

KNP 15/1/2 - 07

Project Reports 2007

**Scientific Reports on Research Projects
undertaken in the Kruger National Park
during 2007**



**South African
NATIONAL PARKS**

Declaration

These reports are edited versions of progress reports received from the researchers. They are aimed at giving information regarding the type of research that has been conducted in the Kruger National Park over the past year. Any details regarding individual projects can be obtained by contacting the individual researcher via e-mail.

Table of Contents

A regional scale passive monitoring study of sulphur dioxide (SO ₂), nitrogen oxides (NO _x) and Ozone (O ₃).....	10
Annegarn HJ	10
Leaf area dynamics in a semi-arid African savanna	11
Archibald S	11
A scaled exploration of the deep-structure of landscapes; Wavelet analysis of vegetation along the Shingwedzi River	12
Barichievy C	12
Molecular detection and characterization of Bartonella bacteria from South African artiodactyls.....	13
Bastos ADS.....	13
Prevalence and diversity of Bartonella in South African carnivores.....	14
Bastos ADS.....	14
Tsetse fly (<i>Glossina</i> spp.) surveillance in the Kruger National Park.....	15
Bengis RG.....	15
Potential for the use of LiDAR remote sensing to examine riparian vegetation structure along the Sabie River (Kruger National Park).....	16
Botts EA.....	16
Understanding spatial dynamics of foot and mouth disease in Kruger National Park interface of South Africa.....	17
Brahmbhatt DP.....	17
Interactions between herbivore size and fire regime on plant community structure	18
Burkpile D.....	18
Structure and Function of Riparian Upland Boundaries.....	19
Cadenasso ML	19
Comparison of habitat selection by sable antelope in three areas of the Kruger National Park	20
Cain JW.....	20
Impact of human habitation on population dynamics of spotted hyenas.....	21
Cameron EZ.....	21
The sampling method of elephant (<i>Loxodonta africana</i>) tusks	22
Codron J.....	22
Molecular characterization of <i>Theileria equi</i> and <i>Babesia caballi</i> , the causative agents of equine piroplasmosis.....	23
Collins NE.....	23
<i>Varroa</i> mite infestations and the population genetics of honeybees in the Kruger National Park	24
Crewe R	24
Tooth wear and cementum annuli counts of African buffalo for age determination.....	25
Cross PC.....	25
A hierarchical framework for the analysis of savannas as water-controlled ecosystems, applied to the landscapes of Kruger National Park.....	26
Cullum C.....	26

Ecology of anthrax in the Kruger National Park	27
de Vos V	27
Investigation of possible risk factors associated with the skewed natal sex ratio in black rhinoceroses	28
Dennis PM	28
Survey of Arachnida of the Kruger National Park with emphasis on spiders (excluding mites and ticks)	29
Dippenaar-Schoeman AS.....	29
<i>Breonadia salicina</i> response to the 2000 flood, Sabie River, Kruger National Park: Implications for rule based modelling and monitoring.....	30
Dowson LM	30
Establishing a groundwater reference monitoring network in the Kruger National Park: Monitoring the response of groundwater levels under unimpacted conditions to determine short, medium and long term trends in groundwater levels and to estimate TPC levels for abstraction boreholes	31
du Toit WH	31
Water use in relation to biomass of indigenous tree species in woodland, forest and plantation conditions.....	32
Dye PJ	32
Vertical aerial photography as an aid for ecological monitoring in the Kruger National Park	33
Eckhardt HC.....	33
Fixed-point photography as an aid for long-term vegetation monitoring in the Kruger National Park	34
Eckhardt HC.....	34
Geomorphological dynamics of the major rivers of the Kruger National Park.....	35
Eckhardt HC.....	35
Riparian vegetation index (RVI now called VEGRAI) as part of river health programme (RHP)	36
Eckhardt HC.....	36
Development of a clearing protocol based on ecological criteria for mesic Savannas and sweet grassveld for the Working for Water Programme	37
Euston-Brown DIW	37
Investigating spatial heterogeneity and resilience using piospheres.....	38
Farmer H	38
Mechanisms of grass/tree interactions in savannas	39
February EC.....	39
Chemical immobilization of hyena with Medetomidine, butorphanol, midazolam combination, with full reversal	40
Fleming GJ.....	40
Patterns and processes of invasion in an African savanna ecosystem, with emphasis on multiple spatio-temporal scales.....	41
Foxcroft LC.....	41
The impact of age and climate on reproductive rates of African elephants (<i>Loxodonta africana</i>) in Kruger National Park	42
Freeman EW	42

Treehouse Research Program for People and Conservation.....	43
Freimund W	43
Analysis of the spatial patterns of large herbivores population dynamics in Kruger National Park	44
Fritz H.....	44
Assessment of lion population demography and abundance in the Kruger National Park: is bovine tuberculosis having an effect?.....	45
Funston PJ.....	45
Trigger and regulatory mechanisms of musth in African elephants.....	46
Ganswindt A	46
Longitudinal studies of bovine tuberculosis in the buffalo population of the Kruger National Park, South Africa.....	47
Getz WM.....	47
Fire history and long term vegetation dynamics in southeastern Kruger National Park ..	48
Gillson L	48
Artificial waterpoints: How their distribution affects the herbaceous, woody structure and composition?.....	49
Goodall V.....	49
Veld burning in the Kruger National Park.....	50
Govender N.....	50
Seismic monitoring of Southern Africa and the Mozambique channel.....	51
Saunders I.....	51
The present status and future sustainability of the pollination system of <i>Ficus sycomorus</i> in the Kruger National Park	52
Greeff JM.....	52
Tree Patterning as a result of fire frequency.....	53
Groen TA	53
Developing an improved CyberTracker interface through participatory design for managing human resources and biodiversity data in Nature Conservation.....	54
Gruijters D	54
Biocomplexity in African Savannas: Pattern and Process of Woody Community Structure in the Kruger National Park	55
Hanan NP	55
Community Perceptions of the TEBA recruitment center in Pafuri and the development of a public cultural heritage site in the GLTP.....	56
Hansen HS	56
Assessing local scale impacts of <i>Opuntia stricta</i> (Cactaceae) invasion on arthropod assemblages in the Kruger National Park, South Africa.....	57
Harris KR.....	57
Population dynamics and elephant movements within the Associated Private Nature Reserves adjoining the Kruger National Park.....	58
Henley MD.....	58
SynBioSys Kruger - An information system for the evaluation and supporting the management of biodiversity among plant species, vegetation types and landscapes in the Kruger National Park	59
Hennekens SM	59

Ennobling the indigenous South African marula (<i>Sclerocarya birrea</i> subsp. <i>caffra</i>)	60
Holtzhausen LC	60
Development of a decision model for assessing the dynamics of foot and mouth disease (FMD) and African swine fever in the Great Limpopo Transfrontier Conservation Area (GLTFCA)	61
Jori F	61
Plant available nitrogen under different water regimes in a savanna, Kruger National Park	62
Keretetse MK	62
Forest colonization of savannas: Pattern and Process	63
Khavhagali VP	63
Soil evolution on granitic catenas	64
Khomol L	64
A predictive model to identify the location and extent of sodic sites in the Kruger National Park using remote sensing techniques	65
Kleyn L	65
The role of megaherbivore behavior in driving fire-grazing interactions and grassland community structure: “Comparing processes across continents”	66
Knapp AK	66
Vegetation resource distribution and dynamics assessed using hyperspectral (and broadband) remote sensing and the response of wildlife in the South African savanna ..	67
Knox NM	67
The role of elephants in enhancing species richness	68
Kohi EM	68
Biodiversity and resilience of riparian vegetation under different management regimes ..	69
Kotschy K	69
Resource partitioning between low density and high density grazers: Sable antelope, zebra and buffalo	70
Macandza VA	70
The anatomy of the brain of the African Elephant	71
Manger PR	71
The role of environmental education (EE) in promoting sustainable management of natural resources	72
Manyaka M	72
Isolation of potential probiotic bacteria from the intestinal tract of hyenas	73
Mare L	73
Correlation between tetracycline resistance in <i>Escherichia coli</i> isolated from impala and <i>Escherichia coli</i> isolated from their water source	74
Mariano V	74
A proposal to study stability, recovery and resilience in piosphere systems in the Kruger National Park	75
Matchett KJ	75
Pollination ecology of soft-winged flower beetles (Insecta: Coleoptera: Melyridae) in Kruger National Park	76
Mawdsley JR	76

Ecology of tiger beetles (Insecta: Coleoptera: Cicindelidae), with focus on riparian species.....	77
Mawdsley JR.....	77
Implementing strategic biodiversity monitoring for conservation of the Kruger National Park Rivers.....	78
McLoughlin CA.....	78
Evaluation of rapid field serologic test for TB detection in rhinoceros and Evaluation of hematologic and biochemical parameters in translocated and boma-confined rhinoceros.....	79
Miller M.....	79
The impacts of invasive alien plant clearing on riparian vegetation recovery along the Sabie River in the Kruger National Park.....	80
Morris TL.....	80
A phytosociological study in the Kruger National Park, south of the Sabie River.....	81
Mostert RE.....	81
The implementation of a veld condition assessment method for Marakele National Park: Preliminary herbaceous component survey.....	82
Mugwabana FH.....	82
Integrated Management of Iconic National Parks: A Comparative Study.....	83
Munro JK.....	83
Vegetation resources quantification: Input to the rare antelope research.....	84
Mutanga O.....	84
Optimizing Resource Management Actions by Incorporating the Spatio-Temporal Distribution of Elephants.....	85
Mwakiwa E.....	85
Contrasting Collaborative Arrangements in Natural Resources Management Using a Behavioral Approach to Relationships Theory: Case Studies of River and Fire Management Systems in Kruger National Park, South Africa.....	86
Nkhata A.....	86
Environmental impacts of elephants on riverine vegetation.....	87
Ntshane BC.....	87
Mycorrhizal colonisation and the associated phosphorus status in selected grass species along a catena in the Kruger National Park.....	88
Scholes MC.....	88
Developing a method for monitoring the influence of elephants on woody vegetation.....	89
Slotow R.....	89
Spatial demography and diet of elephants: implications for management.....	90
Slotow R.....	90
Monitoring of growth, recruitment and elephant damage of Marula trees inside and outside the Nkuhlu and Makhohlola exclosures in the Kruger National Park.....	91
Stam EM.....	91
Modelling Consequences of Elephant Damage for the Vegetation in the Kruger National Park.....	92
Stam EM.....	92
The role of soil seed banks in the regeneration of Acacia species in the Kruger National Park, South Africa.....	93
Stelli SA.....	93

Biological control of <i>Parthenium hysterophorus</i> , pre-release studies.....	94
Strathie L.....	94
Global climate change and primary productivity: the effect of inter-rainfall interval on grass growth.....	95
Swemmer AM.....	95
Lion (<i>Panthera leo</i>) predation patterns in the central region of the Kruger National Park: Methods and consequences.....	96
Tambling CJ.....	96
Legitimacy and the use of natural resources in Kruger National Park, South Africa.....	97
Tanner RJ.....	97
The life history, entomophagy and conservation of the Emperor Moths, <i>Gynanisa maia</i> and <i>Imbrasia belina</i> in the Kruger National Park and neighbouring environs.....	98
Taylor LR.....	98
Comparing the effectiveness of parks co-managed by government and local or indigenous groups.....	99
Timko JA.....	99
Can trees improve grass quality and therefore attract grazing wildlife? A study on the sub-canopy herbaceous vegetation in eastern and southern African savannas.....	100
Treydte AC.....	100
A survey of the composting fungi in a Mopani landscape and the effect of different fire regimes on their species composition.....	101
Truter M.....	101
Nest search/harvesting proposal for Southern ground hornbill in Kruger National Park.....	102
Turner AMS.....	102
The influence of stream order on riparian biodiversity: The links between compositional, functional and structural biodiversity.....	103
Tye N.....	103
Rapid assessment of the population demography of elephants in the Kruger National Park.....	104
van Aarde RJ.....	104
DNA barcoding of the Kruger National Park's flora for conservation and biodiversity.....	105
van der Bank M.....	105
A survey on non-grass herbaceous plant species including creepers, succulents and bulb plants in the Limpopo Valley.....	106
van der Walt AS.....	106
A study of susceptibility to bovine tuberculosis in African Buffalo.....	107
van Helden PD.....	107
The spotted hyaena: a model system to study resistance to tuberculosis.....	108
van Helden PD.....	108
Determination of buffalo and giraffe heart weights.....	109
van Schalkwyk OL.....	109
A historical and archaeological investigation of the cultural remains of the different outposts of the Steinaecker's Horse military unit in the Kruger National Park.....	110
van Vollenhoven AC.....	110
The ecology and distribution of the southern barred minnow (<i>Opsaridium peringueyi</i>) in Southern African river systems.....	111

Venter JA	111
Niche differentiation in savannas: Competition-based models for inter life-form coexistence.....	113
Verweij RJT	113
The effects of translocation on African elephant.....	114
Viljoen JJ	114
A baseline survey of the instream biota, water quality, riverine vegetation and geomorphology and an EcoStatus determination of the Shingwedzi River and its tributaries	116
Vlok W.....	116
The role of cloven-hoofed animals in the epidemiology of foot-and-mouth disease	117
Vosloo W	117
Movements and feeding behavior of Epauletted fruit bats and their impact on the regeneration of fig trees	119
Winkelmann JR.....	119
Regional description of the groundwater chemistry of the Kruger National Park	120
Witthüser KT	120
Elephant habitat selection according to vegetation changes in space and time in the Kruger National Park	121
Young K.....	121
Tourism Policy and Biodiversity Conservation and Management: A Case Study of Kruger National Park, South Africa.....	122
Zhou L.....	122
List of authors	123

A REGIONAL SCALE PASSIVE MONITORING STUDY OF SULPHUR DIOXIDE (SO₂), NITROGEN OXIDES (NO_x) AND OZONE (O₃)

*Annegarn HJ*¹, Josipovic M¹, Kneen MA¹ & Piketh SJ²

¹ Department of Geography, Environmental Management and Energy Studies, University of Johannesburg

² Climatology Research Group, University of the Witwatersrand

hannegarn@gmail.com

This research aims to measure concentrations of sulphur dioxide (SO₂), nitrogen oxides (NO_x) and ozone (O₃) centred on the industrial Highveld. This project extends previous monitoring studies to regions beyond the Mpumalanga Highveld, covering a much wider area around and downwind (within the political boundaries of South Africa).

The project aims to establish for the first time a regional scale quantitative deposition pattern of important acid precursor gases and ozone, with which to validate regional scale air pollution dispersion models. Mapping of critical concentration levels and temporal variations of these pollutants will be then possible and seasonal and annual averages and trends will be identified. The information derived will then indirectly test possible effect-based impacts on natural systems (critical loads estimates), such as the KNP, arising from industrial atmospheric emissions from the Highveld.

Information on regional SO₂, NO_x, and O₃ ground level concentrations has been obtained. The samplers received back from 21 (SO₂), 13 (O₃), and 12 (NO₂) months of exposure were chemically analysed by the School of Chemistry, North-West University (Potchefstroom Campus). Results reported here are until September 2006. Concentrations are compared with the South African ambient air quality standards (NEMA: Air Quality Act No. 39, 2004). Spatial distribution patterns, seasonal and inter-annual values and distribution variations will be discussed in our subsequent publications.

Although there were sites in this reporting period, which experienced irregular, and on average low data returns, sufficient samples were available for the satisfactory calculation of concentration isopleths. These mainly one year sampling results, illustrate ability of the passive sampling spot measurements to provide an understanding of the distribution of study trace gas species over a large spatial region. It is obvious from these concentration isopleths that average measured values do not reach or exceed the limits (currently valid standards) for the measured gases.

LEAF AREA DYNAMICS IN A SEMI-ARID AFRICAN SAVANNA

*Archibald S*¹, Makhado R¹, Scholes RJ¹, Vogel M¹ & Kubheka WM¹

¹ Natural Resources and Environment, Centre for Science and Industrial Research

sarchibald@csir.co.za

This project aims to collect field data on the seasonal patterns of leaf display of the major trees and grasses in two sites in the south of the Kruger National Park. Phenology is the main driver of carbon and water exchange over the year, yet patterns of leaf out and leaf drop in these systems have never successfully been described. Two years of field data have now been collected, allowing us to explore the phenological patterns of the grass community and a range of tree species under different rainfall conditions. This information is being used to; understand the causes of variation in leaf phenology in savannas, ground-truth satellite information on seasonal patterns of leaf display, and to develop mechanistic models of leaf out and leaf drop for trees and grasses in savannas.

Patterns of leaf fall are more variable than patterns of green-up, and all trees are only in full leaf simultaneously for a portion of the growing season. Green-up date and green-up rate varied significantly. A regression of green-up date against green-up time shows that later greening individuals take shorter to reach full leaf ($r^2 = 0.87$, $P < 0.01$, 25 trees). Satellite data was used to predict green-up at the Skukuza flux site using climatic inputs. Using a day length cue for trees and a soil moisture cue for grass, the prediction was correct to within two satellite data time steps 80 % of the time. This accuracy could be improved with finer resolution satellite data.

Current research involves developing a reliable model of leaf fall, and testing some of the assumptions of the green-up model by applying it to other sites. If savanna leaf phenology can be derived from climatic inputs, then it will be possible to use these as inputs to biophysical models (such as Sib3) for predictive purposes.

A SCALED EXPLORATION OF THE DEEP-STRUCTURE OF LANDSCAPES; WAVELET ANALYSIS OF VEGETATION ALONG THE SHINGWEDZI RIVER

*Barichievy C*¹ & Rogers KH¹

¹Centre for Water in the Environment, University of the Witwatersrand

barichievy@gecko.biol.wits.ac.za

This project aims at developing an easy to use method for objectively determining the scales at which vegetation patches are distributed across the landscape. By analyzing the distribution of vegetation scales across the landscape the researcher will enhance understanding of the hierarchical structure of vegetation, describing the “deep structure” (the investigation of the structure at all scales) and investigate issues such as ecosystem lumpiness. Thus far the analysis technique has been coded and has been shown to work on test data. Sensitivity analysis is being completed on the code and Statistical protocol is being drawn up. Real data are to be tested by December 2007.

MOLECULAR DETECTION AND CHARACTERIZATION OF BARTONELLA BACTERIA FROM SOUTH AFRICAN ARTIODACTYLS

*Bastos ADS*¹, Bengis RG² & Buss P³

¹ Department of Zoology and Entomology, University of Pretoria

² State Veterinarian, National Department of Agriculture

³ Veterinary Wildlife Services, South African National Parks

ADBastos@zoology.up.ac.za

The main objective of this project is to assess the diversity of *Bartonella* species occurring in wild South African artiodactyls in order to increase our knowledge and understanding of the prevalence of this bacterial genus. From January 2007 to present, efforts were directed at assessing *Bartonella* prevalence in one species, namely the African buffalo, *Syncerus caffer*. To this end, DNA was extracted from 100 EDTA blood samples. Screening of 50 of these samples with primers targeting the *gltA* gene of the bacterial genome has been concluded thus far. Of these, 20 were positive, corresponding to a prevalence rate of 40 %. Nucleotide sequencing of the species-informative *gltA* gene of 9 of the positive samples revealed the presence of two distinct bacterial lineages, corresponding on the basis of genetic distance to two different *Bartonella* species. Of particular interest is that none of these buffalo-associated *Bartonella* species, correspond with any of the 16 presently recognized bacterial species within this genus. Furthermore, with the exception of the *Bartonella* identified in buffalo L123 and L129, which were identical to each other, all *Bartonella* sequenced from buffalo were genetically distinct, attesting to high levels of intra-specific diversity.

PREVALENCE AND DIVERSITY OF BARTONELLA IN SOUTH AFRICAN CARNIVORES

*Bastos ADS*¹, Keet DF² & Buss P³

¹ Department of Zoology and Entomology, University of Pretoria

² State Veterinarian, National Department of Agriculture

³ Veterinary Wildlife Services, South African National Parks

ADBastos@zoology.up.ac.za

The two main objectives of this project were: (i) to assess the *Bartonella* infection rates in large carnivores in the KNP and (ii) to assess the genetic variation of *Bartonella* bacteria present by genetic characterisation and phylogenetic analysis of the citrate synthase (*gltA*) gene. From January 2007 to present, efforts were directed at assessing *Bartonella* prevalence in one species, namely the African lion, *Panthera leo*. To this end, DNA was extracted from 112 EDTA blood samples. Screening of these samples with primers targeting the *gltA* gene of the bacterial genome revealed a prevalence rate of 16 % (18 of the 112 samples were positive). This finding is significant as this prevalence rate is much higher than that reported previously by Molia and co-workers in 2004 for lions from Kruger, namely 3 positive lions from 58 samples screened (5.2 % prevalence), and for *Bartonella* prevalence in Free State lions (1.5 %; Pretorius *et al.* 2004). These results attest to the sensitivity of the PCR, developed in South Africa, specifically for the purpose of screening carnivores, which are notoriously difficult to work with due to the low bacterial loads. Nucleotide sequencing of 3 of these positive samples has been concluded thus far, and phylogenetic analysis indicates that the *Bartonella* species found in African lions is the same as that found in the domestic cat. However, in contrast to the results of both Molia *et al.* 2004 and Pretorius *et al.* 2004, the species identified was *B. koehlerae*, and not *B. henselae*.

TSETSE FLY (GLOSSINA SPP.) SURVEILLANCE IN THE KRUGER NATIONAL PARK

*Bengis RG*¹ & Keet DF¹

¹ State Veterinarian, National Department of Agriculture

royb@nda.agric.za

The main objective of this surveillance project is to institute an early warning system for detecting and monitoring any re- incursion of Tsetse flies into the Limpopo/Levubu drainage system in the north of the Kruger National Park.

During the past two years, tsetse flies were detected for the first time south of the Save River, in the northeastern corner of Gonarezhou National Park in Zimbabwe. Both *Glossina morsitans* and *Glossina pallidipes* were identified in this incursion. Gonarezhou National Park is one of the areas being linked to KNP in the TFCA initiative. It is quite predictable that as biological bridges are formed between the three participating countries, pathogens and vectors will also expand their geographical range together with their traditional vertebrate hosts. We can therefore expect tsetse flies to expand their range southwards, as preferred host populations increase and disperse.

Tsetse flies usually recolonise suitable landscapes containing preferred hosts at a rate of 5 to 10 km per year, and with this scenario, if the flies cross the watershed south of the Lundi River, then these flies would enter the Nwanedzi/Limpopo drainage system, and within a few years could feasibly spread into the northern regions of the Kruger National Park. The movement of tsetse flies southward may however be retarded due to the current paucity of hosts, both wild and domestic in post civil war Mozambique. This situation is changing as translocations of plains game and dispersal of elephants into Limpopo National Park progresses.

In May, 2007 the annual tsetse survey was again completed in the Limpopo/Levubu drainage. The relatively dry climatic conditions in the northern KNP at that time resulted in low activity of haematophagous flies. Once again the main genera represented in our catches were several species of *Tabanus*, *Stomoxys calcitrans*, and *Musca spp.* no flies of the genus *Glossina* were detected.

POTENTIAL FOR THE USE OF LIDAR REMOTE SENSING TO EXAMINE RIPARIAN VEGETATION STRUCTURE ALONG THE SABIE RIVER (KRUGER NATIONAL PARK)

*Botts EA*¹ & Rogers KH¹

¹ Centre for Water in the Environment, University of the Witwatersrand

botts@gecko.biol.wits.ac.za

The aims of the project were, to establish the effectiveness of LiDAR as a tool for remotely quantifying riparian vegetation structure and to investigate the relationship between the distribution of vegetation structure and the physical aspects of the river landscape. Twelve sites were selected along the length of the Sabie River encompassing 4 channel types (Bedrock Anastomosing, Mixed Anastomosing, Pool Rapid and Braided). Each site containing 30m wide transects across riparian zone.

