WILDLIFE & ECOLOGICAL INVESTMENTS

DINOKENG GAME RESERVE: WINTER 2016 SUMMARY REPORT

Introduction

Wildlife and Ecological Investments (WEI) has conducted ecological surveys and biodiversity monitoring in the Dinokeng Game Reserve. To best understand the health of an ecosystem we need to 1) monitor the response of organisms to their environment, 2) examine the response of populations of a specific species to the environment and considering processes such as abundance and fluctuations and 3) investigate the composition and structure of communities within a defined area. With this information we are better able to further examine the processes occurring within an ecosystem.

Ecosystems have a wide range of components each responding to their environment. Complete and holistic biodiversity monitoring is impossible due to the large taxa representation. It is for this reason that WEI surveys macro fauna and flora. By surveying key organisms within an ecosystem, we obtain clues into ecosystem functioning and processes. This winter season the data that has been collected covers a wide ecological range and consists of herbaceous, woody vegetation, bird and mammal surveys. The data was collected systematically and consistently using the same methods within the same sampling sites. Camera trapping for Limpopo Leopard Monitoring Project (Project Pardus), an initiative by Panthera, was conducted as part of the mammal surveying. The aim of the camera trapping in Dinokeng Game Reserve was to collect information about leopard populations in the area to support and inform management and policy.

Vegetation communities are a critical foundation for determining numerous factors about an ecosystem. The health of an ecosystem can be determined by the quality of the vegetation particularly in terms of its function to provide food, shelter and soil stabilising amongst others. Detecting changes in vegetation quantity and quality influences the available browse and graze for ungulates. When considering large mammals such as elephants then monitoring of vegetation becomes of high importance for management. For this reason, WEI conducts habitat assessments by monitoring the impacts on woody vegetation by elephants specifically however, other ungulates are taken into account. Given the changes in land use in areas of Dinokeng Game Reserve, understanding the impacts of elephants on vegetation may provide insight into the role of elephants as drivers in an ecosystem.

Similarly, birds are influenced by vegetation structures thus it is necessary to monitor birds to assess biodiversity and as indicators of ecosystem health. When monitoring the different bird species, we categorise them into feeding guilds (frugivore, carnivore etc.) as this provides more detailed insight into the ecosystem health and processes. Birds are relatively diverse, easy to identify in the field and have different habitat requirements depending on the feeding guild. By subdividing the bird community into feeding guilds, we compensate for yearly changes in populations.

The reserve can make use of the data collected and analysed by WEI to review changes across the reserve where management can gain insight into the functioning and health of the reserve. Furthermore, the baseline data can contribute towards future specialised research or management decisions. This report describes benchmark information from some of the sites where surveys were conducted (Figure 1). More information will be provided as more surveys are conducted and data collected.

Study Area

Figure 1: Location of where the ecological surveys including bird point counts, habitat assessments and veld condition assessments were conducted in 2016.

Methods

Bird Surveys

Bird Point Counts (BPC) were conducted at each of the sampling sites at dawn when bird activity was highest. All birds seen and heard were recorded, the birds behaviour (flying, perched in the canopy or mid-storey etc.), GPS geotagged the location and the environmental information recorded. Bird species richness and diversity were calculated at 24 sites. For ease of analysis the bird species were divided into feeding guilds namely insectivore/invertebrates, omnivore, carnivore, frugivore, nectivore and granivore. The feeding guild of each species identified was verified in the Roberts Bird Guide (Chittenden 2009). Species richness is the number of different species represented in an ecological community. Species richness is basically a count of species, and it does not take into account the abundances of the species or their relative abundance distributions. To calculate the species richness we used the Menhinick's Index (*IM*$_n$) (Menhinick 1964). This index is based on the total number of species and individuals in the sample:

$$I_{Mn} = S\sqrt{N}$$

The index is calculated by determining the ratio of species in a guild (*S*) and the total number of individuals in the guild (*N*).

