

Arid Zone Ecology Forum

16 - 18 October 2018

Callie de Wet Sports Centre

Robertson, Western Cape



Plant Conservation Unit



Funded by
National Research Foundation, SAEON & Plant Conservation Unit, University of Cape Town.

Arid Zone Ecology Forum 2018

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FUNDING AND SUPPORT



Plant Conservation Unit



ACKNOWLEDGEMENTS

AZEF would like to acknowledge the following people and organizations for their support:

- SAEON Arid Lands Node for their sponsorship.
- Plant Conservation Unit, University of Cape Town for their sponsorship.
- Endemic Vision for their sponsorship.
- Painted Wolf Wines for the gift boxes presented to invited speakers, and for subsidising the wine served at conference dinners.



Committee: 2017/2018

AZEF: Ismail Ebrahim – SANBI (Chair)
 Simon Todd – SAEON (Vice Chair)
 Samantha Venter – PCU, UCT (Treasurer)
 Megan Simons – ARC & UWC
 Marco Pauw – SAEON
 Stephanie Borchardt – University of Stellenbosch
 Gina Arena – SAEON

Secretariat: Gill Murray

MONDAY, 15 OCTOBER 2018

Meet & Greet – 17:00 to 19h00

FINGER SNACKS & EARLY REGISTRATION

Graham Beck Skills Centre, R60 Riverside/Goree Road

TUESDAY, 16 OCTOBER 2018

Callie de Wet Sports Centre, 8 Kerk Street, Robertson

08:00	Late Registration	
08:30	Ismail Ebrahim - AZEF Chair	Welcome

Opening Address (Chair: Ismail Ebrahim)

08:40	A/Prof. Adam West	Opening Address
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Session 1 - Karoo Special Issue (Chair: Simon Todd)

09:10	Henschel JR, Hoffman MT & Walker C	Introduction to the Karoo Special Issue: Trajectories of change in the Anthropocene
09:30	Walker C	Reflections on the drivers & trajectories of social & ecological change in the Karoo, South Africa
09:50	Hoffman MT, Skowno A, Bell W & Mashele S	Long-term changes in land use, land cover & vegetation in the Karoo drylands of South Africa: Implications for degradation monitoring
10:10	du Toit JCO, Ramaswiela T, Pauw M & O'Connor T	Interactions of grazing & rainfall on vegetation at Grootfontein in the eastern Karoo

10:30 - 10:50 **Tea**

Session 2 - Karoo Special Issue Continued (Chair: Timm Hoffman)

10:50	Schmiedel U & Oldeland J	Vegetation responses to seasonal weather conditions but not to release of grazing pressure - results from 16 years of plot-based monitoring in the arid Succulent Karoo
11:10	van Rooyen MW, le Roux A, <u>van der Merwe H*</u> , van Rooyen N & Geldenhuys C	Long-term vegetation change (>20 years) in the plains habitat on Goegap Nature Reserve, Succulent Karoo, South Africa

11:30 - 13:00 **Discussion Session on Karoo Special Issue (Leader: Joh Henschel)**

13:00 - 14:00 **Lunch**

14:00 - 15:30 **Annual General Meeting**

15:30 - 15:50

Tea

Session 3 - Land Degradation & Drivers of Change in the Arid Zone (Chair: Cheryl Walker)

15:50		Saayman N, Botha JC & Swart R	The impact of grazing animals in the Nama Karoo, South Africa: Plants vs Soil
16:10	♀	Hebbelmann L & O'Connor T	Fire as a driver of vegetation change in the Eastern Upper Karoo
16:30	♀	Bell WD & Hoffman MT	Mapping land degradation in Namaqualand

16:50 - 17:50

Session 4 - Poster Session

18:00 - DINNER & QUIZ NIGHT - Four Cousins Restaurant, 3 Kromhout Street, Robertson

WEDNESDAY, 17 OCTOBER 2018

08:00

Late Registration

Session 5 - Animal Ecology (Chair: Lisa Hebbelmann)

08:30		Prof. Allan Ellis - Keynote Address	Bee-flies, and not bees, are the keystone pollinators of spring mass flowering displays in southern African deserts
09:00	♀	Adekola OE & Agbelusi EA	Avian pests of cereal crops in rainforest & savanna agro-ecological zones, Ondo State, Nigeria
09:20		Joseph GS, <u>Seymour CL*</u> , Coetzee BWT, Ndlovu M, Foord S, De La Torre A, Suttle R, Hicks N, Oxley S, Deng L, Fowler K, Hagan J, Brooks BJ & Seminara JA	Elephants, termite mound vegetation & mound thermoregulation in a progressively warmer world
09:40		Todd, S.W*. Bragg, C.J. and Brassine, A.	What Can Camera Trapping Surveys Tell Us About Faunal Community Structure and Diversity in Southwestern South Africa?

Session 6 - Karoo Biogaps Project (Chair: Gina Arena)

10:00		Ebrahim I	Karoo Biogaps: Update on the Karoo Biogaps project. Results from the Flora group
10:20	♀	Simba LD, Pryke J & Seymour CL	Dung beetles in farms used for pastures bury dung faster than dung beetles in protected areas in the Nama & Succulent Karoo
10:40	♀	Mitchell S, Sole CL, Lyle R & Engelbrecht IA	The genetic structure & phylogeography of cork-lid trapdoor spiders, <i>Stasimopus</i> Simon, 1892 (Araneae, Mygalomorphae, Ctenizidae) in the Karoo

11:00	Ⓡ	Tshililo P & Bazelet CS	Investigating the relationship between different individuals of <i>Euryphymus</i> genus collected in the southern Karoo, South Africa
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11:20 - 11:40 **Tea**

Session 7 - Aliens & Poisonous Plants in the Veld (Chair: Samantha Venter)

11:40		Prof. John Wilson - Keynote Address	The status of biological invasions & their management in the arid zones of South Africa
12:10		Kemp ME	Reconstructing the past: A first attempt at using dendrochronology & alien invasive trees
12:30		Moshobane MC, Marks, CJ, Stephen CR & Mothapo PN	A retrospective investigation of the impacts of alien plant taxa on human health using Poison Information Centre call data
12:50		Cupido CF, Muller FM, Samuels MI & Engelbrecht WL	Death traps in the Succulent Karoo: investigating plant & landscape associations within poisonous plant patches in communal rangelands

Session 8 - Land Protection (Chair: Stephanie Borchardt)

13:10		Basson M	Challenges of proclaiming a protected environment for in the Robertson Karoo
13:30		Purnell KJ, Norval M & Dreyer B	Wilderness Foundation Africa: Northern Cape Land Project
13:50		Schumann, B.D*., Todd, S. W. and Haarmse, C.	Evaluating riparian restoration in the Nama Karoo

14:10 - 17:00 **Field Trips - Profiles by fieldtrip leaders & collection of packed lunches:**

18:00 - DINNER - Saggy Stone, Amandalia Farm, Agtervinkrivier, Robertson

THURSDAY, 18 OCTOBER 2018

08:00 **Late Registration**

Session 9 - Drought & Rangeland Ecology in Namaqualand (Chair: Justin du Toit)

08:30		Prof. Beatrice Conradie - Keynote Address	Human dimensions of drought in the Karoo, 2012 - 2015
09:00	Ⓡ	Donkor FK & Mearns K	Desperate times, desperate measures: A case study on the adoption of climate mitigation strategies amongst generalist & specialist smallholders
09:20		Samuels MI, Cupido CF, Masubelele ML, Swarts MBV, van Orsdol K & Lynes LS	Socio-economic vulnerability to climate change of a small farming community in the arid zone of South Africa
09:40	Ⓡ	Schroeder A, Samuels MI, Swarts M & Morris C	Diet selection & forage tendencies of three livestock groups during drought conditions in a semi-arid to arid communal rangeland in South Africa

10:00 - 10:20 **Tea**

Session 10 - Drought & Development in Namaqualand Continued (Chair: Wesley Bell)

10:20		Petersen H, van der Merwe H, Milton-Dean SJ, Dean WRJ & Henschel JR	The effect of drought on canopy mortality in Succulent Karoo plant communities
10:40		Genis AJ	Trying & drying: The way ahead for farmers in Namaqualand
11:00	♀	Borchardt SP	What's Watt in De Aar? An exploration of local energy needs & challenges in a renewable-energy hub in the Karoo region of South Africa

11:20 - 13:00 **Discussion Session on Drought & Climate Change in the Arid Zone**

13:00 - 14:00 **Lunch**

Session 11 - Long-Term Ecological Monitoring (Chair: Helga van der Merwe)

14:00		Scott SL, Navarro RA & Hoffman MT	Citizen scientists & the photographic documentation of long-term environmental change in southern Africa
14:20	♀	Arena G, van der Merwe H, Hoffman MTH & O'Connor T	Elucidating long-term vegetation change in the eastern Nama-Karoo–Grasslands ecotone
14:40		Moyo MS & Scholes RJ	The Phenology of the Enkangala Grasslands

15:00 - 15:30 **Tea**

Session 12 - The Succulent Karoo Ecosystem Programme (SKEP)

15:30		Davids S & Ebrahim I	SKEP saam & future of SKEP
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16:00 - 16:30 **Discussion Session on SKEP**

**17:00 - GALA DINNER - Spaces Restaurant, 2D Voortrekker Ave, Robertson
PRIZE GIVING – STUDENT PAPERS & POSTERS
AUCTION OF ANTIE BABES!**