LiDAR is still the only remote sensing technique which directly measures vegetation structure and has much potential when used wisely. Improvements to the LiDAR instrument and the ways in which the data is processed are constantly being developed, such that any inaccuracies will soon be reduced. Both hydrology and geomorphology are related to the structure of vegetation in the riparian zone. These are formative abiotic factors which, through various ecological processes, may have an effect on what vegetation is able to establish and the growth form that it takes. Flooding and geomorphology are just two of multiple factors, both abiotic and biotic, which affect the structure of vegetation. The heterogeneity of an African savanna is achieved through the combination of many processes acting at many scales.

Remote sensing of vegetation structure will support investigation into both the determinants and consequences of vegetation structure at the landscape scale. This will result in a better understanding of the ecosystem processes responsible for maintaining heterogeneity and biodiversity.

UNDERSTANDING SPATIAL DYNAMICS OF FOOT AND MOUTH DISEASE IN KRUGER NATIONAL PARK INTERFACE OF SOUTH AFRICA

*Brahmbhatt DP*¹, Gummow B², Vosloo W³, Fosgate GT¹, Ward MP¹, Budke CM¹, Jori F⁴

¹ College of Veterinary Medicine & Biomedical Sciences, Texas A&M University

² Faculty of Veterinary Science, University of Pretoria

³ Exotic Diseases Division, Agricultural Research Council

⁴ Department of Tropical Veterinary Medicine and Production, CIRAD

dbrahmbhatt@cvm.tamu.edu

Foot-and-mouth disease (FMD) is one of the most important diseases affecting cloven hoofed wildlife and domestic livestock in the Kruger National Park Region (KNPR) of the Republic of South Africa (RSA). The KNPR is defined as including the Kruger National Park (KNP) and the adjacent provinces of Limpopo and Mpumalanga. The goal of this project is to understand the spatial dynamics of FMD in the KNP interface (KNPI) which is a subsection of the KNPR. The objectives of the project are: 1) define the distribution of species susceptible to FMD in the KNPR; 2) estimate the contact rate between wildlife and domestic livestock in the KNPI; 3) to perform a spatial risk assessment employing a FMD transmission model. This study will fill a critical gap in our understanding of FMD because very little is known about predictors for spread of FMD in regions with extensive human-wildlife-livestock interactions. The model may be employed for a targeted surveillance of FMD, to mitigate potential adverse economic consequences of FMD within the KNPR.

INTERACTIONS BETWEEN HERBIVORE SIZE AND FIRE REGIME ON PLANT COMMUNITY STRUCTURE

*Burkepile D*¹ Fynn RWS², Thompson D³, Knapp AK³ & Smith MD¹

¹ Department of Ecology and Evolutionary Biology, Yale University

² University of KwaZulu Natal

³ Colorado State University

deron.burkepile@yale.edu

Humans have simultaneously altered the key biotic and abiotic forces that structure savanna ecosystems by reducing the diversity of native herbivores, removing them completely, or replacing them with domestic livestock, and by altering fire regimes. This can have important implications for ecosystem function as herbivory by a diverse community of mammalian herbivores (primarily ungulates) and fire are both drivers of plant community biomass, plant species diversity, and nutrient cycling. Large herbivores (> 150 kg, e.g. elephant, rhino, giraffe, and buffalo) may serve keystone roles by dramatically altering vegetation structure and by facilitating smaller herbivores, such as impala and bushbuck. However, large herbivores are at much greater risk of extinction and generally are the first to be lost from ecosystems in the face of human encroachment resulting in a herbivore assemblage dominated by smaller animals. Additionally, fire is also an important structuring force for savannas as it reduces encroachment of woody species into grasslands and decreases nitrogen availability. Yet, humans have dramatically altered natural fire regimes in many areas worldwide. Thus, the goal of my research is to quantitatively show how herbivores of different size and fire regime interact as ecological drivers to determine the community structure and ecosystem function of savanna grasslands.

STRUCTURE AND FUNCTION OF RIPARIAN UPLAND BOUNDARIES

*Cadenasso ML*¹, Picket STA², Cook E² & de Buys A¹

¹ Department of Plant Science, University of California, Davis

² Institute of Ecosystem Studies

mlcadenasso@ucdavis.edu

The project goal is to determine whether the structure of riparian vegetation influences the role of the riparian zone as a modulator of flows moving between the upland savanna and the river. Animal movement and nutrient distributions across the riparian zone may be differentially affected by vegetation structure. Additional contrasts in the system such as soil parent material and location on the hydrologic network may influence the interaction among vegetation structure, animal movement, and nutrient dynamics. In previous reports we have provided data and syntheses on the nutrient pools in plant tissues and soils across riparian zones of contrasting vegetation structures. Animal movement through the riparian zone is also influenced by the location of persistent surface water. In this reporting year we have collaborated with Angela Gaylard and Abri de Buys to quantify surface water at the end of the dry season (November 2006). The Shingwedzi, Mphogolo and Pugwane tributaries were captured on video by helicopter. All three rivers were flown twice and three different views were filmed each time: 1) the macrochannel floor, 2) the macrochannel to floor break, and 3) the riparian vegetation. In addition, data was collected on the location and amount of elephant digging in the macrochannel floor. This was done using a system that allows multiple video cameras to feed into one unit that contains a GPS so that the videos are spatially referenced. The system also allows the user to “mark” a feature on the video for future data analysis. Using these videos the researcher is now mapping persistent water in the riparian zone and macrochannel floor, classifying vegetation structure into the same classes used in the plant and soil nutrient study, identifying animal trails and cut banks.

COMPARISON OF HABITAT SELECTION BY SABLE ANTELOPE IN THREE AREAS OF THE KRUGER NATIONAL PARK

*Cain JW*¹ & Owen-Smith N¹

¹ Animal, Plant & Environmental Sciences, University of the Witwatersrand

cain@gecko.wits.ac.za

This project forms part of an ongoing research programme by the University of the Witwatersrand to determine potential causes of rare antelope declines in the Kruger National Park. It will expand on two studies currently being conducted by post-graduate students; it will supplement data currently being collected by post-graduate students on the ecology of sable antelope. The objective is to assess potential differences in habitat conditions of areas of concentrated use and areas within the home range not used by sable. In addition, it will determine ideal habitat use patterns by sable, buffalo and zebra in the Punda Maria area. Data collection has begun in the Punda Maria area, however no results are available at this time, due to the limited amount of data collected thus far any analysis would be premature.

IMPACT OF HUMAN HABITATION ON POPULATION DYNAMICS OF SPOTTED HYENAS

*Cameron EZ*¹, Hofmeyr MS², Belton L¹ & Ryan B¹

¹ Mammal Research Institute, University of Pretoria

² Veterinary Wildlife Services, South African National Parks

ezcameron@zoology.up.ac.za

The project aims to investigate whether spotted hyenas behave differently around areas of intense human use and habitation (Skukuza) compared to areas of lower human habitation (Doispane). This will enable us to better understand the dynamics of the hyenas in both areas, as well as the potential for conflict between humans and wildlife, potential resolutions to such conflict, and the zoonotic potential.

The field research has begun for this project. We have identified several of the individuals in each clan. A photo identifiile has been created for the long-term recognition of individuals. In addition, 3 individuals have been fitted with a proximity tag in the Skukuza clan, and the alpha female has been collared with a tag reader and GPS collar. Individuals have been identified at Doispane, but no collars have been fitted to date. We have collected over 150 scat samples for dietary analysis to determine whether there are differences in diet between high and low human contact areas.

THE SAMPLING METHOD OF ELEPHANT (*LOXODONTA AFRICANA*) TUSKS

Codron J¹, Lee-Thorp JA², Sealy J¹, Sponheimer M³ & Grant CC⁴

¹ Department of Archaeology, University of Cape Town

² Department of Archaeological Sciences, Bradford University

³ Department of Anthropology, University of Colorado at Boulder

⁴ Scientific Services, South African National Parks

Jackie@age.uct.ac.za

The aim of the project is to determine whether elephant diets in the Kruger National Park (KNP) have changed in response to environmental change throughout the 20th century, determine which natural and human-induced disturbances have driven these changes (e.g. climate, vegetation, management policies), and to predict future responses of elephants to current environmental change trajectories. The study is based on stable isotope compositions of elephant ivory, hair, and faeces to resolve diet shifts not only over the long-term, but also for the short-term (seasonal/spatial) to establish patterns in the relationship between diet and habitat heterogeneity. Faeces afford insight over a few days, hair several months, and serial profiles from ivory cover several decades because elephant tusks grow continually throughout the animal's life in ordered annual and sub-annual layers. Comparisons with temporally and spatially-specific plant isotope data improves the reliability of interpretations from results obtained from elephant tissues and faeces in KNP.

Plant sampling transects were established at 16 sites within the northern and southern granites and basalts, and Punda Maria sandveld. Elephant faeces were collected from 9 sub-regions in KNP, i.e. northern and southern granites and basalts, south-central and north-central granites and basalts, and Punda Maria. Elephant tail hairs (representing northern and southern individuals) were received from the game capture unit in 2004, and analysed in series for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ to compare with faecal isotope data. Ivory cross-sections were removed from 7 broken/damaged tusks selected from the Skukuza ivory stockpiles in January 2003, and cores were removed from 1 elephant tusk in storage at the Transvaal Museum in Pretoria and from 6 of the tusks on display in the Letaba Elephant Hall in January 2005. Of the tusks sampled, six represent southern KNP and eight the north.

MOLECULAR CHARACTERIZATION OF *THEILERIA EQUI* AND *BABESIA CABALLI*, THE CAUSATIVE AGENTS OF EQUINE PIROPLASMOSIS

Collins NE¹ & Bhoora R¹

¹ Department of Veterinary Tropical Diseases, University of Pretoria

nicola.collins@up.ac.za

A study was thus undertaken to determine whether the same level of genetic variation exists in the 18S rRNA genes of zebras infected with *T. equi* and/or *B. caballi*. Twenty EDTA blood samples, which included Bontebok as well as Cape Mountain Zebra were obtained from the South African National Parks (SANParks). These samples were screened for the presence of parasites using PCR and the reverse line blot hybridization (RLB) assay. The RLB enables the detection of parasitic infections to a species level and also aids in the identification of samples containing novel genotypes.

Fifteen samples showed mixed infections with hybridization signals present for the *T. equi*-like probe, *T. equi* probe, *Theileria* sp. Morito probe and to a *Babesia*-genus specific probe. Samples with mixed infections were thus selected and an attempt was made to amplify the full-length 18S rRNA gene. Due to the low parasitaemias, however, it was not possible to amplify the full-length 18S rRNA gene from these samples. The Genomiphi DNA amplification kit (Amersham Biosciences) was thus used to exponentially amplify the genomic DNA prior to performing a nested PCR reaction, in which the V4 hypervariable region could then be amplified. For sequencing purposes, amplified products were purified using the QIAamp PCR purification kit (Qiagen, Germany). Purified fragments were cloned into the pGEM T-Easy vector system (Promega, Madison, USA), following the manufacturer's protocols. Sequencing was carried out using the ABI 3130 automated sequencer. At least six clones from each sample, containing the amplified fragment were sequenced. Preliminary sequence results indicate that the 18S rRNA genes amplified from zebras were on most occasions of the *T. equi* genotype. Further phylogenetic analysis is still required to determine whether new genotypes exist within the zebra population.

VARROA MITE INFESTATIONS AND THE POPULATION GENETICS OF HONEYBEES IN THE KRUGER NATIONAL PARK

*Crewe R*¹, Dietemann V¹ & Kryger P²

¹ Department of Zoology and Entomology, University of Pretoria

² Department of Integrated Pest Management, University of Aarhus

robin.crewe@up.ac.za

The main aim of the study was to investigate the population genetics of honeybees (*Apis mellifera*) within the Kruger National Park (KNP). Other aspects concern the determination of the honeybee population structure within KNP, the investigation of the gene flow between any subpopulations and the estimation of the degree of migration between any subpopulations. In addition, the progress of *Varroa* mite infestations and occurrence of capensis parasites in the park was monitored.

We have not observed the presence of the capensis parasitic honeybee. This is because beekeepers are the main vector of this parasite and absence of commercial beekeeping activity in the park is enough to keep the problem at bay. In contrast, we have found that the *Varroa* mite has now spread throughout the park, but an independent study suggests that African bees are resistant to the effects of this parasite. Preliminary analysis of the population genetics shows the occurrence of 5-6 colonies per square kilometer in the park. More detailed analyses of population structure, gene flow and honeybee reproduction are under way.

This project has multiple purposes and beneficiaries. It will benefit the park by increasing the knowledge of the population structures of one of the main if not the most important pollinator species, as well as monitoring the spread of *Varroa* mites and other parasites. Although there is no practical way to manage the wild population of bees, knowledge about natural spread of disease and precise population dynamics can help determine the threats posed by beekeeping outside of the park and possible conservation measures if needed. It will also help us understand the complex dynamics of honeybee reproduction, migration and interaction with the ecosystem from a biological point of view.

TOOTH WEAR AND CEMENTUM ANNULI COUNTS OF AFRICAN BUFFALO FOR AGE DETERMINATION

*Cross PC*¹ & Sanson G²

¹ Department of Ecology, Montana State University

² Department of Biological Sciences, Monash University

pcross@usgs.gov

This project is intended to provide a more objective age classification for African buffalo. In particular, we wish to compare age estimates based upon cementum annuli with our subjective age classification of individuals that were extensively studied as a part of a long term study of bovine tuberculosis. The teeth samples have been sent to Monash University and are currently in process.

A HIERARCHICAL FRAMEWORK FOR THE ANALYSIS OF SAVANNAS AS WATER-CONTROLLED ECOSYSTEMS, APPLIED TO THE LANDSCAPES OF KRUGER NATIONAL PARK

*Cullum C*¹ & Rogers KH¹

¹Centre for Water in the Environment, University of the Witwatersrand

cullum@gecko.biol.wits.ac.za

The aim of this project is to describe the spatial organisation of savanna landscapes in Kruger National Park in terms of patterns constrained both by the configuration of drainage networks and a hierarchy of interdependent soil, vegetation and hydrological systems.

In this first year of research, the researcher has read widely and outlined the theoretical framework for this research, developed methodology involving delineating streams and their catchments, nested by stream order, deriving network metrics such as Horton ratios, flow lengths, area drained, stream density, basin shape etc.; delineating individual hillslopes and their elements, deriving metrics such as slope gradient, length, curvature, aspect etc, in terms of which landforms and hillslope elements can be defined and indices of wetness and erosion can be calculated, classifying vegetation and soil differences evident in SPOT 5 imagery and searching for spatial correlations between each of the above and other known data such as geology and climate. These correlations will form the basis of the classification.

Furthermore, the researcher has evaluated a wide variety of software, and learnt to use programs best suited to different tasks, such as, ArcHydro, TauDEM and Rivex (for stream and catchment delineation), TAS (for hillslope metrics) and eCognition [(Definiens Professional) for object-based image classification]

ECOLOGY OF ANTHRAX IN THE KRUGER NATIONAL PARK

*de Vos V*¹ & Bengis RG²

¹ Scientific Advisor, Wildlife Diseases

² State Veterinarian, National Department of Agriculture

v.devos@absamail.co.za

The object of the project is to ascertain the effect of the last major flood on the anthrax spore count. Pafuri was visited during May 2007 and soil samples collected from the Hape permanent plots. The 2006 sampling showed the following results:- Six soil sites, sampled down to seven levels, were cultured for anthrax. Site 1, Level 2 and Site 3, Level 2 were positive for *Bacillus anthracis*. Both had concentrations of 10^3 anthrax spores /gm of soil.

With a lack of laboratory backup, which seriously hampers future research, a meeting of an “Anthrax Interest Group” was convened at Skukuza during April 2007. It was concluded that anthrax still poses a major problem in Africa, especially to transfrontier park development. It was further decided that a lot of misconceptions around anthrax exist, that defective surveillance exist in many countries and that there is no reliable and fast diagnostic service for anthrax in southern Africa (and the rest of Africa).

INVESTIGATION OF POSSIBLE RISK FACTORS ASSOCIATED WITH THE SKEWED NATAL SEX RATIO IN BLACK RHINOCEROSSES

*Dennis PM*¹ & Raghanti M¹

¹ Conservation and Science, Cleveland Metroparks Zoo

pmd@clevelandmetroparks.com

The goal of this project is to establish normal serum value range for parameters associated with body condition (insulin, glucose, leptin) in free-ranging black rhinoceros living in South Africa for comparison with animals housed at zoos in the United States. These values will be used to test the hypothesis that increased body condition associated with diets fed to animals in zoos is a risk factor for the skewed natal sex ratio seen in captive black rhinoceroses. Establishment of a normal value range for these parameters will also allow comparison among wild black rhino, particularly useful for evaluation of the supposed skewed sex ratios in certain wild populations.

A successful validation of a leptin radioimmunoassay and insulin ELISA has been achieved for use with black rhino, however difficulties were experienced regarding the completion of sample collection and sample analysis. The researcher is pursuing alternate means of achieving this goal. They are currently investigating the option of using the validated RIA in South Africa to test the samples. However, the challenge with the option is that it requires access to a laboratory equipped to run RIAs.

SURVEY OF ARACHNIDA OF THE KRUGER NATIONAL PARK WITH EMPHASIS ON SPIDERS (EXCLUDING MITES AND TICKS)

*Dippenaar-Schoeman AS*¹

¹ Plant Protection Research Institute, Agricultural Research Council

DippenaarA@arc.agric.za

As part of the South African National Survey of Arachnida (SANSA) an inventory of the Arachnida of the Kruger National Park are underway. The arachnids (spiders, scorpions, solifugids, amblypygids and pseudoscorpions) constitute an abundant and highly successful group of invertebrate animals. In the past invertebrates were largely ignored in conservation endeavours. Meaningful conservation cannot take place if species involved are not known. Therefore, surveys of invertebrate fauna become more important, especially in reserved areas where conservation strategies are already in place.

The overall aim of this project, as part of the South African National Survey of Arachnida (SANSA) is to collect, describe and make an inventory of the Arachnida species of the Kruger National Park, to publish results in the form of checklists and taxonomic papers, and to include data in the SANSA electronic database on arachnid fauna in conserved areas.

New surveys are underway in the park and material collected are presently sorted and identified. A second project to examine the effect of fire on different invertebrate groups such as spiders has been submitted. If funds are available grit bloc surveys to determine the conservation status of the larger baboon and trapdoor spiders and scorpions are needed.

BREONADIA SALICINA RESPONSE TO THE 2000 FLOOD, SABIE RIVER, KRUGER NATIONAL PARK: IMPLICATIONS FOR RULE BASED MODELLING AND MONITORING

*Dowson LM*¹, Parsons M¹ & Rogers KH¹

¹ Centre for Water in the Environment, University of the Witwatersrand

lisadowson@gmail.com

This study aims to improve understanding of *B. salicina* population dynamics and response to catastrophic floods by examining the different response strategies of the *B. salicina* population subsequent to the 2000 catastrophic flood event. This study also re-evaluated the application of the negative-J demographic profile-focused *Breonadia* Model. Assessments were made of the applicability of the *Breonadia* Model and monitoring in the pool-rapid channel type within the context of the SAM framework utilised in the KNP.

This study has revealed the importance of disturbance events in shaping the demography of a riparian species and the importance of using changing conditions (such as those brought about by disturbance) for improving knowledge on the biology of species used in monitoring programmes. The physical template of the Sabie River forms a complex and patchy template on which riparian vegetation processes occur. Management of the Sabie River needs to take this complex relationship into account in the context of the variable hydrological regime in order to update and apply valid management strategies to the system. Continual updating and application of predictive tools such as the *Breonadia* model promotes the assessment of goal achievement and strategic adaptive management of ecosystems.

**ESTABLISHING A GROUNDWATER REFERENCE MONITORING NETWORK
IN THE KRUGER NATIONAL PARK: MONITORING THE RESPONSE OF
GROUNDWATER LEVELS UNDER UNIMPACTED CONDITIONS TO
DETERMINE SHORT, MEDIUM AND LONG TERM TRENDS IN
GROUNDWATER LEVELS AND TO ESTIMATE TPC LEVELS FOR
ABSTRACTION BOREHOLES**

*du Toit WH*¹, Verster H¹, Tleane A¹ & Smit IPJ²

¹ Water Resource Information, Department of Water Affairs & Forestry

² Scientific Services, South African National Park

willem@dwaf.gov.za

The objective of the project was to monitor the response of groundwater levels under unimpacted conditions and to determine seasonal and long term trends in comparison with rainfall; contribution of groundwater to base flow during dry winter periods; comparison of water level behavior in the different surface water catchment areas or lithologies (geohydrological units) and subsequently to optimize and determine the most effective monitoring station density. This will enable management and subsequently reporting on the status of the groundwater resources as required by the National Water Act. DWAF is also intending to advise the KNP with respect to the identification of optimum sites for monitoring, parameters to be monitored, frequency of compliance as well as early warning monitoring as part of abstraction, sanitation and waste disposal management (protection of the groundwater). The relatively unimpacted groundwater conditions in large areas of the KNP provide an excellent opportunity to study the behavior of aquifers to rainfall, drought, river flow and other related natural influences, which will support the determination of TPC levels.

Due to delays in the purchasing of electronic monitoring equipment the first monitoring boreholes were only identified, visited and equipped in July 2007. To date 12 boreholes have been equipped but no data has been downloaded as yet. The objective is to have all the selected boreholes equipped by the end of November.

WATER USE IN RELATION TO BIOMASS OF INDIGENOUS TREE SPECIES IN WOODLAND, FOREST AND PLANTATION CONDITIONS

*Dye PJ*¹ & Gush MB¹, Everson CS¹, Clulow A¹, Scholes RJ¹, Wise R¹ & Kubheka WM¹

¹ Natural Resources and the Environment, Centre for Science and Industrial Research

pdye@csir.co.za

The overall aim of the project is to investigate rates of growth and water use of a selection of indigenous tree species in various production systems (mixed evergreen forest, indigenous plantations and savannah woodland) and to make economic and hydrological comparisons against current commercial forestry systems. Comparisons are being conducted for sites spanning a wide rainfall gradient. The KNP phase of research took place in woodlands south of Skukuza, where two separate techniques were used to estimate water use. The scintillometer technique provided measurements of spatially averaged total evaporation rates over a 4.25 km path above savannah vegetation. A large aperture scintillometer (LAS) was used, and measurements were performed in Spring (August 2004), Summer (February 2005) and Autumn (May 2005) to cover different phases of the growing season. Daily ET and energy balance data were thus recorded over a total of 22 and reflected a wide range of evaporative conditions and vegetation growth phases.

ET and transpiration data from the Sandveld savanna show the expected dominance of soil water availability and seasonally varying leaf area on water use patterns. Models suited to savanna simulations require a good soil water balance module, as well as sufficient plant physiological detail to mimic leaf area dynamics, leaf senescence, and rapid responses to rainfall and weather conditions. Variations in tree density, tree species, and catena effects on soil characteristics and water availability are all important, necessitating a larger scale of analysis to assess average water use patterns and water use efficiency of trees.

VERTICAL AERIAL PHOTOGRAPHY AS AN AID FOR ECOLOGICAL MONITORING IN THE KRUGER NATIONAL PARK

*Eckhardt HC*¹

¹ Scientific Services, South African National Park

holgere@sanparks.org

Vertical aerial photography is a useful tool for ecological monitoring and is especially applied in the vegetation monitoring field as well as detecting land-use changes. The objective of aerial photography in the KNP is to monitor changes in the cover of different vegetation types. At a broader scale, distinction can be made between woody and herbaceous vegetation and bare ground, whereas at a finer scale, cover classes for different vegetation types can be determined. The existing aerial photographic data set is of such a scale that it can be used for detecting changes in vegetation structure such as cover and density but other analyses can also be conducted on this set. In some cases it is possible to distinguish between different woody species, especially where these are large specimens. The latter is especially important in assessing mortality amongst larger trees of specific species. The photographic data set covers a relatively long period, dating back to 1981, enabling one to compare historic with more recently taken photographs. Changes in vegetation cover particularly, but also to a limited extent in species composition, are easily detectable and could provide important management feedback. Since the aerial photographs are in digital format, image processing can be conducted to analyse the data. Heterogeneity indices can also be derived from the images.

Aerial photographs were taken of all transects, exclosures, enclosures and experimental burn plots during 2006. No image processing and analyses were conducted though.

