

**VERTEBRATE FAUNA AND FLORA EXPECTED IN
THE PEL 73 (BLOCKS 1819 & 1820), KAVANGO
EAST AND WEST REGIONS
[Desktop Study – Baseline/Scoping]**

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1 Introduction

A comprehensive literature study (desktop) of the vertebrate fauna (i.e. amphibians, birds, mammals and reptiles) and flora (i.e. larger trees/shrubs [$>1\text{m}$ in height] and grasses) expected to occur in the general Kavango Basin – Blocks 1819 and 1820 – was conducted between December 2018 – January 2019. This area includes PEL 73 (with the most important areas viewed as between Ncaute and Karukuvisa along the Omuramba Omatako approximately 50-100km south of Rundu – See white oblongs) which falls within communal area – i.e. Kavango (Figure 1).

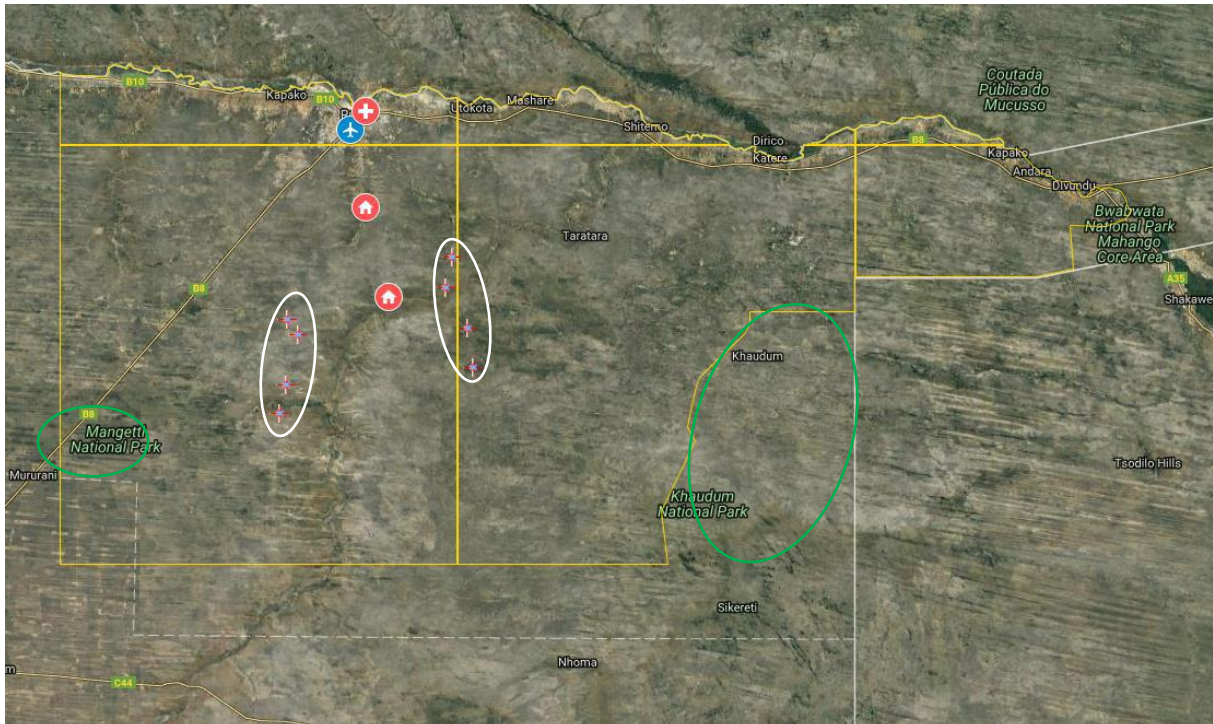


Figure 1. The location of PEL 73 (Blocks 1819 and 1820) south and southeast of Rundu (yellow blocks). The most important prospecting/drill sites are indicated by white oblongs between Ncaute and Karukuvisa adjacent the Omuramba Omatako, while the approximate locations of the Mangetti and Kaudum National Parks are indicated by green oblongs.

This literature review was to determine the actual as well as potential vertebrate fauna and flora associated with the general area commonly referred to as the Tree Savanna and Woodlands (Northern Kalahari) (Giess 1971) or a combination of North-eastern Kalahari Woodland; Eastern Drainage; Northern Kalahari and Omatako Drainage, with the North-eastern Kalahari Woodland being the dominant vegetation type (Mendelsohn *et al.* 2002) (Figure 2). The vegetation structure is classified as broadleaved woodlands (Mendelsohn *et al.* 2002). The most important perennial drainage line in the area is the Okavango River (to the north), while the most important ephemeral drainage line is the Omuramba Omatako which meanders down the centre between Blocks 1819 and 1820 (See Figure 1). The northeast wetlands – including the Okavango River frontage – have known distinctive values which include biotic richness, threatened plants and insects. Ephemeral rivers – especially the larger ones such as the Omuramba Omatako – are viewed as sites of special ecological importance due to their biotic richness and high value for human subsistence and tourism, throughout Namibia (Curtis and Barnard 1998).

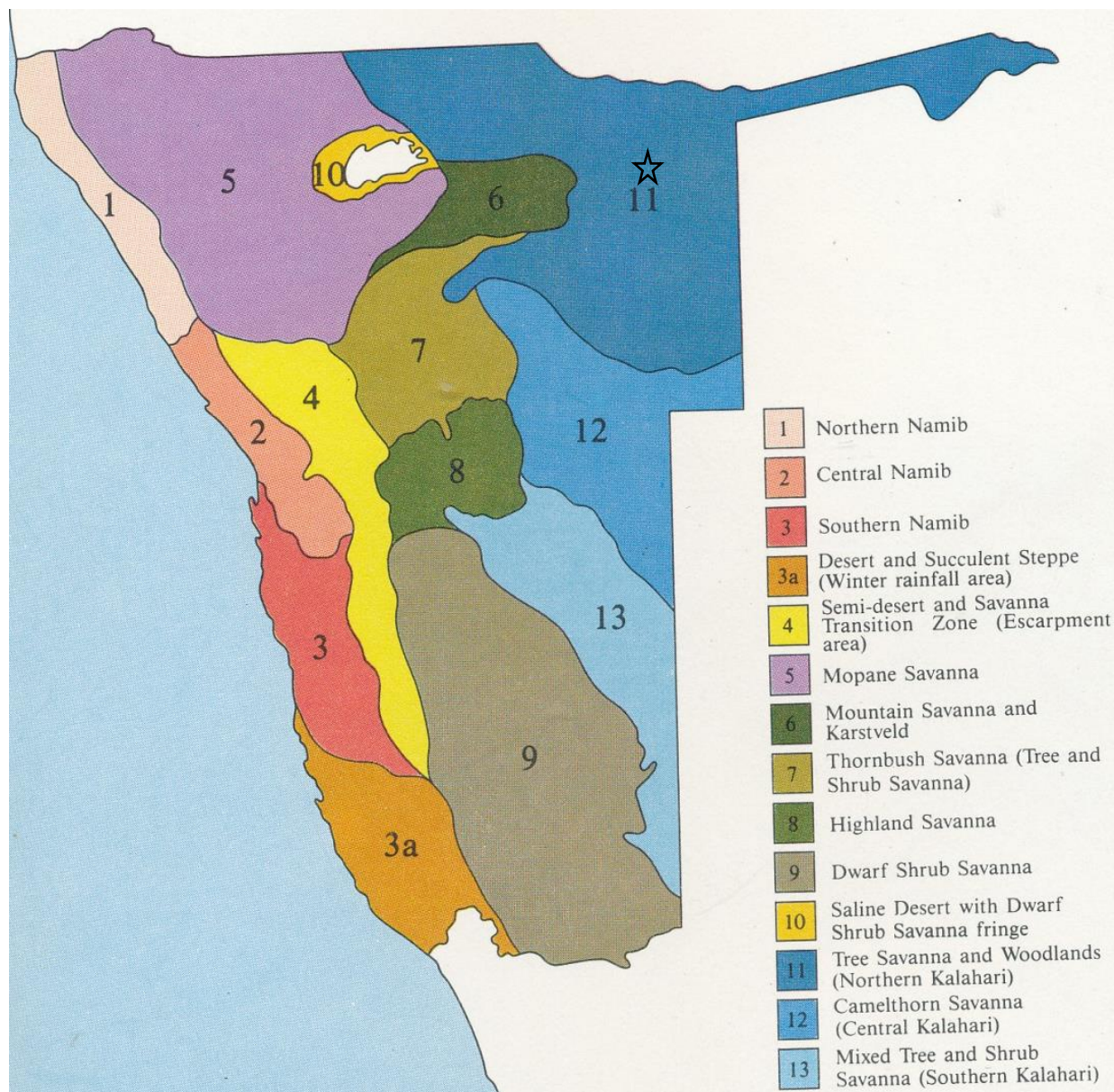


Figure 2. The PEL 73 (black star) falls within the Tree Savanna and Woodlands (Northern Kalahari) vegetation type (Giess 1971).

The Woodland Biome – of which the PEL 73 area forms part of – is not well represented in the protected area network in Namibia of which only 8.4% of the biome is protected (Barnard 1998). The closest Government protected areas are the Mangetti National Park and the Kaudum National Park. The Mangetti National Park falls within Block 1819 while the Kaudum National Park is on the eastern boundary of Block 1820 (See Figure 1). The Mangetti National Park (420km²) was proclaimed in 2008 while the Kaudum National Park (3,842km²) was proclaimed in 1989 (See www.met.gov.na).

Blocks 1819 and 1820 fall within the Kavango communal area with communal conservancies in the general area including the N#a-Jaqa (south), Nyae Nyae (southeast), Joseph Mbambangandu (north), George Mukoya and Muduva Nyangana (east) (NACSO 2010). There are no freehold (commercial) conservancies in the area. There are six registered community forests throughout the general area. The closest freehold (commercial)

conservancy is the Ngarangombe Conservancy located to the southwest in the Grootfontein area (Mendelsohn *et al.* 2002, See: www.canam.iway.na).

The general area is regarded as “medium” in overall (all terrestrial species) diversity (Mendelsohn *et al.* 2002). Overall terrestrial endemism – all species – in the area on the other hand is “low” (Mendelsohn *et al.* 2002). The overall diversity and abundance of large herbivorous mammals (big game) is viewed as “average” with oryx, kudu and giraffe dominant especially in areas bordering the National Parks while the overall diversity and density of large carnivorous mammals (large predators) is determined as “average” with 1-5 species expected – e.g. leopard, brown hyena, spotted hyena, cheetah and wild dog (Mendelsohn *et al.* 2002).

It is estimated that at least 67 species of reptile, 32 amphibian, 116 mammal and 210 bird species (breeding residents) are known to or expected to occur in the general Kavango East region.

According to Maggs (1998) there are approximately 4344 higher plant species with the most species being within the grasses (422), composites (Asteraceae) (385), legumes (Fabaceae) (377) and figs (Moraceae) (177), recorded from Namibia. Total species richness depends on further collecting and taxonomic revisions. High species richness is found in the Okavango, Otavi/Karsveld, Kaokoveld, southern Namib and Central Highland (Windhoek Mountains) areas. Endemic species – approximately 687 species in total – are mainly associated with the Kaokoveld (northwestern) and the succulent Karoo (southwestern) Namibia. The major threats to the floral diversity in Namibia are:

- 1). Conversion of the land to agriculture (with associated problems) and,
- 2). poorly considered development (Maggs 1998, Mendelsohn *et al.* 2002).

Tree Savanna and Woodlands (Northern Kalahari)

A large variety of deciduous trees are found in the Savannah and Woodlands [Northern Kalahari area] vegetation type. The grasses are usually hard and unpalatable in this area with *Antheophora pubescens*, *Brachiaria nigropedata* and *Schmidtia pappophoroides* viewed as the climax grasses in the open savannah areas (Giess 1971).

The general area has a “medium” plant diversity of between 300-399 species although the Okavango River to the north has a higher diversity (400-499 species). The endemism is viewed as “low” throughout with no species viewed as endemic (Mendelsohn *et al.* 2002). Simmons (1998a) puts the plant endemism in the general area at between 1-10 species depending on the locality. These estimates are limited to “higher” plants as information regarding “lower” plants is sparse. The greatest variants affecting the diversity of plants are habitat and climate with the highest plant diversity generally associated with high rainfall areas. Pockets of high diversity are found throughout Namibia in “unique” habitat – often transition zones – e.g. mountains, inselbergs, etc. – and riparian areas.

Furthermore, Mendelsohn *et al.* (2002) views the overall plant production as “very to extremely high” while the variation in plant production is mostly “very low to low” (0-10%) although dependant on the location. The grazing potential is viewed as “low to average” in the general area while the browse potential is viewed as “good”. Bush thickening (encroachment) is not viewed as problematic in the general area (Bester 1996, Cunningham 1998). The risk of farming is viewed as “low” with the tourism potential viewed as “average to high” (Mendelsohn *et al.* 2002).

It is estimated that at least 107 species of larger trees and shrubs (>1m in height) and up to 111 species of grasses are known to or expected to occur in the general area, none of which are viewed as endemic.

2 Methods

2.1 Literature Review

A comprehensive and intensive literature review (i.e. desktop study) regarding the vertebrate fauna (i.e. reptiles, amphibians, mammals and birds) and flora (i.e. trees/shrubs >1m in height and grasses) that could potentially occur in the general area was conducted using as many references as manageable. A list of the references consulted can be viewed in the Reference section (Page 36).

3 Results

3.1 Reptile Diversity

Reptile diversity known and/or expected to occur in the general PEL 73 area (literature study only) is presented in Table 1.

Approximately 261 species of reptiles are known or expected to occur in Namibia thus supporting approximately 30% of the continents species diversity (Griffin 1998a). At least 22% or 55 species of Namibian lizards are classified as endemic. The occurrence of reptiles of “conservation concern” includes about 67% of Namibian reptiles (Griffin 1998a). Emergency grazing and large scale mineral extraction in critical habitats are some of the biggest problems facing reptiles in Namibia (Griffin 1998a).

