content in S1.

PLATFORM PRESENTATION: EVALUATION OF N-ALKANES, LONG CHAIN ALCOHOLS, AND CARBON STABLE ISOTOPE ENRICHMENTS OF N-ALKANES AS DIET COMPOSITION MARKERS FOR FORAGE SPECIES

Abubeker Hassen, Teklu Wegi, Melkamu Bezabih, Ajebu Nurfeta, Sentayehu Yigrem, Aduugna Tolera*

Plant species exhibit different patterns of plant cuticular wax profiles, which can potentially be used as diet composition markers in free grazing herbivores. The study aimed to evaluate the suitability of the plant cuticular n-alkanes, long chain alcohols (LCOH) profiles and carbon stable isotope enrichment ($\delta^{13}C$) of n-alkanes for forage species to use as markers in the estimation of diet composition of grazing animals. Forage samples were collected from 100

representative quadrats of 0.5 m x 0.5 m at 10 m transects and sorted by species and pooled from different quadrats to obtain enough quantities of representative individual species. A total of ten dominant forage species were identified and analyzed for n-alkanes and LCOH by gas chromatography (GC) and the isotopic ratio ($^{13}\text{C}/^{12}\text{C}$) by using Gas Chromatography-Combustion-Isotope Ratio Mass Spectrometry (GC-C-IRMS). Principal component analysis (PCA) was used to identify inter-species differences in the concentration patterns of plant wax components. Odd-chain n-alkanes comprised the highest proportion of the total n-alkane concentration ranging from 79% in *Ischaemum afrum* to 95% in *Haplocarpha hastata*. N-alkanes C31, C29 and C33 were the most abundant with an average 167, 80 and 61 mg/kg DM, in that order in all species. Even-chain LCOH comprised the highest proportion of the total LCOH concentration accounting for 92% in *Brachiaria scalaris* to 97% in *Ischaemum afrum*. The dominant even-chain LCOH were C30OH, C32OH, C28OH and C26OH, with an average concentration of 362, 348, 266 and 237 mg/kg DM, respectively across species. The $\delta^{13}\text{C}$ of n-alkanes showed relatively large variations between forage species ranging from -19.7‰ in *Andropogon amethystinus* to -40.6‰ in *Trifolium mattirolianum*. The result of the PCA showed that 81% of the variance in the pattern of concentrations of n-alkanes was explained by the first two principal components compared to 69.3 and 82.9% in the case of LCOH and $\delta^{13}\text{C}$ of n-alkanes, respectively. Noticeable variations were observed for forage species studied in the patterns of plant wax components. The differences in the patterns of concentrations of n-alkanes, LCOH and $\delta^{13}\text{C}$ of n-alkanes could be suitable as markers for diet composition estimation of grazing animals.

PLATFORM PRESENTATION: IN-VITRO DIGESTIBILITY AND METHANE PRODUCTION OF DIFFERENT FORAGE SPECIES AS INFLUENCED BY NITROGEN FERTILISATION AND DIFFERENT HARVEST STAGES

Makda Mahrai, Lindeque Du Toit, Wayne Truter*

With the increasing human population, the demand for livestock production is required to fulfil the need for animal protein. However, in many countries, the major constraint for livestock production is the shortage and variation of feed supply in terms of quality and yield throughout the year. Intensification of agricultural systems is a means to meet these demands, but is partly responsible for the high emissions of greenhouse gases, especially methane (CH_4). The research reported here is aimed at measuring the cumulative *in-vitro* gas and CH_4 production and *in-vitro* organic matter digestibility (IVOMD) of several pasture species in relation to three rates of nitrogen (N) fertiliser application and two stages of harvest. The applied rates of N were N1: (15 kg ha⁻¹), N2: (30 kg ha⁻¹) and N3: (60 kg ha⁻¹), whilst the two stages of harvest were early-harvest (boot stage) and late-harvest (flowering stage). The experimental design was a factorial design with five replicates. The pasture species under study were Sorghum (*Sorghum bicolor*), Japanese radish (*Raphanus sativus*), Italian ryegrass (*Lolium multiflorum*), Cowpea (*Vigna unguiculate*), and Oats (*Avena sativa*). These species were grown in a controlled greenhouse at the Innovation Africa Campus, University of Pretoria, to avoid the influence of the external environment. *In-vitro* organic matter digestibility was calculated using the Tillery and Terry (1963) technique as modified by Engels and Van der Merwe (1967). *In-vitro* gas pressure was recorded using a digital data-tracker and converted to ml. *In-vitro* CH_4 concentration was analysed by chromatography (GC) from the collected gas samples. Rate of N applications, harvest, and the interaction effect between harvest and rate of N application on cumulative gas was not significant. However, with early-harvested Japanese radish, N1 (15 kg ha⁻¹) had the highest cumulative gas production of 96.0 ml, whereas late-harvested Cowpea N1 (15 kg ha⁻¹) had the lowest cumulative gas of 43.7 ml. The effect of harvest stage and rate of N application on CH_4 production and IVOMD was significantly different ($p < 0.05$). Late harvest increased CH_4 production in all the pasture species under study. Methane production of late-harvest Italian ryegrass treatment N2: (30 kg ha⁻¹) was the highest 6.6 ml g⁻¹ of incubated DM, and early-harvest Sorghum N1: (15 kg ha⁻¹) had the least CH_4 at 2.3 ml g⁻¹ of incubated DM. All five pastures harvested at early-stage had



higher IVOMD. *In-vitro* organic matter digestibility from highest to lowest was as follows; Japanese radish N1 (80.9%) followed by early-harvested Italian ryegrass N1 (74.5%), oats N1 (74%), sorghum N1 (66%) and cowpea N1 (56.5%). The results obtained in this research are linked to the fact that as pastures reach maturity, the leaf-to-stem ratio decreases and the cell wall component of stems in pastures is higher, which lowers the quality. In conclusion, harvesting pastures at an early growth stage increases the quality i.e. organic matter digestibility and decreases *in-vitro* CH₄ production.

PLATFORM PRESENTATION: THE EFFECTS OF ADDITIVES ON FERMENTATION AND NUTRIENT COMPOSITION OF SENEGALIA MELLIFERA (BLACK THORN) BUSH SILAGE

Magdalena Kamati, Maria Shipandeni, John Mupangwa, Emmanuel Lutaaya*

During the rainy seasons browse plants constitute quality livestock feed, however, the quality declines rapidly during dry seasons. Conservation of browse forage may be a potential solution to seasonal variation in livestock feed quality and quantity. This study was carried out to investigate the effects of additives on fermentation quality and chemical composition of *Senegalia mellifera* bush silage. Fresh branches of *S. mellifera* of 2 cm thickness containing leaves were harvested and milled to 1 cm particle sizes. Milled *S. mellifera* was treated with fermentation enhancers: 15% molasses, 15% maize and 15% malted maize and the mixtures were further treated with or without microbial inoculants; Lactic Acid Bacteria (LAB) and Fibrolytic enzyme (Enz). The treatments (n=12) were: Control (bush materials with no additives), Control + LAB, Control + Enz, bush + 15% molasses, bush + 15% Molasses + LAB, bush + 15% Molasses + Enz, bush+ 15% maize, bush + 15% maize + LAB, bush + 15% maize + Enz, bush +15 % malted maize, bush + 15% malted maize + LAB, bush +15% malted maize + Enz. From each treatment, 250g was ensiled in vacuumed plastic bags replicated 3 times (for each storage time) and stored at room temperature for 0, 21, 60, and 90 days of incubation. Fermentation parameters, chemical composition, and *in vitro* digestibility were determined. Data was analyzed as a 4×3×4 factorial arrangement (4 fermentation enhancers; 3 microbial inoculants; and 4 incubation times) in a Completely Randomized Design. Silage quality was affected ($p \leq 0.05$) by fermentation enhancers, microbial inoculants, and time of incubation. The pH of *S. mellifera* silage was reduced from 6.41 to 4.25 in all treatments from 0 to 90 days of incubation. Dry matter of *S. mellifera* silage with fermentation enhancers ranged from 56.87g/kg (bush+ 15% maize) to 58.24 g/kg (bush +15 % malted maize) which was higher than 55.32 g/kg in the control. *Senegalia mellifera* silage treated with LAB and Enz had similar ($p = 0.067$) DM content of 56.56 g/kg and 56.70 g/kg, respectively. Incubation times of 21, 60, and 90 days had a DM content of 55.04, 55.44, and 63.34 g/kg, respectively higher than the initial time at 53.04 g/kg. Fermentation enhancer treatments significantly reduced ($p = 0.00$) the neutral detergent fibre (NDF) (51.14 g/kg, 53.70 g/kg, and 52.80 g/kg in molasses, maize, and malted maize, respectively) compared to control (57.29 g/kg). With microbial inoculants fibrolytic enzyme had lower ($p = 0.00$) NDF content (54.06 g/kg) compared to LAB (54.29 g/kg). The incubation time did not affect both NDF ($p = 0.298$) and ADF content ($p = 0.31$) of *S. mellifera* silage. Inclusion of fermentative enhancers and microbia innoculants increased ($p \leq 0.05$) the *in vitro* NDF digestibility of *S. mellifera* silage. In conclusion, the addition of maize molasses and malted maize would improve the silage quality of *S. mellifera* by increasing preserving properties such pH after minimum of 21 days of incubation, although little effect can also be achieved with microbial inoculants.

PLATFORM PRESENTATION: RUMINAL FERMENTATION CHARACTERISTICS, METHANE EMISSION AND BACTERIAL PROFILE OF MEAT-MASTER LAMBS SUPPLEMENTED WITH HORDEUM VULGARE (BARLEY) SPROUT

Thamsanqa Mpanza, Thabo Dhlamini, Khanyisile Mbatha, Lomas Mavulwana, Rian Pierneef*

Sprout is the fresh, green and nutritious fodder produced hydroponically in 7 to 10 days. The technology is becoming popular in South Africa even with emerging farmers, because the technology requires less space and water with no necessity for fertilizer. The objective of this study was to determine the effect of supplementing meat-master lambs with barley fodder sprout on ruminal fermentation, methane emission and bacterial profile. A total of 21 meat-master weaners with mean initial body weight of 23.4 kg were randomly assigned into three dietary treatments: *Eragrostis curvula* 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 700 g of grass hay and barley sprouts was offered in addition to the full amount of grass hay. Each animal was offered 300 g of hominy chop (50%), wheat bran (36%), soybean (12%), feed lime (1.5%), salt (0.5%) and primix (1 bag) as concentrate. Barley sprout was produced in a room without fluorescent light. Seeds were soaked for 30 minutes in 10% Sodium hypochlorite solution. After 30 minutes, seeds were rinsed three times with tap water, further soaked in tap water overnight. The next day, barley seeds were spread in a perforated plastic trays. Trays were irrigated manually with tap water using a 12 L Knapsack spray three times daily at 9h00, 13h00 and 16h00. At harvest (i.e. day eight) , barley sprout per tray was weighing about 5 to 6 kg fresh biomass. Animals were housed individually and were fed twice a day 8h00 and 15h00 with free access to water. The experiment lasted for 70 days excluding 10 days for adaptation, enteric methane data was recorded for nine days from day 61 to 69 using hand held laser detector and rumen fluid was collected on day 70 using an esophageal stomach tube, divided into two portions, one portion was for volatile fatty acid and the other for DNA sequencing. Results showed that sprout addition significantly ($P < 0.05$) affected enteric methane emission. Methane gas emission of animals as influenced by treatment were 1.76, 1.54 and 1.26 g/kg BW, for treatments 1, 2, and 3 respectively. However, on rumen fermentation the significant effect was observed on ammonia nitrogen ($\text{NH}_3\text{-N}$), acetic acid and a tendency ($p < 0.0536$) to increase propionic acid. Treatment 2 (11.1 mg/dL) and 3 (9.8 mg/dL) had lower $\text{NH}_3\text{-N}$ than the control group (19.4 mg/dL). Treatment 2 (67.3 mmol/dL) and 3 (67.8 mmol/dL) had lower acetic acid than control (73.3 mmol/dL). The observed difference in bacterial among the treatments was not statistically significant ($P > 0.05$). However, principal coordinate analysis (PCoA) showed that there was a clear separation of bacteria on animals that were eating treatment 2 and 3 as compared with control group. Thus, it is concluded that barley fodder sprout may be strategically used as climate smart feed resource for ruminants in order to reduce methane gas emission without affecting rumen fermentation.



SESSION CHAIR: PAUL MALAN

Wednesday 27 July 2022, 14:15 – 16:00

PLATFORM PRESENTATION: WHAT IS REGENERATIVE GRAZING?

Paul Malan

Many grazing systems were investigated and implemented in Southern Africa during the past 60 years. From conventional three camp rotational grazing systems, to various multi-camp systems. Although some attempts, like that of Acocks, strived towards non-selective grazing, it was regarded as overcapitalization at that stage, during the sixties. “Recently”, different ways of high pressure grazing became popular, especially amongst some dissenting farmers. These ways of grazing management are grouped under the term Regenerative Agriculture, as Regenerative Grazing. Regenerative grazing involves grazing of high densities of livestock, on small areas, for short periods, followed by long rest periods. The result implies regeneration of soil health, regeneration of vegetation health, regeneration of animal health and ultimately regeneration of whole ecosystem health. The question arises: Is regenerative grazing scientifically quantified in the South African context yet?

PLATFORM PRESENTATION: EXPLORING THE DIFFERENT FACETS OF REGENERATIVE GRAZING IN SEMI-ARID GRASSLANDS IN SOUTH AFRICA

Jamie Paulse, Paul Malan, Nico Smit*

In South Africa, multi-camp rotational grazing using ‘conservative stocking rates’ have been the conventional approach to livestock grazing management systems. However, as of late, the regenerative grazing approach has been adopted by numerous farmers. This approach is considered to be an adaptable one, incorporating the ‘herd effect’ concept, whereby large numbers of animals occupy an area for short periods of time, and allowed an extended rest period. The aim of our research is to explore the different facets of regenerative grazing, practiced by various livestock farmers in natural veld in the semi-arid grasslands of South Africa. These facets, of which all will be discussed, include different soil (physical and chemical parameters), vegetation (composition, necromass, cover and quality), animal and human (decision-making and financials) interactions and dynamics, in comparison to conventional, rotational grazing.

PLATFORM PRESENTATION: REGENERATIVE GRAZING IN MESIC GRASSLANDS

Kevin P Kirkman

Increasing awareness of negative impacts of industrialised agriculture has given rise to the regenerative agriculture concept and movement. Currently, regenerative agriculture is rather amorphous, with no single definition. However, the over-arching objective of all forms of regenerative agriculture is to reverse, rather than minimise, the negative environmental impacts of agriculture. Within the livestock sector, regenerative grazing is a term increasingly used to refer to grazing practices aimed at reversing any negative or perceived negative impacts of grazing on the grassland environment, including plants, soil, hydrology, and biodiversity in general. Most regenerative grazing practices referred to in scientific and grey literature include some form of high density grazing for short periods, followed by lengthy periods of absence. Claims of success vary, but include increased grass productivity, increased carrying capacity, increased diversity, increased soil carbon, increased soil biological activity and improved hydrology. Experiments investigating high density grazing practices, ranging from small-scale to farm-scale, in mesic grasslands in South Africa do not show convergence with commonly made claims. Where livestock performance has been included in experiments, performance is generally reduced in high density scenarios. The divergence in experimental results and claims based on farming operations requires careful analysis. It is clear that the application of high density/regenerative grazing practices has been apparently successful on farms. It may be that expert management of such systems is based on active decision making on a daily basis, while experimental investigations are based on predetermined treatments and are too rigid to take advantage of changing conditions. Perhaps a paradigm shift in research methodology and analysis is called for to scale research to focus on whole farm, multivariate investigations. Such research should also take into account rainfall cycles and account for periodic wet/dry cycles that may influence perceptions of success.

