



SAWMA  
2019

## ABSTRACTS



**Sustainable  
landscapes for  
wildlife conservation  
and management**

# Abstracts

## SAWMA conference 2019

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### Theme 1: Managing biodiversity in the face of disturbance and extreme events

#### Keynote 1

**Severity of the recent extreme southern Cape fires in perspective, and implications for biodiversity.**

**Tineke Kraaij<sup>1</sup>, Johan Baard<sup>2</sup>, Jacob Arndt<sup>3</sup>, Lufuno Vhengani<sup>4</sup> & Brian W van Wilgen<sup>5</sup>**

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The southern Cape recently experienced two of the worst sets of fires in recorded history, which spurred questions about factors contributing to the extremity of these fires and potential implications for biodiversity conservation in the region. We examined climate, weather and fuel factors that contributed to the fires. We quantified the extents of different vegetation types that burnt in these fires, and used satellite imagery to compare burn severity among vegetation types. We calculated fire danger and drought indices over 70 years, and compared the conditions associated with the fires to the long-term weather record. More than half the area burnt in the 2017 Knysna fires (15 000 ha) was in pine plantations or vegetation severely invaded by alien plants. These vegetation types burnt at higher intensity than uninvaded fynbos, thereby contributing to the severity of, and damage caused by, the fires. The daily weather conditions associated with the Knysna fires were extreme but not unprecedented. The 2018 Outeniqua fires (120 000 ha) comprised the largest fire ever recorded in the Fynbos Biome. It mostly burnt mountain fynbos (100 000 ha) but daily weather conditions were less extreme than those associated with the Knysna fires. However, both sets of fires occurred after the worst prolonged droughts (1.5 and 3.0 years, respectively) in recorded history. Post-fire recovery of biodiversity is expected to have been compromised by the extreme severity of the Knysna fires in places, the excessive size of the Outeniqua fires, and unprecedented drought conditions before and after the fires.

(Full presentation)

**The effect of fire on bird communities in a subtropical dune thicket ecosystem in the southern Cape Floristic Region.**

**Tiaan Strydom<sup>1</sup>, Tineke Kraaij<sup>1</sup> & Mark Brown<sup>2</sup>**

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Fire is important to maintain ecological diversity of fire-dependent fynbos, which coexists with fire-avoiding subtropical thicket (hereafter 'dune thicket') on dunes along the southern Cape Coast of South Africa. Recent extreme fires burnt large areas of dune thicket thereby destroying the habitat of dune thicket bird communities. This study investigated the effects of fire on these bird communities by comparing bird species diversity and abundance between burnt and unburnt (control) dune thicket 12-22 months after fire. We surveyed seven sites each in burnt and unburnt dune thicket with three count stations per site. At all 14 sites, bird species were identified, and individuals were counted through visual and vocal detection in each of four seasons. Bird species diversity was significantly higher in unburnt dune thicket than in burnt dune thicket although the latter harboured more individuals. In terms of relative importance of feeding guilds, burnt dune thicket had more granivorous species (13%) but fewer frugivores (4%) than unburnt dune thicket (5% and 10% , respectively). The relative abundance of insectivores and generalist species were comparable between burnt (43% and 34%, respectively) and unburnt (42% and 38%, respectively). The percentage of feeding guilds in burnt dune thicket was 4% frugivores, 13% granivores, 43% insectivores and 34% generalist species. In unburnt dune thicket it was 10% frugivores, 5% granivores, 42% insectivores and 38% generalist species. In general, dune thicket birds appear to be resilient to fire as most of the birds are insectivores and generalist allowing for continued foraging after fire.

(Speed presentation)

**Exploring how extreme temperature events influence movement patterns of giraffes at Rooipoort Nature Reserve, Northern Cape Province.**

**Rinae Mukwevho<sup>1</sup>, Adriaan J Van der Walt<sup>1</sup> & Francois Deacon<sup>2</sup>**

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Researching movement patterns of giraffes in relation to climatic factors is important to help understand their habitat preferences and to inform management of these animals. This study aims to explore the movement patterns of male and female giraffes in relation to extreme warm or cold temperature events to determine the influence on movement and habitat preference. Seven male and 11 female giraffes were fitted with GPS collars, for a 12 month period; October 2017-November 2018 in the Rooipoort Nature Reserve, Northern Cape. The spatial distribution and activity data from GPS collars, together with temperature data from a weather station located in the reserve was used for the analysis. Correlations will be made between the weather station data and the activity data of each individual in the reserve. Furthermore, ArcMap will be used to create maps, visually portraying movement patterns of the different animals during an extreme temperature event. Preliminary results show that the temperature in the reserve varies between -1°C in the winter and 31°C in the summer and

that male and female giraffe ranges is far greater in the summer and as compared to winter and autumn.

(Full presentation)

**Climatic correlates of migrant Natal Long-fingered Bat (*Miniopterus natalensis*) phenology in north-eastern South Africa.**

**Mariëtte E Pretorius<sup>1</sup>, Ernest CJ Seamark<sup>2</sup>, Hugh G Broders<sup>3</sup> & Mark Keith<sup>1</sup>**

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Environmental change alters the availability and abundance of resources. For migratory animals, changing weather patterns cause a mismatch between periods of expected and actual resource availability. Here, echolocation data from a maternity site in Limpopo, South Africa were used to investigate the phenology of the migratory Natal Long-fingered Bat *Miniopterus natalensis* (A. Smith 1833). Data from 2013 to 2018 were used to explore patterns of activity between years and relationships of bat activity with photoperiod, temperature, rainfall, dew point, humidity and wind speed. Results suggest that *M. natalensis* show predictable and annual fidelity to this maternity site in northeastern South Africa, highlighting its importance in this species' life history. For *M. natalensis*, photoperiod cues migration to the winter hibernacula (Kendall's  $\tau_b = -0.77$ ,  $p < 0.0001$ ). Cumulative annual rainfall was strongly associated with the magnitude of *M. natalensis* activity (Kendall's  $\tau_b = 0.71$ ,  $p < 0.0001$ ) and is expected to affect bat activity through insect availability. There was significantly less *M. natalensis* activity in 2015 and 2016 ( $p < 0.001$ ), which coincided with the 2014-2016 El Niño-induced drought conditions, which likely impacted resources and led to a reduction in activity and population size. Regardless of climate fluctuations such as drought years and the associated resource shortages, the timing of *M. natalensis* departure from the maternity site was consistent, supporting the contention that the drive to migrate is innate and this may increase the conservation risk of climate change to the species given their phenological response may not be flexible.

(Speed presentation)

***Metrosideros excelsa*: its ecology, invasive status and options for control in South Africa.**

**Nicole Blignaut<sup>1</sup>, Sjirk Geerts<sup>2</sup> & Tineke Kraaij<sup>1</sup>**

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Invasive alien plants are one of the greatest threats to biodiversity, with woody plants the most widely distributed group of invasive organisms globally. South Africa has the second highest number of invasive alien trees of which *Metrosideros excelsa* is an emergent invader in the Overberg region, Western Cape. *Metrosideros excelsa*, the New Zealand Christmas tree, was introduced as an ornamental plant and has subsequently invaded coastal Fynbos on peat soils, thereby threatening rare flora and associated fauna. It flourishes with disturbance, which is common in its invaded peri-urban landscape. Fynbos wildfires increase these cumulative impacts. Additionally, the species exerts high propagule pressure through

self-pollination and release large numbers of wind dispersed seeds. A comprehensive risk assessment is required for this species. Therefore this study aims to assess the status of, and invasion risk posed by *M. excelsa* in South Africa, and explore the species' ecology to inform appropriate management responses by 1) assessing the species' current distribution and abundance, and conduct a risk assessment; 2) assessing post-fire regeneration success in terms of post-fire survival and resprouting vigour of established individuals, and recruitment from seed; 3) quantifying propagule pressure in terms of viable canopy-produced and soil-stored seed banks in burnt and unburnt stands; and possibly 4) determining the most effective foliar applied herbicide for treating post-fire resprouting individuals. The proposed study outcomes will inform appropriate legislative listing and relevant management approaches for the species in the interest of biodiversity conservation.

(Full presentation)

**Extreme male-biased mortalities in mammals: intervention and prevention.**

**Armanda Bastos<sup>1</sup>**

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Extreme gender-biased mortalities are rarely observed. However, from 1993-4 male-biased mortalities were recorded in African elephants (*Loxodonta africana*) from the Kruger National Park and in sub-Antarctic fur seals (*Arctocephalus tropicalis*) from sub-Antarctic Marion Island in 2007. In both cases, there was an extreme bias in mortalities towards adult males in these two sexually dimorphic species, viz. 83% and 100% over an 11 and 1-month period, respectively. Whereas encephalomyocarditis (EMC) virus was confirmed to be the causative agent of the African elephant mortalities, the cause of the mass fur-seal die-off seals could not be determined. This was despite the high rodent population densities associated with both events that signaled the likelihood of EMC virus involvement. The inability to confirm EMC virus presence in invasive house mice on Marion Island, the only rodent species on the island, was likely due to the 6-month interval between the seal die-off and sampling and to the apparently very low levels of virus circulation in rodent reservoir hosts. The latter has been demonstrated through extensive sampling and testing of *Mastomys* reservoir host species in the Kruger National Park. Whenever male-biased mortalities in sexually dimorphic mammals coincide with rodent population irruptions, it is important to secure appropriate samples from both the animal that has succumbed and from sympatric rodents in order to make a definitive diagnosis and identify the reservoir rodent host, respectively. Once EMC is confirmed, counter-measures such as vaccination can be considered, particularly for small, managed populations. Although molecular analyses indicate that the currently available vaccine strain differs from the outbreaks strain that affected African elephants in the 1990s, this vaccine when trialed in South Africa was shown to be protective for African elephants. Efforts to develop a vaccine that matches strains specific to southern Africa are needed to ensure that a viable and effective counter-measure to EMC outbreaks is in place.

(Full presentation)

**The effects of landscape level changes in land use on mammal communities and mesopredator conflict in the SKA region of the Northern Cape, South Africa.**

**Michelle C Blanckenberg<sup>1</sup>, Garry Bronner<sup>1</sup> and M Justin O'Riain<sup>1</sup>**

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The establishment of the Square Kilometer Array (SKA) in the Northern Cape is driving a landscape level change in land use from small livestock farming to a Protected Area (PA). This presents a unique opportunity to design a Before-After-Control-Intervention (BACI) study to investigate the impacts of sheep removal on vegetation and the distribution and abundance of wildlife using three farm types (core – within the PA, edge – neighbouring PA, and control). We predicted that sheep removal would result in 1) increased cover and height of vegetation through reduced grazing pressure, 2) increased small mammal abundance linked to reduced trampling by domestic animals and increased cover, 3) increased medium-large mammal abundance linked to reduced persecution of predators and grazing competition and 4) increased conflict between edge farmers and predators as a result of decreased lethal management within the PA. Baseline results (sheep still present) reveal no significant change in the number of small, medium and large mammal species between the different farm types (core and edge  $17.3 \pm 4.9$ , and control  $15.3 \pm 3.5$ ). Small mammal richness and abundance were consistent between the three farm types. Preliminary results, six months after sheep removal, suggest that predator (i.e. Jackal) abundance increased across farm types, while other medium-large mammal species decreased slightly (i.e. Steenbok). On two farms where sheep were absent for seven years significant changes in vegetation were apparent. However, small mammal richness and abundance had not increased. Increased predator abundance on core farms may have implications in the context of the potential predicted increase in conflict between farmers on edge farms and predators within the PA.

(Speed presentation)

**How big is too small?: Experiences in managing instinctively migratory large mammals in a fenced protected area during a drought**

**Declan M Hofmeyr<sup>1</sup> & Hercules P Nel<sup>1</sup>**

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Extended periods of below average rainfall and above average temperatures can have dramatic effects on fenced protected areas resulting in insufficient annual vegetation renewal and subsequent varying levels of nutritional stress among fenced in wildlife populations. This downward pressure on fenced in wildlife populations can be compounded by a complacency in managing population numbers during above average or average rainfall periods resulting in a population of animals larger than the vegetation reserve can accommodate. We provide discussion on our experiences in managing a fenced in population of large herbivores on the 23,876 hectare Molopo Nature Reserve in the North West Province during an extreme dry season in 2018 and 2019. Rainfall during the season was the lowest since recording began in 1988 while the population of large herbivores was at its highest level since the proclamation of the reserve in 1987. Of special interest is the resurgence of a previously unrecorded apparent migration attempt in the populations of *Taurotragus oryx*, *Connochaetes taurinus* and *Oryx gazelle* with large mixed herds of >100 animals

congregating in the north west corner of the reserve during a prevailing northwesterly wind and, unable to cross the fenced boundary, eventually succumbing to nutritional stress. Extreme events are often stochastic and we re-emphasise the importance of taking a more conservative approach to managing fenced in wildlife populations, particularly in arid areas and in the absence of large predators.

*(Speed presentation)*

**The characteristics of feeding sites used by five specialist browser species in a fragmented Fynbos and Renosterveld ecosystem.**

**Amaurée Jansen van Vuuren<sup>1</sup>, Hervé Fritz<sup>2</sup> & Jan A Venter<sup>1</sup>**

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Human impacts have caused landscapes to alter. Livestock have been introduced to African herbivore ecosystems over millennia. Some of the biggest threats to indigenous herbivores are competition with livestock and the change of land use. The Fynbos ecosystem has a diverse range of indigenous herbivorous mammal species. This includes the bushbuck (*Tragelaphus sylvaticus*), grey rhebok (*Pelea capreolus*), common duiker (*Sylvicapra grimmia*), steenbok (*Rhaphicerus campestris*) and cape grysbok (*Rhaphicerus melanotis*), which is also the focal species of the study. The study was conducted in the Overberg in the Western Cape of South Africa. In the Overberg area, the Renosterveld biome is highly suitable for agricultural practices because of its rolling hills and nutrient rich soils. Currently little natural vegetation remains with the majority of the area being covered in crops. The purpose of the study is to determine the difference in habitat selection between the five specialist browser species and how fragmented landscapes influence habitat selection. Data collected in 2019, using camera traps and micro-habitat analysis, was used to determine the difference in habitat selection between the study species. Preliminary results suggest that the five specialist browser species select different habitat characteristics when selecting feeding sites. This may be influenced by body size. The study is important as it reports on the effect of fragmentation on habitat selection and the effectivity of protected areas and corridors in the Overberg area. This is crucial as there has been a significant amount of investment placed into protected areas, and it plays a large role in conservation.

*(Speed presentation)*

**The implications of transformed landscapes on the occupancy of five specialist browser species in a lowland fynbos and renosterveld ecosystem.**

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Human activities have dramatically transformed the natural environment over the last century and have often resulted in the destruction and fragmentation of habitats which is considered the main driver of biodiversity loss. However, in some areas the transformation of landscapes

through agriculture has resulted in population booms for some animals due to highly nutritious crops. The effect of these transformed landscapes in different regions such as Fynbos and Renosterveld are still unknown. Preliminary results from a study conducted in the Overberg region of the Western Cape, South Africa, provides insight into this issue by comparing the occupancy of five specialist browsing species (*Tragelaphus scriptus sylvaticus*, *Rhaphicercus melanotis*, *Sylvicapra grimmia*, *Palaea capreolus*, *Rhaphicercus campestris*) between a natural and transformed landscape. Data collected from 40 camera traps over 6 months within a 2x2 km grid was analysed in an occupancy and detection framework to assess species occurrence across the natural and transformed landscape. The preliminary results indicate that 3 of the 5 specialist browsing species have a higher occupancy within the transformed landscape compared to the natural vegetation. Factors that may influence the results include food availability, distance from roads, presence or absence of domestic animals, as well as distance from natural vegetation. By understanding how the transformation of landscapes affect wildlife populations, better management decisions can be made in order to help conserve species.