We used the Shannon Index of Diversity to determine the species diversity between the guilds. The Shannon Index (*H*) determines the heterogeneity indices of the bird groups. This index measures species richness and evenness (Mirzaie *et al.,* 2013).

$$H = \sum_{i=1}^{S}(pi)lnpi$$

The Shannon Index (*H*) is scored with a range from no diversity to high diversity. Where *S* is the total number of species in the community (richness), *pi* the proportion of *S* made up of the i^{th} species.

Habitat Assessment

At each of the 17 habitat assessment sites we recorded all woody vegetation over 1 metre tall. The tree height was categorised into five categories (1 – 2m, 2 – 4m, 4 – 6m, 6 – 10m and >10m). Other data recorded included species name, height class, basal stem diameter, average stem diameter (for multi-stemmed bushes), the width of the widest point of the canopy, and the extent of elephant and fire impact (fire data is not featured in this report). A qualitative and quantitative evaluation of elephant and other browser impact was graded according to the Walker scale (Walker 1976) as detailed below:

TYPE:	CODE:
Pulled or kicked out	A
Pushed over and dead or apparently dead	B
Main trunk broken, is or appears to be dead	C
Main trunk broken but re-sprouting or likely to re-sprout	D
Pushed over but still alive	E
Main trunk tusk-slashed	F
Main trunk debarked (% of the circumference)	*G
Roots exposed and eaten (% of the circumference)	*H
Primary branches broken	*J
Secondary and/or smaller branches broken	*K
None:	Z

*Impact types G, H, J, K must be quantified according to the percentage classes given below. The percentage classes refer to the percentage of the total canopy volume (J & K) and are estimated. In the case of exposed roots and debarking of the main trunk (types G & H), the percentage of the root base or trunk's perimeter (i.e. a circle) affected must be estimated and coded accordingly.

1-10%
11-25%
26-50%
51-75%

76-90%
91-100%

For the purpose of this report we focused on the height categories and species of the woody vegetation.

To assess the Damage Index for the woody vegetation we compared the species at each site. We assigned each plant a percentage for each damage category which was dependent on the amount of damage recorded (according Walker scale). Each damage category was assigned a weighting according to the severity of the damage. We were then able to calculate the total impact score per site:

$$X_1 + X_2 + X_3 = P$$

Where X is the averaged individual species damage scores, P is the sum of average species damage scores and T is the total number of recorded individuals on site. This produces the DI, Damage Index for a site.

$$P/T = DI$$

The impact of elephants on woody vegetation was analysed by generating an impact score (*IS*) per species:

$$\%\ impacted = (\frac{si}{Nti})x100$$

Where *si* is the number of trees of the species or height category impacted and N_{ti} is the total number of trees impacted.

$$\%\ availability = (\frac{s}{Nt})\ x\ 100$$

Where *s* is the number of tree species or height category measured and N_t is the total number of trees.

$$IS = \frac{\%impacted}{\%availability}$$

Grass surveys

The herbaceous layer was measured to monitor volume of grass available. Grasses were measured at 8 of the sites. The volume of the grass was measured using a Disk Pasture Meter (DPM) which was calibrated according to the Kruger National Park measurements. We analysed the data using equations from Zambatis *et al.,* (2006) for grasses (> 26 cm) as stipulated in studies conducted in the Kruger National Park.

The equation used to measure the grass volume for grasses >26 cm:

$$Kg/ha^{-1} = [31.7176(0.3218^{1/x})x^{0.2834}]^2$$

Where *x* is the mean DPM height of at a site.

Veld condition was determined using the grazing status and classifies the grasses into categories with a score. These categories were scored (Decreaser - 10, Increaser I - 7, Increaser II - 4 and Invaders - 1). We then used Veld Management in South Africa (Tainton, 1999) and Guide to Grasses in southern Africa (van Oudtshoorn & van Wyk (2014) to classify each grass species and then calculate a veld condition score.

Game Transects

The game transects are driven between 07:00 – 09:00 and 14:00 – 16:00 and each drive was 10km. The game transects are conducted from a vehicle driving at an average speed of

20km/hr. During a game transect a visibility index is developed by determining the visibility distance which is measured and recorded on a 5 Category Scale (<10m, 11-20m, 20-50m, 50 -100m, >100m). This is based on the vegetation type and density and how this affects the visibility of the animals.

