

**DESKTOP STUDY:
VERTEBRATE FAUNA AND FLORA EXPECTED IN
THE PETROLEUM EXPLORATION LICENCE No. 68
– BLOCKS 2219 and 2319, ARANOS TO GOBABIS
AREA**

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CONTENTS

Vertebrate fauna and flora expected in the PEL No. 68 – Blocks 2219 and 2319 – Aranos to Gobabis area

1	Introduction	1
2	Methods	3
2.1	Literature review	3
3	Results	3
3.1	Reptile Diversity	3
3.2	Amphibian Diversity	7
3.3	Mammal Diversity	8
3.4	Avian Diversity	12
3.5	Tree and Shrub Diversity	17
3.6	Grass Diversity	19
3.7	Important Species	22
4	Conclusion	23
5	Recommendations	24
6	References	26

Vertebrate fauna and flora expected in the PEL No. 68 – Blocks 2219 and 2319 – Aranos to Gobabis area

1 Introduction

A desktop study (i.e. literature review) was conducted between 9 and 12 March 2015 on the vertebrate fauna (e.g. reptiles, amphibians, mammals and birds) expected to occur in the general Aranos to Gobabis area in central/eastern Namibia for PEL No. 68 (Petroleum Exploration Licence) – Blocks 2219 and 2319. These Blocks extend roughly from north of Aranos to north and east of Gobabis. Block 2219 falls completely in the Omaheke Region while Block 2319, adjacent but south of Block 2219, falls mostly in the Omaheke Region although the southernmost portion of this block falls within the Hardap Region just north of Aranos. This petroleum exploration operation includes geochemical survey, sampling and geophysical surveys leading to the identification of suitable areas for drilling of at least three (3) stratigraphic wells in mid-2016.

The proposed development area falls on the boundary of two vegetation types according to Giess (1971):

- 1) Camelthorn Savanna [Central Kalahari] (Giess 1971); and
- 2) Mixed Tree and Shrub Savanna [Southern Kalahari] (Giess 1971)

Or

Only known as Central and Southern Kalahari vegetation types according to Mendelsohn *et al.* (2002) (Figure 1).

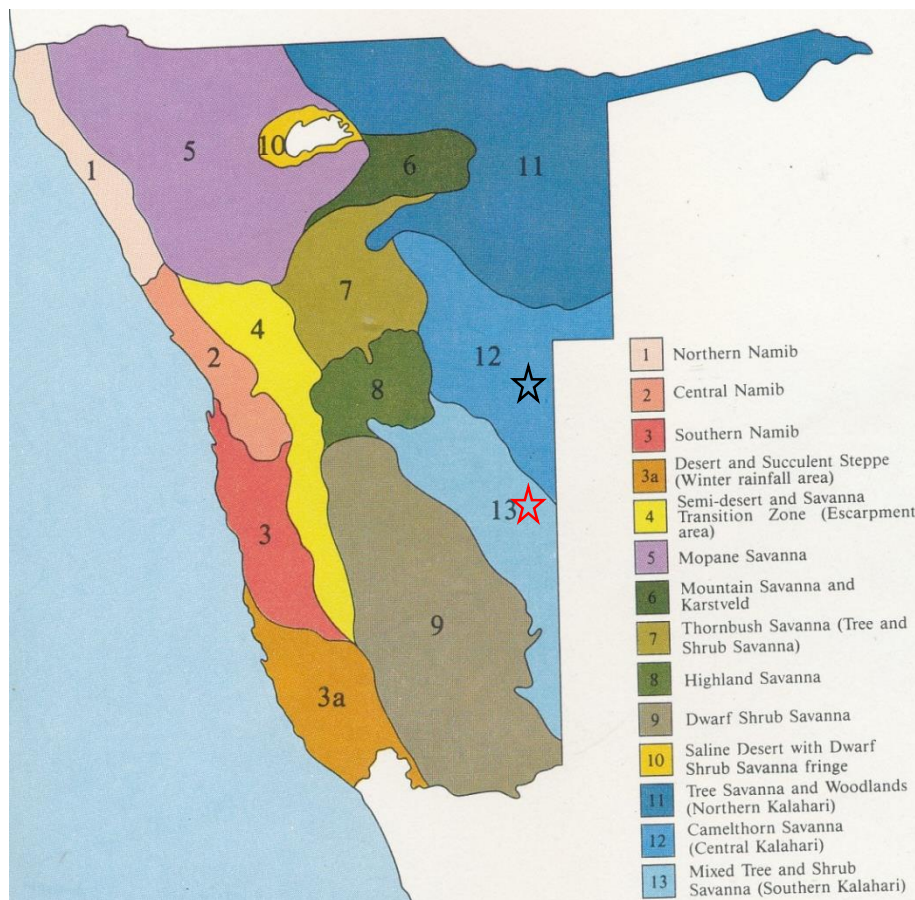


Figure 1. The PEL No.68 Project – Block 2219 (Black star) and Block 2319 (Red star) – falls within two vegetation types – i.e. Camelthorn Savanna [Central Kalahari] and Mixed Tree and Shrub Savanna [Southern Kalahari] (Giess 1971).

This literature review was to determine the actual as well as potential vertebrate fauna and flora associated with the general areas – two vegetation types – commonly referred to as the Camelthorn Savannah (Central Kalahari) and Mixed Tree and Shrub Savannah (Southern Kalahari) (Giess 1971) or Central and Southern Kalahari (Mendelsohn *et al.* 2002). The vegetation structure is classified as open Acacia woodlands (Mendelsohn *et al.* 2002). Although the Kalahari is not classified as an area of special ecological importance, certain features such as ephemeral drainage lines throughout this vegetation type are important (Curtis and Barnard 1998).

