

# CENTRE FOR AFRICAN CONSERVATION ECOLOGY

## ANNUAL REPORT 2012

Nelson Mandela Metropolitan University



## INTRODUCTION

The formation of the Terrestrial Ecology Research Unit (TERU) was approved by the Council of the then University of Port Elizabeth in 1991, in response to a need for terrestrial ecology training opportunities for postgraduate students and for terrestrial ecological research by conservation and environmental management agencies. TERU began operating in 1992 within the Zoology Department, and in 1997 received Council recognition as a research unit within the Faculty of Science. In 2005, TERU was registered as a Centre within the Faculty of Science of the Nelson Mandela Metropolitan University. Following an internal debate, it was agreed upon that changing the name of TERU would be an opportunity to reflect its new status as a Centre and would help identify TERU as a centre of excellence in the field of conservation and ecological research. TERU's name was changed to the *Centre for African Conservation Ecology, ACE*.

ACE comprises staff and postgraduate students of the Zoology, Botany and Geosciences Departments, with an Advisory Board comprising representatives of State, NGO and private conservation and environmental management interests. This is the twentieth Annual Report, and deals with the activities of ACE during 2012.

### VISION

The Vision of ACE is to build its national and international recognition as a centre of excellence in the fields of ecological and conservation research, and postgraduate training, and to expand this role in Africa.

### MISSION

The Mission of ACE is to develop scientific knowledge of the ecology and conservation of African ecosystems, especially in the Eastern Cape and adjacent regions of high biodiversity, which will enable society to make wise environmental management decisions. In achieving its Mission, ACE will build human capacity through postgraduate training.

The mission and vision of the Centre for African Conservation Ecology are aligned with the Nelson Mandela Metropolitan University's mission and strategic directions, in the context of the fields in which ACE operates.

## DIRECTOR'S REPORT

The central objectives of the Centre for African Conservation Ecology are to produce research and to train postgraduate students. In this respect, ACE has had another excellent year in terms of both research outputs and students. Thus, during 2012, the production of Refereed Scientific Publications was substantially up (29) compared to in 2011 (23), and this was nearly double the number of papers produced in 2010 (16). Other research outputs included 2 book chapters, 2 technical reports, 4 popular articles, a video and 17 conference presentations. There was also a substantial increase in the number of MSc students who graduated (7 within NMMU, and 2 at other universities), compared with only one in 2011, and the number of PhDs graduating has remained the same (3 in both 2011 and 2012). The large number of currently-registered MSc and PhD students (11 and 15, respectively) bodes well for the future in terms of research activities and outputs.

It has not been plain sailing, as ACE is increasingly facing challenges, these relating to funding of research activities and the management of resources. In terms of the latter, it is increasingly apparent that NRF funding is erratic in terms of its administration, and less reliable in terms of covering the research costs of postgraduate students. This is a concern in the light of the fact that the NRF has traditionally represented the major foundation for the support of postgraduate studies conducted within ACE. In terms of resources, ACE lost a vehicle through an accident during December – fortunately no-one was injured. The remainder of the vehicles are also ageing. Thus, the focus is now on developing a strategy to re-new the ACE research vehicle fleet.

Any organization is only as strong as the individuals who make up that organization. It is with sadness, that I have to report the resignation of Dr Kwezi Mzilikazi from the NMMU, as she and her students were serving as an increasingly vibrant component of ACE's research team. Fortunately, Kwezi is not lost to ACE as she has elected to stay on as a Research Associate. This year was also a milestone year in terms of being the first year that ACE was able to provide an internship through the NRF/DST internship programme.

Two notable milestones should be recognized for 2012. Firstly, the signing of an MoU between the NMMU and the Swedish Agricultural University provides the funding foundation for a major project, this being the Hotspot project, which focusses on the cascading effects of large predators on ecosystem function. Secondly, both the funding targets and the draft text for the book on the historical incidence of mammals in the Free State Province and Lesotho have been achieved. This project represents a major contribution from ACE, and is on track for publication of the book in 2013.

ACE has once again benefitted from the support of a broad range of individuals and entities. The Dean of the Faculty of Science, Prof Andrew Leitch, who also chairs the ACE Advisory Board, provided valuable advice and guidance. The NMMU departments of Research Management and Finances supported ACE activities through their service input. The NMMU Department of Research Capacity Development played a key role in administering student bursaries, the provision of funds and support of students. My thanks to the numerous funding agencies and supporters who have provided the resources to make this all happen, in particular the Nelson Mandela Metropolitan University. Finally, my thanks to the staff (especially Shirley Parker-Nance and André Boshoff) and students of ACE for the generous and enthusiastic contribution that they have all made in 2012.

**Prof. G I H KERLEY**  
**DIRECTOR: CENTRE FOR AFRICAN CONSERVATION ECOLOGY**

## AWARDS

The following students and staff received awards in 2012:

- Hayley Clements won the prize for Best Student Presentation at South African Wildlife Management Association Annual Symposium.
- Gail Potgieter, Janis Smith and Adriaan Grobler were awarded their MSc degrees *cum laude*.
- Adriaan Grobler was awarded the Albert Wessels Award.
- Adriaan Grobler was awarded the NMMU Vice Chancellor's Award.
- Adriaan Grobler was awarded the Rupert Gesinstigting Award.
- Adriaan Grobler was awarded the S2A3 Bronze Medal Award.

## RESEARCH ACTIVITIES

Research activities are grouped into themes, and are reported within these on a biome or project specific basis. A unifying feature of these themes is that global change serves as a cross-cutting theme.

### CONSERVATION BIOLOGY

*This theme seeks to identify priorities in terms of areas and implementation options for the efficient and effective long-term conservation of populations, species, habitats, and the ecological and evolutionary processes that maintain them.*

#### Elephant Research

The population monitoring of the Addo elephants continued. Given the growth in this population, it is crucial to increase the capacity to undertake this work.

#### Refugee Species

The refugee species concept focuses on the prospect of a species being trapped in suboptimal habitat through anthropogenic pressures. The implications of the refugee species concept were further explored in a paper on the application of inappropriate habitat suitability estimates for the European bison. During 2012, two papers appeared on the refugee species concept as applied to European bison.

Lizette Moolman (PhD student) is working on the hypothesis that the presence of elephants in the Knysna forest is an example of a refugee species. She has been collecting extensive samples of historical and museum material from this population and has been working with Carlos Cordova to look at using fossil phytoliths from elephant dental tartar to reconstruct the diet of these elephants.

#### Cape Vulture Research

As and when resources permit, André Boshoff continues his involvement in research and monitoring activities associated with the ongoing attempt by South African scientists and conservationists to halt the decline, and promote population growth, of the Cape vulture *Gyps coprotheres*. This vulture, which is endemic to southern Africa, is listed as 'Vulnerable' in the IUCN Red List of Threatened Species (ver. 3.1).

In the year under review, a short article, which provides breeding activity information from 2006, 2010 and 2011 for the Karmelkspruit Cape vulture colony in the Lady Grey district, in the north-eastern Cape Province, was published. This colony decreased from over 100 breeding pairs in the mid-1900s to zero pairs in 1990. When monitoring was resumed in 2006, it was discovered that breeding was again taking place at the colony and, since then, the number of active pairs has increased to 32 (in 2011, when monitoring last occurred). In 2011, signboards, aimed at reducing or preventing disturbance to the colony by visitors, were erected at a point where there is easy access (across private land) to the vulture cliffs. André is collaborating with David Allan of the Durban Natural History Museum, and others, on a project to collate, analyse and interpret data and information on the current breeding

status of this vulture in southern Africa. The publication that will emanate from this work will, inter alia, support current attempts to change the IUCN Red list status of this bird from 'Vulnerable' to 'Endangered'.

### **Plains Zebra Research**

Halszka Hrabar (Postdoctoral fellow) looked at the effect of translocations and selective breeding on reproduction in plains zebra, using data from the quagga breeding program which spans more than 20 years. Management interventions were found to result in immediate costs to reproductive rates, as inter-foaling-intervals increased after females were translocated, for example. An improved understanding of factors affecting reproductive sex allocation in plains zebra was also achieved. This research will enable improved management decisions for this and other such metapopulations, thereby enhancing future conservation efforts.