FIXED-POINT PHOTOGRAPHY AS AN AID FOR LONG-TERM VEGETATION MONITORING IN THE KRUGER NATIONAL PARK

*Eckhardt HC*¹

¹ Scientific Services, South African National Park

holgere@sanparks.org

Fixed-point photography is a useful method of recording long-term changes in the vegetation. It shows gross vegetation changes in an objective visual way. Quantitative data are not easily extractable from the images because of the absence of a fixed surface area, which is ascribed to the horizontal view into space contrary to vertical views focusing on ground surface. There are, however, semi-subjective means that can be used to derive quantifiable information. One of the easier parameters is the number of individual trees, which can be simply counted in order to obtain time series data.

During end of March, all exclosures (Nkhuflu, Letaba and Makhohlolo) and enclosures (Hlangwini, Buffalo camp and Capricorn Breeding camp) were visited to photograph selected fixed-point sites; this happens every three. Approximately 1350 photographs derived from 93 sites were analysed during the last period. The findings support the general observation that large trees are lost from the system at a higher rate than they can be recruited.

Dead trees and those between 2-5m tall showed no significant changes. The change in size classes was accompanied by other structural changes as well, such as an increase in woody cover mainly by lower height strata, and reduced visibility. These are typical symptoms of bush encroachment experienced in large parts of the country and especially in higher rainfall areas. Loss of heterogeneity in terms of woody structure is clearly emphasized by a reduction in the structural diversity index of all vegetation types monitored. This index is based on loss of large trees and increase in cover and density by smaller size classes (bush encroachment).

GEOMORPHOLOGICAL DYNAMICS OF THE MAJOR RIVERS OF THE KRUGER NATIONAL PARK

*Eckhardt HC*¹

¹ Scientific Services, South African National Park

holgere@sanparks.org

This monitoring programme resulted from the concern of alluviation of rivers which is one of two major threats to the rivers of the KNP, the other being deterioration of water quality. Since the focus was falling on the Sabie River and therefore most of the work conducted on it, TPC's and models were developed based specifically on conditions prevailing along this river. The geomorphology of the Sabie and Letaba River were described in detail, resulting in a hierarchical classification system. Within a river, so-called macro-reaches were identified which were further subdivided into reaches, channel types and morphological units. The latter units form the finest scale at which the geomorphology of the rivers is monitored. While this detailed classification system is lacking for the Luvuvhu, Olifants and Crocodile River, a different system of characterization in terms of reaches will suffice in the meantime.

While this monitoring programme focuses on geomorphological changes *per se*, it must be considered in association with the riparian vegetation monitoring programme which measures geomorphological change in an indirect way. All geomorphological work so far has been conducted by Wits University's Centre for Water in the Environment (CWE) and is on-going, constantly seeking new improved ways of monitoring.

RIPARIAN VEGETATION INDEX (RVI NOW CALLED VEGRAI) AS PART OF RIVER HEALTH PROGRAMME (RHP)

*Eckhardt HC*¹

¹ Scientific Services, South African National Park

holgere@sanparks.org

The Riparian Vegetation Index (RVI) as part of the River Health Programme (RHP) is a national monitoring programme applied by various provincial conservation bodies to monitor the state of specific rivers throughout the country. This programme was implemented three years ago; however, the collected data have not been captured on computer yet for administrative reasons. All five major rivers were surveyed according to this technique staggered over the last three years, *i.e.* two rivers each in one year and one river in another year. For the last year, no surveys were conducted due to the current programme being revised. After major revision, this programme was renamed to Vegetation Response Assessment Index (VEGRAI) and is in the process of being implemented. Future responsibility towards this monitoring programme still needs to be determined but will most probably no longer resort under the current portfolio.

DEVELOPMENT OF A CLEARING PROTOCOL BASED ON ECOLOGICAL CRITERIA FOR MESIC SAVANNAS AND SWEET GRASSVELD FOR THE WORKING FOR WATER PROGRAMME

*Euston-Brown DIW*¹, Rathogwa N² & Richardson DM³

¹ Independent Researcher

² University of Venda

³ Centre for Invasion Biology, University of Stellenbosch

dougeb@netactive.co.za

The difficulties experienced by WfW to control chromolaena and lantana in mesic savannas and sweet grassveld stimulated the commissioning of this project. The project commenced in 2004 and used a multi-faceted approach that included field studies, a review of international literature, and informal discussions with managers and experts to develop a range of clearing options.

The report also provides the methods and results of two field studies that were done between 2004 and 2006 in the Appendices. The results of these studies show that alien plant control is effective and that indigenous diversity increases following the application of control measures, especially after high summer rainfall. Working for Water and all its staff and workers can be proud of their control efforts to date on these two invasive plants. However, control of the other invasive plant species that tend to invade freshly cleared or burnt savanna requires urgent attention. This report strives to provide information, data and ideas that can be used to enhance the efficiency and effectiveness of WfW clearing teams in the control of invasive alien plants in the savannas of the east and north east part of South Africa.

INVESTIGATING SPATIAL HETEROGENEITY AND RESILIENCE USING PIOSPHERES

*Farmer H*¹, Witkowski ETF¹ & Peel MJS²

¹ Restoration and Conservation Biology Research Group, School of Animal, Plant & Environmental Sciences, University of the Witwatersrand

² Savanna Ecosystem Dynamics, Agricultural Research Council

farmer.helen@gmail.com

The availability of ephemeral natural water decreases along an east west gradient whilst the availability of seasonal and semi-permanent natural water increases. Availability of permanent natural water peaks in Kruger. Artificial water provision varies greatly across the study area. Artificial water provision is greatest in the high intensity management zone (private reserves) and non-existent in the low intensity management zone (Limpopo National Park). Within Kruger National Park artificial water provision varies between landscape types from 0 points/km² to 0.042 points/km² within landscape types included in the study area. The relationship between mean annual rainfall and waterpoint density suggests artificial water provision still represents management objectives of the 1970s – spreading the impact of water dependent herbivores.

MECHANISMS OF GRASS/TREE INTERACTIONS IN SAVANNAS

*February EC*¹, Bond WJ¹ & Higgins S²

¹ Department of Botany, University of Cape Town

² Department of Vegetation Ecology, Technical University of Munchen, Germany

Edmund.February@uct.ac.za

The primary objective of the Tree/Grass Programme is to develop a predictive understanding of tree/grass interactions in savanna ecosystems. The suggestion is that there is competition for water between trees and grasses at Pretoriuskop. This competition is however only at the establishment stage when trees are rooting in the same soil horizon as grasses. Once trees have matured our data suggests that there is no longer competition for water with grasses as these larger trees are using a deeper water source.

In the different treatments an increased infiltration could be seen with increased rainfall although the degree to which this occurs does differ at the two study sites (Pretoriuskop and Satara). Even though there was increased infiltration there is no corresponding increase in tree growth. This leads to a conclusion that the NSH is not correct. Instead grass growth is stimulated by increases in available water. With that increase in grass growth there is more competition for resources leading to a decline in tree growth rates. The increase in grasses also leads to an increase in grass biomass which results in increases in fire intensity and thus a decline in tree dominance. So we suspect that the first of the predictions for the DBM are true.

CHEMICAL IMMOBILIZATION OF HYENA WITH MEDETOMIDINE, BUTORPHANOL, MIDAZOLAM COMBINATION, WITH FULL REVERSAL

*Fleming GJ*¹ & Hofmeyr MS²

¹ Disney's Animal Kingdom, Orlando Florida

² Veterinary Wildlife Services, South African National Parks

Greg.Fleming@disney.com

Numerous drug combinations have been used to immobilize hyena of which all have their own draw backs, such as stormy induction and recovery times and hyper salivation. In this project we used a combination of medetomidine, butorphanol, midazolam to immobilize a hyena for a period of 30-40 minutes. The great benefit of this combination is that it is fully reversible with flumazenil, naltrexone and atipamezole. The project was an excellent success. This combination allowed for a fast induction 3-5 min, great oxygen saturations and fast recovery times (M=8 min in wild dogs). In addition if the animal is to be released into a new area or a boma the midazolam does not have to be reversed providing for some post immobilization sedation. This combination can then be used for short field procedures of less than 50 min, if using the reversal drugs, or for longer translocations without reversing the drug combination. Once immobilized the hyena was intubated and end title CO₂, blood pressure, arterial blood gas, and vital signs were recorded for 30 min then the hyena was reversed (woken up). This drug combination provides a safer more effective immobilizing drug combination for Hyena than previous combinations. In fact one of the study hyenas's had two snares, one around his neck and one around a foot, that were removed during the project. This animal was immobilized three times over nine days and was then released back into the bush. A total of 22 hyena immobilizations were completed along with 8 TB testing and 4 collars placed. No injuries to animals or staff occurred and in numerous occasions immobilized hyena were seen the next evening after being released.

PATTERNS AND PROCESSES OF INVASION IN AN AFRICAN SAVANNA ECOSYSTEM, WITH EMPHASIS ON MULTIPLE SPATIO-TEMPORAL SCALES

*Foxcroft LC*¹, Richardson DM² & Rouget M³

¹ Scientific Services, South African National Parks

² Centre for Invasion Biology, University of Stellenbosch

³ Conservation Science Group, University of Cambridge

llewellynf@sanparks.org

Biological invasions are a significant ecological and economic global crisis. Protected areas also suffer from the increased burden that invasions place on their resources and the impacts placed on the ecosystem. However, management requires an ecological foundation which can inform best practice and optimize its responses. I used spatially-explicit alien plant data at various scales from: a national database, the whole of KNP, a specific region, river system, and small scale plots in one invaded area of KNP. Using various statistical techniques, primarily classification and regression tree analysis, logistic regression, ANOVA, Nestedness and spatial pattern analysis, the relationship between the patterns observed at a specific spatial grain and extent were assessed, discussing the implications for invasion ecology and management. Using this knowledge and conceptual tools, I developed a new framework and model which contributes to invasion theory. Scale is a critical component in evaluating alien plant invasions. Without careful consideration of scale, studies from different scenarios cannot be compared and the science of invasion ecology will not advance.

THE IMPACT OF AGE AND CLIMATE ON REPRODUCTIVE RATES OF AFRICAN ELEPHANTS (*LOXODONTA AFRICANA*) IN KRUGER NATIONAL PARK

Freeman EW¹ & Brown JL¹

¹ National Zoological Park's Conservation and Research Center

freemane@si.edu

The aim of the project was to determine if social and environmental factors impact ovarian activity in wild and captive African elephants. Most of the female elephants culled in Kruger National Park over this 20 year period were reproductively active (pregnant and/or lactating), thus cycling females were relatively rare. Data analyses demonstrate that age and precipitation affected reproductive success. The percent of pregnant and/or lactating females declined as females reached an older age (> 45 years). Only half of these non-reproductive, older females showed signs of ovarian activity; they had corpora lutea or albicantia present on their ovaries. Similar age-related trends have been documented for elephant populations in Kenya and Uganda (Laws et al., 1970; Moss, 2001). Whether this phenomenon is evidence for reproductive senescence or the result of other factors has yet to be determined. Although elephants conceived throughout the year, reproductive activity was associated with changes in the annual precipitation. Most of the predicted births preceded peak rainfall; such timing ensures females are in optimal condition as lactational demands. Reproductive seasonality also has been documented for populations of elephants in Kenya, Tanzania, Uganda, Zambia. Poor nutritional quality during the dry season causes a decline in body condition which may negatively impact the success of implantations and early pregnancies. Yet, dry ecological conditions also cause lower progesterin concentrations in pregnant elephants and could hinder normal ovarian activity.

TREEHOUSE RESEARCH PROGRAM FOR PEOPLE AND CONSERVATION

*Freimund W*¹, Breen C² & McCool S¹

¹ Department of Society and Conservation, University of Montana

² Centre for Environment, Agriculture and Development, University of KwaZulu-Natal

Wayne.freimund@umontana.edu

The Treehouse Research Program for People and Conservation (TRPPC) endeavors to develop and test an integrated learning framework that incorporates clear and measurable social objectives into adaptive management systems for protected areas. This effort is motivated by the recognition that the lack of well-defined social objectives in Protected Area Management (PAM) perpetuates a system of partially informed decisions. Through engaging and evaluating the implementation of social objectives, the role of protected areas in local and national society will be better defined and the on-going cultural/social relevance of protected areas can be enhanced and secured.

To understand the contextual relevance of protected areas, the TRPPC is assessing the relationship between parks and people in settings throughout southern Africa and the United States. Cross-cultural comparisons of the degree to which learning is featured in Protected Area Management organizations will facilitate a deeper understanding of their unique circumstances and challenges. Examination of how problems are framed and addressed within differing systems will provide opportunities to expose the effectiveness of how differing paradigms for developing and managing the social values of protected areas.

One of the primary purposes of the research described above is to facilitate the development of training materials for protected area managers. These training materials will be designed to amplify protected area managers' capacity to proactively confront the social and political challenges that protected areas are faced with.

In February 2007, the Treehouse Program convened a meeting in Missoula, Montana USA to coordinate on the development of a book to include an analysis of several current issues of concern to protected area managers. At this meeting it was decided that the book would feature a "systems thinking" approach to understanding the various issues highlighted in the book. In July 2007, members of the Program met in Skukuza, Kruger National Park to develop and critique outlines of the chapters of the book. In October 2007, a prospectus will be submitted to a publisher. Following the review of the prospectus, authors will continue to draft their respective chapters and then circulate for peer review. Chapters should be completed by July 2008. At that time, the draft book will then be submitted to the publisher.

ANALYSIS OF THE SPATIAL PATTERNS OF LARGE HERBIVORES POPULATION DYNAMICS IN KRUGER NATIONAL PARK

*Fritz H*¹ & Chamaillé S¹

¹ Centre d'Etudes Biologiques de Chizé, CNRS

h.fritz@wanadoo.fr

The project aimed at better understanding the declines observed in large herbivore populations during the 80s in Kruger National Park, particularly investigating spatial distribution and group size changes. Due to a slight reorientation of the project, only spatial distribution analyses have been conducted so far.

Because Kruger has been fully-censused during the study period, we investigated the usefulness of a remote-sensing based technique, standardized principal component analysis on time-series to study distribution changes of herbivores over time. Two main findings arising out of the research, the analysis successfully detected the changes in census methodology that occurred in 1985 and 1994, and revealed that the change occurring in 1985 was detectable at the 1km scale, but not at the 5km or larger scale. Furthermore, the analysis produced maps of the mean distribution of herbivores during the study period, then identified the main patterns of divergence over time. Interestingly, for all species but zebra the major change in distribution occurred somewhat gradually over time, indicating that some general changes in the community were occurring. The pattern of these changes were however unclear for most species, and appear to occur at small scale, as it was rarely possible to identify large areas of similar changes. Patterns of change were also not correlated between species.

A similar analysis was conducted on an index of vegetation productivity (NDVI) to investigate if changes in herbivore resource matched some of the observed patterns. We separately analysed wet and dry season NDVI, but none display pattern similar to the ones observed in herbivores.

ASSESSMENT OF LION POPULATION DEMOGRAPHY AND ABUNDANCE IN THE KRUGER NATIONAL PARK: IS BOVINE TUBERCULOSIS HAVING AN EFFECT?

*Funston PJ*¹ & Ferreira S²

¹ Department of Nature Conservation, Tshwane University of Technology

² Conservation Ecology Research Unit, University of Pretoria

funstonpj@tut.ac.za

This project aims to develop a technique that can be used by managers and researchers of lion populations to determine population estimates and population processes. This report presents final findings from the work conducted in Kruger National Park (KNP) from May 2005 to September 2006. Few lion populations have reliable estimates of population size, trends in these, or demographic assessments. We set out to first develop a statistically robust approach to estimate selected population variables. The KNP was chosen to evaluate the perceived threat of a recently introduced exotic disease, bovine tuberculosis (BTb), in a landscape of varying prey biomass. We calibrated standard call-up surveys, defined the sampling intensity for a desired precision of estimates, and estimated lion densities for six BTb influenced prey biomass zones. Previous estimates helped us to define the population growth. Assigning sex and age to responding lions allowed the extraction of age distributions, from which we estimated survival rate.

Population size was estimated to be 1684 (95% CI: 1617-1751) lions for Kruger as a whole, this has not changed significantly for 30 years. Density and survival rates were strongly associated with prey biomass density and survival was higher at high biomass. However, some of the variation in survival was associated with the prevalence of BTb in lion prey rates were higher in areas that had high prevalence of BTb. In addition, male survival was lower than female survival disregarding the effects of prey biomass or how prey was infected by BTb. The effect of an exotic disease on the Kruger lions may be negligible at present. Intra-specific competition in areas where lions live in high densities, even with high prey biomass, affect survival rate. However, droughts could disrupt the hierarchical influences of prey biomass and BTb prevalence on lion densities and survival. Given the stability in lion numbers, trend detection is hard. Hence, to evaluate the likely accentuated effect of an exotic disease on lion demography when conditions change from what it is at present, population surveys should include structure assessments and be complimented by focal assessments of fecundity.

TRIGGER AND REGULATORY MECHANISMS OF MUSTH IN AFRICAN ELEPHANTS

*Ganswindt A*¹, Muenschler S¹, Henley MD^{2,3}, Henley SR^{2,3}, Whyte IJ⁴, Bertschinger HJ¹ & Douglas-Hamilton I³

¹ Department of Production Animal Studies, University of Pretoria

² Transboundary Elephant Research

³ Save the Elephants

⁴ Scientific Services, South African National Parks

andre.ganswindt@tuks.co.za

This study is part of the recently initiated *African Elephant Musth Research Project* and partly funded by the University of Pretoria, Save the Elephants, Claude Leon Foundation, South African Veterinary Foundation, University of Veterinary Medicine Vienna, and German Primate Centre. The overall aim of the study is to identify possible triggers and regulatory mechanisms of musth by describing physiological, physical and behavioural musth related changes and how these influence the use of ecological and social resources by free-ranging male African elephants during musth and non-musth. The information gained from the study could be important to optimize local conservation and wildlife management by finding new strategies for better elephant population management and control. This information will contribute towards the reduction in human-elephant conflict and problem-animal control issues by finding solutions that will enable people to live alongside wildlife while developing sustainable livelihoods.

The project is being conducted on trained (pre-study) and free-ranging (main study) animals, located in different facilities and nature reserves in South Africa, and planned for a total of three years (Mar 2006 - Mar 2009). The pre-study was extended for some additional experiments and is now almost completed. The main study is currently conducted on up to eight adult elephant bulls, which were collared by Kruger National Park (KNP) in collaboration with Save the Elephants in December 2006 in the northern part of KNP.

LONGITUDINAL STUDIES OF BOVINE TUBERCULOSIS IN THE BUFFALO POPULATION OF THE KRUGER NATIONAL PARK, SOUTH AFRICA

Getz WM¹

¹Department of Environmental Science, Policy and Management, University of California at Berkeley

getz@nature.berkeley.edu

Bovine tuberculosis, caused by *Mycobacterium bovis*, is an exotic disease to southern Africa and has a wide range of potential hosts. The prevalence of bovine tuberculosis (BTB) increased in the buffalo population of the Kruger National Park (KNP) from 1991 to 1998, and the buffalo population acts as a reservoir host in the KNP with spillover to lions, baboons, and some other mammalian hosts. The rationale for the study was that, tuberculosis provides a particularly appropriate model system to explore questions relating to the interaction between demography and epidemiology, and the emergence of new prevalence patterns as a response to a changing environment. The aims of the study were to use methods from epidemiology, field ecology, GIS, microbiology, mathematical modeling and statistics to develop a general theory of how the spread and maintenance of diseases in metapopulations (a population of spatially structured subpopulations) is influenced by the ecology of migration among fixed or mobile local populations; collect data on the ecological, epizootological, and demographic processes influencing the spread and impact of BTB in a reservoir host, the African buffalo (*Syncerus caffer*), in the KNP, as well as to other hosts, including lion (*Panthera leo*) preying on buffalo, and cattle and humans living on the boundaries of the KNP; and to develop a spatially explicit and ecologically detailed predictive model of BTB in African buffalo that provides a tool for evaluating management alternatives (e.g. vaccination, removal of infectives, manipulation of access to water), and the impacts on spill-over hosts.

FIRE HISTORY AND LONG TERM VEGETATION DYNAMICS IN SOUTHEASTERN KRUGER NATIONAL PARK

*Gillson L*¹, Ekblom A², Duffin K² & Breman E²

¹ Botany Department, University of Cape Town

² African Environments Programme and Long-Term Ecology Laboratory, Oxford University Centre for the Environment

Lindsey.gillson@uct.ac.za

The Kruger National Parks' environment utilises palaeoecological techniques like fossil pollen, charcoal and stable isotope analysis to study vegetation change over time-scales of hundreds to thousands of years. The aim of the project was to study patterns of variability in savanna vegetation, exploring the role of climate, fire and disturbance in ecosystem dynamics. The understanding of the long term influence of socio-natural interactions in the shaping of the landscape is of importance for the maintenance of the park ecosystem today. Gillson and Ekblom are working on long-term palaeo records (pollen, isotopes, diatoms and charcoal from throughout the park, while Dr Ekblom has also taken a specific focusing on fire history and long term vegetation dynamics in eastern Kruger National Park and Limpopo National Park. Samples have been taken in Mozambique as part of this project. The paleoecological studies of these sites will enable a comparison of vegetation patterns and its linkages to the differences in management practices on either side of the Kruger National Park and Limpopo National Park over long term and particularly during the last century. Kristina Duffin is completing work on pollen landscape modelling, and calibration of the charcoal record, while Elinor Breman is working outside of the KNP in the savanna grassland ecotone to the west.

ARTIFICIAL WATERPOINTS: HOW THEIR DISTRIBUTION AFFECTS THE HERBACEOUS, WOODY STRUCTURE AND COMPOSITION?

*Goodall V*¹, Radloff S¹, Vetter S², Gaylard A³ & Grant CC³

¹ Department of Statistics, Rhodes University

² Department of Botany, Rhodes University

³ Scientific Services, South African National Parks

victoriagoodall@gmail.com

The project aims to investigate the changes to the composition of the grass layer within the enclosures as a result of selective grazing, to analyze the differences in grass biomass between the inside and the outside of the enclosures, and to analyze the differences and similarities between the 3 enclosures in terms of vegetation composition.

The study has shown that there has been a significant change in the vegetation proportions when the grazing is only available to selective grazers. The results of these analyses have shown that the decreaser proportion has increased significantly since the closure of the boreholes. This is the desired result of the closures as the vegetation is now more favourable for the selective grazers such as the roan. It is hoped that these changes will result in an increase in the roan population and other rare antelope. The changes are universal, and are not restricted to certain regions or landscape types within the KNP. The grass biomass however has not changed significantly since the closures of the boreholes.

Thus the removal of the permanent artificial water sources has led to an increase in herbaceous decreaser species, which indicates a decline in intense herbivory. Secondly, the closure of the boreholes has not resulted in a significant increase in the grass biomass; and finally the changes that have occurred have not been caused by the rainfall, regional locality and the geology of the landscape.

In terms of the elephant damage aspect, the data for the three years does show that the heaviest utilization of the tree species occurs between the heights of 1m and 4m. Before the tree has reached one metre, it is probably ignored as not being worth eating; and once it has exceed 4m; it is utilized but the tree is strong enough that the damage does not pose such a severe threat to the tree. Although the tree species within the riparian zone are being heavily utilized by elephants, there does not appear to be one species that is suffering noticeably more than any other. In fact, the changing climatic conditions from year to year seem to influence the elephants to concentrate their feeding on different species; thus giving the others a chance to recover and grow. This growth will bring them closer to the 4m point where they should then be able to recover from the utilization more successfully.

VELD BURNING IN THE KRUGER NATIONAL PARK

*Govender N*¹

¹ Scientific Services, South African National Parks

navashnig@sanparks.org

The role of fires in the history and shaping of the landscape of the Kruger National Park (KNP) can be traced as far back as 1912. Biggs & Potgieter 1999 briefly summaries this history and point to further references. By the 1950's it had become clear that knowledge pertaining to where, when and how often the veld (rangeland) in the KNP should be burnt was severely lacking. In 1954 a fire research programme was initiated in the KNP in the form of the experimental burn plots (EBP's) (Brynard 1971). The initial objective of this project was to investigate the effect season and frequency of burning has on vegetation in the four major vegetation communities in the park (Van der Schijff 1958). The history of these plots has been described by Trollope *et al.* 1998.

