Avifaunal Habitat Assessment of:

NKOSI CITY MIXED-USED DEVELOPMENT

May 2017

Report author:

Dr Pieter I. Olivier

Pr. Nat. Sci. (400119/17)

E-mail: pieter@mapss.co.za

Tel no: 084 612 7724

M.A.P SCIENTIFIC SERVICES

DECLARATION OF INDEPENDENCE:

I, Pieter Ignatius Olivier (8304095030084), declare that I:

- am committed to biodiversity conservation but also recognize the need for economic development. Whereas I appreciate the opportunity to learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them;
- act as an independent specialist consultant in the field of ornithology;
- am subcontracted as specialist consultant by Bokamaso Environmental Consulting for the proposed Nkosi City development described in this report;
- have no financial interest in the proposed development other than remuneration for work performed;
- neither have nor will have any vested or conflicting interests in the proposed development;
- undertake to disclose to Bokamaso Environmental Consulting and its client, and the competent authority, any material information that has or may have the potential to influence decisions by the competent authority as required in terms of the Environmental Impact Assessment Regulations, 2010.

Pieter I. Olivier

BSc (Ecology), BSc (Hons) (Zoology), MSc (Zoology), PhD (Zoology), Pr. Sci. Nat (Ecological Science).

SACNASP Registration number: 400119/17

Table of Contents

1. INTRODUCTION 4
2. SCOPE AND OBJECTIVES OF THE STUDY 4
3. STUDY AREA 5
   3.1 LOCALITY 5
   3.2 LAND-USE 5
   3.3 BIOPHYSICAL INFORMATION 5
4. METHODS 8
   4.1 FIELD SURVEYS 8
   4.2 DESKTOP SURVEYS 8
5. RESULTS 8
   5.1 AVIFAUNAL HABITAT ASSESSMENT 8
   5.2 OBSERVED AND EXPECTED SPECIES RICHNESS 12
   5.3 RED LIST AVIFAUNAL SPECIES 20
   5.4 SUMMARY OF RED LIST AVIFAUNAL SPECIES 21
6. FINDINGS AND POTENTIAL IMPLICATIONS 28
   6.1 RED LIST AVIFAUNAL SPECIES CONFIRMED FOR THE STUDY AREA 28
   6.2 IMPORTANT BIRD AREAS AND PROTECTED ENVIRONMENTS 28
7. LIMITATIONS, ASSUMPTIONS AND KNOWLEDGE GAPS 30
8. DISCUSSION AND RECOMMENDED MITIGATION MEASURES 30
9. CONCLUSIONS 33
10. REFERENCES 34
11. SUPPORTING INFORMATION 37
   11.1 DESKTOP SURVEYS 37

1. INTRODUCTION

Dr Pieter Olivier of M.A.P Scientific Services was sub-contracted by Bokamoso Environmental Consultants to form part of the independent team of specialists to undertake an avifaunal specialist assessment for the Nkosi City mixed-use development. The project is still in the scoping phase, but if it goes ahead will include business, institutional, industrial, bonded housing, social housing and farming activities. This assignment was in accordance with the 2014 EIA Regulations (No 982 -984) emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

The primary objective of the study was to determine the presence of Red List avifaunal species and evaluate the impact of the proposed mixed-use development on these species. Furthermore, the study aimed to identify suitable habitat for Red List avifaunal species and to propose mitigation measures should the development proceed. Direct observations and published information were used to determine the likely presence and/or absence of Red List avifaunal species.

2. SCOPE AND OBJECTIVES OF THE STUDY

- To provide a list of avifauna that occur, or are likely to occur, on the study site;
- To identify species of conservation importance (Red List species) that occur, or are likely to occur, on the study site;
- To describe avifaunal habitats on the study site;
- To identify and comment on ecologically sensitive areas;
- To highlight potential impacts of the proposed developments on the avifauna of the study site;
- To propose management recommendations to mitigate negative impacts should the development proceed.

3. STUDY AREA

3.1 LOCALITY

The study site is situated adjacent to Pienaar and Daantjie east of Mbombela in the Mbombela Local Municipality, Mpumalanga. The Kruger National Park (KNP) and the Mthethomusha Game Reserve is located approximately 5km east and 7km south-east of the study site respectively. To the north, the Phakane and Hlauhlau residential areas borders the study site, while the Luphisi stream formed the study site's southern boundary (Fig. 1).

3.2 LAND-USE

The study site is relatively undisturbed savanna interspersed with rocky outcrops. Signs of livestock and grazing activities were common. There were also parts of the study site where habitats were transformed to agricultural fields, low density settlements and sand mines. A tar road bisected the study site, with areas to the west of the road generally more disturbed than those to the east.

3.3 BIOPHYSICAL INFORMATION

The study site was located in a summer rainfall region with dry winters. Mean annual precipitation ranged from 550 - 800 mm per year, while the mean monthly maximum and minimum temperatures for the nearby (~35 km) Pretoriuskop rest camp in the Kruger National Park were 37.3°C and 5.2°C respectively.

The geology of the area was granite and gneiss from the Nelspruit Suite, which form hills with large boulders and shallow coarse sandy lithosols, largely comprised of Glenrosa or Mispah soil types. Some rocks were also weathered and formed a shallow, leached, red to yellow-brown sand of the Glenrosa, Hutton and Clovelly forms (Mucina and Rutherford, 2006)

The vegetation comprised Malelane Mountain Bushveld (approximately 90%), Pretoriuskop Sour Bushveld, and a small area of Crocodile Gorge Mountain Bushveld in the north-western corner of the study site (Mucina and Rutherford, 2006) (Fig. 2). Malelane Mountain Bushveld features open savanna on mountains and higher-lying slopes, with open or dense short mountain bushveld on rocky outcrops and lower lying areas. *Pterocarpus angolensis* is the largest tree frequently encountered in this vegetation type. Small tree species are more numerous and include: *Senegalia caffra, Senegalia davyi, Combretum molle, Dombeya rotundifolia, Faurea saligna, Heteropyxis natalensis, Kirkia wilmsii, Sterculia murex, Acacia swazica, Combretum collinum suluense, C. zeyher, Englerophytum magalismontanum,*

Ficus abutilifolia, Maytenus undata, Mimusops zeyheri, Pterocarpus rotundifolius, Rhus leptodictya, Terminalia sericea, Vitex obovata. Succulents (e.g. *Euphorbia cooperi*), tall shrubs (e.g. *Acalypha glabrata, Croton madandensis, Diospyros lycoides sericea, Grewia monticola*) and low shrubs (e.g. *Barleria rotundifolia, Orthosiphon labiatus, Polygala producta*) are also common. Graminoids typically found here include *Bothrichloa radicans, Enneapogon scoparius, Eragrostis rigidior, Eustachys paspaloides* and *Heterpogon contortus*. About 39% of a targeted 24% is statutorily conserved in the Kruger National Park (KNP), the vegetation type is therefore considered least threatened. An estimated 4% is transformed by cultivation and urban and rural settlements.

Pretoriuskop Sour Bushveld is an open tree savanna dominated by *Terminalia sericea* and *Dichrostachys cinerea* with relatively few low shrubs (e.g. *Agathisanthemum bojeri*, *Baleria obtuse*, *Sida chrysantha*). The dense grassy layer is dominated by sour grasses such as *Hyperthelia dissolute*, *Elionurus muticus* and *Hyparrhenia hirta*. Grass composition changes along the midslopes and in the narrow bottomlands dominant species include *Acacia nilotica*, *A. gerrardii* and *A. tortilis*, *Digitaria eriantha*, *Eragrostis superba* and *Aristida congesta*. This vegetation type is classified as least threatened, with some 40% statutorily conserved in the Kruger National Park (KNP). Some 16% is transformed by cultivation and development of settlements (Mucina and Rutherford 2006).

Crocodile Gorge Mountain Bushveld occupied a small area (<5%) of the north-western section of the study site (Fig. 2). It is characterised by open savanna on mountains and higher lying slopes, and short mountain bushveld on rocky outcrops and lower-lying areas. Plant species composition affected by altitude and aspect. Small trees include *Vachellia davyi*, *Combretum molle*, and *Heteropyxis natalensis,* while tall and low shrubs species such as *Olea capensis, Canthium inerme*, *Flemingia grahamiana*, and *Helichrysum kraussii* are also common. The vegetation type is classified as least threatened, with about 39% and 6% conserved in the KNP and the Mthethomusha Nature Reserve respectively. At least 4% is transformed, mainly by cultivation and urban and built-up areas. All information on vegetation types were sourced from Mucina and Rutherford (2006).

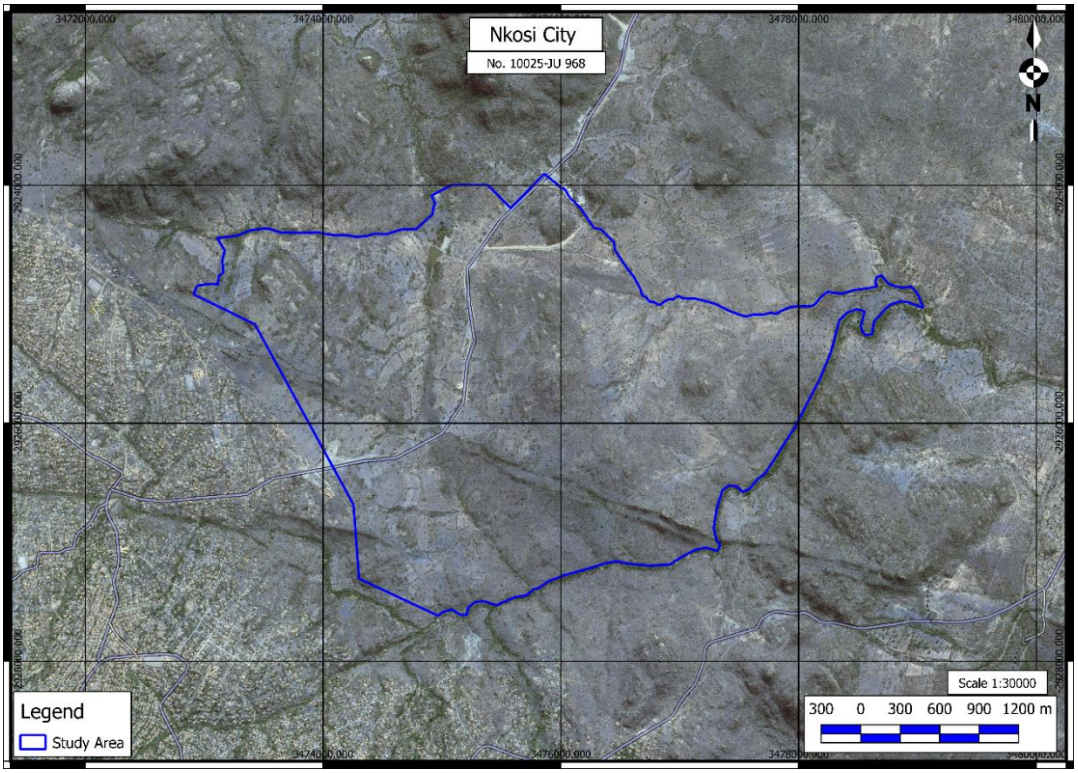

Figure 1. Locality map of the study site.