The Savannah Biome – of which the PEL No. 68 area forms part of – is underrepresented in the protected area network in Namibia covering 37% of the land area, but only 7.5% of the biome (Barnard 1998). More specifically, the Central and Southern Kalahari area is totally underrepresented in the protected area network with only 0% of the area having formal protection (Barnard 1998). The closest Government protected areas are the Daan Viljoen and Hardap Game Reserves, all situated to the west in the Windhoek and Mariental areas, respectively.

The general area is regarded as “low” in overall (all terrestrial species) terrestrial diversity and endemism (Mendelsohn *et al.* 2002). According to Simmons (1998b) central/eastern Namibia has between 40-120 endemic vertebrates (all vertebrates included). The overall diversity and abundance of large herbivorous mammals (big game) is viewed as “average to high” with 3-6 species while the overall diversity of large carnivorous mammals (large predators) is determined at 2-4 species with leopard and cheetah being the most important with “medium” (leopard) to “high” (cheetah) densities (Mendelsohn *et al.* 2002).

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).

Central Kalahari

The Camelthorn Savannah or Central Kalahari is dominated by *Acacia erioloba* with the following trees/shrubs also usually present: *Acacia hebeclada*, *Grewia flava*, *Sarcia lancea*, *Ozoroa paniculosa*, *Tarchonanthus camphorates* and *Ziziphus mucronata*. *Terminalia sericea* can dominate sandy soils. Grasses are usually hard and unpalatable species such as *Aristida stipitata* and *Eragrostis pallens* while *Schmidtia kalahariensis* is dominant in degraded veld (Giess 1971).

Southern Kalahari

The Mixed Tree and Shrub Savannah or Southern Kalahari is mostly covered with sand and long parallel dunes which extend in a north-westerly to south-easterly direction. *Acacia haematoxylon* (usually in shrub form) is characteristic of these sandy areas. Harder ground is found in the valleys or streets between the dunes and is generally covered by *Rhigozum trichotomum* shrubs. Other common trees are *Acacia erioloba*, *A. mellifera*, *A. reficiens*, *A. hebeclada*, *Boscia albitrunca*, *B. foetida*, *Grewia flava*, *G. deserticola* and *Searsia tenuinervis*. Perennial grasses include *Antheophora argentea*, *Centropodia glauca*, *Eragrostis lehmanniana*,

Stipagrostis ciliata and *S. uniplumis* while disturbed areas are dominated by *Schmidtia kalahariensis* and *Stipagrostis amabilis* acts as stabilizer on dune crests (Giess 1971).

The average plant production is “high” in the general Gobabis area – i.e. Block 3218 – and “medium” in the general Aranos area – i.e. Block 3219 – with the variation in green vegetation biomass viewed as “low to medium” estimated at 5-15% (Mendelsohn *et al.* 2002). Simmons (1998b) puts the plant endemism in the general area at between 1 and 10 species depending on the locality. The overall plant diversity (all species - “higher” plants) in the general area is “low to average” and estimated at between 50-149 species, increasing from south to north (Mendelsohn *et al.* 2002). Plant endemism is “low” with no endemic species expected from the general area. Furthermore, Mendelsohn *et al.* (2002) views the grazing and browse as “good to average”, respectively, in the general area with the risk of farming viewed as “average to low” and the tourism potential of this area viewed as “average to high”.

Bush thickening or encroachment is viewed as an economic problem in the general area with an estimated 2,000 to 3,000 plants/ha – mainly *Acacia mellifera* – being the dominant problematic species in the Gobabis area and 4,000 to 12,000 plants/ha – mainly *Terminalia sericea* – northeast of Gobabis (Bester 2001, Cunningham 1998, Mendelsohn *et al.* 2002).

The main rivers – all ephemeral – draining the general area are the Black and White Nossob Rivers (draining southwards) to the west of the Blocks 2219 and 2319 as well as Rietfontein and Epukiro Rivers (draining eastwards) towards the north of Block 2219. Although no open surface water occurs in the general area there are pans, temporary pools in various ephemeral drainage lines, ground farm dams and farm reservoirs.

The closest communal conservancy is located to the north of Gobabis – i.e. north of the PEL No. 68 area – and known as Eiseb with major wildlife resources viewed as elephant, leopard, giraffe, eland, kudu, gemsbok, steenbok, African wild dog, spotted hyena, cheetah and black-backed jackal (NACSO 2010). The main freehold (commercial) conservancy in the general area are the Black Nossob and Seeis Conservancies located towards the west (Mendelsohn *et al.* 2002, See: www.canam.iway.na).

It is estimated that at least 74 reptile, 11 amphibian, 93 mammal, 206 bird (breeding residents), 77-84 species of larger trees and shrubs (>1m in height) and up to 74 species of grass species are known to or expected to occur in the general PEL No. 68 area of which a moderate proportion (e.g. 22.9% of reptiles) are endemics.

2 Methods

2.1 Literature review

A comprehensive and intensive literature review (i.e. desktop study) regarding the reptiles, amphibians, mammals and birds that could potentially occur in the general PEL No. 68 area was conducted using as many references as manageable. A list of the references consulted can be viewed in the Reference section (Page 26).