The overall reptile diversity and endemism in the general area is estimated at between 41-60 species and 1-4 species, respectively (Mendelsohn *et al.* 2002). Simmons (1998) indicates that 1-6 endemic reptiles are expected from the general area while Griffin (1998a) presents figures of between 1-30 and 41-50 for indigenous lizards and snakes, respectively. The closest Government protected area – Kaudum National Park – has an estimated 66 species of reptiles although no data for Mangetti National Park is included (Griffin 1998a).

At least 67 species of reptiles are expected to occur in the general area with 2 species being endemic – *Ichnotropis grandiceps* and *Lygodactylus bradfieldi* (i.e. 3% endemic). Three species are viewed as rare (*Lycophidion multimaclatum*, *Psammophis jallae*, *Causus rhombeatus*); 6 species as vulnerable (*Stigmochelys pardalis*, *Psammobates oculiferus*, *Kinixys spekii*, *Python natalensis*, *Varanus albigularis*, *Varanus niloticus*); 7 species as protected game (*Stigmochelys pardalis*, *Psammobates oculiferus*, *Kinixys spekii*, *Python natalensis*, *Varanus albigularis*, *Varanus niloticus*, *Crocodylus niloticus*); 3 species as insufficiently known (*Lycophidion multimaclatum*, *Psammophis jallae*, *Causus rhombeatus*) and 7 species as peripheral. All the other species are classified as “secure”. Seventeen species have some form of international conservation status – i.e. IUCN (2018) lists 7 species as least concern and 1 species as data deficient – *Ichnotropis grandiceps* (all other species have not yet been assessed by the Red List); SARDB (2004) lists 4 species as vulnerable and 3 species as peripheral and CITES lists 8 species as C2 and 1 species as C3 – i.e. Appendix 2 or 3 species. Some species have more than one conservation status.

The 67 species expected to occur in the general area consist of at least 3 tortoises (all vulnerable and protected game), 3 terrapins, 31 snakes (2 blind snakes, 1 thread snake, 1 python, 1 burrowing snake, 1 purple glossed, 1 quill snouted and 24 typical snakes) of which 3 species are classified as rare and 1 species as vulnerable, 5 worm lizards, 8 skinks, 4 old world lizards, 2 plated lizards, 2 monitor lizards, 1 agama, 1 chameleon and 6 geckos and 1 crocodile.

Snakes (31 species), skinks (8 species) and 6 geckos are the most important groups of reptiles expected from the general area.

Namibia with approximately 129 species of lizards (Lacertilia) has one of the continents richest lizard fauna (Griffin 1998a). Geckos expected and/or known to occur in the general area have the highest occurrence of endemics (78.6%) of all the reptiles in this area. Griffin (1998a) confirms the importance of the gecko fauna in Namibia.

Table 1. Reptile diversity known and/or expected to occur in the general PEL 73 – i.e. north-eastern Namibia – area.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status		
			IUCN (2018)	SARDB (2004)	CITES
TURTLES AND TERRAPINS					
<i>Stigmochelys pardalis</i>	Leopard Tortoise	Vulnerable; Peripheral; Protected Game	LC		C2
<i>Psammobates oculiferus</i>	Kalahari Tent Tortoise	Vulnerable; Protected Game			C2
<i>Kinixys spekii</i>	Speke's Hinged Tortoise	Vulnerable; Protected Game			C2
<i>Pelomedusa subrufa</i>	Marsh/Helmeted Terrapin	Secure			C3
<i>Pelusios bechuanicus</i>	Okavango Hinged Terrapin	Peripheral			
<i>Pelusios rhodesianus</i>	Mashona Hinged Terrapin	Peripheral		P	
SNAKES					
Blind Snakes					
<i>Rhinotyphlops boylei</i>	Boyle's Beaked Blind Snake		Secure		
<i>Rhinotyphlops schlegelii</i>	Schlegel's Beaked Blind Snake		Secure		
Thread Snakes					
<i>Leptotyphlops scutifrons</i>	Peters' Thread Snake		Secure		
Pythons					
<i>Python natalensis</i>	Southern African Python	Vulnerable; Peripheral; Protected Game		V	C2
Burrowing Asps					
<i>Atractaspis bibronii</i>	Bibron's Burrowing Asp		Secure		
Purple-Glossed Snakes					
<i>Amblyodipsas ventrimaculata</i>	Kalahari Purple-glossed Snake		Secure	LC	
Quill Snouted Snakes					
<i>Xenocalamus mechowii</i>	Elongate Quill-snouted Snake		Secure		
Typical Snakes					
<i>Lamprophis fuliginosus</i>	Brown House Snake		Secure		
<i>Lycophidion capense</i>	Cape Wolf Snake		Secure		
<i>Lycophidion multimaculatum</i>	Spotted Wolf Snake	Insufficiently known; Rare?			
<i>Mehelya capensis</i>	Cape File Snake		Secure		
<i>Pseudaspis cana</i>	Mole Snake		Secure		
<i>Prosymna angolensis</i>	Angola Shovel-snout		Secure		
<i>Psammophylax tritaeniatus</i>	Striped Skaapsteker		Secure		
<i>Psammophis leightoni</i>	Namib Fork-marked Sand Snake		Secure		
<i>Psammophis jallae</i>	Jalla's Sand Snake	Insufficiently known; Rare?		P	

Desktop study: Vertebrate Fauna & Flora - Cunningham

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status		
			IUCN (2018)	SARDB (2004)	CITES
<i>Psammophis subtaeniatus</i>	Stripe-bellied Sand Snake	Secure	LC		
<i>Psammophis mossambicus</i>	Olive Grass Snake	Secure			
<i>Philothamnus semivariegatus</i>	Spotted Bush Snake	Secure			
<i>Philothamnus angolensis</i>	Western Green Snake	Secure			
<i>Dasypeltis scabra</i>	Common/Rhombic Egg Eater	Secure	LC		
<i>Telescopus semiannulatus semiannulatus</i>	Eastern Tiger Snake	Secure			
<i>Dispholidus typus</i>	Boomslang	Secure			
<i>Thelotornis capensis oatesii</i>	Twig or Vine Snake	Secure			
<i>Aspidelaps scutatus scutatus</i>	Shield-nose Snake	Secure			
<i>Elapsoidea semiannulata</i>	Angolan Garter Snake	Secure			
<i>Naja anchietae anchietae</i>	Snouted Cobra	Secure			
<i>Naja mossambica</i>	Mozambique Spitting Cobra	Secure			
<i>Dendroaspis polylepis</i>	Black Mamba	Secure	LC		
<i>Causus rhombeatus</i>	Common or Rhombic Night Adder	Insufficiently known; Rare?			
<i>Bitis arietans</i>	Puff Adder	Secure			
Worm Lizard					
<i>Zygaspis quadrifrons</i>	Kalahari Round-headed Worm Lizard	Secure			
<i>Monopeltis anchietae</i>	Anchieta's Spade-snouted Worm Lizard	Secure			
<i>Monopeltis sphenorhynchus</i>	Slender Spade-snouted Worm Lizard	Secure			
<i>Dalophia pistillum</i>	Blunt-tailed Worm Lizard	Secure?		P	
<i>Dalophia longicauda</i>	Long-tailed Worm Lizard	Secure?			
LIZARDS					
Skinks					
<i>Typhlosaurus lineatus</i>	Striped Blind Legless Skink	Secure			
<i>Typhlacontias rohani</i>	Kalahari Burrowing Skink	Secure			
<i>Lygosoma sundevallii</i>	Sundevall's Writhing Skink	Secure			
<i>Trachylepis acutilabris</i>	Wedge-snouted Skink	Secure			
<i>Trachylepis striata wahlbergi</i>	Striped Skink	Secure			
<i>Trachylepis varia</i>	Variable Skink	Secure			
<i>Trachylepis variegata punctulata</i>	Variiegated Skink	Secure			
<i>Panaspis maculicollis</i>	Spotted-neck Snake-eyed Skink	Secure			
Old World Lizards					
<i>Heliobolus lugubris</i>	Bushveld Lizard	Secure			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status		
			IUCN (2018)	SARDB (2004)	CITES
<i>Ichnotropis capensis</i>	Cape Rough-scaled Lizard	Secure			
<i>Ichnotropis grandiceps</i>	Caprivi Rough-scaled Lizard	Endemic; Secure	DD		
<i>Ichnotropis squamulosa</i>	Common Rough-scaled Lizard	Secure			
Plated Lizards					
<i>Zonosaurus (Gerrhosaurus) multilineatus</i>	Kalahari Plated Lizard	Secure			
<i>Zonosaurus (Gerrhosaurus) nigrolineatus</i>	Black-lined Plated Lizard	Secure			
Monitors					
<i>Varanus albigularis</i>	Rock or White-throated Monitor	Vulnerable; Peripheral; Protected Game		V	C2
<i>Varanus niloticus</i>	Nile or Water Monitor	Vulnerable; Peripheral; Protected Game		V	C2
Agamas					
<i>Agama aculeata</i>	Ground Agama	Secure			
Chameleons					
<i>Chamaeleo dilepis</i>	Flap-neck Chameleon	Secure	LC		C2
Geckos					
<i>Colopus wahlbergii wahlbergii</i>	Kalahari Ground Gecko	Secure			
<i>Lygodactylus bradfieldi</i>	Bradfield's Dwarf Gecko	Endemic; Secure			
<i>Lygodactylus capensis</i>	Cape Dwarf Gecko	Secure			
<i>Pachydactylus capensis</i>	Cape Thick-toed Gecko	Secure			
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko	Secure			
<i>Pachydactylus punctatus</i>	Speckled Thick-toed Gecko	Secure			
Crocodiles					
<i>Crocodylus niloticus</i>	Nile Crocodile	Peripheral; Protected Game	LC	V	C2

Namibian conservation and legal status according to the Namibian Conservation Ordinance of 1975 (Griffin 2003)

"Endemic" include endemic species to South Africa (Branch 1998)

IUCN (2018) – International Union for the Conservation of Nature and Natural Resources [All species not listed by the IUCN (2018) have not yet been assessed for the IUCN Red List]. LC = Least Concern

SARDB (2004) – South African Red Data Book. V = Vulnerable; P = Peripheral

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora C2 = CITES Appendix 2 or 3 species.

Source for literature review: Alexander and Marais (2007), Branch (1998), Branch (2008), Boycott and Bourquin 2000, Broadley (1983), Buys and Buys (1983), Cunningham (2006), Griffin (1998a), Griffin (2003), Hebbard (n.d.), IUCN (2018), Marais (1992), SARDB (2004), Tolley and Burger (2007).

The most important species are viewed as those with some form of conservation status (Namibian and International – See Table 1) with the tortoises, pythons and monitor lizard probably the most important groups of reptiles in the general area. Tortoises and the monitor lizard are often killed for food or succumb as road kills while snakes are killed for various reasons often on sight. The 2 endemics (*Ichnotropis grandiceps* and *Lygodactylus bradfieldi*), 3 species classified as rare (*Lycophidion multimaculatum*, *Psammophis jallae*, *Causus rhombeatus*) and 6 species classified as vulnerable (*Stigmochelys pardalis*, *Psammobates oculiferus*, *Kinixys spekii*, *Python natalensis*, *Varanus albigularis*, *Varanus niloticus*) are viewed as the most important species in the general area. The 1 species classified as data deficient – *Ichnotropis grandiceps* – by the IUCN (2018) is also viewed as important. Due to the fact that reptiles are an understudied group of animals, especially in Namibia, it is expected that more species may be located in the general area than presented above.

However, none of the reptiles, especially the important species, are exclusively associated with the PEL 73 area.

3.2 Amphibian Diversity

Amphibian diversity known and/or expected to occur in the general PEL 73 area (literature study only) is presented in Table 2.

Table 2. Amphibian diversity known and/or expected to occur in the general PEL 73 – i.e. north-eastern Namibia – area.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status: IUCN (2018)
Tree Frogs			
<i>Leptopelis bocagii</i>	Bocage's Tree Frog		LC
Rain Frogs			
<i>Breviceps adspersus adspersus</i>	Bushveld Rain Frog Δ		LC
Toads			
<i>Amietophrynus gutturalis</i>	Guttural Toad Δ		LC
<i>Amietophrynus lemairii</i>	Lemaire's Toad		LC
<i>Amietophrynus maculatus</i>	Flat-backed Toad Δ		LC
<i>Amietophrynus poweri</i>	Western Olive Toad Δ		LC
Pygmy Toads			
<i>Poyntonophrynus kavangensis</i>	Kavango Pygmy Toad		LC
Shovel-nosed Toads			
<i>Hemisis guineensis</i>	Guinea Shovel-nosed Frog		LC
<i>Hemisis marmoratus</i>	Mottled Shovel-nosed Frog		LC
Reed Frogs			
<i>Hyperolius benguellensis</i>	Bocage's Sharp-nosed Reed Frog		LC
<i>Hyperolius nasutus</i>	Long Reed Frog		LC
<i>Hyperolius parallelus</i>	Angolan Reed Frog		LC
Kassinias			
<i>Kassina senegalensis</i>	Bubbling Kassina Δ		LC
Rubber Frog			
<i>Phrynomantis affinis</i>	Spotted Rubber Frog Δ		LC
<i>Phrynomantis bifasciatus</i>	Banded Rubber Frog Δ		LC
Puddle Frog			
<i>Phrynobatrachus mababiensis</i>	Dwarf Puddle Frog Δ		LC
<i>Phrynobatrachus natalensis</i>	Snoring Puddle Frog Δ		LC
<i>Phrynobatrachus parvulus</i>	Small Puddle Frog		LC
Ornate Frogs			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status: IUCN (2018)
<i>Hildebrandtia ornata</i>	Ornate Frog Δ		LC
Grass Frogs			
<i>Ptychadena mascareniensis</i>	Mascarene Grass Frog		LC
<i>Ptychadena mossambica</i>	Broad-banded Grass Frog		LC
<i>Ptychadena oxyrhynchus</i>	Sharp-nosed Grass Frog		LC
<i>Ptychadena subpunctata</i>	Speckled-bellied Grass Frog		LC
<i>Ptychadena taenioscelis</i>	Dwarf Grass Frog		LC
Platannas			
<i>Xenopus laevis</i>	Common Platanna Δ		LC
<i>Xenopus muelleri</i>	Müller's Platanna		LC
<i>Xenopus petersii</i>	Peter's Platanna Δ		LC
Cacos			
<i>Cacosternum boettgeri</i>	Boettger's Caco Δ		LC
Bullfrogs			
<i>Pyxicephalus adspersus</i>	Giant Bullfrog Δ		LC
Sand Frogs			
<i>Tomopterna cryptotis</i>	Tremolo Sand Frog Δ		LC
<i>Tomopterna krugerensis</i>	Knocking Sand Frog Δ		LC
<i>Tomopterna tandyi</i>	Tandy's Sand Frog Δ		

Δ = Species potentially occurring in the Ncaute-Karukuvisa area (other species associated with the Okavango River)

Namibian conservation and legal status according to the Namibian Conservation Ordinance of 1975 (Griffin 2003)

IUCN (2018) – International Union for the Conservation of Nature and Natural Resources; LC = Least Concern

Source for literature review: Carruthers (2001), Channing (2001), Channing and Griffin (1993), Du Preez and Carruthers (2009), Griffin (1998b), IUCN (2018), Passmore and Carruthers (1995).