PLATFORM PRESENTATION: ADAPTIVE MULTI-Paddock GRAZING OF COVER CROPS: A PROMISING TOOL FOR ECOSYSTEM SERVICE PROVISION IN INTEGRATED CROP-LIVESTOCK SYSTEMS

Guy Musto, Pieter Swanepoel, Johann Strauss, Willem Hoffmann, GFHVg Bekker*

The integration of conventionally grazed pasture phases into small-grain cropping systems has been shown to support long-term economic and ecological resilience and sustainability of these production systems. However, the use of adaptive multi-paddock (AMP) grazing of cover crop mixtures has received growing interest for its potential to restore degraded soils and enhance ecosystem function and stability. AMP grazing is designed to mimic the intense, periodic grazing by large, concentrated herds of ungulate grazers that historically moved over native grasslands. This grazing action transformed these grasslands into highly resilient grazed ecosystems capable of sustaining higher levels of herbivory and plant biomass. To gain a similar effect, AMP grazing uses short grazing periods with a high stocking density to ensure a similar non-selective grazing of plant species, followed by extended recovery periods. Animal numbers and grazing intensity are adaptively adjusted to match available forage and ensure sufficient post-grazing plant residual for optimal regrowth. In small-grain crop-livestock systems of the Western Cape, the regenerative grazing approach through AMP remains virtually unexplored. The applicability and potential of these practices to deliver and enhance ecosystem services in mixed crop-livestock systems is thus explored. Within the context of mixed crop-livestock systems in Mediterranean regions, the aim of this review is to critically compare AMP grazing of multi-species cover crops with conventional grazing of monoculture pastures, in terms of their effects on soil quality, crop productivity and profitability. Although there is a lack of AMP grazing studies that focus specifically on multi-species cover crops, the use

of AMP grazing management in rangeland systems always achieved better outcomes in terms of forage production, soil-plant interactions, and profitability, compared to conventionally managed grazing systems. It can be inferred that these benefits will also be accrued under the regenerative grazing of multispecies cover crops. Under AMP grazing, the ecosystem services specifically attributed to the cover crops, are also more likely to be retained and even enhanced, rather than compromised, as is often the concern when incorporating a grazing component. The option of integrating a regenerative cover crop-livestock component in these systems warrants further research. It is clear, however, that these systems require long-term studies to establish a better understanding of the impact of these practices on soil quality, crop productivity and profitability.

PLATFORM PRESENTATION: REGENERATIVE GRAZING – A FARMER’S PERSPECTIVE

Gerrit Van Zyl, Jamie Pause*

Mr Gerrit Van Zyl is a well-known Bonsmara cattle stud farmer and owner of Hanzyl Bonsmaras in the Dewetsdorp area of the Free State Province, South Africa. He has been farming for over 20 years, and has received numerous awards, including the Voermol Cattle Farmer of the Year award in 2011. His focus has been on animal production i.e calf yield per cow, weight recovery by cows after calving, rate of weight gain by calves and rate at which animals gain weight per hectare, but he has recently embraced the concept of regenerative grazing. Through this, he aims to grow more grass, improve the variety and quality of his veld, and in turn, harvest his grass more effectively. His talk will focus on this, and he will share his experiences thus far on regenerative grazing.

**POSTER
SESSION 4**

Feed & nutrition

Fire ecology

SESSION CHAIR: FRANCOIS DEACON

Tuesday 26 July 2022, 16:00 – 16:30

Posters can be viewed on twitter @ <https://twitter.com/GrasslandSocSA>

STANDARD POSTER: CHAR HEIGHT ON FENCE POSTS AS A PRACTICAL POST-HOC INDICATION OF FLAME LENGTH IN GRASSLAND AND SAVANNA HEAD FIRES

Matthew Danckwerts

Numerous measures of vegetation fire behaviour, comprising many metrics, both quantitative and qualitative, exist for wide variety of purposes, including research, management, and safety. Many of these fire behavioural parameters such as rate of spread, intensity, and severity are notoriously difficult to measure. There is a demand from both researchers and practitioners for accurate, low-cost, and easy-to-use measures of fire behaviour. Given that surface fire flame length is driven by a combination of the release of hydrocarbon gases and convective heat transfer, it has long been accepted that direct correlations exist between flame length and fireline intensity. Several conversion formulas have been



developed which produce fireline intensity values from recorded flame length inputs. Notwithstanding the worth of using flame length as a proxy for fireline intensity, accurate real-time measurements of flame length in the field is a difficult task. Charring height on trees has previously been proposed as useful *post-hoc* indicator of flame length and thus fire intensity for researchers and land managers. Based off data collected from a series of fire experiments between 1990 and 1994 in eucalypt savannas at the Kapalga research site, Australia, the height of char on savanna trees (including various other metrics) was associated with fireline intensity. This study aimed to develop a relationship between char height on fence posts and flame length in southern African grassland and savanna systems based on data collected from 143 fires in Eastern Cape montane grassland. Flame length measurements were made visually using objects of known heights (planted fence posts) in the fire's path as visual aids. Height of char was recorded on 143 pre-planted fence posts. Measurements were made in centimetres, from the base of the pole at the soil surface, to the maximum height of char on the fence post. Double (2x) char height produced a more precise fit to observed flame lengths ($y = 0.711x + 0.971$; $r^2 = 0.609$) than char height itself, particularly in head fire scenarios, showing a strong positive correlation ($\rho = 0.807$; $p < 0.001$). Back fire char heights and double char heights did not show any significant association with flame lengths ($\rho < 0.15$; $p > 0.567$). Double char height in flank fires appeared to have a moderate positive correlation with flame length ($\rho = 0.532$; $p < 0.005$). While there was certainly a relationship between char height and flame length in mesic montane grasslands of the Eastern Cape, double height of char, proved to be an accurate *post-hoc* indicator of flame length, particularly in head fire scenarios. This is a very simple relationship which could have wide practical application in Southern African grassland and savanna systems. While it is acknowledged that the relationship is not perfect, as a general guide, this should be a useful tool for all wildfire practitioners.

STANDARD POSTER: VARIATION IN PHYTOCHEMICAL PROPERTIES OF WOODY SPECIES FOUND IN SEMI-ARID AREAS OF SOUTH AFRICA

*Humbelani Silas Mudau**, *Khuliso Ravhuhali*, *Kwena Mokoboki*

A limitation to the utilization of the woody species as feed for livestock is the knowledge of the phytochemical composition and other bioactive compounds found in these plants. The current study hypothesized that the phytochemicals constituted in woody species are affected by harvesting site. The study sought to assay the qualitative and quantitative bioactive constituents of some woody species harvested in semi-arid areas of South Africa viz. *Adansonia digitata*, *Androstachys johnsoni*, *Balanites maughamii*, *Berchemia discolor*, *Berchemia zeyheri*, *Bridelia mollis hutch*, *Carissa edulis*, *Catha edulis*, *Colophospermum mopane*, *Combretum Imberbe*, *Combretum molle*, *Combretum collinum*, *Dalbergia melanoxylon*, *Dichrostachys cinerea*, *Diospros lycioides*, *Diospyros mespiliformis*, *Euclea divinorum*, *Flueggea virosa*, *Grewia flava*, *Grewia flavescens*, *Grewia monticola*, *Grewia occidentalis*, *Melia azedarach*, *Peltophorum africanum*, *Prosopis velutina*, *Pseudolachnostylis maprouneifolia*, *Pterocarpus rotundifolius*, *Schinus molle*, *Schotia brachypetala*, *Sclerocarya birrea*, *Searsia lancea*, *Searsia leptodictya*, *Searsia pyroides*, *Senegalia caffra*, *Senegalia galpinii*, *Senegalia mellifera*, *Senegalia nigrescens*, *Senegalia polyacantha*, *Strychnos madagascariensis*, *Terminalia sericea*, *Trichilia emetic*, *Vachellia erioloba*, *Vachellia hebeclada*, *Vachellia karroo*, *Vachellia nilotica*, *Vachellia nilotica subsp. Kraussiana*, *Vachellia rechmanniana*, *Vachellia robusta*, *Vachellia tortilis*, *Vachellia tortilis subsp raddiana*, *Vangueria infausta*, *Ziziphus mucronata*. These browse species leaf samples were harvested from two provinces (Limpopo and North West) of South Africa. The data found in the qualitative analysis was not subjected to statistical analysis because the data was more focused on the presence or absence of phytochemical composition. In quantitative analysis, data were subjected to a two-way analysis of variance to assess the effect of harvesting site and species on measured parameters for those species that were common in both harvesting sites. Distilled water and



methanol extracts of the browse species showed the presence of common phytoconstituents including saponin, flavonoids, tannins, phenols, cardio glycosides, terpenoids and phlobatannins as major active compounds in browse species. *Dichrostachys cinerea* (0.1011% DM) in the Limpopo and *Z. mucronata* (0.1009% DM) in the North West site depicted the highest ($p < 0.05$) concentration of soluble phenols. At the North West site, *D. cinerea* (0.0453% DM) had the highest insoluble tannin concentration, while *V. hebeclada* had the least (0.0064% DM) insoluble tannin content. *Vachelia hebeclada* had the least ($p < 0.05$) condensed tannins concentration levels of all other browse plants in both harvesting sites. In this study, most of the woody species found in Limpopo displayed a lower level of tannins than those harvested in the North West. To improve and maximize the browsing of these browse species for animal production, it is necessary to identify the amount of unquantified phytochemicals contained in these browse species and valorize the high bioactive compound-browse species.

STANDARD POSTER: NUTRIENT INTAKE AND GROWTH PERFORMANCE OF NGUNI STEERS FED VARYING INCLUSION RATES OF STOEBE PLUMOSA

Motswapo Phoko, Julius Tjelele, Jones Ng'ambi*

One of the factors limiting livestock productivity under extensive production systems in South Africa is the inadequate supply of nutritious feeds, especially during the dry season. This may be exacerbated by the encroachment of woody plants in the rangelands because woody shrubs reduce grass production. Bush encroachment is characterized by increased woody plants, which alter ecosystem services such as forage production to sustain livestock. Bankrupt bush (*Stoebe plumosa*) is an indigenous specie that invades semi-arid grasslands, and despite generally being unpalatable, it may have value as a livestock feed. The objective of this study was to evaluate varying dietary inclusion levels of *Stoebe (S) plumosa* meal in a diet on feed intake, growth performance and digestibility of Nguni steers. Twenty-eight Nguni steers, aged 22-months and with a mean bodyweight of $300\text{kg} \pm 10$ (SE), were assigned to isocaloric (11.59%) and isonitrogenous (12.41%) diets containing 0%, 10%, 20% and 30% of *S. plumosa* meal. The steers were single penned at the feedlot facility in a completely randomised design. Dry matter intake was measured by subtracting leftovers from feed given, while daily live weight gain was determined by subtracting the initial live weight from the final weight and then dividing the result by the number of days. A digestibility trial was conducted using the total faecal collection method. The results showed that *S. plumosa* meal inclusion in the diets improved ($p < 0.05$) dry matter intake by Nguni steers. Similarly, *S. plumosa* meal inclusion in the diets improved ($p < 0.05$) crude protein, acidic detergent fibre and neutral detergent fibre digestibility by Nguni steers. However, it did not have any effect ($p > 0.05$) on the live weight gain and body condition score of Nguni steers. It is concluded that the use of *S. plumosa* in diet formulation may have the potential to improve ruminant production while also offering a strategy for controlling bush encroachment.

STANDARD POSTER: FLUITJIESBOS AS A POTENTIAL INDIGENOUS FODDER CROP? AN ANALYSIS OF THE NUTRITIONAL QUALITY OF CALOBOTA SERICEA AT DIFFERENT PHENOLOGICAL STAGES

Clement Cupido, Francoois Müller, Igshaan Samuels

Extensive droughts and irregular rainfall caused by the climatic change phenomena has an enormous negative impact on the fodder flow system of livestock farmers in the arid and semi-arid regions of South Africa. In the winter rainfall regions, the fodder gap in summer was to a certain extent filled by either exotic planted pastures, which require high water utilization, or drought resistant crops which pose a plant invasive risk to the natural environment. In the search

for potential indigenous species which could be utilized to fill the summer fodder gap, the Agricultural Research Council identified 25 legume species with some potential to do so. *Calobota sericea*, an indigenous legume from the winter rainfall semi-arid rangelands of South Africa is one such species which has been prioritised as a fodder resource for water-limited agro-ecological areas. No information regarding the nutritional quality of *C. sericea* fodders harvested at different phenological stages is currently available, limiting our knowledge as to when the best time would be to harvest the fodder resource for inclusion in fodder flow programs. The aim of this study was to quantify the nutritional quality of *C. sericea* fodders harvested at five phenological stages. Fifteen composite (5 – 7 plants/sample) *C. sericea* plant samples were collected from five locations within the Leliefontein communal rangelands of Namaqualand. At each of the sampling locations, the fodders were collected at five phenological stages i.e., non-reproductive, flower bud formation, full flowering, seed pods and dry plant materials. The plant samples were air dried for five days after which the samples were oven-dried at 60 °C and thereafter milled using a stainless steel laboratory blender. The total N concentration in the digest was determined by direct titration with 0.01 M HCl after Kjeldahl distillation using Büchi Nitrogen Distillation unit. The mineral nutrients were determined for the elements Ca, Mg, P, K, Na, Mn, Fe, Zn and Cu using an Inductively Coupled Plasma Optical Emission Spectrometer. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined using an ANKOM 220 Fiber Analyzer. NDF and ADF was in turn used to calculate the dry matter digestibility, metabolizable energy, total digestible nutrients, digestible forage energy, digestible organic matter, net energy for lactation, net energy for maintenance and net energy for gain/growth. Results show that crude protein, fiber, energy and digestibility generally decreased with increasing plant maturity, but for mineral nutrients, no such relationship was observed. In general, *C. sericea* fodders harvested at non-reproductive, early flower bud and full flower stages could provide sufficient energy and protein content to maintain livestock condition, and at these stages, NDF and digestibility of the harvested materials are also good suggesting that intake and processing of these forages would also not be a problem to the livestock. At these phenological stages Ca, Mg, Na, K and Zn were at sufficiently high levels to meet the minimum requirements of small stock but P and Mn were not suggesting that additional mineral nutrient supplementation would be required.