Key to symbols used in programme:

* Speaker

♀ Student presentation

PAPER ABSTRACTS:

Introduction to the Karoo Special Issue: Trajectories of change in the Anthropocene

Keywords: Social-Ecological Research, Drivers of Change, African Journal of Range and Forage Science

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The Anthropocene – the current age in which humans are driving planetary changes by transforming the Earth’s environmental and social systems – requires broad, holistic accounts which embrace its complexity and inform intelligent stewardship. The role of socio-economic processes in benefiting, or otherwise, local biodiversity and key ecosystem processes prompts transdisciplinary research, embracing natural and social sciences, ultimately to further policies that promote the wellbeing of people and nature. This Karoo Special Issue (KSI) of the African Journal of Range and Forage Science, for which we are celebrating the publication date today, brings together bodies of work in both natural and social sciences, blending disciplinary, multi-, inter-, and trans-disciplinary social and ecological approaches to enhance understanding of drivers of change and map out their possible trajectories. This introduction provides context to the KSI. We briefly define what we mean by the Karoo in the KSI and some of the kinds of changes taking place, or that could potentially take place. The KSI celebrates the contributions of knowledge, inspiration and leadership to a generation of scientists through the works of Drs Suzanne J Milton and W Richard J Dean. Citations of their work are laced through much of the KSI, and it also features work of these two outstanding Karoo scientists and of their erstwhile protégés. The KSI starts with an overarching lead article, followed by six sections concerning: Climate in the Anthropocene, Gharo across History, Long-term Trends and Processes, Dynamics of Current Developments, Farming Impacts, Ecosystem Processes and Rehabilitation, and ends with a Synthesis and Gap Analysis. We weave together different perspectives of change as

described in the KSI articles as well as various suggestions concerning future research made by authors of the KSI.

Reflections on the drivers and trajectories of social and ecological change in the Karoo, South Africa

Key words: Karoo, social--ecological systems, change, inter--disciplinary research

Cherryl Walker, Stellenbosch University

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This presentation provides an overview of the lead article written by an inter-disciplinary team of authors (Walker, Milton, O'Connor, Maguire, Dean) for the Karoo Special Issue of the *African Journal of Range and Forage Science*. It explores broad past, present and possible future drivers of change in Karoo social--ecological systems. Biogeographically the Karoo comprises the arid Succulent and Nama Karoo biomes covering significant portions of the Northern, Eastern and Western Cape provinces and a smaller part of the Free State. Despite the Karoo's specific environment and spatial importance nationally (covering some 30% of South Africa), no government structures address its needs holistically. Today it is a politically and economically marginalised region;; perceptions of it as a desert easily morph into perceptions of it as deserted and ripe for exploitation for the benefit of external constituencies, whether in the name of astronomy, shale--gas and uranium mining or renewable energy. To manage the Karoo better for present and future generations it is clearly desirable for social and natural scientists to work collaboratively, yet there is relatively little inter-disciplinary work to date. Against this background the review article presented here provides an overview of the drivers of social and ecological change historically and in the present, and offers some cautious reflections concerning climate change, changing land use and governance as key drivers affecting trajectories of change into the future.

Long-term changes in land use, land cover and vegetation in the Karoo drylands of South Africa: Implications for degradation monitoring

Keywords: desertification, land cover change, NDVI, remote sensing, repeat photography

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We used several large data sets at a range of temporal and spatial scales to document the land use land cover change (LULCC) dynamics of the semi-arid Succulent Karoo and Nama-Karoo biomes of South Africa. The national land cover data base indicates that more than 95% of the Karoo is comprised of land classified as Natural which has been relatively stable since 1990. The agricultural census record shows that over the last 100 years cultivation, as well as the number of domestic livestock, has declined significantly in both biomes. The South African Protected Areas Database shows that protected areas have increased since 1980 to comprise nearly 8% of the Succulent Karoo biome although they only cover 1.6% of the Nama-Karoo biome. There has been a significant recent increase in renewable energy installation applications. Those which are either approved or in review which cover 4% of the Karoo drylands. An analysis of satellite imagery shows that the trend in vegetation productivity (NDVI) (1982-2015) is unchanged over 90% of both biomes while nearly 10% of the Karoo has shown a significant increase in NDVI trend. A synthesis of 280 repeat photographs shows that vegetation cover has either remained unchanged or has increased at most locations. Although the Karoo drylands appear less degraded than they were in the mid-20th century, on-going monitoring at different temporal and spatial scales is essential to evaluate the future impact of LULCC on these semi-arid environments.

Interactions of grazing and rainfall on vegetation at Grootfontein in the eastern Karoo

Key words: Long term grazing trials

Justin CO du Toit, Tshililo Ramaswiela, Marco Pauw, Timothy G O'Connor

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Rainfall and grazing are primary drivers of vegetation composition in the Nama-Karoo. Increased rainfall increases grassiness, to where Nama-Karoo transitions to grassland. Severe grazing

treatments (e.g. continuous or summer-only) increase abundance of grazing-tolerant dwarf shrubs and annual grasses, and decrease perennial grasses. Grootfontein, ecotonal between Nama-Karoo and Grassland Biomes, houses long-term grazing trials. The area has experienced higher than average rainfall in recent decades. Plant basal cover data from the 1960s and 2010s allow several hypotheses to be addressed 1) Historical severe grazing (until 1985) will limit subsequent grassiness (grazing legacy effect); 2) Severe grazing will preclude increases in grassiness, independent of rainfall (herbivore trap effect); and 3) Historically leniently-grazed sites will transition to grassland with increased rainfall (biome shift effect). Rainfall was lower from 1957-1966 (350 mm) than from 2003-2012 (490 mm). The grazing legacy effect was supported based on the abundance of *Aristida diffusa*, despite all sites becoming much grassier. The herbivore trap effect was not supported. The biome shift effect was supported in that shifts to grassland sometimes occurred. Results suggest that increasing rainfall has prompted a shift to much increased grassiness and decreased abundance of dwarf shrubs, and that grazing had a smaller secondary effect.

Session 2 - Karoo Special Issue Continued

Vegetation responses to seasonal weather conditions but not to release of grazing pressure – results from 16 years of plot-based monitoring in the arid Succulent Karoo

Key words: Standardised Precipitation-Evapotranspiration Index (SPEI), rainfall, vegetation dynamic

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The Succulent Karoo biome is a renowned centre of biodiversity and endemism in the arid winter rainfall region of South Africa, which is threatened by climate change. We studied the vegetation dynamic at the young commonage of Soebatsfontein, which experienced a strong decrease of grazing pressure around the year 2000 when the land was converted from a commercial farm to the Soebatsfontein commonage. On 20 permanently marked plots within a biodiversity observatory, species inventory and cover per species was annually assessed from 2002 to 2017 towards the end of

the growing season (August / September). We were interested a) whether the vegetation showed any trends in response to the strong decrease of grazing pressure, which occurred at the beginning of the monitoring period, and b) what the effect of seasonal climate on the vegetation would be. We analysed the responses of cover and species richness per of life-form group to time (year) and the seasonal rainfall and the seasonal Standardised Precipitation-Evapotranspiration Index (SPEI) using Linear Mixed effect Models. We also tested whether upland or lowland habitat had any effect.

Time had a positive effect on richness of annual species and a negative effect of cover of shrubs and annuals. Cover of shrubs and annuals increased in response to SPEI and (less strongly) to rainfall during autumn and winter. Habitat did not have any effect and geophytes and perennial herbs did not show any response. The importance of SPEI during autumn and winter is discussed in relation to the plants' germination ecology and the projected decrease of rainfall and increase of temperature during these seasons.

Long-term vegetation change (>20 years) in the plains habitat on Goegap Nature Reserve, Succulent Karoo, South Africa

Key words: diversity, rainfall, wildlife

Margaretha W. van Rooyen^{1,2}, Annelise le Roux^{3,*}, [Helga van der Merwe](#)^{2,*}, Noel van Rooyen² & Conrad Geldenhuys⁴

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*At the time when the surveys were conducted A. le Roux was employed by Cape Nature Conservation and H. van der Merwe by the then Northern Cape Nature Conservation Service.

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Long-term data are essential to gain an understanding of how vegetation responds to short-term, inter-annual variation in rainfall, long-term cyclic rainfall patterns, and grazing pressure in arid ecosystems. Over a period of more than 20 years five transects on the plains of Goegap Nature Reserve (Northern Cape) were surveyed annually using the point intercept method. Vegetation change was assessed in terms of vegetation cover, species composition and abundance, growth form composition, range condition and plant diversity. Vegetation cover and plant diversity parameters were analysed separately for the perennial and annual component. Nonmetric Multidimensional Scaling was used to illustrate the trajectories in floristic data and to determine the strength of the correlations with rainfall and grazing variables.

Generally canopy cover of the perennial component showed a downward trend as did range condition. Palatable perennial grass species decreased while unpalatable and less palatable perennial shrub species increased. Perennial species richness showed no increase while in some instances species diversity decreased. Canopy cover of the annual component showed large interannual variation and was significantly related to winter rainfall. The lack of trends in diversity parameters of the annual component could possibly be ascribed to the significant positive relationship between rainfall and diversity at several of the sites. The strong relationship with rainfall, is expected to mask the relationship, if any, with stocking density.