(Speed presentation)

### **Population dynamics of leopards in the Magaliesberg Biosphere Reserve.**

**Leanne Ray<sup>1</sup>, John Power<sup>2</sup>, Nimmi Seoraj Pillai<sup>1</sup> & Brian Reilly<sup>1</sup>**

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Information on leopard population demography is essential for implementing suitable conservation priorities and effective management plans. Currently there are few up to date population size estimates for leopards (*Panthera pardus pardus*) in South Africa, outside of protected areas. In the Magaliesberg Biosphere Reserve (MBR), leopards are keystone species. This leopard population is however believed to be in decline, mainly due to threats such as snaring, reduction in natural prey and illegal killings. A camera trap survey is being conducted to create a spatially explicit capture-recapture model and this is being combined with data drawn from previous research conducted from 2014 to 2015, in order to determine trends in leopard density and population demography. This study aims to assess the present state of the MBR leopard population, by determining leopard density and population demography and to identify high-risk areas for human-leopard conflict. We estimate the population size to be fewer than six individuals, which is predicted to be below carrying capacity for the area, based on the size and the availability of prey in the MBR. Some preliminary results from the second camera trap survey yielded only one individual between October 2018 and February 2019. The research undertaken in this study will provide much needed information to further leopard conservation in South Africa.

(Full presentation)

**Impacts of cattle (*Bos taurus*) grazing pressure on vegetation and soil characteristics in an arid grassland of South Africa.**

**Gert S Botha<sup>1</sup>, Willem Matthee<sup>1</sup> & Anton G Schmidt<sup>1</sup>**

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Natural grasslands are often degraded due to the implementation of incorrect grazing systems. This study aims to increase our understanding of the effects of cattle (*Bos taurus*) grazing intensity on the vegetation and soil characteristics of arid grasslands in South Africa. The effects of a heavy stocking rate in experimental plots (90 cattle for 5 days, followed by a year-long resting period) are compared to a more conservative stocking rate (6 cattle for 14 days, rested for two months, and repeated throughout the study) and ungrazed plots. Forage quantity (disc pasture meter), grass diversity and forage quality (step-point method), and soil compaction (Eijkelkamp hand penetrometer), soil infiltration (Mini Disk infiltrometer) and soil properties (in top- and sub-soil) were measured. Soil properties analysed included pH, NH<sub>4</sub><sup>+</sup>, organic Carbon, P<sup>3-</sup>, Na<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, and K<sup>+</sup>. Under high intensity grazing, NH<sub>4</sub><sup>+</sup> increased significantly in the top soil from before grazing (133 ± 23 %) to post grazing (150 ± 30 %). Soil organic carbon significantly increased in the top soil under high intensity grazing after grazing (1,09 ± 0,46) compared to before grazing (0.89 ± 0.24). Forage quantity differed significantly among treatments across seasons. Soil compaction differed significantly among seasons but not among treatments. We found that different grazing intensities had mixed effects on arid grasslands by affecting soil properties, forage quantity but not vegetation diversity, soil compaction and infiltration. Our study suggests that grazing intensity impacts are context dependant and that these impacts should be tested further.

(Full presentation)

**Effects of short-term intensive trampling on Karoo vegetation.**

**Jeannine McManus<sup>1,2</sup>, Stefan A Goets<sup>1,3</sup>, William J Bond<sup>4</sup>, Joh R Henschel<sup>3,5</sup>, Bool Smuts<sup>1,2</sup> & Suzanne J Milton<sup>3</sup>**

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Plant growth forms likely respond differently to disturbances such as trampling. We investigated the trampling effect of 1 600 sheep encamped at night in temporary enclosures (kraals, corrals or pens), which were relocated weekly. To examine trampling effects and regeneration rates of the various growth forms we compared vegetation composition, canopy cover and foliar nitrogen inside and outside kraals, between one and 12 months after the trampling event. We predicted that inside kraals (1) succulent and non-succulent shrubs would be affected more severely than grasses, (2) perennial plant cover would decrease compared with annual plant cover, (3) foliar nitrogen concentrations would increase, and (4) vegetation recovery would be affected by time and rainfall since last use of the kraal.

Grasses and shrubs (succulent and non-succulent) responded differently to kraaling. Density and diversity of succulent and non-succulent shrubs decreased, while annual and perennial grass cover inside and outside kraaling areas did not differ. Foliar nitrogen was greater inside kraals. Both succulent and non-succulent shrub cover increased over time after kraaling irrespective of the rainfall. Our study demonstrates that short-term intensive trampling and dunging creates nutrient-rich, heterogeneous patches that may enhance restoration of degraded production landscapes.

(Speed presentation)

**Diet and feeding ecology of aardvark (*Orycteropus afer*) in the Great Fish River Nature Reserve.**

**Amy Hunter<sup>1</sup> & Nokubonga Mqgatsa<sup>1</sup>**

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While the feeding ecology of aardvark has been studied, there are contrasting ideas regarding the relative importance of ants and termites in their diet. Given that ants and termites are ectotherms, climate change is likely to alter their abundance and distribution, thus affecting aardvark. Therefore understanding the feeding ecology of aardvark will provide an insight into the potential impacts of climate change on the population of aardvark. This study assessed the feeding preference of aardvark in the Great Fish River Nature Reserve (GFRNR), a semi-arid area in the Eastern Cape, South Africa. We predicted that the diet of aardvark would vary with season and abundance of ants and termites. We tested this hypothesis, using pitfall traps to sample ant and termite populations in areas with dense and sparse vegetation, for a one-week period during both wet and dry seasons. Fresh faecal samples were collected opportunistically during each season, and prey items were identified using the undigested head capsules of ants and termites. Aardvark at GFRNR consumed a lower proportion of ants and higher proportion of termites compared to other studies conducted in the Karoo. Termites formed a more significant component of aardvark diet during the dry season. It is suggested that the less physiologically demanding environment of the GFRNR compared to more arid and unpredictable regions like the Karoo facilitates “pickiness” in aardvark diet, allowing more selection and less opportunistic feeding.

(Speed presentation)

**Seasonal dietary composition of white rhinoceros on Karongwe Game Reserve.**

**Kobus Havemann<sup>1</sup>, Kerry Slater<sup>1</sup> & W Maartin Strauss<sup>1</sup>**

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Although white rhino (*Ceratotherium simum*) were reintroduced to Karongwe Game Reserve in the Limpopo province during 2000. Information regarding their diet on the reserve is unknown. An investigation into the seasonal diet of the white rhino on Karongwe was undertaken through the use of microhistological faecal analysis. A total of 42 faecal samples, equally spread across the dry (April-September) and wet (October-March) seasons, were collected. A total of 4 200 plant fragments were examined. Of these fragments 3 191 (76%) were grass, 231 (6%) forbs and 62 (2%) woody species. A further 716 fragments, 17% of the total assessed, could not be identified. We identified 23 grass species in the diet of the white rhinos, with the top four species comprising 48.2% of the annual diet. *Cynodon dactylon*

contributed most (20.3%) towards the annual diet, followed by *Urochloa mosambicensis* (13.7%), *Eragrostis curvula* (7.1%) and *Digitaria eriantha* (7.1%). The wet season diet showed a decrease in the frequency of occurrence of *Cynodon dactylon* and *Urochloa mosambicensis*. The dry season showed an increase in the frequency of *Digitaria eriantha* and *Panicum deustum*. The total number of grass species identified in the dry season samples were higher (n = 23) than in the wet season samples (n = 17 species). Based on an analysis of similarities (ANOSIM) the white rhinoceros diet composition differed significantly between seasons.

(Full presentation)

### **Effects of space use on fitness in African wild dogs.**

**David G Marneweck<sup>1</sup>, Dave J Druce<sup>2,3</sup>, Chris Kelly<sup>4</sup>, & Michael J Somers<sup>1,5</sup>**

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Space use strongly affects fitness where non-linear ecological variables drive spatial arrangements in carnivores. However, extreme variation in ecological factors is difficult to test empirically, especially in open systems. We used a reintroduced and spatially restricted population of African wild dogs (*Lycaon pictus*) in Hluhluwe-iMfolozi Park to investigate factors affecting space use and the subsequent fitness effects over 22 years. This population has a wide range in density simultaneous to high levels of interspecific competition and extreme variation in prey. Larger territories were associated with larger packs but there was also an inverse effect of lion density on territory size. We also found an inverted-U shaped effect of intraspecific competition on territory size with a positive effect at low density, no effect at intermediate density and an inverse effect at high density. These results collectively suggest that wild dogs adjust territory size to ensure adequate resource intake while avoiding dominant competitors like lions. We found non-linear effects of prey and lions on territorial overlap, with results suggesting that territoriality is economically feasible when monopolising low or high amounts of resources at low and high levels of intruder pressure. Ultimately, the highest levels of fitness were realised in the largest and most exclusive territories. However, inter-pack overlap occurs in response to avoiding dominant competitors, but this only occurs when there is enough food. This illustrates that co-existence for wild dogs at high levels of interspecific competition is possible when the ecological condition of high prey availability is met.

(Full presentation)

**Futuristic climate change scenarios predict a shrinking habitat for the African elephant (*Loxodonta africana*): evidence from Hwange National Park, Zimbabwe.**

**Kudzai Shaun Mpakairi<sup>1</sup>, Henry Ndaimani<sup>1</sup>, Paradzayi Tagwireyi<sup>1</sup>, Mark Zvidzai<sup>1</sup> & Tinaapi Hilary Madiri<sup>2</sup>**

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The earth is gradually warming and will likely exceed the 2°C threshold by 2050. Species range shifts and extinction are imminent from the temperature increase especially in human dominated landscapes. Several regions are projected to become less habitable as a result of heat stress, reduced water availability and other secondary effects (e.g. diseases). As such the future of the African Elephant (*Loxodonta africana*) remains uncertain when pressure exist from habitat loss, poaching and temperature anomalies. In this study, we tested whether there would be any change in the 2050 potential distribution of the African elephant in the Hwange National park, Zimbabwe. We used Stochastic Gradient Boosting with elephant presence as response and distance from the park boundary, temperature seasonality, precipitation of the wettest month, land cover and annual precipitation as predictor variables. Results showed that predicted elephant habitat will likely shrink by 40% in 2050 from the potential present range of 146.76 km<sup>2</sup>. Our model on the current potential habitat of elephants was successful (AUC = 0.76) as well as for the projected habitat using RCP 8.5 data (AUC = 0.87). Our findings are amongst the first to show the likely effect of projected climate on the potential distribution of elephants in a savannah ecosystem. This study endorses the notion that anthropogenic interference negatively influences the elephant habitat size dynamics especially in human dominated landscapes currently but size of the elephant habitat will be driven mainly by temperature seasonality in the future.

## Theme 2: Methods and approaches for wildlife management and conservation

(Full presentation)

**Mammal Assemblage Integrity Index: a tool for measuring protected area effectiveness in mammal biodiversity conservation.**

**Mika M Vermeulen<sup>1</sup>, Jan A Venter<sup>1</sup>, Hervé Fritz<sup>1</sup> & W Maartin Strauss<sup>2</sup>**

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There are two tools that protected area managers can use to measure conservation effectiveness, and consequently biodiversity status in South Africa; the Threshold of Potential Concern used by SANParks, and the Management Effectiveness Tracking Tool used by conservation agencies under the auspices of the Department of Environmental Affairs. However, after reviewing both local and global assemblage integrity indices and conservation effectiveness tools we found numerous examples where they have failed to successfully measure the effectiveness of protected areas in protecting mammal biodiversity. These failures were largely attributed to poorly-defined and executed monitoring programmes.

Under escalating anthropogenic-driven impacts, managers are neither effective in measuring changes in mammal biodiversity, nor the subsequent effects on protected areas. A critical gap in our knowledge on conservation effectiveness is knowing the numbers and types of biodiversity features and how effectively they are being conserved. Not knowing how successful we are in conserving biodiversity features suggests that we could be experiencing greater biodiversity loss than previously anticipated. Therefore, ecosystem integrity could be collapsing without us realising. To help address these issues we are working towards the development of a Mammal Assemblage Integrity Index. Here we present a comprehensive review of integrity indices used both locally and globally, investigate the causes of their failures and suggest what we believe to be the fundamental components of an effective integrity index. We anticipate that the integrity index will assist managers in effectively measuring changes in biodiversity features over time, thereby facilitating conservation effectiveness in protected areas

*(Speed presentation)*

**Assessing mammal diversity and the effectiveness of different methods for monitoring mammal diversity in diverse land tenures in a South African arid ecosystem.**

**Chloe Burt<sup>1</sup>, Mark Keith<sup>2</sup>, Herve Fritz<sup>1</sup>, Chloe Guerbois<sup>1</sup> & Jan Venter<sup>1,2</sup>**

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Management and conservation actions are only as effective as our ability to monitor and assess diversity measures and trends. We therefore need to assess which methods are efficient and effective at assessing mammal diversity. We assessed 9 different methods: camera traps, small mammal traps, track plates, mist nets for bats, acoustic surveys, spotlight surveys, and block transects recording individual animals, scat, and tracks. We also conducted interviews to assess local knowledge, which we will verify with the other methods. We surveyed at Erin game-hunting farm and in the livestock farms in the Khomani San Community Protected Area. The combination of field survey methods detected 26 species in Erin and 27 in the livestock area. Species-accumulation curves presented differences in the amount of time needed to effectively survey the area between the land-tenures, the curve asymptotes around day 5 in Erin, but with the livestock areas only on day 8. Community member interviews identified a total of 37 species in Erin and 33 species in the livestock area. The main difference between interviews and what we detected is likely due to some trap shy rodent species. Our preliminary results suggest that there is no major difference in mammal diversity between the livestock and game-hunting areas. Block transects looking for tracks were the most effective method in both areas, as it detected the most species. However more effort is needed to effectively survey mammal diversity in the livestock area.

(Full presentation)

**When does fencing and metapopulation management become necessary for the conservation of wild Cheetah (*Acinonyx jubatus*) populations?**

**Vincent C van der Merwe<sup>1,3</sup>, Nick Dowhaniuk<sup>2</sup>, Harriet Davies-Mostert<sup>1,4</sup>, & M Justin O’Riain<sup>3</sup>**

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Cheetahs (*Acinonyx jubatus*) have been eradicated from 91% of their historical distribution during the Anthropocene. Broad-scale spatio-temporal trends suggest that the reduction of wild Cheetah populations is largely a consequence of anthropogenic disturbance, and the duration of exposure to such disturbance. In order to test this hypothesis, we used Random Forest Modelling in the form of unbiased conditional inference trees to analyse the impacts of livestock density, human density, road density, protected areas, and climate on Cheetah occurrence. Based on multiple diagnostic methods including conditional variable importance measures and the calculation of partial dependence, the model suggests that protected areas, human population density, road density, and ruminant density are important variables in predicting Cheetah occurrence. We then projected this model into the future using multiple climate and human population growth scenarios to view future spatio-temporal trends in Cheetah occurrence. The current conservation strategy for Cheetah advocates a paradigm shift towards a more holistic approach that incentivises protection and promotes sustainable human-wildlife co-existence across large multiple-use landscapes. While this is an ideal scenario, in reality the only wild Cheetah population in the world that is expanding in range is the fenced metapopulation. This growth is largely attributed to the effectiveness of predator-proof fencing which reduces spatial overlap of wild Cheetahs with human dominated landscapes. Regardless, 77% of current Cheetah range still occurs outside of protected areas. Further research should closely scrutinise remaining free roaming wild Cheetah populations outside of protected areas to identify the levels of anthropogenic pressure they can withstand.