We used Riney's (1960) 3 Category Scale (1- poor, 2- fair, 3 healthy) to assess the health condition of the animals seen. This scale uses fat reserves distributed on the spine, ribs and hind quarters as indicators of the animals' condition. The average condition of the herd is recorded unless an individual is seen then only that animals' condition is recorded. Within the herd, the adults and juveniles are conditioned together. This method allows for the detection of seasonal trends and patterns as well as any changes that may occur overtime.

Camera Trapping

The camera traps were spread out evenly across the reserve, however they did not necessarily overlap with the predefined ecological survey sites. The combination of road access, aerial maps and visual surveys for suitable camera trapping were used for site selection.

Results

Summary

Table 1: A summary of the number of ecological sites surveyed and game transects driven in 2016.

Ecological Survey	Survey Sites
Bird Surveys	24
Woody Vegetation	7 / 9[1]
Veld Condition Assessments	8
Game Transects	11
Camera Traps	36

Bird Surveys

We calculated the species richness and diversity by feeding guilds and by site. Menhinicks Index suggests that the Insectivores had the highest species richness and were the most represented guild. According to the Shannon's Index of Diversity, Insectivores and Granivores were the most diverse while the Frugivores and Nectivores were the least diverse (Figure 2). The Insectivores and Granivores were highly represented in the surveys.

Between the sites there was general species evenness in regards to the proportion of feeding guild representation. According to the Shannon's Index, site 17 had the greatest species diversity followed by site 42 and then 19 and 25 equally.

[1] Two methods were used this season; at 7 sites we conducted surveys on 1ha plots and 9 sites we conducted surveys using 20 x 20m plots. The same sites had both habitat assessments methods conducted on them.

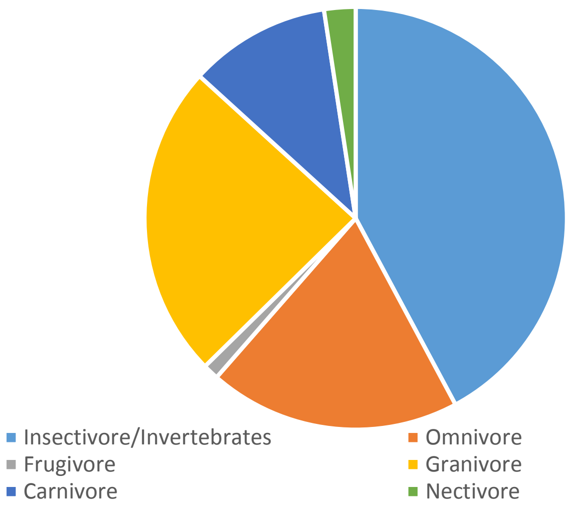

Figure 2: Proportion of bird feeding guilds represented in Dinokeng Game Reserve in 2016

Habitat Assessments

Both woody and herbaceous species were recorded at the habitat assessment sites. Data from the 1ha plots were used for analysis in this report. The data suggests that site 28 had the greatest species abundance while site 18 and 37 had the lowest, according to Chao1 measure of abundance. In regards to species Chao2, species richness, site 28 and 20 had the highest species richness. Site 18 had the lowest species richness. According to the Damage Index, site number 43 had the greatest elephant impact while site 28 had the least (Figure 3).