3 Results

3.1 Reptile Diversity

The reptile diversity known, and/or expected to occur in the general PEL No. 68 area is presented in Table 1 below:

Table 1. Reptile diversity known and/or expected to occur in the general PEL No. 68 – i.e. central/eastern Namibia – area.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status		
			SARDB (2004)	IUCN (2014)	CITES
TURTLES AND TERRAPINS					
<i>Stigmochelys pardalis</i>	Leopard Tortoise	Vulnerable; Peripheral; Protected Game			C2
<i>Psammobates oculiferus</i>	Kalahari Tent Tortoise	Vulnerable; Protected Game			C2
<i>Pelomedusa subrufa</i>	Marsh/Helmeted Terrapin	Secure			C3
SNAKES					
Blind Snakes					
<i>Rhinotyphlops boylei</i>	Boyle's Beaked Blind Snake	Endemic; Secure	P		
<i>Rhinotyphlops schinzi</i>	Schinzi's Beaked Blind Snake	Endemic; 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			
Quill Snouted Snakes					
<i>Xenocalamus bicolor bicolor</i>	Bicoloured Quill-snouted Snake	Secure			
<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>Mehelya vernayi</i>	Angola File Snake	Insufficiently known; Rare?			
<i>Pseudaspis cana</i>	Mole Snake	Secure			
<i>Prosymna bivittata</i>	Two-striped Shovel-snout	Secure			
<i>Prosymna frontalis</i>	South-western Shovel-snout	Endemic; Secure	P		
<i>Hemirhagerrhis viperrinus</i>	Viperine Bark Snake	Endemic; Secure			
<i>Dipsina multimaculata</i>	Dwarf Beaked Snake	Endemic; Secure			
<i>Psammophylax tritaeniatus</i>	Striped Skaapsteker	Secure			
<i>Psammophis notostictus</i>	Karoo Sand Snake	Secure			
<i>Psammophis leightoni trinasalis</i>	Namib Sand Snake	Secure			
<i>Psammophis jallae</i>	Jalla's Sand Snake	Insufficiently known; Rare?	P		
<i>Psammophis subtaeniatus</i>	Stripe-bellied Sand Snake	Secure			
<i>Psammophis brevirostris leopardinus</i>	Leopard and Short-snouted Grass Snakes	Secure			
<i>Psammophis mossambicus</i>	Olive Grass Snake	Secure			
<i>Philothamnus semivariatus</i>	Spotted Bush Snake	Secure			
<i>Dasypeltis scabra</i>	Common/Rhombic Egg Eater	Secure			LC
<i>Telescopus semiannulatus</i>	Eastern Tiger Snake	Secure			
<i>Dispholidus typus</i>	Boomslang	Secure			
<i>Aspidelaps lubricus infuscatus</i>	Coral Snake	Secure			
<i>Aspidelaps scutatus</i>	Shield-nose Snake	Secure			
<i>Elapsoidea semiannulata</i>	Angolan Garter Snake	Secure			
<i>Elapsoidea sunderwallii</i>	Sundevall's Garter Snake	Endemic; Secure			
<i>Naja anchietae</i>	Snouted Cobra	Secure			
<i>Naya nigricincta</i>	Black-necked Spitting Cobra	Endemic; Secure	R		
<i>Dendroaspis polylepis</i>	Black Mamba	Secure			
<i>Bitis arietans</i>	Puff Adder	Secure			
<i>Bitis caudalis</i>	Horned Adder	Secure			
Worm Lizard					

Desktop study: Vertebrate Fauna & Flora - Cunningham

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International status		
			SARDB (2004)	IUCN (2014)	CITES
<i>Monopeltis anchietae</i>	Anchieta's Spade-snouted Worm Lizard	Secure			
<i>Zygaspis quadrifrons</i>	Kalahari Round-headed Worm Lizard	Secure			
<i>Monopeltis infuscata</i>	Dusky Spade-snouted Worm Lizard	Secure			
<i>Monopeltis sphenorhynchus</i>	Slender Spade-snouted Worm Lizard	Secure			
LIZARDS					
Skinks					
<i>Acontias (percivali) occidentalis</i>	Percival's Legless Skink	Secure			
<i>Lygosoma sundevallii</i>	Sundevall's Writhing Skink	Secure			
<i>Trachylepis occidentalis</i>	Western Three-striped Skink	Secure			
<i>Trachylepis spilogaster</i>	Kalahari Tree Skink	Endemic; Secure			
<i>Trachylepis striata wahlbergi</i>	Striped Skink	Secure			
<i>Trachylepis sulcata</i>	Western Rock Skink	Secure			
<i>Trachylepis varia</i>	Variable Skink	Secure			
<i>Trachylepis variegata punctulata</i>	Variegated Skink	Secure			
Old World Lizards					
<i>Heliobolus lugubris</i>	Bushveld Lizard	Secure			
<i>Ichnotropis capensis</i>	Cape Rogh-scaled Lizard	Secure			
<i>Ichnotropis squamulosa</i>	Common Rough-scaled Lizard	Secure			
<i>Nucras intertexta</i>	Spotted Sandveld Lizard	Endemic; Secure			
<i>Nucras holubi</i>	Holub's Sandveld Lizard	Secure			
<i>Pedioplanis lineoocellata lineoocellata</i>	Spotted Sand Lizard	Endemic; Secure			
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard	Secure			
Plated Lizards					
<i>Gerrhosaurus multilineatus</i>	Kalahari Plated Lizard	Secure			
<i>Gerrhosaurus validus maltzahni</i>	Giant Plated Lizard	Secure			
Girdled Lizards					
<i>Cordylus jordani</i>	Jordan's Girdled Lizard	Endemic; Secure			C2
Monitors					
<i>Varanus albigularis</i>	Rock or White-throated Monitor	Vulnerable; Peripheral; Protected Game			C2
Agama					
<i>Agama aculeata</i>	Ground Agama	Secure			
<i>Agama anchietae</i>	Anchietae's Agama	Secure			
<i>Agama planiceps</i>	Namibian Rock Agama	Endemic; Secure			
Chameleons					
<i>Chamaeleo dilepis</i>	Flap-neck Chameleon	Secure		LC	C2
Geckos					
<i>Lygodactylus bradfieldi</i>	Bradfield's Dwarf Gecko	Endemic; Secure			
<i>Narudasia festiva</i>	Festive Gecko	Endemic; Secure			
<i>Pachydactylus bicolor</i>	Velvety Thick-toed Gecko	Endemic; Secure			
<i>Pachydactylus capensis</i>	Cape Thick-toed Gecko	Endemic; Secure			
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko	Secure			
<i>Pachydactylus punctatus</i>	Speckled Thick-toed Gecko	Secure			
<i>Ptenopus garrulus garrulus</i>	Common Barking Gecko	Endemic; Secure			