### **Plant conservation in road reserves**

Research in North America, Europe, New Zealand and Australia has focused on the ecological effects of roads on both biotic and abiotic components of ecosystems, including numerous studies examining the vegetation and conservation importance of road reserves. In contrast, perilously little research has been done on this topic in South Africa, and it is only recently that researchers have started to investigate the ecology of South African road reserves. Road reserves have been emphasized as being important refuges for plants and provide vital corridors for the dispersal of species in modified landscapes. Although there has been a call for these reserves to be included in conservation planning efforts, their value tends to be neglected in conservation planning, both internationally and in South Africa. Two major biogeographic conservation planning projects have been carried out in the Eastern Cape, namely the Cape Action for People and the Environment (CAPE) and the Subtropical Thicket Ecosystem Programme (STEP), but neither of these projects incorporated road reserves in their proposed conservation networks. However, the potential contribution of road reserves is immense, as even in a small country like New Zealand, the legally defined road verges provide a potential area of approximately 80 000 ha. As part of his PhD studies, Adriaan Grobler is investigating whether plant species and communities are able to persist in national road reserves of the Eastern Cape and also determine which factors influence their persistence. The potential of using these reserves as corridors in proposed conservation networks will also be assessed. Recommendations will be made for future management and planning of road reserves to maximise their contribution to conservation in South Africa.

### **Classification of Hopewell Conservation Estate's vegetation**

Meredith Cowie (Hons student) mapped the vegetation of Hopewell Conservation Estate, a recently established, privately owned nature reserve near St Albans in Port Elizabeth. The vegetation types present at Hopewell Nature Reserve are from the Fynbos and Thicket biomes, namely: Goudini Grassy Fynbos; Skurweberg Grassy Fynbos; Rocklands Renoster Bontveld; Rocklands Valley Thicket; and Sundays Valley Thicket. The Skurweberg Grassy Fynbos was restricted to the southern section of the reserve. The transitional vegetation type, Rocklands Renoster Bontveld, had the greatest spatial extent and covered the northern area of the Reserve. Ordinations indicated that vegetation types of the same biome were similar to each other, but dissimilar to the other biome. Rocklands Renoster Bontveld lies between the two biomes and showed great dissimilarity in species and samples. Hopewell Nature Reserve contained two species of conservation concern and little alien invasion. This Reserve makes a significant contribution to the conservation statuses of the above mentioned vegetation types.

### **Design of an exclusion zone for the critically endangered *Cyclopia pubescens***

*Cyclopia pubescens* is a critically endangered species of the honeybush genus that is endemic to Algoa Sandstone Fynbos. *Cyclopia pubescens* has specific environmental requirements that have restricted its distribution to an 11 km stretch aside the N2 National

Road west of Port Elizabeth. As part of her Honours degree, Meredith Cowie determined the current distribution of *Cyclopia pubescens* and designed an exclusion zone for its protection.

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## **ANIMAL-PLANT INTERACTIONS**

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*This theme seeks to develop an understanding of the nature of the interactions between animals and plants, and a predictive understanding of perturbations associated with animal impacts on communities and ecosystems.*

### **Impacts of megaherbivores**

Marietjie Landman (PhD student) has completed her research on the resource use and implications of elephant and black rhinoceros in succulent thicket, including preparing all the associated manuscripts for publication. Her findings show that (1) only 18% of plants thought vulnerable to elephant browsing appear in their diet, which refutes the idea that herbivory is the primary driver of decline among these plants, (2) succulent thicket is vulnerable to being transformed (particularly near water) as the accumulated influences of elephant reduce community composition and structure. She predicts that these impacts will eventually bring about landscape-level degradation and a significant loss of biodiversity. Importantly, results further show an uneven distribution of effects between the elements of this community: from community composition and structure, to the structure of individual canopy species and ecological functioning. While these findings confound our interpretation of the extent of the impacts, it demonstrates the importance of explicitly recognizing biodiversity and heterogeneity for the conservation management of elephant. Furthermore, developing a predictive understanding of the spatial and temporal variations of elephant impacts between elements of biodiversity and the mechanisms driving these changes are key to their management. This implies that the effective conservation management of elephant can only be achieved through the careful, scientific design of monitoring programmes. Finally, Marietjie tested the consequences of the impacts for coexisting black rhinoceros. She shows that rhinoceros change their foraging strategies in the presence of elephant at high densities, but that elephant may also facilitate access to food for rhinoceros at reduced densities. This indicates the importance of elephant in driving the structure and composition of the thicket shrub community and the consequences of this for coexisting large herbivores. Three of the Chapters from this thesis have now been accepted for publication and Marietjie submitted her PhD for examination at the end of the year.

Given the extensive effects of elephant on biodiversity in succulent thicket shown above, the impacts could cause irreversible ecosystem shifts. Thus, to identify thresholds of ecosystem change, measureable indicators are required that caution management of impending changes. However, these thresholds are difficult to discern and suitable indicators are poorly understood. Thus, Marietjie (with colleagues from SANParks) have been expanding on the outcomes of her PhD to (1) evaluate the sensitivity of stakeholder-values in informing the quantitative Thresholds of Potential Concern approach in ecosystems with elephant, and (2) evaluating the role of stakeholder opinions in monitoring elephant effects. Initial results show similar values between local farmers, scientists and conservation managers, suggesting that these values can be consolidated in order to determine the desired state of succulent thicket with elephant. These values have been correlated with both ecological and remote-sensed measures that can be used for monitoring. This work represents a novel approach to identifying critical thresholds in complex socio-ecological systems, and two manuscripts are being prepared for publication.

Charl Lyell (MSc student) is investigating the patterns of resource use by elephant while the Addo Elephant National Park was expanded to accommodate the steadily growing elephant population. The emphasis of the project is on determining how elephant resource use and preferences change with a change in resource availability. Such an understanding may provide key insights into the role of elephant herbivory as a threat to vulnerable plant taxa, and therefore the mechanisms of elephant effects that are responsible for their decline.

### **Elephant impacts**

A study was conducted by Ms Janis Smith (MSc student) to assess temporal and spatial trends in Elephant induced thicket degradation within the Addo Elephant National Park (AENP), using multi-temporal satellite imagery between 1973 and 2010. Changes in thicket condition in relation to the AENP expansion were analysed using the Normalized Difference Vegetation Index (NDVI), post-classification and landscape metrics. Temporal changes in vegetation gradients in relation to water points and thicket condition within the botanical reserves were also assessed. Landscape spatial metric analyses revealed evidence of increased vegetation fragmentation as new areas of the AENP were opened for elephant activity. A progressive decline in intact thicket and increase in degraded thicket were observed. An expansion of degraded vegetation away from the water points was also identified during the study period. Considering the current elephant densities, elephant induced thicket degradation within AENP is a serious threat to the thicket biome. Janis successfully completed this study and graduated in 2012.

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## **RESOURCE ECOLOGY**

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*This theme seeks to develop a predictive understanding of the responses of biota to different forms of utilization, and of how these natural resources are utilized.*

Many of the projects listed under other themes also contribute towards the goals of this theme.

### **Sustainable harvesting of *Cyclopia intermedia***

With the growing success of the Honeybush tea industry, the demand for material is ever increasing. *Cyclopia intermedia* is the species on which most of the pressure is placed as this is used to bulk-up the supply of other, less wide spread species of *Cyclopia* that are also used to produce this herbal tea. An understanding of the distribution and ecology of *C. intermedia* is required to propose a management plan and possible harvesting time frames that would aid in the sustainable use of this resource. To gain this knowledge, Nadia Barnardo (MSc) plans to compile a predictive distribution map and describe the ecosystems where *C. intermedia* occurs. Through species composition and environmental factors such as soil particle size, the phenology of the species will be monitored across its distribution, and population demographics will be done to identify the optimum time to harvest the population. Results will be used to inform decision makers on management strategies that would allow for sustainable usage of this economically valuable resource.

### **The effect of *Acacia karroo* on Eastern Cape pastures**

Neels De Ridder's PhD thesis aims to establish the effect of *Acacia karroo* tree density on grass species composition, forage yield and quality throughout different rainfall regimes in the Eastern Cape region. This project will further investigate whether density differences are consistent between different rainfall regimes and areas, as well as the practical implications of a possible grass production loss per hectare, if any.