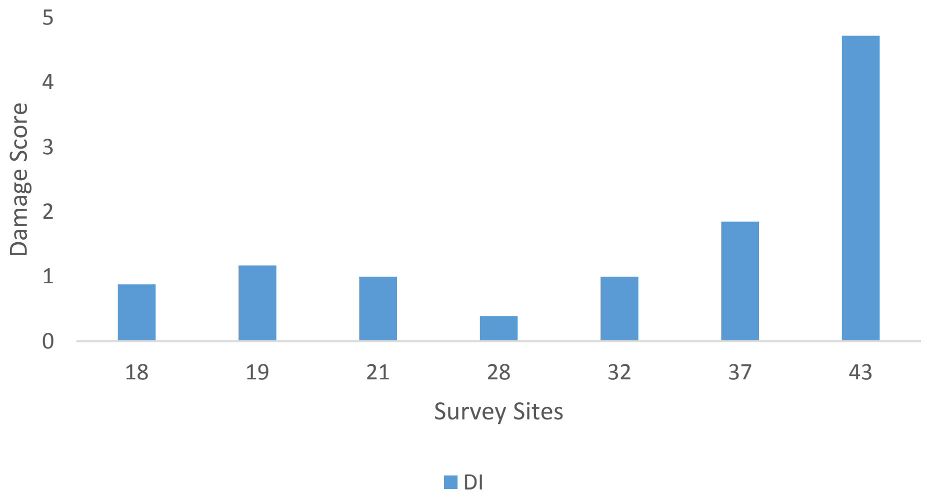

Figure 3: Damage Index per site of trees impacted by elephants.

A total of 26 tree species were recorded this season. Of these species recorded 16 sustained some form of elephant damage. *Combretum zeyheri* and *Spirostacys Africana* had the greatest damage followed by *Acacia caffra* (Figure 4). According to the category of damage sustained, *Combretum zeyheri, Spirostacys Africana, Acacia caffra* and *Acacia ludaritis* had high category impacts where the main trunk of the tree was damaged. Impact on the other trees was secondary and of less intensity. Of the trees measured, 47% were between 1 and 2m in height of which 40% of the trees in this height category had sustained (1-10%) secondary damage. Less than 1% of the trees in this height category sustained (>25%) secondary damage. Of the trees measured, 32% were in the 2 to 4 m of which 50% trees in this height category sustained (1 – 10%) secondary damage. When all tree heights were combined, less than 1% had sustained primary damage to the main trunk.

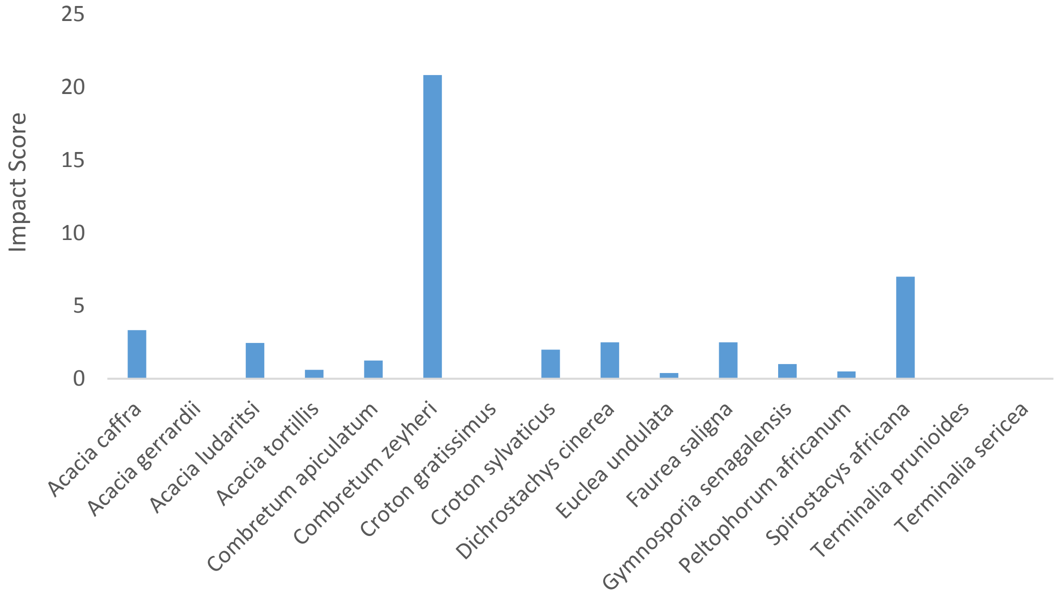

Figure 4: Species impact score of trees damaged by elephants.

We conducted bird surveys at the sites where habitat assessments were also conducted and found a relationship between the damage index and the bird species diversity (Figure 5). There is a negative correlation (R = -0.36) between the damage index and the bird species diversity.