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 (2014) – International Union for the Conservation of Nature and Natural Resources [All species not listed by the IUCN (2014) have not yet been assessed for the IUCN Red List]. LC = Least Concern

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

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora
C2 = CITES Appendix 2 and 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 (2003), Hebbard (n.d.), Marais (1992), Tolley and Burger (2007)

Approximately 261 species of reptiles are known or expected to occur in Namibia thus supporting approximately 30% of the continent's 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 61-70 species and 1-8 species, respectively (Mendelsohn *et al.* 2002). Griffin (1998a) presents figures of between 1-10 and 1-2 for endemic lizards and snakes, respectively, from the general area. The closest protected areas – i.e. Daan Viljoen Game Reserve and Hardap Nature Reserve – have an estimated 79 and 62 reptiles, respectively (Griffin 1998a).

At least 74 species of reptiles are expected to occur in the general area with 17 species being endemic – i.e. 22.9% endemic. Two species are classified as insufficiently known and rare (*Mehelya vernayi* and *Psammophis jallae*) while four species are classified as vulnerable and protected game; of which 2 are tortoises (*Stigmochelys pardalis*, *Psammobates oculiferus*, *Python natalensis* and *Varanus albigularis*) (See Table 1). Thirteen species have an international conservation status (7 CITES Appendix 2 and 3 species; 5 SARDB species; 2 IUCN species – some species have more than one status). *Naya nigrincta* is classified as rare (SARDB 2004) although it is more common in Namibia than South Africa. However, very few reptiles have been formally assessed by the IUCN Red List.

The 74 species expected to occur in the general area consist of at least 2 tortoises; 1 terrapin; 37 snakes (3 Blind snakes, 1 Thread snakes, 1 Python, 1 Burrowing Asp, 1 Purple Glossed Snake, 2 Quill Snouted and 28 typical snakes) of which 7 species (18.9%) are endemic, 2 species classified as insufficiently known (rare?) and 1 (*Python natalensis*) classified as vulnerable and protected game; 26 lizards of which 5 species classified as endemic (19.2% endemic) and 1 species (*Varanus albigularis*) classified as vulnerable and protected game; 1 chameleon and 7 geckos of which 5 species classified as endemic (i.e. 71.4% endemic).

Snakes (2 species classified as insufficiently known (rare?) – *Mehelya vernayi* and *Psammophis jallae* – and 1 (*Python natalensis*) classified as vulnerable and protected game) and geckos (5 of 7 species being endemic – 71%) are the most important groups of reptiles expected from the general Otjozondou/Hochveld area. Griffin (1998a) confirms the importance of the gecko fauna in Namibia. Tortoises are viewed as the group of reptiles most under threat in Namibia (Griffin 1998a) making *Stigmochelys pardalis* and *Psammobates oculiferus* probably the most important reptiles expected in the area followed by the python – *Python natalensis* – and *Varanus albigularis*. All the above mentioned species are either consumed as food or indiscriminately killed when encountered.

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 PEL No. 68 area – e.g. burrowing species – than presented above.

However, none of the reptile species are expected to be exclusively associated with the PEL No. 68 area.

3.2 Amphibian Diversity

The amphibian diversity known, and/or expected to occur in the general PEL No. 68 area is presented in Table 2 below:

Table 2. Amphibian diversity known and/or expected to occur in the general PEL No. 68 – i.e. central/estern Namibia – area.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status: IUCN (2014)
Rain Frogs			
<i>Breviceps adpersus</i>	Bushveld Rain Frog		
Toads			
<i>Amietophrynus poweri</i>	Western Olive Toad		LC
Rubber Frog			
<i>Phrynomantis annectens</i>	Marbled Rubber Frog	Endemic	LC
<i>Phrynomantis bifasciatus</i>	Banded Rubber Frog		LC
Puddle Frog			
<i>Phrynobatrachus mababiensis</i>	Dwarf Puddle Frog		LC
Cacos			
<i>Cacosternum boettgeri</i>	Boettger's Caco		LC
Bullfrogs			
<i>Pyxicephalus adpersus</i>	Giant Bullfrog	Near Threatened	LC
Sand Frogs			
<i>Tomopterna cryptotis</i>	Tremolo Sand Frog		LC
<i>Tomopterna krugerensis</i>	Knocking Sand Frog		LC
<i>Tomopterna tandyi</i>	Tandy's Sand Frog		LC
Platannas			
<i>Xenopus laevis</i>	Common Platanna		LC

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

Near threatened (Du Preez and Carruthers 2009)

IUCN (2014) – 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), 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 4-11 species. Griffin (1998b) puts the species richness in the general area at between 8-11 species. The closest protected areas – i.e. Daan Viljoen Game Reserve and

Hardap Nature Reserve – have an estimated 13 and 8 amphibians, respectively (Griffin 1998b).