### **Lion-human conflict in Botswana**

For his PhD studies, Gosiamo Neo-Mahupleng analysed spatio temporal patterns of human carnivore conflict (HCC), assessed kraals as effective enclosures of livestock at night and compared spotted hyaena diet between communal and protected area in the Chobe enclave of Northern Botswana. Lion (62%), spotted (23%) and leopard (13%) were the most important problem carnivores, disproportionately attacking and killing mainly cattle (57%) the most valuable livestock type in the Chobe Enclave. HCC and resulting livestock losses exhibited significant spatial and temporal variability. However, this variability was more pronounced for lion conflict and cattle losses. Lion conflict incidents and cattle losses depicted strong seasonality and being high during the wet season. Seasonality of lion

conflict is attributed to fluctuations in relative livestock density as a result of seasonal changes in wild prey density in response to availability of water. Spotted hyaena conflict was comparable between seasons and this is attributed to its high adaptability to anthropogenic influences and ecological plasticity. The number of different prey items identified in spotted hyaena scats range was 1 – 4, and food items ranges from elephant to rock mouse and pumpkin. Spotted hyaena diet indicated differences in diet between the communal area and areas of livestock, i.e. diet niche breadth was least in the no livestock area and diet overlap across sites was very high (>70%) but the least overlap was between the no livestock area and Floodplains. These two areas are at the extreme ends on a scale of anthropogenic influences. In addition proportionate representation of diet weight range indicated that in areas of high livestock and human activity, spotted hyaena diet was predominantly small prey items. Traditional routine of kraaling at night and grazing by day is still practiced in the Chobe Enclave. Kraals in the area. These actions were assessed as to whether they effectively protected livestock from predatory carnivore and also if they were designed and constructed as part of HCC mitigation. In general, the majority of kraals in the Chobe Enclave were found to be ineffective against predator attacks. However, some attributes of the kraals were consistent with expected carnivore predation risk. For example, kraal height, shape, size and perimeter were related to predation risk based on past HCC incidents and proximity to high anthropogenic activity. Most kraals were constructed from thorn bushes, suggesting availability and cost as factor in selecting material for kraal fencing. Kraal fence type (i.e. thorn bushes) was related to kraal strength.

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## ECOPHYSIOLOGY

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*This theme seeks to understand how physiological traits/characteristics constrain/aid the flow of energy from the environment into living organisms and how that energy is ultimately translated into an organism's fitness, especially those animals that cannot migrate when confronted with unpredictable inputs of energy in time and space.*

### **Interpopulation physiological variation**

MSc candidate Tanja van de Ven investigated the plasticity of three physiological variables, body mass ( $M_b$ ), basal metabolic rate (BMR) and summit metabolism ( $M_{sum}$ ) in red bishops from two populations (inland and coastal) in the Eastern Cape. Previous studies have examined the plasticity of the above-mentioned variables, but emphasis is often placed on multispecies comparisons along some ecological gradient, e.g. aridity. In this study, Tanja investigated physiological plasticity intra-specifically because for a widely-distributed species such as the southern red bishop, it is unlikely that a single phenotype has equal fitness value in all environments. Her results show that the largest changes occurred in the body mass. BMR also changed quite significantly in members from both populations. However, the direction and magnitude of change in metabolism differed between populations. Inland birds up-regulated BMR whilst coastal birds down-regulated their BMR. This is a critically important finding in that previous studies often report BMR as a species-specific parameter, and in this study Tanja has shown that not only does BMR change seasonally, but that change differs in direction (increase/decrease) and magnitude between populations. Tanja also measured  $M_{sum}$  for the first time in any Afrotropical bird species. This is an important parameter as it represents the uppermost limit of thermogenic performance.  $M_{sum}$  was not correlated with BMR, nor did it change with season in the inland population, although it was increased in the coastal population.

Tanja also investigated the rate and nature of physiological responses to short term thermal acclimation. The most striking result was that changes in BMR occurred within 2 days of acclimation to a new ambient temperature. By day 21 (three weeks acclimation is a routinely used time frame in physiological studies), the temperature effects had been reversed to values similar to those measured prior to acclimation. This has implications on two fronts a) that BMR responds rapidly to ambient temperature changes, and that b) acclimation effects are reversible in this species. Tanja's work has resulted in two publications, both in



reputable international journals, *Physiological and Biochemical Zoology* (published in 2013) & *Comparative Biochemistry and Physiology* (in press).

### **Bat Physiology**

The past decade has seen a steady increase on the number of studies investigating daily torpor and hibernation in the Afrotropics. Within the southern African context, the literature on heterothermy is dominated by studies on rodents and the smaller members of the Afrotheria and studies on the Microchiroptera remain relatively scant despite the fact that bats comprise one fifth of all mammalian species. MSc candidate Anna Doty investigated the thermoregulatory capabilities of four, locally occurring bat species (*Rhinolophus clivosus*, *R. capensis*, *Miniopterus natalensis* and *Myotis tricolor*). Specifically, she investigated seasonal changes in body temperatures (T<sub>b</sub>), metabolic rates (MR) and capacity for non-shivering thermogenesis.

Anna investigated resting metabolic rates during both summer and winter for the different species. She found that during both seasons, members of all species had a high propensity for torpor, especially at low temperatures, suggesting that heterothermy plays a huge role in the energy balance of this species in the wild. An unexpected finding was that *R. clivosus* tended to be normothermic in summer and more heterothermic in winter. Because non-shivering thermogenesis (NST) is an important part of arousal from torpor, Anna investigated the capacity for NST in two bat species, *R. clivosus* and *M. natalensis*, and confirmed that NST is an important component of arousal from torpor for these species. Her work raises some pertinent questions regarding the use of NST by species that use roosts with access to ambient solar heating. In conclusion, Anna has increased the number of current studies on thermoregulatory physiology of South African bats by 16%. She has provided the first ever data on thermoregulation of two previously unstudied species. She has shown that unlike other endothermic animals that periodically abandon normothermia to exhibit heterothermy, the heterothermic state is the norm in the bat species studied here. She has also provided the first NST data on South African Microchiroptera.

### **Hierarchical patterns in heat production**

Shaun Welman (MSc student) investigated the heat production of an African small mammal, *Rhabdomys pumilo*. Heat production in mammals is fascinating because although it is energetically expensive, it also confers several evolutionary advantages to endothermic animals. The strength of this work lies in the fact that heat production was investigated at multiple levels of animal organization. In his dissertation he has shown that small mammals 1) display significant seasonal adjustments in thermogenesis, 2) that these thermogenic changes may be related to significant changes in the associated organ mass, 3) that the specific metabolism of these organs may not be as predictable as expected, but may in fact be mediated by the animal's behavioural adaptations, and 4) that certain metabolic parameters show varying degrees of correlation with different ambient temperature variables. The results of his study contrasts are in contrast to long held conclusions from northern hemispherical species. It also presents the first account of seasonal variation in summit metabolism of a free-ranging Afrotropical small mammal species. Shaun submitted his MSc dissertation in December 2012 and two manuscripts are currently being prepared for publication. The work will be presented at the 2013 ZSSA conference.

### **Physiological costs of advertising**

There have been numerous studies on the fascinating sexual dimorphism observed in the widowbirds and bishops (Genus: *Euplectes*), as well as the factors that drive sexual selection in these species. Currently, the widely-held hypothesis of 'honest signalling' states that animal signals, in particular sexually selected ornamental traits, have evolved and are maintained as 'honest' advertisements ('indicators') of some aspect of individual quality (health, competitive ability, etc), that is of interest to the receiver. However, very little is known about both the physiological cost incurred during growth of these ornaments and what 'message' these signals convey. Stacey Webb (PhD student) is using members of the genus *Euplectes* as model species, with the aim to investigate the possible correlations

between the quality of the sexual ornaments and various physiological parameters. Using an integrated scientific approach the metabolic rate of individuals will be compared with other physiological aspects such as body condition. Basic body measurements and degree of furcula fat storage are used as indices of body condition. Blood samples are being collected for DNA sexing, carotenoid and hormone analyses, as well as blood smears for a white blood cell and a blood parasite count. Feather samples will be analysed in Sweden using reflectance spectrometry, and HPLC analyses will be used for pigment content and hormones. Plumage quality information will be analysed from tail length and carotenoid patch size. Controlled experiments will be performed in the laboratory to estimate the cost of growing specific feathers and natural moult is being measured in the field.

### **Freezing stress of Thicket and Nama-Karoo Plants**

Freezing stress is a major environmental driver of biome boundary distribution. Albany Thicket (AT) is characteristic of the frost-free lowlands whereas Nama-Karoo (NK) occupies frost exposed highlands in the South African interior. In some instances this altitudinal segregation is reversed as a result of frost occurrence due to cold air pooling in valleys – valley slopes have taller growing AT, whereas moist, nutrient rich valley floors have lower growing NK where AT should be dominant. The aim of this study was to investigate freezing stress as a determinant of biome boundaries between AT and NK using naturally occurring species. Ten NK and AST species were selected from Frost-Exposed Lowlands (FELs) and Frost-Free Midlands (FFMs), respectively, and cuttings were exposed to different freezing treatments (-4°C; -7°C and -10°C) for one hour. Chlorophyll fluorescence imaging was then used to compare freezing-induced changes in photosynthetic efficiency ( $\Delta Fv/Fm$ ) in AST and NK species from both areas under the different freezing treatments. AST species sustained significant decreases in  $Fv/Fm$  in all freezing treatments, while NK species only were significantly damaged by -10°C treatments. AST species were intolerant to freezing temperatures when compared with NK species, but within each biome there was considerable variation in freezing tolerance.