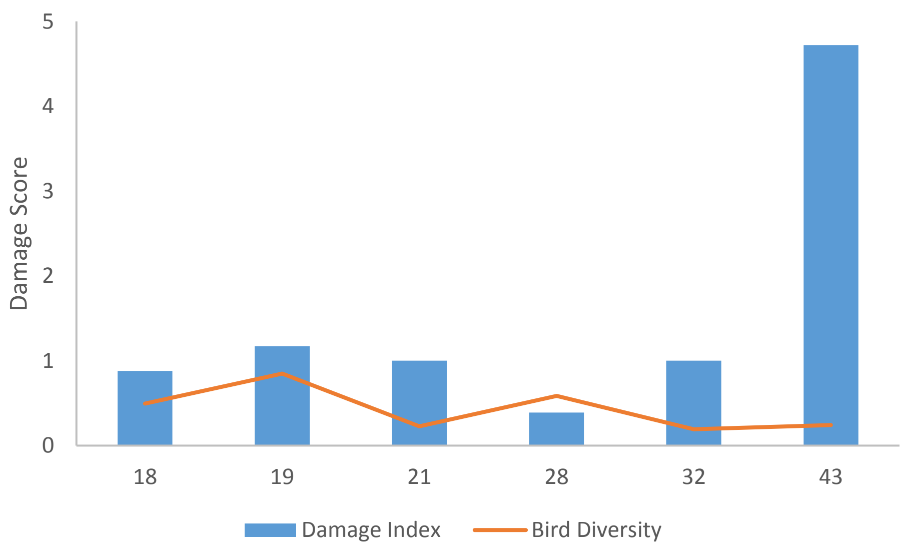

Figure 5: Relationship between woody damage and bird species diversity.

Of the known 32 grass species in Dinokeng Game Reserve, 18 were recorded this season at the survey sites. According to the DPM measurements, the mean grass volume at each site (*x* = 10150kg/ha^{-1} ± 1077) was above 26cm (*x* =63.30 cm). The graze level at each site (Figure 6) followed the trend (R = 0.26) of decreasing grazing impacts with increasing grass volume (Figure 7). For ease of identifying the quality of the graze available we categorised the grasses into ecological values (Tainton, 1999). From this we were able to determine a benchmark Veld Condition Score which was then assigned to each site (Figure 8). Although more data is needed, the data suggests that the mean veld condition scores at all sites (*x* = 371 ± SD 90) are generally poor to moderate (Tainton, 1999).

Of the two habitat assessment methods used this season, the 1 ha plot provided more information about species richness, abundance and elephant damage than the 20 x 20m plots.