(Full presentation)

**Can leopard pelage patterns be used to determine relatedness?**

**Lucy K Smyth<sup>1,2,3</sup>, M Justin O’Riain<sup>1,2</sup>, Ross T Pitman<sup>2,3</sup> & Guy A Balme<sup>2,3</sup>**

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Leopards (*Panthera pardus*) are widely distributed throughout Africa, Asia and parts of the Middle East, but have suffered substantial population declines in recent times. Reliable monitoring of populations is essential to inform ongoing and future efforts to conserve leopards. For cryptic, wide-ranging species like leopards, this is best achieved using camera-traps because the unique markings of individuals allow population density to be estimated using spatial capture-recapture models. However, such markings may be able to provide additional information on population dynamics and health, including relatedness among

conspecifics. We used *HotSpotter*, a pattern recognition program designed specifically for use on wild animals, to generate similarity scores between flank images of 118 leopards with known relatedness, photographed in the Sabi Sand Private Game Reserve. Additionally, we manually generated whisker-spot dissimilarity scores for these individuals. Similarity scores correlated positively with relatedness scores among both flank rosettes and whisker-spots. However, these relationships were tenuous, with one degree of familial separation increasing flank similarity scores by 1.55 units and decreasing dissimilarity scores with regards to whisker-spot number, total position and mean position by 1.54, 3.32, 0.32 units respectively. This suggests that phenotypic resemblance in leopard markings does not provide a strong enough indication of relatedness to be of use within populations. It may, however, have applications for comparisons at a broader geographic scale, particularly with regards to determining the origin of illegally traded leopard skins, thus providing a tool to help identify areas of management concern.

(Speed presentation)

### **A comparative study of bird flight height: man vs photogrammetry.**

**Francis R Martens<sup>1</sup>, Morgan B Pfeiffer<sup>2</sup>, Colleen T Downs<sup>3</sup> & Jan A Venter<sup>1</sup>**

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Flight height of large soaring birds is influenced by topographic and climatic conditions, putting them at risk with wind energy development (WED). Various techniques to identify collision probability are available in South Africa. Monitoring of flight height through ground observations is considered a suitable method in environmental impact assessments prior to WED. The accuracy of such methods however remains unknown. This study aimed to compare accuracy of ground observations with photogrammetry observations. Photogrammetry is a well-established science that makes use of photographs to measure features. The study was conducted at a vulture restaurant adjacent to the De Hoop Nature Reserve, Western Cape Province, South Africa. The reserve holds a southern African endemic bird species, the Cape Vulture (*Gyps coprotheres*), currently listed on the IUCN Red List as "Endangered". With the establishment of a WED close to the colony, the Cape Vulture is a priority species for determining flight height. Photogrammetry flight height was recorded with three DLSR cameras. Photographs were uploaded to PhotoModeler to determine flight height. Ground observations were conducted by inexperienced and experienced observers. Accuracy of flight height between observers and photogrammetry was tested. Accuracy of flight height between inexperienced and experienced observers was tested. Accurate flight height may help to mitigate collision probability of large soaring birds with WED's.

(Full presentation)

**Rehabilitation method affects welfare and adaptation potential for subsequent release of orphaned white rhinoceros.**

**María C Fàbregas<sup>1</sup>, Geoffrey T Fosgate<sup>2,3</sup>, André Ganswindt<sup>3,4</sup>, Henk Bertschinger<sup>2,3</sup>, Markus Hofmeyr<sup>1,5</sup> & Leith Meyer<sup>1,3</sup>**

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Poaching is the primary threat to the survival of rhinoceros' populations. One frequent consequence of poaching is the creation of orphan calves. If found, orphans are taken into captivity for rehabilitation and subsequent release. However, rehabilitation practices can influence the welfare and adaptation potential of these animals, potentially compromising their post-release adaptation and survival. In this study, the effects of hands-on and hands-off rehabilitation methods on the welfare and adaptation potential of orphaned white rhinoceros (*Ceratotherium simum simum*) were compared. To achieve these aims, welfare and adaptation potential were assessed against 12 behavioural, one physiological, and five physical variables on 25 orphaned rhinos at two rehabilitation facilities in South Africa. Results showed significant differences in six out of the 12 behaviours measured. Orphan welfare was not compromised under either rehabilitation method, but hands-off rehabilitated rhinos showed better overall welfare, as indicated by fewer indicators of poor welfare. Regarding adaptation potential, hands-off rehabilitated rhinos reacted to human presence, and alert and defence behaviours were part of their behavioural repertoire. The hands-on cohort, on the other hand, were less social, showed habituation to humans, and seldom expressed alert or defence behaviours, which could potentially compromise their survival and social integration once released into the wild. Post-release studies are required to confirm whether adaptation and survival are compromised in hands-on rehabilitated rhinos. Until then, we suggest a conservative approach where facilities that rehabilitate animals for the purpose of reintroduction minimize anthropogenic exposure.

(Speed presentation)

**The application of digital soil mapping to South Africa's protected areas: A study of Phinda Private Game Reserve.**

**Pierre J Fourie<sup>1</sup>, Gerhardus P Nortjé<sup>1</sup> & George M van Zijl<sup>2</sup>**

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With the development of digital technology during the last decade and the improvement of geographic information systems (GIS), it has become easier for various scientific fields to predict and extrapolate data. These can also be effectively applied in the field of pedology. Traditional soil mapping, although effective and an essential part of digital soil mapping (DSM), is time consuming, arduous and expensive. Conservation areas, such as Phinda

Private Game Reserve, which covers a large area (more than 28 000 ha) can benefit from a soil map for wildlife management and planning. A proper soil map has many important applications in conservation management, but unfortunately, most conservation areas do not have a soil map. DSM makes it possible and affordable for conservation areas to have its own soil map. Substantial research and development has gone into the development of methodology and software systems for DSM although it has never been applied to conservation management thus far. By applying these techniques, accurate and interactive soil maps can be developed without the burdensome expenses or dangers associated with soil sampling in a conservation area. A DSM can be presented to conservation management whereby planning can be conducted, literally, from the ground up. Combining soil information with other GIS layers (vegetation, animal sightings, topography, water bodies etc.), conservation organisations can obtain better-informed decisions. These decisions, in turn, prevent long-term soil and biodiversity loss while still providing clients with a true African bush experience.

(Full presentation)

**Sign-based surveys for vertebrates across arid and semi-arid Australia using 2 ha plots: occupancy estimates for key species from the Great Sandy and Great Victoria Deserts.**

**Rick Southgate<sup>1</sup>, Martin Dziminski<sup>2</sup>, Karajarri Rangers, Nyangumarta Rangers, Yawuru Country Managers & Oak Valley Community**

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Our understanding of the distribution and relative abundance of invasive and native wildlife species across the arid regions of Australia remains poor because conventional methods to monitor medium-sized species are largely unsuited for broad application. Information on the status and threats posed by species is based largely on presence-only data and there is little information on the efficacy of wildlife mitigation or restoration initiatives applied at a landscape scale. We describe a technique using a 2 ha plot searched for animal tracks and sign. A range of detection and occupancy covariates are recorded and plots are spaced >5 km apart. As an example, the occupancy and detection estimates for key native species are compared from a large study area in the north-western part Australia where invasive foxes and rabbits are scarce with another large study area in central-southern Australia where these species are common. The technique is now being widely applied by Indigenous ranger groups, government agencies, arid zone ecologists and consultants.

(Speed presentation)

**Analysis of the effect of heavy metal distribution on the browsing patterns of giraffes (*Giraffa camelopardalis*).**

**Jeaneme Kuhn<sup>1</sup>, Hendrik Visser<sup>1</sup>, Marietjie Schutte-Smith<sup>1</sup> & Francois Deacon<sup>2</sup>**

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Giraffes (*Giraffa camelopardalis*) are undergoing a silent extinction, with an approximate 40% decline in population size during the last 30 years. The decrease in giraffe numbers predominantly is due to anthropogenic activities and the resultant habitat transformation. Moreover, rapid industrialization and urbanization has led to an increase in environmental toxins, including radio nuclides, heavy metals and various types of inorganic substances. In

wildlife, an increase in heavy metal concentration results in impaired reproduction, mutagenicity, carcinogenicity, immunosuppression, poor body condition, and finally death. Little attention has been given to the importance of heavy metal distribution within giraffes. Therefore, this research investigated heavy metal distribution and the browsing patterns of giraffes in the Rooipoort Nature Reserve outside Kimberley. In total, 60 soil and 60 leaf samples were collected, 40 samples from sites where the giraffes were observed most and 20 sites that they had access to but did not utilize. Water samples were collected from the Vaal River as well as from the water holes in Rooipoort Nature Reserve. Preliminary qualitative analyses confirmed the presence of heavy metals, including aluminum (Al), copper (Cu), and manganese (Mn) in the soil and water samples from Rooipoort Nature Reserve. Future work will focus on quantitative analyses of all samples to determine the heavy metal concentration within each sample. In addition, the effect of each heavy metal must be investigated as well as the threshold levels of each heavy metal within giraffes.

*(Speed presentation)*

**Investigating aspects that are considered during the development of a non-invasive BCS (Body Condition Score) for giraffes (*Giraffa camelopardalis*).**

**Amaria Janse van Rensburg<sup>1</sup>, Francois Deacon <sup>1</sup> & Jamie Paulse<sup>1</sup>**

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Effective body condition scores (BCS) have been developed for different wildlife species, and entails the recognition of the body condition changes over time. However, the only existing BCS system and criteria was developed by Kearney & Ball (2001) (EAZA Husbandry guidelines) on giraffes in captivity. In extensive wildlife systems, variable factors, such as habitat fragmentation and subsequent food shortages, are known causes of loss of physical body condition in herbivores. With the rapid reduction of giraffe populations and habitats in Africa, the understanding and improvement of natural resource management in relation to animal wellbeing is important. The aim of this study is to investigate links between habitat and animal health in extensive systems by adjusting the current *in-situ* BCS-criteria.

Factors influencing physical body condition will be evaluated through weekly monitoring of five extralimital giraffe populations in game reserves within the Free State. These factors include food availability and quality, as well as the presence and density of internal parasites. Parasite load will be determined through the collection and inspection of faeces, with food availability and nutritional composition being calculated and determined through tree biomass quantification (BECVOL-model) and foliage nutrient quality testing respectively. It is hypothesized that fluctuations in the parasite-load are linked to factors, such as rainfall influencing food availability, feeding habits and management practices leading to possible changes in physical condition. If this non-invasive approach allows for physical conditions of giraffes to be evaluated, it can be used to manage giraffe populations and remaining natural resources more effectively.

(Full presentation)

**Using the present to uncover the past: Reconstructing the ecology and behaviour of extinct large mammals on the Palaeo-Agulhas Plain (south coast, South Africa).**

**Christopher F Brooke<sup>1,2</sup>, Curtis Marean<sup>1,3</sup>, Jacob A Harris<sup>3</sup> & Jan A Venter<sup>1,2</sup>**

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Understanding the ecological role of extinct large mammals is an ongoing challenging research problem. The use of species traits (physical and behavioural) to characterise functional communities is becoming common in ecological modelling and is key to understanding the ecological role that species would have filled under historic conditions. This same approach may help elucidate the ecological role of extinct species. Here we illustrate this approach with extinct species of the Palaeo-Agulhas Plain (PAP) during the last glacial maximum (24-18 thousand years ago). Using functional groups representing an array of characteristics displayed by similar species (e.g. social behaviours, stress response, forage choice, and interpretation of the landscape) we can understand the ecological niche that the extinct species of the PAP would have filled. To relate current behaviour of large mammals to those that are now extinct we determined functional groups of extant species (southern and east Africa) using hierarchical and k-means cluster analysis. Model outputs predicted six functional groups explaining 92% of the variation in the data that grouped both the extinct and extant species of the PAP, through known taxonomic and feeding guild characteristics. This provides us with an understanding of the ecological and behavioural characteristics of extinct large mammals and the integral part these species played in the PAP landscape.

(Full presentation)

**First guidelines and ethical protocol for surveying African elephants (*Loxodonta africana*) with an unmanned aerial vehicle.**

**Wesley Hartmann<sup>1</sup>, Alison J Leslie<sup>1</sup> & Vicki Fishlock<sup>2</sup>**

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The use of unmanned aerial vehicles, commonly called drones, in ecological and conservation research is rapidly becoming common practice. While the ways in which drones can be utilized are numerous and well understood, the influence they have on the intended study species is not. Therefore, impact studies leading to recommendations for best flight protocols are urgently needed. We investigated the behavioural responses of African elephants (*Loxodonta africana*) to the approach and sustained presence of a drone. The impact of approach speed (2, 4, 6 m/s), angle (45°, 90°) and starting altitude (30, 50, 100 m) was quantified, as well as the impact of sustained flight speed (2, 4, 6 m/s) and flight pattern (fixed-height vs varied-height). A successful approach/flight was defined as reaching/maintaining a straight-line distance of 30 m between the elephant(s) and drone without eliciting a strong behavioural response from an adult elephant. A failed flight would be if an adult elephant displayed any signs of agitation (head shakes, flexed ears, etc.), aggression or an active flight response. To date, 70 flights have been conducted with a DJI

Mavic Pro in Majete Wildlife Reserve, Malawi. Preliminary trends indicate the highest rates of success using slow approach speeds, a 45° approach angle, and a fixed-height flight pattern. Starting altitude appears to have little impact on elephant behavior whereas an approach from directly above (90°) almost always resulted in failure. Further similar studies are encouraged and should assess the impacts of the various types of drones on other taxa.

*(Speed presentation)*

**The effect of harvesting method and short-term storage on the viability of epididymal African buffalo (*Syncerus caffer*) spermatozoa.**

**Maira M van Leeuwen<sup>1</sup> & Helet Lambrechts<sup>1</sup>**

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The African buffalo features strongly in ecotourism, game ranching and trophy hunting. Limited information is available on the processing of African buffalo sperm to ensure viable samples that can be stored in a genome resource bank for this species, which can then be used for production and conservation purposes. The study investigated the influence of harvesting technique and extended liquid storage on the viability, morphology, morphometry and acrosome integrity of epididymal buffalo spermatozoa. Testes were collected from 24 adult African buffalo bulls that were culled as part of routine tuberculosis monitoring. Testes were processed immediately after harvesting, as well as after 24 hours of storage at 5°C. Harvested spermatozoa were either analyzed immediately, or after storage at 5°C for 24 hours. Sperm samples analyzed immediately after retrieval of the testes were characterized by the highest mean motility ( $1.75 \pm 0.284$  on a scale of 1-5). Acrosome integrity of sperm harvested immediately after testis collection was on average  $12.07 \pm 5.92\%$ , which did not differ from that of sperm harvested 24h after collection and stored for 24h at 5°C ( $12.71 \pm 4.8\%$ ). The testes that were processed 24h after harvesting with spermatozoa analysed immediately resulted in the highest mean viability (percentage live spermatozoa) ( $84.98\% \pm 1.39\%$ ) and the lowest mean percentage of abnormal morphologies ( $26.66\% \pm 2.86\%$ ). Preliminary findings from this study provide valuable insight into the potential to maintain sperm viability in a scenario where testes cannot be processed immediately after being collected from culled animals.

## Theme 3: Social- ecological approaches to wildlife management

### Keynote 2

#### Embracing the challenges and opportunities of wildlife conservation in the Anthropocene

**Chloé Guerbois**<sup>1</sup>

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In the Anthropocene, humans are compromising their own fate by suppressing biological diversity on Earth and rapid social and environmental changes are triggering conservation conflicts. Biodiversity intrinsic values and ecosystem services have been used to raise awareness in modern societies, unravelling the interdependences between the state of our planet and humans mental and physical well-being. Since the Millennium Ecosystem Assessment, many schools of thought around the world have explored sustainability pathways, from sustainable development to biosphere-based sustainability. Social-ecological approaches to biodiversity conservation have been emphasised for the past 10 years resulting in more integrative land-use planning, public participation and collaboration. I will use contrasted social-ecological research examples in Southern Africa to illustrate the importance of appropriate frameworks and openness to transdisciplinary and co-learning to inspire societal changes. I will show how large scale processes are affecting the resilience of small communities of subsistence farmers and protected areas in Hwange District, Zimbabwe. Inversely, in South Africa's Garden Route, the use of social media and participatory approaches is providing platforms for improving human-baboon coexistence locally and more broadly. Place-based and long-term research, reflective and anticipatory approaches are essential tools to engage with local stakeholders and sustain societal changes. However, there is a need to embed these learning opportunities in governance systems to influence political agendas and power relationships, to enable collective actions.