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## **PREDATOR PREY INTERACTIONS**

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*This theme seeks to understand the nature and consequences of predator prey interactions, to provide guidelines for the management of predators and their prey, as well as understanding the consequences of apex predator reintroductions on other components of the ecosystem*

### **Apex predator impacts**

Craig Tambling (Postdoctoral research) has continued monitoring the impacts of reintroduced carnivores on buffalo in the Addo Elephant National Park (Addo). The buffalo population in Addo Main Camp and Colchester has increased during 2012 and remains largely unaffected by lion predation. The buffalo related research has resulted in a further accepted publication towards the end of 2012. During 2012 camera traps were once again monitored in the Colchester Section to assess the impact of the reintroduced lions in Colchester on prey species (replicated sites from 2010 were monitored again). Findings from these sampling periods revealed that a synergistic interaction between elephants and apex predators may be detrimental to populations of small ungulates that use dense vegetation as a refuge. The camera trap research has further lead to the submission of another manuscript, with another manuscript in preparation. Additionally, during 2012 the diets of the reintroduced lions in Nyathi Section were monitored using Global Positioning System (GPS) cluster investigations. Each month, all the monitoring from the various Addo sections culminates in a report submitted to the Addo management. The research also enabled a presentation on the efficacy of locating kills using GPS clusters from four sites to be presented at the South African Wildlife Management Association Annual Symposium. During 2012 an additional project was initiated that will investigate eland-lion interactions during 2013 and 2014, focusing on how a non-combative ungulate species co-exists with its

main predator. A successful application was made to the International Foundation for Science for funds for this project.

### **Prey switching by lion and spotted hyaenas**

Julia Wentworth's MSc dissertation on prey switching and resource partitioning of lion and hyaena diets in relation to prey availability in the Addo Elephant National Park was successfully examined. She showed that both species showed prey preferences and that these preferences increased over time.

### **Responses of mesopredators**

The large scale project investigating the impact that apex predators have on mesopredators conducted across the Frontier region of SANParks project has continued during 2012 with laboratory work being undertaken to assess the diets of the jackals in association with different large predators.

### **Landscape ecology of jackals**

Liaan Minnie (PhD Student) has continued genetic sample collection of jackals on reserves and farms in order to assess if jackals are moving between protected landscapes and neighbouring farms. In addition he is also investigating differences in reproduction, population structure, and diet (predator-livestock interactions, prey switching) between the reserves and neighbouring farms.

### **Modelling predator diets**

Hayley Clements (MSc Student) submitted her thesis at the end of the year. She refined predictions of cheetah prey preference by accounting for prey demographics (sex and age) and predator social structure (solitary / group hunting and male / female). These refined diet predictions were used to improve the current cheetah carrying capacity model, and develop a new, more mechanistic model. These models allow for improved predictive ability in terms of understanding how many large carnivores small-medium sized reserves can hold. This work included a new approach for assessing carnivore diet. This data was presented at two conferences during the year and manuscripts are being developed which uses this approach to better describe the diets of the large African carnivore guild, with the intention of improving current diet predictions.

### **Impacts of cheetah on prey**

Doug Makin (MSc student) investigated the impact of cheetah reintroduction on the behavioural responses of an ungulate community. This was achieved through monitoring prey species' behavioural responses across a range of spatial and temporal scales. In response to predation risk from cheetah, prey species employ a range of anti-predator behavioural responses to reduce perceived predation risk, but at a cost of lower foraging effort. This study illustrated an asymmetrical response within the ungulate community as different species and demographic classes within species exhibited varied responses to cheetah presence depending on perceived susceptibility to predation. The results from this study were presented at SAWMA in 2012 and two manuscripts for publication are currently being developed. Doug submitted his dissertation for examination at the end of the year.

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## **TRANSFORMATION AND RESTORATION ECOLOGY**

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*This theme seeks to understand the causes and consequences of ecosystem transformation across all levels of integration, to provide guidelines for the restoration of biodiversity and ecosystem function.*

### **Factors influencing ecological thresholds in Thicket**

The majority of endemic species in the Thicket biome are dwarf succulents, of which many are found in Thicket. These species are threatened by overutilization by domestic

herbivores, but also by enclosed populations of megaherbivores such as elephants. Clayton Weatherall-Thomas' PhD thesis aims to identify the effects of new and established populations of elephants on the dwarf succulents of Thicket. This should result in identifying the utilization threshold of Thicket based on dwarf succulents, a necessary management tool for the many game reserves in Thicket. The initial baseline vegetation assessment has been conducted in the Colchester section of Addo Elephant National Park, which has recently been opened to elephants. This is presently being repeated after a period of two and a half years. To understand the impact of megaherbivores on the bushclump scale, succulent diversity of different areas that have undergone various levels of megaherbivore utilization has been sampled and analysis is on-going. Succulent diversity is being compared between Thicket refugia during the Last Glacial Maxima (LGM), as well as outside these areas.

### **Soil erosion and sediment source dynamics**

Munyaradzi Manjoro conducted a study in the Mgwalana Catchment, Eastern Cape Province to enhance our understanding of the soil erosion and sediment source dynamics using of remote sensing and sediment source fingerprinting techniques. Spatial and temporal patterns of soil erosion and woody shrub encroachment were assessed between 1998 and 2008. Qualitative and quantitative interpretations of mineral magnetic data were used to evaluate the potential for distinguishing catchment sediment sources and inferring the soil erosion history of the catchment. Caesium-137 ( $^{137}\text{Cs}$ ) was used to establish a chronology of the main floodplain sediment core and to estimate the rate of overbank floodplain deposition in the catchment. An increase in both woody shrub encroachment (11.51%) and severe soil erosion (3.23%) was observed during the ten year period. Sediment source types and spatial provenance in the catchment showed that grassland areas have consistently been the main sediment source (83%) throughout the period represented by the main sediment core, although between about 1960 and 1975, there was an increase in contributions from abandoned cultivated fields and cultivation. Sediment contribution from surface sources was dominant (54%) before 1965 and thereafter, subsurface sediment input increased (62 %). This trend indicates increased severity of gully erosion since the late 1960s and is consistent with previous studies. The application of the  $^{137}\text{Cs}$  technique estimated an overbank floodplain deposition rate of 2.4 cm/year, which is relatively high by regional standards. The study is a significant advance in our understanding of the sediment source dynamics in rural catchments of the former homelands of the Eastern Cape, South Africa.

### **Warthog as an invasive species**

Gideon Rossouw has extended the previous studies done in ACE on warthog as an invasive species to focus on the reproductive capacity of warthog to explain why they are so successful. Gideon is describing the reproductive cycle of males and females, including hormone levels, as well as addressing some interesting questions regarding their age at sexual maturity, age-related litter sizes and embryonic growth. The reproductive biology of any species, particularly those that are invasive, is important for developing realistic population models to inform management plans. It is hoped that this study will contribute towards a broader understanding of how to manage this alien invasive species in the Eastern Cape more efficiently.

### **Bats and wind turbines**

Bats are known to be particularly vulnerable to being killed by wind turbines, and with the growth of wind farms in South Africa, understanding this process is increasingly important in order to reduce these impacts. Tiffany Thwaites (MSc student) is investigating the relationships between bat activity and environmental variables at a proposed wind farm site near Van Stadens, and her data show a strong seasonal variation in bat activity. She is also exploring whether physiological responses of bats can be used to predict bat activity. Understanding the drivers of bat activity can potentially be used to develop mitigating measures for wind farms.

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## BIODIVERSITY

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*This theme seeks to gain a predictive understanding of the patterns, determinants and functions of biodiversity.*

### **The historical incidence of the larger mammals of the Free State Province and Lesotho**

This project involves the writing of a book, by André Boshoff and Graham Kerley, that investigates and describes the historical incidence of the larger mammals in the Free State Province (South Africa) and Lesotho. The project will extend eastwards and north-eastwards the geographical coverage, on the same topic, of the revised editions of the two books written by CJ Skead (Skead 2007, 2011), which form a model for this book. However, this project involves the preparation of a First Edition, as no prior material exists. During 2012 the focus of the work was on the completion of the literature research phase, followed by the analysis and interpretation of the information that was obtained. This, in turn, was followed by the commencement of the writing phase, which involved the preparation of the first drafts of accounts for each of the 55 species covered by the book. In addition, first drafts of the introductory chapter, and a chapter that deals with various associated topics, were completed. During the year under review, the geo-referencing of the written distribution records was completed and draft species distribution maps were then prepared for the 44 qualifying species. In addition, suitable pictures, to illustrate the contents of the book, were obtained. The book is due for publication in September 2013.