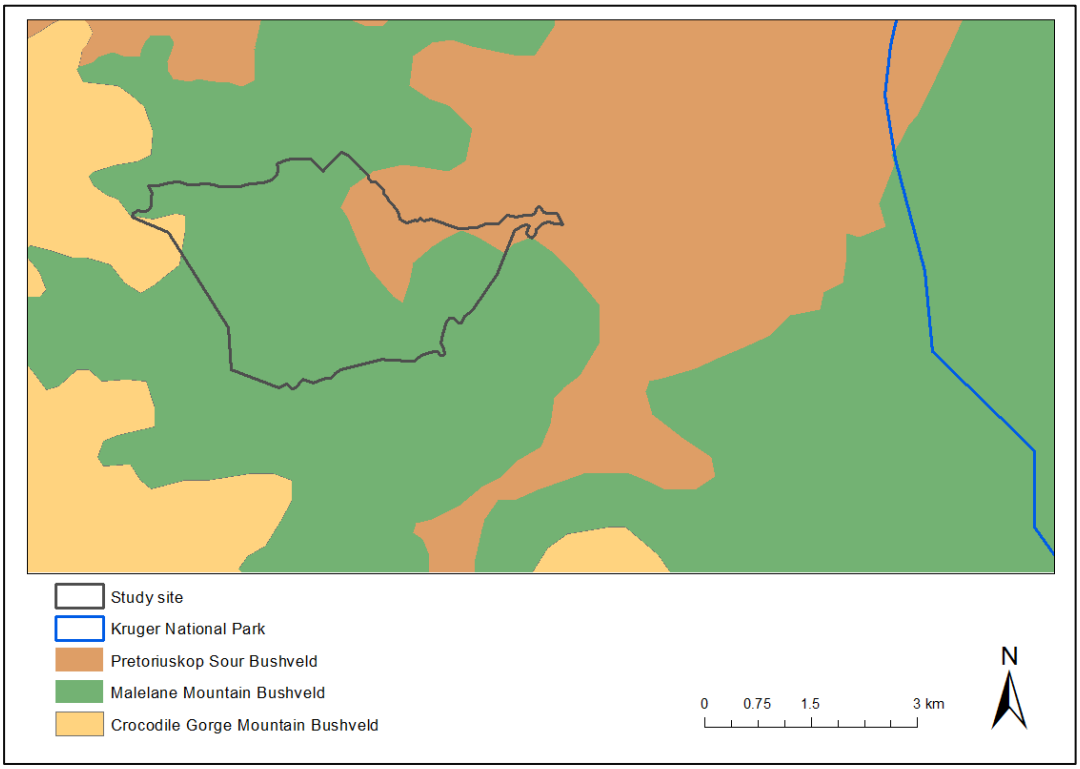

Figure 2. Vegetation types of the study site following the classification of Mucina and Rutherford (2006). Shapefiles denoting the vegetation types were downloaded from www.bgis.sanbi.org

4. METHODS

4.1 FIELD SURVEYS

Bird species were identified visually and by call using 10x42 Zeis Victory binoculars. Surveys comprised random point counts on the study site and were conducted on the 9th of May 2017. Identifications were verified with field guides (Sasol Birds of Southern Africa, Sinclair et al., 2013) and audio recordings (Southern African Bird Sounds, Gibbon, 1991). No trapping or mist netting was conducted. Bird species were also identified from feathers, nests, signs, burrows or roosting sites.

4.2 DESKTOP SURVEYS

Two approaches were employed to determine the likely occurrence of bird species on the study site. First, the study site was located close to the south-western boundary of the Kruger National Park (~5 km) and shared the same vegetation type (Fig. 2). It therefore follows that species found within this habitat type in the KNP are also highly likely to occur on the study site. To identify these species, bird species lists for this section of Kruger were sourced from Birds in Reserves Project (www.birp.adu.org.za), Birding in Kruger National Park (www.birdingkrugerpark.co.za) and the published literature (Hausler & Slater 2017).

Second, bird species that could potentially occur on the study site were verified from the distribution records obtained during the South African Bird Atlas Project 1 and 2 (SABAP1 & SABAP2). Thereafter, the presence of suitable habitats was used to deduce the likelihood of presence and/or absence of bird species. This likelihood was inferred from the scientific literature (e.g. Barnes 2000; Hockey et al., 2005; Taylor et al. 2015), field guides (Sinclair et al., 2013), and the South African Bird Atlas Project (www.sabap.org). Particular care was taken to identify threatened (i.e. Red List) bird species that had the potential to occur on the study site. The Supplementary Material contains a detailed description on how the potential occurrence of bird species were verified using the information from SABAP1 and SABAP2.

5. RESULTS

5.1 AVIFAUNAL HABITAT ASSESSMENT

The habitat on the study site mostly comprised Malelane Mountain Bushveld (~ 90%), while the rest was made up of Pretoriuskop Sour Bushveld and Crocodile Gorge Mountain Bushveld (see section 3.3 for a detailed description). Both habitat types were characterised by a mixture

of trees, shrubs and grasses, typical of savanna habitats. Vegetation varied from tall dense woodland patches, to open woodland and dense thickets. Rocky outcrops covered by trees and bush clumps were also scattered across the site. During the survey, a number of mixed-species foraging flocks (MSFFs) were recorded within this habitat. MSFFS can be defined as aggregations of more than two species that actively initiate and continue their association while foraging, without being drawn to a single resource (Harrison & Whitehouse 2011). MSFFs are typically led by a particular species, a role fulfilled by a so-called 'nucleus species', that are wholly or partially responsible for the formation and continued cohesion of the MSFF (Goodale & Beauchamp 2010). In this survey, the most frequent encountered species within MSFFs were the Fork-tailed Drongo (*Dicrurus adsimilis*) and the Chinspot Batis (*Batis molitor*), both which could act as nucleus species in this habitat. Other species that were often recorded in MSFFs during the survey were the Long-billed Crombeck (*Sylvietta rufescens*), Black-backed Puffback (*Dryoscopus cubla*), Yellow-breasted Apalis (*Apalis flavida*) and Tawny-flanked Prinia (*Prinia subflava*). Such positive associations between species in MSFFs could be to facilitate more efficient foraging by flushing prey from the vegetation through which they move. None of the species that made up MSFFs were Red List species – however inconspicuous MSFF participants such as Stierling's Wren-Warbler (*Calamonastes stierlingi*) may have been under-recorded because of the dense nature of some of the areas surveyed in this habitat type. Red List species that could forage and/or breed within this habitat include the Bateleur (*Terathopius ecaudatus*), Martial Eagle (*Polemaetus bellicosus*), Tawny Eagle (*Aquila rapax*), Southern Ground Hornbill (*Bucorvus leadbeateri*), as well as four vulture species: Hooded (*Necrosyrtes monachus*), Lappet-faced (*Torgos tracheliotos*), White-headed (*Trigonoceps occipitalis*) and White-backed Vulture (*Gyps africanus*).

The Luphisi stream represented the southern boundary of the study site. Riverine vegetation were prevalent along this watercourse and varied from dense thicket to open woodland where a few large trees were dominant. Water flows varied from fast flowing, clear water to pools of stagnant water. Because the survey was conducted during the dry season, sand banks were prevalent along the stream. No water birds were recorded during the survey, however species closely associated with water such as the Water Thick-knee (*Burhinus vermiculatus*) and Malachite Kingfisher (*Alcedo cristata*) did occur here. A man-made dam was also present on the study site, which may also attract bird species closely associated with water. However, during the survey only common water birds such as Egyptian Geese (*Alopochen aegyptiaca*) and White-faced Whistling Ducks (*Dendrocygna viduata*) were

recorded. Red List species that may utilize these aquatic habitats include African Finfoot (*Podica senegalensis*), Half-collared Kingfisher (*Alcedo semitorquata*) and possibly four stork species: Abdims (*Ciconia abdimii*), Black (*Ciconia nigra*), Marabou (*Leptoptilos crumenifer*), Saddle-billed (*Ephippiorhynchus senegalensis*) and Yellow-billed (*Mycteria ibis*) Stork

Large parts of the study site were undisturbed or only influenced by small-scale, local disturbances. For example, signs of livestock and specifically cattle grazing were prevalent across all habitat types. However, there were also parts of the study site where habitats were completely transformed to agricultural fields, settlements and sand mines. This was specifically the case to the west of the tar road (Fig 3a). The Dark-capped Bulbul (*Pycnonotus tricolor*) was the species most often recorded in these areas. The Sombre Greenbul (*Andropadus importunes*), Cape Turtle Dove (*Streptopelia capicola*) and Bronze Manniken (*Lonchura cucullata*) were also recorded regularly here. It is unlikely that this habitat would harbour any Red List species, however the Lanner Falcon (*Falco biarmicus*) and some of the raptors listed above for savanna habitats may occasionally forage here.

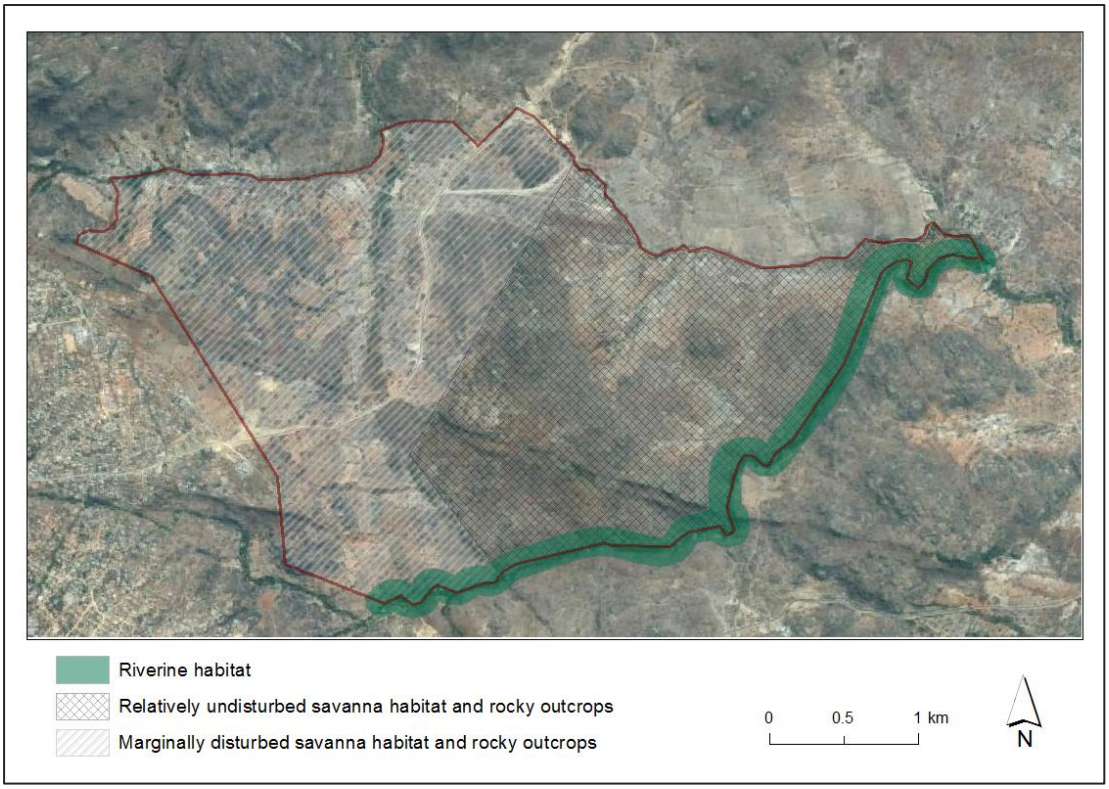

Figure 3. Habitat types present on the study site. Sensitive riverine habitats were present along the Luphisi stream. The rest of the study site was made up of savanna habitats and rocky outcrops that were exposed to small scale, local disturbances. It was not possible to accurate delineate disturbed and undisturbed savanna areas on the map – however savanna habitats east of the tar road were generally less disturbed than those west of the road, and is indicated as such on the map.

Figure 4. a) Typical savanna habitats and b) rocky outcrops on the study site. Local disturbances such as sand mining operations (c) and rubbish dumping (d). Habitats that could attract bird species closely associated with water: g) man-made dam, and h) sensitive riverine habitats along the Luphisi stream.

5.2 OBSERVED AND EXPECTED SPECIES RICHNESS

During the survey, 62 bird species were recorded (Table 1). The most frequently recorded species were the Dark-capped Bulbul (*Pycnonotus tricolor*), Fork-tailed Drongo (*Cossypha caffra*), Chinspot Batis (*Acridotheres tristis*) and Cape Turtle Dove (*Streptopelia capicola*) (Fig. 5). Based on SABAP1 and SABAP2 records a total of 334 bird species have been recorded for the QDGC 2531 AD where the study site was located. Of these 75 (22%) had a high-, 101 (30%) had a moderate-, and 96 (28%) had a low likelihood of occurring on the study site (Table 1).