(Full presentation)

#### **Assessment of chacma baboon crop preference as a foundation for developing crop foraging mitigation techniques.**

**Leah J Findlay**<sup>1</sup>, **Sara Guidolin**<sup>2</sup> & **Russell A Hill**<sup>1</sup>

<sup>1</sup> *Department of Anthropology, Durham University, Durham, UK*

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Conflict between crop farmers and primates is a world-wide conservation issue of increasing concern. Despite its increasing severity there are very few accounts of effective techniques that deter primates from crop fields, especially within a commercial setting. Working in partnership with local commercial farmers in Alldays, Limpopo, South Africa we obtained baseline information on primate crop foraging behavior. However, what we currently lack is an understanding of the types of crops that are preferred by primates, and as such which crops they would be willing to take higher risks to obtain. We conducted paired crop preference trials on chacma baboons (*Papio ursinus*), the species often cited as causing

most crop damage. Alongside this, we gathered information on farmer perceptions of baboon crop preference to evaluate whether the two match. Melon and watermelon were significantly preferred over the other crops tested, while peppers were only eaten when nothing else was available, and chilies were avoided altogether. Farmer perceptions generally agreed with this outcome. These results enable us to make recommendations to crop farmers regarding mitigation techniques, depending on what they cultivate.

(Full presentation)

**Different types of land-use by the private wildlife industry of South Africa.**

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The purpose of this research was to determine the different land-use practices of the private wildlife industry of South Africa. Dickinson and Shaw (1977) define land use as man's activity on the land or the purpose for which the land is being used. Wood (2019) add to this by defining land use as the function or functions that humans apply to the land available to them. The study of land-use is thus the study of how land is managed, including how the natural world is adapted to human needs. A semi-structured questionnaire was used to interview 223 private wildlife establishment owners or managers, at fifteen wildlife auctions spread across South Africa, as well as at the 2017 Wildlife Ranching South Africa (WRSA) annual symposium. Five land-use practices, namely hunting, breeding, ecotourism, by-products (i.e. meat production, curios, and leather products) and mixed farming (i.e. wildlife and crops or wildlife and livestock) were identified. The research further compared the size of the land and the province the land is located in, with the identified land-use forms. The results revealed that different land sizes and provinces have distinctly different land-use types and can provide practitioners with guidelines on suitable practices across a gradient of farm sizes in the respective provinces. It also provides suggestions on which land use practices would be more resilient to specific changes (i.e. the decline in game prices) in the wildlife industry.

(Full presentations)

**Farmers' local ecological knowledge best predict risk of carnivore predation on livestock in northern Botswana.**

**Lucas P Rutina<sup>1, 2, 3</sup>, K Mogwera<sup>3</sup> & M Makonyela<sup>3</sup>**

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Farmers' Local Ecological Knowledge (LEK), landscape variables, livestock husbandry and management variable and predator-prey interaction have been individually suggested to influence carnivore predation on livestock. We used spatial and temporal data to model the interactive influence of these factors in predicting potential risk areas for three carnivore's (lion (*Panthera leo*), leopard (*Panthera pardus*) and wild dog (*Lycaon pictus*)) predations on livestock in Makgadikgadi agro-ecosystem, northern Botswana. The data used include incidents of carnivore predation on livestock, landscape variables, density of carnivores,

predator preference of wild and domestic prey and farmers. The data on carnivore predation on livestock was obtained from Botswana Department of Wildlife and National Parks. For LEK, farmers were interviewed on their perceptions on each carnivore risk (knowledge about where the predator tend to be, when, movement patterns, and prey choices). For livestock husbandry and management variables included cost of the predation to the livelihoods and husbandry used to mitigate the risk. Line transects were used to determine carnivore and their preferred prey abundances. Landscape variables used included Normalized Difference Vegetation Index (NDVI), Fractional Cover, aspect, terrain ruggedness, slope and climate. The data was subjected to hierarchical multivariate analysis which showed landscape variables to have accounted for 2%, 8% and 3% for lion, leopard and wild dog, respectively. Abundances of carnivore and their preferred prey accounted for 6%, 11% and 8% for lion, leopard and wild dog, respectively. Local ecological knowledge predicted 5, 2%, 12% and 5% for lion, leopard and wild dog, respectively, while livestock husbandry and management predicted 10%, 0% and 7% for lion, leopard and wild dog, respectively. The results revealed the importance of involvement of local communities in human–wildlife conflict management and hence calls for a change in the management of human–wildlife conflict.

*(Speed presentation)*

### **Shifting paradigms and the relevance of South Africa's current conservation model.**

**Peter J Mills<sup>1</sup> & Brian K Reilly<sup>1</sup>**

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Conservation paradigms have been subject to constant paradigm shifts since the mid nineteenth century with particularly significant changes in the late twentieth century. Growing human populations in sub-Saharan Africa, the rise of the environmental movement, animal rights, international Non-Government Organisations (NGO's), poor socio-economic circumstances, unstable political environments and international treaties prompt the question – Is the current conservation paradigm in South Africa relevant and will it ensure the long-term sustainability of biodiversity. It has become apparent, after a review of literature on various approaches to conservation practice manifested in an increasing need for protection of species within the conservation estate and degradation outside the conservation estate together with private, and even government disinvestment, is not ecologically sustainable. Alternative approaches should explore different models for conservation that must include several key parameters. These parameters should comprise people and their activities in living landscapes taking cognisance of biodiversity hotspots, coolspots and centres of endemism while not excluding novel and altered environments. This paper will begin to explore the disjuncture that exists within ever changing philosophies and paradigms that drive conservation practice.

(Speed presentation)

**Baboon crop raiding patterns and farmer perceptions of deterrent methods in Waboomskraal, Herold and George agricultural areas in the Western Cape, South Africa.**

**Keesha Chetty<sup>1</sup>, Brandi Wren<sup>2</sup> & Bianca Currie<sup>1</sup>**

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Human-wildlife conflict is an increasing problem in the Anthropocene, an era in which co-existence strategies are required. The Chacma baboon (*Papio ursinus*) is a species often coming into conflict with farmers in the agricultural sector, causing damage to crops and infrastructure. Research carried out throughout Africa has identified crop raiding baboon deterrent methods that include, visual deterrents (chasing and patrolling), aural deterrents (shouting and firing warning shots), physical deterrents (electric fences), lethal deterrents (shooting), chemical deterrents (irritates and contraceptives), and capture deterrents (snare and traps). However, little research has been carried out to understand which methods are used and perceived to be effective by farmers in the Garden Route. This presentation introduces research currently being undertaken to understand baboon crop raiding patterns and farmer perceptions about deterrent methods used in the Waboomskraal, Herold and George areas. Data are being collected using semi-structured interviews and log books. The interviews are being used to elicit farmers' experiences and opinions related to baboon raiding, and the methods used to deter them. The log books aim to capture baboon raiding patterns, deterrent methods being used, and their perceived effectiveness over a year. Baboon movement through the raided farms is being mapped using GIS to identify raiding patterns. The data collection is still in progress and results of this research will be available in 2020. This research will aid in understanding baboon raiding patterns in the study area and how best farmers can deter baboon crop raiding in an effort to co-exist with the species in the Anthropocene.

(Full presentation)

**Participation: practical lessons from a provincial game reserve in North West province, South Africa.**

**Ian Gordon-Cumming<sup>1</sup> & Kevin F Mearns<sup>1</sup>**

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Systematic reviews of multiple case studies have highlighted participation as one of the most important strategies for generating local community support of protected areas in developing countries. Participation, however, takes many forms, is complex and there are several challenges in execution. This research investigated the nature and main characteristics of participation at Borakalalo National Park, a 14 873 ha provincial game reserve in North West province. A pragmatic, embedded single case study approach was applied across five neighbouring communities. Borakalalo staff were also interviewed in an attempt to triangulate findings. Data from 150 household surveys, a series of focus group discussions and semi-structured interviews were analysed. Results indicated key variances between village and park authority viewpoints. Over 70% of the community respondents stated that they are not involved and that there is little or no relationship with Borakalalo. By comparison park authorities considered the relationship was improving. Identified challenges included minimal formal communication channels, which were both intermittent and unmonitored.

Further comparisons between the two groups advised not only were current communications ineffective but to a degree were also a prime reason for much of the mistrust highlighted in the study. A greater appreciation of the true value and complexities of participation as well as identifying and establishing more effective everyday interactions with individual communities could improve the relationship, mitigate against unrealistic expectations and help lay foundations for building longer-term sustainable solutions.

(Full presentation)

### **The corruptness of corruption: A rhino case study.**

**Sam Ferreira<sup>1</sup>, Ian Glenn<sup>2</sup> & Johan Jooste<sup>3</sup>**

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<sup>2</sup> *Communications Sciences, University of the Free State, Bloemfontein*

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Rhino crimes are presently dominating conservation discussions. Poaching of rhinos is hard without the assistance of colluding officials at various levels. Corruption is dishonest or fraudulent conduct by those in power, typically involving bribery. Using this understanding, we focus on information reported in the media and anecdotal reports to illustrate various kinds of corruption associated with the poaching of rhino for their horn. Our central question, however, is why do people get corrupt? We develop key hypotheses and refute statements such as “power corrupts” and “people are just greedy”. Instead, we propose that corruption starts at the breaking of small rules, and how breaking small rules make the breaking of larger ones easier. We also highlight several other mechanisms such as social and financial entrapment, as well as intimidation. In the end though, corruption is typically an active decision that a person has made whether under duress or not. With this insight we use the rhino case study to propose an approach that rewards honesty and carries consequences for dishonesty. Integrity management is then aimed at building a cadre of officials that trust each other through rewarding integrity, establishing awareness of entrapment, providing support and amnesty to inadvertently entrapped corrupt people, while targetting the truly corrupt roleplayers and king pins with the full might of the law. We advocate that such an approach may provide pro-active options to deal with corruption in environmental crimes.

(Full presentation)

### **Socio-economic and biophysical determinants of wire-snare poaching incidence and behaviour in the Boland Region of South Africa.**

**Willem Nieman<sup>1</sup>, Alison Leslie<sup>1</sup>, Anita Wilkinson<sup>2</sup> & Theresa Wossler<sup>3</sup>**

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Bushmeat harvesting, fuelled by wire-snare poaching, is recognized as a severe threat to biodiversity throughout East and Central Africa, and has been directly linked to severe reductions or extirpations of target species, high rates of non-target off-take of threatened species, and the loss of entire wildlife communities. Studies dedicated to assessing the extent and underlying dynamics of wire-snare poaching in South Africa are lacking, and no formal research has been conducted in the Boland Region, despite growing evidence of wire-snare incidence. Through structured interviews with farm owners or managers (103) and labourers (307) on private agricultural properties bordering protected areas (PA's), this study

quantified the influence of several socio-economic and biophysical determinants on the distribution of wire-snare poaching across the study area (~3500km<sup>2</sup>). Reported wire-snare poaching incidence and behaviour was strongly influenced by economic factors relating to poverty, a perceived lack of governing regulations and punitive measures, interpersonal development, and abiotic factors such as proximity to major residential areas, roadways and PA's. Respondents reported that small antelope and Cape porcupine (*Hystrix africaeaustralis*) were most affected by wire-snare poaching. Several activity hotspots across the region were identified. This study provided the first demonstration of the multifaceted and complex nature of wire-snare poaching in the Boland, opening a dialogue between rural communities and conservation agencies to broaden our understanding of the heterogeneity in local-scale socio-ecological dynamics, to apply policies for effective management and eradication, and to provide grounds for future research in the area and elsewhere.

(Full presentation)

**No more cheating with cheetahs: How effective regulation stopped illicit international trade in cheetahs from South Africa.**

**Jeanetta Selier<sup>1</sup> & Kelly Marnewick<sup>2</sup>**

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Cheetahs (*Acinonyx jubatus*) are sought after captive animals due to their economic value and ability to be tamed into exotic pets. Consequently, trade has become an international concern for cheetah conservation. The international trade in cheetahs is governed under CITES Appendix I and in South Africa, trade is regulated by legislation. A Non-Detriment Finding Assessment (NDF) done in 2015, had a negative outcome: trade posed a high risk to cheetah survival in the wild. In 2015, several key recommendations from the NDF were implemented by government to manage cheetah trade more effectively. To measure the impact of these recommendations, we analysed CITES trade records (pre 2015 and 2015-2017). We found that the number of cheetahs exported under the CITES source code "captive" dropped from 59 to five, while the number of cheetahs exported under CITES purpose code "commercial" increased from zero to 36. The average number of cheetahs exported under all source and purpose codes per annum decreased from 60 to 42 per annum and the main import destination changed from the USA (25%) to the United Arab Emirates (29%). The NDF was repeated in 2019 and the outcome was positive: trade does not negatively impact wild populations. This demonstrates how the NDF process can inform policy development and improve the management of traded species. We additionally show that focused regulatory interventions can change the nature of the trade and minimize impacts on wild populations ensuring that trade is sustainable.

(Speed presentation)

**Rhino poaching and community involvement: a critical examination of comparative approaches.**

**Ian Glenn<sup>1</sup>**

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Critics have directed particular animus towards South African anti-rhino poaching measures, and the Kruger Park in particular. Critiques of Green Militarization and green violence typically allege that poachers are animated by a sense of social injustice and exclusion, and

argue that more effective social outreach measures are necessary to curb the violence. By examining factual errors and using frame analysis, this paper argues that many of the criticisms of the Kruger and surrounding reserves and lodges are erroneous. One common argument is that there is a war on poaching using many of the extreme measures of the US War on Terror, but careful comparison shows how exaggerated most of these claims are. Another claim in many papers is that poachers are driven primarily by a historical sense of injustice and by social neglect. This paper disputes these arguments by close analysis of comparisons between the Kruger Park and other areas facing rhino poaching. In particular, the paper examines claims that Nepal's Chitwan Park provides a strong model of social outreach for the Kruger Park. It suggests rather that robust policing, new legal measures, and a heavy army presence were the major causes for the Nepalese success against poaching. It then examines the success of the Sabi Sands reserve in curbing rhino poaching, looking at the factors they and the Chitwan Park have in common.

(Full presentation)

### **Towards a national elephant strategy for South Africa.**

**Jeanetta Selier<sup>1,3</sup>, Sam Ferreira<sup>2</sup> & Rob Slotow<sup>3</sup>**

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Since the gazetting of the National Norms and Standards for the Management of Elephants in South Africa in 2008, its implementation have faced several challenges. Elephant (*Loxodonta africana*) numbers increased in South Africa, landscapes and their use by people and elephants have changed, and socio-political expectations have evolved. A number of government stakeholder engagement processes (including the new Elephant Norms and Standards), identified several areas not covered by the regulatory nature of the norms. These areas require a consolidated and coordinated national approach, which is focused and efficient, that enhances elephant conservation and contributes to the well-being of South Africans through various benefits. This will be done through defining a common vision, goals, risks, and how to best achieve these goals given the identified risks. The development of an effective national elephant strategy will promote the conservation and evidence based management of elephants. This strategy will also enhance and leverage the potential value that elephants contribute to all South Africans. Moving from single species elephant to a broader contextualisation of the role of elephants for society will promote effective and robust planning and management decision-making and highlight what this means for sustainable human beneficiation from elephants and their ecosystems. Using a societal consultation approach, we describe the process followed to date in developing the strategy and provide summaries of the outcomes of six stakeholder workshops (>150 participants) that focused on elephant managers, scientists, NGOs and government. We also discuss the way forward in developing the strategy.