### **Bontveld landscape ecology**

Eastern Cape thicket mosaic vegetation units are plant ecosystems that host patches of thicket communities (bushclumps with succulent, sclerophyllous or spiny evergreen shrubs, trees and climbers) scattered within a matrix of various vegetation communities (Grassland, Fynbos, Karoo). These mosaic units are widespread and often regarded as transformed thicket with low importance. There are currently numerous controversial vegetation classifications for Eastern Cape thicket mosaics with no clear directive on how to differentiate between them. Even though a calcrete associated mosaic unit has shown to have unique plant communities in the bushclumps, it remains unclear if all calcrete associated vegetation share the same dynamics. Similarly, it is unclear how the calcrete associated matrix community relates to other mosaic matrix communities. In her PhD project, Betsie Milne aims to investigate phytosociology, faunal communities, plant-faunal interactions and spatial heterogeneity in calcrete associated- and non-calcrete thicket mosaics to be able to interpret biodiversity, rarity and endemism, and landscape functioning. Ultimately she aims to produce strategies for biodiversity conservation and resource management for Eastern Cape thicket mosaics.

### **Taxonomic review of rambling aloes**

Aloes in series *Macrifoliae* in the section *Prolongatae* are known as rambling, scrambling or climbing aloes. This series is considered to be a natural assemblage of closely related species. They are characterised by slender, wiry stems, which use surrounding trees and shrubs for support. The slightly fleshy leaves are usually widely spaced, with the sheathing section of the leaves often striated. Inflorescences are short racemes, with few small to large flowers. The rambling aloes are centered in the Eastern Cape where they are quite common, but some species do have disjunct distributions in other South African provinces. Through her Masters thesis, Kristin Ellis aims to revise the series fully, in terms of anatomical, cytological and molecular evidence, to clarify the phylogenetic relationships between the species in the series, and to confirm varietal ranks within variable species within the series.

### **Predator impacts on ecosystem function**

Elizabeth le Roux joined the research group in July as a PhD student investigating the non-consumptive effects of predation across trophic levels. This project examines the

behavioural responses of prey to the perceived risk of predation and its consequences to vegetation and nutrient dynamics. During the year under review, the study design and planning has been completed. The project is carried out in collaboration with the Department of Wildlife, Fish and Environmental Studies of the Swedish University of Agricultural Sciences and will be conducted in the Hluhluwe-iMfolozi Game Reserve in Kwazulu Natal.

### **International Ecological Modeling workshop**

As part of the 2012/13 South Africa-Germany Year Of Science Celebrations, a two day workshop on inter-disciplinary ecological modeling was hosted by ACE, with participants from Germany, the USA and South Africa. A key aspect of this workshop was its interdisciplinary nature, with ecologists and computer scientists sharing perspectives in a productive fashion. It is anticipated that further collaborative inter-disciplinary projects will emerge from this workshop.

## **SCIENCE MANAGEMENT**

ACE staff and students contributed to Science Management through a number of activities. These include the following:

- Graham Kerley served on the editorial boards of the Journal of Arid Environments, African Zoology, African Journal of Range and Forage Sciences, South African Journal of Wildlife Research.
- Staff and students reviewed proposals for the Austrian Science Fund, Cape Wools, Science and Technology Foundation (Portugal), University of Kwazulu-Natal, University of Zurich, Whitely Awards,
- Staff and students served as manuscript reviewers for the following journals: *Acta Theriologica*, *African Zoology*, *Ecography*, *Journal of Comparative Physiology B*, *Journal of Mammalogy*, *Journal of Zoology, London*, *Oryx*, *South African Journal of Wildlife Research*, *Wildlife Research*.

## **COMMUNITY SERVICE**

- Graham Kerley serves as a member of the Board of South African National Parks.
- Staff and students provided valuable opportunities for participants in the volunteer programmes in Addo Elephant National Park and Samara Private Game Reserve to learn about the various research programmes.
- Staff and students provided educational talks to a variety of school groups.
- Liaan Minnie has provided numerous talks to livestock farmers on the issue of predator conservation.
- Liaan Minnie and Craig Tambling presented talks to the St Francis Bay Morning Group.
- Craig Tambling presented a talk to the Mountain Club of South Africa, Port Elizabeth Group
- ACE continued to operate the Grysbok Environmental Education Trail, with nearly 1000 school-level learners participating in the trail experience in 2012.
- Marietjie Landman and Graham Kerley assisted with the compilation of a digital video production (translated into English, Xhosa, Zulu and Sotho) on recommendations for the management of small carnivore-livestock conflicts in South Africa.
- Graham Kerley and André Boshoff participated, by invitation, in a workshop organised and run by the national Department of Environmental Affairs, to develop maps of the estimated historical distributions of TOPS (Threatened and Protected Species) – larger mammals – in South Africa.

- Adriaan Grobler and Clayton Weatherall-Thomas are involved with the Custodians of Rare and Endangered Wildflowers (CREW) who survey and monitor populations of threatened plants in the Nelson Mandela Bay area.
- Derek Du Preez, Adriaan Grobler and Clayton Weatherall-Thomas serve on the committee of the Algoa Branch of the Botanical Society of South Africa, which hosts monthly activities to promote the conservation and public knowledge of South Africa's flora.

## EXTERNAL ACADEMIC SERVICE

ACE members served as supervisors for students registered at universities besides the Nelson Mandela Metropolitan University, reflecting the levels of collaboration being achieved. These included:

- STEERS, K. Competitive behavior in goats. MSc thesis, University of Kwazulu-Natal, with co-supervision by Graham Kerley.
- MKETENI, F. Small elephant populations in South Africa: identification and characterization of populations. MSc thesis, University of the Free State, supervised by Graham Kerley.
- NOWACK, J. Energy balance in lesser bushbabies . PhD thesis, Biozentrum Grindel und Zoologisches Museum, Universität Hamburg, Germany, with co-supervision by Kwezi Mzilikazi
- OELKRUG, R. The evolution of BAT mediated nonshivering thermogenesis in the Afrotheria. PhD thesis. Department of Animal Physiology, Philipps Universität Marburg, Germany

ACE Members served as External Examiners to Rhodes University, University of Fort Hare, University of Kwazulu Natal, University of Malawi, University of Putra, Malaysia, University of the Witwatersrand and Walter Sisulu University.