SEISMIC MONITORING OF SOUTHERN AFRICA AND THE MOZAMBIQUE CHANNEL

*Saunders I*¹, Molea TT¹, Buso L¹ & Sutherland BE¹

¹ Council for Geoscience

ians@geoscience.org.za

The Council for Geoscience (CGS) is mandated by the Department of Mineral and Energy (DME) to report on earthquakes in the Republic of South Africa through quarterly seismological bulletins compiled from instrumentally recorded waveform data from 23 seismological stations comprising the South African National Seismograph Network (SANSN).

The location of the Mopani site is ideal for monitoring earthquake activity in southern Mozambique and the Mozambique Channel. The site was equipped during April 2004 using an existing vault that was constructed during a project hosted by the University of the Witwatersrand. The equipment consisted of a Guralp-CMG-40T extended short-period (30 sec) seismometer, 24-bit digitizer and a Stand-Alone Quake Seismometer recorder.

A program to address the delay in transmitting waveform data recorded by the SANSN to the CGS offices in Silverton was established during the first quarter of 2006. General Packet Radio System (GPRS), a mobile data service for wireless communications that operates at speeds up to 115 kilobits per second, compared with Global System for Mobile Communications (GSM) that operates at 9.6 kilobits per second, proved to be the most attractive in both transfer speed and cost. GPRS additionally supports a wide range of bandwidths that is particularly suited for sending and receiving large volumes of data. A refitting program to phase out 18-bit digitizers and replacing Stand Alone Quake Systems (SAQS) with in-house developed Earthquake Acquisition Recording System (EARS) was executed in parallel with the communication program. The need to replace the SAQS recorders was paramount as spares for the equipment was becoming difficult to obtain. The seismological equipment at Mopani was upgraded to facilitate near real-time data transmission during November 2006.

THE PRESENT STATUS AND FUTURE SUSTAINABILITY OF THE POLLINATION SYSTEM OF *FICUS SYCOMORUS* IN THE KRUGER NATIONAL PARK

*Greeff JM*¹

¹ Department of Genetics, University of Pretoria

jaco.greeff@up.ac.za

There are several factors that may threaten the long-term sustainability of the fig-fig wasp obligate mutualism. First, competition between the pollinating wasp species and other wasp species that seem to utilize the same niche could result in the systematic loss of the pollinator. Second, since wasps only live in the fig fruits, irregular and clumped fruiting patterns can lead to periods where there may be no habitat for the wasps. This may become a crucial problem if phenology is closely linked to precipitation, which is expected to change in the future.

Apart from quantifying the phenology, we are testing four possible explanations for a stable coexistence between competing species. 1) Niches are actually different, 2) Competition is prevented by temporal division of habitat, 3) Facultative sex ratio adjustment by wasps may be a density dependent population growth regulator, and 4) the wasp population may consist of a metapopulation that will allow a 'chaotic' coexistence. A brief look at the data seems to support the hypothesis that there will be a slow down in fruiting through the dry months. Surprisingly most periods have fairly large crops with the exception of July-August during which very few trees fruit and have very few fruits.

The legitimate pollinator seems to be more dominant during winter months, or perhaps the two cheat species are less common, but as the summer progresses the cuckoo and parasitic species increase in abundance.

TREE PATTERNING AS A RESULT OF FIRE FREQUENCY

*Groen TA*¹, van Langevelde F¹, van de Vijver CADM², Prins HHT¹ & Govender N³

¹ Resource Ecology Group, Wageningen University

² University of Cape Town

³ Scientific Services, South African National Parks

Thomas.Groen@wur.nl

The purpose of this project was to understand the role of fire in the spatial clustering of trees in savannah ecosystems. The main goal was to increase knowledge about savannah burning regimes since it can create insight in the long-term fire resistance of woody species that form clusters. These clusters potentially exclude fire and thus remain unaffected by fire regimes.

The data was collected in the winter of 2005 at the experimental burning plots. Data collected included nearest neighbour distances for randomly selected trees in the experimental burning plots, and clay content of the soil. Further data was obtained on fire frequencies, fire intensities and distances to water points. The study has shown that clustering of savanna trees is a function of competition and fire. Fire however, plays a less important role than was hypothesized on the basis of models. Competition for water seemed a more important factor determining whether trees occur in clustered patterns. Also, we showed that clustering is probably an active process that occurs through the recruitment of seedlings or the clonal fashion of growing of tree species like *C. mopane*. Finally, the results showed that trees can protect each other from the negative effect of fire.

DEVELOPING AN IMPROVED CYBERTRACKER INTERFACE THROUGH PARTICIPATORY DESIGN FOR MANAGING HUMAN RESOURCES AND BIODIVERSITY DATA IN NATURE CONSERVATION

*Grujters D*¹, Blake E¹ & Liebenberg L¹

¹ Department of Computer Science, University of Cape Town

dom@cs.uct.ac.za

This project set out to assess the impact of the existing CyberTracker interface and approach in the adoption of the software in South African National Parks. The project has yielded informative and interesting results but has not yet achieved all its objectives. From user interviews and observations a model of the usage of the CyberTracker software has been developed.

Observations of various users using the CyberTracker software for common tasks using walk-throughs and contextual enquiry showed that the underlying software metaphor used in CyberTracker hinders the Data Querying Users from creating new and creative queries. An understanding of the metaphor used for sequence design is required to create new and creative queries. Data Querying Users have little or no understanding of this metaphor and therefore cannot create new and creative queries on their own. Paper-prototyping and low-fidelity software prototyping of the new interface, where the two functions (Sequence Design and Data Querying) had separate underlying metaphors yielded promising preliminary results.

BIOCOMPLEXITY IN AFRICAN SAVANNAS: PATTERN AND PROCESS OF WOODY COMMUNITY STRUCTURE IN THE KRUGER NATIONAL PARK

*Hanan NP*¹ & Bucini G¹

¹ Natural Resource Ecology Laboratory, Colorado State University

gbucini@nrel.colostate.edu

The project aims to look at the creation of a tree-cover map for Kruger National Park (KNP) based on remotely sensed data and the development of an ecological model for the understanding of tree distribution as a response to environmental and disturbance factors in the KNP. The work has been successful at collecting the data for the analysis and completing the fine-resolution classification of tree cover. An object-oriented analysis was applied within the Definiens Professional 5 software to classify a set of 35 aerial photos and extract the woody vegetation component from the savanna matrix. We The accuracy assessment was performed obtaining an average overall accuracy of 89.2%. For the subsequent purpose of modeling, we applied focal analysis and calculated tree-cover percent at a resolution of 28.5 m. Both the aerial photos and the tree-cover percent rasters were geo-referenced to Landsat images.

The project includes the development of two models. The first one is an explanatory model, with an ecological nature that aims at describing the tree cover distribution in the KNP as a function of climate, soil types, topography, and coupled variations in herbivory and fire frequency. The database of the explanatory variables is mainly composed of the GIS layers provided by the KNP Scientific Services. The second is a predictive model to extrapolate tree-cover estimates from the aerial photo to the entire KNP. Both models will be based on the tree-cover estimates derived from the aerial photos. To help the development of the two models the researcher is working on a general map of tree density at the Park extent based on Landsat imagery.

COMMUNITY PERCEPTIONS OF THE TEBA RECRUITMENT CENTER IN PAFURI AND THE DEVELOPMENT OF A PUBLIC CULTURAL HERITAGE SITE IN THE GLTP

*Hansen HS*¹

¹ Rock Art Research Institute, University of the Witwatersrand

heidisuz76@gmail.com

The success of the goldmines in South Africa can be largely attributed to the system of recruiting cheap, unskilled, migrant labour from centres outside the mining fields. The industry's success led to Johannesburg becoming the largest supplier of gold to the world, and so established South Africa's economy. In an attempt to centralise and standardise the recruitment of such labour, the Chamber of Mines established the WNLA and the NRC (the two were later merged and renamed TEBA). One of TEBA's most important recruitment centres was situated on the South African- Mozambique border in Pafuri (north eastern Kruger).

The aims of the project are to document the experienced memory and current perceptions of the site held by mineworkers recruited through the centre and their families, who live within close proximity to the site and who will be most affected by the establishment of the GLTP. It was also to explore the possibility of developing and presenting the site as a place of cultural and historical reconnections for communities nearby. Included here is the transfer of recruitment history from one generation to another, opinion of the importance of the history, the documentation of songs sung and opinions for the future use of TEBA.

Interviews were conducted with mineworkers and their families, Makuleke elders and relevant officials (TEBA, Kruger and Limpopo National Parks) in July and August 2006. In general TEBA was often portrayed in a positive light, i.e. providing the people with work and the consequent money to support their new growing families and therefore played an important role in the lives of people living near and being recruited through the site. The main concern and influencing factor was definitely the desperation for work opportunities and elevation out of dire poverty. Further analysis of the interviews is still needed.

ASSESSING LOCAL SCALE IMPACTS OF *OPUNTIA STRICTA* (CACTACEAE) INVASION ON ARTHROPOD ASSEMBLAGES IN THE KRUGER NATIONAL PARK, SOUTH AFRICA

Harris KR¹, van Rensburg BJ¹, Robertson M¹ & Coetzee J²

¹ Department of Zoology & Entomology, University of Pretoria

² Department of Zoology & Entomology, Rhodes University

krharris@zoology.up.ac.za

In the Kruger National Park (KNP), introduced prickly pear (*Opuntia stricta*) has invaded some 35 000 ha of conserved land and its effects on biodiversity are a major cause for concern. The researcher investigated the effect of *O. stricta* infestation on beetle (Order Coleoptera) and spider (Order Araneae) species assemblages in the Skukuza region of the KNP using unbaited pitfall traps over a 12-month period. Species density for beetles and spiders did not differ significantly across treatments and abundance of beetles was found to be significantly higher in heavy infestations when compared across the treatments. We conclude that at the current infestation level, *O. stricta* does not have a significant effect on beetle or spider species density. However, further examination of other arthropod groups is required to fully understand the effects of the *O. stricta* infestation and a continued biocontrol programme is essential to further mitigate the effects of *O. stricta* on biodiversity.

POPULATION DYNAMICS AND ELEPHANT MOVEMENTS WITHIN THE ASSOCIATED PRIVATE NATURE RESERVES ADJOINING THE KRUGER NATIONAL PARK

Henley MD^{1,2}, Henley SR^{1,2}, Douglas-Hamilton I² & Whyte IJ³

¹ Transboundary Elephant Research Programme

² Save the Elephants

³ Scientific Services, South African National Parks

michelephant@worldonline.co.za

The objective of the project is to understand what motivates elephants to move across boundaries. The social and nutritional motivating forces behind elephant movements to the east and west of core conservation areas such as the KNP are currently being studied. Elephants are tracked using either GPS satellite or GMS/GPS radio collars. Individual elephants are identified, study population dynamics and habitat use studied, and examine the effects of elephants on key tree species.

A total of 2 397 sightings of bulls and 710 sightings of breeding herds have been made between May 2003 and August 2007. Currently, 30 collars have been deployed in two focal areas, twenty-two in the western KNP and adjacent private reserves (APNR) and eight in the north-eastern KNP and Limpopo National Park, Mozambique.

Over 1300 large trees (>5m in height) within the Associated Private Nature Reserves have been labeled and the impact of elephants on these individual trees are being recorded over time. A total of 591 large trees have been protected on request of various landowners to maintain the aesthetic features of certain landscape types. The methodology includes the direct application of 13mm mesh wire netting around the trunk of mature tree stems to prevent these trees from being extensively bark stripped by elephants. Heavy wire netting proved to be more efficient in protecting trees against debarking and required less maintenance but was also more visible than 13mm mesh wire at distances further than 5m from the protected tree. Wire netting techniques did not protect trees from being uprooted or broken. Results from these studies indicate that the absolute use or avoidance of protected trees may not be as important as the degree to which the wire-netting prevents extensive bark-stripping and consequently increases the survival rate of trees that are susceptible to bark-stripping by elephants.

SYNBIOSYS KRUGER - AN INFORMATION SYSTEM FOR THE EVALUATION AND SUPPORTING THE MANAGEMENT OF BIODIVERSITY AMONG PLANT SPECIES, VEGETATION TYPES AND LANDSCAPES IN THE KRUGER NATIONAL PARK

*Hennekens SM*¹, Schaminee JHJ¹, Verweij PJFM, Kuiters AT¹, Bredenkamp GJ² & Mostert T²

¹ Centre for Ecosystem Studies, Alterra Wageningen University Research

² Department of Botany, University of Pretoria

Stephan.Hennekens@wur.nl

SynBioSys Kruger is a collaborative project between Alterra Wageningen University Research, University of Pretoria and South African National Parks, aiming at the development of a biological information system, which will operate as a tool for supporting the evaluation and management of biodiversity in Kruger National Park. By bringing together the wealth of existing data at the levels of plant and animal species, ecosystems and landscapes, the system will strongly contribute to understanding the ecology of the biological levels involved. The power of the computer software package *SynBioSys Kruger* is threefold: (1) the entire system is data driven, (2) it is an open-ended system, and (3) large datasets can be analyzed and displayed visually using a GIS platform. Due to the availability of scientifically sound vegetation data, the first version of *SynBioSys Kruger* is focused on vegetation and plant species data, together with available environmental data influencing the vegetation of the KNP. Data from fields such as zoology, entomology, tourism and management programs will be incorporated as data become available. Any data containing spatial or temporal information can therefore be incorporated into this open-ended multi-disciplinary information system.

Until recently, data such as species distribution, population demography, migrations, ecosystem composition and dynamics, plant-herbivore interactions, predator-prey relationships, landscape changes were stored, managed and analyzed as separate entities. *SynBioSys Kruger* will safeguard and integrate the existing data and will enhance data compilation.

**ENNOBLING THE INDIGENOUS SOUTH AFRICAN MARULA
(SCLEROCARYA BIRREA SUBSP. CAFFRA)**

*Holtzhausen LC*¹ & de Vos V²

¹ Emeritus Professor

² Scientific Advisor, Wildlife Diseases

profkas@telkomsa.net

The project aims to select the best marula varieties in the natural state (with production, fruit quality and tree size as parameters), to clone and name the superior cultivar, register them and release them to the horticultural world. Five cultivar trails of the new registered and the application for registration were planted and inspected after a year. Two trees died and were replaced, ants and weeds were controlled and the trees were fertilized. The cultivars Pharulani, Kaserula and Technorula was registered by the National Department of Agriculture, Genetical Resources as bearing daughter trees and could be observed and proved to be genetically stable and true to type.

The newly found Pabenirula, (selected because of the very dark green leaves) were observed as a male tree but this year bear fruit and may be a hermaphrodite (not ever reported in literature). A definite hermaphrodite marula was found at the De Vos farm, Jakkalsdraai in the Nelspruit district. This will be confirmed the next season.

DEVELOPMENT OF A DECISION MODEL FOR ASSESSING THE DYNAMICS OF FOOT AND MOUTH DISEASE (FMD) AND AFRICAN SWINE FEVER IN THE GREAT LIMPOPO TRANSFRONTIER CONSERVATION AREA (GLTFCA)

*Jori F*¹, Gummow B¹, Vosloo W², Kriek N¹ & Brahmabhatt DP³

¹ Production Animal Studies, Faculty of Veterinary Science, University of Pretoria

² Exotic Diseases Division, Agricultural Research Council

³ College of Veterinary Medicine & Biomedical Sciences, Texas A&M University

jori@cirad.fr

Wildlife diseases are common within national parks. In that context, Transfrontier Conservation Areas (TFCA's) increase interactions between different components at the human-livestock-wildlife interface and require accurate management of diseases. The spread of disease within the wildlife populations in TFCA's could have disastrous consequences for ecotourism in the region. In addition, the spread of disease from wildlife to domestic herds will impact on food security in the region and should be minimized. To tackle the issue, a consortium of international research institutions and the TFCA Veterinary Programme at the University of Pretoria have the goal to develop a stochastic decision/risk assessment model to assess the risks and impact of selected diseases within the TFCA and the possible knock on effects of these diseases. The selected region is the Great Limpopo Transfrontier Conservation Area (GLTFCA) where diseases of major economic importance involving wildlife host such as Foot and Mouth Disease (FMD).

To address this goal qualitative risk assessment framework was developed in order to assess the current risk of FMD occurrence in the Western boundary of the KNP. Since the year 2000 at least five declared outbreaks of FMD have occurred in the area adjacent to the KNP, despite the implementation of control measures. Although only one of these outbreaks threatened the free zone, it was found necessary to develop decision tools in order to help in the implementation of efficient disease control strategies. The OIE assessment method was used based on data collected during a three month period between February and May 2007 and expert opinion. Although the data were not sufficient to allow a quantitative risk assessment to be performed, the investigation served as a useful initial approach prior to undertaking a quantitative risk assessment. Risk was assessed using the following parameters: prevalence of infection in buffalo in the KNP, permeability of the fence along its Western Boundary, the potential for contacts between livestock and buffalo, the level of immunity in cattle herds and the efficiency of surveillance measures. The magnitude of the consequences is derived from the probability of transmission and spread. The method and results will be used as a basis for further discussion and for the development of a quantitative risk assessment model.

PLANT AVAILABLE NITROGEN UNDER DIFFERENT WATER REGIMES IN A SAVANNA, KRUGER NATIONAL PARK

Keretetse MK^{1,2}, February EC², Higgins S³ & Bond WJ²

¹ Scientific Services, South African National Parks

² Botany Department, University of Cape Town

³ Lehrstuhl für Vegetationsökologie, Technische Universität München

moagik@sanparks.org

The aim of the project is to examine the role of available water and nitrogen in different experimental combinations of trees and grasses, in order to determine if the coexistence of trees and grasses is determined or modified by a combination of available nitrogen and water. Information on how trees and grasses respond to varying levels of water and nitrogen availability will contribute towards understanding the interaction between trees and grasses, water and nitrogen availability. Data on grass and tree growth in response to varying levels of soil moisture, coupled with data on available nutrients would inform us as to the importance of nutrients or water as a driver in savanna systems.

The preliminary data shows that treatments with additional rainfall have higher mineralization rates than those treatments where rainfall is reduced. Furthermore, the data shows a seasonal pattern in mineralization rates, with the dryer season experiencing lower rates than the wetter season. The rate of mineralization peaks immediately after the spring rains and then shows a steady decline through out the season.

Treatments with different combinations of grass and tree also showed differences in mineralization rates. The grass treatments are wetter than the tree treatment due to increased infiltration and water retention. This also explains the high mineralization rates in the grass treatments. The data on grass biomass and tree radial increments shows that there is competition for water and nutrients, with grasses having a competitive edge in wetter treatments and trees showing a competitive edge in dryer treatments. These results suggest that it is a complex interplay between nutrients and water that are essential for plant growth in savanna systems.

FOREST COLONIZATION OF SAVANNAS: PATTERN AND PROCESS

*Khavhagali VP*¹, Bond WJ¹ & Craine J²

¹ Botany Department, University of Cape Town

² The Environmental Studies Program, Dartmouth College

vkhavhagali@half.ncape.gov.za

The project investigates competition between *T. sericea* seedlings and grass species at different supply of water and nutrients using a field experiment. This paper reports on a field experiment designed to test the following hypothesis for *T. sericea*: (1) seedling growth would be enhanced by addition of water and nutrients, and (2) competition with grasses would reduce seedling growth in all sites, and (3) the presence of grasses would reduce soil resource (moisture, N & P) availability.

The results show that frequent fires are reducing woody plants, by killing and damaging saplings, whereas fire exclusion is promoting tree seedling establishment. Despite fire exclusion in the no burn plot, there were no forest elements on the open habitats. That implies that forest invasion is being promoted by the presence of the tree canopy. Several questions were addressed as to how do tree canopy influence seedling establishment. Factors such as soil moisture, soil nutrients and organic matter were quantified. Only *S. birrea* showed an impact on soil resources. Therefore it is still unclear how and when do tree cover influence understory vegetation. Fire exclusion alone did not lead to forest invasion because few new saplings were found on the open sites and under *T. sericea*, but there was a shift to dense trees and shift in species composition with no burn under *S. birrea*. Forest colonization depends on both fire exclusion and resource availability.

SOIL EVOLUTION ON GRANITIC CATENAS

*Khomo L*¹, Rogers KH¹, Hartshorn T² & Chadwick O²

¹ School of Animal, Plant and Environmental Sciences, University of the Witwatersrand

² University of California, Santa Barbara

khomol@biology.biol.wits.ac.za

The first stage of the research is to resolve the landscape into a series of watersheds along the north-south axis of the park. The second objective of the study is to validate our predictive model by measuring a suite of soil properties across the spectrum of potential energies in the granitic landscape.

The most exciting data so far have been the erosion rates, chemical depletion and mineralogy. Kruger has one the lowest erosion rates recorded by cosmogenic isotopes, This finding gives us confidence that catenas have plenty time to develop in the lowveld due to the high residence time of the soils before they are eroded. The great age of the soils means that chemical weathering is likely the dominant mode of landscape evolution. Calculations of chemical depletion confirm that these soils are highly leached in most of the rock forming elements such as Silicon and Aluminium. Finally, unexpected trends have been found in the clay mineralogy of soils on catenas. The southern African dogma dictates that smectite should be expected on footslopes and kaolinite on crests. Preliminary findings, however, show that it not smectite on the footslopes but large concentrations of kaolinite; and, both smectite and kaolinite occur on the crests.

A PREDICTIVE MODEL TO IDENTIFY THE LOCATION AND EXTENT OF SODIC SITES IN THE KRUGER NATIONAL PARK USING REMOTE SENSING TECHNIQUES

*Kleyn L*¹, Grant CC², Smit IPJ² & Erasmus B¹

¹ School of Animal, Plant and Environmental Science, University of Witwatersrand

² Scientific Services, South African National Parks

kleyns@spesfeed.co.za

The aim of the project is to produce a digital map of the sodic sites found in the entire Kruger National Park from digital images obtained using remote sensing, and digital image classification.

Field work was carried out during November 2006 and March 2007 to determine the measurable variables of sodic sites in the Shingwedzi River catchment in the northern KNP and the Ripape River system in the southern KNP. These areas were chosen because previous work was carried out on the sodic sites in these areas by other researchers. The result of this investigation was that it is difficult to quantify sodic patches using soil chemistry based on 'in field' tests using pH, electrical conductivity, slaking, dispersion, deflocculation and turbidity tests, due to variation within and between sodic sites. The presence of the grass species, *Sporobolus ioclados* can be used as an indicator to positively identify a sodic site, but this is best done during the wet season while inflorescence are still present.

The second objective is to use aerial photographs, digital elevation models (DEM), satellite imagery and remote sensing techniques to identify sodic sites over the entire KNP. Aerial photography will no longer be used due to the availability of a set of SPOT5 images for the entire KNP. The resolution of these images is 2.5m in the panchromatic bands and 10m in the multispectral bands, and was received in March 2007. ASTER images are available for the entire park at 15m multispectral, although these vary between wet and dry season images in different areas of the KNP. LANDSAT images are available for the entire park for multiple time scales and can be used to compare classification at different scales and changes over time. The 90m SRTM DEM has been included in the classification process, as well as the Rivers GIS layer to measure distance from rivers.

THE ROLE OF MEGAHERBIVORE BEHAVIOR IN DRIVING FIRE-GRAZING INTERACTIONS AND GRASSLAND COMMUNITY STRUCTURE: “COMPARING PROCESSES ACROSS CONTINENTS”

*Knapp AK*¹, Smith MD², Collins SL³, Blair JM⁴, Kirkman K⁵, Burkepile D² & Fynn RWS¹

¹ Department of Biology, Colorado State University

² Yale University

³ University of New Mexico

⁴ Kansas State University

⁵ University of KwaZulu Natal

aknapp@lamar.colostate.edu

The goals of our project are (1) to compare how ecosystem and community structure and function respond to key ecological drivers (fire and grazing) in South African vs. North American savanna grasslands, and (2) to identify those ecological processes that are similar (convergent) despite the potential contingent factors of differing evolutionary history, herbivore diversity and soil fertility.