Amphibians are declining throughout the world due to various factors of which much has been ascribed to habitat destruction. Basic species lists for various habitats are not always available with Namibia being no exception in this regard while the basic ecology of most species is also unknown. Approximately 4,000 species of amphibians are known worldwide with just over 200 species known from southern Africa and at least 57 species expected to occur in Namibia. Griffin (1998b) puts this figure at 50 recorded species and a final species richness of approximately 65 species, 6 of which are endemic to Namibia. This “low” number of amphibians from Namibia is not only as a result of the generally marginal desert habitat, but also due to Namibia being under studied and under collected. Most amphibians require water to breed and are therefore associated with the permanent water bodies, mainly in northeast Namibia.

According to Mendelsohn *et al.* (2002), the overall frog diversity in the general area is estimated at between 12-27 species with the latter total associated with the Okavango River. Griffin (1998b) puts the species richness in the general area at 14-29 species. The closest Government protected area – Kaudum National Park – has an estimated 19 species of amphibians although no data for Mangetti National Park is included (Griffin 1998b). No endemics occur in the area (Simmons 1998a).

According to the literature, at least 32 species of amphibians can occur in suitable habitat in the general area although only 17 species potentially occur in the Ncaute-Karukuvisa area. The area is under represented, with 1 tree frog, 1 rain frog, 4 toads, 1 pygmy toad, 2 shovel-nosed toads, 3 reed frogs, 1 kassina, 2 rubber frogs, 3 puddle frogs, 1 ornate frog, 5 grass

frogs, 3 platannas, 1 caco, 1 bullfrog and 3 sand frogs known and/or expected (i.e. potentially could be found in the area) to occur in the area. Of these, none are endemic from the general area.

The most important species from the area is the Giant Bullfrog (*Pyxicephalus adspersus*) with “population decreasing” according to the IUCN (2018) as it is consumed as food throughout its range. Most amphibians are expected to be associated with the Okavango River system in the area rather than the sandy interior, although the ephemeral Omuramba Omatako and pans throughout the general area would also be suitable habitat.

However, none of the amphibians, especially the important species, are exclusively associated with the PEL 73 area.

3.3 Mammal Diversity

Mammal diversity known and/or expected to occur in the general PEL 73 area (literature study only) is presented in Table 3.

Namibia is well endowed with mammal diversity with at least 250 species occurring in the country. These include the well known big and hairy as well as a legion of smaller and lesser-known species. Currently 14 mammal species are considered endemic to Namibia of which 11 species are rodents and small carnivores of which very little is known. Most endemic mammals are associated with the Namib and escarpment with 60% of these rock-dwelling (Griffin 1998c). According to Griffin (1998c) the endemic mammal fauna is best characterized by the endemic rodent family *Petromuridae* (Dassie rat) and the rodent genera *Gerbillurus* and *Petromyscus*.

High mammal richness is greatly enhanced by the major river systems running through the Kavango area (Griffin 1998c). These rivers also support marginal populations of many tropical African species. Deforestation affects the tree dependent and wetland dependent mammals in the area while 10% of Namibia’s mammal species depend on, or are restricted to, wetland habitats. All the inland species, including species associated with the rivers, are under some threat and thus ultimately at risk with only a small section of the Okavango River formally protected (Griffin 1998c).

The overall mammal diversity in the general area is estimated at between 76-90 species with no species being endemic to the area (Mendelsohn *et al.* 2002). Griffin (1998c) puts the species richness distribution of endemics at 9-11 species in the general area while Simmons (1998a) indicates that no endemics occur in the area. The closest Government protected area – Kaudum National Park – has an estimated 92 species of mammals although no data for Mangetti National Park is included (Griffin 1998c).

According to the literature at least 116 species of mammals are expected to occur in the general area although not all the species (i.e. 11 species) indicated in Table 3 are found away from the Okavango River and associated floodplains – e.g. otters, hippo, etc. Of the species expected to occur in the greater area, 6 species are viewed as rare (*Nycteris hispida*, *Kerivoula argentata*, *Kerivoula lanosa*, *Mastomys shortridgei*, *Civittictis civetta*, *Paracynictis selousi*), 3 endangered (*Lycaon pictus*, *Lutra maculicollis*, *Equus (burchellii) quagga*), 15 vulnerable, 3 specially protected game, 20 protected game, 7 indeterminate, 10 insufficiently known, 4 huntable game, 3 problem animals, 25 peripheral and 12 not listed under Namibian legislation (Griffin and Coetzee 2005). The IUCN (2018) classifies 1 species as endangered (*Lycaon pictus*), 7 species as vulnerable (*Loxodonta africana*, *Smutsia (Manis) temminckii*, *Acinonyx jubatus*, *Panthera pardus*, *Panthera leo*, *Hippopotamus amphibious*, *Giraffa camelopardalis*) and 1 species as near threatened (*Hipposideros vittatus*). The SARDB (2004) classifies 2 species as endangered, 5 species as vulnerable,

Table 3. Mammal diversity known and/or expected to occur in the general PEL 73 – i.e. north-eastern Namibia – area.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status:		
			SARDB (2004)	IUCN (2018)	CITES
Shrews					
<i>Crosidura mariquensis</i>	Swamp Musk Shrew Δ	Insufficiently known; Vulnerable?	DD		
<i>Crosidura fuscomurina</i>	Tiny Musk Shrew	Secure	DD		
<i>Crosidura (occidentalis) olivieri</i>	Giant Musk Shrew Δ	Peripheral	DD		
<i>Crosidura hirta</i>	Lesser Red Musk Shrew	Secure			
Elephant Shrews					
<i>Elephantulus brachyrhynchus</i>	Short-snouted Elephant-shrew	Secure	DD		
Aardvark					
<i>Orycteropus afer</i>	Aardvark	Secure; Protected Game			
Elephant					
<i>Loxodonta africana</i>	African Savanna Elephant	Vulnerable; Specially Protected Game		V	C2
Bats					
<i>Epomophorus crypturus</i>	Peter's Epauletted Fruit Bat	Not Listed (#V)			
<i>Cloeotis percivali</i>	Percival's Short-eared Trident Bat	Not Listed			
<i>Hipposideros caffer</i>	Sundevall's Leaf-nosed Bat	Secure	DD		
<i>Hipposideros gigas</i>	Giant Leaf-nosed Bat	Not Listed (#NT)			
<i>Hipposideros vittatus</i>	Striped Leaf-nosed Bat	Not Listed		NT	
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat	Secure	NT		
<i>Rhinolophus denti</i>	Dent's Horseshoe Bat	Secure (#DD)	NT		
<i>Rhinolophus fumigatus</i>	Rüppell's Horseshoe Bat	Secure	NT		
<i>Rhinolophus hildebrandtii</i>	Hildebrandt's Horseshoe Bat	Not Listed			
<i>Rhinolophus landeri</i>	Lander's Horseshoe Bat	Not Listed			
<i>Rhinolophus swinnyi</i>	Swinny's Horseshoe Bat	Not Listed (#NT)			
<i>Taphozous mauritanus</i>	Mauritian Tomb Bat	Secure			
<i>Nycteris hispida</i>	Hairy Slit-faced Bat	Indeterminate; Rare?; Peripheral	NT		
<i>Nycteris macrotis</i>	Large-eared Slit-faced Bat	Not Listed			
<i>Nycteris thebaica</i>	Egyptian Slit-faced Bat	Secure			
<i>Chaerephon ansorgei</i>	Ansorge's Free-tailed Bat	Not Listed			
<i>Chaerephon nigeriae</i>	Nigerian Free-tailed Bat	Secure			
<i>Chaerephon pumilus</i>	Little Free-tailed Bat Δ	Secure			
<i>Mops midas</i>	Midas Free-tailed Bat	Secure			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status:		
			SARDB (2004)	IUCN (2018)	CITES
<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat	Secure			
<i>Miniopterus natalensis</i>	Natal Long-fingered Bat	Secure (#NT)	NT		
<i>Eptesicus hottentotus</i>	Long-tailed Serotine Bat	Secure			
<i>Glauconycteris variegata</i>	Butterfly Bat	Secure	NT		
<i>Hypsugo (Pipistrellus) anchietae</i>	Anchieta's Pipistrelle	Not Listed			
<i>Kerivoula argentata</i>	Damara Woolly Bat Δ	Indeterminate; Rare?	E		
<i>Kerivoula lanosa</i>	Lesser Woolly Bat	Indeterminate; Rare?; Peripheral	NT		
<i>Laephotis botswanae</i>	Botswana Long-eared Bat	Secure	V		
<i>Mimetillus thomasi</i>	Thomas's Flat-headed Bat	Not Listed			
<i>Neoromicia capensis</i>	Cape Serotine Bat	Secure			
<i>Neoromicia nana</i>	Banana Bat	Secure			
<i>Neoromicia zuluensis</i>	Zulu Serotine Bat	Secure			
<i>Nycticeinops schlieffeni</i>	Schlieffen's Twilight Bat	Secure			
<i>Pipistrellus rueppellii</i>	Rüppell's Pipistrelle	Insufficiently Known; Peripheral			
<i>Pipistrellus rusticus</i>	Rusty Pipistrelle	Secure	NT		
<i>Scotophilus dinganii</i>	Yellow-bellied House Bat	Secure			
<i>Scotophilus leucogaster</i>	White-bellied House Bat	Not Listed			
<i>Scotophilus viridis</i>	Green House Bat	Secure			
Monkeys, Baboons and Bushbaby					
<i>Cercopithecus pygerrythrus</i>	Vervet Monkey	Secure			C2
<i>Papio ursinus</i>	Chacma Baboon	Secure; Problem Animal			C2
<i>Galago moholi</i>	South African Galago	Vulnerable; Protected Game			C2
Pangolin					
<i>Smutsia (Manis) temminckii</i>	Pangolin	Vulnerable; Protected Game; Peripheral	V	V	C2
Hares and Rabbits					
<i>Lepus saxatilis</i>	Scrub Hare	Secure			
Rodents					
Molerat					
<i>Cryptomys (Fukomys) damarensis</i>	Damaraland Mole-rat	Secure			
Squirrels					
<i>Paraxerus cepapi</i>	Tree Squirrel	Secure			
Porcupine, Canerat, Springhare, Squirrel					

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status:		
			SARDB (2004)	IUCN (2018)	CITES
<i>Hystrix africaeaustralis</i>	Cape Porcupine	Secure			
<i>Thryonomys swinderianus</i>	Greater Canerat Δ	Peripheral			
<i>Pedetes capensis</i>	Springhare	Secure			
<i>Paraxerus cepapi</i>	Tree Squirrel	Secure			
Dormice, Rats and Mice					
<i>Graphiurus murinus</i>	Woodland Dormouse	Secure			
<i>Lemniscomys rosalia</i>	Single-striped Grass Mouse	Secure	DD		
<i>Zelotomys woosnami</i>	Woosam's Desert Mouse	Rare			
<i>Mus setzeri</i>	Setzer's Pygmy Mouse	Secure			
<i>Mus indutus</i>	Desert Pygmy Mouse	Secure			
<i>Mastomys natalensis</i>	Natal Multimammate Mouse	Secure			
<i>Mastomys coucha</i>	Southern Multimammate Mouse	Secure			
<i>Mastomys shortridgei</i>	Shortridge's Mouse	Rare; Peripheral Δ			
<i>Thallomys paedulus</i>	Acacia Rat	Secure			
<i>Thallomys nigricauda</i>	Black-tailed Tree Rat	Secure			
<i>Aethomys chrysophilus</i>	Red Veld Rat	Secure			
<i>Aethomys namaquensis</i>	Namaqua Rock Mouse	Secure			
<i>Otomys angoniensis</i>	Angoni Vlei Rat Δ	Peripheral			
<i>Gerbillurus paeba</i>	Hairy-footed Gerbil	Secure			
<i>Tatera (Gerbilliscus) leucogaster</i>	Bushveld Gerbil	Secure	DD		
<i>Tatera (Gerbilliscus) brantsii</i>	Highveld Gerbil	Secure			
<i>Saccostomus campestris</i>	Pouched Mouse	Secure			
<i>Dendromus melanotis</i>	Grey Climbing Mouse	Peripheral			
<i>Dendromus mesomelas</i>	Brants' Climbing Mouse	Peripheral			
<i>Steatomys pratensis</i>	Fat Mouse	Secure			
<i>Steatomys parvus</i>	Tiny Fat Mouse	Peripheral			
Carnivores					
<i>Proteles cristatus</i>	Aardwolf	Insufficiently Known; Vulnerable?; Peripheral; Protected Game			
<i>Crocuta crocuta</i>	Spotted Hyena	Secure; Peripheral; Protected Game			
<i>Acinonyx jubatus</i>	Cheetah	Vulnerable; Protected Game	V	V	C1
<i>Panthera pardus</i>	Leopard	Secure; Peripheral; Protected Game		V	C1
<i>Panthera leo</i>	Lion	Indeterminate; Vulnerable?; Peripheral; Protected Game	V	V	C2
<i>Felis caracal</i>	Caracal	Secure; Problem Animal			C2