According to the literature, at least 11 species of amphibians can occur in suitable habitat in the general area. The area is under represented, with 1 species each for rain frog, toad, caco, puddle, bullfrog and platanna; 2 species of rubber frogs and 3 species of sand frogs. Of these, 1 species is endemic (*Phrynomantis annectens*) (Griffin 1998b) and 1 species classified as near threatened due to habitat loss and development (*Pyxicephalus adspersus*) (Du Preez and Carruthers 2009) – i.e. 15.4% of amphibians of conservation value from the general area. *Phrynomantis annectens* is widespread in Namibia while *Pyxicephalus adspersus* is more common in northern Namibia where their numbers are also declining due to overutilization as food by humans (Griffin pers. com.). All the amphibians are classified as least concern by the IUCN (2014).

The most important species are the endemic *Phrynomantis annectens* although they are widespread in Namibia and not exclusively associated with the PEL No. 68 area in particular. Although no permanent water bodies occur in the area the closest dams are the Tilda Viljoen at Gobabis and Hardap Dam at Mariental. Furthermore, temporary pools in the ephemeral Black and White Nossob and Rietfontein and Epukiro Rivers and their tributaries are viewed as additional suitable amphibian habitat, albeit temporary, in the general area. Other potential habitats in the area include ephemeral pans – Aminuis area – farm reservoirs and earth dams although the latter are also dependant on localised showers and temporary of nature.

However, none of the amphibian species are expected to be exclusively associated with the PEL No. 68 area.

3.3 Mammal Diversity

The mammal diversity known, and/or expected to occur in the general PEL No. 68 area is presented in Table 3 below:

Table 3. Mammal diversity known and/or expected to occur in the general PEL No. 68 – i.e. central/estern Namibia – area.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB (2004)	IUCN (2014)	CITES
Elephant Shrews					
<i>Elephantulus intufi</i>	Bushveld Elephant-shrew	Secure	DD		
Aardvark					
<i>Orycteropus afer</i>	Aardvark	Secure; Protected Game			
Shrews					
<i>Crocidura fuscomurina</i>	Tiny Musk Shrew	Secure	DD		
<i>Crocidura cyanea</i>	Reddish-grey Musk Shrew	Secure	DD		
<i>Crocidura hirta</i>	Lesser Red Musk Shrew	Secure	DD		
Hyrax					
<i>Procavia capensis</i>	Rock Hyrax	Secure; Problem animal			
Bats					
<i>Eidolon helvum</i>	African Straw-coloured Fruit Bat	Secure; Migrant			
<i>Hipposideros caffer</i>	Sundevall's Leaf-nosed Bat	Secure	DD		
<i>Hipposideros gigas</i>	Giant Leaf-nosed Bat	Not Listed			
<i>Hipposideros vittatus</i>	Striped Leaf-nosed Bat	Not Listed			
<i>Rhinolophus blasii</i>	Blasius's Horseshoe Bat	Not Listed			
<i>Rhinolophus clivosus</i>	Geoffroy's Horseshoe Bat	Secure	NT		
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat	Secure; Peripheral	NT		

Desktop study: Vertebrate Fauna & Flora - Cunningham

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB (2004)	IUCN (2014)	CITES
<i>Rhinolophus denti</i>	Dent's Horseshoe Bat	Secure	NT		
<i>Rhinolophus fumigatus</i>	Rüppell's Horseshoe Bat	Secure	NT		
<i>Rhinolophus hildebrandtii</i>	Hildebrandt's Horseshoe Bat	Not Listed			
<i>Taphozous mauritanus</i>	Mauritian Tomb Bat	Secure			
<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>Mops midas</i>	Midas Free-tailed Bat	Secure			
<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat	Secure			
<i>Miniopterus natalensis</i>	Natal Long-fingered Bat	Secure	NT		
<i>Eptesicus hottentotus</i>	Long-tailed Serotine Bat	Secure			
<i>Neoromicia capensis</i>	Cape Serotine Bat	Secure			
<i>Cistugo seabrai</i>	Namibian Wing-gland Bat	Endemic; Rare	V		
<i>Glauconycteris variegata</i>	Variiegated Butterfly Bat	Secure	NT		
<i>Laephotis botswanae</i>	Botswana Long-eared Bat	Secure	V		
<i>Neoromicia capensis</i>	Cape Serotine	Secure			
<i>Neoromicia zuluensis</i>	Zulu Serotine	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			
Hares and Rabbits					
<i>Lepus saxatilis</i>	Scrub Hare	Secure			
Mice and Rats					
Molerat					
<i>Cryptomys damarensis</i>	Damaraland Mole-Rat	Secure			
Porcupine					
<i>Hystrix africaeaustralis</i>	Cape Porcupine	Secure			
Rats and Mice					
<i>Petromys typicus</i>	Dassie Rat	Endemic; Secure	NT		
<i>Pedetes capensis</i>	Springhare	Secure			
<i>Xerus inaurus</i>	South African Ground Squirrel	Secure			
<i>Graphiurus murinus</i>	Woodland Dormouse	Secure			
<i>Lemniscomys rosalia</i>	Single-striped Grass Mouse	Secure	DD		
<i>Rhabdomys pumilio</i>	Four-striped Grass Mouse	Secure			
<i>Zelotomys woosnami</i>	Woosnam's Desert Mouse	Rare			
<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>Thallomys paedulus</i>	Acacia Rat	Secure			
<i>Thallomys nigricauda</i>	Black-tailed Tree Rat	Secure			
<i>Aethomys chrysophilus</i>	Red Veld Rat	Secure			
<i>Micaelamys namaquensis</i>	Namaqua Rock Mouse	Secure			
<i>Desmodillus auricularis</i>	Cape Short-tailed Gerbil	Secure			
<i>Gerbillurus paebe</i>	Hairy-footed Gerbil	Secure			
<i>Tatera leucogaster</i>	Bushveld Gerbil	Secure	DD		
<i>Tatera brantsii</i>	Highveld Gerbil	Secure			
<i>Saccostomus campestris</i>	Pouched Mouse	Secure			
<i>Malacothrix typica</i>	Gerbil Mouse	Secure			
<i>Steatomys pratensis</i>	Fat Mouse	Secure			
<i>Mus musculus</i>	House Mouse	Invasive alien			