(Full presentation)

**Animal welfare considerations for using large carnivores and guardian dogs as vertebrate biocontrol tools against other animals.**

**Benjamin L Allen<sup>1,2</sup>, Lee R Allen<sup>3</sup>, Guy Ballard<sup>4,5</sup>, Marine Drouilly<sup>6</sup>, Peter JS Fleming<sup>4,5</sup>, Jordan O Hampton<sup>7</sup>, Matthew W Hayward<sup>2,8,9</sup>, Graham IH Kerley<sup>9</sup>, Paul D Meek<sup>4,5</sup>, Liaan Minnie<sup>10</sup>, M Justin O'Riain<sup>6</sup>, Daniel M Parker<sup>10,11</sup> & Michael J Somers<sup>12</sup>**

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Introducing consumptive and non-consumptive effects into food webs can have profound effects on individuals, populations and communities. Consequently, the deliberate use of predation and/or fear of predation is an emerging technique for controlling wildlife. Many now advocate for the intentional use of large carnivores and livestock guardian dogs as more desirable alternatives to traditional wildlife control approaches like fencing, shooting or trapping. However, there has been little consideration of the animal welfare implications of deliberately using predation as a wildlife management tool. We assess the animal welfare impacts of using dingoes, leopards and guardian dogs as biocontrol tools against wildlife in Australia and South Africa following the 'Five Domains' model commonly used to assess other wildlife management tools. Application of this model indicates that large carnivores and guardian dogs cause considerable lethal and non-lethal animal welfare impacts to the animals they are intended to control. These impacts are likely similar across different predator-prey systems, but are dependent on specific predator-prey combinations; combinations that result in short chases and quick kills will be rated as less harmful than those that result in long chases and protracted kills. Moreover, these impacts are typically rated greater than those caused by traditional wildlife control techniques. The intentional lethal and non-lethal harms caused by large carnivores and guardian dogs should not be ignored or assumed to be negligible. A greater understanding of the impacts they impose would benefit from empirical studies of the animal welfare outcomes arising from their use in different contexts.

(Full presentation)

**When love and hate collide: does conserving charismatic predators blind authorities to more mundane wildlife challenges?**

**Gareth K H Mann<sup>1,2</sup>, M Justin O’Riain<sup>2</sup> & Daniel M Parker<sup>3</sup>**

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Human persecution as a result of conflict poses a major threat to the persistence of free-roaming large carnivores in the existing matrix of natural and human-transformed habitats. In addition to the primary conflict between humans and wildlife, secondary conflicts may arise between those who suffer economic damage due to wildlife, and conservation authorities tasked with wildlife management. Our study investigated conservation conflicts in the Little Karoo, South Africa. We interviewed 53 landowners that collectively manage an area of ~154 000 hectares. Landowners were asked to identify wildlife species that caused damage to their property, estimate the annual cost of the damage, specify any preventative measures that had been implemented and to comment on the effectiveness of these measures. Most landowners suffered some damage due to wildlife, and stock farmers reported losing approximately 6.6% of stock value due to livestock depredation annually, one of the highest rates of loss ever reported. Perceptions of conservation authorities were strongly influenced by the extent of wildlife damage suffered. Black-backed jackals (*Canis mesomelas*) were the species thought to be responsible for the most damage. However, there was little active management of these species by conservation authorities, which instead focussed on locally endangered species such as leopards (*Panthera pardus*) that are seldom involved in conflict in the Little Karoo. We discuss the consequences of this apparent disconnect between effort provided by conservation authorities and the needs of affected landowners, and suggest ways to improve the service provided by governmental authorities to private landowners living with wildlife.

(Speed presentation)

**Robustness of local natural resource governance institutions: Lessons from Kaindu Community Conservancy, Zambia.**

**Kampinda Luaba<sup>1</sup>, Paul Vedeld<sup>2</sup>, Vincent Nyirenda<sup>3</sup> & Kobus Muller<sup>1</sup>**

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The paper assesses the robustness of local wildlife, forest, and fishery governance institutions within the Kaindu community conservancy. The good governance principles developed by the IUCN/UNDP and the design principles for robust common pool resource institutions posited by Ostrom (1990) were applied to analyse the evolution of local governance systems. Findings indicate a long history of internal migration in the area, a complex political history and a succession of unstable governance models since the 20<sup>th</sup> century, forming a complex and layered institutional landscape. This landscape result in low levels of participation and a lack of consensus and joint strategic visions, low accountability, and transparency in decision-making, a lack of fairness and weak recognition

and enforcement of rights and duties. This situation unravels the weaknesses of both formal and informal local institutions. Consequently, uncontrolled access and utilisation have led to widespread resource degradation and destruction. Our study highlights the need to reconsider natural resources governance system in light with the local social and environmental context.

(Full presentation)

**Evaluating human-carnivore coexistence using a multi-stakeholder socio- ecological approach.**

**Chloe Lucas<sup>1</sup>, Samantha Bremner-Harrison<sup>1</sup>, Jacqueline Abell<sup>2</sup> & Katherine Whitehouse-Tedd<sup>1</sup>**

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A range of mitigation strategies have been deployed to reduce competition between livestock and carnivores. The success of these interventions is typically assessed using crude measures of perceived livestock losses. However, the perceptions of the people who live and work alongside carnivores (stakeholders) are not shaped by livestock loss alone. For people and carnivores to coexist, mitigation strategies that address the cause of conflict must be perceived as successful by all stakeholders. However, the extent of this human behaviour change is rarely included in mitigation evaluations. This holistic investigation of stakeholder perceptions explores how successful coexistence or conflict-mitigation is understood by different stakeholders, and elucidates the relationship between perceptions of coexistence and stakeholder behaviour towards carnivores in South Africa. A range of methods from the social and natural sciences is used to generate recommendations for improving the efficiency of coexistence interventions and defining best practice evaluation methods for implementation in the field. Pilot interviews reveal that perceptions of coexistence and conflict-mitigation are shaped by a variety of factors including willingness to invest, liability to theft and human maintenance/use of the mitigation strategy in place. Pilot camera trap data indicates that most interactions between livestock and carnivores are undetected by farmers and do not result in livestock injury or loss. An awareness of neutral livestock-carnivore interactions may prove important in increasing stakeholder tolerance of carnivores on their property. This presentation conveys the preliminary findings of the project to date and highlights current areas of ongoing research.

## Theme 4: Conservation management and its effects on species, food-webs and ecosystem functioning

### Keynote 3

**Options for evaluation of wildlife species conservation and their relative strength of inference.**

**Jim Hone<sup>1</sup>, Alistair Drake<sup>1</sup> & Charles Krebs<sup>1</sup>**

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Management of wildlife species to conserve them needs to evaluate whether the conservation aim(s) has been achieved. Managers and researchers can be very confident (stronger inference) to uncertain (weaker inference) about whether an aim has been achieved and whether that was caused by management. We describe the relative strength of inference of evaluations that conservation management has caused the observed outcomes. There are three broad methods of evaluations; first, those showing trajectories over time; second, those showing responses to management efforts; and third, those showing trajectories over time in response to management. Conceptual graphs of assumed, or expected, outcomes are useful for planning but provide the weakest inference about cause and effect of conservation management. Graphs of trajectories, for example of trends in abundance, can provide stronger inference that a change has occurred. Graphs of outcomes relative to management efforts provide stronger inference of cause and effect. Graphs of trajectories over time, with and without management or different types and intensities of management, provide the strongest inference that management caused the effects. All approaches should use analysis of response to evaluate management effects, and evaluate predictions of trends and effects of management efforts. We illustrate the methods with examples from wild populations, including honeyeaters, malleefowl, kangaroos and crocodiles in Australia, forest birds, possums and skinks in New Zealand, elephants in Zambia, mallards in North America, farmland birds in Britain, and amphibians world-wide. The results and their implications are of relevance to wildlife conservation around the world.

(Full presentation)

**Land management strategies can increase mammal diversity and oil palm plantation use by terrestrial mammals in Colombia.**

**Lain E Pardo<sup>1,2</sup>**

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Colombia is the largest producer of oil palm in the Neotropics, but the effects of this cultivation on native fauna are poorly understood. Using camera trap records and a combination of multivariate methods, we evaluated the effect of oil palm plantations (OP) and concomitant landscape and habitat covariates on the species richness and community composition of terrestrial mammals across the Llanos region of Colombia. Further, we use an occupancy framework to evaluate the effect of undergrowth vegetation and proximity to forest on habitat use within OP sites. Site level richness inside plantations was 47% lower,

on average, than in riparian forest. Within OP, species richness was negatively correlated with cattle abundance, and positively correlated with the density of undergrowth vegetation. Habitat type influenced habitat use of four of the 12 more widely distributed species with OP negatively affecting species such as capybara (*Hydrochoerus hydrochaeris*) and naked-tailed armadillo (*Cabassous unicinctus*). The remaining species showed no apparent effect from habitat type. Overall, generalist mesocarnivores, white-tailed deer (*Odocoileus cariacou*), and giant anteater (*Myrmecophaga tridactyla*) were more likely to use OP, while the remaining species, including ocelot (*Leopardus pardalis*) and lesser anteater (*Tamandua tetradactyla*), showed preferences for forest. Distance to nearest forest had mixed effects on species habitat use, while understory vegetation facilitated the presence of species using OP habitat. Our findings suggest that relatively simple management actions inside OP and maintaining nearby vegetation would increase the diversity of terrestrial mammals and would increase their likelihood to move across oil palm landscapes in Colombia.

(Full presentation)

**The role of private land conservation areas in maintaining natural land cover and conserving biodiversity.**

**Tafadzwa Shumba<sup>1,2</sup>, Hayley S Clements<sup>1</sup>, Alta De Vos<sup>1,3</sup>, Reinette Biggs<sup>1</sup>, Karen J Esler<sup>2</sup> & Judith M Ament<sup>4</sup>**

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It has become apparent that global biodiversity conservation targets cannot be exclusively achieved by state protected areas. Private land conservation areas (PLCAs) are one potential complementary strategy. However, despite their growing acknowledgement, little has been done to quantify their effectiveness. Here, we quantified the effectiveness of South African PLCAs using natural cover and biodiversity intactness a measure of the amount of biodiversity that can persist given different land use scenarios. We thus tested the hypothesis that if PLCAs are effective, losses in natural cover and biodiversity intactness would be less within their boundaries than in unprotected control points. We therefore generated 500 random points within 5121 PLCAs properties and matched them to a million unprotected random points, based on similarities in environmental factors for comparison. From 1990-2013 PLCAs lost 3% natural cover, which corresponded to a 2% loss in biodiversity intactness. This was significantly lower than in matched unprotected areas which lost 6% natural cover and 4% biodiversity intactness. Protection offered by PLCAs thus significantly reduced losses in natural cover and biodiversity intactness indicating their effectiveness. We also found significant differences in natural cover and biodiversity intactness loss across PLCAs with different levels protection. However, increase in legal protection was not associated with reduced losses in natural cover and biodiversity intactness, with informal PLCAs, having better retention than some of the strictly protected PLCAs. Nevertheless, our study provides evidence that PLCAs are an effective strategy and in combination with state protected areas biodiversity conservation can be improved.

(Full presentation)

**The influence of predator control and nest location on Cape gannet egg predation by Kelp gulls at Lambert's Bay gannet colony.**

**Zanri Schoeman<sup>1</sup>, Lauren Waller<sup>2</sup>, Mark Brown<sup>3</sup>, Herve Fritz<sup>1</sup> & Jan Venter<sup>1</sup>**

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Gannet populations across the globe are threatened by predation, with some populations experiencing localised extinctions. The Cape gannet's *Morus capensis* breeding range currently includes just six of ten islands formerly used by this species. Nest predation is a key factor in the reduction in breeding success of many bird species. At Lambert's Bay gannet colony, Kelp gulls *Larus dominicanus* predated on more than 7600 gannet eggs between 2006 and 2018, most of which took place around 7 AM and 6 PM. In the 2018/19 breeding season, we monitored 100 nests over 11 weeks in two different sections of the colony to investigate predation rates on Cape gannet nests. For each section, we separated our monitoring between 25 central and 25 peripheral nests. Predation rates on Cape gannet nests were positively related to increased egg availability, and more predation (1.5 eggs per week) took place in the peripheral area when compared to the central area (1 egg per week). Targeted predator control on Kelp gulls was conducted in 2015, 2017 and 2018 providing the opportunity to assess predation rates in relation to Kelp gull presence. Predation rates on Cape gannet eggs during culling periods were lower (1.8 eggs per day) than during non-culling periods (5.8 eggs per day). Predation is inevitable, but due to the Cape gannet's conservation status we suggest that an alternative, long-term, and more sustainable solution to reduce predation be explored.

(Full presentation)

**Association benefits between Harvester termites (*Trinervitermes trinervoides*) and Num-num plants (*Carissa bispinosa*) in a semi-arid savanna setting.**

**Gosego Nampa<sup>1</sup> & Mduduzi Ndlovu<sup>1,2</sup>**

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Many studies have documented the benefits that plants derive from termite mounds, however, the reciprocal benefits that termites derive from plants in the ecosystem remain poorly studied. We studied the association between *Carissa bispinosa* (thorny shrub), and *Trinervitermes trinervoides*, termite mounds in Nylsvley nature reserve, South Africa and further assessed whether the association changed in its importance in different seasons. We hypothesised that mounds provide nutrients for plants, hence trees establish better on mounds and, in return, plants protect the mounds from predation. We measured plants (height, canopy diameter, leaf appearance and fruiting) and mounds (height, diameter, damage and activity) and also evaluated soil nutrient properties from mounds with active colonies and the adjacent matrix. There was a significant benefit accrued to both organisms from the plant-insect association. Plants on mounds were larger (~ 33% taller), greener and fruited more in the dry season compared to matrix plants. Mounds under plants were

significantly less damaged compared to exposed mounds. Sodium, magnesium, potassium, sulphur and copper were enriched in mounds relative to the matrix, which further validates the high productivity of plants on mounds. The study unravelled a plant-insect association and an anti-predation defence strategy that termites use in semi-arid environments.

(Speed presentation)

**Habitat use of southern white rhinoceros (*Ceratotherium simum simum*) in a small, fenced game reserve in South Africa**

**Lisa Graham<sup>1</sup>**

<sup>1</sup>*Ecological Surveying Techniques, Department of Continued Education, Oxford University, United Kingdom*

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The current high security demands for rhino in the poaching crisis means that numerous southern white rhino (*Ceratotherium simum simum*) are managed within small fenced game reserves. Historically, literature on rhino habitat use and home ranges has studied larger open areas that fall within or close to the historic native range of the species and is therefore not generalisable to these confined areas. The current study investigates one population of white rhino in a small, fenced game reserve in the Eastern Cape of South Africa, where density is 4.6 rhino/km<sup>2</sup>. Spatial analyses using the 95% minimum convex polygon method revealed an average home range size much larger than previous research, (41.75km<sup>2</sup> ± 13.55 km<sup>2</sup>), with most of the rhino making use of the majority of the reserve. There was no significant correlation between home range size and age, time spent on reserve or social group. Proximity to water sources was a significant positive predictor of rhino presence but not proximity to roads or fence-lines. The rhino population showed a preference for grassland and savanna habitats, similar to previous evidence. This information offers a baseline understanding of habitat use that can inform management decisions of this particular rhino population. Further spatiotemporal analyses, including kernel density estimates and investigation of other influencing variables, will give more insight about spatial use and degree of home range overlap as well as other influencing variables.