STANDARD POSTER: FORAGING PATTERNS AND VOLATILE FATTY ACID PRODUCTION LEVELS FROM BORAN AND NGUNI COWS IN DROUGHT STRICKEN ARID RANGELANDS

Soul Washaya, Lizwell Mapfumo, John Mupangwa, Voster Muchenje*

The objective of this study was to determine the plant selection patterns and volatile fatty acid production levels from Boran and Nguni cows grazing in arid rangelands. A total of 24 cows (12 from each breed) were randomly selected for the study. The animals were identified according to their parities as: P1 ($n = 6$), P2 ($n = 6$), P3 ($n = 6$), P4 ($n = 6$). Forage analysis, microhistological analysis and rumen fluid analysis were done. Faecal samples were collected through rectal grabs for 6 consecutive days once a month and rumen liquor samples were collected every fortnight for 12 months using a stomach tube. Breed, season (wet or dry) and parity were considered as fixed effects while the individual animal was considered to be the random variable. A principal component (PCA) was run to show the relationship between VFAs and fixed factors. A total of 11 herbaceous and 8 browse forage plant species were positively identified from faecal samples. A high proportion of increaser herbaceous plant species was selected by both the Boran and Nguni cows. All cows selected similar proportions of either decreaser or increaser herbaceous species. There were no breed effects ($p > 0.05$) on acetic, propionic, iso-butyric and valeric acid production from both herds. However butyric, iso-valeric and rumen pH was significantly influenced by breed ($p > 0.05$). Parity and season significantly influenced acetate, propionate, iso-butyric and iso-valeric acid production ($p < 0.05$). Higher acetate and propionate concentrations were

produced by P1 cows for both breeds, while cows in P3 showed the least acetate and propionate concentrations for both breeds ($p < 0.05$). For each season the acetate concentration was significantly different, with the highest concentrations being recorded in the wet season, while propionate concentration did not differ between wet and cold seasons ($p > 0.05$). Iso-butyrate and iso-valerate were highest ($p < 0.05$) in cold than wet or dry seasons ($p < 0.05$). Parity x season interaction was observed for butyric, valeric and iso-butyric acid production and rumen pH. Parity 2 cows produced significantly ($p < 0.05$) higher concentrations of iso-butyrate in the dry season while P1 and P4 produced higher iso-butyric acid in wet and dry seasons respectively. Parity 2 and 4 produced higher iso-valeric acid in the wet season while P1 produced the highest iso-valeric acid in the dry season. All parities had the lowest iso-valeric acid production during the wet season. Cows in all parities showed higher rumen pH values during the wet season ($p < 0.05$) while P3 and P4 had higher values during the dry season. In conclusion, all cows showed similar plant selection patterns while Boran cows had overall higher molar concentrations of acetic, propionic, and butyric acid. Nguni cows had higher molar concentrations of iso-butyric, iso-valeric and valeric acid in all the seasons under investigation. The VFAs are a clue to enteric methane production, hence we recommend proxy evaluations based on our results.

STANDARD POSTER: SEASONAL VARIATION IN NUTRITIVE VALUE OF FOUR BROWSE SPECIES USED BY SMALLHOLDER FARMERS FOR LIVESTOCK IN EASTERN CAPE PROVINCE, SOUTH AFRICA

Siza Mthi, Jean Rust, Soul Washaya, Dorine D Washaya, Bavuyise Sondzaba*

The use of browse plants as livestock feed during the dry season can improve deficiency of certain nutrients and sustain livestock production under small-scale farming system. This study was conducted to investigate the seasonal variation of nutrients of four browse species in the Eastern Cape Province. Samples (2kg) of fresh leaves from *Vachellia karoo*, *Prunus persica*, *Vepris lanceolata* and *Diospyros dichrophylla* were collected during winter, spring and summer. The experiment was a completely randomized design with three replicates for each species in each season. The chemical composition of these samples was determined using standard laboratory analytical techniques. The results indicate that, crude protein (CP) content range from 1.84% to 19.9% for winter and spring respectively. The average CP content was higher ($P < 0.05$) 16.0% in *P. Persica* compared to 15.29, 13.28 and 6.47% for *V. lanceolata*, *V. karoo* and *D. dichrophylla* respectively. A range of 1.06% to 34.9% and 5.9% to 20.5% values were recorded for ether extract (EE) and ash respectively, while the mean values for neutral detergent fibre (NDF) and acid detergent fibre (ADF) ranged from 17.4 to 69.54 and 17.59 to 37.11 respectively. The condensed tannin (CT) content of browse species were observed to vary widely ($P < 0.05$) ranging from 0.12% (*P. persica*) to 28.89% (*V. Karoo*). The Ca, Na, P, and Fe contents were influenced by species while the Mg, Na, P, K Zn, Cu differed among seasons ($P < 0.05$). The results of this study showed that *Vachellia karoo*, *Prunus persica*, *Vepris lanceolata* contained adequate levels of nutrients to support ruminant animal production while *Diospyros dichrophylla* does not.

SESSION 10 | FIRE ECOLOGY

SESSION CHAIR: KEVIN P KIRKMAN

Wednesday 27 July 2022, 16:30 – 17:00

PLATFORM PRESENTATION: MULTIDECADAL EFFECTS OF FIRE IN A GRASSLAND BIODIVERSITY HOTSPOT: DOES PYRODIVERSITY ENHANCE PLANT DIVERSITY?

Paul Gordij, Timothy O'Connor*

Indigenous grasslands have been vastly transformed with the expansion of human activities. Applied fire regimes offer conservation-based management an opportunity to enhance remaining grassland biodiversity and secure its persistence into the future. Fire regimes have complex interactions with abiotic and biotic ecosystem components that influence environmental heterogeneity and biodiversity. We examined the pyrodiversity-biodiversity hypothesis, which suggests that more species are supported where pyrodiversity, that is, the level of environmental heterogeneity associated with different fire regimes, is greater. A mesocosm-type field experiment, maintained for 38-years, was used to determine the response of plant diversity to one-, two-, five- and 12-year fire-return interval treatments, with early-dormant, mid-dormant and early-growing season burns. Our sampling regime was designed to assess the influence of fire treatments and combinations thereof, over spatial scale, on plant diversity. Pyrodiversity was maximized where fire regime diversity, simulated by varying the size of patches with different fire treatments, was greatest. Species richness was predicted to be reduced at short and long extremes of fire-return interval, as suggested by the intermediate disturbance hypothesis. The influence of fire treatments on alpha and beta diversity, and plant functional groups, were tested using multivariate and Bayesian models. Multilevel models of plant height and growth form, with fire-return interval, reflected the strong indirect influence of fire-return interval on sward structure and the plant environment. The pyrodiversity-biodiversity and intermediate disturbance hypotheses were only partially supported and depended on the plant group and spatial scale of assessment. While both frequent and infrequent burns made important contributions to overall species richness, richness peaked where 20-40% of the area was protected from frequent fires. The larger, contribution of frequent burning to diversity was due to an interaction with scale and forb turnover over the trial area. Extremes in fire-return intervals reduced forb richness supporting the predictions of the intermediate disturbance hypothesis. Spring burns had a weak negative influence on forb alpha diversity, but only at small scales. For a meaningful contribution of management to plant diversity, traditional fixed biennial burns need to be supplemented with smaller patches burnt with longer fire-return intervals, and extremes in fire-return intervals avoided.

PLATFORM PRESENTATION: HOW DO VARIOUS FIRE BEHAVIOUR PREDICTION MODELS COMPARE WITH RECORDED GRASSFIRE CONDITIONS?

Matthew Danckwerts, Heath Beckett, Guy Midgley*

Wildland fire managers and practitioners in southern Africa use fire as a management tool in grassland and savanna systems to achieve a range of management goals for ecological, agricultural, and safety purposes. However, the occurrence of uncontrolled wildland fires and subsequent damage to property, is inevitable. Acknowledging that there is always risk prescribed burns may get out of control, an important safety consideration for wildland fire managers and pastoralists is whether to conduct prescribed burns under prevailing weather and fuel conditions. When making decisions in this regard, one of the tools available to fire practitioners, are fire behaviour prediction models. Given their increasing credibility and value in predicting and forecasting fire behaviour, mathematical fire models can also be useful aids in reconstruction of fire conditions of past fire events, in forensic wildfire investigations, conducted in contemplation of litigation. Given the risks involved in conducting prescribed burns, it is important these models be considered accurate and reliable for local conditions. Equally, given the weight forensic reports can hold in legal matters, it is critical that the evidence used in these reports (simulated fire behaviour) be considered credible and accurate. While there have been several studies which have constructed and tested site appropriate fuel models in South Africa, few, if any, have shown accurate application (simulation) over a range of conditions. Fewer have compared various models or model configurations against each other, or over a range of input (fuel model) assumptions. This study aimed to test accuracy of model outputs (rate of spread, fire intensity, and flame length) under a range of model configurations, from five widely used practical fire behaviour prediction base models, in montane grasslands of the Eastern Cape, South Africa. Base models were arranged into 20 total configurations based on several existing fuel models, various input assumptions, and the inclusion or exclusion of supplementary slope correction functions. Simulated fire behaviour values were generated *post-hoc*, from fuel, weather, and topographical conditions prevailing at time of combustion and compared with real-time actual fire behaviour data, collected from 143 fires. Slope proved to be a critical driver of fire behaviour in the mountainous Eastern Cape grasslands. Model slope factor correction functions were a crucial configuration inclusion for accurate simulation in this area. Fire behaviour models (encompassing a wide range of fuel model configurations constructed for southern African grassy systems), did not suitably predict (or retrodict) actual fire conditions, generally under predicting rate of spread, fire intensity, & flame length values. It is recommended that current fuel model and input assumptions which exist for southern African grassland and savanna systems be re-evaluated. Suggested changes include a higher dead fuel moisture of extinction value, probably close to 40%, and adjusted (perhaps larger) fuel surface area to volume ratios (finer coarseness). The McArthur Mk5 grassland model was found to be the most suitable simulation model for fire ROS in montane grasslands of the Eastern Cape. McArthur based models are recommended for simulation of ROS in cured (>70%) grassland fuels of southern Africa.



SESSION CHAIR: YVETTE BRITS

Thursday 28 July 2022, 08:00 – 09:30

KEYNOTE ADDRESS: RANGELAND SCIENCE - BACK TO THE FUTURE

Paul Avenant

Department Of Agriculture, Land Reform & Rural Development

Data, Information, Knowledge & Wisdom – we are all very familiar with these terms. In the field of rangeland science, these concepts are also well known, but unfortunately, the last two receive very little attention. The rangeland community is extremely effective in gathering mountains of data and information, but create very little knowledge and wisdom. The lack of good mentorship will cause valuable knowledge and wisdom not being transferred to the next generation of scientist, leaving a void and causing rangeland scientists to invent the wheel all over again. If we want to propel rangeland science into the next century, we will have to take stock of all the mountains of information gathered over centuries of research. It need to be packaged into useful and user-friendly products that will ensure the transfer of knowledge and wisdom to future scientists and the broader rangeland community. Rangeland scientists will also have to identify crucial gaps in the spheres of knowledge and wisdom – what is important for us to know but we do not have the slightest idea. Maybe it will be worthwhile investing into such projects instead of looking at the impact of overgrazing on *Themeda triandra* for the thousand and tenth time! Through listening to experienced farmers, we can tap into an inexhaustible source of wisdom and knowledge. By working in this “reverse order”, one can trace back the kind of data and information that will be needed to scientifically proof the basis of their wisdom. The field of rangeland science need to be kept relevant, fresh and making a difference in the lives of livestock and game farmers. It is a living science, always in motion and so much more than just a few figures on a survey form; it is the foundation of securing food, protecting soil and safeguard biodiversity.

PLATFORM PRESENTATION: DRIVERS OF ECOSYSTEM DYNAMICS – SOME POSITIVE EFFECTS OF ELEPHANTS ON SAVANNA SYSTEMS IN THE GREATER KRUGER SYSTEM

Mike Peel, Lucas Manaka, Sweetness Myeni, Dalton Masia*

The interactions among elephant, vegetation and herbivores in savanna ecosystems is complex. Elephant can modify habitats rapidly and extensively, and as such may precipitate a cascading effect through the ecosystem, affecting both plants and animals. The aesthetic value of large trees for example is as an acceptable aspiration as the more ‘concrete’ objectives like preventing biodiversity loss. Declines in tall charismatic trees due to elephant and concomitant fire risk

receives much attention, as homogenisation of tree structure is both ecologically and aesthetically unacceptable. The above notwithstanding, elephant have positive effects on the system. In this presentation, we present the results of a paired plot survey of an area where elephant are excluded using an electrical high wire and adjacent area open to elephant. This presentation speaks to reasons behind bush encroachment and the loss of sensitive grazing species, so that the vegetation is replaced by short closed woodland. Results show that in an area with a tourism objective, the visibility is greater in the 'open' system than the 'fenced' system and that the grass standing crop is higher in the 'open' versus the 'fenced' system. These preliminary results illustrate the positive effects of elephant opening up the 'thickened' understory, improved grass conditions and ultimately improved game viewing. The situation, we acknowledge is much more complex than reported here and forms part of an in depth study around the sensitive issue of elephant and their management. One of the questions being the point where the loss of tree structural diversity, dominants and sub-dominants, characteristic and other woody components change to a point where there is negative impact on shade loving productive grasses, herbaceous cover, smaller vertebrates and invertebrates, large previously extant herbivores and general habitat patchiness.

PLATFORM PRESENTATION: EXPLORING THE HOME RANGES AND MOVEMENT PATTERNS OF GIRAFFES (*GIRAFFA CAMELOPARDALIS*) UNDER CURRENT CLIMATE CHANGE CONDITIONS BY USING EXTREME WARM TEMPERATURE EVENTS AS AN INDICATOR

Rinae Mukwevho, Francois Deacon, Adriaan Van Der Walt*

Lacking long-term studies is a limiting factor in understanding the effects of climate change on the habitat, spatial ecology, and the movement patterns of giraffes. Climate change have caused major habitat losses and therefore giraffes have had a great population decline. For this reason, we investigated how climate change, extreme warm temperature events (for example, heatwaves) could affect the movement patterns of giraffes. In total, 18 giraffes (7 males and 11 females) were equipped with Africa wildlife Tracking (AWT) Global Positioning System (GPS) satellite collars and tracked for twelve months from October 2017 to November 2018. Hourly data were further analyzed on the movement of two male and two female giraffes in the Rooipoort Nature Reserve in the Northern Cape Province. It is important to note that this is the first male giraffes with long term GPS tagged data obtained, as males proofed difficult to attempt with collaring procedures in the past. The climatic data extracted from the weather station located within the reserve was used to determine occurring warm temperature extremes indicated by a significance level of $p < 0.01$ computed from the R software. It was found that during the summer months (January to December) the daily movement patterns of the giraffes were different compared to the other seasons. The males and females travelled longer distances during winter (860 km and 586 km, respectively) compared to summer (804 km and 513 km, respectively). The movement of both male and female giraffes was high (15%) during the hot summer months (December, January) and dry winter months (June, July and August). It was also observed that the spatial movement patterns of the giraffes corresponded with the water sources within the reserve. Based on these results it can be deduced that temperature does play a role in the spatial distribution of giraffes since it may determine the vegetation utilization and the plant physiological productivity, combined with accessibility to water sources. If preferred and key resource areas are not well planned, managed and not located near a water source, giraffes might find it difficult to get sufficient quality foliage to survive with the on going climate change.