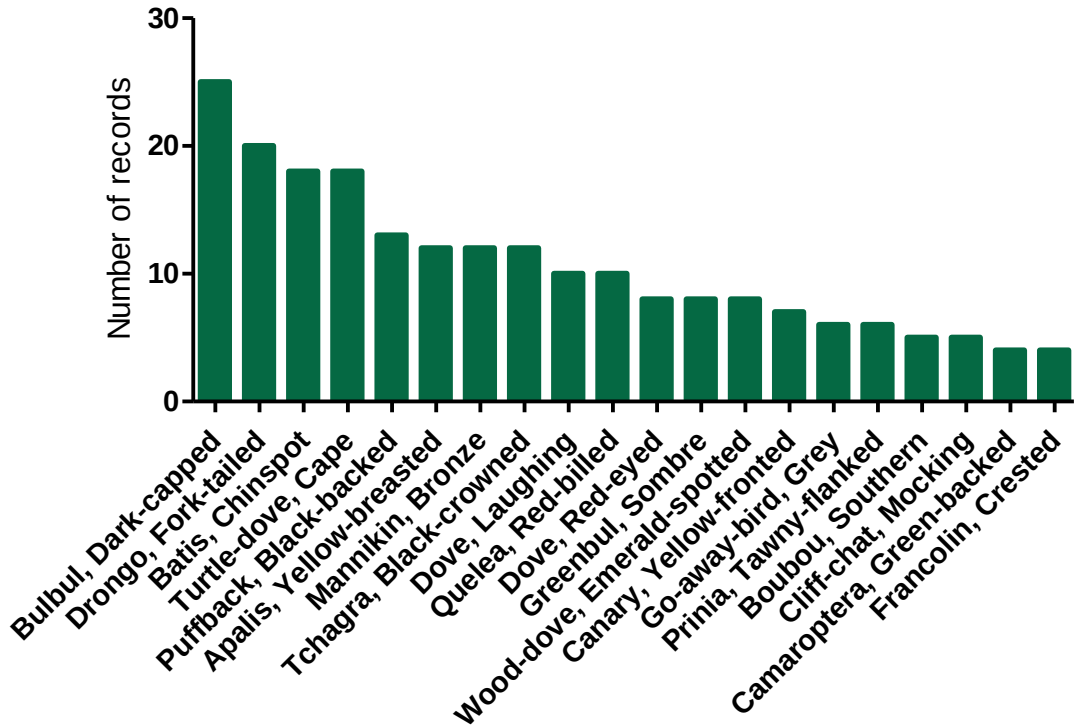

Figure 5. Rank abundance distribution showing the 20 bird species most often recorded during the survey.

Bird lists sourced for the adjacent KNP, lists 44 species that are typically found in Malelane Mountain Bushveld and Pretoriuskop Sour Bushveld that have not been recorded during the survey. These species are therefore likely to also occur, or occasionally forage on the study site. The similar habitats present on the study site and the south-western section of the KNP suggest that the study site might harbour a nested assemblage of the KNP bird community. Indeed, the 62 bird species that were recorded on the study site have all been recorded in the KNP.

Table 1: Avifaunal species that are likely to occur on the study site. Species recorded on the study site are highlighted in green. Species typical of Malelane Mountain Bushveld and Pretoriuskop Sour Bushveld are highlighted in yellow. Species names in bold indicate Red List species that have been recorded in the 2531AD QDGC.

Common name	Scientific name	Reporting rate	Probability of occurrence
Apalis, Bar-throated	*Apalis thoracica*	3.12	Moderate
Apalis, Yellow-breasted	*Apalis flavida*	50.78	Present
Babbler, Arrow-marked	*Turdoides jardineii*	70.31	High
Barbet, Acacia Pied	*Tricholaema leucomelas*	5.85	Moderate
Barbet, Black-collared	*Lybius torquatus*	82.81	Present
Barbet, Crested	*Trachyphonus vaillantii*	75.00	High
Bateleur (EN)	***Terathopius ecaudatus***	46.87	Moderate
Batis, Cape	*Batis capensis*	0.39	Low
Batis, Chinspot	*Batis molitor*	61.32	Present
Bee-eater, European	*Merops apiaster*	39.84	High
Bee-eater, Little	*Merops pusillus*	10.54	Present
Bee-eater, Southern Carmine	*Merops nubicoides*	0.78	Low
Bee-eater, White-fronted	*Merops bullockoides*	52.34	High
Bishop, Southern Red	*Euplectes orix*	3.12	Present
Bittern, Dwarf	*Ixobrychus sturmii*	0.78	Low
Bittern, Little	*Ixobrychus minutus*	0.39	Low
Boubou, Southern	*Laniarius ferrugineus*	34.37	Present
Brownbul, Terrestrial	*Phyllastrephus terrestris*	7.81	Moderate
Brubru, Brubru	*Nilaus afer*	41.01	Present
Buffalo-weaver, Red-billed	*Bubalornis niger*	28.51	Moderate
Bulbul, Dark-capped	*Pycnonotus tricolor*	89.84	Present
Bunting, Cinnamon-breasted	*Emberiza tahapisi*	19.53	High
Bunting, Golden-breasted	*Emberiza flaviventris*	54.68	Present
Bush-shrike, Gorgeous	*Telophorus quadricolor*	1.17	Moderate
Bush-shrike, Grey-headed	*Malaconotus blanchoti*	56.64	Present
Bush-shrike, Olive	*Telophorus olivaceus*	1.17	Low
Bush-shrike, Orange-breasted	*Telophorus sulfureopectus*	54.29	High
Bustard, Black-bellied	*Lissotis melanogaster*	1.95	Moderate
Bustard, Kori (NT)	***Ardeotis kori***	0.39	**Low**
Buttonquail, Kurrichane	*Turnix sylvaticus*	1.56	Low
Buzzard, Jackal	*Buteo rufofuscus*	1.17	Moderate
Buzzard, Lizard	*Kaupifalco monogrammicus*	4.69	High
Buzzard, Steppe	*Buteo vulpinus*	8.59	High
Camaroptera, Green-backed	*Camaroptera brachyura*	50.39	Present
Canary, Black-throated	*Crithagra atrogularis*	0.78	Low
Canary, Brimstone	*Crithagra sulphuratus*	0.39	Low
Canary, Cape	*Serinus canicollis*	67.58	High
Canary, Yellow-fronted	*Crithagra mozambicus*	3.13	Present
Chat, Familiar	*Cercomela familiaris*	10.94	Moderate
Cisticola, Croaking	*Cisticola natalensis*	12.89	Low
Cisticola, Lazy	*Cisticola aberrans*	0.39	Low

Cisticola, Levaillant's	*Cisticola tinniens*	69.92	High
Cisticola, Rattling	*Cisticola chiniana*	1.17	Present
Cisticola, Red-faced	*Cisticola erythrops*	13.28	Moderate
Cisticola, Zitting	*Cisticola juncidis*	5.08	Low
Cliff-chat, Mocking	*Thamnolaea cinnamomeiventris*	5.08	Present
Coot, Red-knobbed	*Fulica cristata*	25.00	Low
Cormorant, Reed	*Phalacrocorax africanus*	2.34	Low
Cormorant, White-breasted	*Phalacrocorax carbo*	35.94	Low
Coucal, Burchell's	*Centropus burchellii*	1.95	High
Courser, Bronze-winged	*Rhinoptilus chalcopterus*	14.45	Moderate
Crake, Black	*Amaurornis flavirostris*	0.39	Low
Crested-flycatcher, Blue-mantled	*Trochocercus cyanomelas*	60.16	Low
Crombec, Long-billed	*Sylvietta rufescens*	2.73	Present
Crow, Pied	*Corvus albus*	5.47	Moderate
Cuckoo, African	*Cuculus gularis*	0.39	Moderate
Cuckoo, African Emerald	*Chrysococcyx cupreus*	8.59	Low
Cuckoo, Black	*Cuculus clamosus*	23.83	Moderate
Cuckoo, Diderick	*Chrysococcyx caprius*	13.28	Moderate
Cuckoo, Jacobin	*Clamator jacobinus*	17.97	Moderate
Cuckoo, Klaas's	*Chrysococcyx klaas*	20.70	Moderate
Cuckoo, Levaillant's	*Clamator levaillantii*	14.45	Moderate
Cuckoo, Red-chested	*Cuculus solitarius*	25.78	High
Cuckoo, Thick-billed	*Pachycoccyx audeberti*	0.78	Low
Cuckoo-shrike, Black	*Campephaga flava*	12.89	High
Darter, African	*Anhinga rufa*	2.73	Low
Dove, African Mourning	*Streptopelia decipiens*	0.78	Low
Dove, Laughing	*Streptopelia senegalensis*	71.88	Present
Dove, Lemon	*Aplopelia larvata*	0.39	Low
Dove, Namaqua	*Oena capensis*	0.78	Moderate
Dove, Red-eyed	*Streptopelia semitorquata*	53.52	Present
Dove, Tambourine	*Turtur tympanistria*	2.34	Low
Drongo, Fork-tailed	*Dicrurus adsimilis*	83.98	Present
Drongo, Square-tailed	*Dicrurus ludwigii*	0.78	Low
Duck, Comb	*Sarkidiornis melanotos*	5.47	Low
Duck, White-faced	*Dendrocygna viduata*	18.75	Present
Duck, Yellow-billed	*Anas undulata*	4.42	Present
Eagle, African Crowned (VU)	***Stephanoaetus coronatus***	0.39	**Low**
Eagle, Lesser Spotted	*Aquila pomarina*	1.95	Low
Eagle, Long-crested	*Lophaetus occipitalis*	0.78	Low
Eagle, Martial (EN)	***Polemaetus bellicosus***	8.98	Moderate
Eagle, Steppe	*Aquila nipalensis*	1.56	Moderate
Eagle, Tawny (EN)	***Aquila rapax***	18.75	Moderate
Eagle, Wahlberg's	*Aquila wahlbergi*	30.08	Moderate
Eagle-owl, Spotted	*Bubo africanus*	1.95	High
Eagle-owl, Verreaux's	*Bubo lacteus*	3.91	**Moderate**
Egret, Cattle	*Bubulcus ibis*	20.70	High
Egret, Great	*Egretta alba*	6.64	Low
Egret, Little	*Egretta garzetta*	7.81	Moderate

Egret, Yellow-billed	*Egretta intermedia*	2.73	Low
Eremomela, Burnt-necked	*Eremomela usticollis*	0.39	Low
Eremomela, Green-capped	*Eremomela scotops*	0.78	Moderate
Eremomela, Yellow-bellied	*Eremomela icteropygialis*	6.64	Moderate
Falcon, Amur	*Falco amurensis*	4.30	Low
Falcon, Lanner (VU)	***Falco biarmicus***	1.56	**Low**
Falcon, Peregrine	*Falco peregrinus*	0.78	Low
Finch, Cuckoo	*Anomalospiza imberbis*	1.56	Moderate
Finch, Cut-throat	*Amadina fasciata*	0.78	Low
Finfoot, African (VU)	***Podica senegalensis***		Moderate
Firefinch, African	*Lagonosticta rubricata*	5.47	Present
Firefinch, Jameson's	*Lagonosticta rhodopareia*	9.77	High
Firefinch, Red-billed	*Lagonosticta senegala*	6.25	High
Fiscal, Common (Southern)	*Lanius collaris*	1.17	Present
Fish-eagle, African	*Haliaeetus vocifer*	31.64	Moderate
Flycatcher, African Dusky	*Muscicapa adusta*	4.69	High
Flycatcher, Ashy	*Muscicapa caerulescens*	17.97	High
Flycatcher, Fiscal	*Sigelus silens*	0.78	Moderate
Flycatcher, Pale	*Bradornis pallidus*	8.20	Moderate
Flycatcher, Southern Black	*Melaenornis pammelaina*	43.36	Present
Flycatcher, Spotted	*Muscicapa striata*	26.56	Present
Francolin, Coqui	*Peliperdix coqui*	3.91	Moderate
Francolin, Crested	*Dendroperdix sephaena*	50.39	Present
Francolin, Shelley's	*Scleroptila shelleyi*	1.95	Moderate
Go-away-bird, Grey	*Corythaixoides concolor*	83.98	Present
Goose, Egyptian	*Alopochen aegyptiacus*	51.56	Present
Goshawk, African	*Accipiter tachiro*	1.95	High
Goshawk, Dark Chanting	*Melierax metabates*	4.69	High
Goshawk, Gabar	*Melierax gabar*	6.25	Moderate
Grebe, Little	*Tachybaptus ruficollis*	11.33	Present
Greenbul, Sombre	*Andropadus importunus*	66.02	Present
Greenbul, Yellow-bellied	*Chlorocichla flaviventris*	2.34	Moderate
Green-pigeon, African	*Treron calvus*	52.73	High
Greenshank, Common	*Tringa nebularia*	1.95	Low
Ground-hornbill, Southern (EN)	***Bucorvus leadbeateri***	18.36	**Moderate**
Guineafowl, Helmeted	*Numida meleagris*	47.27	High
Hamerkop, Hamerkop	*Scopus umbretta*	34.77	High
Harrier-Hawk, African	*Polyboroides typus*	5.47	Moderate
Hawk, African Cuckoo	*Aviceda cuculoides*	0.39	Low
Hawk, Bat (EN)	***Macheiramphus alcinus***	0.39	**Low**
Hawk-eagle, African	*Aquila spilogaster*	12.11	Moderate
Helmet-shrike, Retz's	*Prionops retzii*	15.63	Moderate
Helmet-shrike, White-crested	*Prionops plumatus*	14.45	High
Heron, Black	*Egretta ardesiaca*	0.39	Low
Heron, Black-headed	*Ardea melanocephala*	1.17	Moderate
Heron, Goliath	*Ardea goliath*	1.17	Low
Heron, Green-backed	*Butorides striata*	26.17	High
Heron, Grey	*Ardea cinerea*	17.58	Moderate