In KNP in 2006/2007 a total of 105 grazing exclosures (37.5-m²) were erected in replicated unburned, 1- and 3-year burn treatments, and in two burn treatments within a large Cape buffalo enclosure (a single grazing species treatment) near Satara in the central part of KNP. In each exclosure and in nearby areas open to grazing, we established a 2x2 m permanent subplot in the first year of the project and we have sampled plant species composition for two growing seasons. In addition, in each paired grazed and ungrazed plot we have measured annual aboveground net primary production and collected soils for measuring total C and N content, labile C and N pools (potentially mineralizable C and N), available soil P, and a suite of other soil characteristics. We have also surveyed herbivore use and behavior in response to fire treatments. This allows for the determination of the individual and interactive effects of grazing and fire on plant community composition in both ecosystems using identical sampling protocols.

The first year ANPP data has also been analyzed and these data suggest that differences in past grazing intensity at KNP strongly influence responses to fire. Upon removal of the herbivores through exclosures, fire did not increase ANPP the first year in KNP where grazing intensity was historically very high.

VEGETATION RESOURCE DISTRIBUTION AND DYNAMICS ASSESSED USING HYPERSPSCTRAL (AND BROADBAND) REMOTE SENSING AND THE RESPONSE OF WILDLIFE IN THE SOUTH AFRICAN SAVANNA

Knox NM^{1,2}, Skidmore AK¹, Prins HHT² & Grant CC³

¹ International Institute for Geo-Information Science and Earth Observation (ITC)

² Wageningen University

³ Scientific Services, South African National Parks

knox@itc.nl

The research project aims to map the distribution of different grass leaf biochemicals considered to act as attractants and deterrents of wildlife, the mapping will be done using remote sensing. The distribution of the biochemicals is to be mapped over the Kruger National Park (KNP) and this will be related to wildlife distribution.

The second stage of data collection took place from March 2007-June 2007. Logistically it is difficult to collect data across the Kruger and the Associated Private Nature Reserves (APNR) so much of the data collection made was focussed in the area of the northern overflight. The same fieldwork sites were used as those defined by Dr Onnie Mutanga. By using these same sites it will allow the data to be compared and determine the amount of change that has occurred since his field-study done during the same period in 2003. It is expected that changes will have occurred, particularly in areas that have been affected by burns since his time of study. The field campaign was divided into 2 collecting campaigns. The first of these captured the grasses in the late growing season, the majority of the grasses were in full flower, where 43 samples were collected. During the second stage 60 samples were measured, this included the previous 43 samples. The vegetation had by this stage started to dry out and senesce. So in the chemical analysis of the plants the shift in nutrient concentration should be evident.

The grass samples collected during this phase of the study were dried, ground and taken back to the Netherlands for chemical analysis.

THE ROLE OF ELEPHANTS IN ENHANCING SPECIES RICHNESS

*Kohi EM*¹, Prins HHT¹, Skidmore AK², de Boer FW¹, van Wieren SE¹, Page B³, Grant CC⁴ & Slotow R³

¹ Resource Ecology Group, Wageningen University

² ITC Enchede, The Netherlands

³ School of Biological and Conservation Science, University of KwaZulu Natal

⁴ Scientific Services, South African National Parks

Edward.kohi@wur.nl

The research focuses on understanding the effects of elephants on browse production and the quality of browse. The responses of browsed trees, stems, branches, or pushed over trees were measured in terms of changes in the availability of browsable biomass and forage quality at different feeding heights. The changes in available biomass will be calculated not only for elephants but also for other browser species (e.g. impala, kudu, steenbok). Individual browsed trees (with different elephant impact, such as pushed over trees, or trees with changes in canopy architecture) will be identified and browse biomass and quality will be estimated at different feeding heights. In addition, a defoliation experiment will be carried out, comprising different defoliation intensities and aimed at finding out the effect of season and the browser return period on the availability and quality of the browse. The results will help to understand how the browse intensity and timing of the browsing events influences the browse biomass and quality

Basing on elephant feeding strategies (push over trees, breaking branches and main stem), trees were divided into four groups. Pushed over trees divided into two groups, the first group is with exposed roots and second group is the trees broken at the base without exposing their roots. The third group is the snapped main stem and the fourth is the intact trees. Measurements were taken using BECVOL model plus leaf age (% young and old leaves and % yellow and green leaves). Measurements were taken in June and will be repeated in September 2007. The fieldworks were conducted at Letaba ranger section, Phalaborwa ranger section and Mopani ranger section.

BIODIVERSITY AND RESILIENCE OF RIPARIAN VEGETATION UNDER DIFFERENT MANAGEMENT REGIMES

*Kotschy K*¹ & Rogers KH¹

¹Centre for Water in the Environment, University of the Witwatersrand

karen@gecko.biol.wits.ac.za

The aim of the study is to test and further develop recently developed methods for measuring resilience in vegetation. Sample sites were stratified according to zones. Three sites will be sampled within each zone for each of the main-stem Sabie and Sand Rivers, with sites chosen to cover the range of variability in geomorphology and channel platform. In addition, 3 small sub-catchments were identified within each zone, along each river. One first order stream will be sampled from each of these sub-catchments. The idea is for these streams to be far enough away from the main-stem river to reflect conditions in the surrounding catchment rather than influences from upstream.

The Kruger National Park was assumed to be the most 'natural' of the 3 management regimes. First order streams in the communal lands were chosen to reflect the impact of harvesting of wood/plant parts and livestock browsing/grazing. Streams where the riparian vegetation has been destroyed by planting of crops in the riparian zone were not selected. In the Sabi-Sand complex, first order streams impacted by the common management practice of upland vegetation clearing were selected. In all 3 zones, streams directly impacted by roads, bridges, camps, settlements or other human activities were not chosen.

RESOURCE PARTITIONING BETWEEN LOW DENSITY AND HIGH DENSITY GRAZERS: SABLE ANTELOPE, ZEBRA AND BUFFALO

Macandza VA¹, Owen-Smith N¹ & Erasmus B¹

¹ School of Animal, Plant & Environmental Sciences, University of the Witwatersrand

valeriom@gecko.biol.wits.ac.za

The aims of the project were, to assess space use and movement patterns of sable antelope, zebra and buffalo in order to determine differences in diet composition between these species and to determine the quality of the diet obtained by these species at different stages of the dry season.

It was found that the sable used smaller home range than buffalo and zebra. This indicates precision in landscape use. Zebra traveled longer distances per day than sable and buffalo. About 40% of sable annual core area (50% kernel) was overlapped with buffalo, suggesting potential for exploitative and apparent competition. While sable and buffalo show clear patterns of increasing daily distance traveled per day with the reducing availability of food of adequate quality towards the end of the dry season, zebra did not reveal any pattern. This suggests that unlike sable and buffalo, zebra movements are less influenced by the seasonal variability in food availability. Sable move shorter distance per day than buffalo and zebra.

Panicum maximum and *Heteropogon contortus* contributed more to sable diet than to buffalo and zebra diet. The most abundant grass species, i.e. *Urochloa mosambicensis* and *Setaria incrassata*, contributed more to buffalo and zebra than to sable diet. *Themeda triandra* and *Digitaria eriantha* were important dietary components for the three herbivores

The nitrogen content on sable antelope's faecal samples was significantly lower than on buffalo's but higher than on zebra's faecal samples. The percentage of phosphorous on sable faecal samples was higher than on zebra but was not significantly different from the phosphorous content on buffalo faecal samples. For the three herbivore species there was no significant change in the faecal nitrogen and phosphorous content between the early dry season and the late dry season of 2006.

THE ANATOMY OF THE BRAIN OF THE AFRICAN ELEPHANT

*Manger PR*¹

¹ School of Anatomical Sciences, University of the Witwatersrand.

mangerpr@anatomy.wits.ac.za

There has been no progress on this project thus far.

THE ROLE OF ENVIRONMENTAL EDUCATION (EE) IN PROMOTING SUSTAINABLE MANAGEMENT OF NATURAL RESOURCES

*Manyaka M*¹ & Fraser WJ¹

¹ Faculty of Education, University of Pretoria

mmapeu.manyaka@postoffice.co.za

The main goal of the study was to determine what role environmental education (EE) and awareness played in facilitating the partnership between communities and the SANParks in the past and to determine what role it should play in promoting sustainable management of resources in terms of the agreement between the KNP and the Makuleke community. The Makuleke community is made up of 3 villages. There is a need to consult all structures of the community in all developmental initiatives. The Makuleke community is under traditional leadership which is recognised, acknowledged, supported and respected by community members.

Tourism is considered the main benefit for communities surrounding protected areas. It is also believed that tourism is likely to be supported by external donors as compared to EE initiatives. Respondents also believed that EE can be used as a vehicle to educate communities on environmental policies and regulations pertaining to natural resources' harvesting in protected areas. Capacity for implementing EE initiatives or any developmental programme is lacking. It should however, be appreciated that on the tourism side, a lot has been done but the capacity to allow communities to access the region is still a challenge. This would involve proper research and creation of an inventory on communities' expectations versus availability of such resources and their yield levels.

Divergent views emerged as to whether the current legislation is an enabler for community participation. Key to this is that natural resources accessibility is locally based. National laws can only guide but cannot sufficiently address the local needs and expectations. It seems that it is up to local structures to develop their own policies. Interviews with community members revealed that there were no EE programmes in place.

ISOLATION OF POTENTIAL PROBIOTIC BACTERIA FROM THE INTESTINAL TRACT OF HYENAS

*Mare L*¹, Meissner HH¹, Makete G¹ & Bruwer M¹

¹ Irene Animal Production Institute, Agricultural Research Council

marel@arc.agric.za

The objective of the project is to isolate potential probiotic bacteria from various sources including the intestinal tract of hyenas. The lactic acid bacteria and bifidobacteria population present in the gastro-intestinal tract (GIT) of wildlife species including hyenas have not been investigated as far as we are aware. Since hyenas tend to eat even decomposing carcasses without developing illnesses such as diarrhoea, the hypothesis can be made that there should be some unique gastro-intestinal bacteria present to sustain the balance of the GIT bacteria population. The collection of samples from hyenas will be ongoing, depending on the frequency of sample availability. The phases of the project will include collection of intestinal samples, isolation and identification of potential probiotic bacteria and screening of these bacteria for probiotic properties. The animal production sector, agricultural research institutes as well as universities will benefit if this project can be completed successfully. The Kruger National Park and the wildlife industry as a whole may also benefit from this project since probiotic bacteria can also be introduced in wildlife breeding programs.

Two batches of samples were received from the KNP. The first batch received included samples that were already stored for approximately 3 months at -20°C. Previous research done on porcine intestinal samples showed that porcine samples could be stored for such a period and potential viable probiotic bacteria could still be isolated. However, with the hyena samples no viable bacteria could be isolated, we concluded that we needed samples that were not stored for such long periods. We then arranged for another batch of samples which we received during May this year. We were able to isolate some potential probiotic bacteria from these samples and we are currently in the process of screening these bacteria to determine their probiotic properties. We do now know that “fresh” samples are the best to use, if they can be obtained. Thus far there are at least five isolates that showed some potential, further screening is needed.

CORRELATION BETWEEN TETRACYCLINE RESISTANCE IN *ESCHERICHIA COLI*/ISOLATED FROM IMPALA AND *ESCHERICHIA COLI*/ISOLATED FROM THEIR WATER SOURCE

*Mariano V*¹, McCrindle CME¹ & Picard JA²

¹ Department of Paraclinical Sciences, University of Pretoria

² Department of Veterinary Tropical Disease, University of Pretoria

valeria_m3@yahoo.it

Although the acquisition of antimicrobial resistance (AMR) in common commensal and pathogenic bacteria is currently recognized as a worldwide problem in both human and veterinary medicine, there is little information available on the role that the environment and in particular drinking water plays in its spread. Thus a case control study was performed in the Kruger National Park, to find out whether the faeces of impala (*Aepycerus melampus*) were more likely to contain tetracycline resistant *Escherichia coli* (TREC) when they drank from rivers that contained these bacteria compared to rivers that were uncontaminated with TREC.

Five mainly perennial rivers were selected in the KNP and a total of 11 points in these rivers were sampled in March, April and June and cultured for *E. coli*. The rivers were then grouped as containing TREC or not. Between 5 to 10 fresh impala faeces was collected within 5 kilometres range of each water collection site for a total of 209 faecal specimens. Based upon the MIC method, 12% of the 33 water specimens were contaminated by TREC (MIC \geq 8mg/L). Among the 209 impala faeces sampled, 191 were positive for the presence of *E. coli* (91.38%). Within them, 35.6% had resistant *E. coli* (based upon the LRP method). The OR was found to be 5.25 times greater in the faeces of impala drinking from TREC contaminated rivers than unexposed impala.

A PROPOSAL TO STUDY STABILITY, RECOVERY AND RESILIENCE IN PIOSPHERE SYSTEMS IN THE KRUGER NATIONAL PARK

*Matchett KJ*¹, Kirkman K¹, Morris C^{1,2} & Peel MJS³

¹ School of Biological and Conservation Sciences, Discipline of Grassland Science, University of KwaZulu-Natal

² Range and Forage Institute, Agricultural Research Council

³ Ecology Department, Agricultural Research Council

202517799@ukzn.ac.za

The aim of this study was to resurvey piosphere systems in the Kruger National Park, previously described by Thrash in 1990. The objectives of the project were to document spatio-temporal change in soil infiltration rate, compaction, soil fertility, herbaceous community composition and structure, herbaceous basal cover and woody plant community composition and structure. Approximately 35 % of the piosphere systems surveyed by Thrash are now associated with closed waterholes. The study addresses recovery and resilience in closed piosphere systems and stability in open systems (1990 – 2006). We are considering changes in soil and vegetation parameters at open and closed waterholes in relation to rainfall and soil gradients. To date, the basal cover, soil infiltration and compaction and herbaceous vegetation composition data have been analyzed.

A significant difference ($p \leq 0.05$) in species composition between 1990 and 2006 occurred at 7 out of 9 waterholes. Reanalysis of Thrash (1990) dataset using identical method (DCA axis 1 scores regresses against distance from water) and analysis of 2006 data – logistic regression model not suitable to describe response pattern neither in 1990 nor 2006. Very variable responses – no consistently applicable model. Slight increase in grazing-sensitive, climax species at closed sites, esp. between 500 m and 5 km. A noteworthy increase in *Urochloa mosambicensis* across majority of sites and piosphere zones was observed as well as an increase in *Panicum coloratum* in intermediate zones of piospheres in central (Satara) region. Large increase in *Dactyloctenium aegyptum*, especially near zonal boundary between sacrifice and intermediate zones, at most sites were observed.

POLLINATION ECOLOGY OF SOFT-WINGED FLOWER BEETLES (INSECTA: COLEOPTERA: MELYRIDAE) IN KRUGER NATIONAL PARK

*Mawdsley JR*¹

¹ The H. John Heinz III Center for Science, Economics and the Environment, Washington DC

mawdsley@heinzctr.org

This project will provide basic ecological data on flower visitation and pollination by soft-winged flower beetles (Insecta: Coleoptera: Melyridae) in Kruger National Park. Numerous beetle species ($\geq 200,000$ worldwide) are found on flowers but their contributions to the pollination of these flowers are poorly understood. Soft-winged flower beetles have been identified as one group of beetles which are likely to be significant pollinators. Although South Africa is home to some of the world's largest and most colorful melyrid beetles, there have been few studies to date of the pollination ecology of these beetles. This project will investigate pollen transport by species of the genus *Melyris* in the KNP.

Initial fieldwork was conducted in the vicinity of Skukuza within Kruger National Park on September 8-12, 2006. This phase of the study focused on early-spring flowering trees in the Park, and in particular on the common tree species *Acacia nigrescens*, *Cassia abbreviata*, *Combretum hereroense*, *Combretum zeyheri*, and *Euclea divonorum*. Floral visitors were observed and standard beating techniques were used to collect non-flying insects from inflorescences. Voucher specimens of all insect species were collected and identified to insect order and family. These vouchers will be deposited in the Skukuza herbarium insect collection. Beetles comprised the most diverse group of insects on flowers of these tree species, although ants were the most numerous in terms of numbers.

All beetle specimens bore at least some pollen grains, although most pollen loads were light, confined to legs. Some of the more pubescent beetle species (some Coccinellidae, Melyridae) had heavier pollen loads. Further field investigations are planned for 2007 and 2008 to better characterize the relationship between these beetles and the flowers they visit, and to determine their relative importance as pollinators, in comparison to other floral visitors.

ECOLOGY OF TIGER BEETLES (INSECTA: COLEOPTERA: CICINDELIDAE), WITH FOCUS ON RIPARIAN SPECIES

*Mawdsley JR*¹

¹ The H. John Heinz III Center for Science, Economics and the Environment, Washington DC

mawdsley@heinzctr.org

This project will provide basic ecological data on tiger beetles found in riparian areas of the Kruger National Park. Many species of tiger beetles are in decline worldwide (including several taxa in South Africa) and better ecological data is needed to better manage populations of these insects. In September 2006, the dry season ecology of tiger beetles was studied at fifteen discrete sites along the Letaba, Olifants, and Sabie Rivers. Thirteen sites yielded adult beetles, with six species represented. Based on field observations, the microhabitat associations of adults of these six species were described and ovipositional/larval substrates of five of the six species.

The microhabitat associations and ovipositional and/or larval substrates of the following species were recorded; *Chaetodera regalis* (Dejean), *Cylindera disjuncta* (Dejean), *Habrodera nilotica* (Dejean), *Lophyra neglecta intermediola* (Horn), *Lophyridia fimbriata imperatrix* (Srnka), and *Myriochile melancholica* (Fabricius).

In 2007 and 2008, additional field investigations are planned to refine the microhabitat models that have been developed in this study. The analysis will also be expanded to include other tiger beetle species that may be encountered at the study sites during the course of field work. The initial fifteen study sites will be re-visited during the rainy season to determine whether microhabitat associations hold true for these six beetle species across different seasons. Abundances of the individual species across seasons will also be compared. Additional sites will be investigated along these rivers, to determine whether these microhabitat models hold true for these same species across a larger number of sites within the park.

IMPLEMENTING STRATEGIC BIODIVERSITY MONITORING FOR CONSERVATION OF THE KRUGER NATIONAL PARK RIVERS

*McLoughlin CA*¹, Rogers KH¹, Biggs HC², Foxcroft LC² & Eckhardt HC²

¹Centre for Water in the Environment, University of the Witwatersrand

² Scientific Services, South African National Park

craigm@sanparks.org

The main objective of this project was to look into and instigate proposed adaptive management processes for the rivers of the Kruger National Park. To a large degree this was to revamp the river TPCs for future use within the Strategic Adaptive Management process. A major outcome was the River TPC workshop held in February of 2007 which helped pave the way for future use of river TPCs and broader issues surrounding the adaptive management of rivers. An integrated strategy for river monitoring was documented (see attached file), including river flows and water quality, biodiversity related TPCs and incorporating the River Health monitoring efforts. Linking with the terrestrial biodiversity monitoring programme has been discussed and will be incorporated as far as possible. Current issues regarding strategic adaptive management for rivers and associated integrated catchment processes are important and have been considered. Additionally, capacity within SANParks has been highlighted and processes are being put in place to address this issue. All this has culminated in a new strategy for longer-term research and management involving the Kruger rivers, but also for other relevant parks under management of SANParks.

EVALUATION OF RAPID FIELD SEROLOGIC TEST FOR TB DETECTION IN RHINOCEROS AND EVALUATION OF HEMATOLOGIC AND BIOCHEMICAL PARAMETERS IN TRANSLOCATED AND BOMA-CONFINED RHINOCEROS

*Miller M*¹, Buss P², Lyaschenko K³ & Hofmeyr MS²

¹ Disney's Animal Programs

² Veterinary Wildlife Services, South African National Parks

³ Chembio Diagnostic Systems Inc.

Michele.Miller@disney.com

The project aims to perform antemortem diagnostic testing to assess the health status of translocation candidates and develop a baseline for field captured rhinoceros and evaluate parameters that may be indicators for individuals that develop health problems during boma confinement or transport. It was also to investigate antemortem diagnostic testing for tuberculosis to determine the significance of this disease in the KNP and other SA rhinoceros population(s) using a “field test” and discuss plans to validate and improve this test in white rhinoceros if positive results are found.

A total of 116 white rhinoceros samples were collected in 2007 and were available for analyses. Heparinized plasma was used for the rapid test and biochemical analyses. Some paired samples were collected when rhinos were initially captured in the field and then again when immobilized to be loaded from the boma. The mycobacterial diagnostics were based on a commercially available rapid test (ElephantTB STAT-PAK, Chembio Diagnostic Systems, Inc., www.chembio.com) developed for detection of antibodies to *M. tuberculosis* and *M. bovis* in elephants. The reported sensitivity and specificity of this test in elephants is 100% and 96.9%, respectively. Mycobacterial serologic tests (ElephantTB STAT-PAK) were performed on 116 individual samples. Preliminary results show promise for TB diagnosis in this species and further validation tests are being planned.

THE IMPACTS OF INVASIVE ALIEN PLANT CLEARING ON RIPARIAN VEGETATION RECOVERY ALONG THE SABIE RIVER IN THE KRUGER NATIONAL PARK

*Morris TL*¹, Witkowski ETF¹ & Coetzee J¹

¹ Department of Animal, Plant and Environmental Sciences, University of the Witwatersrand

morris@gecko.wits.ac.za

Recovery of indigenous species subsequent to the clearing of invasive alien plants (IAP) is usually essential for ecosystem recovery to occur. However, cleared sites are often just left in the hope that re-vegetation will occur naturally. In riparian areas of Kruger National Park (KNP), the *Working for Water (WfW)* Programme clears IAP on a regular basis, but little post-clearance monitoring takes place. Thus investigating short term effects of IAP and their clearing on plant community structure as well as the patterns of recovery subsequent to IAP clearing provided an ideal opportunity to assess feasible targets of natural ecosystem recovery in similar areas. Vegetation was sampled at twelve sites along the Sabie River in and adjacent to the KNP, before (March 2006) and after (March 2007) clearing of IAP by *WfW*. There was an average reduction in IAP density of 80% (S.E \pm 6%) (P=0.02) after clearing. Rarefield species richness, alpha diversity and evenness of distribution of species all declined with increasing relative density of IAP (P<0.05). Indigenous vegetation densities increased after the clearing of IAP, with herbaceous growth forms increasing the most in transects that were previously heavily invaded. In this system, that is relatively undisturbed by human activities, recovery of indigenous vegetation after the removal of IAP should occur naturally. This process is more than likely aided by the continuous management of IAP by *Working for Water* as the repetitive clearing depletes alien seed banks and maintains IAP at acceptable and manageable levels.

A PHYTOSOCIOLOGICAL STUDY IN THE KRUGER NATIONAL PARK, SOUTH OF THE SABIE RIVER

Mostert RE^{1,2} & Bredenkamp GJ²

¹ Data Department, South African National Biodiversity Institute

² African Vegetation and Plant Diversity Research Centre, Department of Botany, University of Pretoria

liesl.mostert@gauteng.gov.za

The aim of this phytosociological study was to combine and classify two savanna vegetation datasets that were collected thirty years apart. During the 1970's former Kruger National Park (KNP) scientist, the late Piet Van Wyk collected vegetation data in the southern district of the KNP. Although the floristic data gathered by Van Wyk were captured and stored electronically, the recorded environmental data and locality points were lost together with the original field forms. During 2002 and 2003 the study area was re-sampled in an attempt to link environmental data to the existing dataset. These new relevés included a record of the total floristic as well as environmental data for each sample plot. If a classification of the combined datasets revealed grouping of spatially similar sample plots, then meaningful plant community descriptions could follow, since it would indicate plant community resemblances between the two datasets, despite their temporal separation.

The numerical classification of the total dataset consisting of 516 relevés produced 15 uniquely different plant communities. This vegetation classification will add to understanding ecosystems in the southern district of the KNP on a finer scale than landscape level. Information arising from this study will aid in understanding and maintaining biodiversity as stipulated in the terrestrial ecosystem management objective of the KNP.