## 2012 Products

### Refereed Scientific Publications

1. BRADLEY, B.A., ESTES, L.D., HOLE, D.G., HOLNESS, S., OPPENHEIMER, M., TURNER, W.R., BEUKES, H., SCHULZE, R.E., TADROSS, M.A. AND WILCOVE, D.S., 2012: Predicting how adaptation to climate change could affect ecological conservation: secondary impacts of shifting agricultural suitability, *Diversity and Distributions* 18: 425–437.
2. BUK, K.G. & KNIGHT, M.H. 2012. Habitat suitability model for black rhinoceros in Augrabies Falls National Park, South Africa. *South African Journal Wildlife Research* 42 (2): 82-93. doi:org/10.3957/056.042.0206.
3. CROMSIGT, J.P.G.M., KERLEY, G.I.H. & KOWALCZYK, R. 2012. The difficulty of using species distribution modelling for the conservation of refugee species – the example of European bison. *Diversity & Distributions* 18(12): 1253–1257. doi: 10.1111/j.1472-4642.2012.00927.x
4. DDUMBA, H., MUGISHA, J.Y.T., GONSALVES, J. W. & KERLEY, G.I.H. 2012. The role of predator fertility and prey threshold bounds in the global and local dynamics of a predator-prey model with a prey out-flux dilution effect. *Applied Mathematics and Computation*. 218: 9169-9186. doi:org/10.1016/j.amc.2012.02.074
5. FEELY, J.M. 2012. isiXhosa name for leopard. *African Zoology* 47 (2): 345-347.
6. HAYWARD, M.W. 2012. Time to agree on a conservation benchmark for Australia. *Pacific Conservation Biology* 18(2): 69-76.
7. HAYWARD, M.W. & HAYWARD, M.D. 2012. Waterhole use by African fauna. *South African Journal of Wildlife Research* 42(2): 117-127. doi: org/10.3957/056.042.0209.
8. HAYWARD, M.W., JEDRZEJEWSKI, W. & JEDRZEWSKA, B. 2012. Prey preference of the tiger *Panthera tigris*. *Journal of Zoology* 86(3):221-231. DOI: 10.1111/j.1469-7998.2011.00871.x.
9. KERLEY, G.I.H., KOWALCZYK, R. & CROMSIGT, J.P.G.M. 2012. Conservation implications of the refugee species concept and the European bison: king of the forest or refugee in a marginal habitat? *Ecography* 35:519-529. doi: 10.1111/j.1600-0587.2011.07146.x
10. LANDMAN, M., SCHOEMAN, D.S., HALL-MARTIN, A.J. & KERLEY, GIH 2012. Understanding long-term variations in an elephant piosphere effect to manage impacts. *PLoSOne* 7: e45334.
11. LINKLATER WL, GEDIR JV, LAW PR, SWAISGOOD RR, ADCOCK K, DU PREEZ, P, KNIGHT, M.H. & KERLEY, G.I.H. 2012. Translocations as Experiments in the Ecological Resilience of an Asocial Mega-Herbivore. *PLoS ONE* 7(1): e30664. doi:10.1371/journal.pone.0030664.
12. KAKEMBO, V., NDLELA, S. AND CAMMERAAT, E. 2012. Trends in vegetation patchiness loss and implications for landscape function: the case of *Pteronia incana* in the Eastern Cape. *Land Degradation and Development* 23 (6): 548–556. DOI: 10.1002/ldr.2175.
13. MAKIN, D.F., PAYNE, H.F.P. KERLEY, G.I.H. & SHRADER, A.M. 2012. Foraging in a 3D world: how does predation risk affect space use of vervet monkeys? *Journal of Mammalogy* 93(2): 422-428.
14. MALAN, E.M., REILLY, B.K., LANDMAN, M. & MYBURGH, W.J. 2012. Diet of black rhinoceros *Diceros bicornis m minor* as determined by faecal microhistological analysis at the Mokopane Biodiversity Centre, Limpopo – a preliminary investigation. *South African Journal of Wildlife Research* 42(1):60-62. doi: org/10.3957/056.042.0104.
15. MANJORO, M., KAKEMBO V. AND ROWNTREE, K. 2012. Trends in soil erosion and woody shrub encroachment in Ngqushwa district, Eastern Cape Province, *South Africa Environmental Management* 49 (3): 570-579. DOI: 10.1007/s00267-012-9810-0.
16. MANJORO, M., ROWNTREE, K.M., KAKEMBO, V AND FOSTER, I.D.L. 2012. Gully-fan morphodynamics in a small catchment in the Eastern Cape, South Africa. *Land Degradation and Development* 23 (6): 569-576. DOI: 10.1002/ldr.2174.
17. MARTIN, T.G., NALLY, S., BURIDGE, A.A., ARNALL, S., GARNETT, S.T., HAYWARD, M.W., LUMSDEN, L.F., MENKHORST, P., MCDONALD-MADDEN, E. & POSSINGHAM, H.P. 2012. Acting fast helps avoid extinction. *Conservation Letters* 5(4): 274-280. DOI: 10.1111/j.1755-263X.2012.00239.x.
18. MHANGARA, P. AND KAKEMBO, V. (2012). An object-based classification and fragmentation analysis of land use and cover change in the Keiskamma catchment, Eastern Cape, South Africa. *World Applied Sciences Journal* 19 (7): 1018-1029. DOI: 10.5829/idosi.wasj.2012.19.07.955.



19. MHANGARA, P., KAKEMBO, V. AND KYOUNG J. 2012. Soil Erosion Risk Assessment of the Keiskamma Catchment, South Africa using GIS and Remote Sensing, *Environmental Earth Sciences*, 65: 2087-2102 DOI 10.1007/s12665-011-1190-x.
20. MNONOPI, N., LEVENDAL, R-A., MZILIKAZI, N. & FROST, C. L. 2012. Marrubiin, a constituent of *Leonotis leonurus*, alleviates diabetic symptoms. *Phytomedicine* 19(6):488-93. doi: 10.1016/j.phymed.2011.12.008. Epub 2012 Feb 10.
21. MUGAGGA, F., KAKEMBO V AND BUYINZA, M. 2012. Land use Changes on the Slopes of Mount Elgon and the Implications for the Occurrence of landslides *Catena* 90: 39–46 doi:10.1016/j.catena.2011.11.004.
22. MUGAGGA, F., KAKEMBO V AND BUYINZA, M. 2012. A Characterization of the Physical Properties of Soil and the Implications for Landslide Occurrence on the Slopes of Mount Elgon, Eastern Uganda, *Natural Hazards* 60 (3): 1113-1131, DOI : 10.1007/s11069-011-9896-3. Impact factor 1.53.
23. NOWACK J., MZILIKAZI N., WIPPICH M., & DAUSMANN K.H. 2012. Surviving the cold dry period in Africa: behavioural adjustments as an alternative to heterothermy in *Galago moholi*. *International Journal of Primatology*. DOI 10.1007/s10767-012-9646-8
24. NOWACK J., MZILIKAZI N. & DAUSMANN K.H. 2012. Torpor as an emergency solution in *Galago moholi*: heterothermy is triggered by different constraints. *Journal of Comparative Physiology B: Biochemical, Systems, and Environmental Physiology* DOI 10.1007/500360-012-0725-0
25. ODINDI J., MHANGARA P. AND KAKEMBO V. 2012. Remote sensing land-cover change in Port Elizabeth during South Africa's democratic transition. *South African Journal of Science* 108 (5/6). doi.org/10.4102/sajs. v108i5/6.886.
26. OELKRUG, R., MEYER, C.W., HELDMAIER, G. & MZILIKAZI, N. 2012. Seasonal changes in thermogenesis of a free-ranging afrotherian small mammal, the Western rock elephant shrew (*Elephantulus rupestris*). *Journal of Comparative Physiology B* 182(5):715-27. doi: 10.1007/s00360-012-0647-x. Epub 2012 Feb 16.
27. SHRADER, A.M, BROWN, J.S., KERLEY, G.I.H. & KOTLER, B.P. 2012. Patch use in free ranging goats: does a large mammalian herbivore forage like other central place foragers? *Ethology* 118: 967–974. doi: 10.1111/j.1439-0310.2012.02090.x.
28. TAMBLING, C.J., DRUCE, D.J., CASTLEY, J.G., ADENDORF, J. & KERLEY, G.I.H. 2012. Spatial and temporal changes in group dynamics and range use enable anti-predator responses in African buffalo. *Ecology* 93:1297–1304. <http://dx.doi.org/10.1890/11-1770.1>
29. TAMBLING, C.J., LAURENCE, S.D., BELLAN, S.E., CAMERON, E.Z., DU TOIT, J.T. & GETZ, W.M. 2012. Estimating carnivoran diets using a combination of carcass observations and scats from GPS clusters. *Journal of Zoology* 286 (2): 102-109. DOI: 10.1111/j.1469-7998.2011.00856.x.

### **Book Chapters or Contributions to Books**

1. DAUSMANN, K.A., NOWACK, KOBBE, S. & MZILIKAZI, N. 2012. Afrotropical heterothermy: A continuum of possibilities. In: T. RUF, C. BIEBER, W. ARNOLD AND E. MILLESI (eds.). *Living in a season world*. Springer, Berlin Heidelberg. 13-27.
2. MZILIKAZI, N., MADIKIZA, Z., OELKRUG, R. & BAXTER, R.M. 2012. Hibernation in Free-Ranging African Woodland Dormice, *Graphiurus murinus*. In *living in a season world: Thermoregulatory and metabolic adaptations*. In: T. RUF, C. BIEBER, W. ARNOLD AND E. MILLESI (eds.). *Living in a season world*. Springer, Berlin Heidelberg. 41-50.

### **Reports**

1. BOSHOFF, A.F., MINNIE, J. and MICHAEL, M. 2012. Electrocution of Cape Griffons *Gyps coprotheres* on Power Line Infrastructure: A Pragmatic Approach to Identifying and Prioritising Areas for Conservation Action. Centre for African Conservation Ecology Report C126: 1-13.
2. HRABAR, H. & KERLEY, G. I. H. 2012. Selective breeding in the Quagga Breeding Program – the effect of translocations and inbreeding on Plains zebra reproduction. Centre for African Conservation Ecology Report C127: 24 pp.

### **Popular Articles**

1. MINNIE, L., KERLEY, G. I. H. & BOSHOFF, A. F. 2012. Human-carnivore conflict in the Baviaanskloof Mega-Reserve: Are Leopards the root of all evil or the farmer's friend? *Environment*. 10: 14-16.
2. Plotz, R. 2012. Burdened beast. *Australian Geographic*. May-June: 16-17.

3. BOSHOFF, A.F. 2012. Information from 2006, 2010 and 2011 for the Karmmelkspruit Cape Vulture *Gyps coprotheres* colony, Lady Grey district, Eastern Cape Province, South Africa. *Vulture News* 62: 46-48.
4. BOSHOFF, A.F. 2012. Signboards at the Karmmelkspruit Cape Vulture colony. *Vulture News* 62:49-50.

### **Video**

LANDMAN, M. & KERLEY, G.I.H. 2012. Production of the video: “Roofdiër bestuur: prakties bestuursriglyne vir die hedendaagse vee- en wildboer.” In Afrikaans, with English, Xhosa, Zulu and Sotho translations. Commissioned and distributed by National Wool Growers Association.