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status:		
			SARDB (2004)	IUCN (2018)	CITES
<i>Felis lybica</i>	African Wild Cat	Vulnerable			C2
<i>Leptailurus serval</i>	Serval	Indeterminate	NT		C2
<i>Civittictis civetta</i>	African Civet	Indeterminate; Rare?: Peripheral			
<i>Genetta genetta</i>	Small-spotted Genet	Secure			
<i>Genetta tigrina</i>	South African Large-spotted Genet Δ	Indeterminate; Peripheral			
<i>Otocyon megalotis</i>	Bat-eared Fox	Vulnerable?; Peripheral; Protected Game			
<i>Lycaon pictus</i>	African Wild Dog	Endangered	E	E	
<i>Canis adustus</i>	Side-striped Jackal	Secure	NT		
<i>Canis mesomelas</i>	Black-backed Jackal	Secure; Problem Animal			
<i>Aonyx capensis</i>	African Clawless Otter Δ	Vulnerable?; Peripheral; Protected Game			C2
<i>Lutra maculicollis</i>	Spotted-necked Otter Δ	Indeterminate; Endangered?; Peripheral; Protected Game	NT		C2
<i>Mellivora capensis</i>	Ratel or Honey Badger	Secure; Protected Game	NT		
<i>Ictonyx striatus</i>	Striped Polecat	Secure			
<i>Paracynictis selousi</i>	Selous' Mongoose	Indeterminate; Rare			
<i>Cynictis penicillata</i>	Yellow Mongoose	Secure			
<i>Herpestes ichneumon</i>	Large Grey Mongoose Δ	Peripheral			
<i>Galerella sanguinea</i>	Slender Mongoose	Secure			
<i>Mungos mungo</i>	Banded Mongoose	Secure			
<i>Helogale parvula</i>	Dwarf Mongoose	Secure			
Perissodactyla:					
Zebra					
<i>Equus (burchellii) quagga</i>	Plains Zebra	Insufficiently Known; Endangered?; Peripheral; Specially Protected Game			
Artiodactyla:					
Pigs					
<i>Phacochoerus aethiopicus</i>	Common Warthog	Secure; Huntable Game			
Hippopotamus					
<i>Hippopotamus amphibius</i>	Hippopotamus Δ	Peripheral; Specially Protected Game		V	C2
Ruminants					
<i>Giraffa camelopardalis</i>	Giraffe	Vulnerable?; Peripheral; Specially Protected Game		V	
<i>Syncerus caffer</i>	African Buffalo	Insufficiently Known; Peripheral; Huntable Game			
<i>Connochaetes taurinus</i>	Blue Wildebeest	Insufficiently Known; Vulnerable?; Protected Game			
<i>Hippotragus equinus</i>	Roan	Secure?; Protected Game		V	
<i>Hippotragus niger</i>	Sable	Vulnerable; Peripheral; Protected Game			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status:		
			SARDB (2004)	IUCN (2018)	CITES
<i>Tragelaphus strepsiceros</i>	Greater Kudu	Secure; Hunttable Game			
<i>Oryx gazella</i>	Gemsbok	Secure; Hunttable Game			
<i>Sylvicapra grimmia</i>	Common Duiker	Secure; Protected Game			
<i>Tragelaphus oryx</i>	Eland	Insufficiently Known; Vulnerable?; Protected Game			
<i>Redunca arundinum</i>	Southern Reedbuck	Insufficiently Known; Vulnerable?; Peripheral; Protected Game			
<i>Madoqua damarensis</i>	Damara Dik-Dik	Insufficiently Known; Protected Game			
<i>Raphicerus campestris</i>	Steenbok	Secure; Protected Game			

Δ = Species associated with the Okavango River

Namibian conservation and legal status according to the Namibian Conservation Ordinance of 1975 (Griffin 2003)

SARDB (2004) – South African Red Data Book: E – Endangered; V- Vulnerable; NT – Near Threatened; DD – Data Deficient

IUCN (2018): E – Endangered; V- Vulnerable; NT – Near Threatened. All other species listed as Least Concern (LC).

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora. C1 and 2 = CITES Appendix 1 and 2 species.

#Monadjem *et al.* (2010): V- Vulnerable; NT – Near Threatened; DD – Data Deficient

Source for literature review: De Graaff (1981), Estes (1995), Griffin (1998c), Griffin and Coetzee (2005), IUCN (2018), Joubert and Mostert (1975), Monadjem *et al.* (2010), Picker and Griffiths (2011), SARDB (2004), Skinner and Smithers (1990), Skinner and Chimimba (2005), Stander and Hansson (2003) and Taylor (2000).

12 species as near threatened and 7 species as data deficient while CITES lists 2 species as Appendix I and 12 species as Appendix II. Some species have more than one classification. The House Mouse (*Mus musculus*) is viewed as an invasive alien species to the area. *Mus musculus* are generally known as casual pests and not viewed as problematic although they are known carriers of “plague” and can cause economic losses (Picker and Griffiths 2011). Habitat alteration and overutilization are the two primary processes threatening most mammals (Griffin 1998c) with species probably underrepresented in Table 3 for the general area being the bats and rodents, as these groups have not been well documented from the arid central-western part of Namibia.

At least 31.9% 21.6% and 18.1% of the mammalian fauna that occur or are expected to occur in the general area are represented bats (37 species), carnivores (25 species) and rats and mice (21 species). Habitat alteration and overutilization are the two primary processes threatening most mammals in Namibia (Griffin 1998c). Mammal species probably underrepresented in Table 3 for the general area are bats and rodents, as these groups have not been well documented from the general area.

The most important species from the general area are probably those classified as rare (*Nycteris hispida*, *Kerivoula argentata*, *Kerivoula lanosa*, *Mastomys shortridgei*, *Civittictis civetta*, *Paracynictis selousi*) and endangered (*Lycaon pictus*, *Lutra maculicollis*, *Equus (burchellii) quagga*) under Namibian legislation and those classified by the IUCN (2018) as endangered (*Lycaon pictus*), vulnerable (*Loxodonta africana*, *Smutsia (Manis) temminckii*, *Acinonyx jubatus*, *Panthera pardus*, *Panthera leo*, *Hippopotamus amphibious*, *Giraffa camelopardalis*) and near threatened (*Hipposideros vittatus*). However, some of the above species – e.g. other, hippo, etc. – are only associated with the Okavango River. The most important species expected to occur in the Ncaute-Karukuvisa area would be the African wild dog (*Lycaon pictus*) and pangolin (*Smutsia (Manis) temminckii*).

However, none of the mammals, especially the important species, are exclusively associated with the PEL 73 area.

3.4 Avian Diversity

Bird diversity known and/or expected to occur in the general PEL 73 area (literature study only) is presented in Table 4.

Although Namibia’s avifauna is comparatively sparse compared to the high rainfall equatorial areas elsewhere in Africa, approximately 658 species have already been recorded with a diverse and unique group of arid endemics (Brown *et al.* 1998, Maclean 1985). Fourteen species of birds are endemic or near endemic to Namibia with the majority of Namibian endemics occurring in the savannas (30%) of which ten species occur in a north-south belt of dry savannah in central Namibia (Brown *et al.* 1998).

Bird diversity is viewed as “average” in the general area with between 111-230 species estimated of which no species are viewed as endemic (Mendelsohn *et al.* 2000). Simmons (1998a) also indicates no endemic species in the area as well as “very low” rankings for southern African endemics and red data birds. Furthermore, although the PEL 73 area is not classified as an Important Birding Area (IBA) in Namibia, Bushmanland, to the immediate south of the area and Etosha, to the west, have Global IBA status (Simmons 1998b).

At least 210 species of terrestrial [“breeding residents”] birds occur and/or could occur in the general area – focus on the Ncaute-Karukuvisa area and excludes birds associated with the Okavango River – at any time (Hockey *et al.* 2006, Maclean 1985, Tarboton 2001). All the aquatic, extralimital breeders and migrant species have been excluded here. Only one – rosy-faced lovebird – of the 14 Namibian endemics is expected to occur in the general area.

Six species are classified as endangered (hooded vulture, white-backed vulture, tawny eagle, martial eagle, bateleur, southern ground-hornbill), 3 species as vulnerable (secretarybird, white-headed vulture, lappet-faced vulture and) and 3 species as near threatened (marabou stork, peregrine falcon, kori bustard) from Namibia (Simmons *et al.* 2015). The IUCN (2018) classifies 3 species as critically endangered (hooded vulture, white-headed vulture, white-backed vulture), 1 species as endangered (lappet-faced vulture), 4 species as vulnerable (secretarybird, tawny eagle, martial eagle, southern ground-hornbill) and 2 species as near threatened (bateleur, kori bustard).

Twenty seven species (12.9% of all the birds expected) have a southern African conservation rating with 2 species classified as endemic (7.4% of southern African endemics or 1% of all the birds expected) and 25 species classified as near endemic (92.6% of southern African endemics or 11.9% of all the birds expected) (Hockey *et al.* 2006).

Many species expected to occur in the general area are migratory – e.g. bustards and korhaan – and not found permanently in the area. Other species may frequent the area only if water collects in the Omuramba Omatako or whilst moving between wetlands in Etosha and Bushmanland – e.g. cranes, ducks, flamingo, etc. As very little ringing/recording occurs in this part of Namibia, little is known about the distribution and ecology of many species from the general area with many more species expected to occur.

The most important species are viewed as those classified as endangered (hooded vulture, white-backed vulture, tawny eagle, martial eagle, bateleur, southern ground-hornbill), vulnerable (secretarybird, white-headed vulture, lappet-faced vulture and) and near threatened (marabou stork, peregrine falcon, kori bustard) from Namibia (Simmons *et al.* 2015) as well as those classified by the IUCN (2018) as critically endangered (hooded vulture, white-headed vulture, white-backed vulture), endangered (lappet-faced vulture), 4 vulnerable (secretarybird, tawny eagle, martial eagle, southern ground-hornbill) and near threatened (bateleur, kori bustard).

However, none of the birds, especially the important species, are exclusively associated with the PEL 73 area.