The effects of the high grazing pressure on the plains were apparent in the overall decrease in total plant cover and cover of grazing sensitive species. Diversity parameters, of especially the annual component, were strongly related to rainfall. A directional change, which supports the equilibrium concept, was evident from changes in perennial species composition over time. However, the annual component showed no directional change, but displayed event-driven, non-equilibrium dynamics by fluctuating in reaction to the timing and quantity of rainfall.

Session 3 – Poster Session

Poster abstracts follow paper abstracts in this programme.

Session 4 - Land Degradation & Drivers of Change in the Arid Zone

The impact of grazing animals in the Nama Karoo, South Africa: Plants vs Soil

Key words: plant cover, soil nutrients, trampling

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Soil is the foundation of basic ecosystem functioning as it serves as a growth medium for plants and supplies it with nutrients, water etc and serves as carbon storage and as a habitat for insects and other organisms. The soil should be healthy to be able to provide sufficient water and nutrients for optimum plant growth to ensure good animal production. The question arises: What are the impact of grazing animals on the soil nutrients and how does it compare with their impact on the vegetation?

A once-off study was done on 36 farms in the Gamka Karoo vegetation type of the Western Cape Province. Vegetation surveys to measure plant density, species composition and plant cover were done along a grazing gradient starting at 50 m from a watering point up to 950 m away from the watering point. Soil samples of the top soil were collected at five different distances from the watering point and analysed to determine physical and chemical properties of the soil along the grazing gradient.

The soil macro-nutrients, % C and pH decreased significantly ($p < 0.05$) with increasing distance from the watering point as animal activity declined. The higher soil nutrients and animal activity had a negative impact on the perennial plants' density, cover and species richness that all increased with distance from the watering point. Opslag was positively correlated with the soil nutrients and grazing intensity as the resulting lower plant cover and less competition from perennial plants favoured opslag. Na, P and K, added through dung, urine and feed supplements, are essential for plant growth, but there is a fine balance between optimum concentrations for plant and soil health and too much trampling and excretions of animals. Good management practices are necessary to ensure sustainable utilisation without degradation of soil and plant health.

Fire as a driver of vegetation change in the Eastern Upper Karoo

Key words: Karoo dwarf shrubs, Fire, Populations

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Fires are uncommon in the Nama Karoo but increased grassiness during years of high rainfall increases the probability of this sudden large disturbance event that has the ability to transform Nama-Karoo vegetation.

This study evaluates how fire affects Karoo dwarf shrub species richness, composition and community structure at nine fire sites that burnt between 2010 and 2017 in the Eastern Upper Karoo. We investigate the different roles and responses of fire-tolerant resprouting species versus fire-intolerant seeder species to fire in these communities.

A compositional change was observed after burning at all sites. Grazing pressure after a burn is an important determinant of post-fire community composition. Growth form, shrub height and canopy spread are affected by fire. Karoo dwarf shrubs were shorter and possessed a smaller canopy spread in burnt than in neighbouring unburnt areas at all sites. Burning is therefore likely to impair soil moisture retention and livestock carrying capacity. Regrowth of resprouter species began weeks after burning and some resprouter species were able to regrow and reproduce within months of burning. Seeder species were lost after fire and only measured at one site eight years after burning, their colonisation appeared to be dependent on proximity to the adult unburnt population and not on a seedbank.

Findings show that fire in the Eastern Upper Karoo is acting as a distinct disturbance that has long term effects on Karoo shrub diversity and species populations. Fire has acted as a driver of vegetation state changes at all sites examined in this study.

Mapping land degradation in Namaqualand

Key words: land degradation; remote sensing; fuzzy

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Comprised of over 50,000 km² Namaqualand is a semi-arid region with a long history of human settlement and use. Evidence of hunter-gatherer presence dates back millennia while semi-nomadic pastoralists first entered the region about 2,000 years ago. With the expansion of settler agriculture in

the 19th century, pastoralists were dispossessed of their land and settled in relatively small communally-managed areas. For nearly 200 years much of the rest of the region has been used for extensive livestock farming and mining. Namaqualand is also world famous for its rich succulent plant diversity and because of this has seen an expansion of the protected area network in recent decades. However, the selection of areas for conservation is dependent, in part, on the condition of the land. Areas that are heavily degraded or have lost their biodiversity as a result of either land use or climate related factors are less highly valued as conservation areas. Even though several global and national institutions require information on the extent of land degradation it is a contested concept with a long history of debate in the literature. The aim of this project is to develop a method to assess land degradation in Namaqualand that can then be adapted to similar semi-arid environments elsewhere. An approach called 'archetype mapping' will be used to produce an adaptable conceptual framework for land degradation mapping in Namaqualand. This approach identifies different archetypes, or conceptualisations of categories or classes, within a vegetation type which best typify the range of conditions possible for that vegetation type. These condition classes are then used in combination with satellite imagery to map the extent of degradation across large areas. Progress with the project as well as preliminary results and images thus far developed will be presented.

Bee-flies, and not bees, are the keystone pollinators of spring mass flowering displays in southern African deserts.

Key words: Pollination biology, Namaqualand flower display, Keystone species

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Bees are usually considered to be the most important pollinators of desert floras. Here I challenge this notion, showing that the spring mass-flowering daisy displays that characterise the southern African deserts are largely reliant on pollination by flies, particularly small bee-flies (Mariobezziinae, Bombyliidae), and that floral diversity in these systems is shaped by selection imposed by these fly pollinators. As many plant species in these displays are self-incompatible annuals, pollination by flies is critical to their persistence in the system. I use pollination network approaches to highlight the diversity of fly pollinators involved and the plants that rely on them, often exclusively, and experimental approaches to demonstrate how selection by fly pollinators has shaped the floral diversity that makes the Namaqualand flower displays so special. I then focus on the little we do know about the evolution of the fly pollinators themselves, showing that their evolutionary history is broadly congruent with the spectacular diversification of the Succulent Karoo flora. More research effort is urgently required to understand the requirements of these underappreciated, and yet critical, keystone pollinators on which the ecological and evolutionary integrity of the economically important mass flowering displays of Namaqualand depends.

Avian pests of cereal crops in rainforest and savanna agro-ecological zones, Ondo State, Nigeria

Key words: Avian Pest, Integrated Pest Management, Agro-ecological zones

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The impacts of wildlife, especially birds, on agriculture cannot be underestimated, resulting into human-wildlife conflicts. This study examined avian pests of rice and maize in two agro-ecological zones of Ondo State, Nigeria. Information gathered from informal interviews and questionnaires administered to FADAMA farmers in local communities, together with direct observations made over exploratory transects, were used to survey avian pests. A total of 27 avian pest species belonging to nine families and three orders were recorded as avian pests of rice and maize in the two agro-ecological zones in Ondo State. In the Savanna agro-ecological zone, a total of 18 avian pest species, eight families and three orders were recorded whereas in the Rainforest agro-ecological zone, a total of 21 avian pest species, eight families and two orders were recorded. The study revealed that there is no significant difference between the frequencies of avian pest occurrence of rice and maize in the two agro-ecological zones. Crops were mostly affected during the germination and harvesting growing cycles which poses serious problem on the harvest quality and yield abundance of the crops. Bird damage usually occurs when birds remove grains from panicles or remove seeds from the soil after planting. Farmers revealed that bird damage is a serious problem which usually lead to reduction in yield, harvest quality and interest in production respectively. Human bird scarers and scare crows were reported as the most effective control measures against birds' infestation and damage. The survival of birds in agrarian areas requires the attention of farmers, crop scientists and ornithologists in order to synergize efforts towards Integrated Pest Management (IPM). This approach will not only help farmers but also conservationists.

Elephants, termite mound vegetation and mound thermoregulation in a progressively warmer world

Key words: ecosystem engineers, heat waves, herbivory

Grant S. Joseph, Colleen L. Seymour*, Bernard W.T. Coetzee, Mduduzi Ndlovu, Stefan Foord, Alejandro De La Torre, Ryan Suttle, Nia Hicks, Sarah Oxley, Luana Deng, Kelly Fowler, James Hagan, Brian J. Brooks, Jackson A. Seminara

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The years 2016, 2015 and 2017 were the world's three hottest on record. Vegetation becomes increasingly important in high temperatures, creating microclimates that are cooler than the surrounds. The vegetation on termite (genus *Macrotermes*) mounds is a hot-spot for megaherbivore herbivory, so removal of this vegetation can happen where elephant densities are high. *Macrotermes* colonies rely

on gardens of symbiotic fungi to digest lignin, but the fungi require temperatures between 29°C-32°C, which termites strive to maintain. We measured temperatures on mounds, within mounds and in the surrounding vegetation, to assess whether mound vegetation did indeed create cooler microclimates, at the hottest part of the day in summer at three sites in the Kruger National Park. Vegetation on mounds did create cooler environments, and this cooling effect increased as temperature increased. That is, at 40°C, a cooling effect of up to 4°C occurred, compared to one of 2°C at 34°C. As expected, elephant damage to mound-associated vegetation reduced the modulating effect of mound vegetation on climate. Termites were still able to regulate internal mound temperatures, however, within the band of 29°C-32°C. In contrast, the internal temperatures of abandoned mounds increased with elevated surface temperatures. We conclude that termites can persist despite loss of mound-associated microclimates, but the loss likely increases energetic costs of mound thermoregulation. The “tipping point” of minimum vegetation cover, at which the mound becomes too expensive to maintain is unknown, however. Given that *Macrotermes* are important ecosystem engineers, creating heterogeneity in soil nutrients, vegetation and microclimates, cover of vegetation on termite mounds might be an important tool for monitoring ecosystem health, particularly because of possible importance of mound vegetation microclimates as refuges during heat waves.