### **Conference Presentations**

1. CLEMENTS, H., TAMBLING, C.J. & KERLEY, G.I.H. Evolving carnivore carrying capacity models: The influence of predator social grouping and prey demographics on cheetah prey preference in southern Africa. Oral presentation. IWMC: International Convention Centre, Durban: 9-12 July 2012.
2. KOWALCZYK, R., KERLEY, G.I.H. & CROMSIGT, J.P.G.M. Conservation management of refugee species - the European bison as an example. Oral presentation. IWMC: International Convention Centre, Durban: 9-12 July 2012.
3. GROBLER BA, CAMPBELL EE & DU PREEZ, DR. 2012. The contribution of national road reserves to plant conservation in the Eastern Cape: A research proposal. Fynbos Forum, 17-20 July 2012, Cape St Francis Resort, Cape St Francis, Eastern Cape.
4. MEYER-MILNE E, PROCHES S & CAMPBELL EE. August 2012. Arthropod function and redundancy: a baseline for monitoring environmental change in naturally fragmented habitats across disturbance regimes. 24th International Congress of Entomology, August 2012, Daegu, South Korea.
5. HRABAR, H. & KERLEY, G.I.H. Cape mountain zebra conservation goals - security in numbers? Oral presentation. IWMC: International Convention Centre, Durban: 9-12 July 2012.
6. SMIT, I., LANDMAN, M., COWLING, R., GAYLARD, A. & KERLEY, G.I.H. 2012. Expert opinion on the desired state of Sundays Spekboom Thicket in the Addo Elephant National Park. Oral presentation: Thicket Forum, Rhodes University, Grahamstown, South Africa, September 2012. (Best Oral presentation).
7. CLEMENTS, H., KERLEY, G.I.H. & TAMBLING, C.J. Managing large carnivores on small reserves: the implications of incorporating predator social structure and demographic-level prey preferences in a cheetah carrying capacity model. Oral presentation, Southern African Wildlife Management Symposium - Bela Bela, 16-19 September 2012 (Best student presentation).
8. MAKIN, D.F. & KERLEY, G.I.H. How does the presence of cheetah (*Acinonyx jubatus*) drive fine scale behavioural responses within the ungulate community in Samara Private Game Reserve? Oral presentation, Southern African Wildlife Management Symposium - Bela Bela, 16-19 September 2012.
9. TAMBLING, C.J. & KERLEY, G.I.H. How much does it cost to generate lion diet estimates? Oral presentation, Southern African Wildlife Management Symposium - Bela Bela, 16-19 September 2012.
10. MINNIE, L. & KERLEY, G.I.H. Regional variation in black-backed jackal (*Canis mesomelas*) diet in the Karoo. Oral presentation, Southern African Wildlife Management Symposium - Bela Bela, 16-19 September 2012.
11. HRABAR, H. & KERLEY, G.I.H. Cape mountain zebra conservation goals - security in numbers? Oral presentation, International Wild Equid Conference, Vienna, Austria, 18-22 September 2012.
12. HRABAR, H., TAMBLING, C.J. & KERLEY, G.I.H. A new threat to Cape mountain zebra? – lion introductions in the Karoo National Park. Poster presentation, International Wild Equid Conference, Vienna, Austria, 18-22 September 2012.
13. SMITH, I., LANDMAN, M., COWLING, R. & GAYLARD, A. 2012. Expert opinion on the desired state of Sundays Spekboom Thicket in the Addo Elephant National Park. Oral presentation: Thicket Forum, Rhodes University, Grahamstown, South Africa (Best oral presentation).
14. Radloff, F., Martins, Q. & Tambling, C.J. Stable isotope analysis and carnivore feeding ecology – new ways to address persistent questions. Southern African Wildlife Management Symposium – Bela Bela, 16-19 September 2012.
15. DAUSMANN, K.A., NOWACK, KOBBE, S. AND MZILIKAZI, N. Afrotropical heterothermy: A continuum of possibilities. 14th International Hibernation Symposium, 8 – 14 August 2012. Austria

16. MZILIKAZI, N., MADIKIZA, Z., OELKRUG, R. & BAXTER, R.M. Hibernation in Free-Ranging African Woodland Dormice, *Graphiurus murinus*. 14th International Hibernation Symposium, 8 – 14 August 2012. Austria
17. HALLAM, SL. & MZILIKAZI, N. Heterothermy in the southern African hedgehog. 14th International Hibernation Symposium, 8 – 14 August 2012. Austria.

### **Post- Graduate Training**

#### **Honours Projects**

1. COWIE, M. Classification of Hopewell Conservation Estate's vegetation.
2. COWIE, M. Design of an exclusion zone for the critically endangered *Cyclopia pubescens*.
3. WEYER, N. 2012. The influence of predator cues and ambient temperature on the resting metabolism and torpor patterns of woodland dormice, *Graphiurus murinus*.
4. DUKER, R. The effects of frost on Thicket and Nama-Karoo: Biome boundaries explored.

#### **Postgraduate degrees completed – M.Sc**

1. WENTWORTH, J. 2012 Trends in large carnivore diets in the Addo Elephant National Park. MSc thesis, Nelson Mandela Metropolitan University.
2. STEERS, K. 2012. Scrounging herbivores use both patch quality and dominance status of patch holders when deciding which patch to join Competitive behavior in goats. MSc thesis, University of Kwazulu-Natal.
3. POTGIETER, G.C. 2012. Effectiveness of livestock guarding dogs. MSc thesis, Nelson Mandela Metropolitan University. (*cum laude*).
4. MKETENI, F. 2012. Characterizing small elephant populations in South Africa. MSc thesis, University of the Free State.
5. GROBLER, B.A. A systematic conservation assessment and plan for the Baakens River Valley, Port Elizabeth. MSc thesis, Nelson Mandela Metropolitan University. (*cum laude*).
6. SMITH, J. Using remote-sensing to assess elephant-induced vegetation change in the Addo Elephant National Park. MSc dissertation, Nelson Mandela Metropolitan University. (*cum laude*).
7. DOTY, A. Aspects of heterothermy in four species of Afrotropical bats. MSc dissertation, Nelson Mandela Metropolitan University.
8. VAN DE VEN, T. Phenotypic plasticity of metabolic rate in an Afrotropical bird species . MSc dissertation, Nelson Mandela Metropolitan University.
9. FINCA, A. Modelling Trends of Evapotranspiration using MODIS LAI in the catchments of the Eastern Cape. MSc dissertation, Nelson Mandela Metropolitan University.

#### **Postgraduate degrees completed – Ph.D**

1. MUNISHI, L. 2012. The influence of genetic relatedness on sociality and demography of female African elephants. PhD thesis, Nelson Mandela Metropolitan University.
2. MACIEJEWSKI, K. 2012. Exploring the linkages between biodiversity and ecotourism in protected areas. PhD thesis, Nelson Mandela Metropolitan University.
3. DDUMBA H. 2012. Repulsive-Attractive Models for the Impact of Two Predators on Prey Species Varying in Anti-Predator Response. PhD thesis, Nelson Mandela Metropolitan University.

#### **Postgraduate degrees in progress – M.Sc**

1. BARBARDO, N. Sustainable harvesting of wild populations of *Cyclopia intermedia* in Kouga, Eastern Cape, South Africa. MSc thesis, Nelson Mandela Metropolitan University.
2. CLEMENTS, H. Impacts of reintroduced cheetah. MSc thesis, Nelson Mandela Metropolitan University.
3. ELLIS, K. Revision of Aloe Section *Prologatae* Series *Macrifoliae*. MSc thesis, Nelson Mandela Metropolitan University.
4. HAINDONGO, P. An investigation of the factors influencing vegetation stress in a section of the Keiskamma Catchment, Eastern Cape. MSc dissertation, Nelson Mandela Metropolitan University.
5. LOUW, M. The propagation and ecophysiology of thicket species: in contribution to rehabilitation of Eastern Cape thickets. MSc dissertation, Nelson Mandela Metropolitan University.
6. LYELL, A. Diet shifts in the Addo elephants. MSc thesis, Nelson Mandela Metropolitan University.

7. MAKIN, D.F. Patch use response of prey species to reintroduced predators. MSc thesis, Nelson Mandela Metropolitan University.
8. NDOU, N. Linking vegetation condition to grazing management systems in the Keiskamma catchment, Eastern Cape Province: A GIS and Remote Sensing approach. MSc dissertation, Nelson Mandela Metropolitan University.
9. SINGH, K. Population dynamics of the Zuurberg cycad and the predicted impact of climate change. MSc thesis, Nelson Mandela Metropolitan University.
10. THWAITTS, T. E. Can bat activity patterns make them vulnerable to wind turbines? MSc thesis, Nelson Mandela Metropolitan University
11. WELMAN, S. Seasonal heat production in *Rhabdomys pumilio*. MSc thesis, Nelson Mandela Metropolitan University.