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Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB (2004)	IUCN (2014)	CITES
Primates					
<i>Galago moholi</i>	South African Galago	Vulnerable; Protected Game			C2
<i>Papio ursinus</i>	Chacma Baboon	Secure; Problem animal			C2
Hedgehog					
<i>Atelerix frontalis angolae</i>	Southern African Hedgehog	Insufficiently known; Rare; Protected Game	R; NT		
Pangolin					
<i>Manis temminckii</i>	Ground Pangolin	Vulnerable; Peripheral; Protected Game	V	V	C2
Carnivores					
<i>Proteles cristatus</i>	Aardwolf	Insufficiently known; Vulnerable?; Peripheral			
<i>Hyaena brunnea</i>	Brown Hyena	Insufficiently known; Vulnerable?; Peripheral	NT	NT	
<i>Crocuta crocuta</i>	Spotted Hyena	Secure?; Peripheral	NT		
<i>Acinonyx jubatus</i>	Cheetah	Vulnerable; Protected Game	V	V	C1
<i>Panthera pardus</i>	Leopard	Secure?; Peripheral; Protected Game		NT	C1
<i>Caracal caracal</i>	Caracal	Secure; Problem Animal			
<i>Felis lybica</i>	African Wild Cat	Vulnerable			C2
<i>Felis nigripes</i>	Black-footed Cat	Indeterminate; Rare		V	C1
<i>Genetta genetta</i>	Small Spotted Genet	Secure			
<i>Suricata suricatta</i>	Suricate	Secure			
<i>Cynictis penicillata</i>	Yellow Mongoose	Secure			
<i>Galerella sanguinea</i>	Slender Mongoose	Secure			
<i>Mungos mungo</i>	Banded Mongoose	Secure			
<i>Helogale parvula</i>	Dwarf Mongoose	Secure			
<i>Otocyon megalotis</i>	Bat-eared Fox	Vulnerable?; Peripheral			
<i>Vulpes chama</i>	Cape Fox	Vulnerable?			
<i>Canis mesomelas</i>	Black-backed Jackal	Secure; Problem animal			
<i>Mellivora capensis</i>	Honey Badger/Ratel	Secure; Protected Game	NT		
<i>Ictonyx striatus</i>	Striped Polecat	Secure			
Pigs					
<i>Phacochoerus africanus</i>	Common Warthog	Secure; Huntable Game			
Antelopes					
<i>Tragelaphus strepsiceros</i>	Greater Kudu	Secure; Huntable Game			
<i>Tragelaphus oryx</i>	Eland	Insufficiently known; Vulnerable?; Protected Game			
<i>Connochaetes taurinus</i>	Blue Wildebeest	Insufficiently known; Vulnerable?; Protected Game			
<i>Alcelaphus buselaphus</i>	Red Hartebeest	Secure; Protected Game			
<i>Oryx gazella</i>	Gemsbok	Secure; Huntable Game			
<i>Sylvicapra grimmia</i>	Common Duiker	Secure			
<i>Antidorcas marsupialis</i>	Springbok	Secure; Huntable Game			
<i>Madoqua damarensis</i>	Damara Dik-Dik	Insufficiently known; Protected Game			
<i>Raphicerus campestris</i>	Steenbok	Secure; Protected Game			
<i>Oreotragus oreotragus</i>	Klipspringer	Secure; Specially Protected Game			

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

IUCN (2014) – International Union for the Conservation of Nature and Natural Resources. NT = Near Threatened; V = Vulnerable; LC = Least Concern (All other species without another conservation status).

SARDB (2004) – South African Red Data Book. R = Rare; V = Vulnerable; NT = Near Threatened; DD = Data Deficient

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

Source for literature review: De Graaff (1981), Griffin and Coetzee (2005), Estes (1995), Joubert and Mostert (1975), Picker and Griffiths (2011), Skinner and Smithers (1990), Skinner and Chimimba (2005), Stander and Hansson (2003) and Taylor (2000)

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*.