Heron, Purple	*Ardea purpurea*	0.78	Moderate
Heron, Squacco	*Ardeola ralloides*	0.39	Low
Hobby, Eurasian	*Falco subbuteo*	3.91	Low
Honeybird, Brown-backed	*Prodotiscus regulus*	0.39	Moderate
Honeyguide, Greater	*Indicator indicator*	7.81	High
Honeyguide, Lesser	*Indicator minor*	7.42	High
Honeyguide, Scaly-throated	*Indicator variegatus*	35.55	Moderate
Hoopoe, African	*Upupa africana*	57.81	High
Hornbill, Crowned	*Tockus alboterminatus*	0.39	Moderate
Hornbill, Red-billed	*Tockus erythrorhynchus*	55.47	High
Hornbill, Southern Yellow-billed	*Tockus leucomelas*	69.92	High
Hornbill, Trumpeter	*Bycanistes bucinator*	4.69	Low
House-martin, Common	*Delichon urbicum*	0.39	Low
Ibis, African Sacred	*Threskiornis aethiopicus*	0.78	Moderate
Ibis, Hadeda	*Bostrychia hagedash*	39.84	Present
Indigobird, Dusky	*Vidua funerea*	4.30	Present
Indigobird, Purple	*Vidua purpurascens*	3.13	High
Indigobird, Village	*Vidua chalybeata*	1.56	High
Jacana, African	*Actophilornis africanus*	21.88	Moderate
Kingfisher, Brown-hooded	*Halcyon albiventris*	64.06	Present
Kingfisher, Giant	*Megaceryle maximus*	6.25	Moderate
Kingfisher, Grey-headed	*Halcyon leucocephala*	2.34	Moderate
Kingfisher, Half-collared (NT)	***Alcedo semitorquata***		Moderate
Kingfisher, Malachite	*Alcedo cristata*	14.45	Present
Kingfisher, Pied	*Ceryle rudis*	25.39	High
Kingfisher, Striped	*Halcyon chelicuti*	12.89	High
Kingfisher, Woodland	*Halcyon senegalensis*	40.23	High
Kite, Black-shouldered	*Elanus caeruleus*	7.42	Moderate
Kite, Yellow-billed	*Milvus aegyptius*	23.83	High
Korhaan, Red-crested	*Lophotis ruficrista*	12.89	High
Lapwing, African Wattled	*Vanellus senegallus*	16.41	Moderate
Lapwing, Blacksmith	*Vanellus armatus*	43.36	Moderate
Lapwing, Crowned	*Vanellus coronatus*	8.59	Present
Lark, Dusky	*Pinarocorys nigricans*	0.39	Low
Lark, Flappet	*Mirafra rufocinnamomea*	6.25	Moderate
Lark, Monotonous	*Mirafra passerina*	2.34	Low
Lark, Rufous-naped	*Mirafra africana*	10.16	Moderate
Lark, Sabota	*Calendulauda sabota*	10.16	Moderate
Longclaw, Yellow-throated	*Macronyx croceus*	16.80	Moderate
Mannikin, Bronze	*Spermestes cucullatus*	8.98	Present
Martin, Brown-throated	*Riparia paludicola*	3.52	**Low**
Martin, Rock	*Hirundo fuligula*	1.56	Low
Masked-weaver, Lesser	*Ploceus intermedius*	3.52	Low
Masked-weaver, Southern	*Ploceus velatus*	25.78	Moderate
Moorhen, Common	*Gallinula chloropus*	0.39	Moderate
Mousebird, Red-faced	*Urocolius indicus*	36.72	High
Mousebird, Speckled	*Colius striatus*	46.48	Present
Myna, Common	*Acridotheres tristis*	1.17	Moderate

Neddicky, Neddicky	*Cisticola fulvicapilla*	29.69	**High**
Nicator, Eastern	*Nicator gularis*	5.47	**Low**
Night-Heron, Black-crowned	*Nycticorax nycticorax*	1.56	Low
Night-Heron, White-backed	*Gorsachius leuconotus*	1.17	Low
Nightjar, Fiery-necked	*Caprimulgus pectoralis*	17.97	High
Nightjar, Freckled	*Caprimulgus tristigma*	5.47	Moderate
Nightjar, Square-tailed	*Caprimulgus fossii*	3.13	Low
Openbill, African	*Anastomus lamelligerus*	1.56	Low
Oriole, Black-headed	*Oriolus larvatus*	82.03	High
Oriole, Eurasian Golden	*Oriolus oriolus*	1.17	Low
Ostrich, Common	*Struthio camelus*	0.39	Low
Owl, Barn	*Tyto alba*	3.13	Moderate
Owlet, African Barred	*Glaucidium capense*	5.47	Moderate
Owlet, Pearl-spotted	*Glaucidium perlatum*	19.92	Moderate
Oxpecker, Red-billed	*Buphagus erythrorhynchus*	74.22	High
Oxpecker, Yellow-billed	*Buphagus africanus*	0.39	Low
Palm-swift, African	*Cypsiurus parvus*	37.89	Moderate
Paradise-flycatcher, African	*Terpsiphone viridis*	23.44	Present
Paradise-whydah, Long-tailed	*Vidua paradisaea*	5.47	Moderate
Parrot, Brown-headed	*Poicephalus cryptoxanthus*	61.33	High
Penduline-tit, Grey	*Anthoscopus caroli*	7.81	Moderate
Petronia, Yellow-throated	*Petronia superciliaris*	28.13	Moderate
Pigeon, Speckled	*Columba guinea*	0.78	Moderate
Pipit, African	*Anthus cinnamomeus*	3.91	High
Pipit, Buffy	*Anthus vaalensis*	0.78	Moderate
Pipit, Bushveld	*Anthus caffer*	5.86	Present
Pipit, Striped	*Anthus lineiventris*	1.17	Moderate
Plover, Three-banded	*Charadrius tricollaris*	39.06	Moderate
Prinia, Tawny-flanked	*Prinia subflava*	69.14	Present
Puffback, Black-backed	*Dryoscopus cubla*	76.17	Present
Pygmy-Kingfisher, African	*Ispidina picta*	1.56	Moderate
Pytilia, Green-winged	*Pytilia melba*	6.25	High
Quail, Harlequin	*Coturnix delegorguei*	0.78	Low
Quailfinch, African	*Ortygospiza atricollis*	0.39	Moderate
Quelea, Red-billed	*Quelea quelea*	13.28	Present
Reed-warbler, African	*Acrocephalus baeticatus*	0.78	Low
Robin-chat, Cape	*Cossypha caffra*	1.95	Present
Robin-chat, Chorister	*Cossypha dichroa*	0.39	Low
Robin-chat, Red-capped	*Cossypha natalensis*	7.81	Moderate
Robin-chat, White-browed	*Cossypha heuglini*	44.14	Present
Robin-chat, White-throated	*Cossypha humeralis*	17.58	Moderate
Roller, European	*Coracias garrulus*	17.97	High
Roller, Lilac-breasted	*Coracias caudatus*	79.69	Present
Roller, Purple	*Coracias naevius*	6.25	High
Sandgrouse, Double-banded	*Pterocles bicinctus*	1.95	Low
Sandpiper, Common	*Actitis hypoleucos*	6.64	**Low**
Sandpiper, Wood	*Tringa glareola*	14.06	Low
Saw-wing, Black	*Psalidoprocne holomelaena*	0.39	Low

Scimitarbill, Common	*Rhinopomastus cyanomelas*	16.80	High
Scops-owl, African	*Otus senegalensis*	28.13	High
Scops-owl, Southern White-faced	*Ptilopsus granti*	1.17	Moderate
Scrub-robin, Bearded	*Cercotrichas quadrivirgata*	0.39	Present
Scrub-robin, White-browed	*Cercotrichas leucophrys*	54.30	High
Secretarybird (VU)	***Sagittarius serpentarius***		**Low**
Seedeater, Streaky-headed	*Crithagra gularis*	4.69	Moderate
Shikra, Shikra	*Accipiter badius*	2.73	Moderate
Shrike, Lesser Grey	*Lanius minor*	0.78	Low
Shrike, Magpie	*Corvinella melanoleuca*	61.33	Moderate
Shrike, Red-backed	*Lanius collurio*	19.92	Moderate
Shrike, Southern White-crowned	*Eurocephalus anguitimens*	8.20	Present
Snake-eagle, Black-chested	*Circaetus pectoralis*	2.73	Moderate
Snake-eagle, Brown	*Circaetus cinereus*	17.58	Moderate
Sparrow, House	*Passer domesticus*	5.86	High
Sparrow, Northern Grey-headed	*Passer griseus*	0.78	Low
Sparrow, Southern Grey-headed	*Passer diffusus*	56.64	Present
Sparrowhawk, Black	*Accipiter melanoleucus*	1.17	Low
Sparrowhawk, Little	*Accipiter minullus*	8.98	Moderate
Spoonbill, African	*Platalea alba*	0.78	**Low**
Spurfowl, Natal	*Pternistis natalensis*	81.25	Present
Spurfowl, Swainson's	*Pternistis swainsonii*	19.53	High
Starling, Black-bellied	*Lamprotornis corruscus*	1.56	Low
Starling, Burchell's	*Lamprotornis australis*	17.58	High
Starling, Cape Glossy	*Lamprotornis nitens*	77.73	High
Starling, Greater Blue-eared	*Lamprotornis chalybaeus*	61.72	High
Starling, Red-winged	*Onychognathus morio*	11.33	Moderate
Starling, Violet-backed	*Cinnyricinclus leucogaster*	31.64	High
Starling, Wattled	*Creatophora cinerea*	2.34	Moderate
Stilt, Black-winged	*Himantopus himantopus*	1.56	Low
Stonechat, African	*Saxicola torquatus*	1.17	Present
Stork, Black (VU)	***Ciconia nigra***	2.73	**Low**
Stork, Marabou (NT)	***Leptoptilos crumeniferus***	43.75	**Low**
Stork, Saddle-billed (EN)	***Ephippiorhynchus senegalensis***	1.56	**Low**
Stork, White	*Ciconia ciconia*	0.39	Low
Stork, Woolly-necked	*Ciconia episcopus*	4.30	Low
Stork, Yellow-billed (EN)	***Mycteria ibis***	1.17	**Low**
Sunbird, Amethyst	*Chalcomitra amethystina*	12.11	Present
Sunbird, Collared	*Hedydipna collaris*	12.89	High
Sunbird, Marico	*Cinnyris mariquensis*	14.84	Moderate
Sunbird, Purple-banded	*Cinnyris bifasciatus*	1.56	Moderate
Sunbird, Scarlet-chested	*Chalcomitra senegalensis*	48.44	High
Sunbird, White-bellied	*Cinnyris talatala*	67.19	Present
Swallow, Barn	*Hirundo rustica*	41.80	High
Swallow, Greater Striped	*Hirundo cucullata*	0.39	Moderate