#### Postgraduate degrees in progress – Ph.D.

1. DE RIDDER, K. The effects of *Acacia karroo* tree density on grass species. PhD thesis, Nelson Mandela Metropolitan University.
2. GROBLER, A. Ecological importance of road reserves. PhD thesis, University Nelson Mandela Metropolitan University
3. GOUGH, K.F. Association patterns of elephants: do behavioural patterns reflect genetic relationships? PhD thesis, University Nelson Mandela Metropolitan University.
4. LANDMAN, M. Megaherbivores in succulent thicket: resource use and implications. PhD. thesis, Nelson Mandela Metropolitan University.
5. LE ROUX, E. The role of apex predators in ecosystem function. PhD thesis, Nelson Mandela Metropolitan University.
6. MGQATSA, N. Ecological cascading effects: an insight from elephant coarse woody debris in the Addo Elephant National Park. PHD thesis, Nelson Mandela Metropolitan University.
7. MILNE, E. Bontveld Landscape Ecology: a platform for biodiversity conservation and resource management in Eastern Cape thicket mosaics.. PhD thesis, Nelson Mandela Metropolitan University.
8. MINNIE, L. Ecology and population dynamics of black-backed jackal (*Canis mesomelas*) in the Karoo, South Africa. PhD thesis, Nelson Mandela Metropolitan University.
9. MOOLMAN, L. The Knysna elephants as a refugee species. PhD thesis, Nelson Mandela Metropolitan University.
10. NEO-MAHUPELENG, G. Lion human interactions in the Chobe District Botswana. PhD thesis, Nelson Mandela Metropolitan University.
11. NYAMUGAMA, A. Modeling the impact of land use/cover change and its impact on soil organic carbon in the Thicket Biome of Southern Africa. PhD thesis, Nelson Mandela Metropolitan University.
12. SCHMIDT, A.G. Factors affecting ecological thresholds in Mosaic Thicket. PhD thesis, Nelson Mandela Metropolitan University.
13. WEATHERALL-THOMAS, C.R. Utilization thresholds for the maintenance of thicket floral diversity. PhD thesis, Nelson Mandela Metropolitan University.
14. WEBB, S.L. The physiological cost of extravagant plumage in birds of the genus *Euplectes*. PhD. thesis, Nelson Mandela Metropolitan University.
15. ZENGENI, R. Assessing the potential of soil carbon sequestration as a climate change mitigatory option in the Eastern Cape Province of South Africa, PhD thesis, Nelson Mandela Metropolitan University.

#### Postdoctoral Research In Progress

1. Dr Halszka Hrabar. 2009 - . Conservation biology and behavioural ecology of Cape Mountain Zebra.
2. Dr Craig Tambling. 2010 - . Interactions between predators in the Eastern Cape.

## Financial Statements

The 2012 Financial statements are presented as two separate statements,

- One representing the Operational Funds for running ACE (this page),
- One representing the research funds for projects undertaken under the auspices of ACE (the next page).

This format serves to highlight the efficient manner in which funds are focused on the core business (research) of the Centre, and operation expenses are minimized.

### INCOME STATEMENT OF ACE OPERATIONAL FUNDS

ENTITY NAME: ACE  
ENTITY LEADER: Prof G Kerley  
FACULTY: Science  
COST CENTRE(S): 4850,BC67,N087,N096,N100,N267

INCOME STATEMENT FOR PERIOD : 31 December 2012

Opening Balance	115 872
Income	161 504
Funds Received	83 373
Funds Research	78 131
<b>EXPENDITURE</b>	<b>185 529</b>
Salaries	55 437
Operating Expenses	129 688
Admin Fee	405
Project Invoices not Paid	35 628
Closing Balance	<u><u>127 474</u></u>

Signed off by Finance Dept.

Name : Rheinard van Onselen

Title : Accountant Research & Wild Stream

Signature: 

Date : 19/04/2013

## INCOME STATEMENT OF ACE RESEARCH FUNDS

ENTITY NAME: ACE  
ENTITY LEADER: Prof G Kerley  
FACULTY: Science  
COST CENTRE(S): N217, N311, G152, G478, G508, G534, G536, G537, G541, G687, L238, L149, L153, L273, N084, N085, N088, N089, N091, N092, N093, N094, N095, N097, N098, N219, N250, N254, N255, N265, N301, N364, N365, G387, L196, L259, L266, L286, N292, N306, G231, N310

INCOME STATEMENT FOR PERIOD : 31 December 2012

Opening Balance	1 749 656
Income	2 344 002
Private Grants unrestricted	223 143
Funds Research	957 937
NRF Funds	659 367
Council Funds	503 555
<b>EXPENDITURE</b>	<b>1 695 492</b>
Salaries	299 209
Operating Expenses	1 116 500
Equipment	119 783
Bursaries	160 000
Travel and Subsistence	-
Project Invoices not Paid	-
<b>Closing Balance</b>	<b>2 398 166</b>

Signed off by Finance Dept.

Name: Rhinard van Onselen

Title: Accountant Research & Third Stream

Signature: 

Date: 19/04/2013

### **In Kind Contributions**

The Mazda Wildlife Fund continues to provide a fully-serviced 4x4 twincab for research support. This is valued at about R50 000 per year.

Budget Rent-a-Car have again provided a 4x4 bakkie, which has primarily been used for research on predators in the Addo Elephant National Park. This is valued at about R50 000 per year.

### **Bursaries**

The provision of bursaries by a variety of funding institutions directly to students is not reported in the above statements. These institutions include, inter alia, the National Research Foundation, the Nelson Mandela Metropolitan University, and the Claude Leon Foundation. These bursaries are critical to the ability to support students with their research projects.

## ADVISORY BOARD, STAFF AND ASSOCIATED STUDENTS

### Advisory Board 2012

Prof. Andrew Leitch (Chair)	Dean Faculty of Science, NMMU (Chair)
Dr Achuo Enow	National Research Foundation
Prof. James Gambiza	Department of Environmental Sciences - Rhodes University
Mr. Alan Southwood	Department of Economic Development, Environmental Affairs & Tourism, Eastern Cape
Mr Wesley Berrington	Nelson Mandela Bay Municipality – Environmental Management
Dr Luthando Dziba	Council for Scientific and Industrial Research
Mr Andrew Muir	Wilderness Foundation
Dr Mike Knight	South African National Parks
Mr Sybert Liebenberg	Eastern Cape Parks & Tourism Agency
Mr A Muir	Wilderness Foundation
Dr William Fowlds	Indalo: Eastern Cape Association of Private Reserves

### Staff

Prof. G. I. H. Kerley, (Director)	Dr. G. J. Rossouw
Prof. E. E. Campbell (Deputy Director)	Dr. S. Parker-Nance (part time)
Prof. V. Kakembo	Dr. S. R. Henley
Dr. D. du Preez	Dr. S. L. Wilson
Dr. A. F. Boshoff	
Dr. N. Mzilikazi (until September)	

### Research Associates

Dr. W. Linklater (NZ)	Dr. A. R. Palmer (SA)
Dr. M.W. Hayward (Aus)	Dr. M. H. Knight (SA)
Dr. S. Holness (SA)	Dr J.P.G.M. Cromsigt (Sweden)
Dr. N. Mzilikazi (after September)	Mr. J. Feely (SA)

### Postdoctoral Researchers

Dr. H. Hrabar	Dr. C. Tambling
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### Postgraduate students (and their academic departments)

MSc		PhD	
Ms. N Barbado	Botany	Mr. N. De Ridder	Botany
Ms. H. Clements	Zoology	Mr. A. Grobler	Botany
Ms K Ellis	Botany	Ms. K. Gough	Zoology
Mr P Haindongo	Geosciences	Ms. M. Landman	Zoology
Ms. M. Louw	Botany	Ms. E Le Roux	Zoology
Mr A Lyell	Zoology	Ms N Mqatsa	Zoology
Mr. D. Makin	Zoology	Ms. B. Milne	Botany
Ms. N Ndou	Geosciences	Mr. L. Minnie	Zoology
Ms K Singh	Botany	Mr. M. Manjoro	Geosciences
Ms T Thwaites	Zoology	Ms. L. Moolman	Zoology
Mr. S. Welman	Zoology	Mr. G. Neo-Mahupeleng	Zoology
		Mr. A. Nyamugama	Geosciences
		Mr. A. Schmidt	Zoology
		Mr. C. Weatherall-Thomas	Botany
		Ms. S. Webb	Zoology
		Ms. R. Zengeni	Geosciences