**PLATFORM PRESENTATION: TRENDS IN VELD CONDITION IN A PLANTATION FORESTRY ENVIRONMENT HIGHLIGHT
THE DATA MANAGEMENT CHALLENGES OF LONG-TERM MONITORING**

Alan Short, Chris Foster, Francois De Wet*

Despite decades of discussion on the importance of data management systems for long-term monitoring and management of rangelands there are still no data management protocols that have been widely adopted for rangeland (veld) monitoring in southern Africa. This study discusses the real-world impacts of data management approaches. The South African Forestry Company SOC Ltd. (SAFCOL) commissioned veld monitoring in rangelands across its forestry holdings in South Africa in 2012, with some sites initially surveyed in the 1990s. Over 80 sites across two biomes and a wide range of geological and climatic regions stretching from Limpopo Province to northern KwaZulu-Natal are surveyed annually or biennially and new sites are frequently added to the program, with grazing and burning recommendations provided to forestry staff annually. However, a change of personnel in the last two years caused a significant loss of institutional knowledge in processes, model assumptions and parameters, and interpretation of results. The original data was stored and analysed across scores of individual spreadsheets and data were reported on a site-by-site basis. The spreadsheets were parsed and extracted into a single database and the 2021/22 data added directly into the database, allowing for retrospective temporal and spatial analysis across all sites and simple updating of models and assumptions. Incorporating the dataset into a spatial database allowed for rapid testing of hypotheses of environmental and management drivers including slope, aspect, soils and geology, and in future stocking densities, fire and grazing regimes. Geology was a major driver of trends in veld condition after accounting for other environmental and management variables, and plant species diversity appeared significantly affected by operators. Several different veld condition and grazing capacity models were included in the results, allowing for estimates of the range of variation between models derived from the same underlying data and increasing confidence in the recommendations presented to managers.

**POSTER
SESSION 5**

Rangeland
ecology &
management

Livestock &
game
management

SESSION CHAIR: YVETTE BRITS

Tuesday 26 July 2022, 09:30 – 10:00

Posters can be viewed on twitter @ <https://twitter.com/GrasslandSocSA>

**STANDARD POSTER: ROTATIONAL GRAZING IS MARGINALLY BETTER THAN CONTINUOUS GRAZING IN
MAINTAINING ECOSYSTEM RESILIENCE OF TEMPERATE GRASSLAND IN SOUTH AFRICA**

Nomusa Chonco, Zivanai Tsvuura, Sindiso Nkuna, Rob Slotow*

Grazing practices affect the soil and vegetation of grasslands, which further influence the provision of ecosystem services and the productivity of grasslands. We determined the ecosystem resilience of a mesic grassland under three different grazing management systems: cooperative (continuously grazed since 2017), commercial (rotationally grazed for > 20 years), and communal (continuously grazed for > 20 years) farms. We compared the effects of grazing practices on the grassland resilience by measuring soil compaction and soil infiltration, soil nutrients, forage quality contents for livestock such as acid detergent fibre (ADF), neutral detergent fibre (NDF), and crude protein (CP), veld condition, and plant species composition and richness, and functional diversity of grasses and forbs. The study was conducted in the Pakkies area near Kokstad in KwaZulu-Natal Province, South Africa. Ten 10 m × 10 m plots were laid out on each farm to measure soil and vegetation parameters. Veld condition, forage quality of dominant grasses (*Themeda triandra*, *Tristachya leucothrix* and *Elionurus muticus*), soil pH and amounts of nitrogen (N), organic carbon (OC), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and zinc (Zn) in the soil were analysed. The soils were more compacted in the continuously grazed communal farm and had lower soil infiltration capacity. The cooperative farm had the highest soil infiltration capacity and less soil resistance penetration, while the rotationally grazed commercial farm had moderate resistance penetration and soil infiltration compared with the two farming systems. The plant species richness, and functional diversity of grasses and forbs, were greater in the rotationally grazed commercial farm than in the continuously grazed farms. The cooperative farm had the highest veld condition score (97%), while the commercial farm and the communal farm had 82% and 56%, respectively. The amount of ADF, NDF, and CP present in *T.triandra* and *T.leucothrix* was similar ($p > 0.05$) for all the farming systems, and CP for *E.muticus* was significantly greater in the rotationally grazed commercial farm than in the continuously grazed farms. Soil N was significantly higher in the continuously grazed communal and cooperative farms than in the commercial farm, while soil OC was significantly lower in the communal farm than in the commercial and cooperative farms. The mean concentrations of Mg, Ca, and Zn were significantly higher on the communal and cooperative farms than on the commercial farm. The amounts of P, K, and Mn, and soil pH were similar among the farms. The lower plant diversity under continuous grazing compared with rotational grazing may indicate that the ecological system was not as resilient to continuous grazing. However, for forage quality, soil nutrients, and veld condition it was resilient, which indicates that continuous grazing may not be better than rotational grazing for livestock production. As long as a minimum level of ecological resilience can be retained, continuous grazing will improve return on investment, particularly by small-holder farmers.

STANDARD POSTER: VEGETATION CHARACTERISTICS ON AND OFF GRAZING LAWNS IN THE BONTEBOK NATIONAL PARK

Claire Grootboom, Igshaan Samuels, Adriaan Engelbrecht, Mmoto Masubelele*

The Bontebok National Park (BNP) houses herbivorous wildlife that have the potential to impact their natural environment because of constant grazing. In wetland and Renosterveld habitats, this results in grazing lawns, which in turn becomes an integral part of the park as it serves as a source of nutrients for these grazers and maintains their populations in the park. A plethora of plant species of special concern in renosterveld and lowland fynbos vegetation types are found in the park and these species are being impacted by the proliferation of the lawns due to unmanaged grazing. This study aimed to determine how the establishment and growth of existing lawns could potentially affect the diversity of the natural, and endangered vegetation that occurs in the park. Four big (> 20 m), medium (between 10 m and 20 m), and small (between 5 m and 10 m) lawns were surveyed for plant diversity by identifying and counting the number of each species in five 1x1 m quadrats within a 4x4 m quadrat. In ecotones (between grazing lawns and intact



vegetation) and in intact areas as well, plant species were recorded within the 4x4 m quadrats. Vegetation cover was assessed using the step point method along a 100 m transect (four 25 m) in the ecotone and natural vegetation. It was seen that the most dominant plant species found in the lawns were low-growing and non-woody species like grasses, especially funnel weed (*Cotula turbinata*), and Bermuda grass (*Cynodon dactylon*) which is a good source of nutrition, highly competitive species and tolerant to intense grazing. The intact vegetation consisted mainly of woody shrubs such as renosterbos (*Elytropappus rhinocerotis*) that can reach heights of more than one meter in length, and geophytes belonging to the Iridaceae family. *Cynodon dactylon* is a fast growing and tough grass that is heat and drought tolerant, making it easier to survive and outcompete other plant species. It is a highly invasive species, which allows it to easily inhabit areas that become disturbed, such as patches where overgrazing has occurred. *Cotula turbinata* is also an indicator of a disturbed areas. Renosterveld plant species persists in largely intact areas that has not experienced a lot of disturbance in comparison to the lawns. The difference in vegetation between the lawns and intact areas poses a problem as the natural vegetation is endangered and therefore is important biodiversity that needs to be conserved. However, the lawns are also important to the maintenance of the grazers such as bontebok in the park. A management plan would need to be developed to accommodate both the conservation of the vegetation as well as the source of nutrition that the lawns serve for the endangered bontebok. This could include barking off certain areas to restrict the movement of the animals into demarcated sections of the park for preservation of the endangered vegetation, or potentially having to remove some animals from the park to better control the establishment of new lawns and avoid expansion of existing ones.

STANDARD POSTER: ECOLOGICAL EFFECTS OF HERBIVORE BROWSING IN SEMIARID GRASSLANDS OF SOUTH AFRICA

*Nokuthula Mmbadi**, Mamokete Dingaan

Ungulates are considered ecological engineers because they have the potential to change the structure and functioning of their environment. They have led to substantial changes in woodlands ecosystems, where the impact on the abundance of plant species usually preferred by the herbivore community was established, leading to the plant community composition to shift in favour of avoided species. The difference in the palatability of one species can lead to differences in browse damage and potential shifts in understory composition towards dominance by less palatable species. The aim of this study was to investigate the effects of herbivore browsing on seedlings of the most browsed species in association with change in climatic conditions in semi-arid grassland. It was hypothesized that the survival of preferred seedlings to matured trees depends on their protection from ungulates. The field work for this study was conducted in three locations in the Free State province namely, Sandveld nature reserve (SNR), Soetdoring nature reserve (SoNR) and Willem Pretorius Game Reserve (WPGR). Six study sites were randomly selected in every study location. A site was chosen when an animal was spotted browsing a specific tree species. Each study site had one major plot (30m X 30m) with nine small plots (10m X 10m) for sampling. The first plant species browsed by the herbivore was the starting point and was at the centre of the major plot. The following was recorded in each plot (i) conditions of the habitat, (ii) name of browsed plant species, (iii) abundance of the species browsed, (iv) the cover of each woody species found in the plot using the Braun-Blanquet scale, (v) the number of grass and forb species and counting the number of animals browsing on the site. Enclosures of 2 x 2 m² were made around seedlings of the browsed plant species to protect them against herbivores. These plots were surveyed in a seasonal manner from winter–summer to determine their ecological differences and to also find out the shift in browsed species as seasons change. The growth of the protected and unprotected individual species was monitored and measured seasonally by repeated measurements of height and stem circumference between July 2019 and February 2020. Pre-liminary results indicate that plant species such

as *Ziziphus mucronata*, *Diospyros Lycioides*, *Searsia lancea*, *Celtis africana* were browsed the most in all the study locations. Unprotected seedlings were browsed the most and some went missing. Protected seedlings showed some growth, and it was positive. Protected seedlings showed a growth rate which was between 4.8% –31% from the initial phase. The magnitude of herbivore browsing in association with extreme change in climatic conditions, may result in elimination of certain plant species.

STANDARD POSTER: SPATIO-TEMPORAL STATUS OF VEGETATION, SOIL AND CATTLE SERUM MINERALS IN DEGRADED RANGELANDS OF THE EASTERN CAPE, SOUTH AFRICA: IMPLICATIONS FOR LIVESTOCK SUSTAINABILITY AND MANAGEMENT INTERVENTIONS

*Nangamso Mlaza**, *Solomon Tefera Beyene*, *Abubeker Hassen*

Better understanding of the components of the ecosystem's dynamics in degraded areas is essential to design appropriate rangeland policies and interventions. We examined the forage, soil and cattle blood serum status in less severely (LSD) and severely (SD) degraded semi-arid rangelands of South Africa. LSD characterised by small sized bare patches with few rills, sheet erosion, and abundance of strong perennial grasses, while SD consisted of large bare patches with rills, gullies and frequency of annual grasses. In each degraded area, three villages were identified, and grazing sites near, at intermediate (middle) and far distance from homesteads were selected per village. The villages in the LSD rangeland were Nonzwakazi, Lenge and Gaga Skolweni and in the SD rangeland, these were Kwezana, Memela and Esiginqini. At each village, three 100 x 20 m plots were established in three directions to cover the whole grazing area. Grass species composition was estimated from each plot using a step point method. In each plot, four 0.25 m² quadrants were randomly placed aboveground for grass biomass sampling, Soil, and forage samples for chemical analyses. In each degraded rangeland eight cattle were used to collect blood samples. All data were analysed using the general linear model (GLM) procedure of SAS (2007). Perennial grasses: *Cynodon dactylon* (*C. dactylon*), *Digitaria eriantha* (*D. eriantha*), *Eragrostis chloromelas* (*E. chloromelas*), *Themeda triandra* (*T. triandra*) ($p < 0.05$) were more abundant in LSD than SD rangeland. Degradation significantly ($p < 0.05$) influenced local abundance of decreasers (*T. triandra*, *D. eriantha*), and common grasses (*Aristida conjesta* (*A. conjesta*)) between sites along distance gradient from homestead. Grass yield during the wet season was lower in SD (76 kg ha⁻¹) rangelands than LSD (193 kg ha⁻¹). Soil from LSD rangelands had greater ($p < 0.05$) concentrations of soil Magnesium (Mg), Nitrogen (N), Phosphorus (P), Copper (Cu), Manganese (Mn) and Zinc (Zn) than soils from SD rangelands. During the dry season, animals that grazed LSD grazing lands showed greater concentrations of all serum minerals than those grazing SD rangeland. Seasonal variations in serum mineral levels depended on degraded areas. Forage minerals, DM yield and some soil minerals did not show local variations (distance from homestead), but the abundance of species and palatability and ecological groups did to some extent. Low Zn in the soil, Cu and N in the pasture coupled with the very limited pasture production could potentially limit livestock production in the degraded areas. All pastures showed deficiency in copper (Cu) and nitrogen (N). Animals grazing SD rangelands exhibited drastic decrease ($P < 0.05$) in all serum minerals during the dry season, but in LSD there was a decline in zinc (Zn) and Cu. Cattle grazing SD rangelands in winter displayed serum minerals (except for iron (Fe)) below critical levels. The low forage yield may limit animal mineral intake and production. On the other hand, great abundance of perennial grasses with high forage values (60–76%) suggests that LSD areas may be regenerated. In SD rangelands, complete mineral supplementation of cattle is recommended during dry period.

STANDARD POSTER: THE VIGOUR OF A MESIC GRASSLAND FORB IS RAPIDLY REDUCED BY INFREQUENT, SEVERE LEAF DISTURBANCE

*Sindiso Nkuna**, Craig Morris, Anita Morris

Herbaceous monocots and dicots (forbs) in South African mesic grassland are ancient, numerous and diverse, outnumbering grass species 5-6 times. Forbs - many of which have underground storage organs (USOs) enabling regrowth - are maintained by disturbance from recurrent fires and light grazing but can be markedly diminished in number and richness by chronic, severe livestock grazing, particularly if accompanied by intense trampling of plants. We aimed to test the hypothesis that repeated damage to aerial parts, simulating trampling effects, would reduce the regrowth and vigour of a mesic grassland forb, *Thunbergia atriplicifolia*, which declines under overgrazing. In a pot trial, plants (seven replications) were subject to severe, infrequent disturbance by clipping all shoots and stems to 10 cm above soil level (~70% initial defoliation intensity) three times during the growing season, every 60 days. Plant height, number of stems, and seasonal dry matter production of defoliated plants were compared against the growth of undisturbed controls. Aerial regrowth and root mass were measured after the following spring (end of October) while defoliation was continued on a second set of plants to measure cumulative effects on plant vigour (continuing in 2022). Plants were able to compensate in the short-term for leaf and shoot removal, producing 2.5 times as much total aerial biomass as controls ($p < 0.001$) over the growing season. However, repeated disturbance took its toll, with defoliated plants progressively declining to 63.5% and 55.4% of the control height after the 1st and 2nd clip, respectively, leaving them with 55.5% less standing biomass at the end of the season in July ($p < 0.001$). The disturbance effect carried over into the subsequent spring when the height and stem number of clipped plants were reduced ($p < 0.01$) by 9.2% and 27.6%, respectively, compared to the controls. Roots were more sensitive than leaves and shoots: previous clipping diminished root dry mass by 60.4% ($p < 0.05$) and aerial dry mass by 47.7% ($p < 0.01$) in spring. In the second growing season (ongoing), clipped plants remained, on average, 15% shorter ($p < 0.05$) with 34-45% fewer stems ($p < 0.05$) than controls, providing further evidence that the effects of aboveground disturbance on a forb can be cumulative and severe. We conclude that the mesic grassland forb, *T. atriplicifolia*, is highly sensitive to recurrent, severe leaf damage, even with long recovery periods (two months) between growing-season disturbances, despite it possessing partially thickened roots (a USO) to fuel its regrowth. Therefore, we recommend that if the species diversity of mesic grassland is to be preserved it should not be trampled at high stocking densities, as employed in high intensity, short-duration grazing systems.