Swallow, Grey-rumped	*Pseudhirundo griseopyga*	2.34	Low
Swallow, Lesser Striped	*Hirundo abyssinica*	48.83	High
Swallow, Red-breasted	*Hirundo semirufa*	16.41	Moderate
Swallow, White-throated	*Hirundo albigularis*	0.78	Low
Swallow, Wire-tailed	*Hirundo smithii*	26.17	Low
Swamp-warbler, Lesser	*Acrocephalus gracilirostris*	0.39	Low
Swift, African Black	*Apus barbatus*	2.73	Low
Swift, Common	*Apus apus*	0.78	Low
Swift, Horus	*Apus horus*	1.56	Low
Swift, Little	*Apus affinis*	29.30	Moderate
Swift, White-rumped	*Apus caffer*	25.39	Moderate
Tchagra, Black-crowned	*Tchagra senegalus*	49.61	Present
Tchagra, Brown-crowned	*Tchagra australis*	35.16	Present
Thick-knee, Spotted	*Burhinus capensis*	7.03	High
Thick-knee, Water	*Burhinus vermiculatus*	51.17	Present
Thrush, Groundscraper	*Psophocichla litsipsirupa*	11.33	Moderate
Thrush, Kurrichane	*Turdus libonyanus*	52.34	High
Thrush, Olive	*Turdus olivaceus*	0.39	Low
Tinkerbird, Yellow-fronted	*Pogoniulus chrysoconus*	6.64	Present
Tinkerbird, Yellow-rumped	*Pogoniulus bilineatus*	1.95	Low
Tit, Southern Black	*Parus niger*	53.13	High
Tit-flycatcher, Grey	*Myioparus plumbeus*	17.58	High
Turaco, Purple-crested	*Gallirex porphyreolophus*	60.16	High
Turtle-dove, Cape	*Streptopelia capicola*	86.72	Present
Vulture, Hooded (CR)	***Necrosyrtes monachus***	**3.52**	**Low**
Vulture, Lappet-faced (EN)	***Torgos tracheliotus***	**4.69**	**Low**
Vulture, White-backed (CR)	***Gyps africanus***	**31.25**	**Moderate**
Vulture, White-headed (CR)	***Trigonoceps occipitalis***	**1.95**	**Low**
Wagtail, African Pied	*Motacilla aguimp*	33.20	Present
Wagtail, Cape	*Motacilla capensis*	1.56	High
Wagtail, Mountain	*Motacilla clara*	0.39	Low
Warbler, Garden	*Sylvia borin*	0.78	Low
Warbler, Icterine	*Hippolais icterina*	1.56	Moderate
Warbler, Marsh	*Acrocephalus palustris*	3.13	Present
Warbler, Willow	*Phylloscopus trochilus*	10.55	Moderate
Waxbill, Blue	*Uraeginthus angolensis*	69.14	Present
Waxbill, Common	*Estrilda astrild*	16.02	High
Weaver, Cape	*Ploceus capensis*	0.39	Low
Weaver, Red-headed	*Anaplectes rubriceps*	8.98	Moderate
Weaver, Spectacled	*Ploceus ocularis*	29.69	Present
Weaver, Thick-billed	*Amblyospiza albifrons*	4.69	Moderate
Weaver, Village	*Ploceus cucullatus*	5.08	High
White-eye, Cape	*Zosterops virens*	15.23	High
Whydah, Pin-tailed	*Vidua macroura*	16.02	High
Widowbird, Fan-tailed	*Euplectes axillaris*	0.78	Low
Widowbird, Red-collared	*Euplectes ardens*	5.47	Low
Widowbird, White-winged	*Euplectes albonotatus*	14.84	Low
Wood-dove, Emerald-spotted	*Turtur chalcospilos*	76.95	Present
Wood-hoopoe, Green	*Phoeniculus purpureus*	50.00	High

Wood-owl, African	*Strix woodfordii*	0.39	Low
Woodpecker, Bearded	*Dendropicos namaquus*	21.09	High
Woodpecker, Bennett's	*Campethera bennettii*	13.67	Moderate
Woodpecker, Cardinal	*Dendropicos fuscescens*	29.30	Present
Woodpecker, Golden-tailed	*Campethera abingoni*	32.81	High
Wren-warbler, Stierling's	*Calamonastes stierlingi*	5.86	High
Wryneck, Red-throated	*Jynx ruficollis*	0.78	Moderate

5.3 RED LIST AVIFAUNAL SPECIES

No Red List species were recorded during the survey. However, twenty Red List species have been recorded for the 2531AD QDGC during SAPAP1 and SABAP2 survey periods (Table 2). The reporting rates for each species within the 2531AD QDGC for both periods are shown.

Table 2. Red List avifaunal species that have been recorded for the 2531AD QDGC during SABAP1 & SABAP2 and that could occur on the study site if suitable habitats are available. No Red List species were recorded on the study site during the survey. Three pentads that make up the 2531AD QDGC overlapped with the Kruger National Park (KNP) (pentads 2515_3115, 2520_3115, and 2525_3115). The reporting rates for Red List species within these pentads were compared with the pentad outside the KNP where the study site was located (pentad 2520_3110). This was done to illustrate that, although some species could likely occur on the study site, they have a much higher reporting rate inside than outside the KNP. Such species are unlikely to occur outside the KNP, even though suitable habitats may be available.

Common name	Scientific name	Red List Status	Reporting rate %			
			SABAP1		SABAP2	
			KNP	ADJ	KNP	ADJ
Bateleur	*Terathopius ecaudatus*	Endangered	68	0	47	1
Bustard, Kori	*Ardeotis kori*	Near-threatened	4	0	1	0
Eagle, African Crowned	*Stephanoaetus coronatus*	Endangered	3	0	1	7
Eagle, Martial	*Polemaetus bellicosus*	Endangered	43	1	9	1
Eagle, Tawny	*Aquila rapax*	Endangered	43	1	19	1
Falcon, Lanner	*Falco biarmicus*	Vulnerable	3	1	2	2
Finfoot, African	*Podica senegalensis*	Vulnerable	1	1	0	1
Ground-Hornbill, Southern	*Bucorvus leadbeateri*	Endangered	44	0	18	0
Hawk, Bat	*Macheiramphus alcinus*	Endangered	0	0	1	15

Kingfisher, Half-collared	*Alcedo semitorquata*	Near-threatened	0	10	0	1
Secretarybird	*Sagittarius serpentarius*	Vulnerable	36	0	0	1
Stork, Abdim's	*Ciconia abdimii*	Near-threatened	3	1	0	1
Stork, Black	*Ciconia nigra*	Vulnerable	13	1	3	1
Stork, Marabou	*Leptoptilos crumeniferus*	Near-threatened	67	0	44	1
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*	Endangered	31	0	2	1
Stork, Yellow-billed	*Mycteria ibis*	Endangered	6	0	1	1
Vulture, Hooded	*Necrosyrtes monachus*	Critically Endangered	8	0	4	0
Vulture, Lappet-faced	*Torgos tracheliotus*	Endangered	32	0	5	1
Vulture, White-backed	*Gyps africanus*	Critically Endangered	15	0	31	2
Vulture, White-headed	*Trigonoceps occipitalis*	Critically Endangered	51	0	2	0

5.4 SUMMARY OF RED LIST AVIFAUNAL SPECIES

Table 3 provides a list of the Red List species recorded for the 2531 AD QDGC during the SABAP1 and SABAP2 survey periods (Harrison et al. 1997). Information on species specific ecology and threats were extracted from Taylor et al. (2015).

The presence of suitable habitat and the species' likelihood of occurrence on the study site are reported. The likelihood of occurrence for Red List species that may occur on the study site is defined as: **Highly likely** > 75% probability of occurring on the study site; **Likely** >50% probability of occurring on the study site; **Unlikely** > 25% probability of occurring on the study site; and **Highly unlikely** < 25% probability of occurring on the study site.

Table 3. Red List avifaunal species assessment for the study site based on SABAP1 and SABAP2 data and information summarised in Taylor et al. (2015).

Species name	Ecology, threats and on site conclusion
Bateleur *Terathopius ecaudatus* 2015 Regional status: **EN** 2000 Regional status: **VU** 2015 Global status: **NT**	**Ecology:** The Bateleur is found in savannah and open to moderately dense woodland (e.g. *Vachellia* savanna and Mopane woodlands). The species is a scavenger and hunter, with juveniles in the KNP scavenging up to 85% of prey items. The species can cover up to 400km per day while foraging (Elwell 2000). **Threats:** Habitat transformation, which affect the available prey base is the most likely reason for the Bateleur's demise outside protected areas (Barnes, 2000). Its tendency to scavenge widely put the species at risk of indiscriminate poisoning, even if they are resident within protected areas. **On site conclusion:** Suitable habitats for the Bateleur did exist on the study site. In addition, the close proximity of the study site to the KNP suggest that the species could occur here. However, observational records from the SABAP indicate that the species is seldom recorded outside of protected areas. For instance, the reporting rate for the two pentads that included the study site differed from 47% inside and 1% outside the KNP respectively. The species is thus **unlikely** to be resident here, but may visit the site as an **occasional foraging visitor**.
Bustard, Kori *Ardeotis kori* 2015 Regional status: **NT** 2000 Regional status: **VU** 2015 Global status: **NT**	**Ecology:** The Kori Bustard inhabits fairly open and dry savanna, where it usually occurs alone or in small groups. The species occupy home ranges of 8.6 – 66.3 km^2 and their diet includes various invertebrates, small vertebrates and a vegetable component (Osborne & Osborne 1998). **Threats:** Habitat destruction and changes in land-use and habitat quality may lead to diminish food supply and cause local extinction events (Young 2003). Invasive plant species, may also alter the suitability of habitats. **On site conclusion:** The savanna habitats present on the study site may be too dense for the species to occur here. Kori Bustards could, however, occasionally forage in the more open and disturbed areas -yet this is considered **highly unlikely** given its low reporting rate for the region (1%) and specifically outside protected areas (0%).
Eagle, African Crowned *Stephanoaetus coronatus* 2015 Regional status: **VU** 2000 Regional status: **NT** 2015 Global status: **NT**	**Ecology:** This species is primarily found in forests, but also occurs in woodland and forested gorges in savanna and grassland (Simmons 2005a). Their diet is mostly composed of mammals (96%), with large birds and reptiles making up the remainder. **Threats:** Because of their tendency to predate small stock animals, they have been persecuted by stock farmers. The loss of forests also threatens the species, although they have adapted to some extent to nesting in alien plantations.

	<u>On site conclusion:</u> Suitable habitats were largely absent - the species are thus **highly unlikely** to occur on the study site.
Eagle, Martial *Polemaetus bellicosus* 2015 Regional status: **EN** 2000 Regional status: **VU** 2015 Global status: **NT**	**Ecology:** Martial Eagles occur in a variety of habitats, but are most commonly found in arid or mesic savanna, forest edges and open shrubland (Simmons 2005b). They need tall trees for nesting and perching, but are also known to nest on human-made structures such as pylons, wind-pumps, and alien trees (Machange et al. 2005). Studies suggest that adult breeding pairs dominate the best habitats, with immatures having to disperse into marginal habitats where they may face a higher mortality risk (Kemp & Begg 2001). **Threats:** Direct persecution (shooting, trapping, poisoning) is one of the main threats faced by Martial Eagles (Barnes 2000). Reduction of natural prey through habitat transformation, nest site disturbance, and electrocution are also major factors contributing to the decline of the species. As a result, Martial Eagles are mostly restricted to protected areas in South Africa. **<u>On site conclusion:</u>** Suitable habitats for the Martial Eagle did exist on the study site. In addition, the close proximity of the study site to the KNP suggest that the species could occur here. However, observational records from the SABAP indicate that the species is seldom recorded outside of protected areas. For instance, the reporting rate for the two pentads that included the study site differed from 9% inside and 1% outside the KNP respectively. This difference was even higher when only SABAP1 records were considered – 43% inside vs. 1% outside the KNP. The species are thus **unlikely** to be resident here, but may visit the site as an **occasional foraging visitor**.
Eagle Tawny *Aquila rapax* 2015 Regional status: **EN** 2000 Regional status: **VU** 2015 Global status: LC	**Ecology:** Tawny Eagles are found in lightly wooded savannah, thornveld, and semi-desert, but avoid dense forest and highlands. They have large home ranges of (±70km^2), but also respond temporarily to favourable environmental conditions or prey outbreaks. Scavenging and piracy are their two most important foraging strategies (Simmons 1997). **Threats:** Like other eagles, Tawny Eagles are threatened by land transformation – they are therefore largely dependent on conservation areas to survive (Herremans & Herremans-Tonnoeyer 2000). They also suffer from deliberate and inadvertent poisoning, collisions with power lines and may also be captured by gin traps (Anderson et al. 2000). **On site conclusion:** The study site did have suitable habitats for the Tawny Eagle. The species are also often recorded in the adjacent KNP, which suggest that it could also occur on the study site. However, observational records from the SABAP indicate that the species is seldom recorded outside of protected areas. For instance, the reporting rate for the