THE IMPLEMENTATION OF A VELD CONDITION ASSESSMENT METHOD FOR MARAKELE NATIONAL PARK: PRELIMINARY HERBACEOUS COMPONENT SURVEY

*Mugwabana FH*¹

¹ Conservation Services, South African National Parks

Hendrickm@sanparks.org

The study is a response to the need of a veld monitoring programme for a newly developed Park such as Marakele National Park. The annual veld condition assessment is a tool that can assist Marakele National Park management to assess its nature conservation objectives. All of the foregoing being in direct compliance with the desired state and management objectives for Marakele National Park. Marakele National Park has inherited different properties that were under different land uses and therefore veld monitoring can show some improvement on some of the badly degraded properties. Being a small park (67 000 ha) it demands some high intensive management such as introduction and removal of game, carrying capacity, stocking rates, artificial water supply and many more.

One of the major challenges of the Park is its partnership arrangements with the private sector, marrying of economic and ecological systems which bring complexity, uncertainty and disagreement about the outcomes of the park.

The veld condition assessment will be able to show this negative impact especially if it can be extended to cover the whole park including the contractual land. For example, the expected dropping of the fence between Marakele National Park and Welgevonden Private Reserve. The projection shows that mega herbivore (more especially elephants) will migrate down to the low lying areas which are composed of sweetveld as compared to the mountaneous Sourveld of Welgevonden. I project that this arrangement will have an impact on vegetation in the long term, therefore veld condition assessment is critical to monitor this arrangement. This assessment assumes that it will be extended to cover the whole park and form part of vegetation monitoring of the greater Marakele National Park. Greater Marakele National Park will compose of Marakele National Park , Marakele Pty (Ltd) (private) and Welgevonden Nature Reserve (private).

INTEGRATED MANAGEMENT OF ICONIC NATIONAL PARKS: A COMPARATIVE STUDY

*Munro JK*¹, Moore S¹, Freitag-Ronaldson S² & Palmer D¹

¹ School of Environmental Science, Murdoch University

² Scientific Services, South African National Park

J.Munro@murdoch.edu.au

This research is designed to develop thresholds of acceptable change associated with the effects of tourism on local communities. The research will focus on two iconic national parks, Kruger National Park (KNP) in South Africa and Purnululu National Park (PNP) in the eastern Kimberley region of WA. Both case studies provide good opportunities to explore issues of social equity, tourism sustainability and adaptive management practices.

As the project is in the very early stages, progress to date has centered on developing a literature for the subject area, to guide the data collection process and to provide background. A conference presentation (to be presented at the Society for Conservation Biology Annual Meeting in Port Elizabeth, 1-5 July 2007) and journal article are currently being finalised regarding the conceptual basis on the research and will be reported on in the next progress report.

VEGETATION RESOURCES QUANTIFICATION: INPUT TO THE RARE ANTELOPE RESEARCH

*Mutanga O*¹

¹ School of Applied Environmental Sciences, University of KwaZulu-Natal

mutangao@ukzn.ac.za

This project focused on the quantification of herbaceous biomass (especially under trees) using an integrated approach involving remote sensing and spatial statistics. This formed part of the rare antelope research project by Prof. Owen Smith, However the integration of results from this and the rare antelope study have not yet been done.

We investigated the possibility of improving under storey biomass estimates using cokriging. Individual bands and ratios computed from MODIS image were correlated with field measurements of biomass covering the Kruger National Park. The band that yielded the highest correlation with biomass was then used for further analysis using cokriging.

The variogram models were developed and then used in cokriging to estimate biomass distribution over the whole study area. Results indicate that cokriging greatly improved biomass estimates ($r = 0.74$ between the predicted and measured test data set and a RMSE of $\pm 27\%$ of mean) as compared to multiple linear regression or ordinary kriging between biomass and the MODIS variables. Results of the study are well detailed in the previous report, therefore no need to detail them here.

What is critical in reporting is that the ongoing research has triggered new research questions which led to a new project focusing on scale issues as well as improving biomass estimates by minimizing the effect of tree canopy cover.

OPTIMIZING RESOURCE MANAGEMENT ACTIONS BY INCORPORATING THE SPATIO-TEMPORAL DISTRIBUTION OF ELEPHANTS

*Mwakiwa E*¹, Prins HHT¹, Hearne J², Bulte EH³ & Stigter H⁴

¹ Resource Ecology Group, Wageningen University

² School of Mathematical and Geospatial Sciences, Royal Melbourne Institute of Technology

³ Department of Economics, Tilburg University

⁴ Systems and Control Group, Wageningen University

emmanuel.mwakiwa@wur.nl

The aims of the project were, to determine which factors influence wildlife management by different types of landowners in South Africa; to get an insight on effects of different management actions available to landowners (e.g. investment in forage manipulation, fire mgt, provision of artificial water points) to wildlife population dynamics and welfare of the landowners; and to understand the effects of cooperation and non-cooperation amongst landowners undertaking wildlife management and suggest actions for optimization.

The researcher is in the process of developing an analytical model to assess the effects of investing in a technology which improves vegetation in a rangeland on landowner's welfare when the control variables are nonlinear. The growth function of herbivores is a simple logistic function in which growth is limited by the availability of vegetation.

CONTRASTING COLLABORATIVE ARRANGEMENTS IN NATURAL RESOURCES MANAGEMENT USING A BEHAVIORAL APPROACH TO RELATIONSHIPS THEORY: CASE STUDIES OF RIVER AND FIRE MANAGEMENT SYSTEMS IN KRUGER NATIONAL PARK, SOUTH AFRICA

*Nkhata A*¹, Breen C¹, Fincham R¹, Biggs HC², Freitag-Ronaldson S² & Rogers KH³

¹ Centre for Environment, Agriculture, and Development, University of KwaZulu-Natal

² Scientific Services, South African National Parks

³ Centre for Water in the Environment, University of the Witwatersrand

bankhata@yahoo.com

The preliminary findings thus far indicate that it is from the perspective of relational capital and relational connectedness that behavioral processes are vital in interpreting change in the long-term social relationships that underlie collaborative schemes. The findings suggest that the two variables provide the basis of change to the extent that they enable relationships to grow, mature, collapse, and reorganize based on mutual adaptations in behavior. It is envisaged that these findings will facilitate the development of a methodology for evaluating the effectiveness of relationship management in park management. This methodology will provide criteria, indicators, and standards for measuring the effectiveness of relationship management in Kruger National Park. It thus accords well with one of the core objectives of SANParks, that of constituency building. SANParks seeks to strengthen positive relationships between interested and affected parties. Importantly, it is hoped that this study will provide a foundation for integrating relationships management into the strategic adaptive management processes of Kruger National Park.

ENVIRONMENTAL IMPACTS OF ELEPHANTS ON RIVERINE VEGETATION

*Ntshane BC*¹

¹ Conservation Services, South African National Parks

Clairen@sanparks.org

The main purpose of this study was to investigate, whether elephants do damage riverine vegetation; whether damages differ per landscape; whether seasonality or permanency of the river makes any difference to the selection of targeted species; and how much elephants are impacting on the riverine vegetation and whether we should be concerned.

Based on the data collected from the two seasons (dry & wet) surveys, on Timbavati and Olifants rivers, it has been possible to determine the impacts that elephant population could have on riverine vegetation. The Perennial (Olifants) river's vegetation is significantly more impacted during the dry season as compared to the non-perennial (Timbavati) river. The non-perennial (Timbavati) river is significantly more impacted during wet season as well as over time. Landscape 7 of the Olifants River received significantly more impacts as compared to all landscapes surveyed on both rivers on both seasons. Landscape 22 of the Olifants River was the least impacted during the wet season and landscape 31 of the Olifants River the least impacted during dry season.

The utilization of the riverine vegetation by elephants is higher during the dry season than the wet season on both river types. Elephant utilize woody vegetation less during the wet season than the dry season because we expect elephant to eat more herbaceous material due to the abundance of grazing and drinking water in the area. Utilization is higher during the dry season since herbaceous material and water are scarce, and woody species provide the highest quality food at this time. The results of this study therefore suggest that water availability played a very important role in affecting elephant utilization of vegetation in KNP since animals have shown to prefer feeding in areas where there is availability of water, and since water plays a very important role in vegetation production that contribute to high elephant numbers in the park.

Elephants are impacting on riverine vegetation, but not at a rate that can rapidly change woodlands in to shrublands/ grasslands, although this is perceived to be happening in some areas of the park. There may be some concern for those species that were highly selected (*Terminalia Prunoides*, *Euclea divinorum*, *Diospyros mespiliformis*, *Croton megalobotrys*, *Combretum apiculatum*, *Lonchocarpus capassa* and *Combretum imberbe*). Although the impacts were not very high at this stage, increased utilization may have an effect on the woody species that are highly selected in the long term. Utilization is higher along perennial rivers and increasing elephant populations may have a large impact on the perennial river vegetation.

MYCORRHIZAL COLONISATION AND THE ASSOCIATED PHOSPHORUS STATUS IN SELECTED GRASS SPECIES ALONG A CATENA IN THE KRUGER NATIONAL PARK

*Scholes MC*¹ & Reid JL¹

¹ School of Animal, Plant and Environmental Sciences, University of the Witwatersrand,
mary@gecko.biol.wits.ac.za

The purpose of the project was to develop a better understanding of root mycorrhizal colonisation status of grass species and the soil phosphorus concentrations along a catena. Five landscape positions along the catena were sampled.

This study has led to a greater understanding of the vesicular-arbuscular mycorrhizal (VAM) fungal symbiosis associated with grass species in a semi-arid savanna in the Kruger National Park. VAM colonisation is influenced by a number of edaphic, climatic and biological variables including phosphorus availability, soil pH and host plant characteristics. The interactions between these variables results in different patterns and different ecological consequences which are difficult to understand without a long-term understanding of fluctuations within the system.

Savannas are shaped by climate, soil nutrition, fire and herbivory and this study focussed on soil nutrition. The influence of fire, which is a primary driver of savanna ecosystems' structure and function, was ignored in this study, but it is thought that the fire regime would have significant consequences on the effect of VAM in savanna grasses, since fires in savannas alter both the pH of the soil and nutrient concentrations such as nitrogen and available phosphorus. Herbivory is also likely to affect the levels of VAM colonisation since fungal diversity is closely tied to above-ground diversity and carbon allocation to below-ground diversity. With fires and herbivory shaping savannas, the carbon allocation is likely to change with different management strategies, and elevated CO₂ levels are likely to advantage mycorrhizal plants over non-mycorrhizal plants. While this study focussed on grasses, a savanna consists of both grasses and trees.

DEVELOPING A METHOD FOR MONITORING THE INFLUENCE OF ELEPHANTS ON WOODY VEGETATION

*Slotow R*¹, Page B¹, Druce D¹, Shannon G¹, Grant CC² & Eckhardt HC²

¹ School of Biological and Conservation Sciences, University of KwaZulu-Natal

² Scientific Services, South African National Parks

slotow@ukzn.ac.za

Although this project does indicate an impact of elephants on large trees in southern KNP, this should not be interpreted as an unsustainable impact from this agent alone. Firstly, the percentage of trees killed over the previous six month period was relatively low (2%). Secondly, not all of this mortality came from elephants, i.e. a lot of it was caused by subsequent damage by fire. Further, we are not certain what the desirable state for large trees (or desirable limits) are, and the recent historical state may have been an anomalous situation at one of the extremes.

In order to understand the relative role of elephants and other agents, and in order to manage the large tree structure sustainable, a more rigorous decision-making framework has to be generated. The TPC approach offers one such framework, and as part of this project we are working with SANParks staff to use these data to generate such a decision-making framework.

SPATIAL DEMOGRAPHY AND DIET OF ELEPHANTS: IMPLICATIONS FOR MANAGEMENT

Slotow R¹, Page B¹, Delsink A¹, Millspaugh J², Prins HHT³, de Boer FW³, Whyte IJ⁴ & Grant CC⁴

¹ School of Biological and Conservation Sciences, University of KwaZulu-Natal

² Department of Fisheries and Wildlife, University of Missouri

³ Environmental Sciences, Wageningen University

⁴ Scientific Services, South African National Parks

slotow@ukzn.ac.za

As elephants are a major component of the Kruger National Park (KNP) ecosystem, the aim of this project is to understand herd's spatial demography and the feeding behaviour of male and female elephants in various age classes, to provide a spatially explicit predictive model of elephant impact across the study site.

To date, 16 collars have been deployed in the Satara, Skukuza and Lower Sabie triangle. Two collars were fitted in December 2005, 10 were fitted in March/April 2006 and the remaining four were fitted in May 2007. Field observations have been underway since mid-March 2006 (14 months). To date, insufficient data has been collected on the population demography of the collared herds to accurately determine population age-structure, inter-calving intervals, and age of sexual maturity and the resultant population growth rates. This is attributed in part to unsuitable driving conditions on management roads and the inaccessibility of the herds that frequent the neighbouring private reserves.

An important preliminary result is that the ranges of the females extend across the proposed elephant management plan intervention boundaries and furthermore, that herds do not appear to be limited within their clan's fidelity. There appears to be a high degree of association or overlap between neighbouring clans. One hundred seventeen feeding bouts have been recorded. Average feeding time was 2:29 mins. The main causes for animals moving from a targeted species were moving to another patch/tree and disturbance from vehicles. Most selected species included Forbes (*Convolvulis*), *Grewia* sp and grass. Sightings of elephant were most frequent on Ecozone D (46%) i.e. Sabie/Crocodile thorn thickets, followed by Ecozone F (22%) i.e. Knobthorn/Marula savannah.

MONITORING OF GROWTH, RECRUITMENT AND ELEPHANT DAMAGE OF MARULA TREES INSIDE AND OUTSIDE THE NKUHLU AND MAKHOHLOLA ENCLOSURES IN THE KRUGER NATIONAL PARK

*Stam EM*¹, Mabuduga FD¹ & Eckhardt HC³

¹ Department of Ecology and Resource Management, University of Venda

² Scientific Services, South African National Parks

stame@cput.ac.za

In December 2005 ± 90 marula trees were selected; 60 at the Nkuhlu enclosure (10 for each treatment) and 30 at the buffalo enclosure (15 inside and 15 outside). These trees were marked, and their circumference was measured at the base and at breast height.

They were also photographed from two fixed points. Furthermore, any damage was classified and photographed. All these actions are meant to be repeated every year in December for a still to be determined period (at least five years). Furthermore, at the buffalo enclosure we established 4 transects (2 inside and 2 outside) where the numbers of seedlings and saplings were counted. This was also to be repeated yearly.

In June 2006, 9 trees in the Nkuhlu enclosure and 10 in the buffalo enclosure were fitted with dendrobands. In December 2006 they were revisited on which occasion most of the readings were found to be unreliable as the bands had been slipping. They were reset and revisited again in August 2007. On this occasion a tenth dendroband was placed in the Nkuhlu enclosure. All bands except one do not appear to have slipped on this second visit.

During the December 2006 revisit to all the marked trees were measured and photographed again from their fixed points. Finding back the point markers proved to be unproblematic in most cases. The markers were iron rods that could potentially injure animals. They were replaced with rods with a bend tip. One tree had died over the year between December 2005 and December 2006. One juvenile tree was never found back. After the December 2005 visit there was some dissatisfaction over the fact that the shrub size trees (between 1 and 4 m) were underrepresented in the sample, because they were very rare in the two sampling sites. This omission has been corrected during the December 2006 visit by including 10 trees within that size range along the Orpen gravel road.

MODELLING CONSEQUENCES OF ELEPHANT DAMAGE FOR THE VEGETATION IN THE KRUGER NATIONAL PARK

*Stam EM*¹, Mabuduga FD¹, Owen-Smith N², Grant CC³, Eckhardt HC³, Getz WM⁴ & Hanan NP⁵

¹ Department of Ecology and Resource Management, University of Venda

² Department of Animal, Plant and Environmental Sciences, University of the Witwatersrand

³ Scientific Services, South African National Parks

⁴ Department of Environmental Science, Policy & Management, University of California at Berkeley

⁵ Natural Resource Ecology Laboratory, Colorado State University

stame@cput.ac.za

The previous report ended with the decision that the project was going to entail parameterization of the Baxter/Getz model for marula trees and implementation of it on a GIS platform. From 24 April Mr. Mabuduga spent three weeks at Wits to do a modeling course offered by Prof. Norman Owen-Smith on which occasion he also had an opportunity to flesh out the new approach together with Prof. Owen-Smith. After return from this course Mr. Mabuduga started on attempts to link the Baxter/Getz model, programmed in Matlab, to the GIS environment. Furthermore, he made a start with assembling the relevant datasets. At about the same time he started on his literature review chapter which was to be about the effects of megaherbivores on the landscape.

THE ROLE OF SOIL SEED BANKS IN THE REGENERATION OF ACACIA SPECIES IN THE KRUGER NATIONAL PARK, SOUTH AFRICA

Stelli SA¹, Kinahan AA¹ & Witkowski ETF¹

¹ School of Animal Plant and Environmental Sciences, University of the Witwatersrand

stelli@biology.biol.wits.ac.za

This study has been running for just over two years. All fieldwork has been completed and lab work is in the process of completion. The study aimed to identify key factors influencing *Acacia* seed bank dynamics and consequently the regeneration of *Acacia* species in a savanna ecosystem.

The study into whether *Acacia* seeds are ingested by herbivores or predated on by rodents was done at chosen grids within the vicinity of trees sampled for natural soil seed banks. Rodent activity was noticeably decreased in grids where the rate of herbivore activity, indicated by the presence of large amounts of dung, was greater. In cafeteria experiments rodents selected all seeds as a food type and did not seem to select a preferred species. All seeds predated on by rodents were rendered unviable as it appeared that over $\pm 70\%$ of the contents of the seed coat were consumed.

Studies of herbivore dung showed that herbivores appeared to select seeds of indehiscent species: 82% of seeds sampled from dung were *A.tortilis*, 16% were *A.nilotica* and only 1% were *A.grandicornuta*. No *A.senegal* seeds were found in dung. Similar studies have shown that seeds consumed by herbivores are not damaged; in fact seeds are scarified by the acidic content of the herbivore gut, which facilitates germination once the seed has found favourable conditions. This suggests that the presence of herbivores may be beneficial to the survival of seeds as their presence deterred rodent predators and their activity and movement beneath parent trees appears to aid incorporation of seeds into the soil.

BIOLOGICAL CONTROL OF *PARTHENIUM HYSTEROPHORUS*, PRE-RELEASE STUDIES

*Strathie L*¹, McConnachie A¹ & Ntushelo K¹

¹ Plant Protection Research Institute, Agricultural Research Council

strathiel@arc.agric.za

Results indicate the huge potential that parthenium has to increase the density of current infestations as well as to spread. All three sites have dense infestations of *P. hysterophorus*, with the Skukuza old dump site the most densely invaded and with the greatest soil seed bank of the three sites. The large variability in plant and soil seed bank density between years can be expected as parthenium is an annual plant, therefore seasonal and annual climatic variability have a strong influence on population dynamics. In this regard, for management purposes, it is advisable to take advantage of the drier years to further reduce the population by implementing chemical control measures. Additionally, caution should be taken in wetter years when populations can increase and spread dramatically and rapidly, and control actions should be taken.

GLOBAL CLIMATE CHANGE AND PRIMARY PRODUCTIVITY: THE EFFECT OF INTER-RAINFALL INTERVAL ON GRASS GROWTH

*Swemmer AM*¹

¹ Graduate Degree Program in Ecology, Colorado State University

tony@saeon.ac.za

The objectives of this study were to determine whether the temporal distribution of rainfall within the growing season affects productivity, independently of rainfall amount, for South African grasslands, whether the magnitude of variation in the above-ground growth responses of dominant grass species to rainfall, for a range C₄ grass communities, or whether regular grazing alters such variation, and whether easily-measured, above-ground plant traits can predict the above-ground growth response of individual species to water availability and grazing. The above-ground production of grasses in KNP is likely to be determined as much by the timing of rainfall (specifically the size of rainfall events and the length of the intervals between them) as by the total amount of rainfall in a year. This should be considered when making prediction of future levels of forage production, particularly as global climate change is predicted to alter rainfall timing.

Common, co-occurring grass species respond differently to patterns of water availability during the growing season. Changes in the timing of rainfall within the growing season are therefore likely to drive changes in the species composition of the various grass communities in KNP. In addition, changes in species composition caused by other factors, such as grazing pressure or fire frequency is likely to alter the relationship between grass production and rainfall. Frequent non-selective grazing alters the response of grass communities to rainfall, by reducing differences in the responses of individual species, and reducing maximum rates of growth. Differences in species composition between heavily-grazed areas are therefore likely to be of less consequence than differences between lightly-grazed areas. Furthermore, the relationship between annual rainfall and productivity is likely to be weaker in heavily-grazed areas. Predictions of the forage production of heavily grazed areas, as well as management strategies for such areas, should take this into account.

LION (*PANTHERA LEO*) PREDATION PATTERNS IN THE CENTRAL REGION OF THE KRUGER NATIONAL PARK: METHODS AND CONSEQUENCES

*Tambling CJ*¹, Getz WM^{1,2}, du Toit JT^{1,3}, Cameron EZ¹ & Buss P⁴

¹ Mammal Research Institute, University of Pretoria

² Department of Environmental Sciences, Policy and Management, University of California, Berkeley

³ Department of Forest, Range and Wildlife Sciences, Utah State University

⁴ Veterinary Wildlife Services, Kruger National Park

cjtambling@zoology.up.ac.za

The project aims to investigate the interactions between lions and their main prey items in the central region of the Kruger National Park. In order to collect the required data a new technique to locate and identify lion kills was developed and tested. Finally the interaction between lion and buffalo was highlighted and the possible interactions with Bovine tuberculosis will be investigated. The new method of locating lion kills, the aggregation point follow up method (APFM) has proved to be successful in locating larger prey items, with potential bias against smaller prey items. The method allowed the investigation into the predation patterns of more than one pride of lions simultaneously. Numerically, zebra are the dominant prey item around the Satara camp. Buffalo make up approximately 15 – 20% of the diet, considerably less than in the south of the park, although the lions in the central region kill more medium sized ungulates and giraffe. Selection of different prey items needs to be related to the availability of the prey items and can be based on the numerical abundance of individuals or the numerical abundance of groups. Based on the total availability of individual prey items, giraffe is the most preferred prey species. However, if the number of groups is used as the criterion for availability buffalo are the most important prey item due to the low number of very large groups.

Lions are selecting male and older buffalo in comparison to what is regionally available within the two main herds in the area. There has been a slight shift in selection, from a predominantly male biased kill sample during the previous buffalo research (2000 – 2006) to a proportionally older kill sample with fewer males during the current lion based research (2005 – 2007). This can either be ascribed to an actual shift in prey preference or to the different methods of collecting the data and need to be investigated further. An ad hoc observation was that the proportion of female buffalo, especially older females, being killed increased sharply when the summer rains were late and erratic. Additionally lions are killing buffalo significantly closer to the major rivers. Using GPS collars and all the available spatial data, the range that lions are utilizing is considerably larger (up to 400km² for a coalition of males and almost 400km² for a group of females for the duration of the project) than previously reported when using VHF collar data.

LEGITIMACY AND THE USE OF NATURAL RESOURCES IN KRUGER NATIONAL PARK, SOUTH AFRICA

*Tanner RJ*¹ & Freimund W¹

¹ Department of Society and Conservation, University of Montana

² Centre for Environment, Agriculture and Development, University of KwaZulu Natal

randy.tanner@umontana.edu

As relationships between protected areas and local residents have changed, so too have the demands placed on protected areas. In many contexts, demands for direct benefits – such as access to natural resources – have been expressed by those living near protected areas. Resource use among local residents for subsistence purposes is an increasingly important issue for Kruger National Park as reflected in the Protected Areas Act which provides for it and the recent Statement of Intent for a Resource Use Policy, as outlined in the 2006 Park Management Plan. The purpose of this study is to better understand how the legitimacy of resource use is conceptualized across different social groups. In particular, more than 100 interviews were conducted with Park staff, local residents, and Park visitors, as well as 800 surveys distributed to Park visitors, in an effort to arrive at this understanding. The research was conducted throughout 2006 and early 2007, and the dissertation for this study is scheduled to be completed in late 2007.