## Keynote 4

### Web of ecological interactions and indirect effects of management decisions.

**Hervé Fritz**<sup>1,2</sup>

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Conservation areas are often managed for a diverse array of goals than often focus on a restricted set of ecosystem features or processes. This often leads to unexpected state shifts in ecosystems. The sustainability of conservation area may depend on how well they manage their incomes (financial sustainability) or on their integration with neighbouring communities (social sustainability), but the ecosystems and adaptation services provided by the conservation area largely depend on the integrity of ecosystem processes (ecological sustainability), hence tracking the changes in ecosystem functioning is crucial. In this paper, I use long-term research in the Hwange National Park area and its surrounding land-uses to illustrate how transitions in management and conservation decisions have set the pace for new dynamics and possibly alternative states of the system. I focus on (1) the changes related to the shift in elephant management paradigm (the release from culling and increase elephant population) and the effects on some biodiversity dynamics; (2) change in lion trophy hunting outside the park (5 year ban) and foodweb changes. The recorded indirect ecological effects could be relevant in the design of the future management decision framework. Here I wish to illustrate that monitoring and evaluation of decisions should span further than the immediate management objectives, and advocate for long-term ecosystem-based studies and observatories associated with conservation actions.

(Full presentation)

**For elephants Kruger will never be the same again.**

**Rudi J van Aarde**<sup>1</sup>, **Robert A R Guldemond**<sup>1</sup> & **Samuel M Ferreira**<sup>2</sup>

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For elephants in South Africa's Kruger National Park life has changed considerably over the past 50 years. Our assessment of data accumulated over this period suggest that the replacement of management actions such as culling, water provisioning and restriction of movement through fencing by actions to promote spatial heterogeneity effected elephants. Elephants responded to these management actions by changes in spatial use patterns, landscape specific recruitment rates, age-specific reproduction and survival, and apparent impact on vegetation. Freed from culling to limit population growth, from fences and water provisioning that restricted movement and dispersal, as well as accentuated impact, and exposed to population density dependence, population growth declined, and distribution evened across the landscape with consequences for impact on vegetation. In the case of elephants in Kruger conservation management that focused on instating rather than controlling ecological processes have had desirable consequences for conservation at large.

(Speed presentation)

**Large tree utilization of the African elephant (*Loxodonta africana*) in the savanna biome.**

**Daniel H Ball<sup>1</sup>, Herve Fritz<sup>1</sup>, Yentl Swartz<sup>1</sup> & Jan A Venter<sup>1</sup>**

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Elephant (*Loxodonta africana*) are understood to be one of the main ecological drivers which affect diversity and ecosystem functioning at most levels. Large trees are intrinsic to the structure and composition of savanna and plays a role in ecosystem functioning. We re-evaluated the utilisation of four large Savanna tree species ( $\geq 5$  m in height) by elephant. Established in 2014, the ongoing study was undertaken in the Timbavati Private Nature Reserve of the Limpopo and Mpumalanga provinces, South Africa. Low and comparatively high rainfall areas are compared to relative landscape positions (nutrient status variation) and the associated impact type and severity. *Senegalia nigrescens* (59.29%), *Sclerocarya birrea* (6.73%), *Lannea schweinfurthii* (6.73%), and *Terminalia sericea* (26.37%) form the entirety of the dataset (n=556) and are re-evaluated biennially. 64.96% of all individuals were directly impacted upon as a result elephant behaviour. Utilisation intensity is expected to increase as nutrient status improves within the landscape, and increases in severity in low rainfall areas are anticipated.

(Speed presentation)

**African elephants (*Loxodonta africana*) in Madikwe Game Reserve: Measuring past and predicting future impacts.**

**Yentl R P Swartz<sup>1</sup>, Jan A Venter<sup>1</sup>, Herve Fritz<sup>1</sup>, Rob Slotow<sup>2</sup> & Jeanetta Selier<sup>3</sup>**

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Balancing the requirements of large iconic herbivores against the maintenance of biodiversity conservation within protected areas has become a concern for many protected area managers. Several studies have been done on the impacts large herbivores such as elephants have on vegetation; however, very little is known about how these impacts influence other species within enclosed systems. The woody vegetation in Madikwe Game Reserve, a fenced conservation area of approximately 65 000 ha, was monitored in 2000 and 2001 to assess the impact of browsers on the vegetation structure and composition. The focus of the study is to investigate the effects of habitat alteration by elephants since 2000 and 2001, and their effect on associated species e.g. birds at 35 sites with elephants and 35 sites without elephants in Madikwe Game Reserve and the neighbouring Barokologadi community area, situated in the North West Province, South Africa. We predict that vegetation structure and composition will have significant changes over the study period and that there will be a significant difference in the associated species diversity in elephant impacted areas when compared to un-impacted areas. The study will highlight elephant impacts on the ecosystem and biodiversity within enclosed systems.

(Speed presentation)

**Developing parameters for the welfare of elephants in response to various management intensities and social structures.**

**Tamara Eggeling<sup>1</sup>, Marion Garai<sup>1,2</sup>, Brett Mitchell<sup>1</sup>, Yolanda Pretorius<sup>1,2,3</sup> & Hanno Killian<sup>1,4</sup>**

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To manage elephants (*Loxodonta africana*) we need to understand the importance of their social dynamics. The majority of existing small to medium reserves in South Africa contain elephants selectively translocated from Kruger National Park (KNP) or other southern African countries. Often elephants introduced into conservation areas are managed primarily based on total numbers and carrying capacity, however, we are finding that it is increasingly important that social structure and dynamics are equally considered when carrying out management actions. Social networking analysis reveals that elephants are selective in their social grouping choices and can respond differently to environmental factors based on their group composition. Without complete population structures and consideration of social bonds, the welfare of these elephants comes into question as this leads to increased stress levels and abnormal movements and social behaviours. Stressed elephants can often become very aggressive and thus pose a threat to themselves, other animal species, people and infrastructure. This project, being the first ever study on welfare parameters for free ranging elephants, aims to develop parameters for measuring welfare under the various conditions based on rigorous monitoring on several reserves across South Africa. This will be done primarily by looking at the different intensities of management of elephant, measuring stress hormone levels from dung while also quantifying and comparing both large and fine scale behavioural tendencies of the elephants in these reserves. This will create a framework to better guide sustainable elephant management directives.

(Speed presentation)

**Ecology, habitat evaluation and best practice habitat management for Cape mountain zebra (*Equus zebra zebra*) in the Western Cape, South Africa.**

**Jaco Olivier<sup>1</sup>, Alison J Leslie<sup>1</sup>, Jason I Ransom<sup>2</sup> & Coral Birss<sup>3</sup>**

<sup>1</sup>Department of Conservation Ecology and Entomology, Stellenbosch University, South Africa,

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Cape mountain zebra (CMZ) historically occurred throughout the Western, Eastern and North Cape of South Africa. However, the species has experienced drastic range reductions as well as population declines over the past 100 years, and is now listed as vulnerable on the IUCN Red List. We studied diet and habitat use of a reintroduced population of CMZ on Bakkrans Nature Reserve (BNR), in the Cederberg Wilderness Area, to assist with identifying new, viable, areas for the further reintroduction of CMZ. Additionally, we carried out a Habitat Suitability Index (HIS) assessment of the Matjiesrivier, Limietberg and Grootwinterhoek

Nature Reserves as potential reintroduction sites. We found that the Bakkrans CMZ demographics were extremely skewed with 17 males and 4 females. This was deemed to be positively correlated to low grass coverage as the HSI of BNR was ( $<0.05$ ). However, grasses still contributed to the majority of the diet ( $>70\%$ ) with *Erharta calycina* (36,3%) contributing most, followed by *Merxmuellera stricta* (17,4%). There was an increase ( $>8\%$ ) in browse consumed in the winter and this coincided with the flowering of wildflower species. Artificial watering hole (AWH) use, time of day and number of visits, were both significantly different ( $p>0.05$ ) between seasons and it was found that habitat type effected the time of day when an (AWH) was utilized. Of all four reserves, Limietberg had the highest HSI, however, it was concluded that none of the proposed reserves were suitable for the reintroduction of mountain zebra based on numerous factors.

(Speed presentation)

### **Black Rhino (*Diceros bicornis minor*) Feeding Ecology and Browse Availability in Majete Wildlife Reserve, Malawi.**

**Anel Olivier<sup>1</sup>, & Alison J Leslie<sup>1</sup>**

<sup>1</sup>Department of Conservation Ecology & Entomology, Faculty of AgriSciences, Stellenbosch University, South Africa

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The black rhino (*Diceros bicornis minor*) is a selective browser and foraging relates to population fitness. Information on feeding habits provides a vital foundation for management plans for this Critically Endangered species. The diet of the black rhino population in Majete Wildlife Reserve, Malawi, was studied in 2016-2017. A total of 16 951 standard bite volumes from 69 browse species, represented by 21 botanical families, were recorded along feeding trails (backtracking) conducted for 3 months each in the dry, early wet and peak wet seasons. High seasonal selectivity for certain principal and preferred food plants was revealed, with highest browse species diversity (H: 2.84) recorded during the peak wet season. *Diplorhynchus condylocarpon* and *Dalbergia melanoxylon* were the most important food plants overall. Browse availability (BA%) was measured as the plant volume available to black rhino, gathered from 82 vegetation plots throughout the reserve. The availability of browse varied markedly between sub-areas and between altitudinal vegetation types. The woodland below 250m altitude had the highest (18.55%) average absolute BA%. An overall area-weighted BA% score of 9.13% was calculated for the entire reserve. This study contributed to the knowledge gaps for black rhino feeding ecology in the reserve, enhancing our broader understanding of browse species selection and preferences. It provided insight into the habitat mosaic best suited for black rhino to aid conservation management practices.

(Speed presentation)

### **Objective home range analysis of GPS collared ungulates using plants and soils as potential prediction indicators.**

**Wesley J Black<sup>1</sup>, Francois Deacon<sup>1</sup> & Pieter Zietsman<sup>2</sup>**

<sup>1</sup>Department of Animal and Wildlife and Grassland Sciences, Faculty of Natural and Agricultural Sciences, University of the Free State, Bloemfontein, South Africa

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Our knowledge of the palatability of plants differs vastly from region to region, and the same plant species which occurs in a variety of soil types may differ substantially in an animal's acceptance towards it. Thus, soils and their associated characteristics may have a far

greater effect on a plants eventual acceptance to the animal than we ever previously imagined. This study therefore tried to connect the above ground rangeland condition and associated plant characteristics with the below ground soil characteristics. It looks to do this by identifying whether soils play a major role in an animal's resource selection criteria. Ten individuals of four herbivore species were collared using GPS collars in the Northern Cape Province. The data was expressed as heat maps of preferred and avoided areas using ArcView 10.4 Optimized Hot Spot Analyses of highly significant home ranges. On these preferred and avoided areas both vegetation samples and soil samples were taken for analysis, and a variety of both ecological and agricultural surveys were done. Early results from the study indicate that density of woody plant species plays an enormous role in determining whether sheep, springbok and cattle will prefer an area regardless of the plant species which occur there. Annual grasses and herbs are more favoured by sheep, goats and springbok than previously thought. The knowledge gained from this study will help to better predict which areas goats, sheep, springbok and cattle will prefer, which can aid farmers to better manage their veld, animals and camp systems.

*(Speed presentation)*

**Nutrient effect on browsing preferences of giraffe (*Giraffa Camelopardalis*) in semi-arid savannas of South Africa.**

**Izak J Taljaard<sup>1</sup>, Francois Deacon<sup>1</sup> & Ockert B Einkamerer<sup>1</sup>**

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Game ranching in South Africa has advanced over the last decade and the current geographic extent of the giraffe (*Giraffa Camelopardalis*) population has substantially expanded. However, little is known about the nutrient preferences and nutrient requirements of giraffes and the exact role that this plays within their movement patterns. Therefore, to gain some understanding on the giraffe's nutrient requirements, we used GPS location data which enabled us to use an objective approach, letting the animal identify which habitat and tree species they prefer or avoid. The study took place at Rooipoort Nature Reserve in the Northern Cape Province. Two female and two male giraffes were fitted with GPS collar devices. The seasonal recorded data was then analyzed, and core home ranges were designed using ArcView 10.4 Optimized Hot Spot Analyses. Significantly preferred and avoided areas were selected based on the highly significant ( $P < 0.001$ ) home range data. Plant and soil samples were collected and analyzed from these preferred and avoided areas. There was a significant ( $P < 0.05$ ) difference between the home range of the female and male giraffes. The male giraffes' home range utilized 63% of the available area, where females utilized only 36% of the available area and of this, the females' total core area was only 28ha of the available 44 000ha. This research will help scientists to better understand the spatial ecology of giraffes as well as their nutrient requirements and how much a role nutritional requirement play in their spatial distribution over seasons.

(Speed presentation)

**Influence of long-term predation risk and habitat complexity on cheetah behavioural responses to short-term predation risk.**

**Laura C Gigliotti<sup>1</sup>, Rob Slotow<sup>2</sup>, Craig Sholto-Douglas<sup>3</sup>, Charli De Vos<sup>3</sup>, Richard Steyn<sup>3</sup> & David S Jachowski<sup>1</sup>**

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To mitigate the risk of predation, animals can use behavioural changes such as reducing the amount of time in a risky area, increasing vigilance behaviour, or fleeing from risky situations. Increased anti-predator behaviour can reduce predation risk, but can ultimately reduce fitness due to foraging trade-offs. Research suggests that the long-term risk of encountering a predator, as well as habitat complexity, might affect how animals respond to short-term predation risk. Previous research has mainly focused on anti-predator behaviours in prey species, while considerable less is known about how spatial variation in long-term predation risk and habitat complexity influence the behaviour of subordinate predators. We collected data on spatial variation in cheetah (*Acinonyx jubatus*) behavioural responses to short-term predation risk by using a call-back experiment in areas of differing long-term predation risk and habitat complexity within the Mun-Ya-Wana Conservancy, South Africa. We recorded 5 minutes of video of cheetah behaviour, then played a 10 second audio clip of a lion (*Panthera leo*), leopard (*Panthera pardus*), spotted hyena (*Crocuta crocuta*), or African hoopoe (*Upupa Africana*) vocalization, followed by 5 minutes of video recording post-callback. We analysed the videos to determine the proportion of time that cheetahs spent vigilant pre and post-callback. Our initial results indicated that cheetahs increased their vigilance behaviour by 27% in response to short-term lion risk, 77% in response to short-term leopard risk, and 33% in response to short-term hyena risk. Future research will focus on identifying spatial drivers of variation in cheetah vigilance behaviour.

(Speed presentation)

**Investigating early post-release movements and establishment of reintroduced cheetah in Liwonde National Park, Malawi.**

**Olivia Sievert<sup>1</sup>, Alison Leslie<sup>1</sup> & Kelly Marnewick<sup>2</sup>**

<sup>1</sup>*Department of Conservation Ecology and Entomology, Stellenbosch University, South Africa*

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Ecotourism demands in South Africa have led to an influx in the reintroductions of charismatic carnivores over past decades. This has resulted in population increases for multiple large carnivore species, renewing opportunities for further reintroduction and range expansion projects. Reintroductions can be viewed as a “forced-dispersal”, as the process resembles natural dispersal in which animals face a trade-off between the exploration and exploitation of their new habitat. This may result in long-distance movements and in turn effect mortality and reproduction, consequently impacting reintroduction success. Increasing our understanding of these processes is therefore crucial to determine variations in strategies used to adapt to a novel environment. This study investigated the early post-release movements and home range establishment of reintroduced cheetahs (*Acinonyx jubatus*) in Malawi. Preliminary results indicate that exploratory moments for males were

greater than females, with movements for all females stabilizing, indicating a transition from exploratory movements to knowledge-based movements and establishment. While post-release movements delayed reproduction by one month for two of the three females, mortality rates did not increase. Within two years the reintroduced population conformed to reproductive rates similar to those documented on South African small fenced reserves (average age of independence was 15.6 months, interbirth interval was 17.7 months, average litter size was 4.0 cubs and cub survival was 60%). We conclude that post-release movements after reintroduction had a minimal long-term effect on population establishment of cheetah in Liwonde National Park and as such, this population has the potential to be a source in the future.