	two pentads that included the study site differed from 19% inside and 1% outside the KNP respectively. This difference was even higher when only SABAP1 records were considered – 43% inside vs. 1% outside the KNP. The species is thus **unlikely** to be resident here, but may visit the site as an **occasional foraging visitor**.
Lanner Falcon *Falco biarmicus* 2015 Regional status: **VU** 2000 Regional status: **NT** 2015 Global status: **LC**	**Ecology:** Lanner Falcons are found in open grasslands, cleared woodlands, and agricultural areas. Breeding pairs favour cliffs as nesting sites; however they will also use alternative structures such as trees, pylons and buildings (Taylor et al. 2015). They prey on birds, small mammals, reptiles, and insects (Jenkins & Avery 1999). **Threats:** Lanner Falcons are threatened by habitat loss and transformation within the Grassland Biome, through urbanization, agriculture, and afforestation (Barnes & Jenkins 2000). Secondary threats include poisoning by agrochemicals, collisions with power-lines, and persecution by farmers that suffer livestock losses (e.g. pigeons and chickens). **On site conclusion:** The lack of open, grassland habitats suggest that the species is **unlikely** to be resident on the study site. This is supported by the low reporting rate for Lanner Falcons in the region (1.5%), both inside and outside the adjacent KNP.
Finfoot, African *Podica senegalensis* 2015 Regional status: **VU** 2000 Regional status: **VU** 2015 Global status: **LC**	**Ecology:** Elusive species that occurs singly or in pairs on clear perennial rivers and streams lined by thick riparian bush and with overhanging trees, shrubbery and reeds (Barnes and Parker 2000). Finfoot's hunt aquatic invertebrates and small vertebrates while swimming or walking along riverbanks. **Threats:** The primary threats facing the African Finfoot are: reduction of water flow through commercial afforestation of catchment areas, damming and water extraction, degradation and clearing of riverine vegetation, and increased salt and silt loads in rivers because of erosion (Barnes and Parker 2000). **On site conclusion:** Suitable habitat for the African Finfoot was present along the Luphisi stream, which comprised the southern boundary of the study site. The species are therefore **likely** to occur on the study site, however their occurrence may be affected by the availability of permanent water in the stream.
Southern Ground-Hornbill *Bucorvus leadbeateri* 2015 Regional status: **EN** 2000 Regional status: **VU** 2015 Global status: **VU**	**Ecology:** The Southern Ground-Hornbill is a monogamous, cooperative breeder with a single dominant pair within a group supported by helpers (Kemp 2005). They most often nest in natural cavities in live or dead trees, but also use cliffs, hollows in earth banks or old stick nests of other species. Nearly half (49%) of all breeding attempts only fledge one chick. Mean recruitment is also extremely low,

	with groups fledging an average of only one chick every 9.3 years (Kemp 2005). **Threats:** Habitat alteration, specifically the loss of large trees, as well as afforestation of grasslands, and/or bush encroachment of savanna are among the primary threats to Southern Ground Hornbills. Other factors that contribute to their decline include poisoning, electrocution and persecution of groups for breaking windows of cars and buildings when hammering at reflections with their bills (Kemp 2005). **On site conclusion:** Suitable habitat for the species were available on the study site. Furthermore, the close proximity of the KNP where breeding populations are known to occur means that the species is **likely** to occur and/or occasionally forage on the study site.
Hawk, Bat *Macheirampus alcinus* 2015 Regional status: **EN** 2000 Regional status: **NT** 2015 Global status: **LC**	**Ecology:** The species occur in evergreen forests, and low-lying mesic woodland, often in hilly country and also river valleys and areas with suitable nesting sites for bats. E.g. caves, old mine workings and Baobab Adansonia digitate trees. **Threats:** The Bat Hawk occurs sparely across its range and has large home ranges (>450km^2). Locally it could be threatened by deforestation, or other factors (e.g. pesticides) that impact upon bat populations. **On site conclusion:** The species is known to roost and breed in Eucalyptus trees in suburban sections of nearby towns Witrivier and Nelspruit (Taylor et al. 2015). The absence of suitable habitat on the study site suggests that the species are **unlikely** to breed here, however given the close proximity of known nesting sites, it could visit the study site as an **occasional foraging visitor**.
Half-collared Kingfisher *Alcedo semitorquata* 2015 Regional status: **NT** 2000 Regional status: **NT** 2015 Global status: **LC**	**Ecology:** A strictly water-associated kingfisher, restricted to the immediate vicinity of fast flowing, clear, perennial streams and rivers offering secluded conditions and dense marginal vegetation (Turpie 2005). It may also frequent well-vegetated banks of lakes, dams, estuaries and coastal lagoons. The species nest in tunnels that it construct within vertical riverbanks, usually 1-1.5m high, facing the water with overhanging vegetation or tree roots to provide concealment. Their diet consists primarily of fish, as well as crabs, amphibians and aquatic insects (Fry et al. 1992). **Threats:** The Half-collared Kingfisher is threatened by degradation of its specialised riverine habitats through siltation, erosion, inflow of water containing sediments, heavy metals and other pollutants, water extraction and the clearing of riparian vegetation. Consequences of these factors are not limited to the point of impact, but also occur downstream. Likewise, dams and other impoundments may have major ecological impacts downstream, through reduced river flow, attenuated flood peaks and altering

	seasonality and temperature of water flow (Barnes 2000). Availability of suitable banks for construction of nest tunnels may be a further limiting factor for this species. **On site conclusion:** Suitable habitat for the species was present along the Luphisi stream, which comprised the southern boundary of the study site. The species are therefore **highly likely** to occur here, even though SABAP reporting rates for the region are low (1 – 10%). The species are easily overlooked in the dense vegetation along streams, which could explain the low reporting rates for the region.
Secretarybird *Sagittarius serpentarius* 2015 Regional status: **VU** 2000 Regional status: **NT** 2015 Global status: **VU**	**Ecology:** The species prefer open grassland and shrub, with ground cover shorter than 50 cm and with sufficient scattered trees as roost/nest sites. It is absent from Mountain Fynbos, forest, dense woodland and very rocky, hilly or mountainous woodland (Boshoff and Allan 1997). Adaptive traits (e.g. variable clutch size, variable nesting habitats and post fledging independence) may indicate the ability to exploit marginal conditions (Barnes 2000). The majority of their diet consist of invertebrates, but they also frequently prey on small mammals, birds, reptiles and amphibians (Taylor et al. 2015). **Threats:** Habitat loss, driven by agriculture and urban development is the primary threat to this species (Barnes 2000). Excessive burning, over grazing, bush encroachment, and collisions with power lines may also drive population declines (Hofmeyr et al. 2014). **On site conclusion:** The lack of open grassland habitats on the study site suggests that the species is **unlikely** to occur here. There is a possibility that Secretarybirds could occasionally forage in the more open and disturbed areas - yet this is considered **unlikely** given its low reporting rate for the region (1%) and the fact that it has not been recorded outside the KNP in the region (0%).
Abdim's Stork *Ciconia abdimii* 2015 Regional status: **NT** 2000 Regional status: **LC** 2015 Global status: **LC** Black Stork *Ciconia nigra* 2015 Regional status: **VU** 2000 Regional status: **NT** 2015 Global status: **LC** Yellow-billed Stork *Mycteria ibis* 2015 Regional status: **EN** 2000 Regional status: **NT** 2015 Global status: **LC**	**Ecology:** Stork species forage in a diversity of permanent and seasonal wetland habitats, with open shallow water that is free of vegetation (Hancock et al. 2010). Food includes frogs, small fish, and other small aquatic prey. These species are usually gregarious, and is often found with other waterbirds. **Threats:** The main threat to most stork species is the loss of wetland habitats, including the system of pans, marshes, and floodplains on which the birds depend for foraging. **On site conclusion:** Suitable habitat is mostly lacking on the study site, which makes it **unlikely** that Abdim's, Black, and Yellow-billed Storks occur here. An estimated 40 individuals of Saddle-billed Storks reside in southern KNP where the large river systems of the Park and adjacent areas form the core of their breeding range and are vitally important from a conservation perspective. The species is virtually absent outside the KNP borders, which

Saddle-billed Stork *Ephippiorhynchus senegalensis* 2015 Regional status: **EN** 2000 Regional status: **EN** 2015 Global status: **LC** Marabou Stork *Leptoptilos crumeniferus* 2015 Regional status: **NT** 2000 Regional status: **NT** 2015 Global status: **LC**	makes it **unlikely** to occur on the study site. However, the habitats along the Luphisi stream could attract **occasional foraging visitors** from the nearby KNP. Marabou Storks are scavengers that feed on a wide range of food resources, including carrion, aquatic vertebrates and human waste (Pomeroy 1975). Given the close proximity of breeding populations in the KNP, the species may visit the site as **occasional foragers**, but it is highly unlikely to breed here.
White-backed Vulture *Gyps africanus* 2015 Regional status: **CE** 2000 Regional status: **VU** 2015 Global status: **CE** Hooded Vulture *Necrosyrtes monachus* 2015 Regional status: **CE** 2000 Regional status: **VU** 2015 Global status: **CE** White-headed Vulture *Aegypius occipitalis* 2015 Regional status: **CE** 2000 Regional status: **VU** 2015 Global status: **CE** Lappet-faced Vulture *Torgos tracheliotos* 2015 Regional status: **EN** 2000 Regional status: **VU** 2015 Global status: **EN**	**Ecology:** The four vulture species inhabit woodland regions of southern Africa. They are scavengers that feed in large groups on large mammalian carcasses, both wild and domestic, favouring the soft internal organs and muscle tissue. They search for food communally, fanning out to search for carcasses on the wing and responding to cues from one another. These vulture species often nest in tall trees, which is mostly concentrated along watercourses. **Threats:** African vulture species have suffered catastrophic population declines in recent years (Ogada et al. 2015). For example, White-backed, White-headed, Hooded and Lappet-faced Vultures have declined by a rate of 80% or more over three generations. As a result, three species, White-backed, Hooded and White-headed Vultures are now classified as **Critically Endangered**. The primary threats to vultures are from contamination of their food supply (poisoning), negative interactions with human infrastructure and their demand for use in the traditional health industry. Other causes of mortality include, drowning in concrete farm reservoirs (Anderson et al. 1999), and disturbance at nesting colonies, which can lead to the desertion of nests. **On site conclusion:** The close proximity of resident populations in the KNP suggest that White-backed, Hooded, Lapped-faced and White-headed Vultures could **occasionally visit** the study site if foraging opportunities arise. However, it is **highly unlikely** that any of these species would be resident on the study site. Given that these vulture species have large home ranges and forage widely for food it is important that infrastructure developments on the study site should be vulture friendly. This may involve the modification of pylons to reduce the risk of electrocution by line-marking and judicious routing of power lines.

6. FINDINGS AND POTENTIAL IMPLICATIONS

6.1 RED LIST AVIFAUNAL SPECIES CONFIRMED FOR THE STUDY AREA

SABAP1 and SABAP2 records indicate that 20 Red List species have been recorded within QDGC 2531 AD. Eleven of these species are closely associated with PAs and may have been recorded within the 2531 AD QDGC only because the QDGC overlaps with the south-western section of the KNP. This pattern is illustrated when reporting rates of two pentads that make up the 2531 AD QDGC are compared. Reporting rates for these Red List species are high for the pentad that included the KNP (2520_3115), but notably low for the pentad that exclude the KNP (2520_3110). For example, the reporting rates for the Bateleur ranged from 47% inside the KNP to 1% outside the KNP (SABAP2 reporting rates). Similar patterns were recorded for the Martial Eagle, Tawny Eagle, Southern Ground Hornbill, Marabou Stork, Saddle-billed Stork and Secretarybird, specifically when looking at SABAP1 reporting rates (see Table 2). This was also the case for all four vulture species that have been recorded in the 2531 AD QDGC. Reporting rates were relatively high in the KNP, but close to zero outside it. For example, the Critically Endangered Hooded and White-headed Vulture has not been recorded in the pentad outside the KNP during the SABAP1 or SABAP2 survey periods. Reporting rates for the Critically Endangered White-backed Vulture and the Endangered Lappet-faced Vulture were similarly low – 1% and 2% outside the KNP. Therefore, although suitable habitats are available, the species listed above are unlikely to be resident on the study site. Yet they may occasionally forage here, given its close proximity to the KNP.

The lack of open grassland habitats mean that the Lanner Falcon, Secretarybird and Kori Bustard are unlikely to occur on the study site – this inference is supported by the low reporting rates of these species in the region (<5%). Moreover, the Secretarybird and Kori Bustard are seldom recorded outside PAs. However, the riverine habitats present on the study site could provide suitable habitat for the Half-collared Kingfisher and African Finfoot, both species are shy, prefer densely vegetated riverbanks and are easily overlooked.

6.2 IMPORTANT BIRD AREAS AND PROTECTED ENVIRONMENTS

The study site is located close to the Kruger National Park (~ 5 km), an Important Bird Area in South Africa (Marnewick et al. 2015). The KNP support more than 490 bird species, which is about 57% of the species found in the entire southern African sub-region. The diversity of birds can be attributed to the numerous different habitats and ecotonal nature of the area. In addition, there are several important populations of widespread species that do not thrive

outside large protected areas. These include the Marabou Stork, Hooded Vulture, White-backed Vulture, Lappet-faced Vulture, White-headed Vulture, Martial Eagle, Bateleur, Tawny Eagle, Kori Bustard and Southern Ground Hornbill (Marnewick et al. 2015).