Table 4. Bird diversity known and/or expected to occur in the general PEL 73 – i.e. north-eastern Namibia – area. This table excludes marine and other aquatic birds (e.g. Petrel, Albatross, Skua, and various ducks, etc.) and species breeding extralimital (e.g. stints, sandpipers, etc.) and rather focuses on birds that are breeding residents or can be found in the area during any time of the year. This would imply that many more birds (e.g. Palaearctic migrants) could occur in the area depending on “favourable” environmental conditions.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status	
			Southern Africa	IUCN (2018)
<i>Struthio camelus</i>	Common Ostrich			
<i>Leptoptilos crumeniferus</i>	Marabou Stork	NT		
<i>Sagittarius serpentarius</i>	Secretarybird	V		V
<i>Necrosyrtes monachus</i>	Hooded Vulture	E		CE
<i>Aegyptius occipitalis</i>	White-headed Vulture	V		CE
<i>Gyps africanus</i>	White-backed Vulture	E		CE
<i>Torgos tracheliotus</i>	Lappet-faced Vulture	V		E
<i>Elanus caeruleus</i>	Black-shouldered Kite			
<i>Aquila rapax</i>	Tawny Eagle	E		V
<i>Hieraaetus fasciatus</i>	African Hawk-Eagle			
<i>Aquila ayresii</i>	Ayres’s Hawk-Eagle			
<i>Aquila wahlbergi</i>	Wahlberg’s Eagle			
<i>Polemaetus bellicosus</i>	Martial Eagle	E		V
<i>Circaetus cinereus</i>	Brown Snake Eagle			
<i>Circaetus gallicus</i>	Black-chested Snake Eagle			
<i>Terathopius ecaudatus</i>	Bateleur	E		NT
<i>Polyboroides typus</i>	African Harrier-Hawk			
<i>Kaupifalco monogrammicus</i>	Lizard Buzzard			
<i>Accipter badius</i>	Shikra			
<i>Micronisus gabar</i>	Gabar Goshawk			
<i>Melierax metabates</i>	Dark Chanting Goshawk			
<i>Melierax canorus</i>	Southern Pale Chanting Goshawk			
<i>Accipiter minullus</i>	Little Sparrowhawk			
<i>Accipiter ovampensis</i>	Ovambo Sparrowhawk			
<i>Falco peregrinus</i>	Peregrine Falcon	NT		
<i>Falco cuvierii</i>	African Hobby			
<i>Falco biarmicus</i>	Lanner Falcon			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status	
			Southern Africa	IUCN (2018)
<i>Falco chicquera</i>	Red-necked Falcon			
<i>Falco rupicolis</i>	Rock Kestrel			
<i>Falco rupicoloides</i>	Greater Kestrel			
<i>Falco dickinsoni</i>	Dickinson's Kestrel			
<i>Bubulcus ibis</i>	Cattle Egret			
<i>Peliperdix coqui</i>	Coqui Francolin			
<i>Dendroperdix sephaena</i>	Crested Francolin			
<i>Scleroptila levailantoides</i>	Orange River Francolin		N-End	
<i>Francolinus adspersus</i>	Red-billed Spurfowl		N-End	
<i>Pternistis swainsonii</i>	Swainson's Spurfowl			
<i>Coturnix coturnix</i>	Common Quail			
<i>Coturnix delegorguei</i>	Harlequin Quail			
<i>Numida meleagris</i>	Helmeted Guineafowl			
<i>Trunix sylvatica</i>	Kurrichane Buttonquail			
<i>Ardeotis kori</i>	Kori Bustard	NT		NT
<i>Eupodotis rufisrista</i>	Red-crested Korhaan		N-End	
<i>Afrotis afroides</i>	Northern Black Korhaan			
<i>Vanellus coronatus</i>	Crowned Lapwing			
<i>Vanellus armatus</i>	Blacksmith Lapwing			
<i>Burhinus capensis</i>	Spotted Thick-knee			
<i>Cursorius temminckii</i>	Temminck's Courser			
<i>Rhinoptilus chalcopterus</i>	Bronze-winged Courser			
<i>Pterocles namaqua</i>	Namaqua Sandgrouse		N-End	
<i>Pterocles bicinctus</i>	Double-banded Sandgrouse		N-End	
<i>Pterocles gutturalis</i>	Yellow-throated Sandgrouse			
<i>Pterocles bicinctus</i>	Burchell's Sandgrouse		N-End	
<i>Streptopelia decipiens</i>	African Mourning Dove			
<i>Streptopelia capicola</i>	Cape Turtle Dove			
<i>Streptopelia senegalensis</i>	Laughing Dove			
<i>Streptopelia semitorquata</i>	Red-eyed Dove			
<i>Turtur chalcospilos</i>	Emerald-spotted Wood Dove			
<i>Oena capensis</i>	Namaqua Dove			
<i>Treron calvus</i>	African Green-Pigeon			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status	
			Southern Africa	IUCN (2018)
<i>Corythaixoides concolor</i>	Grey Go-away-bird			
<i>Tyto alba</i>	Barn Owl			
<i>Otus senegalensis</i>	African Scops-Owl			
<i>Otus leucotis</i>	Southern White-faced Scops-Owl			
<i>Bubo africanus</i>	Spotted Eagle-Owl			
<i>Bubo lacteus</i>	Verreaux's Eagle-Owl			
<i>Glaucidium perlatum</i>	Pearl-spotted Owlet			
<i>Glaucidium capense</i>	African Barred Owlet			
<i>Caprimulgus pectoralis</i>	Fiery-necked Nightjar			
<i>Caprimulgus tristigma</i>	Freckled Nightjar			
<i>Caprimulgus fossii</i>	Square-tailed Nightjar			
<i>Caprimulgus rufigenta</i>	Rufous-cheeked Nightjar			
<i>Cypsiurus parvus</i>	African Palm-Swift			
<i>Colius indicus</i>	Red-faced Mousebird			
<i>Poicephalus meyeri</i>	Meyer's Parrot			
<i>Agapornis roseicollis</i>	Rosy-faced Lovebird	End		
<i>Coracias caudate</i>	Lilac-breasted Roller			
<i>Coracias naevia</i>	Purple Roller			
<i>Merops pusillus</i>	Little Bee-eater			
<i>Merops hirundineus</i>	Swallow-tailed Bee-eater			
<i>Merops apiaster</i>	European Bee-eater			
<i>Merops nubicoides</i>	Southern Carmine Bee-eater			
<i>Upupa africana</i>	African Hoopoe			
<i>Phoeniculus purpureus</i>	Green Wood-Hoopoe			
<i>Phoeniculus cyanomelas</i>	Common Scimitarbill			
<i>Tockus erythrorhynchus</i>	Red-billed Hornbill			
<i>Tockus nasutus</i>	African Grey Hornbill			
<i>Tockus flavirostris</i>	Southern Yellow-billed Hornbill		N-End	
<i>Tockus bradfieldi</i>	Bradfield's Hornbill		N-End	
<i>Bucorvus leadbeateri</i>	Southern Ground-Hornbill	E		V
<i>Lybius leucomelas</i>	Acacia Pied Barbet		N-End	
<i>Indicator minor</i>	Lesser Honeyguide			
<i>Prodotiscus regulus</i>	Brown-backed Honeybird			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status	
			Southern Africa	IUCN (2018)
<i>Campethera bennettii</i>	Bennett's Woodpecker			
<i>Campethera abingoni</i>	Golden-tailed Woodpecker			
<i>Dendropicos fuscescens</i>	Cardinal Woodpecker			
<i>Thrioides namaquus</i>	Bearded Woodpecker			
<i>Pogoniulus chrysoconus</i>	Yellow-fronted Tinkerbird			
<i>Oriolus auratus</i>	African Golden Oriole			
<i>Oriolus larvatus</i>	Black-headed Oriole			
<i>Mirafra passerine</i>	Monotonous Lark		N-End	
<i>Mirafra africana</i>	Rufous-naped Lark			
<i>Mirafra apiata</i>	Eastern Clapper Lark		N-End	
<i>Mirafra africanoides</i>	Fawn-coloured Lark		N-End	
<i>Mirafra sabota</i>	Sabota Lark			
<i>Pinarocorys nigricans</i>	Dusky Lark			
<i>Eremopterix leucotis</i>	Chestnut-backed Sparrowlark			
<i>Eremopterix verticalis</i>	Grey-backed Sparrowlark		N-End	
<i>Calandrella cinerea</i>	Red-capped Lark			
<i>Hirundo albigularis</i>	White-throated Swallow			
<i>Hirundo semirufa</i>	Red-breasted Swallow			
<i>Dicrurus adsimilis</i>	Fork-tailed Drongo			
<i>Corvus capensis</i>	Cape Crow			
<i>Corvus albus</i>	Pied Crow			
<i>Parus rufiventris</i>	Rufous-bellied Tit			
<i>Anthoscopus minutes</i>	Cape Penduline-Tit		N-End	
<i>Anthoscopus caroli</i>	Grey Penduline-Tit			
<i>Parus niger</i>	Southern Black Tit			
<i>Parus cinerascens</i>	Ashy Tit			
<i>Pycnonotus nigricans</i>	African Red-eyed Bulbul		N-End	
<i>Turdus litsitsirupa</i>	Groundscraper Thrush			
<i>Turdus libonyana</i>	Kurrichane Thrush			
<i>Oenanthe pileata</i>	Capped Wheatear			
<i>Myrmecocichla formicivora</i>	Ant-eating Chat		End	
<i>Cercotrichas leucophrys</i>	White-browed Scrub-Robin			
<i>Erythropgyia paena</i>	Kalahari Scrub-Robin			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status	
			Southern Africa	IUCN (2018)
<i>Parisoma subcaeruleum</i>	Chestnut-vented Tit-Babbler		N-End	
<i>Sylvietta rufescens</i>	Long-billed Crombec			
<i>Eremomela icteropygialis</i>	Yellow-bellied Eremomela			
<i>Eremomela scotops</i>	Green-capped Eremomela			
<i>Eremomela usticollis</i>	Burnt-necked Eremomela			
<i>Turdoides melanops</i>	Black-faced Babbler			
<i>Turdoides bicolor</i>	Southern Pied Babbler			
<i>Turdoides jardineii</i>	Arrow-marked Babbler			
<i>Camaroptera fasciolata</i>	Barred Wren-Warbler		N-End	
<i>Cisticola chiniana</i>	Rattling Cisticola			
<i>Cisticola rufilatus</i>	Tinkling Cisticola			
<i>Cisticola aridula</i>	Desert Cisticola			
<i>Cisticola pipiens</i>	Chirping Cisticola			
<i>Cisticola fulvicapilla</i>	Neddicky			
<i>Prinia subflava</i>	Tawny-flanked Prinia			
<i>Prinia flavicans</i>	Black-chested Prinia			
<i>Apalis flavida</i>	Yellow-breasted Apalis			
<i>Camaroptera brevicaudata</i>	Grey-backed Camaroptera			
<i>Bradornis pallidus</i>	Pale Flycatcher			
<i>Melaenornis mariquensis</i>	Marico Flycatcher		N-End	
<i>Melaenornis infuscatus</i>	Chat Flycatcher		N-End	
<i>Melaenornis pammelaina</i>	Southern Black Flycatcher			
<i>Muscicapa striata</i>	Spotted Flycatcher			
<i>Batis molitor</i>	Chin-spot Batis			
<i>Batis pririt</i>	Pirit Batis			
<i>Motacilla aguimp</i>	African Pied Wagtail			
<i>Motacilla capensis</i>	Cape Wagtail			
<i>Anthus cinnamomeus</i>	African Pipit		End	
<i>Anthus leucophrys</i>	Plain-backed Pipit			
<i>Anthus valensis</i>	Buffy Pipit			
<i>Anthus nyassae</i>	Wood Pipit			
<i>Lanius collaris</i>	Common Fiscal			
<i>Corvinella melanoleuca</i>	Magpie Shrike			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status	
			Southern Africa	IUCN (2018)
<i>Eurocephalus anguitimens</i>	Southern White-crowned Shrike		N-End	
<i>Coracina pectoralis</i>	White-breasted Cuckooshrike			
<i>Campephaga flava</i>	Black Cuckooshrike			
<i>Laniarius atrococcineus</i>	Crimson-breasted Shrike		N-End	
<i>Nilaus afer</i>	Brubru			
<i>Dryoscopus cubla</i>	Black-backed Puffback			
<i>Tchagra australis</i>	Brown-crowned Tchagra			
<i>Tchagra senegalus</i>	Black-crowned Tchagra			
<i>Telephorus sulfureopectus</i>	Orange-breasted Bush-Shrike			
<i>Prionops plumatus</i>	White-crested Helmet-Shrike			
<i>Prionops retzii</i>	Retz's Helmet-Shrike			
<i>Creatophora cinerea</i>	Wattled Starling			
<i>Lamprotornis acuticaudus</i>	Sharp-tailed Starling			
<i>Lamprotornis australis</i>	Burchell's Starling		N-End	
<i>Lamprotornis nitens</i>	Cape Glossy Starling			
<i>Lamprotornis chalybaeus</i>	Greater Blue-eared Starling			
<i>Cinnyricinclus leucogaster</i>	Violet-backed Starling			
<i>Chalcomitra amethystina</i>	Amethyst Sunbird			
<i>Nectarinia senegalensis</i>	Scarlet-chested Sunbird			
<i>Cinnyris talatala</i>	White-bellied Sunbird			
<i>Cinnyris fuscus</i>	Dusky Sunbird			
<i>Nectarinia mariquensis</i>	Marico Sunbird			
<i>Zosterops senegalensis</i>	African Yellow White-eye			
<i>Bubalornis niger</i>	Red-billed Buffalo- Weaver			
<i>Plocepasser mahali</i>	White-browed Sparrow-weaver			
<i>Passer domesticus</i>	House Sparrow			
<i>Passer motitensis</i>	Great Sparrow			
<i>Passer griseus</i>	Southern Grey-headed Sparrow			
<i>Petronia supercilialis</i>	Yellow-throated Petronia			
<i>Sporopipes squamifrons</i>	Scaly-feathered Finch			
<i>Ploceus velatus</i>	Southern Masked Weaver			
<i>Anaplectes melanotis</i>	Red-headed Weaver			
<i>Quelea quelea</i>	Red-billed Quelea			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status	
			Southern Africa	IUCN (2018)
<i>Pytilia melba</i>	Green-winged Pytilia			
<i>Uraeginthus granatinus</i>	Violet-eared Waxbill			
<i>Estrilda astrild</i>	Common Waxbill			
<i>Estrilda erythronotos</i>	Black-faced Waxbill			
<i>Uraeginthus angolensis</i>	Blue Waxbill			
<i>Ortygospiza atricollis</i>	African Quailfinch			
<i>Amadina erythrocephala</i>	Red-headed Finch		N-End	
<i>Amadina fasciata</i>	Cut-throat Finch			
<i>Vidua macroura</i>	Pin-tailed Whydah			
<i>Vidua paradisaea</i>	Long-tailed Paradise Whydah			
<i>Vidua regia</i>	Shaft-tailed Whydah		N-End	
<i>Crithagra mozambica</i>	Yellow-fronted Canary			
<i>Serinus atrogularis</i>	Black-throated Canary			
<i>Serinus flaviventris</i>	Yellow Canary		N-End	
<i>Emberiza tahapisi</i>	Cinnamon-breasted Bunting			
<i>Emberiza flaviventris</i>	Golden-breasted Bunting			

Namibian (Simmons *et al.* 2015): CE – Critically Endangered; E – Endangered; V – Vulnerable; NT – Near Threatened

Southern African (Hockey *et al.* 2006): End – Endemic; N-end – Near Endemic

IUCN (2018): CE – Critically Endangered; E – Endangered; V – Vulnerable; NT – Near Threatened; All other birds either listed as least concern or not yet been assessed for the IUCN Red List

Source for literature review: Brown *et al.* (1998), Hockey *et al.* (2006), IUCN (2018), Komen (n.d.), Little *et al.* (2011), Maclean (1985), Peacock (2015), Simmons *et al.* (2015) and Tarboton (2001)

3.5 Tree and Shrub Diversity

The tree and shrub diversity known and/or expected to occur in the general PEL 73 area (literature study only – using Mannheimer and Curtis 2018) is presented in Table 5.

Table 5. Tree and shrub diversity known and/or expected to occur in the general PEL 73 – i.e. north-eastern Namibia – area. The focus is on the Ncaute-Karukuvisa area and excludes species associated with the Okavango River. Species indicated are known from the quarter-degree square distribution principle used and don't necessarily occur throughout the entire area.