(Full presentation)

**Conservation management in confined space: does anthropogenic action influence large mammal space use?**

**Sally J Reece<sup>1</sup>, Frans GT Radloff<sup>1</sup>, Alison J Leslie<sup>2</sup> & Craig J Tambling<sup>3</sup>**

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Majete Wildlife Reserve (MWR) in Malawi is a 700 km<sup>2</sup> conservation area that is home to a range of medium and large mammals (5-5000 kg). The reserve is fenced with intense anthropogenic pressure on its immediate boundary making medium to large mammal dispersal out of the reserve impossible. The enclosed small nature of the reserve necessitates intensive management interventions, including, periodic mammal translocations, artificial water point placement and infrastructure development. This study aims to determine whether these actions influence medium to large mammal space use within MWR. A six month camera trap study was undertaken at MWR during the 2018 dry season to determine medium to large mammal space use. One hundred and forty locations were sampled for 40 days each, using 47 cameras rotated across three blocks tallying to 5454 camera days. Mammal space use was assessed against a suite of environmental, biotic, and anthropogenic drivers using an occupancy and detection framework in the programme PRESENCE. A total of 11 199 independent detections of 21 focal species were recorded with preliminary data analysis indicating surface water availability as an important driver of species space use. In particular, mixed feeders were positively associated with proximity to water, but this coincided with a greater use of riparian vegetation and a landscape with lower curvature. We detected few broad scale patterns within trophic guilds, suggesting that a more detailed species-specific approach is warranted. We will discuss the species-specific results within context of the current management practice to assist future conservation action.

(Full presentation)

**Artificial Water Point Utilisation by Selected Herbivores in Majete Wildlife Reserve, Malawi.**

**Kayla A Geenen & Alison J Leslie**

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Access to water is essential for the survival and reproduction of wildlife and may affect the distribution of species within a reserve. Water supplementation, via artificial water points (AWP's), has become common practice in maintaining wildlife density as natural water becomes scarce during the dry season. Herbivore AWP utilization was studied at ten AWP's in Majete Wildlife Reserve (MWR), Malawi, using camera traps from June 2017 to May 2018. Chi-Square Goodness of Fit Tests were conducted to analyse if the frequency of observations were significantly different by season, AWP and time of day. A total of 219 105 observations were made of twelve herbivore species. African elephant (*Loxodonta africana*) and Cape buffalo (*Syncerus caffer*) were the most frequently observed species. The results show a significant difference between seasons, AWP's and time of day ( $p < 0.001$ ). Majority of observations occurred in the dry season (79%), with emphasis on the late dry season (56%), compared to the wet season (21%). Overall peak utilization times were from 10:00 - 11:59, apart from black rhinoceros (*Diceros bicornis minor*) and Cape buffalo which preferred to utilise AWP's at dawn and dusk. AWP utilization was significantly higher ( $p < 0.001$ ) in the south-eastern region, possibly due to a lack of perennial water sources. This study provides insight into herbivore AWP utilisation in MWR and will aid in future management with regards to the seasonal opening and closing of AWP's. This study proves that AWP's are an important source of water for herbivores in areas void of perennial water within MWR, with emphasis on the dry season.

(Full presentation)

**Water management practices implemented for Asiatic Cheetah (*Acinonyx jubatus venaticus*) conservation in Miandasht Wildlife Refuge, Iran to decrease Climate Change effects.**

**Ali Shams<sup>1</sup>, Atieh Taktehrani<sup>1</sup>, & Navid Gholikhani<sup>1</sup>**

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Iran is home to the last known population of the critically endangered Asiatic cheetah. The total population is now estimated at less than 40 individuals. Much of their remaining habitat is comprised of arid landscapes that have been impacted by climate change. More recently, the limited water sources for cheetahs and their preferred prey species has become a major concern for the cheetahs in Miandasht Wildlife Refuge, which is one of the main northern Asiatic Cheetah habitats. We managed water sources in Miandasht from 2014 using four methods: (1) Cutting the camel access to water resources: Domestic camels drink a substantial amount of water in areas reserved for wildlife (2) Recruitment of a water supplier in the nine most arid months of each year to supply water for artificial water sources; (3) Repaired windmill in 2018; (4) Dam construction in 2019. Wildlife utilises this water and associated vegetative growth around each dam. The cheetah prey population has increased according to the census of the Department of Environment in the last five years. Wildlife monitoring conducted with camera traps indicates that the camel proofing of water resources has been effective at keeping camels out and ensuring the exclusive use of water sources by

wildlife. These results are gained in 4151 trap nights at 62 stations, while before camel proofing we recorded many pictures of the camel beside troughs in the 2429 trap nights.

*(Speed presentation)*

**Index of water dependence of large African herbivores in contrasted ecosystems**

**Amouré D Robinson<sup>1,2</sup>, Curtis Marean<sup>2,3</sup>, Hervé Fritz<sup>1</sup>, Lain V Pardo<sup>1</sup> & Jan A Venter<sup>1,2</sup>**

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African ungulate distribution and habitat selection is influenced by various extrinsic constraints, such as temperature, perceived predation risk and surface water availability. We used species' dependence of water to understand the trade-off between extrinsic constraints and their access to water sources. The focus of the study was on medium to large mammalian herbivore species across five different landscapes in South Africa; namely Madikwe Game Reserve, Timbivati Nature Reserve, Karoo National Park, De Hoop Nature Reserve and Gondwana Game Reserve. We monitored the temporal niches, such as daily activity pattern through camera traps deployed at various waterholes within each site from June 2018 to June 2019 (wet and dry seasonal cycles). We analysed the use of waterholes in relation with body size and species guild through general linear models. Daily activity patterns, whereby the number of events per hour/per day over a month in contrast to predatory and aridity variables were analysed through circular statistics. Findings were interpreted in correlation to specific known species' habitat use. We predicted that herbivore composition would have significant seasonal differences and that perceived predation risk will drive shifts in activity pattern. Preliminary results showed that temporal use of waterholes varied between biomes and between species with peaks just before sunset and just after sunrise, suggesting behavioural variations with temperature and perceived predation risk as a key indicator.

*(Speed presentation)*

**Influence of camera trap deployment on spatial capture recapture estimates of South African servals (*Leptailurus serval*).**

**Johanna M Taylor<sup>1,2</sup>, Gareth K H Mann<sup>2,1</sup>, Matthew S Rogan<sup>1</sup> & M Justin O'Riain<sup>1</sup>**

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Serval (*Leptailurus serval*) and other mesocarnivores are often recorded as by-catch in camera trap surveys designed for larger carnivores. Servals face a range of threats which can impact on their populations both inside and outside of protected areas, but we have little information on their population status across much of their range. Spatial capture-recapture models are the most common means of estimating density of individually identifiable species, but they assume traps are spaced such that the trap array contains no 'holes' where an individual may go undetected and that home ranges encompass multiple traps. Therefore, an array optimized for a far-ranging large carnivore (e.g. leopard) may position camera stations too far apart to allow for accurate population density estimates to be determined for species with smaller home ranges, such as serval. The goal of this study was thus to investigate the

viability and possible limitations of using a survey optimized for leopards to estimate the density of a smaller carnivore, the serval, We compared the density estimates of serval at Ithala Game Reserve in KwaZulu-Natal using data from a Panthera leopard-focused survey (mean trap spacing 2345 m) and serval-focused camera trap survey (mean trap spacing 1327 m), to determine if the leopard array could robustly estimate serval density. With these data we can assess how camera spacing and placement influences this key metric for conservation assessments and monitoring.

(Full presentation)

**Counting the spots puts management on the spot. Evidence-based leopard management imperatives.**

**Bool Smuts<sup>1;2</sup> & Jeannine McManus<sup>1;2;3</sup>**

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The Western and Eastern Capes have 553 (+/- 168) and 448 (+/- 98) adult leopards (*Panthera pardus*) respectively. These individuals appear to be structured into three populations, with emergent genetic bottlenecks. Of the three populations identified by nuclear DNA analyses, two exist in the Western Cape. These cause concern as one population appears to be a sink population. Population structuring is caused by habitat destruction and human-caused mortality. Resource needs by leopards have guided the identification of key connectivity corridors between these isolated populations. Management imperatives for the species with habitat loss, continued persecution and resultant genetic bottlenecks requires a full suite of action to ensure persistence of the species in the province. Firstly, management requires identifying potential corridors and their functionality, secondly, the evaluation of population structure with ongoing genetic analysis of all available samples, and finally, human-carnivore conflict mitigation in these areas. Conflict mitigation efforts, inclusive of the efficacy of compensation schemes to avert human-caused mortality, should be implemented and evaluated for success. Priority should be on effecting safe passage for the species generally, particularly in corridors through conflict mitigation strategies, inclusive of Payment for Ecosystem Services (PES) through ethical produce brand development. Although translocations have often occurred in the region, these have been poorly monitored, and should be scientifically evaluated through pre- and post-translocations for efficacy. For isolated populations, translocations may be the only management option to local extinctions and allow opportunities to exclude needless mortality for condemned damage-causing individuals, allowing rewilding opportunities into formerly extirpated areas.

(Speed presentation)

**Prey preference of spotted hyaenas (*Crocuta crocuta*) on Pro-Namib farmlands of Namibia.**

**Jeanette Fouché<sup>1</sup>, Brian K Reilly<sup>1</sup>, Engela P de Crom<sup>1</sup> & Yvonne K Bäumchen<sup>2</sup>**

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Spotted hyaenas (*Crocuta crocuta*) have few published studies regarding their diets and, on the African continent in particular, there is a lack of information regarding their diets. Information regarding their behaviour, including analyses of diets, plays a crucial role in the development of species-specific management plans, especially when the species is often falsely accused of livestock killings. It is thus important to increase research conducted on this valuable keystone species in order to improve the conservation efforts of this predator. We aimed to determine to primary prey preferred by spotted hyaenas on farmlands located in the Pro-Namib of Namibia. Results from camera traps and drive transects, collected between 2015 and 2017 indicated that springbok (*Antidorcas marsupialis*) and Hartman's mountain zebra (*Equus zebra hartmannae*) are the most abundant prey species. Results from scat samples (n=53) were analysed and indicated a high frequency of occurrence of kudu (*Tragelaphus strepsiceros*) (47%) and various livestock species (15%) present. The frequency of prey species detected compared with the frequency of prey species identified from hair samples clearly suggests that there is no correlation between the two. An asymptote was reached at 15 scat samples, indicating that sufficient samples were collected to provide a concise outcome. The high frequency of kudu occurrence in scat could have been driven by an outbreak of rabies whereas livestock could be due to scavenging as there are no results to indicate whether spotted hyaenas were responsible for any livestock kills.

(Speed presentation)

**A preliminary assessment of spotted hyaena (*Crocuta Crocuta*) density within Madikwe Game Reserve.**

**Terry-lee Honiball<sup>1</sup>, Michael J Somers<sup>4</sup>, Hervé Fritz<sup>2, 3</sup> & Jan A Venter<sup>1, 5</sup>**

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As we see a trend towards small fenced conservation areas across Africa, reintroductions are an increasingly important conservation tool. Species-specific population data is important for the effective management and conservation of wildlife populations within protected areas. Spotted hyaena (*Crocuta Crocuta*) population data will be determined for Madikwe Game Reserve. Data was collected through the use of buffalo carcasses which were strategically placed simultaneously at a number of sites in the reserve in conjunction with Cuddeback cameras strategically placed to capture individuals scavenging at the site. This data was combined with data collected from evening "call out" events whereby a distressed buffalo calf sound was amplified through speakers strategically throughout the reserve. Individual

hyaenas which arrived to investigate were then recorded. Images captured from these occasions were then processed through the “Wild ID” software which uses spot patterns to identify individuals. We utilised this data collected over a three-month period to do a preliminary analysis of spotted hyaena density within Madikwe Game Reserve. Individual data on spotted hyaenas will then be utilised for determining species occupancy and habitat use within Madikwe Game Reserve.

(Speed presentation)

### **Spatial utilisation of a multi-carnivore community in an enclosed African system.**

**Jessica Comley<sup>1,2</sup>, Dusty Joubert<sup>3</sup>, Nokubonga Mggatsa<sup>2</sup> & Daniel M Parker<sup>1,4</sup>**

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Carnivore intra-guild interactions can be important drivers of carnivore community composition and ecosystem functioning. Worldwide, carnivores continue to be restricted by human activities and enclosed protected areas (reserves) present a prospective conservation tool. A major concern, however, is that the ways in which multiple carnivore species compete for shared resources in these systems is poorly understood. We aimed to provide insight into the interactions and co-existence of a multi-carnivore community within a small (< 400 km<sup>2</sup>), enclosed reserve in South Africa (Selati Game Reserve). One aspect of our research was to investigate the activity patterns, habitat selection and occupancy dynamics of multiple carnivores in Selati, through camera trapping and GPS collared large carnivores. We found that carnivore-carnivore interactions, and their associated impacts, varied within the carnivore guild and that co-existence may be due to trade-offs between various risks (i.e. interference and exploitative competition) and benefits (i.e. resources such as food and space). Our findings also revealed that large carnivores, such as lions (*Panthera leo*), spotted hyaenas (*Crocuta crocuta*) and leopards (*Panthera pardus*) do not have homogenous effects across carnivores and that site-specific research on multiple-carnivores is integral for conserving biodiversity and ecosystem dynamics. While our study provides valuable insight into the complexity of carnivore intra-guild competition in a small, enclosed reserve it also highlights major research gaps and emphasises the need for ecosystem-based research throughout southern Africa to fully understand how multiple sympatric carnivores co-exist in these systems.

(Full presentation)

### **Validating Random Encounter Models to Estimate Black-backed Jackal Populations.**

**Haemish Melville<sup>1</sup> & W Maartin Strauss<sup>1</sup>**

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Reliable estimates of animal populations are key to any management programme. Populations of mesopredators are exceptionally difficult to estimate. Recently, models that have potential to overcome this problem, namely the Random Encounter Model (REM) and generalised Random Encounter Model (gREM) have been proposed. Both models rely on

the accurate collection of species-specific movement and encounter variables to estimate population density. Most of the requisite variables, e.g., detections, are simple to collect using camera traps. Velocity, however, is difficult to estimate in absence of either VHF or GPS telemetry data. We calculated black-backed jackal (*Canis mesomelas*) movement velocity from 32 spatially calibrated video-clips, recorded at 10 cameras over 543 camera-nights. We applied REM and gREM models to estimate jackal population density during winter 2016 on Telperion Nature Reserve in Mpumalanga. We derived density estimates using our velocity measures and compared them to estimates (for the same site) derived from the mean winter night-time velocities of GPS-collared jackals in Natal ( $0.43 \pm 0.29$  km/h,  $n = 168$ ) and the Karoo ( $0.50 \pm 0.31$  km/h,  $n = 68$ ). Our velocity measures are an order of magnitude higher than those from GPS collars ( $5.0 \pm 3.4$  vs  $0.5 \pm 0.31$  km/h). Consequently, our population estimates are substantially lower than those derived using telemetry data ( $0.03$  vs  $0.34$  individuals/km<sup>2</sup>). We highlight and discuss differences in the REM and gREM results and argue that the encounter models with camera trap velocity estimates may represent a simple non-invasive, robust, and repeatable method to estimate mesopredator populations.