STANDARD POSTER: VEGETATION SPECIES COMPOSITION, SOIL SEED BANK AND BIOMASS PRODUCTION OF A SEMI-ARID COMMUNAL RANGELAND OF MATABELELAND SOUTH PROVINCE, ZIMBABWE

*Alois Hlatshwayo**, Paul Malan, Mercy Buza

Communal rangelands of semi-arid south western Zimbabwe are major players in the livestock production sector, contributing 90% of cattle in the country. However, sustainability of the rangelands is seriously threatened by several factors, chief among them being poor grazing management methods, rangeland fragmentation and climate change and variability. The study investigated the effect of continuous grazing on Pelele, Gwanda, communal rangeland in a semi-arid savanna during the growing season of 2021. Data was collected on herbaceous species composition, soil seed-bank and biomass production. To collect data on species composition 10 transects, each 50 m long were randomly marked

and the Quadrat-Counting Method used. For soil seed bank data, a quadrat 30 cm x 30 cm was thrown 24 times randomly, 12 of the quadrats were under tree canopies and the other 12 on open ground, soil samples were collected from three different depths; 0-5 cm, 6-10 cm and 11-15 cm. The seedling emergence method (SEM) was then used to assess the soil seed bank. Data on biomass production, was collected by randomly throwing a quadrat 1 m x 0.5 m 30 times, 15 on open ground and the other 15 under tree canopies. A combination of the dry-weight rank method (DWR) and the SWIFTSYND methodology were used for biomass assessment. Species inventory results showed 13 herbaceous species, of these only 4 (30.8%) had good forage value, while 9 (69.2%) had poor forage value. Out of the 4 species with good forage value, 2 were perennials and the other 2 were annuals. Herbaceous species were dominated by *Aristida barbicollis* which contributed 34.0%. Results of the soil seed bank evaluation showed that seed concentration was mostly in the 0-5 cm depth. Soil samples collected on open ground had 12 species of which 7 (58.3%) were grasses, and 5 were forbs. Out of the 7 grass species only 3 were palatable and none of the forbs were. On soil samples collected under tree canopies there were 22 herbaceous species. Out of the 22 herbaceous species 13 were forbs, and 9 were grass species. Both grasses and forbs had 5 species each which were palatable while the rest were not. There were more herbaceous species on soil samples collected under tree canopies due to the protection of *Vachellia tortilis*. Biomass results showed very low production of 0.1185 t/ha under tree canopies and 0.1173 t/ha on open ground. The biomass results were subjected to a two-sample t-test, and there was no significant difference hence $p=0.273$. The general inference from the results of the study is that: continuous grazing practiced on communal grazing causes poor rangeland condition hence in the long run the rangeland may fail to support livestock production.

STANDARD POSTER: THE BIO-ANTIMICROBIAL POTENTIAL OF CULTIVATED CACTUS LEAF (*OPUNTIA FICUS-INDICA*) FOR LIVESTOCK

Portia Mamothaladi Moshidi, Augustine Sindane, Mukengela Claude Muya*

Plant rich secondary compounds had antimicrobial effects by acting against different rumen microbial populations. Plant secondary compounds had antimicrobial effects by acting against bacteria, protozoa and fungi. The aim of the study was to evaluate the feed intake, growth and faecal pathogens on dairy calves supplemented with cactus (*Opuntia ficus-indica*) and *Lactobacillus*. *Lactobacillus* is a gram-positive rod-shaped bacterium, it is probiotics (good bacteria) that can be consumed for diarrhoea and "gut health." The study was conducted at Agricultural Research Council (ARC) Animal Production (AP) located at Old Olifantsfontein Road in Irene, Gauteng province (25° 53' 59.6" S 28° 12' 51.6" E). Twenty-seven Holstein dairy calves were used in a complete randomised block design, with three treatments. The treatments were: 1) Control (no supplementation), 2) cactus powder (CACP) supplemented at 5 g per day, and 3) *Lactobacillus* (LACT) supplemented at 5 g per day. Calves were supplemented with Cactus powder or *Lactobacillus* from day 4 until day 42 at weaning. Calves were housed in an individual pens, to avoid cross contamination. Calves were monitored daily for possible health problems such as diarrhoea. Water was fed ad-lib, feed was provided daily and feed intake was recorded daily. Calf growth was measured weekly using electronic scale. Fresh faecal samples (50 g) were collected from the rectum by massaging the rectum using a finger on weekly basis. Samples were transferred into the labelled tubes and transported to the laboratory for determination of *Escherichia coli*, coliforms and *ENTEROBACTERIACEAE* counts. Data for feed intake and growth were measured daily and reduced to weekly means prior to analysis. Least squares means was presented by using the procedure PROC MIXED of SAS (2009) and significance was declared at $P < 0.05$. The average daily gain and the final body weight did not differ between *Lactobacillus* and cactus powder -calves. These two groups of calves were gaining 0.09 more kg daily ($P < 0.05$) and were 3.15 kg heavier at weaning than control group. Calves supplemented with cactus powder reduces ($P < 0.05$)



faecal coliform on day 10. *Escherichia coli* was reduced on day 5 and 10 respectively, however, did not reduce the *ENTEROBACTERIACEAE* count. Supplementing cactus powder showed benefit for calves with reduced faecal pathogens and consequently improved calf intake and growth. Plant metabolites as antimicrobial feed additives to calves retain many challenges regarding the dosages, levels, adaptation lengths, herbal or herb-drug interactions and public health safety.

STANDARD POSTER: ILLUSTRATING THE FUNCTIONALITY OF THE CAROTID-VERTEBRAL ANASTOMOTIC ARTERY IN THE REGULATION OF BLOOD FLOW IN GIRAFFE (*GIRAFFA CAMELOPARDALIS*), BY DUPLEX ULTRASOUND EXAMINATION

Marna Van Der Walt, Francois Deacon, Jacqueline Goedhals, Willem Daffue*

An adult giraffe stands at a height of 4.5 meters, subjecting it to several physiological difficulties. Giraffes however are equipped with a group of mechanisms that work in unison to allow giraffes to successfully overcome these physiological challenges. Blood supply to the brain is challenging with a heart-to-head distance of over 2 meters. A well-developed carotid-vertebral arterial connection is observed by computerized tomography and physical dissection, situated at the mid-point of the atlas. Blood moved unidirectionally within this anastomotic artery. Duplex ultrasound with doppler waveform examination indicated blood moved from the vertebral artery into the carotid artery when the head is moved into an upright position, providing blood availability for movement into the maxillary artery that transitions into the carotid arterial rete structure, supplying blood to the cerebral arterial circle. With head movement from fully erect to the ground level, blood moved from the carotid artery into the vertebral artery. The blood column driven by gravitational force towards the head was diverted toward the vertebral artery preventing large blood volumes from entering the cerebral arterial circle and causing brain aneurysms. The study validated the existence and blood flow direction in the anastomotic artery at different head positions in giraffes, by means of a CT-scan, doppler sonar, and the physical dissection of latex-filled arteries. The anastomotic artery is functionally essential in giraffes to prevent fainting when the head is moved from ground level to fully erect, with blood from the heart coursing through the vertebral artery pathway that is enclosed by body structures to prevent expansion and collapse. Similarly, the anastomotic artery is also functionally essential in giraffes to prevent brain aneurysms when the head is moved from fully erect to ground level. The result of this study is of major significance, contributing to the understanding of the concurrent evolution of circulatory control in parallel to neck elongation in giraffes.



SESSION CHAIR: SINDISO NKUNA

Thursday 28 July 2022, 10:00 – 11:00

PLATFORM PRESENTATION: THE ROLE OF RAINFALL AND GRAZING ON THE VEGETATION OF THE WEST STRANDVELD, SOUTH AFRICA

Nelmarie Saayman, Craig Morris, Rudi Swart, Christie Rheeder*

The West Strandveld bioregion is situated along the west coast of South Africa in the Fynbos biome, but with many elements of the Succulent Karoo. Hence Acocks' classification of the area as Strandveld of the Succulent Karoo. It is an arid region (MAP = 200 mm; CV = 31.5%) that receives 64% of its annual rain from May to August. It is mainly used for extensive livestock and wildlife grazing as well as potato production. The long-term recommended grazing capacity for the area is 30 ha/AU. A seasonal grazing trial were conducted over a 9-year period (1988-1997) at the Nortier Research Farm, Lambert's Bay. The four main treatments were grazing season (spring, summer, autumn, winter) and the three sub-treatments were high stocking rate (15 ha/AU), moderate stocking rate (19 ha/AU), and low stocking rate (27 ha/AU). Treatment layout followed a complete randomised design with two replicates. Camps were grazed with non-breeding dorper ewes for three months and rested for nine months. Plant surveys was done at the start of each season in every camp from Sept 1988 to Sept 1997. The descending point method was used over 500 points on a fixed-point basis. Crown spread cover and species composition were monitored using a rod and 50 m non-stretch rope. A canonical correspondence analysis (CCA) showed that the treatments and rainfall had a significant effect ($p = 0.001$) on the species composition, with season of grazing the most important followed by stocking rate, previous year's rainfall, and rest. There were no significant interactions between rainfall and the treatments ($p > 0.05$). Control charts show that the species composition did not change significantly over time from the initial composition (remained within 95% confidence level), except for those surveyed in September in year 6 across all treatments. This can be attributed to exceptional high rainfall in the previous 12 months (334 mm). The deviation was least visible in the winter grazed camps that can be ascribed to grazing that took place during the three months prior to the survey within the growing season. The vegetation quickly return to its former composition. *Ehrharta calycina*, *Tetragonia fruticosa*, and ephemerals react to the high rainfall in year 6 with an increase in the plant cover. None of these species' cover were significantly correlated with the previous year's rainfall over the 9-year study period. The species composition of the West Strandveld are very stable and resilient across grazing treatments and only fluctuate in very high rainfall years. Unlike the Gamka Karoo the effect of grazing is not overridden by rainfall and the conclusion can be made that the vegetation dynamics of the West Strandveld follows the equilibrium-based rangeland model.

PLATFORM PRESENTATION: CHANGES IN HERBACEOUS COVER AND SPECIES COMPOSITION ON WITSAND NATURE RESERVE AFTER ABOVE AVERAGE RAINFALL SEASONS FOLLOWING A PROLONGED DROUGHT

Marnus Smit, Francois Deacon, Paul Malan, Nico Smit*

Large parts of the south-eastern Kalahari were affected by the recent drought. It is well documented that during droughts herbaceous cover and species diversity decreases. In the Witsand Nature Reserve herbaceous cover continued to decline as the drought persisted. The end of the drought was followed by two above-average rainfall seasons and saw noticeable changes in the vegetation. The purpose of this study was to determine the changes and as well as potential recovery of the vegetation in response to good rainfall seasons after a prolonged drought. For this, nineteen 100 m long transects were surveyed every three months from November 2019 to March 2022. During each survey the basal cover of all rooted herbaceous species within the transect was measured by placing a frame 1 m x 1 m, subdivided into blocks of 50 mm x 50 mm at every 1 m interval along the 100 m transect. The number of blocks engaged by the perpendicular projection of plants basal crown was counted and total block counts expressed as percentage basal ground cover. In addition, above-ground dry biomass (DM) of prominent herbaceous species per area of basal cover (BC) was also determined (kg DM/ m² BC). Grass tufts and forbs were clipped, dried and weighed and basal cover of harvested tufts or forbs measured. After the first substantial rainfall events post drought (December 2020), the herbaceous layer quickly responded as herbaceous ground cover greatly increased from 1,15% ± 1,28% SD to 11,05% ± 13,01% SD. The high cover increases were mainly attributed to the emergence and dominance of creeper forb species. The following wet season (2022), the cover of grasses further increased, from 1,82% ± 1,18% SD to 2,86 ± 1,25% SD, as forbs were predominantly replaced by grasses. Species diversity of all transects increased after the drought and saw the emergence of a number of newly recorded species. Above-ground biomass production of all grass species substantially increased per area of cover (average of all species 1,17 kg DM/ m² in 2020 to 1,98 kg DM/ m² in 2021), as rainfall improved. The results may indicate that the Kalahari system is extremely resilient to droughts and has the ability to rapidly recover if sufficient rainfall is received. However, the results further indicate that good follow-up wet seasons are an important driver in the recovery of veld.

PLATFORM PRESENTATION: RESPONSE OF HERBACEOUS AND WOODY VEGETATION OF SEMI-ARID SAVANNAS TO WOODY SHRUB CONTROL IN CATTLE AND GAME MANAGEMENT AREAS

Arnim Marquart, Helga Van Coller, Nanette Van Staden, Klaus Kellner*

Impacts of climate and grazing can lead to undesirable shifts in herbaceous and woody layers of semi-arid savannas. Changes in plant community composition include woody shrub encroachment and decreases in desirable herbaceous functional groups. The Kalahari savanna provided a setting to investigate effects of land use (cattle farming and game ranching) and selective treatment of woody shrubs on forb and grass functional groups. Vegetation responses were assessed across land uses and treatments to answer the following questions: 1. What are the effects of land use and selective control of woody shrubs on palatable perennial herbaceous functional groups? and 2. How does selective shrub removal across land uses affect woody vegetation regarding different size classes and coppicing rates? Herbaceous and woody vegetation was sampled along six waterhole transects (as a proxy for grazing pressure) each on three game farms and three cattle ranches. To quantify effects of woody shrub control on herbaceous functional group abundances and assemblages, tree equivalents ha⁻¹ (TE), coppicing rate, and shrub abundance, we compared these variables across two treatments (shrub controlled and untreated) and land uses (game and cattle farming). Shrubs were

chemically controlled about 10 years prior by hand, targeting >70% of encroaching shrub species such as *Senegalia mellifera*, while species considered favorable, such as *Grevia flava* were preserved. Selective shrub control was effective in improving palatable herbaceous vegetation, which often differed among land-uses: Annual forb abundance decreased with distance to waterpoint ($p < 0.05$) from about 7.7 to 3.4 ind./4m² on controlled, while abundance on uncontrolled areas averaged at about 4 ind./4m² (interaction: $p = 0.06$). For perennial forbs the treatment effect was more pronounced at intermediate distances from watering points (300 m and 600 m), where average abundances in treated plots (21.5 ind.) were more than two-fold higher compared to untreated plots (10.5 ind.; $p < 0.05$). On cattle farms, the average abundance of annual grasses was higher in untreated plots (71.4 ind.), compared to treated plots (39.3 ind.), while on game farms this effect was more variable among distances and less pronounced ($p < 0.01$). Average perennial grass abundance was higher on game farms (34 ind.) compared to cattle farms (23.2 ind.) and higher at treated sites (34 ind.), compared to untreated sites (23 ind.) ($p < 0.01$). The composition of the perennial herbaceous vegetation was especially influenced by land use type ($p = 0.001$). Considering the woody component, averaged tree equivalent was higher in untreated compared to treated plots, and this difference was more pronounced on game farms (untreated: 1203 TE; treated: 380 TE), than on cattle farms (untreated: 1051 TE; treated: 525 TE) ($p < 0.01$). Selective shrub control caused higher coppicing rates treated cattle plots (0.75) compared to untreated cattle and game farms (~0.55) ($p < 0.05$). Land use management strategies and animal behavior should be considered when applying woody shrub control. Therefore, shrub control will depend on the objectives of land use, ecosystem services, and biodiversity requirements. Furthermore, herbaceous life forms and their ecosystem functionality should be included when assessing post control conditions and planning aftercare shrub control measures.