Species: Scientific name	Namibian conservation and legal status
<i>Acacia ataxacantha</i>	
<i>Acacia erioloba</i>	Protected (F#)
<i>Acacia erubescens</i>	
<i>Acacia fleckii</i>	
<i>Acacia hebeclada</i>	
<i>Acacia luederitzii</i>	
<i>Acacia mellifera</i>	
<i>Acacia tortilis</i>	
<i>Adansonia digitata</i>	Protected (F#)
<i>Albizia anthelmintica</i>	Protected (F#)
<i>Albizia antunesiana</i>	
<i>Albizia harveyi</i>	
<i>Aloe litoralis</i>	NC; C2
<i>Annona stenophylla</i>	
<i>Baikiaea plurijuga</i>	Protected (F#); LR-nt
<i>Baissea wulfhorstii</i>	
<i>Baphia massaiensis</i>	
<i>Bauhinia petersiana</i>	
<i>Bauhinia urbaniana</i>	
<i>Boscia albitrunca</i>	Protected (F#); LR-nt
<i>Burkea africana</i>	Protected (F#)
<i>Catophractes alexandri</i>	
<i>Combretum apiculatum</i>	
<i>Combretum celastroides</i>	
<i>Combretum collinum</i>	
<i>Combretum engleri</i>	
<i>Combretum hereroense</i>	
<i>Combretum mosambicense</i>	
<i>Combretum imberbe</i>	Protected (F#)
<i>Combretum platypetalum</i>	
<i>Combretum psidioides</i>	
<i>Combretum zeyheri</i>	
<i>Commiphora africana</i>	
<i>Commiphora angolensis</i>	
<i>Commiphora glandulosa</i>	
<i>Commiphora pyracanthoides</i>	
<i>Commiphora tenuipetiolata</i>	
<i>Cordia sinensis</i>	
<i>Croton gratissimus</i>	
<i>Croton menyharthii</i>	
<i>Dialium englerianum</i>	Protected (F#)
<i>Dichrostachys cinerea</i>	
<i>Diospyros chamaethamnus</i>	
<i>Diospyros lycioides</i>	
<i>Diplorhynchus condylocarpon</i>	

Species: Scientific name	Namibian conservation and legal status
<i>Ehretia alba</i>	
<i>Elaeodendron transvaalense</i>	Protected (F#)
<i>Entada arenaria</i>	
<i>Erythrococca menyharthii</i>	
<i>Erythrophleum africanum</i>	
<i>Euclea divinorum</i>	
<i>Flueggea virosa</i>	
<i>Ficus burkei/F. petersii</i>	Protected (F#)
<i>Grewia avellana</i>	
<i>Grewia bicolor</i>	
<i>Grewia falcistipula</i>	
<i>Grewia flava</i>	
<i>Grewia flavescens</i>	
<i>Grewia olukondae</i>	
<i>Grewia retinervis</i>	
<i>Grewia schinzii</i>	
<i>Grewia tenax</i>	
<i>Grewia villosa</i>	
<i>Guibourtia coleosperma</i>	Protected (F#)
<i>Gymnosporia senegalensis</i>	
<i>Gyrocarpus americanus</i>	Protected (F#)
<i>Hyphaene petersiana</i>	
<i>Ipomoea adenioides</i>	
<i>Maerua schinzii</i>	Protected (F#)
<i>Mundulea sericea</i>	
<i>Ochna cinnabarina</i>	
<i>Ochna pulchra</i>	Protected (F#)
<i>Ozoroa insignis</i>	
<i>Ozoroa longipes</i>	
<i>Ozoroa okavangensis</i>	
<i>Ozoroa paniculosa</i>	
<i>Ozoroa schinzii</i>	
<i>Pavetta zeyheri</i>	
<i>Peltophorum africanum</i>	Protected (F#)
<i>Pterocarpus angolensis</i>	Protected (F#); LR-nt
<i>Philenoptera nelsii</i>	
<i>Philenoptera violacea</i>	Protected (F#)
<i>Pseudolachnostylis maprouneifolia</i>	
<i>Psydrax livida</i>	
<i>Rhigozum brevispinosum</i>	
<i>Rothea myricoides</i>	
<i>Searsia ciliata</i>	
<i>Searsia marlothii</i>	
<i>Searsia tenuinervis</i>	
<i>Schinziophyton rautanenii</i>	Protected (F#)
<i>Sclerocarya birrea</i>	Protected (F#)
<i>Securidaca longependunculata</i>	
<i>Steganotaenia araliacea</i>	
<i>Strychnos cocculoides</i>	Protected (F#)
<i>Strychnos pungens</i>	Protected (F#)
<i>Strychnos spinosa</i>	Protected (F#)
<i>Swartzia madagascariensis</i>	
<i>Tarchonanthes camphoratus</i>	
<i>Terminalia brachystemma</i>	
<i>Terminalia prunioides</i>	
<i>Terminalia sericea</i>	
<i>Tinnea ericalyx</i>	

Species: Scientific name	Namibian conservation and legal status
<i>Vangueria cyanescens</i>	
<i>Vangueria infausta</i>	
<i>Ximenia americana</i>	
<i>Ximenia caffra</i> var. <i>caffra</i>	
<i>Ziziphus mucronata</i>	Protected (F#)

F# – Forest Act No. 12 of 2001

NC – Nature Conservation Ordinance No. 4 of 1975

C2 – CITES Appendix 2 (Mannheimer and Curtis 2018)

LR-nt – lower risk, near threatened (Loots 2005)

Source for literature review: Mannheimer and Curtis (2018)

At least 107 species of larger trees/shrubs are expected to occur in the PEL 73 area – i.e. Ncaute-Karukuvisa – of which none are viewed as endemics. Twenty three species (21.5%) are protected by the Forest Act No. 12 of 2001 while 1 species is protected by the Nature Conservation Ordinance No. 4 of 1975 (0.9%) and 1 species is listed as a CITES Appendix 2 species (Mannheimer and Curtis 2018). Three species are classified as Lower Risk (Near Threatened) (2.8%) (Loots 2005).

Species with the most diversity expected from the general area are *Combretum* (10 species) and *Grewia* (10 species) followed by *Acacia* (8 species).

The most important larger trees and shrub species expected to occur in the general Divundu area include all those formally protected (See Table 5). The most important species expected to occur in the general PEL 73 area are *Baikiaea plurijuga*, *Burkea africana*, *Guibourtia coleosperma*, *Dialium englerianum*, *Philenoptera violacea*, *Pterocarpus angolensis*, *Schinziophyton rautanenii*, *Sclerocarya birrea* and *Strychnos* species.

The most important species, classified as Lower Risk/Near Threatened by the IUCN (2018), are viewed as *Pterocarpus angolensis* (African teak or Kiaat) (De Cauwer *et al.* 2014) and *Baikiaea plurijuga* (Zambezi/Rhodesian Teak) due to numbers having decreased due to overutilization for wood production; elephant damage and unseasonal human induced fires.

However, none of the larger trees and shrubs, especially the important species, are exclusively associated with the PEL 73 area.

3.6 Grass Diversity

It is estimated that at least 18-96 grasses (Müller 1984 [18sp.], Müller 2007 [43sp.], Van Oudshoorn 1999 [96sp.]) – approximate total of 111 species – occur in the general PEL 73 area.

The grasses known and/or expected to occur in the general Ncaute-Karukuvisa area (¹Müller 2007, ²Van Oudtshoorn 1999 and ³Müller 1984) is presented in Table 6 below.

Table 6. Grass diversity known and/or expected to occur in the general PEL 73 – i.e. north-eastern Namibia – area.

Species: Scientific name	Namibian conservation and legal status	Ecological Status	Grazing Value
² <i>Acroceras macrum</i>		Decreaser	High
² <i>Andropogon chinensis</i>		Increaser 1	Average

Species: Scientific name	Namibian conservation and legal status	Ecological Status	Grazing Value
² <i>Andropogon eucomus</i>		Increaser 2	Low
^{1,2} <i>Andropogon gayanus</i>		Increaser 1	High
² <i>Andropogon huillensis</i>		Increaser 1	Average
² <i>Andropogon schirensis</i>		Increaser 1	Average
² <i>Anthephora pubescens</i>		Decreaser	High
² <i>Aristida adscensionis</i>		Increaser 2	Low
^{1,2,3} <i>Aristida congesta</i>		Increaser 2	Low
² <i>Aristida junciformis</i>		Increaser 2	Low
^{1,2,3} <i>Aristida meridionalis</i>		Increaser 2	Low
³ <i>Aristida pilgeri</i>		Increaser 2	Low
² <i>Aristida rhinochloa</i>		Increaser 2	Low
² <i>Aristida scabrivalvis</i>		Increaser 2	Low
^{1,2,3} <i>Aristida stipitata</i>		Increaser 2	Low
¹ <i>Aristida stipoides</i>		?	Low
² <i>Bothriochloa bladhii</i>		Increaser 1	Low
² <i>Bothriochloa insculpta</i>		Increaser 2	Average
² <i>Bothriochloa radicans</i>		Increaser 2	Low
² <i>Brachiaria brizantha</i>		Increaser 1	Average
^{1,2,3} <i>Bachiaria deflexa</i>		Increaser 2	Average
¹ <i>Brachiaria dura</i>		?	Average
² <i>Bachiaria eruciformis</i>		Increaser 2	Average
^{1,2,3} <i>Brachiaria nigropedata</i>		Decreaser	High
^{1,2,3} <i>Cenchrus ciliaris</i>		Decreaser	High
^{1,2,3} <i>Chloris virgata</i>		Increaser 2	Average
² <i>Chloris gayana</i>		Decreaser	High
^{1,3} <i>Cymbopogon caesius</i>		?	Low
² <i>Cymbopogon excavatus</i>		Increaser 1	Low
^{1,2,3} <i>Cynodon dactylon</i>		Increaser 2	High
² <i>Dactyloctenium aegyptium</i>		Increaser 2	Low
^{1,2,3} <i>Dactyloctenium giganteum</i>		Increaser 2	Low
^{1,2} <i>Dichanthium annulatum</i>		Decreaser	High
² <i>Digitaria eriantha</i>		Decreaser	High
² <i>Digitaria sanguinalis</i>		Increaser 2	Low
² <i>Digitaria velutina</i>		Increaser 2	Low
² <i>Diplachne fusca</i>		Decreaser	High
^{1,2} <i>Echinochloa colona</i>		Increaser 2	Low
² <i>Echinochloa holubii</i>		Increaser 2	Average
² <i>Echinochloa pyramidalis</i>		Decreaser	Average
² <i>Eleusine coracana</i>		Increaser 2	Low
^{2,3} <i>Elionurus muticus</i>		Increaser 2	Low
² <i>Enneapogon cenchroides</i>		Increaser 2	Low
² <i>Enneapogon desvauxii</i>		Intermediate	Average
² <i>Enteropogon macrostachyus</i>		Decreaser	High
² <i>Eragrostis aspera</i>		Increaser 2	Low
² <i>Eragrostis cilianensis</i>		Increaser 2	Low
² <i>Eragrostis echinochloidea</i>		Increaser 2	Average
² <i>Eragrostis gummiflua</i>		Increaser 2	Low
² <i>Eragrostis heteromera</i>		Intermediate	Low
² <i>Eragrostis inamoena</i>		Increaser 2	Low
^{1,2} <i>Eragrostis lehmanniana</i>		Increaser 2	Average
² <i>Eragrostis nindensis</i>		Increaser 2	Average
^{1,2,3} <i>Eragrostis pallens</i>		Increaser 2	Low
¹ <i>Eragrostis porosa</i>		Intermediate	Low
^{1,2} <i>Eragrostis rigidior</i>		Increaser 2	Average

Species: Scientific name	Namibian conservation and legal status	Ecological Status	Grazing Value
² <i>Eragrostis rotifer</i>		Intermediate	Low
^{1,2} <i>Eragrostis superba</i>		Increaser 2	Average
² <i>Eragrostis trichophora</i>		Increaser 2	Average
² <i>Eragrostis viscosa</i>		Increaser 2	Low
² <i>Eriochloa meyeriana</i>		Decreaser	High
² <i>Hemarthria altissima</i>		Decreaser	High
^{1,2} <i>Heteropogon contortus</i>		Increaser 2	Average
¹ <i>Heteropogon melanocarpus</i>		?	Low
¹ <i>Hyparrhenia rufa</i>		?	Low
^{1,2} <i>Hyperthelia dissoluta</i>		Increaser 1	Low
² <i>Imperata cylindrica</i>		Increaser 1	Low
² <i>Ischaemum fasciculatum</i>		Increaser 1	Average
² <i>Ischaemum afrum</i>		Intermediate	Average
² <i>Leersia hexandra</i>		?	High
¹ <i>Leptochloa fusca</i>		?	Average
² <i>Miscanthus junceus</i>		Increaser 1	Low
^{1,2} <i>Melinis repens</i>		Increaser 2	Low
³ <i>Melinis villosum</i>		?	Low
^{1,2} <i>Panicum coloratum</i>		Decreaser	High
^{1,3} <i>Panicum kalaharensense</i>		?	Average
^{1,2,3} <i>Panicum maximum</i>		Decreaser	High
^{1,2} <i>Panicum repens</i>		Decreaser	High
² <i>Paspalum scrobiculatum</i>		Increaser 2	Average
^{1,2,3} <i>Perotis patens</i>		Increaser 2	Low
^{1,3} <i>Pogonarthria fleckii</i>		Increaser 2	Low
^{2,3} <i>Pogonarthria squarrosa</i>		Increaser 2	Low
^{1,2} <i>Schmidtia kalahariensis</i>		Increaser 2	Low
^{1,2,3} <i>Schmidtia pappophoroides</i>		Decreaser	High
^{1,3} <i>Schizachyrium exile</i>		?	Low
² <i>Schizachyrium jeffreysii</i>		Increaser 1	Low
² <i>Schizachyrium sanguineum</i>		Increaser 1	Low
^{1,2} <i>Setaria sagittifolia</i>		Increaser 2	Low
² <i>Setaria sphacelata</i>		Decreaser	High
² <i>Setaria verticillata</i>		Increaser 2	Average
² <i>Sorghum bicolor</i>		Intermediate	High
² <i>Sorghum versicolor</i>		Increaser 2	Average
² <i>Sporobolus africanus</i>		Increaser 2	Low
² <i>Sporobolus festivus</i>		Increaser 2	Low
^{1,2,3} <i>Sporobolus fimbriatus</i>		Decreaser	High
^{1,2,3} <i>Sporobolus ioclados</i>		Increaser 2	Average
² <i>Sporobolus stapfianus</i>		Increaser 2	Low
² <i>Sporobolus panicoides</i>		Increaser 2	Low
² <i>Sporobolus pyramidalis</i>		Increaser 2	Low
² <i>Stipagrostis hirtigluma</i>		Increaser 2	Low
^{1,2} <i>Stipagrostis uniplumis</i>		Increaser 2	Average
² <i>Themeda triandra</i>		Decreaser	Average
² <i>Trachypogon spicatus</i>		Increaser 1	Low
² <i>Tricholaena monachne</i>		Increaser 2	Average
² <i>Trichoneura grandiglumis</i>		Increaser 2	Low
^{1,2} <i>Tragus berteronianus</i>		Increaser 2	Low
¹ <i>Urochloa brachyura</i>		?	Average
² <i>Urochloa mosambicensis</i>		Increaser 2	High
² <i>Urochloa oligotricha</i>		Decreaser	High
¹ <i>Urochloa trichopus</i>		?	Low

Species: Scientific name	Namibian conservation and legal status	Ecological Status	Grazing Value
¹ <i>Willkommia sarmentosa</i>		?	Low

? – not classified in literature, but often similar to other species within the genus

Source for literature review: Müller (1984), Müller (2007), Van Oudtshoorn (1999)

Although up to 111 grasses are expected to occur in the general area, none of the 4 species of grasses endemic to Namibia is expected in the area (Müller 2007).

Except for the general ecological role of grasses (e.g. stabilising the soil, fodder/grazing value, etc.) none of the grasses are viewed as exceptionally unique in the area. The grasses commonly used for thatching – *Eragrostis pallens* and *Cymbopogon* species – which also have economic value, are the important grasses in the area.