The most important threats to this IBA are located outside of it. For example, some of the KNPs main rivers originate in areas where industrial and agricultural activities cause excessive pollution. Water extraction upstream also results in a low flow, or even none at all, in rivers that were once perennial. In addition, edge effects associated with human activities around PA's have been linked to illegal timber and bush meat extraction, bush meat hunting, fire frequency, and, more generally, species extinction within PAs (Wittemeyer et al. 2008). Increasing isolation due to land transformation (habitat loss), fences, overhunting and disease outside PAs also poses a serious threat to the long-term viability of many animal populations within PA's. These drivers restrict the movement of wildlife into and out of reserves and create sinks in the increasingly human-dominated matrix that surrounds PA's (Newmark 2007).

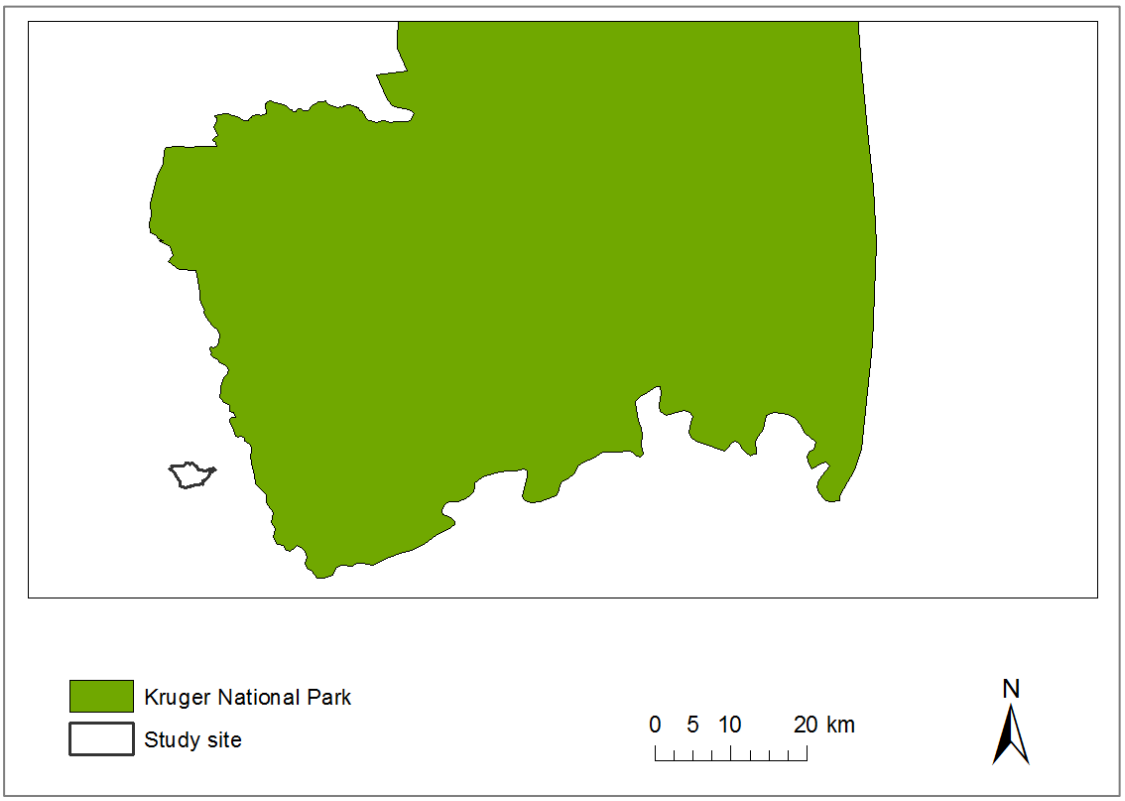

Figure 5: The study site and its proximity to the Kruger National Park, an Important Bird Area in South Africa. Nearly 500 bird species have been recorded in this IBA. These include populations of Rec List and wide-ranging species that are rarely encountered outside PAs.

7. LIMITATIONS, ASSUMPTIONS AND KNOWLEDGE GAPS

Although every care has been taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time, and budget. The site survey were done during one day in May 2017, and not on a regular basis during several seasons. The survey was also done after the wet season when most migrant species already migrated for the season. Discussions and proposed mitigations are therefore made on reasonable and informed assumptions built on available information sources and deductive reasoning. Since environmental impact studies deal with dynamic natural systems, additional information may be discovered at a later stage, which may alter some of the conclusions in this report. For instance, the avifaunal assemblage could change slightly if more species are recorded from the habitat that is present on the study site. I can therefore not accept responsibility for conclusions and mitigation measures made in good faith based on the available information at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

8. DISCUSSION AND RECOMMENDED MITIGATION MEASURES

Development on the study site could have local and regional impacts on bird species that are resident on, or occasionally utilize the study site. Local impacts would involve the clearing of vegetation on the study site, resulting in the disappearance of suitable bird habitats. Although no Red List species were recorded during the survey, two bird species, the Half-collared Kingfisher and African Finfoot, could occur in the riverine habitats along the Luphisi stream. Great care should be given that the development on the study site do not negatively affect this habitat. It is unlikely that any of the other 18 Red List species recorded in the region are resident on the study site. Rather, some of these species could be resident in the adjacent KNP and may therefore occasionally use the study site for foraging, or as a stepping stone to move through the human dominated matrix. Habitat loss associated with development activities on the study site is therefore more likely to have a regional than a local impact on such species.

This is important, as the study site is located close to the KNP, a local and internationally important IBA. The development of the study site therefore has the potential to impact birds that occur here. For example, the transformation of the study site may increase edge effects suffered by the KNP. This may affect bird communities in the park in a number of ways. First, high contrast edges may alter the abiotic conditions in the adjacent

habitat, leading to changes in habitat composition and structure on which bird species depend. Second, edges may have direct biological effects on species in the adjacent habitat, which involve changes in the abundance and distribution of species. For example, the dust, noise, and waste generated from construction activities could allow species with generalist's traits to replace species with specialist's traits, leading to the biotic homogenization of bird assemblage. Third, edge effects may cause changes in species interactions, such as predation, brood parasitism, competition, herbivory, pollination and seed dispersal.

The clearing of vegetation on the study site may also have an indirect effect on bird species of the KNP. For instance, species resident in the KNP would not be able to use the study site to forage or acquire nesting materials. Because the study site is mostly undisturbed at present, bird species likely use the area as a linkage to disperse through the human dominated matrix. This may be particularly important for some of the Red List species discussed in Table 3, as they have large home ranges and forage widely for food and nesting resources. However, the transformation of the study site may prevent such movements and further contribute to the isolation of the KNP bird community. Indeed, large-bodied birds, typically raptors, often decline markedly in abundance outside protected areas (Thiollay 2007).

The creation of large multi-use buffer areas surrounding core habitats and corridors (possibly with mixed-use buffers of their own) between PAs may facilitate effective protection of biodiversity while supporting human settlement on PA borders. Such advanced landscape planning in concert with effective PA management may maintain and increase the benefits of PA's for people while also ensuring those benefits do not result in unsustainably heavy impacts on the flora, fauna and processes PAs endeavour to sustain (Wittemeyer et al. 2008). One way to achieve this is to adopt a 'land sharing' strategy to the planned development. Land sharing involves less intensive production and development to maintain some biodiversity throughout an area earmarked for development or agricultural production (Green et al. 2005). For the study site, it means implementing low density human settlements and agricultural areas and keeping intact much of the natural habitats, specifically the riverine areas and the rocky outcrops scattered throughout the site. For example, development or agricultural areas could be restricted to the flat areas with a minimal slope, and avoid the steep rocky outcrops as well as the sensitive riverine habitats. If this is adhered to, the study site could harbour a similar bird community to the one recorded during the present survey. In addition, these habitats may allow for the movement of bird species through the habitat matrix, support

metapopulation dynamics, and function as a 'low contrast' edge to the KNP, which could lessen the adverse edge effects discussed above.

The local and regional impact of development on bird species can further be mitigated if the following management recommendations are adhered to:

- It is recommended that no development takes place within a 32m buffer zone along the Luphisi stream;
- Developments should furthermore be restricted to flat areas, with a minimal slope to avoid impacts on the rocky outcrops. Such areas should be identified with a fine-scale Digital Elevation Model (DEM);
- Ensure that all new infrastructure, specifically energy infrastructure such as powerlines or pylons, are vulture-friendly. This may involve the modification of pylons to reduce the risk of electrocution by line-marking and judicious routing of power lines;
- It is recommended that an environmental control officer (ECO) be appointed during construction to oversee the vegetation clearing process;
- Vegetation clearing should be restricted to the study site, with no unnecessary clearing permitted outside this area. The study site should be taped off to prevent disturbances to the surrounding areas;
- Cleared areas should be revegetated, covered or kept moist to prevent dust generation;
- Dust suppression through the use of water bowsers should be implemented on all exposed areas including roads, parking zones and lay down areas;
- All onsite traffic must be restricted to designated roads;
- Noise emanating from construction machinery and equipment should be kept at a minimum by the fitting of exhaust silencers and through the regular maintenance of construction vehicles;
- An ECO should be appointed during the construction phase to monitor for the presence of Red List species where vegetation clearing and associated construction activities are to be undertaken. Should such species be identified and require relocation, rescue permits should be obtained from the provincial authority, and suitable ex-situ, and/or in-situ conservation measures developed and implemented. Conservation measures must be approved by the provincial authority and overseen by the ECO.

9. CONCLUSIONS

Development on the site has the potential to affect avifauna as discussed in detail in the report. Although only the riverine habitats could be regarded as highly sensitive to bird species, the study site is located within close proximity to the KNP, which harbour a similar, but more diverse avifaunal community than the study site. Species resident within the KNP could also utilize the study site as occasional foraging visitors. Development of the study site therefore has the potential to affect bird species within the KNP, specifically wide ranging and threatened species such as raptors, storks and vultures. It is therefore important that construction activities and associated disturbances be restricted to the study site, to have as little as possible adverse effects on the surrounding areas. Moreover, given that the study site is earmarked for a mixed-use development, it would be preferable to i) construct low density human settlements and ii) cultivate agricultural areas while keeping intact much of the natural habitats, specifically the riverine areas and the rocky outcrops scattered throughout the site.

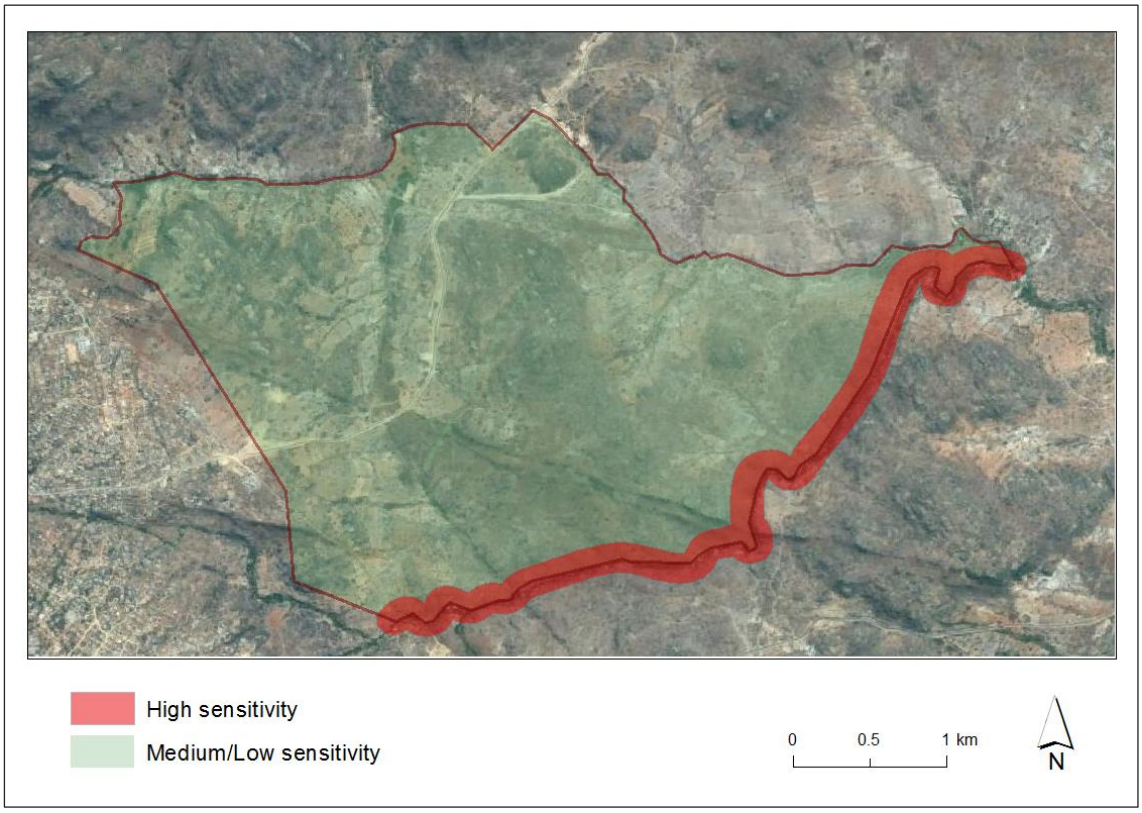

Figure 4. Avifaunal habitat sensitivity map showing the proposed 32m buffer zone along the Luphisi stream.