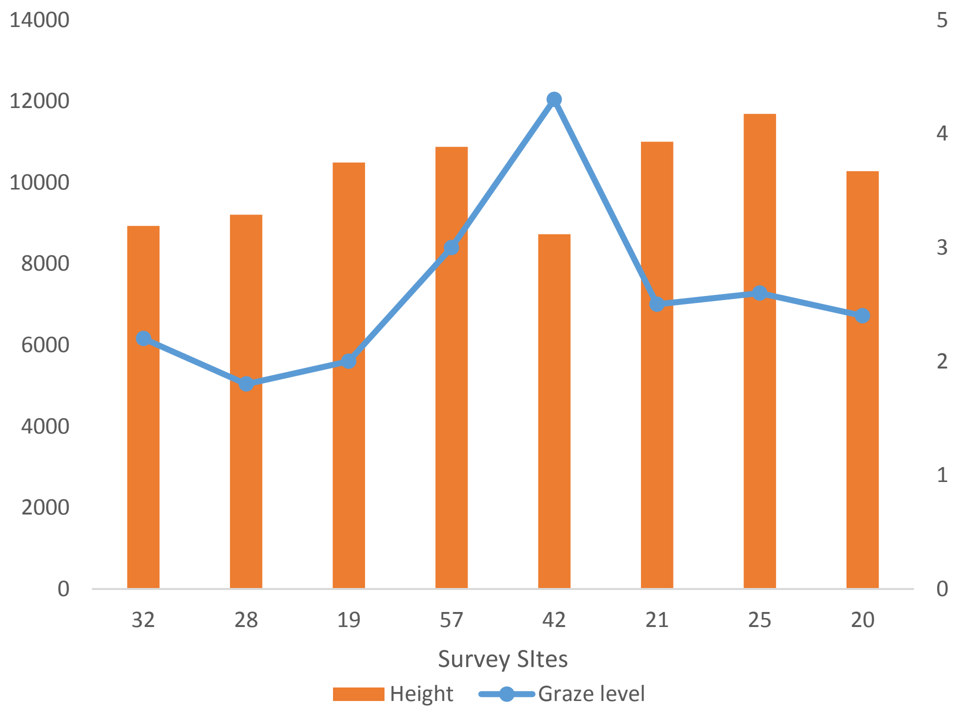

Figure 6: Grass volume and the graze level where 1 is hardly used and 5 highly utilised.

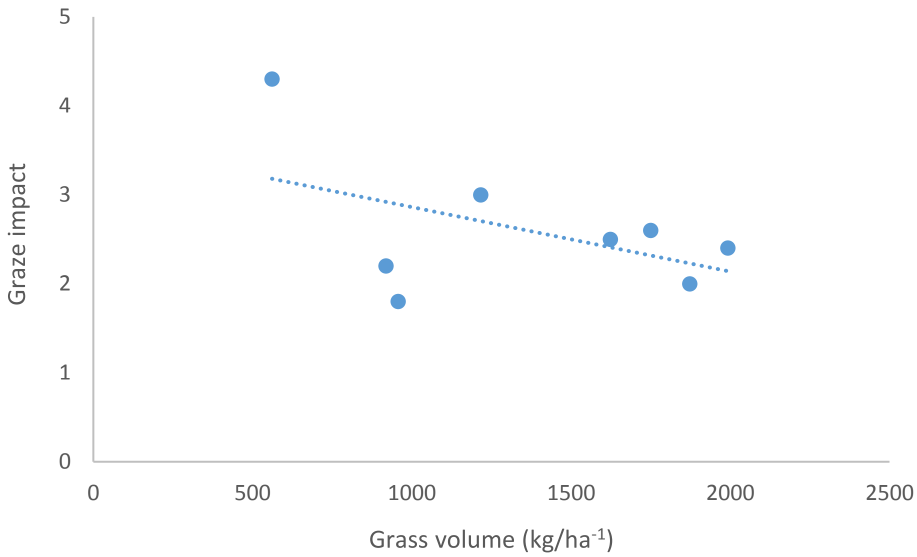

Figure 7: Ratio of grass volume and graze utilisation where grass utilisation decreases with increasing grass volume.

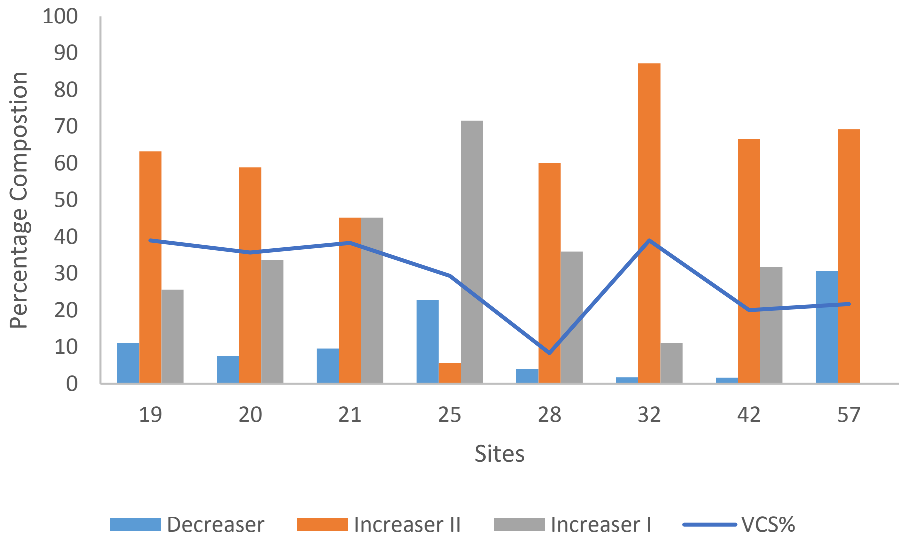

Figure 8: Veld Condition Score at each of the survey sites monitored relative to the ecological grass composition.