THE LIFE HISTORY, ENTOMOPHAGY AND CONSERVATION OF THE EMPEROR MOTHS, *GYNANISA MAIA* AND *IMBRASIA BELINA* IN THE KRUGER NATIONAL PARK AND NEIGHBOURING ENVIRONS

Taylor LR¹, Walker DR¹, Buchanan R & Snyman J¹

¹ Department of Life Sciences, Uplands College

ltaylor@uplandscollege.org

The purpose of the project is to provide a better understanding of the life history of the selected Emperor Moths in order that more informed decisions may be made with respect to the impact of entomophagous use of this resource, the sustainability and agricultural potential thereof and conservation. The basal stem circumference (for at least three stems if multi-stemmed), plant height and canopy size (two-dimensional estimate) was determined for the mopane trees. The sample size varied between 18 and 20 plants per locality quadrat (20 x 20m). Insect foraging and defoliation data was determined by choosing a representative branch for each tree and scoring the branch for the total number of leaves, evidence of surface foraging or margin defoliation and total leaf defoliation. Leaves were scored for secondary to quaternary level branches and leaf stages as young, mature and old.

Six batches of *Gynanisa maia* eggs (on three plants, 15%) were found at Bulweni, with average fecundity of 6.67 eggs per batch. The distinction between unhatched, hatched and parasitized batches was not made. No larvae were found. Ten batches of *G. maia* eggs were found at Makhadzi Spruit, eight of which were unhatched and two hatched. The average fecundity was 6.7 eggs per batch. A total of three larvae were found. Twenty-six batches of *G. maia* eggs were found on 12 trees (46% of those sampled) at the Letaba Enclosure site. Seven batches were unhatched, six batches were hatched and 13 showed evidence of parasitism. The average fecundity was 6.4 eggs per batch. A total of nine larvae were found. Selected soil samples were taken to isolate pupae of *G. maia*. These will be analysed in due course.

COMPARING THE EFFECTIVENESS OF PARKS CO-MANAGED BY GOVERNMENT AND LOCAL OR INDIGENOUS GROUPS

*Timko JA*¹, Innes JL¹ & Satterfield T¹

¹ Faculty of Forestry, Department of Forest Resources Management

jatimko@telus.net

The purpose of this research was to evaluate whether case study parks in Canada and South Africa were simultaneously effective in both ecological and socio-cultural terms. Parks that were heavily co-managed with Aboriginal/tribal people were compared to parks characterized by minimal co-management with Aboriginal/tribal people.

Drawing from diverse literature sources including conservation biology, sustainable livelihoods, cultural justice, common property resource theory and co-management, a set of broad socio-cultural and ecological criteria were compiled and represent an ideal that all parks should strive to address. National parks involved in this study include Pacific Rim (PRNPR), Gwaii Haanas (GHNPR) and Kluane (KNPR) National Park Reserves and Waterton Lakes National Park (WLNP) in Canada, and the Kruger (KNP) and Kgalagadi (KGNP) National Parks in South Africa.

An ordinal rating scale was used to designate both a description and coloured score for effectiveness evaluation final scores. Results from the socio-cultural evaluation demonstrate that the national parks with more involved co-management and support from Aboriginal groups (PRNPR and GHNPR) are more socio-culturally effective. For parks with less stringent levels of co-management, it appears that they provide for local employment perhaps as an easier solution to dealing with more difficult issues such as access to resources and participation in decision-making.

Ecological effectiveness for each park was calculated in two ways. Firstly, parks were evaluated against how well they performed on only those indicators which could be 'assessed' (e.g., they had either ecological monitoring data or could be evaluated using expert opinion). Secondly, parks were evaluated against how well they performed on *all* their priority indicators (identified either through management plans or in collaboration with park scientists). These results demonstrate that the parks score well when measured against the identified priorities for which they have monitoring data or expert knowledge. However, when all priorities identified by the park are included in the evaluation, whether or not there is monitoring data to assess them, scores dropped for most parks. Note that the overall scores for KNPR remained the same because this park has monitoring data for all of their identified indicators, unlike the rest of the parks in the study. Three parks (KNPR, KNP, PRNPR) attained an overall park effectiveness score of 'satisfactory', while one park (KGNP) attained an overall score of 'dissatisfactory'.

CAN TREES IMPROVE GRASS QUALITY AND THEREFORE ATTRACT GRAZING WILDLIFE? A STUDY ON THE SUB-CANOPY HERBACEOUS VEGETATION IN EASTERN AND SOUTHERN AFRICAN SAVANNAS

Treydte AC¹ & Heitkönig IMA¹

¹ Resource Ecology Group, Wageningen Agricultural University

Anna.Treydte@wur.nl

The role of large trees in savanna habitats is poorly understood and little is known about their influence on the surrounding grass layer and thus on wildlife foraging on these resources. With this study we determined the importance of trees in African savanna ecosystems for grazers. We collected data on grass nutrient contents and structure within savanna regions of different rainfall and soil fertility and over season as we hypothesized that in areas of low rainfall and poor soil quality trees will improve sub-canopy grasses to a greater extent than in savannas where environmental conditions are already favourable, and that the importance of trees might vary seasonally. We also sampled both Nitrogen-fixing and non-Nitrogen-fixing trees since Nitrogen-fixers such as *Acacia* trees might have a larger impact on soil and grasses than non-Nitrogen-fixers.

KNP and TIM showed the lowest grass leaf N contents outside of tree canopies during the dry season and the highest improvement in N content underneath trees during the wet season. P-content in grass leaves was significantly influenced by *Acacia* trees. TIM grasses had the lowest, KNP grasses the highest P content both sub- and outside canopy. The grass stem proportion outside of tree canopies was about twice as high than in the sub-canopy grass layer during the wet season, being most pronounced in KNP. Strong differences between sub- and outside canopy, with ratios of 1.4 and 72.1, respectively, were most distinctive during the dry season in KNP where grazing pressure was low.

It can be concluded that that tree canopies significantly enhance the grass quality, i.e. higher N-content, lower NDF-content, more alive grass and leaf grass material, taller grass sward, high abundance of palatable grass species, and that trees are important grass quality improvers in both dry and wet season.

A SURVEY OF THE COMPOSTING FUNGI IN A MOPANI LANDSCAPE AND THE EFFECT OF DIFFERENT FIRE REGIMES ON THEIR SPECIES COMPOSITION

*Truter M*¹, Jacobs A¹, van der Linde EJ¹, Kwindu GT¹ & Rong IH¹

¹ Biosystematics Division: Mycology, Plant Protection Research Institute, Agricultural Research Council

TruterM@arc.agric.za

The Kruger National Park (KNP) has conducted studies on different fire regimes for the past 51 years, but the effect of these fire regimes on fungal populations has not been studied. A survey was conducted of fungi in the mopani landscape in the KNP. Twelve of the possible fourteen fire regime plots in the KNP were sampled within the time period. Samples of leaves and twigs, as well as plant debris and soil surrounding five mopani trees in each burn plot were collected. Samples collected in October 2004 and August 2005 are currently being analyzed. All samples were plated out onto four different media: potato carrot agar (PCA), PCA + antibiotics, selective *Fusarium* agar and moist chambers. All soil samples were plated out directly, as well as serial dilutions made. Colony forming units were recorded for the soil samples. Plant material (a combination of twigs and leaves) was plated out directly as well as surface sterilized. Debris was only plated out directly to assess the composting fungi present. Colonies were recorded, isolated and preserved in ultra low freezing facility. At present this represent 1260 purified fungal cultures. DNA extractions were completed for twenty six soil samples. Total DNA obtained from the samples was used to determine the population dynamics of all the soil samples. This is done by means of the denaturing gradient gel electrophoresis technique. The cluster analysis of the 18S gene resulted in a profile representing the prokaryotic populations present in the different samples. The profiles for all 26 samples are similar with no differences the enclosure plots, or the pre and post burning samples. The cluster analysis of the internal spacer region (ITS) resulted in a profile representing the eukaryotic populations present in the different samples. The three main clusters represent no clear distinction among the enclosure plots, or the pre and post burning samples, although different statistical analysis were done.

NEST SEARCH/HARVESTING PROPOSAL FOR SOUTHERN GROUND HORNBILL IN KRUGER NATIONAL PARK

*Turner AMS*¹ & Kemp A¹

¹ Mabula Ground Hornbill Project

project@ground-hornbill.org.za

The revised project was planned to minimize disturbance at nests and assess any effects of harvesting on nesting success. Visits were made to check nests by members of the Mabula Project. Smaller second chicks, at or just after hatching, were harvested from two nests (Ngotsa Fig and Phalaborwa Gate). At Bateleur, although a second smaller egg was pipping when a larger chick was present, it was not harvested as the larger chick appeared unwell, and in the end it disappeared so that only the second chick survived (until the nest collapsed).

THE INFLUENCE OF STREAM ORDER ON RIPARIAN BIODIVERSITY: THE LINKS BETWEEN COMPOSITIONAL, FUNCTIONAL AND STRUCTURAL BIODIVERSITY

*Tye N*¹ & Rogers KH¹

¹ Centre for Water in the Environment, University of the Witwatersrand

tye@gecko.biol.wits.ac.za

Biodiversity consists of compositional, structural and functional components. However, the study of biodiversity is biased towards compositional diversity, and structural and functional aspects are often neglected. This has been the case in many riparian biodiversity studies. Furthermore, riparian biodiversity research is normally focused upon large perennial rivers, with little attention paid to smaller, lower order streams. Knowledge of how all three components of biodiversity are distributed among rivers of different size will provide a new perspective of riparian biodiversity, and could help focus both research and conservation efforts. With the above in mind, this study investigates compositional, structural and functional diversity along rivers in the Kruger National Park ranging from first stream order to fifth stream order. The two main aims of the study are: 1) To determine how riparian plant (specifically woody species) and riparian animal (specifically bird) compositional, functional, and structural diversity change along a stream order gradient, and 2) To investigate the relationships between compositional, functional and structural plant and animal biodiversity in this spatial context.

The fifth order stream (Sabie River) holds a significantly higher number of plant species than any of the other stream orders (Fig. 1). There is no significant difference in plant species richness between the fourth, third, second and first order streams. There is no significant difference in bird species richness between any of the stream orders. These results pose the question of whether birds are then in fact responding to changes in woody plant composition or if they are responding to changes in woody plant structure and/or function. Rivers show an increase in both geomorphic and hydrologic diversity as stream order increases.

RAPID ASSESSMENT OF THE POPULATION DEMOGRAPHY OF ELEPHANTS IN THE KRUGER NATIONAL PARK

*van Aarde RJ*¹, Shrader A¹, Ferreira S¹ & Whyte IJ²

¹ Conservation Ecology Research Unit, Department of Zoology and Entomology, University of Pretoria, Pretoria

² Scientific Services, South African National Parks

rjvaarde@zoology.up.ac.za

The aims of the project were to study the spatial forces that may limit elephants across their distributional range, and to study the value that population variables may have for managers in conservation.

Information on the birth and death rates provides an opportunity to calculate intrinsic growth rates independent of counts. Counts have inherent biases that detract from their value in calculating growth rates. For instance, the Kruger elephants increased at 6.6% in numbers per year during a period when they were confined. At the same time the estimates of survival and reproductive outputs predicted that their numbers were only increasing at 2.5% per year. Such discrepancies confuse the decisions that managers have to take when designing conservation actions. Our project thus focuses on extracting age-specific survival and reproductive rates to model population growth rates for the elephants in Kruger.

A Canon 10D single-reflex digital camera with a 70-200 mm Canon F4 lens was used to make 10 to 20 digital images of each of the elephant herds encountered. Individual relationships were determined and elephants were grouped into one of 15 age classes based on shoulder heights and back lengths that were measured digitally. We estimated the age at first calving to be 14.1 ± 0.3 (mean \pm SE; 95% CI: 13.2 - 15.0, $n = 40$) years. Cows were giving birth every 3.9 ± 0.3 (mean \pm SE; 95% CI: 3.6 - 4.3, $n = 98$) years. Survival rate irrespective of age was 0.984 (95% CI: 0.941 - 0.995) per annum. These demographic variables predict that Kruger's elephant population should be growing at 3.91% (95% CI: -0.31 - 8.10). Growth rates calculated from recent counts were noted as 4.04% (95% CI: -0.39 - 8.47).

DNA BARCODING OF THE KRUGER NATIONAL PARK'S FLORA FOR CONSERVATION AND BIODIVERSITY

*van der Bank M*¹, Savolainen V², Lahaye R¹ & Dutoith S¹

¹ Department of Botany, University of Johannesburg

² Jodrell Laboratory, Royal Botanic Gardens

mvdbank@uj.ac.za

The aim of the project is to DNA barcode the flora of the KNP and their associated mycorrhiza to study the distribution of biodiversity with regards to plant-microbes and other biotic interactions. Since the start of this project, we have collected more than 1500 specimens of plants. Although we have focused on three diverse ecozones namely, the Sabie/Crocodile thorn thickets (Ecozone D), Sandvelds communities (Ecozone N) and the alluvial plains (Ecozone M), we have also collected duplicates throughout the Park. This represents already the most complete and recent inventory of the Parks Flora, which will be useful to update datasets of the Scientific Services of the KNP. This is also the largest and most diverse sampling ever made for barcoding purposes in a protected area. For around 60% of this material collected, positive identification has already been made. To help identifying remaining specimens of complex groups (i.e. Cyperaceae, Poaceae, Euphorbiaceae, Acanthaceae) we are working in collaboration with South African taxonomist specialized in these groups.

A DNA bank was set up at the University of Johannesburg where DNA extracts for the flora of KNP will be held centrally and made available for the scientific community. DNA extracts will also be duplicated and transferred to the DNA bank of the South African Biodiversity Institute (SANBI) in Kirstenbosch. Scientists from all over the world will then have access to these samples which, would limit bio prospecting and thereby relieve pressure on wild populations from repeated collections.

A SURVEY ON NON-GRASS HERBACEOUS PLANT SPECIES INCLUDING CREEPERS, SUCCULENTS AND BULB PLANTS IN THE LIMPOPO VALLEY

*van der Walt AS*¹ & van der Walt M¹

¹ Private Researcher

The first phase of the project is aimed at the collection of the biggest possible variety of herbaceous species (in flower or fruit) in the specific area, to compile complete herbarium specimens as identification aids, the photography of species, with emphasis on specific characteristics which are important to differentiate between species, to record all information on which will not appear on dried herbarium specimens such as precise locality, exposure, soil type, etc., the complete identification of specimens, to record the distribution and frequency of species, and the collection of all relevant data such as common names, local uses etc.

Detailed trip reports were submitted to Mapungubwe National Park staff after each visit to the Park. Fully annotated herbarium specimens were compiled and sent to the National Herbarium at SANBI for identification or confirmation of identification. A large number of fully annotated duplicate specimens were also prepared to be passed on to SANParks at the end of the survey. Photographs of a good quality were obtained which will be made available to SANParks in CD format at completion of the project.

A STUDY OF SUSCEPTIBILITY TO BOVINE TUBERCULOSIS IN AFRICAN BUFFALO

*van Helden PD*¹ & Hoal E¹

¹ Division of Molecular Biology and Human Genetics, University of Stellenbosch

pvh@sun.ac.za

The aim of the project was to develop genetic markers for assessing biodiversity in African buffalo in terms of resistance to TB. So far, DNA microsatellites have been used to show that KNP buffalo are genetically diverse.

This year 229 new buffalo blood samples were collected during the TB prevalence survey. These samples are still located in KNP and need to be transported to our labs at Stellenbosch University. In the labs at SU, we have continued to purify some DNA from buffalo blood collected during earlier surveys. We have a few hundred samples collected and fewer than half have DNA purified thus far. We have no dedicated person to do this purification and manage to do a few purifications from time to time when we have time or can hire a part-time worker. Until we have sufficient samples to justify it, we cannot go ahead with this as a full time project, since our power calculations suggest there are not yet enough samples to achieve significance.

THE SPOTTED HYAENA: A MODEL SYSTEM TO STUDY RESISTANCE TO TUBERCULOSIS

*van Helden PD*¹ & Hoal E¹

¹ Division of Molecular Biology and Human Genetics, University of Stellenbosch

pvh@sun.ac.za

The objective of the project was to determine the effects of BTB exposure on hyena in KNP, and to determine the feasibility of doing ante-mortem clinical and blood studies. In the past year we were involved in an extensive study into a problem animal that was euthanized and found to have extensive lung lesions indicative of tuberculosis. These lesions were investigated in our labs. It was found that the pathogenic organism was in fact *Mycobacterium goodii*, a rather rare and unusual pathogen, usually associated with post-operative surgery in the developed world. Only one report of *M goodii* has been made (human case in Zambia). The University of Pretoria has begun a long term hyena monitoring project, which is an essential prerequisite to our work. This is most encouraging.

In addition, we have been doing extensive pilot work on other animal species, as a model for the hyena. Thus far, our work has focused mainly on the domestic dog, since there are very few reports of tuberculosis in dogs, as for hyenas.

Domestic dogs from a very high endemic TB area have been euthanized (n=100) and 4 found with TB. Of these, it is likely that only one is a real case, suggesting that the dog is a resistant species, as hypothesized for the hyena and that it is a good model to use for our pilot studies. We have been able to establish macrophage cultures and IFN γ release assays for the dog, which places us in a good position to begin hyena work once KNP and UP are ready for sampling.

As a comparison, we have been looking at other animal species, which are more susceptible. We have studied the rock hyrax (dassie) and from two animals sampled in the Groot Winterhoek mountains near our labs, established that they are infected with a unique subspecies of mycobacterium, known at this stage as the “dassie bacillus”. This is the first time this organism has been reported in a wild dassie in South Africa since 1958. Further studies in the dassie are warranted, since this may explain population crashes in this species.

In addition, we have identified M tuberculosis in a number of baboons, both wild and free living, suggesting that this is a highly susceptible species.

DETERMINATION OF BUFFALO AND GIRAFFE HEART WEIGHTS

*van Schalkwyk OL*¹, Skinner JD² & Mitchell G²

¹ Peace Parks Foundation

² Veterinary Wildlife Unit, University of Pretoria

³ Department of Zoology and Physiology, University of Wyoming

mitchg@uwyo.edu

Giraffe cardiovascular physiology is unique. Their brains, like that in all mammals, require a blood perfusion pressure of 100 mmHg, however unlike other mammals, their heads are 2 or more metres above the level of the heart. To overcome the hydrostatic pressure generated by the column of blood between the heart and the head, their hearts must generate an average blood pressure of about 200 mmHg. The origin of this blood pressure is controversial. It could be caused by a high peripheral resistance to blood flow or by a large and mechanically efficient heart.

The main purpose of this project is to obtain data that will add to our understanding of the origin of giraffe blood pressure. This aim can be achieved by comparing aspects of giraffe morphology with the same morphology of a similar sized but short-necked ungulate (buffalo). The specific analysis that needs to be made is measurement of heart mass, body mass, and neck length to determine correlations. To date we have obtained data on heart mass, body mass and neck length in 32 buffalo (20 females and 12 males) and 9 giraffe. The giraffe were obtained from a private rancher and the buffalo data were obtained from buffalo culled in the KNP.

These data show that the Mh: Mb ratio is significantly higher in giraffe than in buffalo, and, therefore, that the hearts of giraffe form a significantly larger proportion of body mass than they do in buffalo. For this sample size giraffe hearts cannot be shown to be significantly larger than the allometric prediction. However for the larger buffalo sample size, buffalo hearts are significantly smaller than predicted values.

The possibility that differences in heart size of giraffe and buffalo are related to neck length as well as body mass was analyzed by product-moment correlation analysis. In both buffalo and giraffe changes in heart mass correlate significantly with changes in body mass ($R^2 = 0.9169$ and 0.9577 respectively). Mh also is related to neck length, but the correlation is higher in giraffe ($R^2 = 0.7916$) than in buffalo ($R^2 = 0.6413$). Thus while body mass can explain 92% of the variance ($= R^2 \times 100$) in heart size in buffalo and 96% in giraffe, neck length can explain 79% of heart mass in giraffe and 64% of heart size in buffalo. The correlation between NL and Mb in giraffe is much higher ($r = 0.9489$) than it is in buffalo ($r = 0.8093$) indicating that increases in NL in giraffe are strongly linked to increases in Mb.

A HISTORICAL AND ARCHAEOLOGICAL INVESTIGATION OF THE CULTURAL REMAINS OF THE DIFFERENT OUTPOSTS OF THE STEINAECKER'S HORSE MILITARY UNIT IN THE KRUGER NATIONAL PARK

*van Vollenhoven AC*¹, Pelser AJ¹ & Teichert FE¹

¹ Archaetnos Archaeologists

acvv@absamail.co.za

The research was undertaken to show a connection between historical information and the archaeological evidence with regards to Steinaecker's Horse on the Sabi Bridge post. The archaeological research for 2006 was conducted on the Steinaecker's Horse post at Sabi Bridge, near Skukuza in the Kruger National Park. The Sabi Bridge site is one of a number of sites found during a survey of sites linked to the Steinaecker's Horse military unit. Historical information indicates that the site was used as second headquarters by the unit. Steinaecker's Horse was a voluntary unit who fought on the side of the British during the Anglo-Boer War (1899-1902).

Six excavations were conducted during 2005 and another six were done during 2006 (see attached figures). Two of the latter were on refuse middens and two on the same clay rubble (possible remains of huts) extending the excavations of the previous year. The last two was done on two different areas with building rubble and cultural material. These proved to be the remains of two structures.

A large amount of artefacts were uncovered. Although the analysis thereof had not been completed (this will only be done after completion of all excavations on this site) it seems that in comparison with the site at Letaba, there is a similarity between the two sites. The artefacts also clearly indicate that a military unit was present on the site, although material that can be linked to the building of the railway line and bridge, were also found.

THE ECOLOGY AND DISTRIBUTION OF THE SOUTHERN BARRED MINNOW (*OPSARIDIUM PERINGUEYI*) IN SOUTHERN AFRICAN RIVER SYSTEMS

Venter JA¹, Moyo NAG², Vlok W³, Fouche P⁴, Grobler P⁵ & Snyman S²

¹ Scientific Services Section, Eastern Cape Parks Board

² Aquaculture Research Unit, University of Limpopo

³ Bioassets

⁴ Department of Biology, University of Venda

⁵ University of the Free State

Jan.Venter@ecparks.co.za

Water Research Commission Project funding was granted to a group of researchers from the University of Limpopo, University of Venda and, Eastern Cape Parks Board to develop a conservation framework for African threatened fish species, applicable to South African conditions that will lead to an effective conservation strategy. The project team managed to streamline the macro-habitat sampling process with the development of field techniques, field forms, a database format and sampling protocol. A total number of 42 sampling sites were sampled of which 18 were within the borders of the Kruger National Park (KNP). The preliminary results already indicate a number of issues i.e. decline in fish diversity in some rivers and also the obvious absence of *O. peringueyi* in certain river stretches. To make final conclusions on these aspects will be premature as all historic sites have not yet been sampled.

The results obtained on the feeding biology of *O. peringueyi* indicate that based on the diet the species is an insectivore with the accompanying morphological adaptations of the intestinal tract. Because of the small sample size this part of the study is to continue using the samples of the various size classes collected in the micro-habitat study.

The fact that no *O. peringueyi* was collected at any of the historic sites in the KNP is cause for concern. It should however be pointed out that because of the high level of the water during the first and to a lesser extent during the second survey the pools and specifically the deeper pools could not be safely surveyed. In other cases, outside of KNP, *O. peringueyi* was found both inside pools and in the shallower habitat above or below the pools. The number of sites that were surveyed increased chances that *O. peringueyi* would have been encountered if they were present in KNP.