**PLATFORM PRESENTATION: CONSEQUENCES OF WOODY ENCROACHMENT TO ECOSYSTEM PROCESSES:
DIFFERENCES IN CARBON SEQUESTRATION AND EVAPOTRANSPIRATION BETWEEN AN OPEN GRASSLAND AND A
VACHELLIA KARROO ENCROACHED GRASSLAND**

Craig Weideman, Anthony Palmer, Kathleen Smart*

Vegetation in semi-arid ecosystems plays a major role in regulating global carbon, water, and energy budgets, but ecosystem-level fluxes and seasonal and interannual variability are difficult to predict due to significant plant structural and functional complexity and sparse and erratic rainfall, which drives biological activity in these biomes. These systems are experiencing widespread increases in woody cover, which has accelerated in recent decades in response to rapidly changing local and global drivers, with largely uncertain implications for a range of critical ecosystem services such as water production and climate regulation. In addition, national pledges to initiatives such as the Bonn Challenge and AFR100 have nominally committed large areas of semi-arid grassy biomes to widespread tree planting to offset anthropogenic carbon emissions, based on the unsubstantiated premise that higher aboveground biomass equates to greater carbon sequestration efficiency, but the evidence for this is equivocal. Improved process-based understanding of the effects of changing C₃/C₄ ratios on carbon and water fluxes in semi-arid grassy biomes is therefore crucial to evaluate potential trade-offs in ecosystem functioning and develop appropriate policy responses. We installed a pair of identical eddy covariance flux towers at the intersection of a coterminous unimproved semi-arid C₄ grassland and encroaching *Vachellia karroo* dominated woodland on a commercial livestock farm near Adelaide, Eastern Cape, to compare seasonal and interannual C flux rates, water use, and ecosystem water use efficiency (WUE_E) in respective systems. WUE_E reflects the ratio of gross primary production (GPP) to evapotranspiration (ET), and provides a key measure of the carbon sequestration potential of ecosystems in water limited conditions. In general, water use by respective systems was relatively similar over the study period, with both sites transpiring almost all available rainfall,

although differences in net ecosystem fluxes were pronounced. Both systems were net C sinks in the two growing seasons (November – April[CW1]), switching to small carbon sources in dry seasons (May – October), when carbon uptake via GPP and autotrophic respiration declines and net ecosystem exchange (NEE) becomes increasingly dominated by soil microbial respiration. The grassland sequestered more carbon ($197 \text{ g C m}^{-2} \text{ yr}^{-1}$) than the woodland ($144 \text{ g C m}^{-2} \text{ yr}^{-1}$) over the 12 months, with marginally lower total ET in the grassland, resulting in higher WUE_E in the former. Our results show that increasing woody cover in semi-arid grasslands may result in measurable declines in carbon sequestration rates and ecosystem water use efficiency, and suggest that the preservation of natural grasslands should be central to strategies aimed at maximising carbon benefits in semi-arid ecosystems.



SESSION CHAIR: PAUL AVENANT

Thursday 28 July 2022, 11:00 – 12:30

PLATFORM PRESENTATION: THE STRATEGIC IDENTIFICATION OF HIGH POTENTIAL AGRICULTURAL LAND TOWARDS ADDRESSING THE SUSTAINABLE MANAGEMENT AND USE OF THE NATURAL AGRICULTURAL RESOURCES OF SOUTH AFRICA

Anneliza Collett

As a result of agricultural production and related activities, large percentages of the earth's surface have been transformed, which is regarded as one of the major driving forces behind the pushing of the environment beyond the "planetary boundaries". It is therefore of significant importance that land with productive potential, specifically high potential cultivation and grazing areas, be identified and delineated. South Africa is a predominantly arid country, having limited land with agricultural potential that can be used for sustainable production, whilst also being subjected to other demands, which can be conflicting or incompatible non-agricultural land uses. The protection of especially high potential agricultural land as well as the sustainable management and optimal use of the agricultural natural resources of the country has a significant impact on the ability of the country to ensure national food security. These resources need to be preserved for generations to come through appropriate practices, whereas a natural state is to be maintained in marginal or unsuited areas, with a strive towards alignment and complementary initiatives in support of environmental conservation requirements. Using an agro-ecosystem approach towards the identification and delineation of the high potential agricultural land, it will provide for an informed optimal and sustainable utilization of the resource, given the resource's capability and potential. In addition, it will provide for a better knowledge of the complex, dynamic system of interactive linkages between the biotic and abiotic components, not only in relation to the delineated area but also to the larger agro-ecosystem and the provision of agro-ecosystem services that is to inform the basis for decision making towards sustainable land management. The spatial delineation of high potential agricultural areas is to be encapsulated within relevant legislation and policies to provide for legislative strengthening of such protection. Such areas further have to be incorporated within planning activities through a multi-disciplinary

approach to provide for alignment and to compliment affected environmental priorities as well as other planning regimes' requirements. The aim of this paper is to provide an overview of the national strategic intent behind the identification, delineation and protection of high potential agricultural land areas, with specific reference to applicable agricultural legislation. Reference will be made as to how such spatial delineated areas for cultivation purposes have already successfully been implemented thus far at various levels, whilst the process is underway to do the same for grazing areas. It will further provide insight on how such areas will create a platform for finer scale planning, not only from an agricultural and environmental perspective but also for holistic land use planning. It is only through knowledge, supported by relevant legislative interventions that the challenge for sustainable agro-ecosystems can be addressed successfully, whilst retaining ecosystem functionality, maintaining productivity, ensuring economic viability and providing for an equitable social outcome.

PLATFORM PRESENTATION: THE USE OF AGRO-BIODIVERSITY DEMARCATION TO ASSIST THE DELINEATION OF HIGH POTENTIAL RANGELAND

Boyd Escott, Felicity Elliott*

This presentation outlines the mapping methodology followed in the delineation of the Ezemvelo KZN Wildlife Biodiversity Land-Use coverage. It outlines how this can both inform, and potentially be integrated into, the final Protected Agricultural Areas maps, with a special focus on those Protected Agricultural Areas to be developed as high potential rangelands. This process will allow for the identification of areas of common priority to both the Agricultural and Conservation Sectors, the former being areas of high potential rangeland, and the latter being areas of key biodiversity priority. Whilst at first glance the respective mandates for each Sector might appear to be in conflict, the desired land-use management goal from both Sectors is essentially the same, namely, the retention and preservation of natural and semi-natural lands. As such, the end objective would be to integrate the two priority maps for form one common layer which will in turn inform mainstream spatial planning.

PLATFORM PRESENTATION: DEVELOPMENT OF A METHODOLOGY TO DELINEATE HIGH VALUE RANGELAND

Paul Avenant

Very little of South Africa's rangeland can still be regarded as "*pristine*". Anderson (2005) define *pristine* as areas with minimal or no discernible impact by humans and rangelands that exemplify the purest, uncorrupted mixture of soils, microbes, plants and naturally occurring animals, diseases and pests. In an agricultural context, however, livestock grazing is still the primary land use of most of South Africa's rangeland. These areas are complex living landscapes that consists of various land uses that may contribute or support livestock farming. The Department of Agriculture, Land Reform and Rural Development has the mandate and responsibility to protect agricultural land that contributes to food security. This includes both arable land as well as natural rangeland for livestock or game farming activities. Although the high value arable land has already been demarcated, the methodology to demarcate the rangeland areas still needs to be developed. This session will discuss the current proposed methodology on how to delineate high value rangeland areas using natural agricultural resource data. The demarcation will be done at a national scale and national data sets will be used. The purpose of this delineation is to protect certain high value agricultural areas against permanent land use changes that will impact negatively on food production. These protected areas will be proclaimed under the new Protection and Development of Agricultural Land Act (currently in parliament for final approval). Among other, data

layers such as long-term grazing capacity (2018), land cover (2020), non-agricultural land uses, soil properties such as clay content, terrain and precipitation data are suggested as probable inputs to the delineation process. One of the most important parameters that will influence this delineation process is the current veld condition which cannot be obtained from any national data sets. Long-term grazing capacity data is based on the assumption that veld is in a good condition (>70% veld condition score), but in many cases rangelands are extensively degraded and will not be regarded as high value rangeland anymore. Inputs from rangeland scientist familiar with the respective areas will be of utmost importance to the success of this project.



SESSION 14 | LIVESTOCK & GAME MANAGEMENT

SESSION CHAIR: IGSHAAN SAMUELS

Thursday 28 July 2022, 13:30 – 15:00

KEYNOTE ADDRESS: WISHED OUT: REVISITING WHY PASTORALISTS ARE INVISIBLE

Anthony Egeru

Pastoralism is under immense global pressure regardless of its ecological, political, economic, cultural, and social importance. This raises the fundamental questions: why has pastoralism remained invisible despite its enormous contributions and why is such an old livelihood strategy being wished away in the contemporary global dispensation? Despite being resilient through its ability to respond to the dryland ecosystem's delicate balance of a water-limited ecology and a host of livestock diseases that lead to intermittent shocks and emergencies, pastoral production systems have continued to be criticized for their limited ability to deal with longer-term critical trends. Further, as pastoral production systems often take a longer time to enter into a crisis, the transition from crisis to collapse may occur faster than anticipated, and should the crisis become unmanageable, collapse becomes a reality. Thus, protagonists who contend that pastoralism is a production system that is beyond development maintain that it must be modernized, developed and its people in particular be re-settled if the development indicators are to be got right. In this case, I argue that this complex issue and associated contradictions arise largely from an incomplete understanding of pastoral production systems by those in authority, intermingled with a plethora of global and regional geopolitical undertones. As such, decision-makers, global and regional political dynamics have precipitated consistent structural exclusion of pastoralists at various levels including regional, national, and local levels. These have led to deep grievances and mistrust between pastoralist communities and governments, between pastoralists and sedentary farmers, and even within pastoralist groups resulting in an increase in violent conflicts. Such conflicts have strengthened the resolve of policy-makers to transform pastoralism into 'a new development-responsive' production system.

PLATFORM PRESENTATION: ROTATIONAL GRAZING ON COMMUNAL RANGELAND ADOPTED BY 400 VILLAGES IN SOUTHWEST TAJIKISTAN REDUCES EROSION AND IMPROVES LIVESTOCK PRODUCTION

Khatlon region in south-west Tajikistan is the poorest region in the country. Rangelands are degraded and the mountainous landscape is characterised by severe erosion. Khatlon is also the main livestock-production region with 80-90% of households owning livestock that graze communal rangelands ('pastures') in spring-summer from April to September. In winter the animals shelter in barns. Cow's milk is the main food resource and commodity. During the Soviet era, before 1991, cattle were kept in feedlots; after independence they were distributed among individual households, as were poorer-quality cattle and small ruminants that had grazed rangeland. Freed from Soviet constraints, wealthy and influential families grabbed the best land in *de facto* private farms and livestock owned by poor households grazed communal rangelands. Numbers of livestock held by smallholders steadily increased. Degraded, overgrazed land threatened the poor households that depended on animal products for subsistence. In 2011 the government of Tajikistan entered into an agreement with IFAD (International Fund for Agricultural Development) to improve rangeland resources and livestock production and reduce poverty. The Livestock and Pasture Development Project (LPDP) funded by IFAD benefited 73,000 households in 400 poor villages in 10 Districts in Khatlon from 2013 to 2021 in a multi-faceted project centered around better rangeland-and-livestock management and including improved water supply, breed improvement, controlled mating, veterinary services, and specific women-oriented development. Rangeland management was decentralised with the appointment of Pasture Users' Unions with a Board elected by village households and given official recognition to manage land, receive grants, charge fees, and improve infrastructure. LPDP introduced a procedure for estimating carrying capacity and adjusting livestock populations to match that figure, but that was abandoned in favour of improved rangeland management practices to achieve more available forage. Rotational grazing was implemented on 130,000 ha of communal grazing land under the direction of Grazing Supervisors and following guidelines developed by the author. For purposes of land rehabilitation, the recommended rotational grazing strategy emphasised multiple grazing-unit areas each grazed just once per year. Tajik rangelands have demonstrated a remarkable capacity for recovery from degraded conditions when rested from grazing. Impact Analyses done post-project reported a significant 76% increase in livestock income per capita ($p < 0.01$), especially among women-headed households. Within the first year of grazing rotations, villages reported bigger animals and higher milk production. Data from the final 3 years of the project showed that milk yield per cow rose 19% when compared to official Tajik District data. Average cattle live-weight increased significantly by an average of 28% in project herds vs non-beneficiary herds. In the first phase of LPDP, 2013–2017, household ownership of livestock increased by 60%. Perhaps most important, rangelands recovered from erosion, plant cover and forage production increased, and range trend was positive. LPDP has proved to be a model for land-and-livestock development in Central Asia and beyond, and IFAD now touts rotational grazing as an effective degraded-rangeland recovery strategy.

PLATFORM PRESENTATION: EFFECT OF OVERNIGHT KRAALING ON NGUNI COW PRODUCTIVITY AND CALF PERFORMANCE IN THE EAST GRIQUALAND GRASSLAND, KWAZULU-NATAL

Mpumelelo Magawana, Sibongiseni Gcumisa, Trevor Dugmore, Johannes De Villiers*

Due to the paucity of data on the impact of overnight kraaling on Nguni cow productivity and calf performance in the East Griqualand grassland of KwaZulu-Natal. The trial was started in 2016 to examine the effect of overnight kraaling. In the East Griqualand of KwaZulu-Natal, overnight kraaling is gaining popularity among commercial livestock farmers as a method to minimize theft. The objective of the study was to investigate the effect of kraaling, without supplementary feed on Nguni cows and calf performance. The treatment included two groups: control group (CG) with



30 cows, grazing 24 hours a day and overnight kraaled group (OKG) with 30 cows. Both groups were grazing together during the day and separated in the evening. Data was collected using 60 cows and 191 calves, respectively over four years and was subjected to statistical analysis ($p < 0.05$). Data was analysed using GenStat 18th Edition for an unbalanced analysis of variance. Cow body weight was not affected by treatments ($p > 0.05$), while year had a significant effect ($p = 0.001$). The year 2016 had a lower cow body weight (380.1 ± 2.18 kg) compared with 2017 (386.1 ± 2.18 kg), 2018 (395.7 ± 2.41 kg) and 2019 (411.9 ± 3.40 kg), respectively ($p = 0.001$). The interaction between the treatment and the year showed a significant effect on body weight ($p = 0.001$). However, the OKG had a lower body condition score (BCS) (3.50 ± 0.01) compared with the CG (3.37 ± 0.01). The year 2017 had a lower BCS (3.39 ± 0.02) compared with 2018 (3.42 ± 0.02), 2019 (3.46 ± 0.02) and 2016 (3.49 ± 0.02), respectively. The interaction between the treatment and the year showed a significant ($p = 0.002$) effect on BCS. The overall average corrected 205-day weight of calves was affected by treatment, while the OKG consisted of a lower average corrected 205-day weight of calves (172.2 ± 1.90 kg) than that of CGs (187.0 ± 1.90 kg) ($p = 0.001$). Moreover, the year 2016 (125.5 ± 3.50 kg) had a lower corrected 205-day weight of calves compared with 2017 (153.3 ± 2.50 kg), 2018 (167.8 ± 2.60 kg) and 2019 (247.0 ± 2.50 kg). The OKG had a lower average daily gain compared with CG (0.66 ± 0.01 kg/day vs. 0.73 ± 0.01 kg/day). The data on ADG over 4 years showed that calves born in 2017 (0.75 ± 0.02 kg/day) grew faster than those of 2016 (0.61 ± 0.02 kg/day), 2018 (0.69 ± 0.02 kg/day) and 2019 (0.69 ± 0.02 kg/day), respectively ($p = 0.001$). There was no treatment interaction effect between the treatment and the year on ADG. It is evident from the study that an overnight kraaling system is negatively affecting the performance of Nguni cows and calves.