However, none of the grasses, especially the important species, are exclusively associated with the PEL 73 area.

3.7 Important Species

Reptiles

The most important species are viewed as the 2 endemics (*Ichnotropis grandiceps* and *Lygodactylus bradfieldi*), 3 species classified as rare (*Lycophidion multimaculatum*, *Psammophis jallae*, *Causus rhombeatus*) and 6 species classified as vulnerable (*Stigmochelys pardalis*, *Psammobates oculiferus*, *Kinixys spekii*, *Python natalensis*, *Varanus albigularis*, *Varanus niloticus*) from the general area. Furthermore, *Ichnotropis grandiceps*, classified as data deficient (IUCN 2018) is also viewed as important.

Amphibians

The most important species from the area is the giant bullfrog (*Pyxicephalus adspersus*) with “population decreasing” according to the IUCN (2018) as it is consumed as food throughout its range.

Mammals

The most important species from the general area are probably those classified as rare (*Nycteris hispida*, *Kerivoula argentata*, *Kerivoula lanosa*, *Mastomys shortridgei*, *Civittictis civetta*, *Paracynictis selousi*) and endangered (*Lycaon pictus*, *Lutra maculicollis*, *Equus (burchellii) quagga*) under Namibian legislation and those classified by the IUCN (2018) as endangered (*Lycaon pictus*), vulnerable (*Loxodonta africana*, *Smutsia (Manis) temminckii*, *Acinonyx jubatus*, *Panthera pardus*, *Panthera leo*, *Hippopotamus amphibious*, *Giraffa camelopardalis*) and near threatened (*Hipposideros vittatus*). However, some of the above species – e.g. other, hippo, etc. – are only associated with the Okavango River. The most important species expected to occur in the Ncaute-Karukuvisa area would be the African wild dog (*Lycaon pictus*) and pangolin (*Smutsia (Manis) temminckii*).

Birds

The most important species are viewed as those classified as endangered (hooded vulture, white-backed vulture, tawny eagle, martial eagle, bateleur, southern ground-hornbill), vulnerable (secretarybird, white-headed vulture, lappet-faced vulture and) and near threatened (marabou stork, peregrine falcon, kori bustard) from Namibia (Simmons *et al.* 2015) as well as those classified by the IUCN (2018) as critically endangered (hooded vulture, white-headed vulture, white-backed vulture), endangered (lappet-faced vulture), 4

vulnerable (secretarybird, tawny eagle, martial eagle, southern ground-hornbil) and near threatened (bateleur, kori bustard).

Trees/shrubs

The most important species expected to occur in the general PEL 73 area are *Baikiaea plurijuga* (Protected F#; LR-nt), *Burkea africana* (Protected F#), *Guibourtia coleosperma* (Protected F#), *Dialium engleranum* (Protected F#), *Philenoptera violacea* (Protected F#), *Pterocarpus angolensis* (Protected F#; LR-nt), *Schinziophyton rautanenii* (Protected F#), *Sclerocarya birrea* (Protected F#) and *Strychnos* species (Protected F#).

Grass

The grasses commonly used for thatching – *Eragrostis pallens* and *Cymbopogon* species – which also have economic value, are the important grasses in the area.

Other species

Aloes

All aloe species are protected in Namibia and thus viewed as important plants (Mendelsohn *et al.* 2002). Of the 27 Aloe species known from Namibia at least 2 other species not included in Table 5 – e.g. *Aloe hereroensis* and *A. zebrina* – occur on the periphery of the general area and may occur in the PEL 73 area (Rothman 2004).

Commiphora

Although many *Commiphora* species potentially occur throughout the area (Steyn 2003) some species – e.g. *C. wildii* – have economic potential (i.e. resin properties used in the perfume industry) – making them potentially important (Knott and Curtis 2006). Other species potentially occurring in the general area (e.g. northeast – Okavango River), but not listed in Table 5, include *Commiphora karibensis* and *C. mossambicensis* (Steyn 2003).

Ferns

At least 64 species of ferns, of which 13 species being endemic, occur throughout Namibia. Ferns in the general area – include at least 1 endemic species (*Marsilea villifolia*) and at least 6 indigenous species (*Isoetes alstonii*, *Marsilea ephippiocarpa*, *M. macrocarpa*, *M. nubica*, *M. vera*, *Ophioglossum polyphyllum*) (Crouch *et al.* 2011). The general area is undercollected with more species probably occurring in the area than presented above.

Lichens

The overall diversity of lichens is poorly known from Namibia, especially the coastal areas and statistics on endemism is even sparser (Craven 1998). To indicate how poorly known lichens are from Namibia, the recent publication by Schultz *et al.* (2009) indicating that 37 of the 39 lichen species collected during BIOTO surveys in the early/mid 2000's were new to science (i.e. new species), is a case in point. More than 120 species are expected to occur in the Namib Desert with the majority being uniquely related to the coastal fog belt (Wirth 2010). Lichen diversity is related to air humidity and generally decreases inland from the Namibian coast (Schults and Rambold 2007). Many lichens look similar, are highly variable in appearance and notoriously difficult to identify unless with the use of a microscope (e.g. crustose lichens) or certain chemical tests.

Although lichens are known to occur in the general area the diversity and abundance is not known.

Lithops

No Lithops species (all protected: See Nature Conservation Ordinance No. 4 of 1975) are known to occur in the general area (Cole and Cole 2005).

Other species with commercial potential that could occur in the general area include *Citrullus lanatus* (Tsamma melon) and *Harpagophytum procumbens* (devil's claw) which potentially have a huge economic benefit (Mendelsohn *et al.* 2002).

3.8 Important Areas

The most important areas in the general area are:

1. Perennial Okavango River

The Okavango River is viewed as a site of special ecological importance in Namibia due to its biotic richness, threatened plants and insects (Curtis and Barnard 1998) (See Figure 3).

2. Ephemeral Omuramba Omatako

Ephemeral rivers are viewed as sites of special ecological importance in Namibia due to its biotic richness, large mammals, high value for human subsistence and tourism (Curtis and Barnard 1998) (See Figure 3).

3. Ephemeral Pans

Ephemeral pans are viewed as sites of special ecological importance in Namibia due to its biotic richness, endemic crustacean, Red Data birds, habitat/resource for humans and wildlife (Curtis and Barnard 1998). Although important larger pans such as Nyae Nyae, etc. fall outside the PEL 73 area, all other smaller pans are also viewed as important habitat.

4. Kaudum National Park

The Kaudum NP falls within the North-Eastern Kalahari Woodlands vegetation type with omurambas which act as ideal routes for wildlife. Dominant trees include: *Acacia erioloba*, *Adansonia digitata*, *Baikiaea plurijuga*, *Combretum imberbe*, *Guibourtia coleosperma* and *Spirostachys africana*. Important wildlife includes: African wild dog, leopard, lion, spotted hyaena, side-striped jackal, elephant, giraffe, blue wildebeest, eland, kudu, oryx, red hartebeest reedbuck, roan, tsessebe and warthog. Important birds include: Abdim's stork, African golden oriole, African hobby falcon, Bradfield's hornbill, ground hornbill, lesser spotted eagle, racket-tailed roller, steppe eagle and yellow-billed kite (See: www.met.gov.na).

5. Mangetti National Park

The Mangetti NP falls within the North-Eastern Kalahari Woodlands vegetation type with the vegetation on the dune crests markedly different to that in dune valleys – i.e. Kalahari woodland vegetation dominates the dune crests, whereas mixed acacia savannah vegetation characterises the dune valleys. Dominant trees include: *Acacia erioloba*, *Acacia mellifera*, *Combretum collinum*, *Commiphora* species, *Schinziophyton rautanenii* and *Terminalia sericea*. Important wildlife includes: African wild cat, leopard, spotted hyaena, blue wildebeest, common duiker, kudu, oryx, sable, steenbok and occasional elephant and wild dog. Important birds include: bateleur, lapped-faced vulture, tawny eagle, Meyer's parrot and striped kingfisher (See: www.met.gov.na).

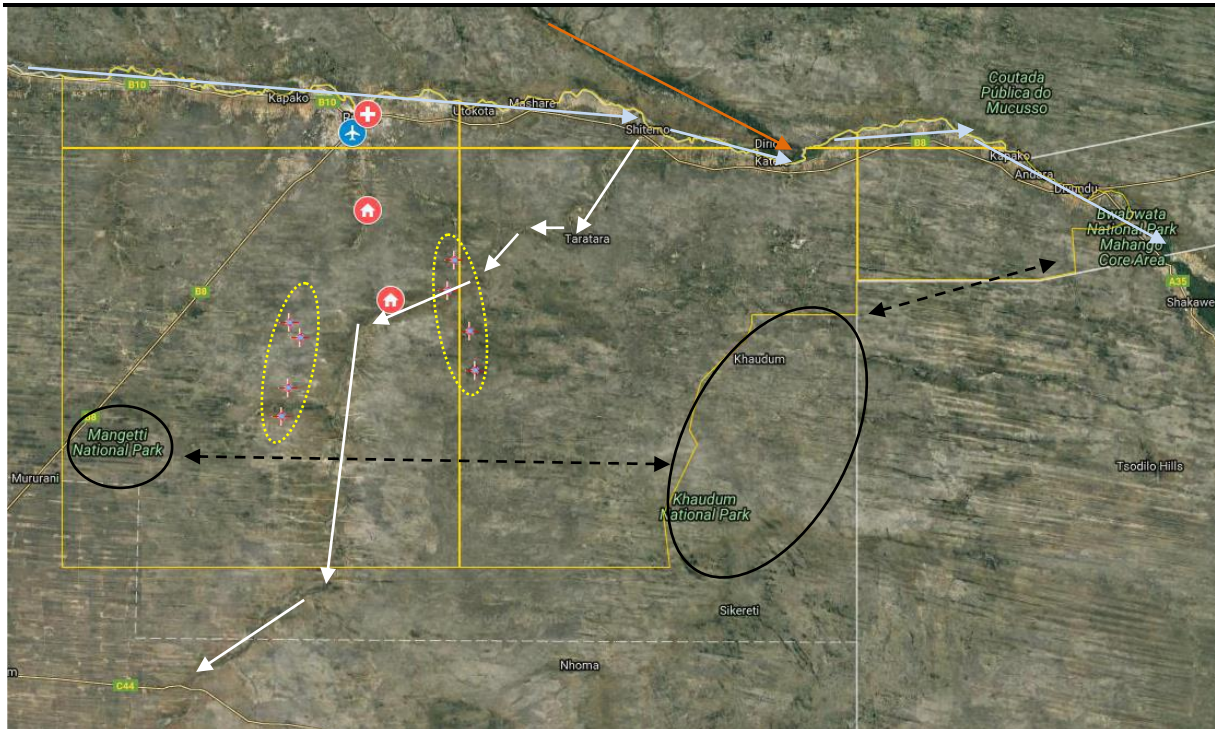


Figure 3. Important habitats in the general area are: Okavango River (blue arrows); Quito River (orange arrow); Omuramba Omatako (white arrows) and the Kaudum and Mangetti National Parks (black oblongs). Elephant movement between Kaudum and Mangetti NP's and Kaudum NP and Bwabwata NP (Mahangu Core Area) are indicated (dotted black lines). Important prospecting sites indicated (dotted yellow lines).

4 CONCLUSION

It is estimated that at least 67 species of reptile, 32 amphibian, 116 mammal, 210 bird species (breeding residents), at least 107 species of larger trees and shrubs (>1m in height) and up to 111 species of grasses are known to or expected to occur in the general PEL 73 area. Although there are not as many endemic vertebrate fauna species in this area as in other parts of Namibia the wetland habitats and species associated with these habitats face numerous challenges due to the high density of humans along most of the river fronts. Wetland habitats in Namibia are not well protected and often have high human densities which place these areas under immense pressure. The over utilization of the fish, wood, reeds and grasses, unseasonal and too frequent fires, poaching, traditional medicine use as well as the high human densities and settlements along the river areas are some of the biggest problems facing the fauna in the Kavango Region. The rivers and floodplains are especially important habitat in north eastern Namibia.

The most important reptile species are viewed as the endemics (*Ichnotropis grandiceps* and *Lygodactylus bradfieldi*), species classified as rare (*Lycophidion multimaculatum*, *Psammophis jallae*, *Causus rhombeatus*) and species classified as vulnerable (*Stigmochelys pardalis*, *Psammobates oculiferus*, *Kinixys spekii*, *Python natalensis*, *Varanus albigularis*, *Varanus niloticus*) from the general area. Furthermore, *Ichnotropis grandiceps*, classified as data deficient (IUCN 2018) is also viewed as important.

The most important amphibian species from the area is the giant bullfrog (*Pyxicephalus adspersus*) with "population decreasing" according to the IUCN (2018) as it is consumed as food throughout its range.

The most important mammal species from the general area are probably those classified as rare (*Nycteris hispida*, *Kerivoula argentata*, *Kerivoula lanosa*, *Mastomys shortridgei*, *Civittictis*

civetta, *Paracynictis selousi*) and endangered (*Lycaon pictus*, *Lutra maculicollis*, *Equus (burchellii) quagga*) under Namibian legislation and those classified by the IUCN (2018) as endangered (*Lycaon pictus*), vulnerable (*Loxodonta africana*, *Smutsia (Manis) temminckii*, *Acinonyx jubatus*, *Panthera pardus*, *Panthera leo*, *Hippopotamus amphibious*, *Giraffa camelopardalis*) and near threatened (*Hipposideros vittatus*). However, some of the above species – e.g. other, hippo, etc. – are only associated with the Okavango River. The most important species expected to occur in the Ncaute-Karukuvisa area would be the African wild dog (*Lycaon pictus*) and pangolin (*Smutsia (Manis) temminckii*).

The most important bird species expected to occur in the general area are those classified as endangered (hooded vulture, white-backed vulture, tawny eagle, martial eagle, bateleur, southern ground-hornbill), vulnerable (secretarybird, white-headed vulture, lappet-faced vulture and) and near threatened (marabou stork, peregrine falcon, kori bustard) from Namibia (Simmons *et al.* 2015) as well as those classified by the IUCN (2018) as critically endangered (hooded vulture, white-headed vulture, white-backed vulture), endangered (lappet-faced vulture), 4 vulnerable (secretarybird, tawny eagle, martial eagle, southern ground-hornbil) and near threatened (bateleur, kori bustard).