Game transects

A total of 11 game transects were driven and were conducted in the north and the south of the reserve. Each transect was 10km in length. In the north where high animal densities were observed the visibility index was 20 to 50m while in the south it was between 10 to 20 and 20 to 50m (Figure 9). All game seen was classified as being in good condition according to Riney's classification.

Figure 9: Game transect routes and the hotspots were game was seen in 2016.

Camera Trapping

Of the predator species identified on the camera traps the species of interest included serval, caracal, lion and cheetah. Although no leopards were actually recorded on the camera's the prey base suggests that DGR could potentially support a leopard population.

Discussion

Savanna systems are generally defined as stable and resilient however dynamic changes in land use and management strategies can manifest in a cascade effect through the trophic levels. Ecosystems such as savannah and grasslands have underlying variables that gradually push that ecosystem towards a threshold. Events such as changes in land use and management strategies can affect habitats and organisms. Although the data is still benchmark, once we have collected data from all habitats across the reserve we can better detect trends and patterns. Similarly, by monitoring habitats and bird communities, WEI is better able to investigate the drivers and consequences.

The results from the bird survey suggest that species richness in terms of feeding guilds favours insectivores. Insectivores represent approximately 42% of the known bird species in Dinokeng Game Reserve thus they are highly represented. This is also likely because this group has the largest guild representation (Morse 1971). Species richness of bird communities in an ecosystem is dependent on the resources available such as food and shelter as well as competition for these resources. Although the insectivores had the highest abundance, the data suggests that evenness was high between the sites for all the guilds except Nectivores. There was a negative relationship between the damage index and the bird species diversity at each site.

Of the habitat assessment methods, the 1ha plot provided better quality and quantity data in terms of abundance, richness and impact by elephants on woody species. The data from the habitat assessments indicated that there was generally little difference between the sites in terms of vegetation species abundance, richness and impact. Within the height categories there was a change in the available and impacted woody vegetation. Tress below 4m were high in abundance and the most impacted by elephants.

The herbaceous data collected was not collected from a wide enough range to provide accurate graze biomass availability. However, as more data is gathered we can better develop the benchmark veld condition score that was assigned to each of the sites this season. We can then better determine the graze unit carrying capacities.

The game transects data and methodology begin to highlight areas of utilisation by wildlife on the reserve. Although we are beginning to observe some hotspots where the wildlife occurs in high densities, more data is needed.

Recommendations

More wide spread data is still needed to be collected. For the habitat assessments we will conduct more 1 ha plots at the designated ecological sites. We will also continue to assess the veld condition. Similarly, more game transects need to be driven before we can analyse and determine the carrying capacities.

In the next report we will discuss the differences in veld conditions between the Northern and Southern part of DGR. The geological and life history differences of the two areas will be considered. Recommendations will be made in terms of managing veld condition.

Acknowledgements

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References

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List of Appendices

Birds seen in Dinokeng Game Reserve during Bird Point Counts in winter 2016.

African Black Duck
African Darter
African Fish-Eagle
African Grey Hornbill
African Spoonbill
African Stonechat
African Wattled Lapwing
Amethyst Sunbird
Arrow-marked Babbler
Ashy Tit
Barn Owl
Bearded woodpecker
Black Heron
Black-backed Puffback
Black-collared Barbet
Black-crowned Tchagra
Black-shouldered Kite
Blacksmith Lapwing
Black-throated Canary
Blue Waxbill
Brown-crowned Tchagra
Brown-hooded Kingfisher
Brubru
Burchell's Coucal
Burchell's Starling
Cape Bunting
Cape Glossy
Cape Robin-Chat
Cape Turtle Dove
Cardinal Woodpecker
Chinspot Batis