Overall terrestrial diversity and endemism – all species – is classified as “low” in the central/eastern part of Namibia (Mendelsohn *et al.* 2002). The overall diversity (5-6 species) and abundance of large herbivorous mammals is “high” in the general area with springbok, kudu, hartebeest and oryx having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall abundance and diversity of large carnivorous mammals is “average to high” (2-4 species) in the general area with cheetah and leopard having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall mammal diversity in the general area is estimated at between 61-75 species with 1-2 species being endemic to the area (Mendelsohn *et al.* 2002). The closest protected areas – i.e. Daan Viljoen Game Reserve and Hardap Nature Reserve – have an estimated 65 and 70 mammals, respectively (Griffin 1998c).

According to the literature at least 93 species of mammals are known and/or expected to occur in the general PEL No. 68 area of which 2 species (2.2%) are classified as endemic. The Namibian legislation classifies 4 species as rare, 10 species as vulnerable, 1 species as specially protected game, 12 species as protected game, 1 species as indeterminate, 7 species as insufficiently known, 8 species as peripheral, 4 species as huntable game, 4 species as problem animals and 6 species (bats) not listed. At least 30.1% (28 species) of the mammalian fauna that occur or are expected to occur in general area are represented by bats of which 1 species – *Cistugo seabrai* – is classified as rare and endemic (3.6%). This is followed by mice and rats with 25.8% (24 species) of which 1 species – *Petromys typicus* – (4.2%) is endemic and carnivores with 20.4% (19 species) species and 1 species – *Felis nigripes* – (5.3%) classified as rare.

Twenty eight species (30.1%) have international conservation status of which the IUCN (2014) classifies 3 species as vulnerable and 2 as near threatened and the SARDB (2004) classifies 1 species as rare; 4 as vulnerable, 12 as near threatened and 7 as data deficient. Furthermore, CITES classifies 7 species as either CITES Appendix 2 (4 species) or Appendix 1 (3 species). 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.

The most important species from the general area are probably all those classified as near threatened (brown hyena) and vulnerable (cheetah and black-footed Cat) by the IUCN (2014). The most important species under Namibian legislation are those classified as rare (Namibian wing-gland bat, Woosnam’s desert mouse, hedgehog and black-footed Cat), endemic and vulnerable (especially eland) species. Pangolin is another species of concern throughout its

range in Namibia. Other important species not listed in Table 3, but occasionally occur in the general area include African wild dog, elephant and lion.

Habitat alteration and overutilization are the two primary processes threatening most mammals (Griffin 1998c) with species probably underrepresented in the above mentioned table for the general area being the bats and rodents, as these groups have not been well documented from the arid central/eastern part of Namibia.

However, none of the mammal species are expected to be exclusively associated with the PEL No. 68 area.

3.4 Avian Diversity

The avian diversity known, and/or expected to occur in the general PEL No. 68 area is presented in Table 4. This table excludes marine birds (e.g. Gulls and Terns, 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 and/or vagrants) could occur in the area depending on environmental conditions.

Table 4. Bird diversity known and/or expected to occur in the general PEL No. 68 – i.e. central/eastern Namibia – area.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN (2014)
<i>Struthio camelus</i>	Common Ostrich			
<i>Dendroperdix sephaena</i>	Crested Francolin			
<i>Scleroptila levaillantoides</i>	Orange River Francolin			N-end
<i>Pternistis hartlaubi</i>	Hartlaub's Spurfowl	End		N-end
<i>Pternistis 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 Guinea fowl			
<i>Turnix sylvaticus</i>	Kurrichane Buttonquail			
<i>Indicator indicator</i>	Greater Honeyguide			
<i>Indicator minor</i>	Lesser Honeyguide			
<i>Campethera bennettii</i>	Bennett's Woodpecker			
<i>Campethera abingoni</i>	Golden-tailed Woodpecker			
<i>Dendropicops fuscescens</i>	Cardinal Woodpecker			
<i>Dendropicops namaquus</i>	Bearded Woodpecker			
<i>Tricholaema leucomelas</i>	Acacia Pied Barbet			N-end
<i>Tockus monteiri</i>	Monteiro's Hornbill	End		
<i>Tockus erythrorhynchus</i>	Red-billed Hornbill			
<i>Tockus damarensis</i>	Damara Hornbill	End		N-end
<i>Tockus leucomelas</i>	Southern Yellow-billed Hornbill			N-end
<i>Tockus bradfieldi</i>	Bradfield's Hornbill			N-end
<i>Tockus nasutus</i>	African Grey Hornbill			
<i>Upupa africana</i>	African Hoopoe			
<i>Phoeniculus purpureus</i>	Green Wood-Hoopoe			
<i>Rhinopomastus cyanomelas</i>	Common Scimitarbill			
<i>Coracias caudatus</i>	Lilac-breasted Roller			
<i>Coracias naevius</i>	Purple Roller			
<i>Merops hirundineus</i>	Swallow-tailed Bee-eater			
<i>Merops persicus</i>	Blue-cheeked Bee-eater			
<i>Colius colius</i>	White-backed Mousebird			End