The most important larger tree/shrub species expected to occur in the general area are *Baikiaea plurijuga* (Protected F#; LR-nt), *Burkea africana* (Protected F#), *Guibourtia coleosperma* (Protected F#), *Dialium engleranum* (Protected F#), *Philenoptera violacea* (Protected F#), *Pterocarpus angolensis* (Protected F#; LR-nt), *Schinziophyton rautanenii* (Protected F#), *Sclerocarya birrea* (Protected F#) and *Strychnos* species (Protected F#). The most important grasses those commonly used for thatching – *Eragrostis pallens* and *Cymbopogon* species – i.e. economic value. If herbs and “lower” plants (e.g. algae, lichens, etc.) were to be included, this would undoubtedly increase the floral composition of the area tremendously – e.g. more than 100 lichen species are known from coastal Namibia. Although, the focus for this desktop study was limited to the bigger and thus more obvious species of trees, shrubs and grasses, the importance other species such as lichens, ferns, Lithops, etc. is also acknowledged.

All human induced activities – including exploration activities – have potential negative environmental consequences, but identifying the most important fauna species including high risk habitats beforehand, coupled with environmentally acceptable recommendations (mitigating factors), lessens the overall impact of such activities. Should exploration and/or drilling activities be envisaged in future, fieldwork to determine the actual species affected/potentially affected on site is recommended.

5 RECOMMENDATIONS

All human induced activities (including exploration) change or are destructive to the local fauna and flora to some or other degree. Assessing potential impacts is occasionally obvious, but more often difficult to predict accurately. Such predictions may change depending on the scope of the activity – i.e. once initiated, may have a different effect on the fauna and flora as originally predicted. Thus continued monitoring of such impacts during the exploration phase(s) is imperative.

General

The following general recommendations are suggested to show environmental sensitivity and commitment regarding the vertebrate fauna and flora should exploration/drilling activities in the PEL 73 realise in future (i.e. Ncaute-Karukuvisa area):

Vehicles and Tracks:

1. Avoid unnecessary affecting areas viewed as important habitat – i.e. Omuramba Omatako and its various tributaries, pans, clumps of protected tree species;

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2. Make use of existing tracks/roads as much as possible throughout the area;
 3. Do not drive randomly throughout the area (could cause mortalities to vertebrate fauna and unique flora; accidental fires; erosion related problems, etc.);
 4. Avoid offroad driving at night as this increases mortalities of nocturnal species;
 5. Implement and maintain offroad track discipline with maximum speed limits (e.g. 30km/h) as this would result in fewer faunal mortalities and limit dust pollution;
 6. Where tracks have to be made to potential exploration sites off the main routes, the routes should be selected causing minimal damage to the environment – e.g. use the same tracks; cross drainage lines at right angles; avoid placing tracks within drainage lines; avoid collateral damage (i.e. select routes that do not require the unnecessary removal of trees/shrubs, especially protected species);
 7. Rehabilitate all new tracks created;

Camps and Exploration Sites:

8. Select camp sites and other temporary lay over sites with care – i.e. avoid important habitats (e.g. raptor breeding sites, pans);
9. Use portable toilets to avoid faecal pollution around camp and exploration sites;
10. Initiate a suitable and appropriate refuse removal policy as littering could result in certain animals becoming accustomed to humans and associated activity and result in typical problem animal scenarios – e.g. baboon, black-backed jackal, crows, etc.;
11. Avoid and/or limit the use of lights during nocturnal exploration activities as this could influence and/or affect various nocturnal species – e.g. bats and owls, etc. Use focused lighting for least effect;
12. Prevent the killing of species viewed as dangerous – e.g. various snakes – when on site;
13. Prevent the setting of snares for ungulates (i.e. poaching) or collection of veld foods (e.g. tortoises, monitor lizard) and unique plants (e.g. *Harpagophytum procumbens*) or any form of illegal hunting activities;
14. Avoid introducing dogs and cats as pets to camp sites as these can cause significant mortalities to local fauna (cats) and even stock losses (dogs);
15. Remove and relocate slow moving vertebrate fauna (e.g. tortoises, chameleon, snakes, etc.) to suitable habitat elsewhere in the general area;
16. Avoid the removal and/or damaging of protected flora potentially occurring in the general area – e.g. various *Baikiaea plurijuga*, *Pterocarpus angolensis*, etc.;
17. Avoid introducing ornamental plants, especially potential invasive alien species, as part of the landscaping of the camp site, etc., but rather use localised indigenous species, should landscaping be attempted, which would also require less maintenance (e.g. water);
18. Remove all invasive alien species wherever encountered – e.g. *Prosopis* spp. This would not only indicate environmental commitment, but actively contribute to a better landscape;
19. Inform contractors/workers regarding the above mentioned issues prior to exploration activities and monitor for compliance thereof throughout;
20. Rehabilitate all areas disturbed by the exploration activities – i.e. camp sites, tracks, exploration/drill sites, etc.;
21. Ensure that adequate fire fighting equipment (e.g. fire beaters; extinguishers, etc.) is available at camp sites and clear kitchen areas to avoid accidental fires;
22. Liaises with MET officials whilst working close to the Mangetti and Kaudum NP's;
23. Employ an independent environmental auditor to ensure compliance, especially of the rehabilitation of all the affected areas.

It is not expected that limited exploration/drilling activities throughout the PEL 73 area will adversely affect any unique vertebrate fauna and flora, especially if the proposed recommendations (mitigation measures) are incorporated. However, should the specific

exploration/drilling site(s) within this PEL become known and viewed as feasible to pursue in future, fieldwork is recommended to determine species actually affected at these site(s).

6 REFERENCES

- Alexander, G. and Marais, J. 2007. A guide to the reptiles of southern Africa. Struik Publishers, Cape Town, RSA.
- Barnard, P. 1998. Underprotected habitats. In: Barnard, P. (ed.). Biological diversity in Namibia: a country study. Windhoek: Namibian National Biodiversity Task Force.
- Bester, B. 1996. Bush encroachment – A thorny problem. *Namibia Environment* 1: 175-177.
- Branch, B. 1998. Field guide to snakes and other reptiles of southern Africa. Struik Publishers, Cape Town, RSA.
- Branch, B. 2008. Tortoises, terrapins and turtles of Africa. Struik Publishers, Cape Town, RSA.
- Boycott, R.C. and Bourquin, O. 2000. The Southern African Tortoise Book. O Bourquin, Hilton, RSA.
- Broadley, D.G. 1983. Fitzsimons' Snakes of southern Africa. Jonathan Ball and AD. Donker Publishers, Parklands, RSA.
- Buys, P.J. and Buys, P.J.C. 1983. Snakes of Namibia. Gamsberg Macmillan Publishers, Windhoek, Namibia.
- Carruthers, V.C. 2001. Frogs and frogging in southern Africa. Struik Publishers, Cape Town, RSA.
- Channing, A. 2001. Amphibians of Central and Southern Africa. Protea Bookhouse, Pretoria, RSA.
- Channing, A. and Griffin, M. 1993. An annotated checklist of the frogs of Namibia. *Madoqua* 18(2): 101-116.
- Cole, D.T. and Cole, N.A. 2005. Lithops Flowering Stones. Cactus and Co. Libri
- Craven, P. (ed.). 1998. A checklist of Namibian plant species. Southern African Botanical Diversity Network Report No. 7, SABONET, Windhoek.
- Crouch, N.R., Klopper, R.R., Burrows, J.E. and Burrows, S. M. 2011. Ferns of southern Africa – a comprehensive guide. Struik Nature, Cape Town, RSA.
- Cunningham, P.L. 1998. Potential wood biomass suitable for charcoal production in Namibia. *Agri-Info* 4(5): 4-8.
- Cunningham, P.L. 2006. A guide to the tortoises of Namibia. Polytechnic of Namibia, Windhoek, Namibia.
- Curtis, B. and Barnard, P. 1998. Sites and species of ecological, economic or archaeological importance. In: Barnard, P. (ed.). Biological diversity in Namibia: a country study. Windhoek: Namibian National Biodiversity Task Force.

De Cauwer, V., Muys, B., Revermann, R. & Trabucco, A. 2014. Potential, realised, future distribution and environmental suitability for *Pterocarpus angolensis* DC in southern Africa. *Forest Ecology and Management* 315: 211-226.

De Graaff, G. 1981. The rodents of southern Africa. Buterworths, RSA.

Du Preez, L. and Carruthers, V. 2009. A complete guide to the frogs of southern Africa. Struik Publishers, Cape Town, RSA.

Estes, R.D. 1995. The behaviour guide to African mammals. Russel Friedman Books, Halfway House, RSA.

Giess, W. 1971. A preliminary vegetation map of South West Africa. *Dinteria* 4: 1 – 114.

Griffin, M. 1998a. Reptile diversity. In: Barnard, P. (ed.). Biological diversity in Namibia: a country study. Windhoek: Namibian National Biodiversity Task Force.

Griffin, M. 1998b. Amphibian diversity. In: Barnard, P. (ed.). Biological diversity in Namibia: a country study. Windhoek: Namibian National Biodiversity Task Force.

Griffin, M. 1998c. Mammal diversity. In: Barnard, P. (ed.). Biological diversity in Namibia: a country study. Windhoek: Namibian National Biodiversity Task Force.

Griffin, M. 2003. Annotated checklist and provisional national conservation status of Namibian reptiles. Ministry of Environment and Tourism, Windhoek.

Griffin, M. and Coetzee, C.G. 2005. Annotated checklist and provisional national conservation status of Namibian mammals. Ministry of Environment and Tourism, Windhoek.

Hebbard, S. n.d. A close-up view of the Namib and some of its fascinating reptiles. ST Promotions, Swakopmund, Namibia.

IUCN, 2018. IUCN Red List of threatened species. Version 2018.2. www.iucn.redlist.org. IUCN, Gland, Switzerland.

Joubert, E. and Mostert, P.M.K. 1975. Distribution patterns and status of some mammals in South West Africa. *Madoqua* 9(1): 5-44.

Knott, K. and Curtis, B. 2006. Aromatic resins from *Commiphora* trees. *Roan News Special Anniversary Edition* 2006: 22-24.

Little, R., Crowe, R. and Barlow, S. 2011. Gamebirds of Southern Africa. Struik Nature, Cape Town, RSA.

Mannheimer, C. and Curtis, B. (eds) 2018. Le Roux and Müller's field guide to the trees and shrubs of Namibia. Macmillan Education Namibia, Windhoek.

Marais, J. 1992. A complete guide to the snakes of southern Africa. Southern Book Publishers, Witwatersrand University Press, Johannesburg, RSA.

Mendelsohn, J., Jarvis, A., Roberts, A. and Robertson, T. 2002. Atlas of Namibia. A portrait of the land and its people. David Philip Publishers, Cape Town, RSA.

Monadjem, A., Taylor, P.J., F.P.D. Cotterill and M.C. Schoeman. 2010. Bats of southern and central Africa. Wits University press, Johannesburg, RSA.

-
- Müller, M.A.N. 1984. Grasses of South West Africa/Namibia. John Meinert Publishers (Pty) Ltd, Windhoek, Namibia.
- Müller, M.A.N. 2007. Grasses of Namibia. John Meinert Publishers (Pty) Ltd, Windhoek, Namibia.
- Passmore, N.I. and Carruthers, V.C. 1995. South African Frogs - A complete guide. Southern Book Publishers, Witwatersrand University Press, Johannesburg, RSA.
- Peacock, F. 2015. Chamberlain's LBJ's – the definitive guide to Southern Africa's little brown jobs. Paavo Publishing, South Africa.
- Picker, M. and Griffiths, C. 2011. Alien and invasive animals – a South African perspective. Struik Nature, Cape Town.
- Rothmann, S. 2004. Aloes – aristocrats of Namibian flora. ST Promotions, Swakopmund, Namibia.
- SARDB, 2004. CBSG Southern Africa. In: Griffin, M. 2005. Annotated checklist and provisional national conservation status of Namibian mammals. Ministry of Environment and Tourism, Windhoek.
- Schultz, M. and Rambold, G. 2007. Diversity shifts and ecology of soil lichens in central Namibia. Talk, Ecological Society of Germany, Austria and Switzerland (GfÖ), 37th Annual Meeting, Marburg: 12/9/2007 to 15/9/2007.
- Schultz, M., Zedda, L. and Rambold, G. 2009. New records of lichen taxa from Namibia and South Africa. *Bibliotheca Lichenologica* 99: 315-354.
- Simmons R.E. 1998a. Areas of high species endemism. In: Barnard, P. (ed.). Biological diversity in Namibia: a country study. Windhoek: Namibian National Biodiversity Task Force.
- Simmons, R.E. 1998b. Important Bird Areas (IBA's) in Namibia. In: Barnard, P. (ed.). Biological diversity in Namibia: a country study. Windhoek: Namibian National Biodiversity Task Force.
- Simmons R.E., Brown C.J. and Kemper, J. 2015. Birds to watch in Namibia: red, rare and endemic species. National Biodiversity Programme, Windhoek.
- Skinner, J.D. and Smithers, R.H.N. 1990. The mammals of the southern African subregion. University of Pretoria, RSA.
- Skinner, J.D. and Chimimba, C.T. 2005. The mammals of the southern African subregion. Cambridge University Press, Cape Town, RSA.
- Stander, P. and Hanssen, L. 2003. Namibia large carnivore atlas. Unpublished Report, Ministry of Environment and Tourism, Windhoek.
- Steyn, M. 2003. Southern Africa Commiphora. Bendor Place, Polokwane, South Africa.
- Tarboton, W. 2001. A guide to the nests and eggs of southern African birds. Struik Publishers, Cape Town, RSA.
- Taylor, P.J. 2000. Bats of southern Africa. University of Natal Press, RSA.

Tolley, K. and Burger, M. 2007. Chameleons of southern Africa. Struik Nature, Cape Town, RSA.

Van Oudtshoorn, F. 2012. Guide to grasses of southern Africa. Briza Publications, Pretoria, South Africa.