What Can Camera Trapping Surveys Tell Us About Faunal Community Structure and Diversity in Southwestern South Africa?

Key words: faunal surveys, rare mammals, detection probability

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We examine the species composition, community structure and diversity of faunal communities captured during camera trapping surveys conducted at various sites across the Northern, Western and Eastern Cape provinces. We identify and characterise different groups of species based on their relative abundance and distribution. A variety of species of conservation concern including Leopard and Riverine Rabbit were observed and these are briefly highlighted and discussed. The implications of the results for camera trapping surveys are discussed and best approaches to once-off surveys identified. Apart from these basic outcomes, the results of this study are still largely unknown at the time of writing of this abstract, as the required analyses have yet to be conducted. However, it promises to be an interesting presentation for the camera trap pictures if nothing else.

Update on the Karoo Biogaps project. Results from the Flora group

Key words: Karoo Biogaps, Progress, iNat, Foundational Biodiversity data

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The Karoo BioGaps Project aims to mobilise foundational biodiversity data to support the SEAs for shale gas development and other potential infrastructure development projects in the Karoo basin. We have now completed the fieldwork phase of the project and approaching the end of the project. We have sampled all of the compulsory sites and embarked on an ambitious attempt to sample the remaining 30 sites by organising Bioblitzes where the data was submitted on the iSpot or iNat platform. We will share the results of the fieldwork conducted, provide feedback on the data mobilization phase which includes digitizing and georeferencing herbarium records. We will also share results of initial analysis of the data that was collected during the fieldwork phase of the project as well as share exciting discoveries and lessons learnt during the implementation of the Karoo Biogaps project.

Dung beetles in farms used for pastures bury dung faster than dung beetles in protected areas in the Nama and Succulent Karoo.

Key words: ecosystem services, dung beetles, rate of removal

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Recent concern on the reduction of insect diversity and abundance as a result of anthropogenic activities and climate change, calls for the need to understand how ecosystem functioning might also be affected. The decline in dung beetles in particular is of major concern, because of the many services that they provide. In this study, we looked at how dung beetles and the rate at which they perform one of their ecosystem services (dung removal) are affected by land use (protected areas, with low stocking rates vs. livestock farms with various different stocking rates), across a rainfall gradient in the semi-arid Karoo, South Africa. Dung beetle abundance and species richness were sampled using soil and water pitfall traps. Rate of dung removal facilitated by dung beetles was assessed using an in situ rate of removal experiment. Species richness increased with an increase in the most recent rainfall and decreased in sites that didn't allow with low stocking rates. Rate of removal was significantly higher in protected areas than it was in the farms. Rate of removal also increased with greater species richness and Standardised Precipitation Index (SPI). The rate at which dung is removed increased with species richness in summer, although this rate of increase was lower in protected areas than in farms. Rate of removal was lower in winter than summer, and not correlated with species richness, which may be because there were fewer species active in winter. These results support the hypothesis that higher species richness yield better ecosystem function.

The genetic structure and phylogeography of cork-lid trapdoor spiders, *Stasimopus* Simon, 1892 (Araneae, Mygalomorphae, Ctenizidae) in the Karoo

Key words: taxonomy, phylogeography, Trapdoor spiders

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The Karoo BioGaps collaborative project was established to assemble baseline biodiversity data on various taxa in the Karoo region, in order to support decision making regarding land-use change. This is vital in light of the land transformation occurring in the Karoo for farming, mining, the square kilometre array (SKA) and shale gas exploration. Spiders (order Araneae) are one of the focal taxa for the project. Trapdoor spiders are long-lived and sensitive to habitat destruction making them a valuable conservation tool. The aim of this study is to perform an assessment of the phylogeographic

relationships of Cork-lid trapdoor spiders (Ctenizidae: *Stasimopus* Simon, 1892) in the Karoo BioGaps study area. A total of 118 individuals were collected from 60 surveyed sites in 2017 and 2018 for the analysis. Phylogeographic insights were drawn from the 16S, CO1 and EF1g nucleotide sequences and suggest substantial undescribed diversity. There is also a novel pattern of an east-west divide present in these spiders and has been observed in other arachnids. There were between 9 and 12 species found in the sampled region. According to current literature only between 5 and 7 are known for the region, indicating either new locality data for already described species or novel undescribed species. Most of the potential species found are short-range endemics which makes them vulnerable to change. The conservation status of *Stasimopus* should be reconsidered as well as their inclusion in environmental impact assessments.

Investigating the relationship between different individuals of *Euryphymus* genus collected in the southern Karoo, South Africa.

Keywords: Karoo, arid regions, South Africa, biodiversity, systematics

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Although grasshoppers of the Karoo have rarely been surveyed, agile grasshoppers (Orthoptera: Acrididae: Euryphyminae), a southern African endemic subfamily, seem to be arid region specialists, and are expected to be abundant and have high levels of endemism in the Karoo in comparison with other insect taxa. Existing taxonomic keys are insufficient for differentiating among species morphologically due to high levels of intraspecific and low levels of interspecific variation among species.

Before this study, *Euryphymus* had three described species distributed across South Africa and another three known to occur only in Madagascar, Botswana and Angola, respectively. On two field trips in October 2016 and March 2017, I collected a variety of individuals belonging to *Euryphymus* genus in the southern Karoo. Here, I investigate if these sampled populations are indeed one species with a variety of forms or if they are different species with similar morphology.

For this, I compiled two datasets of male morphological characters (13 characters) and DNA barcodes (427 bp) for both males and females. DNA barcoding successfully assigned female specimens to their conspecific males identified using morphological characteristics. In two separate cladistic analyses of

morphological characters and DNA barcodes for 13 male specimens, the trees were resolved but with low support. Phylogenetic analysis using DNA barcodes from an ingroup of 27 male and female Euryphymus specimens produced a topology with well-supported nodes. Assuming a 3% species divergence threshold as is often used in insect phylogenetics, different individuals of Euryphymus were reduced to five valid species. From the five species, two are known and three are potential new species. These results show that levels of morphological variation in Euryphyminae can complicate species diagnosis and that DNA barcoding is efficient for differentiating among congeneric species.

Session 7 - Aliens & Poisonous Plants in the Veld

The status of biological invasions and their management in the arid zones of South Africa

Key words: biological invasions, invasive species, indicators

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Biological invasions are a large and growing environment and socio-economic problem across South Africa. In this talk I will use the findings of the 2017 National Status Report on Biological Invasions in South Africa to address the following question: Is there something particular about invasions and their management in arid zones in South Africa? Are plant invasions in South Africa's arid zones different from plant invasions in other arid zones? How do invasions in arid areas compare with invasions in other remote and sparsely inhabited areas (e.g. mountains)? In so doing I will revisit several issues raised by Sue Milton and Richard Milton in their 2010 paper in the journal Biological Invasions, in particular the issues of knowledge gaps, detectability, conflicts of interest, and management options. I will end by briefly highlighting other aspects of the South African National Biodiversity Institute's work on biological invasions: the facilitation of taxon-specific working groups and introduce the Alien Species Risk Analysis Review Panel.

Reconstructing the past: a first attempt at using dendrochronology and alien invasive trees

Key words: Dendrochronology, alien invasive trees, climate

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Reconstructing past climate by using dendrochronology can provide useful insights into the ability of trees to survive our changing climate. In the absence of long term, regional climate data in South Africa, a need for proxy data exists. Trees are living archives that could be a source of climate data, locked up within their tree or growth rings. Dendrochronology deals with the study of cross dating trees by counting annual growth rings. When enough tree cores are collected over a larger geographical area, it is possible to build time series data that link each growth ring to a particular year. Most trees indigenous to the arid zone are angiosperms, or hardwoods, with unique and complex wood anatomy, showing limited distinct annual growth rings due to variable periods of drought - which makes dating challenging. In contrast, alien invasive hardwoods, such as species of *Fraxinus* and *Populus* do form distinct growth rings and so do *Pinus* and *Cupressus* spp. These two gymnosperms, or softwoods, are characterized by distinct tree rings that enables chronological analysis and ecological deductions. These genera, although limited in species composition and sparsely distributed in the arid zone, do occur in and around towns, at homesteads on farms and along watercourses. It is believed that some of these alien invasive individuals were introduced more than 100 years ago, which is older than the existing climate record. Tree core samples collected in the central and southern Free State, indicate that these trees are dateable. Their suitability for dendrochronology will depend on their sensitivity to the formation of false or missing rings. Preliminary results will be presented.

A retrospective investigation of the impacts of alien plant taxa on human health using Poison Information Centre call data

Key words: Human impact, Human poison exposure, Invasive alien species

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Alien and invasive species (AIS) cause considerable negative impacts on biodiversity, economy and public health. Most studies on AIS focus on the direct biodiversity and economic impacts they cause, but few on the human health and socio-economic impacts. Here, we provide an analysis of human poisoning calls received by the Poisons Information Helpline of the Western Cape (PIH), jointly run by the Poisons Information Centres (PICs) at the Red Cross War Memorial Children's Hospital and Tygerberg Hospital. The data collected were on reported human exposure and poisoning cases from native and alien plant species conducted over 2.5 years, between 2015-2017. During the 2 year period, the PIH received 826 plant -and fungi-related calls, with most being received from Gauteng (47.1%) and the Western Cape (29.4%). Most calls were as a result of accidental ingestion (96.7%) and involved infants (55%), with a few cases involving patients over 60 years (2.1%). Adults presented with minor to moderate toxicity, while infants showed no to minor toxicity. The most commonly reported known plant species were *Colocasia esculenta* and *Melia azedarach*, which accounted for (20%) of cases. Of the ingested plants that were listed as unknown, most were due mushrooms and fungi (10%). It is essential to improve public awareness regarding alien and invasive plant species in order to reduce poisoning incidences, particularly for those plants with highly attractive fruiting bodies.