PLATFORM PRESENTATION: GRAZING MANAGEMENT ON COMMERCIAL CATTLE RANCHES: INCORPORATING FORAGING ECOLOGY AND BIODIVERSITY CONSERVATION PRINCIPLES

Richard Fynn, Japie Jackson*

There has been much debate on the efficacy of complex multi-paddock grazing systems for enhancing rangeland condition and animal production. A key point that is often ignored in discussions of optimal rangeland management strategies is that, irrespective of how excellent rangeland condition may be on a ranch under a specific management approach, if the ranch is economically unsustainable, then its management approach is untenable. Economic sustainability is determined by the amount of income from cattle production relative to the overhead costs of running the ranch. It follows, therefore, that any management approach that increases overhead costs or decreases cattle production, or both, undermines economic sustainability. The objective of this synthesis is to examine key foraging ecology principles and how these may be violated by management of cattle in complex multi-paddock grazing systems, with negative consequences for cattle production. Another objective is to discuss how complex multi-paddock grazing systems undermine economic sustainability. Methods included a review and synthesis of the rangeland and herbivore foraging ecology literature. As grasses mature their digestibility and nutrient concentration decline, resulting in reduced intake of dry matter, energy and protein, thereby reducing weight gain of herbivores. For this reason, wild herbivores avoid foraging in mature grassland, favoring fresh regrowth after fire or grazing. Thus, resting paddocks for months before grazing them violates a key foraging ecology principle and is expected to result in reduced weight gain of livestock by forcing them to forage in paddock after paddock of mature, low-quality forage. However, the effect of maturing forage is only expected to have negative effects on animal performance in higher rainfall grasslands where forage loses quality rapidly with maturity. Both sheep and cattle have been observed to gain weight faster when grazing on immature forage. Considering that nutrition is the major factor determining conception rates of cattle, it is expected that forcing cattle to forage in mature grassland will also reduce conception rates. Another factor is that forcing cattle to graze at

high densities in large herds and small paddocks increases competition for forage and reduces adaptive foraging options, which is also expected to reduce animal performance. Consequently, weight gain and conception rates of cattle managed under short duration grazing approaches have been observed to be poorer than under continuous grazing where cattle have more freedom to forage adaptively and at low densities. Finally, several analyses have shown that the elevated costs of fencing and maintaining numerous paddocks in complex multi-paddock grazing systems reduces profits on a ranch, which is further magnified by the elevated costs of time, labour and vehicle use required for regular movement of cattle between numerous paddocks. We conclude that ranches should have fewer and larger paddocks to reduce management costs and promote adaptive foraging options for cattle. In higher rainfall regions especially, season-long grazing and resting is needed to prevent maturation of grassland in grazed paddocks while promoting rangeland recovery and development of a reserve of forage for the dry season in rested paddocks.

POSTER SESSION 6

Research Proposal Posters



SESSION CHAIR: JULIUS TJELELE

Tuesday 26 July 2022, 15:00 – 16:00

Posters can be viewed on twitter @ <https://twitter.com/GrasslandSocSA>

RESEARCH PROPOSAL POSTER: THE INFLUENCE OF SHORT DURATION, HIGH DENSITY GRAZING AND CONVENTIONAL, ROTATIONAL GRAZING ON THE NUTRITIVE VALUE OF THEMEDA TRIANDRA IN SEMI-ARID GRASSLANDS OF SOUTH AFRICA

Carlah Visser, Paul Malan, Jamie Poulse, Foch-Henri De Witt*

With the exponential rise in the human population, together with the increase in consumers preferring products from a sustainable resource, the demand for food is ever-increasing. Over the past few decades, numerous grazing systems have been developed to improve the healthy functioning of ecosystems, increase animal productivity, and thus enhance profitability. These include season-long, continuous grazing, conventional, rotational grazing systems (CRG) (e.g. traditional three-camp system) to more intensive grazing approaches such as short-duration, high-density grazing (SDG). The latter is a form of rotational grazing, that involves several camps being utilized by a single and relatively large herd for a short period of time. This management approach has been gaining interest over the past few years. One of the many claims of SDG is lengthening the active growth stage and thereby improving forage. *Themeda triandra* is a vital grass species in South Africa as it is widespread over the grassland and savanna biome. Ecologically and economically, this species is highly valued as it plays a significant role in livestock production and conservation. Due to the importance mentioned, the aim of the study is to determine the influences of these two grazing approaches on the nutritive value of *Themeda triandra* (which includes crude protein, neutral detergent fibre, acid detergent fibre, acid detergent lignin and organic matter). This will be done using a fence-line approach. Within the North West, Eastern Cape as well as Free State provinces, farm pairs consisting of a CRG and SDG farm will be selected. On each farm, three transects of 100 m in length will be laid out. During the wet and dry season, the harvest method will be used by placing



20 quadrants randomly on either side of the transect. Thereafter, the samples will be oven-dried to a constant weight, milled, and sent for chemical analyses. In addition to this, soluble sugars will be measured in the field using a handheld Brix refractometer. This is merely exploratory, to validate whether Brix refractometry is a suitable in-field method that can be used to determine plant nutritive value. This study will contribute to the better understanding of animal-plant quality relations, as well as the influence of different grazing approaches thereof in semi-arid grasslands of South Africa.

RESEARCH PROPOSAL POSTER: QUANTIFICATION OF GRAZING GRADIENTS OF DIFFERENT GRAZING SYSTEMS

Wanda Madikizela, Paul Malan, Jamie Paulse*

A grazing gradient usually occurs with distance from watering points, with extent of these gradients usually being a result of the type of grazing management system applied. The length of grazing periods per camp, as well as stocking density, influences these gradients the most. In recent years, high pressure grazing systems have become more prominent in practice amongst livestock farmers. High pressure grazing systems aim to reduce selective grazing by making use of high stocking densities, and short grazing periods, which are then followed by long recovery periods. The aims of this study are therefore to: (1) establish if two different types of high-pressure systems do have grazing gradients away from watering points, and (2) compare these results to a grazing gradient of an adjacent conventional grazing system. These aims will be investigated by answering the following research questions: (1) Do conventional and high-pressure grazing systems affect soil and vegetation dynamics differently at increasing distances away from watering points, (2) How does the grazing gradient (if any is found) differ between conventional and high-pressure grazing systems?, and (3) Does a radial layout high pressure grazing system and a rectangular high pressure grazing system affect soil and vegetation dynamics at increasing distances away from watering points? The study will be conducted on two adjacent farms in the savanna biome in the North- West Province of South Africa. Measurements will include botanical composition using the step-point method, herbaceous layer dry matter production using the harvest method and biomass estimates of canopy volume model (BECVOL) to measure woody layer dry matter production and tree density. In addition, physical, biological and chemical properties of the soil will be analyzed at two depth intervals (0-10 cm) and (10-20 cm). The results of this study might contribute to the current, larger debate around high pressure grazing systems, and the influences on soil and vegetation parameters, particularly around watering points.

RESEARCH PROPOSAL POSTER: THE COMPARATIVE EFFECTS OF SHORT DURATION, HIGH DENSITY GRAZING AND CONVENTIONAL, ROTATIONAL GRAZING ON DIFFERENT SOIL AND VEGETATION PARAMETERS IN THE DRY AND MESIC GRASSLANDS OF SOUTH AFRICA

Jamie Paulse, Paul Malan, Nico Smit*

The natural grasslands of South Africa are considered important in terms of extensive livestock farming. Various grazing management strategies exist in these grasslands, from continuous (season-long grazing) to different rotational system approaches (periodic deferments whereby vegetation is allowed to recover in the absence of grazing). Multi-camp rotational grazing (CRG) using 'conservative stocking rates' have been the conventional approach to livestock grazing management systems, however, over recent years, the regenerative grazing approach has been adopted by numerous livestock farmers on planted pastures and natural veld. Regenerative grazing, also known as short duration, high density grazing (SDG), incorporates the herd effect concept, whereby large herds (often double/triple the normal stocking density of an area) utilize small areas for a short period of time. The grazing period is preceded by a long recovery

period. This strategy claims to improve rangeland productivity by improving both vegetation and soil condition, and, in turn, enhancing animal productivity. However, scientifically sound information regarding these claims, as well as the influences of this strategy opposed to the conventional rotational systems is somewhat lacking. The aim of the study is to test the influences of both CRG and SDG on different soil (e.g. nutrient status and bulk density) and vegetation (e.g. composition, dry matter production, necromass and condition) parameters. The study will be conducted using a fence line contrast approach. Farms practicing CRG and a neighboring SDG farm will be selected within the Free State, Eastern Cape, Northern Cape and North-West Provinces. Three 100 m transects will be laid out on each farm, on which all soil and vegetation sampling and measurements will be conducted. Soil nutrient status will be determined by collecting composite soil samples at different soil depths, stored and sent for chemical analyses (pH, exchangeable Ca, Mg, K and Na, extractable P, Mn, Fe, Cu and ZN, and total C and N). Soil bulk density will be determined by gravimetric analysis by removing core soil samples using cylinder samplers, air-drying and determining soil volume and corresponding bulk density. Regarding vegetation parameters, species composition and dry matter production (including necromass) of the herbaceous layer of each site will be determined according to the nearest plant method and harvest method respectively. In addition, semi-structured interviews will be conducted with farmers to obtain information on animal performance and other additional information (e.g. land use/grazing history, farming method setup/grazing calendar, animal numbers, livestock farmed with, inputs (licks, supplementary feed), and outputs (sales, animal weights, etc.)). Incorporation of the social/human component is imperative, as it provides an overall understanding of each site's management. This project has the potential to produce scientific and objective information on the functionality of different grazing systems in the grasslands of South Africa. In addition, it can help livestock farmers understand the rationale behind SDG, and in which areas it may/may not be suitable.

RESEARCH PROPOSAL POSTER: UTILIZING CAMERA TRAPS TO SURVEY ELUSIVE UMBRELLA SPECIES UNDER CONDITIONS OF ECOLOGICAL DISTURBANCE

Ruan Higgs, Francois Deacon*

The change in land use from natural habitat to urban, industrial and agricultural use is the leading factor influencing natural wildlife populations and distribution patterns. Mining has a direct negative impact on local and surrounding ecosystems and habitats through removing, fragmenting and/or degrading habitats. As the actions of humans continually impact natural habitats, the need to regularly monitor population trends of vertebrate populations continually grows. The response of medium to large bodied mammals and specifically predators towards mining activities range from avoidance to selection, with omni- and carnivore preferences still relatively unknown. Using a species' requirements in order to guide the management of an ecosystem is known as the umbrella species concept. By evaluating the use of apex- and mesopredators as indicators of mammal biodiversity, we could perhaps be observing a positive correlation between these species and species biodiversity. The aim of the study is to determine the possible presence of specific Apex- and mesopredators species (Leopards (*Panthera pardus*), Brown hyena (*Parahyaena brunnea*), Honey badger (*Mellivora capensis*) and Black-footed cats (*Felis nigripes*)) through the use of camera traps. After which those species confirmed to be present are to be monitored in order to apply a multi-species umbrella approach to the ecosystem affected by mining activities. The study will take place on Kolomela mine (Kumba Iron Ore, Postmansburg, Northern Cape), over a period of 24 months, to account for seasonal changes throughout the year. The expected outcomes are publications, a master's thesis and collaborative efforts with nature conservation.

RESEARCH PROPOSAL POSTER: INTRODUCING RHIZOBIUM LEGUMINOSARUM BIOVAR VICIAE TO ENHANCE THE PRODUCTION POTENTIAL AND NUTRITIVE VALUE OF VETCH SPECIES

Mihle Sokupa, Khuliso Ravhuhali, Victor Mlambo*

Over the last two centuries, the expanding livestock industry has led to significant degradation of natural vegetation such that it has caused decreased terrestrial biodiversity and increased greenhouse gas emissions. Vetch is now a significant legume component of cereal cropping systems in low and medium rainfall zones. Seed inoculation benefits both the seed and the Rhizobium bacteria. It protects the nitrogen fixing bacteria needed, due to the fact that most seeds carry natural toxins against decay in the soil. The main objective of this study is to give a comparative evaluation of the effect of different levels (0 ml/50 kg seeds, 100 ml/50 kg seeds, 150 ml/50 kg seeds, 200 ml/50 kg seeds and 250 ml/50 kg seeds) of *Rhizobium leguminosarum biovar viciae* inoculant on production potential and nutritive value of Vetch species. The experiment will be conducted at the North-West University research farm. Limited research has been done on the effect of different inoculation levels of *Rhizobium leguminosarum biovar viciae* on agronomic characteristics and nutritive value of Vetch species in the semi-arid regions of South Africa. Seed germination test will be done before planting. Agronomic, morphological, nutritive value, fermentation characteristics and buffer nitrogen solubility of three *Vicia sativa* varieties (Common vetch, Volga vetch and Morava) will be measured when grown under semi-arid environment. Measurements which include germination, seedling emergence, seedling count, plant height, number of leaves, number of branches, stem length and chlorophyll will be collected at different growth stages (pre-flowering, full flowering and seed/pod stage). The nutritive value (Ash, Fat, ADF, ADL, NDF, CP, Ca, Mg, Na, P, K, Cu, Fe, Zn, Mn, Amino acids and Volatile fatty acids), fermentation characteristics (dry matter degradability, gas production and nitrogen degradability) and buffer nitrogen solubility will be evaluated at the three growth stages. Vetch is said to be a drought tolerant species. Therefore, considering the current changing climate conditions, Vetch can be used as a livestock bridging feed, especially during the dry season.