10. REFERENCES

Allan, D.G. (2005) White-bellied Korhaan *Eupodotis senegalensis*. In: Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). Roberts – Birds of Southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town. pp. 304-305.

Anderson, M.D. (2000) Raptor conservation in the Northern Cape Province, South Africa. Ostrich, 71: 25-32.

Anderson, M.D. (2000) Raptor cbonservation in the Northern Cape Province, South Africa. Ostrich, 71: 25-32.

Anderson, M.D., Maritz, A.W.A. & Oosthuysen, E. (1999) Raptors drowning in farm reservoirs in South Africa. *Ostrich*, **70**: 139-144.

Barnes K.N. (2000) *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Johannesburg, South Africa*: Birdlife South Africa.

Barnes, K.N. & Jenkins, A.R. (2000) Lanner Falcon *Falco biarmicus*. In: Barnes K.N. (ed). The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Johannesburg, South Africa: Birdlife South Africa. pp. 141.

Barnes, K.N. & Parker, V. (2000) African Finfoot *Podica senegalensis*. In: Barnes KN (ed.) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Johannesburg, South Africa. BirdLife South Africa. P. 100-101.

Boshoff, A.F. & Allan, D.G. (1997) Secretarybird *Sagittarius serpentarius*. In: Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M.J.L., Tree, A.J., Parker, V. & Brown, C.J. (eds). The atlas of southern African birds Vol I: Non-passerines. Johannesburg, South Africa: Birdlife South Africa. pp. 152-153.

Elwell, N. (2000) Southern Cape Bateleurs. Promerops, 242, 18.

Fry, C.H., Fry, K. & Harris, A. (1992) Kingfishers, Bee-eater and Rollers. Johannesburg, South Africa. Russel Friedman.

Gibbon South African bird sounds

Goodale, E. & Beauchamp, G. (2010) The relationship between leadership and gregariousness in mixed-species bird flocks. Journal of Avian Biology, 41, 99-103.

Green, R.E., Cornell, S.J., Scharlemann, J.P.W. & Balmford, A. (2005) Farming and the fate of wild nature. Science, 307, 550-555.

Hancock, J., Kushlan, J.A. & Kahl, M.P. (2010) Storks, Ibises and Spoonbills of the World. London, United Kingdom: A&C Black.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. (eds). (1997) The atlas of southern African birds. Vol 1&2. Birdlife South Africa, Johannesburg.

Harrison, N.M. & Whitehouse, M.J. (2011) Mixed-species flocks: An example of niche construction? Animal Behaviour, 81, 675-682.

Herremans, M.J.L, Herremans-Tonnoeyer, D. (2000) Land-use and the conservation status of raptors in Botswana. *Biological Conservation*, **94**: 31-41.

Hausler, G. & Slater, K. (2016) The composition of mixed-species foraging flocks of birds in Kruger National Park, South Africa. Koedoe 58(1), a1314. http://dx.doi.org/10.4102/koedoe.v58i1.1314

Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). (2005). Roberts – Birds of Southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

Hofmeyr, S.D., Symes, C.T. & Underhill, L.G. (2014) Secretarybird *Sagittarius serpentarius*: Population trends and ecology. *PloS one*, **9**: e96772.

Jenkins, A.R. & Avery, G.M. (1999) Diets of breeding peregrine and lanner falcons in South Africa. *Journal of Raptor Research*, **33**: 190-206.

Kemp A.C. (2005) Southern Ground Hornbill *Bucorvus leadbeateri*. In: Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). Roberts – Birds of Southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town. pp. 158-159.

Kemp, A.C. & Begg, K.S. (2001) Comparison of time-activity budgets and populations structure for 18 large bird species in the Kruger National Park, South Africa. Ostrich, 72: 179-184.

Machange, R.W., Jenkins, A.R. & Navarro, R.A. (2005) Eagles as indicators of ecosystem health: Is the distribution of Martial Eagle nests in the Karoo, South Africa, influenced by variations in land-use and rangeland quality. *Journal of Arid Environments*, **63**: 223-243.

Marnewick M.D., Retief, E.F., Theron, N.T., Wright, D.R. & Anderson, T.A. (2015) Important Bird and Biodiversity Areas of South Africa. Johannesburg: BirdLife South Africa.

Monadjem, A., Boycott, R.C., Parker, V. & Culverwell, J. (2003) Threatened vertebrates of Swaziland: Swaziland red data book: fishes, amphibians, reptiles, birds and mammals. Mbabane, Swaziland: Ministry of Tourism, Environment and Communications.

Mucina, L. & Rutherford, M.C. (2006) *The vegetation of South Africa, Lesotho and Swaziland*. Sterlitzia19. South African National Biodiversity Institute, Pretoria.

Newmark, W.D. (2008) Isolation of African protected areas. Frontiers in Ecology and the Environment, 6, 321-328.

Ogada, D., Shaw, P., Beyers, R.L., Buij, R., Murn, C. et al. (2015) Another continental vulture crisis: Africa's vultures collapsing toward extinction. Conservation Letters,

Osborne, T. & Osborne, L. (1998) Home on the range. Kori Bustard. Africa – Birds and Birding, 3, 18.

Pomeroy, D.E. (1975) Birds as scavengers of refuse in Uganda. Ibis, 117, 69-81.

Simmons, R.E. (1997) Tawny Eagle *Aquila rapax*. In: Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M.J.L., Tree, A.J., Parker, V. & Brown, C.J. (eds). The atlas of southern African birds Vol I: Non-passerines. Johannesburg, South Africa: Birdlife South Africa. pp. 178-179.

Simmons, R.E. (2005a) African Crowned Eagle *Stephanoaetus coronatus*. In: Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). Roberts – Birds of Southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town. pp. 541-542.

Simmons, R.E. (2005b) Martial Eagle *Polemaetus bellicosus*. In: Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). Roberts – Birds of Southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town. pp. 538-539.

Sinclair, I., Hockey, P., Tarboton W & Ryan P. 2011. *Sasol Birds of Southern Africa*. 4th edition, Struik, Cape Town.

Taylor M.R., Peacock F., Wanless R.W. (eds). (2015) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa.

Thiollay, J. (2007) Raptor declines in West Africa: comparisons between protected, buffer and cultivated areas. Oryx, 41, 322-329.

Turpie, J.K. (2005) Half-collared Kingfisher *Alcedo semitorquata*. In: Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). Roberts – Birds of Southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town. pp. 173-174.

Wittemyer, G., Elsen, P., Bean, W.T., Burton, A.C.O. & Brashares, J.S. (2008) Accelerated human population growth at protected area edges. Science, 321, 123-126.

Young, D.J., Harrison, J.A., Navarro, R.A., Anderson, M.D., Colahan, B.D. (eds.) (2003) Big birds on farms. Mazda CAR report 1993-2001. Cape Town, South Africa. Avian Demography Unit.

11. SUPPORTING INFORMATION

11.1 DESKTOP SURVEYS

The presence of suitable habitats was used to deduce the likelihood of presence and/or absence of avifaunal species. This likelihood was inferred from the scientific literature (e.g. Barnes 2000; Hockey et al., 2005; Taylor et al. 2015), field guides (Sinclair et al., 2013), and the South African Bird Atlas Project (www.sabap.org).

The likely occurrence of avifaunal species was verified from the distribution records obtained during the South African Bird Atlas Project 1 and 2 (SABAP1 & SABAP2). The survey period for SABAP1 ranged from 1981 – 1993 (Harrison et al. 1997), while the survey period for SABAP2 started in July 2007 and is ongoing (www.sabap2.adu.org.za). The reporting rate for each avifaunal species likely to occur on the study site was calculated following Harrison et al. (1997). In brief, each species was scored between 0 – 100%. This score was calculated as $RP = \frac{SABAP1+SABAP2*100}{Total\ per\ QDGC}$, where RP is the reporting rate, $SABAP1$ is the total number of cards on which a species was reported during SABAP1, $SABAP2$ is the total number of cards on which a species was reported during SABAP2 and $Total\ per\ QDGC$ is the total number of cards for the particular quarter degree grid cell (QDGC) where the study site was located.

It is important to note that each QDGC covers a large area. For example, QDGC 2830AB covers an area of approximately 27 x 25 km (675 km^2). Reporting rates for SABAP2 are, however, also available at a finer scale. Each QDGC are comprised of nine pentads. A pentad is an area of approximately 9 x 9 km (81km^2) and in South Africa there are 17 000 pentads in the original atlas area (Fig. 3). Given the approximate size of a pentad, or a QDGC, in relation to the size of a typical study site, it is possible that suitable habitat will exist for a Red List species within the area that make up a QDGC or a pentad, but not necessarily on the study site. For example, the Near-Threatened Maccoa Duck (*Oxyura maccoa*) is found at small, shallow, nutrient rich inland fresh water lakes. Therefore, although it has been recorded for a particular pentad, it

will not inhabit a study site that does not have such suitable habitat. In this report, Red List species follow the classification of Taylor et al. (2015).

2515_3105	2515_3110	2515_3115
2520_3105	2520_3110	2520_3115
2525_3105	2525_3110	2525_3115

Figure S1: The 2531 AD QDGC (27 x 25km) is divided into nine pentads (9 x 9km). The pentad in red represents those in which the study site was located. The three pentads in blue represent those that included the Kruger National Park.

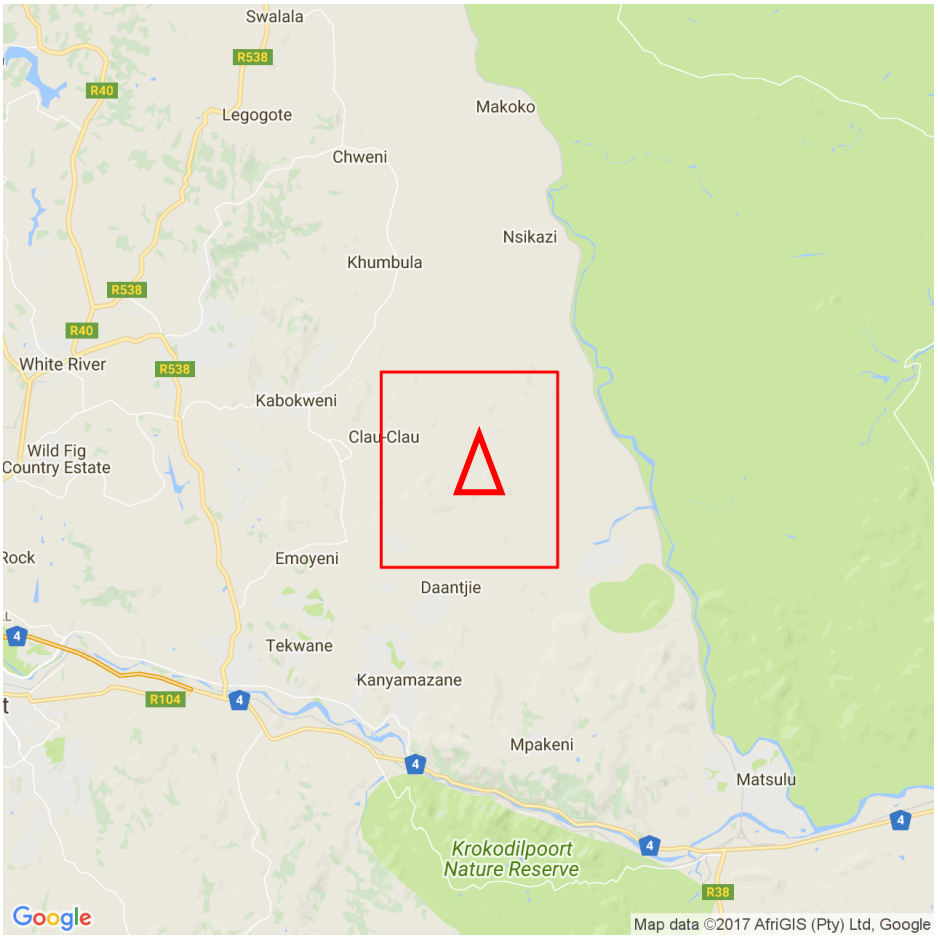

Figure S2: The 2520_3110 pentad where the study site was located. The red triangle indicate the location of the study site.