Death traps in the Succulent Karoo: investigating plant and landscape associations within poisonous plant patches in communal rangelands

Key words: poisonous plants, succulent karoo, Steinkopf

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Globally, poisonous plants constitute a major cause of economic losses in livestock industry, either through direct and indirect losses, such as livestock diseases. With high plant biodiversity in the Succulent Karoo the likelihood of livestock encountering poisonous plants is also higher. Very little is known about the ecology and distribution of these poisonous plant species within the Steinkopf rangelands, therefore the study was aimed at firstly, determining whether edaphic conditions and/or aspect influence the occurrence of the different poisonous plants. Secondly, to determine plant species associations with the different poisonous plant species. Areas containing poisonous plants were identified in 25 locations along livestock grazing routes in the Ikosis area of the Steinkopf communal rangeland. Within each of the 25 locations, a 15 m x 15 m quadrat was laid out within which 20 replicates of 2 m x 2 m quadrats were used to quantify the numbers of individual plant species. At each location, the aspect was recorded and five soil samples were collected which were later pooled to form one composite sample per location. The soil samples were used to determine the texture, pH, conductivity, organic matter content and water holding capacity of the soil. Edaphic conditions were found to not influence the occurrence of the different poisonous plant species however, aspect did. The relative abundance of each of the poisonous plant species differed between different slopes. On North and East facing slopes, *Tylecodon wallichii* was found to be the most abundant poisonous plant species, followed by *Crassula* sp. and *Euphorbia mauritanica* on North and East facing slopes, respectively. *T. wallichii* was not found on West facing slopes. On these West facing slopes, *E. mauritanica* was the most abundant poisonous plant species, followed by *T. reticulatus*.

Wilderness Foundation Africa: Northern Cape Land Project

Key words: Namaqualand, Expansion, Success

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Phase One of the Wilderness Foundation Africa (WFA) “Northern Cape Land Project” came to an end in September 2018 and Phase Two will follow directly on from this. WFA would like to thank the Leslie Hill Succulent Karoo Trust and WWF- SA for enabling both projects.

During the last three years WFA has supported the two main implementing agencies in the province, SANParks and DENC, and have been accepted by the broader conservation community as a catalyst of protected area expansion. Achievements include assessing seven properties and proposing these for purchase to WWF- SA. Two have been purchased and the others are in progress. Eight properties were assessed for Stewardship and six landowners have agreed to enter into Biodiversity Stewardship Agreements, five Nature Reserves and one Protected Environment. Two adjoining Namaqua National Park and four conserving five thousand seven hundred hectares of previously unprotected “Inselberg Bushmanland Shrubland” vegetation near Goegap Nature Reserve. Two “Peer Learnings” were carried out and produced a deeper understanding between all parties as well as a revised “Northern Cape Site Assessment form” and “Grazing Guidelines for Namaqualand”. An “Offsets Decision Making Framework” has been designed with DENC and will help in making strategic decisions regards the placement and approval of offsets in the Northern Cape. The “Technical Assistance” programme was successfully piloted and included erosion rehabilitation, removal of fences, removal of alien vegetation and monitoring.

In Phase Two WFA plans not only to continue expanding the conservation estate in the Northern Cape with its partners but also to offer strategic support in developing areas of conservation such as the “Offset” field of “Reactive Stewardship”, using alternative legal mechanisms for land protection and exploring long term renewable energy funding options and alternative management authorities for Protected Areas in the Northern Cape.

Evaluating riparian restoration in the Nama Karoo

A Case Study

Key words: riparian restoration, evaluation

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The Endangered Wildlife Trust's Drylands Conservation Programme undertook restoration on several locations using different technologies. An evaluation of the progress on two of these sites, located in riparian habitat, was carried out to determine the effectiveness of the restoration technologies, including the use of micro-catchments and plough lines in conjunction with planting plugs. The results show that both technologies had limited success, with the long term success of plant survival under current drought conditions showing poor results. Some of the lessons learnt and the constraints operating within the riparian environment are highlighted and discussed.

A second part of the study involved evaluating riparian and adjacent veld condition on different farms using two different techniques, a direct sampling approach and a drone-based remote sensing approach. The results of the two approaches are compared and the advantages and disadvantages of each are discussed. These results are also discussed in more generally in terms of land use practices and veld condition in the study area and the potential implications of these results for veld evaluation and riverine rabbit habitat quality assessment.

Session 9 - Drought & Rangeland Ecology in Namaqualand

Human dimensions of drought in the Karoo, 2012 -2015

Key words: Drought, productivity, sheep farming

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In the Central Karoo 2013-2015 was 47% drier than the previous two years with conditions getting steadily worse. In 2013 and 2014 gross margin per hectare and total factor productivity (TFP) were still the same as in 2012 because grazing reserves were still available. In 2015 both these efficiency

measures fell considerably, TFP by 19% and gross margin per hectare by 68%, which raises questions about some attempts to maintain productivity. A regression model which explains 77% of the variation in gross margin per hectare reveals that larger wool farms operated by more efficient producers are the most profitable. Under normal conditions pure woolled flocks do 3.5 times better than flocks which contain no woolled sheep and are fed 20% less. During a drought the difference in feed expenditure shrinks to 5% but mutton flocks are much more likely to make big losses than woolled flocks. Better managers handle droughts better, although the efficiency effect is small compared to the rainfall effect; 1% increase in rainfall raises gross margin by R9.49 per hectare while 1% increase in efficiency only adds R0.48 per hectare. In a drought one can switch to hardier breeds, buy more feed or lower stocking density. Flock composition did not change. In 60% of cases stocking density did not respond either, perhaps because its marginal effect on profitability is small ($\epsilon = 0.51$). From 2015 onwards feeding was most farmers' main response to the drought. Feed cost doubled compared to the previous three years but 1% increase in feed cost reduced gross margin by 2.43% at the mean, which meant that two thirds of farmers made a loss or paid out more in wages than the family had left to live on in 2015. Indebtedness rose by 10%. This strategy is viable only if banks are willing to extend credit, the drought ends soon and there enough time to repay loans before the next drought hits. If not forced sales will increase and the fabric of the community might unravel.

Desperate times, desperate measures; a case study on the adoption of climate mitigation strategies amongst generalist and specialist smallholders

Key words: drought, smallholders, climate mitigation strategies

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The recent drought linked to the 2015-2016 El Nino, manifested the incontestable impact of extreme climatic conditions on South Africa's agriculture. This dire consequences on all four dimensions of food security namely availability, access, stability and utilisation. Moreover, climate projections indicate increased severity of drought conditions and significant climate impact on the livelihoods of small-scale subsistence farming households which comprise 70% of South Africa's poorest households. Thus, the importance of climate mitigation strategies in building resilience and enhancing productivity cannot be

overemphasised. This is even more urgent for the small holder systems which sustain 90% of Africa's agriculture and are crucial for enhanced food security as per the Sustainable Development Goals. This study uses the multi-method approach involving 150 farmers to investigate factors affecting uptake of mitigation strategies in small holder systems and the implications on farm output and livestock productivity. Innovation policies will have maximum impact when targeted at the household head instead of a household member. Chi-square results indicate age, educational levels, house-hold head social capital and multiple information sources have a significant association with the uptake of innovation. They represent a cocktail of factors that enhance the adoption of innovation in small holder systems. These factors thus need to be integrated and foregrounded *in adoption policies*. However, the house-hold head related social capital is the trump card for innovation strategies uptake as it is the single factor with a significant effect after controlling for other variables in a generalised linear model. Moreover, *access to financial resources and information* are the key challenges to the adoption of innovation amongst respondents with extensive innovation use. There is therefore the need for capacity building in terms of knowledge, managerial and allied skills to help small holder systems enhance productivity in both crop and animal production.

Socio-economic vulnerability to climate change of a small farming community in the arid zone of South Africa

Keywords: Climate vulnerability, indigenous livelihoods, adaptive capacity

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Indigenous communities particularly in arid environments are at risk of experiencing direct consequences of climate change, given their dependence upon, and close relationship with nature and its resources. Climate change has a direct impact on those resources including the availability of food and water for people and their animals. In addition, climate change exacerbates the challenges faced by vulnerable indigenous communities, including degradation and loss of land and resources, economic and political marginalization, and poor living standards. Because they are often the first to experience the impacts of climate change, indigenous communities are among the first to attempt to mitigate climate risks through land use, cultural practices, habitation characteristics and resource

management techniques. However, in order to understand how these communities cope and adapt to climate change, there is a need to first understand the extent they are vulnerable to climate change.

This study assessed the vulnerability of the indigenous Nama community to natural hazards associated with global climate change. We developed, piloted and implemented a vulnerability assessment of 105 households in the village of Khuboes, Richtersveld. By using the components of vulnerability that include, exposure, sensitivity and adaptive capacity, we assigned vulnerability scores to each household using Principal Component Analysis and standardized co-efficients. These vulnerability scores were correlated with food insecurity indices, access to natural resources, education levels, income and other development indices to assess how different aspects of their livelihoods are affected by climate change and which aspects they mostly rely on to adapt to their changing environment. Understanding these complexities is necessary before implementing adaptation processes and plans that would increase the resilience of indigenous farming communities to climate change.