(Speed presentation)

### **The genetic status of freshwater mussels (*Unio caffer*) in central South Africa.**

**Gerhard van Bosch<sup>1</sup>, Jodea van der Merwe<sup>1</sup>, L Barkhuizen<sup>2,3</sup>, Jess Jones<sup>4</sup>, Eric Hallerman<sup>4</sup> & Paul Grobler<sup>1</sup>**

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From a research perspective, freshwater mussels is a largely neglected group in Southern Africa. Few papers are published on the distribution or biology of this group, and no genetic studies have been published on the genetic characteristics of these freshwater mussel species or populations. Freshwater mussels have a mechanism for dispersal that relies on fish hosts, and patterns of genetic diversity and genetic connectivity will therefore be a function of fish movements. In international regions with fairly consistent water levels, and with few mechanisms for fragmentation of mussel populations or their fish hosts, patterns of differentiation tend to follow a model of isolation by distance only. In contrast, river systems in Southern Africa are dependent on much more unpredictable rainfall. Some rivers are thus episodic and this could influence the patterns genetic diversity severely. We sampled individuals of *Unio caffer* from a locality in the upper reaches of the Vaal River, near the town of Harrismith, Free State Province, and sequenced the ND1 mitochondrial DNA region. Our results revealed some diversity within the group sampled, with one polymorphic position in a sequence length of 432bp. Blasting of our sequences against the online GenBank database confirmed the scarcity of reference material for freshwater mussels from southern Africa, with closest matches confined to species from the northern hemisphere. Future work will concentrate on (i) comparing levels of diversity in populations isolated by distance or real geographic separation; and (ii) determining levels of gene flow among such populations.

(Full presentation)

**The genetic status of the introduced giraffe population in the Free State Province, South Africa.**

**J Paul Grobler<sup>1</sup>, Marieka E Van Niekerk<sup>1</sup> & Francois Deacon<sup>2</sup>**

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Historically, giraffe did not occur in the Free State Province, but the species has been introduced to many localities in the region, partly because small extra-limital populations of large mammals add value to ecotourism in self-financing private protected areas. Giraffe taxonomy, including the actual number of species and the distribution of species / subspecies, have been the subject of considerable debate. There is however consensus that two subspecies are found in southern Africa, generally described as the Angolan giraffe and South African giraffe. Levels of genetic diversity within fragmented giraffe populations in the region is also potential cause for concern, since these animals are often found as small populations. Sequences of the mitochondrial DNA Cytb gene and D-loop region were generated for 47 giraffe, and compared to a database of haplotypes for the two southern African subspecies. Results showed that haplotypes from both the South African and Angolan giraffe occur in privately owned populations, whereas giraffe from a public protected area have haplotypes from the South African giraffe only. Pure giraffe from the public protected area showed least diversity of all groups studied, despite being a large population, whereas elevated levels of diversity was observed in admixed groups. Overall, the patterns of diversity observed display the signature of extra-limited translocations of giraffe, but we also recommend that the geographic and genetic boundaries of the two subspecies in Central South Africa should be investigated at a finer scale, since there was very limited representation of South African populations in previous published studies.

(Full presentation)

**Ongoing gene flow between ancestral lineages may have hindered the evolution of specialization in black and white rhinoceros.**

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Africa's black (*Diceros bicornis*) and white (*Ceratotherium simum*) rhinoceros are closely related sister-taxa that evolved divergent feeding strategies to cope with changing paleohabitats. Both species evolved from the precursors *D. praecox* and *C. mauritanium*, whose earliest fossil appearances both date from about 5.2 Million years (Ma). Intriguingly, by 4 Ma both precursor species had already evolved some of the adaptations to browsing and grazing, but cranial morphology and stable  $\delta^{13}\text{C}$  isotope ratios confirm that both were still mixed feeders relative to their modern descendants. It is also known that both precursors co-occurred at the same time and place at several Pliocene sites. Could it be that *D. praecox* and *C. mauritanium* were not reproductively isolated when they came into secondary contact, and that ongoing genetic exchange between the two precursor species may have delayed the evolution of their obligate modern day feeding strategies? To answer this question, I present the first fully annotated black rhinoceros reference genome, obtained from a South African individual, and compare it with a black rhinoceros genome from East Africa and two

white rhinoceros genomes from northern and southern populations. Analyses show that gene flow did indeed occur between *D. praecox* and *C. mauritanium* and only ceased between 3.3 and 4.1 Ma, and that the development of fully specialised browsing and grazing African rhinoceros species could only have occurred after this time. This provides a cautionary note to conservation managers, not to interpret times of divergence as evidence for the cessation of genetic contact.

(Full presentation)

**Lessons for conservation management: monitoring temporal changes in genetic diversity of Cape mountain zebra (*Equus zebra zebra*).**

**Antoinette Kotzé<sup>1,2</sup>, Rae M Smith<sup>1,2</sup>, Yoshan Moodley<sup>3</sup>, Gordon Luikart<sup>4,5</sup>, Coral Birss<sup>6</sup>, Anna M Van Wyk<sup>1</sup>, J. Paul Grobler<sup>2</sup> & Desiré L Dalton<sup>1,2</sup>**

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The Cape mountain zebra (*Equus zebra zebra*) is a subspecies of mountain zebra endemic to South Africa. The Cape mountain zebra experienced near extinction in the early 1900's and their numbers have since recovered to more than 4,800 individuals. However, there are still threats to their long-term persistence. A previous study reported that Cape mountain zebra had low genetic diversity in three relict populations and that urgent conservation management actions were needed to mitigate the risk of further loss. As these suggestions went largely unheeded, we undertook the present study, fifteen years later to determine the impact of management on genetic diversity in three key populations. Our results show a substantial loss of heterozygosity across the Cape mountain zebra populations studied. The most severe losses occurred at De Hoop Nature Reserve where expected heterozygosity reduced by 22.85% from 0.385 to 0.297. This is alarming, as the De Hoop Nature Reserve was previously identified as the most genetically diverse population owing to its founders originating from two of the three remaining relict stocks. Furthermore, we observed a complete loss of multiple private alleles from all populations, and a related reduction in genetic structure across the subspecies. These losses could lead to inbreeding depression and reduce the evolutionary potential of the Cape mountain zebra. We recommend immediate implementation of evidence-based genetic management and monitoring to prevent further losses, which could jeopardise the long term survival of Cape mountain zebra, especially in the face of habitat and climate change and emerging diseases.

(Full presentation)

**Under the skin of a culture: DNA-based assignment reveals a transnational trade in illegal leopard skins across southern Africa.**

**Vincent Naude<sup>1,2\*</sup>, Guy Balme<sup>1,2</sup>, Jackie Bishop<sup>1</sup>, Garreth Whittington-Jones<sup>2</sup>, Tristan Dickerson<sup>2</sup>, Luke Hunter<sup>2</sup> & M Justin O'Riain<sup>1</sup>**

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The primary threat to leopards across southern Africa is demand for skins in ceremonial attire. In South Africa, members of the 'Shembe' Church practice the custom of royals wearing skins as symbols of power. Mark-resight surveys taken at religious gatherings suggest 1500-2500 leopard skins are required to meet annual demand (up to a third of South Africa's population). Working in close collaboration with regional authorities towards mitigating this trade, we developed a genetic reference database of leopard distribution in eight southern African countries. Using DNA-based assignment we demonstrate the geographic extent of the skin trade and populations most impacted. Analysis of 150 confiscated skins revealed that the majority originated from outside of South Africa, consistent with trader interviews suggesting local-sourcing of leopard skins is increasingly difficult. Source hotspots include the lowveld of Zimbabwe, northern Mozambique and Zambia. Given the absence of both regional and local permits for possession and trade in leopard skins, our results suggest that through the Shembe Church, South Africa is a sink for trans-national illegal trade with an estimated 15000 illegal skins in circulation among the Shembe. Our findings inform statutory authorities, current programs on sustainable trade and the use of alternatives to complement traditional practice.

(Speed presentation)

**Lion (*Panthera leo*), Livestock and Wildlife Interactions in the Kuku Group Ranch Pastoralist Area, Kenya.**

**Iain R Olivier<sup>1</sup>, Frans G T Radloff<sup>1</sup> & Craig J Tambling<sup>2</sup>**

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Large carnivore species have extensive space requirements and with the burgeoning human population in Africa, human-carnivore conflicts are increasing. The Tsavo-Amboseli ecosystem is considered one of the last ten strongholds for lion conservation globally. Within this ecosystem, Maasai group ranches play an important role in supporting viable numbers of lion and retaining connectivity between adjacent protected areas. The Kuku Group Ranch (KGR) is such an area; however, resident lion populations are under threat due to livestock depredation and consequent retaliatory killing. Livestock loss varies across the year with a peak in January and lull in June. To investigate this issue, we investigated prey availability (four aerial surveys and monthly ranger patrols) and lion diet (investigated through GPS cluster analysis). From these metrics, lion diet and prey preferences across seasons will be calculated to determine whether seasonal variation in livestock and wildlife availability drives the observed annual predation patterns of lions on livestock. Eight lions were fitted with GPS satellite collars and provided a location every 3 hours. We investigated 259 (30%) of 856 lion location clusters for evidence of prey remains, with confirmation of lion feeding found at 117 of these clusters. Seasonal variation of lion diet as obtained from the GPS cluster data will be

discussed. A better understanding of lion diet in relation to livestock and wildlife seasonal availability can help management mitigate conflict.

## Theme 5: Wildlife management in peri-urban landscapes

(Full presentation)

**Poisoned chalice? Spatial foraging patterns in Cape Town's caracal reveal a potential ecological trap.**

**Gabriella R M Leighton<sup>1</sup>, Jacqueline M Bishop<sup>1</sup>, M Justin O'Riain<sup>1</sup>, Joleen Broadfield<sup>2</sup>, Justin Johnson<sup>2</sup>, Graham Avery<sup>3</sup>, D Margaret Avery<sup>3</sup>, & Laurel E K Serieys<sup>1,2</sup>**

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As natural landscapes are modified by agricultural development and urban expansion understanding behavioural responses of mesocarnivores to disturbance is key for their conservation. While there are many novel risks to urban wildlife, some highly adaptable mesocarnivores may benefit from subsidised resources around cities through dietary flexibility. However, this attractive increase in resources can have associated costs that are often undetectable, such as exposure to environmental toxins, leading wildlife into an 'ecological trap' wherein the costs outweigh the benefits. Dietary studies may highlight toxicant contamination routes that make urban foraging maladaptive. Here we use multiple methods to investigate spatial foraging in caracal (*Caracal caracal*) within Table Mountain National Park and the surrounding areas of Cape Town, South Africa. We investigated ~700 GPS clusters from 22 caracals to locate prey remains and scats. We then quantified selection of natural and urban landscape features by caracals at ~380 predation sites, in and adjacent to urban and rural areas on the Cape Peninsula. Using generalised linear mixed models we examined the influence of age and sex on predation site selection relative to habitat availability across home ranges. Our results indicate that caracals, particularly males and juveniles, preferentially hunt significantly closer to urban features, which could increase their toxicant exposure risk. Results from rodenticide exposure testing and preliminary data on persistent organic pollutant exposure indicate that this risk is considerable. These data aid in understanding if caracals, along with many other Cape Peninsula species, are caught in an ecological trap, and elucidating possible management solutions.

(Full presentation)

**The investigation of sustainable and humane methods of rock hyrax (*Procavia capensis*) population management in an urban office park.**

**Samanta A Stelli<sup>1</sup>, Kabelo Mashula<sup>2</sup> & Steven G Blenkinsop<sup>2</sup>**

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Rand Water's Rietvlei office is based on a natural site in the southern suburbs of Johannesburg. The office grounds are managed as areas of maintained indigenous

landscaped gardens interspersed with corridors of natural indigenous vegetation with minimal maintenance. The site is located within Andesite Mountain Bushveld, characterized by dense thorny bushveld among undulating grassland and small rocky outcrops. The rocky outcrops are the natural habitat of the rock hyrax (*Procavia capensis* (Pallas, 1766)). Abundant resources year-round and a lack of natural predators have resulted in the establishment of a large population of rock hyrax at Rietvlei. The feeding habits of the rock hyrax have impacted on the quality and aesthetics of the landscaped gardens, while middens in close proximity to the buildings have resulted in complaints from office staff. Various methods of population control and rock hyrax exclusion were assessed, including blocking off access to artificial habitats i.e. storm water drains and pipes; fencing of high-use areas i.e. pool car parking lot; introduction of chemical deterrents; introduction of a predator stimulus; and introduction of 'alternative' plant species. Questionnaires were used to obtain the perception of office staff on the presence of rock hyrax on site. Results showed a significant decline in rocky hyrax numbers ( $t=10.89$ ;  $p\leq 0.05$ ; d.f. = 69) after the implementation of artificial habitat restrictions. The research has shown that humane methods of rock hyrax population management can be successful in an urban office park environment, as well as highlighted the importance of awareness campaigns amongst office staff.

(Speed presentation)

**Habitat variations influencing the frequency of bird strikes in high air traffic areas within the George airport.**

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Increased popularity of aircraft as means of transportation worldwide has had the resultant effect of increased bird-aircraft collisions. The vegetation occurring within the perimeter of an airport are either natural, modified, or a combination thereof. Such vegetation provides habitat opportunities for several avian species, and forms a significant component contributing to bird strikes and associated hazards. Birds display preferential behaviour towards particular localities within an airport's perimeter. Such preferences result in species occurring in high risk areas. We assessed habitat type preference of bird species within George airport, South Africa, and their resultant distribution. Cape longclaw (*Macronyx capensis*), among other avian species, occur in high population densities but do not pose a hazard. Crowned lapwing (*Vanellus coronatus*) and black-headed heron (*Ardea melanocephala*) are of lower densities but poses a greater threat to aircraft. We conclude that vegetation modification is necessary within an airfield, and active bird strike prevention is required as to lower strike-risk.

(Speed presentation)

**Medium-sized mammal diversity, abundances and changes perceived by stakeholders on agricultural buffer properties in the Boland, Western Cape**

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The core protected areas (PA) of the Boland Mountain Complex (BMC) harbours a high diversity of medium-size mammals that also utilise agricultural buffer landscapes, where

human development is prevalent. Anthropogenic activities along peripheral habitat can lead to edge effects that could either limit wildlife populations to PA's or lead to edges acting as sinks outside of PA's. This study aimed to determine whether medium-size mammal populations within agricultural buffers have changed over time. Due to a lack of historic population data, species' presence-only and frequency of observation data were gathered using structured interviews with agricultural labourers and management stakeholders relying on their combined long-term Local Ecological Knowledge (LEK). We assessed species distributions for potential differences and changes in abundances between different locations, farm characteristics and biosphere reserves (BR). On a biosphere level, the Cape Winelands BR had a broader presence of feral pigs *Sus scrofa* (Chi-squared (df=1)=5.17, p=0.02296) and caracal *Caracal caracal* (LS means: F(1,96)=0.99012, p=0.32) while the Kogelberg BR had a higher grey rhebuck *Pelea capreolus* abundance (Chi-squared (df=1)=6.66, p=0.00988). Caracal were the only species with an increasing population abundance in the BMC (Chi-squared(df=18)=44.39, p<0.001). Species abundances varied between mountain sections, percentage farmed area, distances from roads, settlements and protected boundaries. Rhebuck, striped weasel *Poecilogale albinucha*, zorilla *Ictonyx striatus* and hare require priority research. Feral dogs *Canis lupus familiaris* were detected as a threat and we recommend further research. Many of the BMC's populations seem stable, those mentioned need closer attention as to what may be driving their differences.

(Speed presentation)

**#ShareTheShores: conserving beach breeding birds in a dynamic urban context.**

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As tourism and urban development increase in coastal areas, competition for space between people and beach biodiversity is increasing. The disturbance by people and companion animals on shorebirds, particularly when breeding on beaches has resulted in dramatic declines in breeding success, and reporting rates for some species. We present results from our #ShareTheShores program, showcasing how conservation intervention work done in a positive inclusive manner, coupled with research-driven changes in local beach management plans, can effectively enable birds, dogs and people to co-exist on beaches in the greater Plettenberg Bay region.