Cinnamon-breasted Bunting
Coqui Francolin
Crested Barbet
Crimson-breasted Shrike
Crowned Lapwing
Dark-capped Bulbul
Double-banded Sandgrouse
Eagle Owl
Egyptian Goose
Fork-tailed Drongo
Goliath Heron
Great egret
Greater Blue eared
Green Wood-Hoopoe
Grey Go-away-bird
Grey Heron
Grey-headed Bush-shrike
Hadeda Ibis
Helmeted Guineafowl
Laughing Dove
Lilac-breasted Roller
Long-billed Crombec
Magpie Shrike
Martial Eagle
Namaqua Dove
Natal Spurfowl
Olive Thrush
Orange-breasted Bush-shrike

Pearl-spotted Owlet
Pied Crow
Pied Kingfisher
Pied Wagtail
Red-billed Hornbill
Red-billed Oxpecker
Red-billed Quelea
Red-crested Korhaan
Red-eyed Dove
Red-faced Mousebird
Red-Knobbed Coot
Southern Boubou
Southern Yellow-billed Hornbill
Speckled Pigeon
Spur-winged Goose
Swainson''s spurfowl
Tawny-flanked Pirnia
Whiskered Tern
White-backed Vulture
White-bellied Sunbird
White-breasted Cormorant
White-browed Scrub-Robin
Woodland Kingfisher
Yellow Weaver
Yellow-billed Duck
Yellow-fronted Canary

List of trees recorded during habitat assessments in Dinokeng Game Reserve winter 2016.

Acacia caffra
Acacia gerrardii
Acacia hebeclada
Acacia karoo
Acacia ludaritsi
Acacia tortilis
Combretum apiculatum
Combretum zeyheri
Congetum Implication

Croton gratissimus
Croton sylvaticus
Dichrostachys cinerea
Dombeya rotundifolia
Eucalyptus camaldulensis
Euclea divinorum
Euclea undulata
Faurea saligna
Gymnosporia buxifolia

Gymnosporia nemorosa
Gymnosporia senagalensis
Peltophorum Africanum
Peltophorum africanum
Spirostacus africana
Terminalia prunioides
Terminalia sericea
Ziziphus mucronata

List of mammals seen on game transects and camera traps in Dinokeng Game Reserve winter 2016.

Aardvark	Common Duiker	Red Hartebeest
Aardwolf	Eland	Scrub Hare
African Civet	Common Reedbuck	Serval
African Wild Cat	Elephant	Small-spotted Genet
Black-backed Jackal	Giraffe	Spring Hare
Blesbok	Hippopotamus	Steenbok
Blue Wildebeest	Honey Badger	Tsessebe
Brown Hyena	Impala	Vervet Monkey
Buffalo	Klipspringer	Warthog
Bushbuck	Kudu	Waterbuck
Bushpig	Lesser Bushbaby	White Jackal
Caracal	Lion	White Rhino
Cheetah	Nyala	Zebra

List of forbs recorded during habitat assessments in Dinokeng Game Reserve winter 2016.

Cotton Wool
Devils Thorn
Khaki Bos
Lantana
Paper Thorn
Wild Mint

List of grasses recorded during habitat assessments and veld condition assessments in Dinokeng Game Reserve winter 2016.

Anthephora pubescens	*Eragrostis gummiflua*	*Panicum schinzii*
Aristida Bipartita	*Eragrostis gummiflua*	*Paspalum distichum*
Aristida congesta congesta	*Eragrostis lehmanniana*	*Perotis patens*
Aristida transvaalensis	*Eragrostis rigidior*	*Pogonarthria squarrosa*
Avena fatua	*Helictorichon turgidulum*	*Schizachyrium jeffreysii*
Bromus pectinatus	*Heteropogon contortus*	*Schizachyrium sanguineum*
Dichanchiun annulatum	*Impereta cylindrical*	*Setaria incrassata*
Digitaria velutina	*Lolium Perenne*	*Setaria lindenbergiana*
Ehrharta calycina	*Melinis repens*	*Themeda triandra*
Elionurus muticus	*Monocymbium ceresiiforme*	*Tripogon minimis*
Elionurus muticus	*Panicum eckiomii*	