RESEARCH PROPOSAL POSTER: THE INFLUENCE OF SEED COATINGS ON PRODUCTION POTENTIAL AND FORAGE QUALITY OF MEDICAGO SATIVA CULTIVARS

Stephanie Koekemoer, Gjizelle Nel, Wayne Truter*

The recent advancement in seed coating technology suggests that it can significantly influence seedlings' successful emergence and establishment. *Medicago sativa* is a popular choice of pasture legume in South Africa, so the success of dense, uniform lucerne crops is crucial to ensure profitable forage production. This study aims to evaluate the influence of seed coating on the quality, yield, and regrowth rate of three different cultivars of lucerne at various harvesting intervals. The research will be conducted over a three year period at Innovation Africa University of Pretoria. The research will determine the quality, yield and regrowth rate of the coated vs uncoated seeds in a semi-controlled greenhouse environment. The study will also focus on the regrowth rate of the plants at a) fixed interval harvesting and b) harvesting according to the physiological stage of the plant in a randomized field plot trial. It is hypothesized that seed coatings will enhance the emergence of the seedlings, plant vigour, health, growth rate, crop yield and forage quality. The relative feed value (RFV) and relative forage quality (RFQ) will be calculated using Near-Infrared Spectroscopy (NIRS) and wet chemistry analyses to compare the forage quality of the lucerne plants emerging from coated and uncoated seeds. Should the hypothesis be proven true, the expansion of the use of coated *M. sativa* seeds by producers will inevitably be more economically beneficial.

RESEARCH PROPOSAL POSTER: INTRODUCING VETCH SPECIES VARIETIES IN SEMI-ARID AREA OF NORTH WEST PROVINCE, SOUTH AFRICA

*Ntokoza Happy Msiza**, *Khuliso Ravuhali*, *Kwena Mokoboki*, *Sydney Mavengahama*, *Manakedi Chelopo*

Vetch (*Vicia*) species are annual legumes that have distinguishable agronomic traits with multiple purposes that are particularly valued as forage. Vetch species are cultivated under a broad range of climatic conditions. These species are not only known for providing crude protein to livestock but can also improve soil properties which can in turn lead to an improved livestock efficiency. The rate at which plants develop depends on the suitability of the growth environment, which is composed of both abiotic and biotic factors. Environmental factors affect plant growth in isolation and or in combination. These factors also tend to modify one another's effects on plants and have an influence on quality and yield. Goats in semi-arid zones often graze low quality grass, which lowers the quality of their diet during the dry season, leading to poor animal performance. Grazing value, protein and minerals are some of the limiting elements in ruminant forage diets. Grasses can, to a certain degree supply a substantial amount of fibre. However, the need to introduce protein supplements is justified because it satisfies the nutritional needs of these goats. Compared to grass species, legumes have a high crude protein content throughout the growing period until maturity. Little research has been done on the use of vetch species varieties as a supplement to low quality hay in semi-arid areas. Integrated studies are needed to continue screening legumes and generate information that would be useful in identifying species or varieties that have a high adaptability and high feeding value in order to increase animal production. This study will determine the comparative characterisation of the agronomic, morphological, nutritive value, buffer nitrogen solubility, enzymatic *in vitro* digestibility and feeding value of three vetch legume varieties: Common vetch, Volga vetch (*Vicia sativa*) and Haymaker plus vetch (*Vicia villosa Roth*) when grown in a semi-arid environment. At different growth stages (pre-flowering, full flowering and seed stage) the different varieties will be analysed for seedling count, seedling emergence, plant height, number of leaves, number of branches, stem length, runner length and chlorophyll. The nutritive value, buffer nitrogen solubility and enzymatic *in vitro* digestibility will also be evaluated at the three growth stages. The effects of the vetch varieties supplementation on diet intake, digestibility, body weight gain, blood profiles and the productivity of Boer goats fed *ad libitum* grass hay will be analysed. As we gradually adapt to climate change and improving food security, the use of vetch legumes may be a potential solution to mitigate the fluctuating seasonal scarcity of nutritive forage including the overall reliance of imported commercial protein feed. Research trials and data collection are currently underway as per schedule.

RESEARCH PROPOSAL POSTER: FAECAL NEAR INFRA-RED SPECTROSCOPY—A NOVEL APPROACH TO DETERMINE THE HEALTH STATUS OF GIRAFFA CAMELOPARDALIS AND OTHER WILDLIFE SPECIES

*Andri Grobbelaar**, *Francois Deacon*, *Gernot Osthoff*

Giraffes (*Giraffa camelopardalis*) are classified as 'Vulnerable' on the International Union for the Conservation of Nature (IUCN) Red List. A concerning 40% decline in wild populations has been recorded during the past three decades. The development of alternative conservation actions is needed to limit the threat of extinction for this species. One of the most important factors is to evaluate the health status of free roaming giraffes. Most previous research on giraffe health, e.g., the occurrence of parasites, pathogens and diseases, have focused on *ex situ* giraffe populations (e.g., zoos), whilst little is known about giraffes in the wild. Those studies which have focused on the health of *in*

situ populations have mostly made use of invasive techniques (sometimes life-threatening captures), such as post-mortem examinations, sedation (e.g., for tick collection), blood smears and saliva collections in order to establish the occurrence of parasites and pathogens. To assist with the needed protection of giraffe populations, these approaches must be changed to include less lethal and less invasive techniques, to monitor the health of wild giraffe. The analysis of their faecal pellets by means of near infrared spectroscopy (NIRS) could provide one of the least invasive techniques to monitor the health status of giraffe during different seasons and especially during critical periods of lacking quality dietary requirements. An overview of the existing information for the use of faecal NIRS, its applications, advantages and disadvantages are presented. The potential of developing and calibrating this novel, non-invasive technique to assist with the monitoring of giraffe health, provides various exciting research opportunities for other wildlife species, as well.

RESEARCH PROPOSAL POSTER: LESPEDEZA CUNEATA A DROUGHT TOLERANT FORAGE LEGUME WITH POTENTIAL TO REHABILITATE DEGRADED SOILS AND ASSIST FARMERS TO GET THROUGH THE WINTER SLUMP: LESSONS FROM THE EASTERN CAPE, SOUTH AFRICA

Unathi Gulwa

Lespedeza cuneata (poor men's lucerne) is a perennial, summer legume originating from East Asia. It is a thick stemmed shrub-like plant that is abundantly leafy, growing upright to semi- upright. The legume has a strong taproot and can provide moderate quality forage. It grows up to more than one metre tall. Each leaf is composed of three long, narrow small leaves. Although responds well to fertilization, it can also persist in acidic and infertile soils, as it has exceptional tolerance for low soil fertility and the ability to establish in nutrient poor soils. *L. cuneata* is a versatile forage legume that is used for grazing, hay, soil conservation and covering road banks for erosion prevention. In the Eastern Cape the legume was mixed with other forage legumes in old arable lands located in various agro-ecological zones of the to rehabilitate these lands and bridge fodder deficit during dry season. Since establishment during the year 2007, this legume is still persistent and provides moderate quality forage during dry season. This study seeks to highlight success in some of the sites where the legume is still surviving since establishment as well as methods of establishment, management and utilisation, which can be used by farmers to sustain their livestock production.

RESEARCH PROPOSAL POSTER: CARBON AND WATER FOOTPRINT OF EXTENSIVE BEEF CATTLE PRODUCTION AND WATER USE EFFICIENCY OF SEMI-ARID RANGELAND

Marsia Grobler, Michiel Scholtz, Hosia Pule, Michael Kidson, Francoois Müller, Ngoako Letsoalo, Ashira Roopnarain, Garry Paterson*

According to the Water Footprint Network, 98% of the total volume of water being used to calculate the water footprint of animals globally, refers to the water footprint of the feed. In an extensive beef production system, this relates to the water use efficiency (WUE) of the vegetation within the rangeland. In South Africa, approximately 103 million hectares are available for farming. Approximately 70-80% of this land, accounting for more than 82 million ha, is only suitable for extensive livestock production from natural rangelands. The dynamic equilibrium between the grazing animals, plants being grazed, and the soil characteristics, makes it important to calculate the WUE and carbon balance of the rangeland together with the carbon equivalent and water footprint of the grazing cattle. The largest source of greenhouse gases in ruminants originates from methane produced in the gastrointestinal tract, accounting for 16% of

global methane emissions. When actual enteric methane production is measured directly from cattle grazing on rangeland, methane emissions from these animals can then be associated with the WUE, carbon balance, and rangeland condition over different seasons and years. This information will shed light on the soil-plant-animal interaction relating to the carbon and water balance of the system. The results can then be benchmarked against other farming systems, locally and internationally, to assist producers and consumers to make informed choices regarding the sustainability of beef production. This baseline information is also needed for accurate modelling and the development of successful mitigation strategies. The proposed study will be conducted at the Roodeplaats experimental farm (REF) of the ARC-Animal Production (25°34'11.27"S; 28°22'05.36"E) using a 40 ha of rangeland described as Marikana Thornveld veld type. Multiparous Bonsmara cows will be utilized to graze the allocated rangeland in a traditional rotational grazing system. The objectives of the study will be: i) to measure the WUE of rangeland by making use of strategically placed soil water probes to include different soil variants and grass species community composition; ii) to measure enteric methane production from individual animals with a Laser Methane Detector and compare methane production from beef cattle grazing rangeland over different seasons relating to differences in rangeland condition; iii) to calculate a carbon footprint for the system by reworking enteric methane production from animals to carbon equivalents and add this to the carbon footprint of the grazed rangeland; iv) to calculate a water footprint for an extensive beef production system by taking into account both the blue water (water consumed by animals) and green water (calculated from WUE of the rangeland) component.



**POLICY & PRACTICE
WORKSHOP**

**APPLYING SPATIAL PLANNING WITHIN THE
NATURAL AGRICULTURAL RESOURCES
LEGISLATIVE DOMAIN**

SESSION CHAIR: YVETTE BRITS

Friday 29 July 2022, 08:15 – 12:00

**PLATFORM PRESENTATIONS: THE RATIONALE BEHIND THE REGULATION OF THE DEVELOPMENT OF FARM
MANAGEMENT PLANS**

Paul Avenant

Government intends to promulgate a new Regulation under the Conservation of Agricultural Resources Act, 43 of 1983 (CARA) that will provide for the mandatory implementation of farm management plans. Such plans will guide the effective utilization and conservation of the natural agricultural resources on a farm and must contain a list of conservation works as well as supporting maps. Provincial government departments responsible for agriculture will be tasked for the development, maintenance and archiving of such plans. During the first phase of implementation, this proposed Regulation will be applicable to all land under any government-funded program, farms who were issued directives under CARA and farms who applied for cultivation of virgin land. Eventually the Regulation will be rolled out to all land currently used or intended to be used for agricultural production purposes. The data collected from the farm management plans will act as building blocks at the lowest level of spatial planning in agriculture. Natural resource and land use information obtained from the farm management plans will assist in the demarcation of agro-ecosystems and

will provide a foundation for larger scale planning within the natural agricultural resource legislative domain. Through the implementation of the farm management plan Regulations the emphasis is placed on addressing conservation agriculture principles that will benefit the greater eco-system services in the landscape. The Sustainable Landscape Management Calculator that was developed by the UNP is one of the tools that is available to survey and calculate the degradation and conservation indices at a landscape level, with a strong emphasis on the interaction of people, their livelihoods and the environment.

PLATFORM PRESENTATION: THE AGRO-ECOSYSTEM AS FOUNDATION FOR THE NATURAL AGRICULTURAL RESOURCES LEGISLATIVE DOMAIN

Anneliza Collett

The management of natural resources and the use thereof are complex. All components of a landscape are interlinked and the functionality thereof is inter- and intra- dependent for it to be effective and to function optimally. Should one component not be able to function, it can result in the entire landscape not being able to deliver the required ecosystem services. The natural resources of the country are being used for various purposes, one being for the production of food, another for environmental / biodiversity conservation or for economic development. In finding a balance between the mentioned, it is essential that an approach be followed and abide to that will address not only possible conflicting requirements but also to mitigate the various pressures exerted on the resource in order to ensure the most suited and optimal use of the resource. The importance of informed spatial planning cannot be emphasized enough in achieving this objective. Such planning however needs to be supported by relevant legislation and policies to ensure compliance. The introduction of the concept of agro-ecosystem management has been identified as the foundation for agricultural planning. Agricultural production has resulted in converting natural plant communities to artificial crop communities through human manipulation with a subsequent alteration of the ecosystem. Many of the natural plant communities' self-regulatory functions have been modified or lost, mostly as a result of monoculture related production. Agro-ecosystem planning aims to replicate the natural ecological processes, enhance nutrient cycling, increased organic matter as well as veld and soil biodiversity and conservation. Within the legislative environment the first reference thereto can be found in the draft Preservation and Development of Agricultural Land Bill (PDALB) where it is defined as "a spatially and functionally coherent unit of agricultural activity that can be defined on varying spatial scales, and includes the interactions between the living and non-living components of the unit as contained within larger landscapes". However agro-ecosystems is an overarching concept that has the ability to guide natural resources planning and management on an informed basis, much broader than PDALB. It also affects the conservation objective as described under the Conservation of Agricultural Resources Act, 43 of 1983. The aim of this paper is to present the introduction of agro-ecosystem planning within the current relevant legislative environment and to deliberate on the impact and monitoring thereof on long-term sustainable resource management.

PLATFORM PRESENTATION: A UNIQUE MONITORING TOOL TO MEASURE PROGRESS AND INFORM DECISION MAKING ON SUSTAINABLE LAND MANAGEMENT (SLM): THE SLM PROGRESS CALCULATOR

Over the last five years, the Global Environmental Facility (GEF) funded the "Securing multiple ecosystems benefit through Sustainable Land Management (SLM) in the productive but degraded landscapes of South Africa (UNDP GEF 5 SLM) Project". The United Nations Development Programme managed the project on behalf of the Department of Forestry, Fisheries and Environment (DFFE) and developed a unique monitoring tool to measure progress and impact of projects working to improve the state of natural resources with sustainable development outcomes. The tool, called the SLM Progress Calculator was developed from a desire to demonstrate progress toward achieving SLM and perceived impact through project related activities at landscape level. The tool incorporates all aspects of sustainability, where monitoring and assessment are done in a participatory way to achieve joint-learning across knowledge systems and inform collective decisions. The SLM Progress Calculator was specifically designed for the GEF 5 SLM Project and has been piloted across the four project landscapes. The SLM PC has 10 unique assessment variables across three categories, including 1) land degradation, 2) SLM and 3) aspects of the enabling environment for SLM adoption. Each variable is assessed on a simple five-point Likert scale. The SLM PC assessment is performed at defined monitoring intervals through a participatory assessment workshop, involving project staff, stakeholders and beneficiaries. The emphasis during these workshops is participation, open discussion and consensus that draws on existing monitoring and evaluation data and information and the narrative of stakeholders perceptions and experiences. The workshop results are plotted on a graph and an SLM Progress Calculator gauge. The evidence and narratives (stories), together with the assessment results, provide the basis for reflection on progress and impact about management, rehabilitation and development targets and objectives. This critical reflection on progress or the lack thereof, forms then the basis for joint-learning and re-planning which can be shared within project structures and with similar projects in other landscapes. This presentation will briefly explain the philosophy behind the SLM Progress Calculator, demonstrate its use and applicability with case studies from the UNDP GEF 5 SLM Project where systemic progress has been made toward achieving Sustainable Land Management and indicate the tools for further development through a partnership with WOCAT.