Diet selection and forage tendencies of three livestock groups during drought conditions in a semi-arid to arid communal rangeland in South Africa

Key words: Diet selection, drought, forage availability

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Semi-arid to arid areas are prone to droughts which are frequent in South Africa's rangelands. Drought can trigger vegetation change in rangelands influencing availability of forage for livestock. This study aimed to determine forage selection of crossbred sheep, Swakara sheep and Boer goats during the wet season in the semi-arid to arid Steinkopf communal rangeland in Namaqualand. Most livestock in

the communal area are accompanied by herders who make use of seasonal stockpost movements between the Succulent Karoo (SK) and Nama Karoo (NK) biomes to optimally utilize the rangeland. This communal area experienced a drought during the study period of 2016- 2017 and thus focus was placed on determining (1) what forage is available for livestock to eat in the SK and NK biomes during their growing seasons (2) what is the nature of diet selection of livestock groups and how it vary between the two biomes (3) what role livestock species, breeds and season play in forage preference in both biomes? We established diet selection, preference and dietary overlap by using direct observation of livestock grazing in the veld. Results indicate that availability of forage largely influences diet selection and preferences of all livestock groups. There is a high dietary overlap between crossbred and Swakara sheep irrespective of the biomes. During 2016 ephemerals made up a large proportion of the sheep's diet indicating an overdependence to this forage resource when it is available. Due to continuing drought conditions in 2017, annuals became less available and changed the forage choices among both sheep groups. Goats who are usually regarded as browsers, fulfilled this role in the SK biome, but become grazers in the NK biome. We conclude by arguing that having mixed herds in Steinkopf is an effective diversification strategy, for better use of rangelands with herbaceous and woody plants.

Session 10 - Drought & Development in Namaqualand Continued

The effect of drought on canopy mortality in Succulent Karoo plant communities

Key words: drought, mortality, canopy cover

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In the context of an ongoing meteorological drought period in South Africa (2015 - present), mortality has been observed in some common Karoo shrub species, while others continue to grow unhindered.

These differences in survival indicate that there are potential species-level differences in vulnerability to drought, which requires further investigation. This study aimed to investigate the effect of drought on plant communities by assessing mortality, changes in canopy cover, and demography in Succulent Karoo plant species in different habitat types, and under different land-use management practices. Canopy dimensions (length, width, height), an index of canopy mortality, and the presence of shoots, flowers and/or fruit were recorded for all individuals encountered using the line-intercept method. Preliminary results based on data from the Tierberg Karoo Research Centre (TKRC) in Prince Albert suggest that succulent dwarf shrub species (e.g. *Drosanthemum montaguense*, *Galenia fruticosa*) have suffered the greatest canopy mortality in plains habitats. Further analysis and comparisons between different grazing management practices may yield interesting results regarding correlations between shrub composition, palatability and canopy mortality. The results of this study could serve as a baseline for monitoring post-drought recovery rates of various species and functional types.

Trying and drying: the way ahead for farmers in Namaqualand

Key words: farmers' knowledge, grazing, livestock

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A recent study of capital accumulation in the Letaba, Namaqualand and Overberg farming regions of South Africa shows that large-scale commercial farmers employ four broad reproduction and accumulation strategies, i.e. expanding the scale or scope of *production*, expanding the scale or scope of the *business* by expanding into new enterprises up or down the value chain; increasing *economic efficiency* by means of lowering the cost of commodity production, increasing productivity and/or organising workers and tasks to make workers as productive as possible, and taking part in political action to reduce uncertainties, establish preferential access to and control over key resources, markets or policy processes. This paper focuses on Namaqualand where the majority of farmers employ the first and third strategies; either by buying or renting more land and/or improving the productivity of livestock through various means. Farmers pursue access to land in different rainfall zones for winter or summer grazing and vegetation types, e.g. grass in Bushmanland or shrubs and planting grain in the Kamiesberg or areas below the mountain in order to reap the benefits of livestock mobility. During interviews farmers displayed diverse levels of knowledge, beliefs and philosophies about biodiversity, veld utilisation, management and restoration, but also expressed concern about what they perceive as

the deterioration of the veld. The drought exposed fault lines in current knowledge which can be worsened by climate change. Furthermore, pressure is mounting to assist new land reform beneficiaries to farm productively on smaller patches of land. Finally, this paper suggests ways in which the combined knowledge of the Azef community and livestock experts can help farmers to develop more sustainable practices to keep the impact of the pressures at bay and help protect biodiversity.

What's Watt in De Aar? An exploration of local energy needs and challenges in a renewable-energy hub in the Karoo region of South Africa.

Key Words: Renewable Energy, Household energy usage, Sustainable Development.

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While renewable energy is widely regarded as critical for turning South Africa away from its reliance on coal and reducing its national and global carbon footprint, it is not clear to what extent local communities are benefitting from the current roll-out of large scale renewable energy plants in their backyard, whether in the form of cheaper and cleaner sources of household energy locally or improved access to jobs or other social and economic opportunities. This raises larger questions around the understanding of 'sustainable development' informing South Africa's current Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), and the extent to which investment in the renewable energy sector nationally is making a significant contribution to sustainable development at the local level.

My overarching interest is in the potential of South Africa's renewable energy sector to contribute to sustainable development at the local as well as national level. My research will contribute to this by exploring local energy needs and challenges of poor households in De Aar, and the contribution of the renewable energy sector to local as opposed to national commitments to 'sustainable development'.

This paper reports on my preliminary findings from both my quantitative and qualitative data collection methods. My research methods include documentary analysis, a household survey and semi-structured interviews with selected household representatives and key informants from renewable energy companies, the local municipality and local Non-governmental organisations.

Scientists and the photographic documentation of long-term environmental change in southern Africa

Keywords: Ground-based repeat photography, environmental change, citizen science

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Ground-based repeat photography has long been used as a tool for documenting landscape change. To measure broad-scale spatial and temporal change, repeat photography projects require a large set of archival landscape images related to a particular area or region of interest. Since 1989 researchers associated with the Plant Conservation Unit (PCU) have accessioned and scanned over 20,000 historical images in the form of 35 mm colour slides, negatives and prints. The images were sourced from a wide range of institutions and the archive has become one of the largest collections of digital historical landscape photographs in South Africa. To date 1,617 of these images have been repeated by PCU researchers, of which 536 are in the arid zone. The repeats have been used to assess various ecological processes including desertification, bush encroachment and the plant population dynamics of species, such as *Aloe dichotoma* and *Widdringtonia cedarbergensis*. With a growing number of historical photographs and a finite number of researchers and resources, the PCU launched a citizen science project called rePhotoSA in August 2015. rePhotoSA is the repeat photography project of southern African landscapes and was launched as a long-term monitoring tool to supplement the decades-long research programme at the PCU. Approximately 6,000 historical images have been uploaded to rePhotoSA's online interactive map. Since its inception, 32 citizen scientists have uploaded c. 200 repeat photographs to the website at an average rate of 5.5 repeats per month. Here we critically assess the ecological trends that the data from rePhotoSA show and will discuss the benefits and challenges associated with this project, including the availability of historical imagery,

mobilisation of citizen scientists and data quality. We also look at the future of rePhotoSA in the broader context of academic research particularly in combination with tools such as satellite imagery.

Elucidating long-term vegetation change in the eastern Nama-Karoo–Grasslands ecotone

Key words: climate, land use, vegetation change

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Rangeland degradation in South Africa originated from the early European pastoralist practices of high livestock densities and poor grazing management. Land use practices were forced to adapt to declines in productivity in the 1900s. During this time, the government subsidised livestock reduction on farms, implemented soil conservation strategies, and initiated vegetation surveys; all efforts to assist landowners in combating worsening degradation. To an extent, studies conducted through these vegetation surveys improved our understanding of the drivers of vegetation change under different grazing systems. Such historical data sources exist allowing for repeated study in aiding long-term monitoring of these same sites as climate and land uses change over time. The current study was, in part, repeated twice previously in 1989 and in 2009 on natural rangelands in the eastern Nama-Karoo-Grasslands ecotone situated along an east-west gradient of decreasing precipitation. The most notable change reported to date for this area has been the significant increase in grass abundance. This finding rejects the 'expanding Karoo hypothesis' as postulated by John Acocks in 1953 hence allowing alternative hypotheses of change to be tested, including those of global predictions for similar grassland-shrubland ecotones. A broader spatiotemporal assessment for the local context is required to elucidate the extent of these changes, coupled with an extensive analysis of long-term rainfall and land use records. Recently repeated surveys in the study area included the ten sites as repeated previously with an additional 15 sites located along the gradient. Changes in total vegetation cover, species and growth form composition, and range condition were investigated. Overall, a significant increase in total vegetation cover and perennial plant cover for all study sites is reported. A preliminary analysis of vegetation, rainfall and land use data will be presented in this talk.