The low fish diversity, when compared to the data provided by Deacon (pers. com), in the Crocodile River was of greater concern to the team. In this river at one site only six species were collected. Deacon (pers. com) reported that according to KNP records more than thirty species had been collected in surveys in this river. This situation remains a concern, even if the fact that the pools were not surveyed is taken into consideration. However the team noted that a high concentration of algae and specifically filamentous

algae was present at all the sites in the Crocodile River. Based upon this, and because a preliminary results on the water samples was inconclusive as far as pollutants were concerned, it has been decided that a follow-up survey will be undertaken to investigate the diurnal cycle of the oxygen levels at two sites in the river.

NICHE DIFFERENTIATION IN SAVANNAS: COMPETITION-BASED MODELS FOR INTER LIFE-FORM COEXISTENCE

*Verweij RJT*¹, February EC¹ & Bond WJ¹

¹ Department of Botany, University of Cape Town.

rverweij@botzoo.uct.ac.za

The aim of this research is to provide more insight in the functioning of savanna ecosystems, by assessing the water use and nutrient uptake of trees and (to a lesser extent) grasses, using a multi-faceted comparative approach. Studying tree-grass interactions is of great importance for the understanding of savanna ecosystem functioning. The results of the current study are anticipated to contribute to the understanding of the mechanisms that determine the co-occurrence of trees and grasses on the savanna.

Understanding of the proximate causes of pre-rain flushing is needed for a better interpretation of the observed strategy. One objective of this study is to obtain insights by investigating the relationship between water and nutrients in the period between leaf expansion and the first rain shower. It will also be verified how much the water balance must change for trees to abandon their leaves at the end of the growing season and how plastic species are in their response.

THE EFFECTS OF TRANSLOCATION ON AFRICAN ELEPHANT

Viljoen JJ¹, Langbauer WR² & du Toit JT³

¹ Department Nature Conservation, Tshwane University of Technology

² Science & Conservation, Pittsburgh Zoological Society

³ Department of Wildland Resources, Utah State University

ViljoenJJ@tut.ac.za

Records from a range of historical sources were reconstructed which highlights behavioral disorders as a result of removing elephants from existing social structures. The time immediately after translocation will present the translocated elephants with a large number of social and ecological challenges, from maintaining social bonds and relationships with resident elephants, to establishing a new home range.

The Kruger National Park's management objectives are based on a system of thresholds of potential concern (TPC's) (Biggs & Rogers, 2003). In determining these thresholds at any population level, emerging evidence (Stokke & du Toit 2000) is showing that the impact on woody vegetation is sexually dimorphic and this study can contribute to the setting of and refining of the current TPC's. The study area is situated in the southeastern part of the Kruger National Park (KNP). The area is approximately 250 000 ha in extent and covers most of the Lower Sabie section as well as parts of the Crocodile Bridge and Tshokwane sections. The African elephant (*Loxodonta africana* Blumenbach, 1797) is considered a keystone species due to its ecological importance (Owen-Smith, 1987; Western, 1989).

A family group of elephants were followed on foot and data were collected from 931 feeding plots covering all four ecological seasons (early dry season from May to July; late dry season from August to October; early wet season from November to January and late wet season from February to April). A feeding plot is defined as the area within a circle with a radius of 5 m, which had a recently browsed woody plant as its center (Stokke & du Toit 2000).

Analysis for the pre-translocation phase completed by means of log linear regression. Chi squared test showed that none of the 11 response/behavioral variables differed between the experimental and control groups. Data were pooled and were analysed to detect whether there are significant differences between ecological seasons for all behavioural proportions. At a 95% level only response variables leave stripped and pulled out showed significant differences between seasons. As for plant parts utilised only bark and leaves differed significantly.

Feecal glucocorticoid samples ($n= 259$) were collected between May 2001 and April 2003 and glucocorticoid extracted.

There was no significant difference ($F= 0.4525$, $P>0.05$, 258 df) between the glucocorticoid concentrations as measured between the experimental and control groups

therefore the data were pooled. No significant differences were found between the three age classes ($F= 0.0402$, $P>0.05$, 257 df). The only significant difference found was between seasons ($F= 33.6708$, $P<0.05$, 258 df). Among the seasons, significant differences exist between all the seasons with the exception to the early wet- and late wet seasons.

A BASELINE SURVEY OF THE INSTREAM BIOTA, WATER QUALITY, RIVERINE VEGETATION AND GEOMORPHOLOGY AND AN ECOSTATUS DETERMINATION OF THE SHINGWEDZI RIVER AND ITS TRIBUTARIES

Vlok W¹, Wepener V², Fouche P³, Potgieter M⁴ & Gyedu-Ababio T⁵

¹ BioAssets – Biological Assessments

² Department of Zoology, University of Johannesburg

³ University of Venda

⁴ Department of Biodiversity, University of Limpopo

⁵ Conservation Services, South African National Parks

wynandv@mobileemail.vodafonesa.co.za

The study focussed on the Shingwedzi River and some of its important tributaries. The study is conducted on site inside and outside the boundaries of the KNP.

The objective of the project was to get a better understanding of the Shingwedzi River catchment, with reference to the anthropogenic activities on the water quality, biota (fish, macro-invertebrates, riparian vegetation and the geomorphology) and the impacts of pollution on the organisms.

On the 8/ May 2007 all twelve sites outside the KNP were surveyed. The remaining sites within the boundaries of the KNP were surveyed the 5/6 and the 20 June 2007. Tables 4, 5 and 6 show all samples collected. At this point the data set for the low flow condition has now been completed.

An aerial survey outside the Kruger Park was undertaken on 9 June 2007. Three micro-light airplanes were used to fly the selected sites to determine the impacts at each site. The general impacts between sites were also investigated. Dr Vlok and Mr Fouche took some photographs and video material and the different impacts observed were noted. This data is intended for the proposed management plan.

The specimens of the fish collected have been used to confirm the identification in the field. These specimens have been submitted to SAIAB as voucher specimens.

As part of the planning it was decided to calculate both the FAII as well as the FRAI. Where the FAII will be utilised to determine the integrity of the fish assemblage at each individual site, the FRAI will be used to assess the fish responses to driver changes in the river reaches. Because of the lack of data or the difficulty in accessing existing historic data, the calculation of both the FAII and the FRAI is not completed. The historic data has however now been sorted out and the calculation of the index scores are currently underway.

THE ROLE OF CLOVEN-HOOFED ANIMALS IN THE EPIDEMIOLOGY OF FOOT-AND-MOUTH DISEASE

Vosloo W¹, Bengis RG², Lubisi BA¹, Esterhuysen JJ¹, Dwarka RM¹, Jones H¹ & Mkwanzi R¹ & Shileyi B¹

¹ Exotic Diseases Division, Onderstepoort Veterinary Institute

² Division of Veterinary Services, National Department of Agriculture

Vosloow@arc.agric.za

Foot-and-mouth disease (FMD) virus causes the most economically important viral disease of animals. The outbreaks of FMD since 2000 both in the disease free zone and the buffer zone indicated the devastating effects it could have on agricultural production and loss of export markets for agricultural products. The Kruger National Park (KNP) is a FMD endemic area and one of the major tasks of the Directorate of Veterinary Services is to implement measures to prevent the escape of the virus to adjacent domestic animal populations. It is established that buffaloes in southern Africa maintain the SAT types of FMD virus but precisely how they are maintained within free-living buffalo populations and the mechanism by which they can transmit from buffalo to domestic stock are not clearly understood and are studied in this project. Impala are considered an indicator species for FMD outbreaks occurring in the KNP and for this reason a sero-surveillance program is in place to detect the spread of FMD to this species. Furthermore, monitoring the variability and antigenic range of FMD field strains is crucial to ensure that vaccines in current use in the endemic zone that borders the KNP are effective.

After the SAT-3 outbreak (SAR1-4/06/3) in cattle at Sibasa (north eastern part of Limpopo Province) during July 2006, 48 buffalo probang samples were taken from the adjacent northern part of the KNP to see if there was any correlation between the buffalo and outbreak isolates. The table below lists the viruses isolated from probang samples collected between 14/07/06-19/07/06.

Three SAT-1 isolates were characterised, *viz.*, KNP/2/06/1, KNP/3/06/1 and KNP6/06/1. These isolates clustered within one genotype (Fig 1) as part of the southern topotype of viruses *ie.* viruses from the KNP, south-eastern Zimbabwe and Mozambique (Bastos et al., 2001). Two of the isolates, KNP/2 and KNP/3/06/01, which were both isolated from buffalo in the Maseya Sandveld, were closely related and grouped into one significant cluster. None of the new isolates had any significant genetic relationship with previously isolated viruses and differed from the vaccine strains, SAR9/81 and KNP196/91/1.

KNP/5/06/2 and KNP/1/06/2 were not genetically closely related, but clustered as part of the southern topotype of viruses which has the same geographical distribution than the SAT-1 viruses (Bastos et al., 2003b) (Fig 2). Both isolates grouped within a significant cluster that consists of isolates from northern and southern KNP and separate from the cluster that contains the vaccine strain, KNP/19/89/2.

Only one SAT-3 virus was isolated from Crook's Corner, *viz.*, KNP/4/06/1 which grouped in the southern topotype, similar in distribution than the other two SAT serotypes (Bastos et al., 2003a). This isolate clustered with SAT-3 isolates characterised from the northern regions of the KNP (Fig 3), but was different from the outbreak viruses in Sibasa (SAR/1-4/06/03). The clustering of cattle outbreak strains with isolates from buffalo in the KNP suggests that buffalo may have played a role in these outbreaks.

In conclusion, the viruses from the KNP clustered as part of the southern topotype of viruses across all three serotypes. The clustering profile of the buffalo isolates from the KNP as well as the outbreak strains from cattle in the neighbouring region of the park suggests that buffalo may have played a role in outbreaks occurring in regions adjacent to the KNP, but no close genetic relationships were found.

MOVEMENTS AND FEEDING BEHAVIOR OF EPAULETTED FRUIT BATS AND THEIR IMPACT ON THE REGENERATION OF FIG TREES

Winkelmann JR¹ & Bonaccorso FJ²

¹Department of Biology, Gettysburg College, Pennsylvania

²Department of Wildlife Ecology & Conservation, University of Florida, Florida

jwinkelm@gettysburg.edu

The sycamore fig (*Ficus sycomorus*), a riparian emergent tree, occurs in all major river drainages of Kruger National Park (KNP). *Ficus sycomorus* is the dominant food item in the diet of the epauletted fruit bats, *Epomophorus crypturus* and *E. wahlbergi*. Mapping of 891 *F. sycomorus* revealed riverine corridors of this tree throughout KNP. The largest gaps between concentrations of fig trees are <15 km. Most of the flight activity and night “feeding” roosts of *E. crypturus* and *E. wahlbergi* were located <400 m from *F. sycomorus* having ripe figs. There was no significant difference in home range for *E. wahlbergi* (23.8 ± 4.4 ha) and *E. crypturus* (28.5 ± 3.7 ha); however, the mean axis across home range was significantly larger for *E. crypturus* (3068 ± 560 m). Home range size of female *E. wahlbergi* changed significantly with season and abundance of ripe figs; mean home range was 37.9 ± 8.5 ha during the late dry season in 2005 (few figs ripe) and 10.4 ± 2.6 ha mean during the early dry season of 2004 (ripe figs abundant). Core-use areas and long axes across home range of *E. wahlbergi* also were significantly larger in 2005. Many tens of individual *E. wahlbergi* and *E. crypturus* may have overlapping core-use areas centered at *F. sycomorus* trees with ripe fruit crops. New core-use areas emerge for individual bats as different trees ripen figs. Night feeding roosts typically are in trees 10-100 m from fruiting figs, although sometimes bats feed in fruiting trees. Mean feeding cycling time, the time to pluck a fig, fly to a roost, consume the fig and return for another fig, was 5.2 ± 1.9 min ($n = 151$). Captive bats processed a mean of 24.4 figs containing 24,000 seeds per bat per night. During the late dry season, we observed bats commute up to 13.9 km to fruiting trees when few trees produced ripe figs. At Skukuza, female *E. wahlbergi* and *E. crypturus* used the undersides of thatch roofs as day roosts, except in several instances the day after collaring bats when trees were used for single days. In the Shingwedzi area, both female ($n = 9$ roosts) and male ($n = 3$ roosts) *E. crypturus* roosted exclusively in understory trees (<5 m crown height).

REGIONAL DESCRIPTION OF THE GROUNDWATER CHEMISTRY OF THE KRUGER NATIONAL PARK

*Witthüser KT*¹ & Leyland RC¹

¹ Department of Geology, University of Pretoria

ktw@up.ac.za

The Kruger National Park (KNP) has adopted a Strategic Adaptive Management (SAM) program with clear ecosystem management goals based on environmental indicators and their thresholds of potential concern (TPC). Groundwater has been recognized as one of the environmental indicators that needs to be monitored and for which TPCs will have to be developed in the park. While the Department of Water Affairs and Forestry (DWAF) assists the KNP with the groundwater quantity TPCs and monitoring, the current project will assist the KNP with the groundwater quality TPCs by providing a regional characterization of the groundwater chemistry in the park (using National Groundwater Database and own data). Another emphasis of the project is to train KNP staff in groundwater sampling according to SANS/SABS standards.

A total of 29 surface and groundwater samples were taken (Tab. 1) and analyzed for major and trace elements as well as water isotopes (²H, ³H, ¹⁸O). While the raw results of the chemical analysis were already sent to our SANParks project partner (Izak Smit) and are currently interpreted by our project team, most of the isotope analyses are still outstanding.

ELEPHANT HABITAT SELECTION ACCORDING TO VEGETATION CHANGES IN SPACE AND TIME IN THE KRUGER NATIONAL PARK

Young K¹, van Aarde RJ¹ & Ferreira S¹

¹ Department of Zoology and Entomology, University of Pretoria

kyoung@zoology.up.ac.za

The management of large iconic herbivores in protected areas frequently fuels conservation management debates. This holds for southern Africa where elephants (*Loxodonta africana*) confined to protected areas may impact on biological diversity. In response, concerned managers often seek controversial reductions in elephant numbers. However, numbers *per se* may not be the foremost consideration for the management of elephant impacts. This is because density related changes in distribution and habitat utilization known for other herbivores may also hold for elephants. If so, changes in elephant densities may mediate or even moderate impacts according to the distribution of resources. To test whether increasing elephant numbers elicit such changes, we used count data from 1998 to 2004 collected from Kruger National Park during the dry season and studied how elephant numbers influenced their distributions. We did this at four spatial scales and in landscapes defined by vegetation, geology, climate and soils. We then investigated whether observed distributions and patch-specific densities were associated with the remotely sensed Normalized Difference Vegetation Index (NDVI) as a measure of primary productivity as a surrogate of potential food resources. Consistent with density mediated changes, we found that elephant patch occupancy increased with numbers, while patch-specific density became more similar. In addition, the combined distribution of bull groups and breeding herds became less clumped at high numbers. We further found that elephants were present on patches with relatively higher NDVI-values than the patches from where they were absent, albeit that these relations were weak. Our study confirms that while increasing population size influenced the distribution of elephants across the landscape, distributions are not strongly related to resources during the dry season at current densities. Hence, the intensity of impact at any given place during the dry season may not be directly predicted from elephant numbers alone.

TOURISM POLICY AND BIODIVERSITY CONSERVATION AND MANAGEMENT: A CASE STUDY OF KRUGER NATIONAL PARK, SOUTH AFRICA

*Zhou L*¹ & Ceethal CEP¹

¹ Department of Geography and Environmental Science, University of Fort Hare

leocadiazhou@yahoo.com

This study is concerned with evaluating the interlinkages between the policies and how they affect one another, as an avenue to promote a more integrated and comprehensive policy implementation. The rationale for policy integration stems from the interlinkages between the issues they address. These policies include the tourism policy, elephant management policy and the water provision policy. The research methodology for this analysis will be a series of in-depth interviews with the KNP park managers and South African National Parks Officials. The research results will provide the basis for the development of policy making that fuse one policy area's concern with another's resulting in integrated policies for greater effective implementation.

In general, the idea of policy interlinkages and integration is not novel since all policies represent compromises between the principles, approaches and implementation at a policy decision-making, social and political level. However, the approach to policy-making tends to be fragmented. This is attributed by the fact that overall research initiative in KNP is still skewed in favour of compartmentalized knowledge, with a backlog of integration, as in most environmental research settings (du Toit, Kevin and Biggs, 2003). A number of interviewees also pointed that greater public and political awareness and rafts of legislation, inadequate resources has been hampering policy implementation. In particular, the elephant management policy is very complex to implement, as it raises the issue of political support and public support. However, a special feature of KNP policy making is its widespread consultation system that can provide a fertile ground for environmental policy integration.

LIST OF AUTHORS

<i>Annegarn HJ</i>	10	de Boer FW.....	68, 90
Archibald S.....	11	de Buys A.....	19
Barichievy C.....	12	de Vos V.....	27 , 60
Bastos ADS.....	13 , 14	Delsink A.....	90
Belton L.....	21	Dennis PM.....	28
Bengis RG.....	13, 15 , 27, 117	Dietemann V.....	24
Bertschinger HJ.....	46	Dippenaar-Schoeman AS.....	29
Bhoora R.....	23	Douglas-Hamilton I.....	46, 58
Biggs HC.....	78, 86	Dowson LM.....	30
Blair JM.....	66	Druce D.....	89
Blake E.....	54	du Toit JT.....	96, 114
Bonaccorso FJ.....	119	du Toit WH.....	31
Bond WJ.....	39, 62, 63, 113	Duffin K.....	48
Botts EA.....	16	Dutoith S.....	105
Brahmbhatt DP.....	17 , 61	Dwarka RM.....	117
Bredenkamp GJ.....	59, 81	Dye PJ.....	32
Breen C.....	43, 86	Eckhardt HC... 33 , 34 , 35 , 36 , 78, 89, 91, 92	
Breman E.....	48	Ekblom A.....	48
Brown JL.....	42	Erasmus B.....	65, 70
Bruwer M.....	73	Esterhuysen JJ.....	117
Buchanan R.....	98	Euston-Brown DIW.....	37
Bucini G.....	55	Everson CS.....	32
Budke CM.....	17	Farmer H.....	38
Bulte EH.....	85	February EC.....	39 , 62, 113
Burkepile D.....	18	Ferreira S.....	45, 104, 121
Buso L.....	51	Fincham R.....	86
Buss P.....	13, 14, 79, 96	Fleming GJ.....	40
Cadenasso ML.....	19	Fosgate GT.....	17
Cain JW.....	20	Fouche P.....	111, 116
Cameron EZ.....	21 , 96	Foxcroft LC.....	41 , 78
Ceethal CEP.....	122	Fraser WJ.....	72
Chadwick O.....	64	Freeman EW.....	42
Chamailé S.....	44	Freimund W.....	43 , 97
Clulow A.....	32	Freitag-Ronaldson S.....	83, 86
Codron J.....	22	Fritz H.....	44
Coetzee J.....	57, 80	Funston PJ.....	45
Collins NE.....	23	Fynn RWS.....	18, 66
Collins SL.....	66	Ganswindt A.....	46
Cook E.....	19	Gaylard A.....	49
Craine J.....	63	Getz WM.....	47 , 92, 96
Crewe R.....	24	Gillson L.....	48
Cross PC.....	25	Goodall V.....	49
Cullum C.....	26		

Govender N.....	50, 53	Langbauer WR.....	114
Grant CC ...	22, 49, 65, 67, 68, 89, 90, 92	Lee-Thorp JA.....	22
Greeff JM.....	52	Leyland RC.....	120
Grobler P.....	111	Liebenberg L.....	54
Groen TA.....	53	Lubisi BA.....	117
Gruijters D.....	54	Lyaschenko K.....	79
Gummow B.....	17, 61	Mabuduga FD.....	91, 92
Gush MB.....	32	Macandza VA.....	70
Gyedu-Ababio T.....	116	Makete G.....	73
Hanan NP.....	55, 92	Makhado R.....	11
Hansen HS.....	56	Manger PR.....	71
Harris KR.....	57	Manyaka M.....	72
Hartshorn T.....	64	Mare L.....	73
Hearne J.....	85	Mariano V.....	74
Heitkönig IMA.....	100	Matchett KJ.....	75
Henley MD.....	46, 58	Mawdsley JR.....	76, 77
Henley SR.....	46, 58	McConnachie A.....	94
Hennekens SM.....	59	McCool S.....	43
Higgins S.....	39, 62	McCrindle CME.....	74
Hoal E.....	107, 108	McLoughlin CA.....	78
Hofmeyr MS.....	21, 40, 79	Meissner HH.....	73
Holtzhausen LC.....	60	Miller M.....	79
Innes JL.....	99	Millspaugh J.....	90
Jacobs A.....	101	Mitchell G.....	109
Jones H.....	117	Mkwhanzi R.....	117
Jori F.....	17, 61	Molea TT.....	51
Josipovic M.....	10	Moore S.....	83
Keet DF.....	14, 15	Morris C.....	75
Kemp A.....	102	Morris TL.....	80
Keretetse MK.....	62	Mostert RE.....	81
Khavhagali VP.....	63	Mostert T.....	59
Khomo L.....	64	Moyo NAG.....	111
Kinahan AA.....	93	Muenschler S.....	46
Kirkman K.....	66, 75	Mugwabana FH.....	82
Kleyn L.....	65	Munro JK.....	83
Knapp AK.....	18, 66	Mutanga O.....	84
Kneen MA.....	10	Mwakiwa E.....	85
Knox NM.....	67	Nkhata A.....	86
Kohi EM.....	68	Ntshane BC.....	87
Kotschy K.....	69	Ntushelo K.....	94
Kriek N.....	61	Owen-Smith N.....	20, 70, 92
Kryger P.....	24	Page B.....	68, 89, 90
Kubheka WM.....	11, 32	Palmer D.....	83
Kuiters AT.....	59	Parsons M.....	30
Kwinda GT.....	101	Peel MJS.....	38, 75
Lahaye R.....	105	Pelser AJ.....	110

Picard JA.....	74	Tanner RJ.....	97
Picket STA.....	19	Taylor LR.....	98
Piketh SJ.....	10	Teichert FE.....	110
Potgieter M.....	116	Thompson D.....	18
Prins HHT.....	53, 67, 68, 85, 90	Timko JA.....	99
Radloff S.....	49	Tleane A.....	31
Raghanti M.....	28	Treydte AC.....	100
Rathogwa N.....	37	Truter M.....	101
Reid JL.....	88	Turner AMS.....	102
Richardson DM.....	37, 41	Tye N.....	103
Robertson M.....	57	van Aarde RJ.....	104 , 121
Rogers KH 12, 16, 26, 30, 64, 69, 78, 86, 103		van de Vijver CADM.....	53
Rong IH.....	101	van der Bank M.....	105
Rouget M.....	41	van der Linde EJ.....	101
Ryan B.....	21	van der Walt AS.....	106
Sanson G.....	25	van der Walt M.....	106
Satterfield T.....	99	van Helden PD.....	107 , 108
Saunders I.....	51	van Langevelde F.....	53
Savolainen V.....	105	van Rensburg BJ.....	57
Schaminee JHJ.....	59	van Schalkwyk OL.....	109
Scholes MC.....	88	van Vollenhoven AC.....	110
Scholes RJ.....	11, 32	van Wieren SE.....	68
Sealy J.....	22	Venter JA.....	111
Shannon G.....	89	Verster H.....	31
Shileyi B.....	117	Verweij PJFM.....	59
Shrader A.....	104	Verweij RJT.....	113
Skidmore AK.....	67, 68	Vetter S.....	49
Skinner JD.....	109	Viljoen JJ.....	114
Slotow R.....	68, 89 , 90	Vlok W.....	111, 116
Smit IPJ.....	31, 65	Vogel M.....	11
Smith MD.....	18, 66	Vosloo W.....	17, 61, 117
Snyman J.....	98	Walker DR.....	98
Snyman S.....	111	Ward MP.....	17
Sponheimer M.....	22	Wepener V.....	116
Stam EM.....	91 , 92	Whyte IJ.....	46, 58, 90, 104
Stelli SA.....	93	Winkelmann JR.....	119
Stigter H.....	85	Wise R.....	32
Strathie L.....	94	Witkowski ETF.....	38, 80, 93
Sutherland BE.....	51	Witthüser KT.....	120
Swemmer AM.....	95	Young K.....	121
Tambling CJ.....	96	Zhou L.....	122