The Phenology of the Enkangala Grasslands

Key words: Phenology, Climate Change

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Phenology is the study of the timing within the year of life history events in plants and animals. The phenology of plants is usually cued to climate; therefore climate change is likely to have an effect on the date of events such as greening and browning and thus the length of the growing season. Since the growth duration, the rainfall and the temperature all control primary productivity and transpiration, phenological change will lead to changes in the ecosystem services of forage provision and water yield. Remote sensing techniques are used to describe the grassland phenology at landscape scale in the high-altitude Enkangala grasslands of South Africa over a period of 18 years, using an ecologically-based phenological model, in which the parameters were related to climatic cues. A 100-year daily climate data record is then used to hindcast the grassland phenology over the 20th century and test for changes. Finally, possible future phenological trends are made based on climate change projections for the region. We found that the length of the growing season has not increased over the 18 year period but it has increased by 35 days over the past 100 years. This is due to the growing season starting at an earlier date than usual and ending at a later date.

Session 12 - The Succulent Karoo Ecosystem Programme (SKEP)

POSTER ABSTRACTS:

The Ecology of Namaqualand Sand Fynbos Vegetation type

Key words: Succulent Karoo, Namaqualand Sand Fynbos, Namaqua National Park

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Fynbos and Succulent Karoo biomes are well-known for their unique diversity in terms of plant and animal life as well as a high level of endemism for various species. The boundary between these biomes are biologically and ecologically interesting as they are characterised by a transition from sandy to loamy soils while there is a continuous climate transition from cooler wet, to warm dry conditions, closely associated with the winter rainfall season. Namaqualand is physiographically and biogeographically part of southern Africa's Succulent Karoo biome. The Namaqua National Park is located within this biome. The Namaqualand coastal plain located within the Park, supports a fynbos vegetation type classified as Namaqualand Sand Fynbos. This area remains relatively poorly known and is almost entirely coastal, occurring on quaternary and tertiary sands of marine and aeolian origin. Pockets of this vegetation type are located within the boundaries of Namaqua National Park. Twelve of the plant endemism centres of the South Africa, Lesotho and Swaziland vegetation map have not been refined in the nine-year update period. Botanical studies have not been conducted to the same extent as in the eastern and western coastal regions where the updates have occurred. These vegetation units were initially identified and described at a large scale based on research data for the region, environmental patterns and by using land types. The classification, identification and description of plant communities within these vegetation types will lead to future refinement of the different ecosystems that will assist in making scientifically based management decisions for the Park.

Drought resistance and recovery of forage legumes in the genera *Medicago* and *Trifolium*

Key words: Pasture-crop rotations; annual pasture legumes; bioclimatic conditions

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Legume pastures are important for sustainable crop and livestock production systems. In South Africa, it is estimated that approximately 16.9 million hectares of land is suitable for the establishment of forage legumes, while approximately 2.5 million hectares of land is currently being cultivated in the Western Cape province, of which an estimated 600 000 hectares is planted with legumes. The most important annual pasture legumes cultivated in the Western Cape are annual Medicago (*M. polymorpha*, *M. truncatula*) and Trifolium (*T. subterraneum*, *T. michelianum*) species. Because the Medicago and Trifolium species used in South African pasture-crop rotations are not native to South Africa, they first need to be tested for their ability to adapt to specific agroecological, bioclimatic and edaphic conditions. The current stock of commercially available forage legumes are well adapted to the current bioclimatic conditions of South Africa. However, climatic predictions for the Western Cape are indicating a trend of becoming hotter and drier. Unfortunately, no information is currently available in South Africa to predict the responses of commercially available Medics and Clovers to future changes in bioclimatic conditions. These future changes in the bioclimatic conditions of South Africa, specifically the amount and distribution of rainfall and rising temperatures within the Western Cape, could significantly affect the success of these legume-based pastures, affecting the establishment of these species/cultivars and their persistence. It is therefore important to obtain a greater understanding of how currently commercially available cultivars of annual forage legumes will respond to the predicted bioclimatic changes, especially changes in moisture availability and rising temperatures during germination and establishment of the forages. This in turn, could play a major role in the establishment of these forages under the predicted marginal conditions within the Western Cape.

The role of the state support and employment in the livelihoods of young women in Sutherland

Key words: Livelihoods, social grants, young women

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Sutherland is a popular tourist town and the host town of the South African Large Telescope (SALT). Despite some private investment, the town is experiencing high rates of unemployment. High school drop-out rates, alcohol abuse and high teenage pregnancy rates are some of the socio-economic issues the community are faced with. Many young women are relying on social grants as a primary income in Sutherland. The Community Work Programme (CWP) has provided some relief to the unemployment issue in the town. The aim of this paper is to identify livelihood strategies that young women in Sutherland adopt. Furthermore, this research will grapple with questions regarding the role of the state in livelihoods, through a closer look at social grants and the significance of the CWP amongst the livelihoods of young women. I will draw on a mixed methods research design, by means of survey data, interviews and focus groups.

Science research through community engagement as a tool for improving Steinkopf community's livelihood

Key words: community development, livelihoods, Steinkopf

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The Agricultural Research Council's Animal Production Institute has been working in the Namaqualand region for nearly two decades. The 1995 White Paper on Agriculture indicated the need for the ARC to broaden its mandate to include the resource-poor agriculture sector. The ARC Animal Production unit, based at the University of the Western Cape, is ideally positioned to access postgraduate students to assist in fulfilling the ARC's mandate of in terms of research, development and technology transfer. Research is always the primary goal, but the unit's lessons learnt in working with resource-poor livestock communities has directed us in incorporating a development component into our work, especially in collaboration with established farmers associations. The ongoing DAFF/NRF funded project investigating the perceived low livestock productivity in the Steinkopf communal area, is a prime example of how research projects can be used in a win-win situation to help improve the

livelihood of resource poor farmers, develop human capacity through student development whilst conducting research. Several other development projects in our Namaqualand study area (e.g. SKEPPIES, SGF fund) have been implemented in collaboration with the local community that focused on needs identified through our research. As partners in the current SGF funded climate smart herder shelter project led by the Kamiesberg Heritage Foundation, our ARC unit is instrumental in knowledge transfer between farmers from different communal areas while monitoring the project outcome. Our newsletter, Makam, is used to translate our recent work through short popular articles in Afrikaans to demystify our research findings and to explain the applicability of our research in simplistic ways. We regard the incorporation of community development activities into research projects essential when working with resource poor farmers.

Tick communities of the Steinkopf communal rangelands, South Africa

Key words: Parasite ecology, Ticks, Arid rangeland

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Parasites play an important role in ecological population dynamics and community stability. This is particularly pronounced in agricultural livestock production systems; where they may lower overall productivity and the health of herds reducing productivity. Due to the lack of studies on parasites in arid environments in South Africa, our aim is to investigate the tick (Acari) communities harboured by the livestock in Steinkopf, Northern Cape province. This communal rangeland experiences both winter and summer rainfall allowing farmers to move their livestock between these unique habitats as the opportunity presents itself. Here, we conducted a survey of 225 randomly selected animals from 11 herds which comprised mixed sheep (111), karakul sheep (56), and goat (58) after the winter rains. Our results indicate a 56 % overall tick prevalence. From this sheep showed a 59 % prevalence and goats 50 %. Three tick species were found, these included more common species such as *Rhipicephalus gertrudae* (82 %), *Hyalomma truncatum* (15 %) and *Rhipicephalus microplus* (3 %). The intensity of tick infestation per animal was generally higher for sheep (2.47) than goats (1.72) with female sheep having double the amount of ticks when compared to males of both species. Furthermore, body condition showed no significant relationship to tick abundance. The study highlights

the presence of an alien tick species, *R. microplus* (Asiatic blue tick), illustrating that new stock-post management strategies should be implemented to ensure sustainable stocks in the future.

Long-term changes (1984-2018) in vegetation productivity of the Karoo: Implications for the degradation narrative

Key words: land degradation, NDVI, Monitoring

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Land Degradation, as a result of climate change and human disturbance, threatens the functioning of ecosystems in arid regions. Researchers and policy makers are concerned about the extent and rate of land degradation in these areas. Monitoring desertification in arid regions is therefore essential for future conservation initiatives. Ongoing change analysis using satellite remote sensing is studied for the assessment of vegetation productivity. The evaluation of the variation in vegetation productivity provides a basis for understanding ecosystem health and condition. Here, we aim to show the extent of land degradation in the arid regions of South Africa over a long-term period (1984-2018) using the Normalized Difference Vegetation Index (NDVI). We used Google Earth Engine to assess Landsat 5, 7 and 8 sensor products at a 30m pixel resolution to determine changes in the vegetation productivity of the Karoo. The temporal changes in productivity were analysed to assess differences across and within the Desert, Succulent Karoo and Nama-Karoo biomes. The seasonal differences between the bioregions in each biome is also examined. These changes in productivity allow for broad insight into the 'desertification' narrative that has been dominant in the Karoo in particular, and also arid regions around the world. However, this study is limited in that it only uses NDVI as a measure of vegetation greenness in a landscape. Altitude, rainfall, soil and topography, coupled with NDVI and other vegetation indices, can provide a more comprehensive interpretation of the temporal and spatial variability of vegetation productivity in the area. Assessing remote sensing products with Google Earth Engine is an effective and rapid monitoring tool that has become available for conservation initiatives and research alike.

Spatial distribution of soil texture in ephemeral pans across the

Northern Cape

Key words: hydrometer method, particle size distribution, productivity.

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The large semi-arid to arid Northern Cape Province covers nearly a third of South Africa's land area. The high evaporation, high atmospheric temperatures and relatively low rainfall play a major role in the formation and dynamics of ephemeral pans. Therefore, it is not surprising that pans are widespread across the Northern Cape Province. These pans normally develop in depressions and temporarily store water after sufficient rainfall events to create a habitat for numerous aquatic species. The hydro period of the pans indicate a duration in which the pan will retain water. The limited hydro period prevents the colonisation and persistence of large aquatic fauna such as fish, but allows specialised aquatic fauna, particularly Branchiopods to reproduce rapidly and deposit their eggs in the sediment to facilitate genetic persistence. Factors that influence the productivity of pans include soil texture, rainfall and accumulation of sediments. Although rainfall is a key driver of water yield and erosion rates, which influences the accumulation of sediments; soil texture effects soil hydrodynamics. This study aims to determine soil texture of ephemeral pans in the Northern Cape. Soils were randomly collected from 98 pans across four main regions, namely Upper Karoo, Ghaap Plateau, Kalahari and Bushmanland, were analysed using the hydrometer method. We compared the soil particle size distribution of pans across these four regions and ultimately suggest how soil texture may influence the productivity of ephemerals pans in the Northern Cape.

Historical photographs and a decades-long research programme on environmental change

Keywords: Historical photographs, repeat photography, environmental change research

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There is a growing concern over the scale and rate of climate and land-use change, particularly as a result of anthropogenic activities. Ground-based repeat photography, the practice of taking photographs at different points in time from the same site has been used as a tool to monitor landscape and vegetation change over time. It was originally developed as a tool to document changes in the alpine glaciers of Central Europe and has remained an important and cost-effective way for scientists and researchers to track and study landscape change globally. Since 1989, the Plant Conservation Unit (PCU) has been developing a collection of historical photographs to be used in research on long-term environmental change. To date the PCU has accessioned and scanned over 20,000 historical photographs. There are currently 72 collections that have been digitised of which more than 10 consist of photographs that have largely been taken in the arid zone of southern Africa including South Africa, Namibia and Botswana. Some of these photographers include IB Pole Evans, Rudolf Marloth, Hans Herre, John Acocks and various photographers associated with the South African National Biodiversity Institute. Many of these photographs have been made available on rePhotoSA, the citizen science repeat photography project of southern African landscapes (<http://rephotosa.adu.org.za>). As new collections are digitised, this online database is expanded. The repeats uploaded to rePhotoSA build on the above-mentioned decades-long research programme at the PCU. Here we provide examples of some of these photographs from the arid zone and discuss the applicability and prospects of using the images in research, particularly in repeat photography-related projects.

A landscape functionality assessment along a biome boundary between the Succulent Karoo and Desert biomes

Key words: Landscape functional analysis, biome boundary, arid areas.

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The landscape functional analysis (LFA) is a methodology integrating both abiotic and biotic factors to assess landscape health. Along the arid biome boundaries in South Africa, biome boundaries have been projected to shift or remain stable under future climate scenarios. However, we know that boundary shifts could also be a function of land use in addition to climate change. Livestock farming have been shown to affect landscape functionality in arid regions, which could potentially facilitate a more rapid shift in vegetation composition leading to biome boundary shifts. Little is known about the Desert – Succulent Karoo boundary in South Africa, and thus this study aims to assess the landscape health along this boundary. A LFA was performed in 27 sites (9 x Desert, 9 x ecotone and 9 x Succulent Karoo) along the Desert – Succulent Karoo boundary, where the three components of the LFA (soil stability, nutrient cycling, and water infiltration) were assessed. The data was analysed using various appropriate statistical tests to assess the relationship in these three variables in relation to the different sites. This poster presentation will outline and discuss the relationship between soil stability, infiltration/runoff and nutrient cycling in a landscape. We will also discuss the level of functionality within the three different landscapes measured. We will conclude by discussing the potential direction that this boundary will shift or whether it will maintain its current landscape health characteristics.

We move our Citizen Science platform to iNaturalist

Key words: virtual museum, identifications, projects, atlassing

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SANBI has moved our virtual museum citizen science platform from iSpot to iNaturalist at www.inaturalist.org. Migration of data from observers who granted permission is now complete. Some 263,366 observations of 20,965 taxa of animals, plants and fungi were migrated. Some 378 users opted to migrate amounting to 84% of the southern African data on iSpot. All ancillary data have also been migrated. Unfortunately, projects could not be migrated, but iNaturalist has various projects, places and filters that access this data. The major advantage of iNaturalist is that data can be easily filtered and exported in a variety of formats by users. Other advantages are being able to load multiple observations, manage projects with journals, downloads and use projects with filters to refine data

selection, the easy development of checklist and field guides, and efficient identification and curation tools. Courses are underway to train users – please contact the author to arrange a course for your institution. iNaturalist is geared for teaching and coursework and running citizen science projects – see the online tutorials and guidelines for more details.

***Gibbaeum* N.E.Br. and *Glottiphyllum* N.E.Br. (Aizoaceae) – more than just neighbour plants on quartz fields**

Key words: succulent plants, Phylogeny, Quartz fields

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Gibbaeum (18 species) and *Glottiphyllum* (16 species) are two genera of the subfamily Ruschioideae within the ice-plant family (Aizoaceae). They are leaf succulent dwarf shrubs with a main area of distribution in the Little Karoo and adjacent areas. Many of these species are specialists adapted to the adverse environmental conditions of quartz fields in the semi-arid Little Karoo. Notably many *Gibbaeum* species are local endemics, occurring only in a small-scale area, and many of them are endangered. Others are widespread and grow on different soil types. Formerly, morphological characters have separated these genera into different subgroups of the Ruschioideae.

In order to get deeper insights into the molecular relationship of *Gibbaeum* and *Glottiphyllum* and their possible evolution, it is necessary to collect more than just one sample per species. Therefore, we went on a collecting trip to the Little Karoo in October 2016, to obtain samples from as many species and populations as possible. DNA sequences of the nuclear marker *nhx1* and the chloroplast marker *ycf1* from 94 of the samples collected during that trip have been analysed, and preliminary results of the phylogenetic reconstructions will be presented here. Further samples from the living collection of Aizoaceae in the greenhouse of the Botanical Garden Hamburg have been added to obtain a more comprehensive result of the inter- and intrageneric relationships. For the first time a phylogenetic tree with an extensive number of samples from both genera will demonstrate hitherto unknown connections and give possible hints to their evolution.

Two sides to a fence: Disputing the (re-)establishment of vermin-proof fencing around the SKA core site

Key words: Human–wildlife conflict; fencing; political ecology

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The erection of the Square Kilometre Array (SKA) radio telescope has drawn national and international attention to South Africa's semi-arid Karoo region as it promises to identify and understand some of the fundamental laws and structures of the universe. To ensure the ultimate functionality of the instruments, additional properties were purchased around the core site to act as a buffer zone. As the purchased land will be withdrawn from agricultural production and placed under conservation management, farmers on neighbouring privately-owned land have grown increasingly concerned since the expectation is that the buffer zone will become a safe haven for numerous fauna, especially mesocarnivores, such as black-backed jackals (*Canis mesomelas*). The larger research project focuses on unravelling the political forces at work in human–black-backed jackal conflict on the boundary of the SKA core site. Consequently, the aim is to contribute to a sustainable relationship between humans and black-backed jackals, and to improved black-backed jackal management in and around the SKA core site. This paper specifically addresses the conflict surrounding the (re-)establishment of fencing around the SKA core site. The Fencing Act of 1912 was crucial in providing loans and mechanisms to facilitate joint action by neighbouring farmers in constructing fences. While SKA personnel and farmers neighbouring the SKA core site agree that fencing is an important management tool, the decision-making surrounding this physical boundary highlights the pertinence of unequal power relations within black-backed jackal management. Farmers neighbouring the SKA core site are particularly aggrieved that SKA personnel do not seem to take their opinions and concerns, such as those on fence specifications and establishing a national park, into consideration. Last mentioned is but one example of how the dominance of scientists – whether physicists (*viz.* the SKA) or ecologists (*viz.* black-backed jackals) – contributes to farmers' marginalisation.

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

Key words: growth rate, size class distribution, tree age

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This study, on a keystone species in the southern Kalahari, tracks two populations in different landscapes in a large conservation area, where most of the anthropogenic threats that are present outside the park are excluded.

At Dankbaar, 18 trees were permanently marked in a 1 ha plot in the interior duneveld and in the Nossob riverbed (Grootkolk site) all trees in a 1 ha plot were surveyed. At both sites, tree height and stem circumference were measured in order to investigate growth rates and population structure.

Of the 18 marked trees at Dankbaar, six died and three showed coppice regrowth following substantial die-back after a fire. Although the fire caused a few individuals to coppice, no fire-related deaths were reported. A mean height increase of 60 mm per year was recorded. Stem diameter growth rate per

year varied widely between trees and between years, with a mean value of 2.5 mm/yr over the 38-year period. Using this mean growth rate the estimated mean age of the trees at death was approximately 140 years. The study illustrated that the duneveld population was self-sustaining, with recruitment occurring and large individuals presumably dying of old age.

In the Nossob riverbed (Grootkolk) surveys started in a stand of predominantly young trees, although the size class distribution at that stage already showed a lack of recruitment. The mean age at which trees died at this site was appreciably lower than at Dankbaar (26 - 90 years). This stand will likely disappear at this site; however, new young stands are appearing at other sites in the Nossob riverbed. Under the current conditions with negligible anthropogenic influences, it therefore appears that some *Vachellia erioloba* populations in the park are increasing in size while others are decreasing, but that overall the species will persist.

ARID ZONE ECOLOGY FORUM 2018 DELEGATE LIST

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