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN (2014)
<i>Urocolius indicus</i>	Red-faced Mousebird			
<i>Poicephalus rueppellii</i>	Rüppell's Parrot	End	N-end	
<i>Agapornis roseicollis</i>	Rosy-faced Lovebird	End	N-end	
<i>Cypsiurus parvus</i>	African Palm Swift			
<i>Tachymarpis melba</i>	Alpine Swift			
<i>Apus bradfieldi</i>	Bradfield's Swift		N-end	
<i>Apus affinis</i>	Little Swift			
<i>Apus caffer</i>	White-rumped Swift			
<i>Corythaixoides concolor</i>	Grey Go-away Bird			
<i>Tyto alba</i>	Barn Owl			
<i>Otus senegalensis</i>	African Scops-Owl			
<i>Ptilopsis granti</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>Asio capensis</i>	Marsh Owl			
<i>Caprimulgus pectoralis</i>	Fiery-necked Nightjar			
<i>Caprimulgus tristigma</i>	Freckled Nightjar			
<i>Caprimulgus rufigena</i>	Rufous-cheeked Nightjar			
<i>Columba livia</i>	Rock Dove			
<i>Columba guinea</i>	Speckled Pigeon			
<i>Streptopelia capicola</i>	Cape Turtle Dove			
<i>Streptopelia senegalensis</i>	Laughing Dove			
<i>Turtur chalcospilos</i>	Emerald-spotted Wood-Dove			
<i>Oena capensis</i>	Namaqua Dove			
<i>Ardeotis kori</i>	Kori Bustard			NT
<i>Lophotis ruficrista</i>	Red-crested Korhaan		N-end	
<i>Afrotis afraoides</i>	Northern Black Korhaan		End	
<i>Lissotis melanogaster</i>	Black-bellied Bustard			
<i>Pterocles namaqua</i>	Namaqua Sandgrouse		N-end	
<i>Pterocles bicinctus</i>	Double-banded Sandgrouse		N-end	
<i>Pterocles burchelli</i>	Burchell's Sandgrouse		N-end	
<i>Burhinus capensis</i>	Spotted Thick-knee			
<i>Vanellus armatus</i>	Blacksmith Lapwing			
<i>Vanellus coronatus</i>	Crowned Lapwing			
<i>Rhinoptilus africanus</i>	Double-banded Courser			
<i>Rhinoptilus chalconotus</i>	Bronze-winged Courser			
<i>Cursorius rufus</i>	Burchell's Courser		N-end	
<i>Cursorius temminckii</i>	Temminck's Courser			
<i>Elanus caeruleus</i>	Black-shouldered Kite			
<i>Gyps africanus</i>	White-backed Vulture	NT		E
<i>Aegypius tracheliotos</i>	Lappet-faced Vulture	V		
<i>Aegypius occipitalis</i>	White-headed Vulture	V		
<i>Circaetus pectoralis</i>	Black-chested Snake-Eagle			
<i>Circaetus cinereus</i>	Brown Snake-Eagle			
<i>Terathopius ecaudatus</i>	Bateleur	E		NT
<i>Circus maurus</i>	Black Harrier	E		V
<i>Polyboroides typus</i>	African Harrier-Hawk			
<i>Kaupifalco monogrammicus</i>	Lizzard Buzzard			
<i>Melierax canorus</i>	Southern Pale Chanting Goshawk		N-end	
<i>Melierax gabar</i>	Gabar Goshawk			
<i>Accipiter badius</i>	Shikra			
<i>Accipiter minullus</i>	Little Sparrowhawk			
<i>Accipiter ovampensis</i>	Owambo Sparrowhawk			
<i>Aquila rapax</i>	Tawny Eagle	E		

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Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN (2014)
<i>Aquila verreauxii</i>	Verreaux's Eagle	NT		
<i>Aquila spilogaster</i>	African Hawk-Eagle			
<i>Aquila pennatus</i>	Booted Eagle	E		
<i>Aquila wahlbergi</i>	Wahlberg's Eagle			
<i>Polemaetus bellicosus</i>	Martial Eagle	E		V
<i>Sagittarius serpentarius</i>	Secretarybird			V
<i>Polihierax semitorquatus</i>	Pygmy Falcon			
<i>Falco rupicolus</i>	Rock Kestrel			
<i>Falco rupicoloides</i>	Greater Kestrel			
<i>Falco chicquera</i>	Red-necked Falcon			
<i>Falco biarmicus</i>	Lanner Falcon			
<i>Falco peregrinus</i>	Peregrine Falcon	NT		
<i>Egretta garzetta</i>	Little Egret			
<i>Ardea cinerea</i>	Grey Heron			
<i>Ardea melanocephala</i>	Black-headed Heron			
<i>Bubulcus ibis</i>	Cattle Egret			
<i>Scopus umbretta</i>	Hamerkop			
<i>Leptoptilos crumeniferus</i>	Marabou Stork	NT		
<i>Dicrurus adsimilis</i>	Fork-tailed Drongo			
<i>Terpsiphone viridis</i>	African Paradise-Flycatcher			
<i>Nilaus afer</i>	Brubru			
<i>Tchagra australis</i>	Brown-crowned Tchagra			
<i>Laniarius atrococcineus</i>	Crimson-breasted Shrike		N-end	
<i>Prionops plumatus</i>	White-crested Helmet-Shrike			
<i>Batis pririt</i>	Pirit Batis		N-end	
<i>Corvus capensis</i>	Cape Crow			
<i>Corvus albus</i>	Pied Crow			
<i>Lanius collaris</i>	Common Fiscal			
<i>Corvinella melanoleuca</i>	Magpie Shrike			
<i>Eurocephalus anguitimens</i>	Southern White-crowned Shrike		N-end	
<i>Anthoscopus minutes</i>	Cape Penduline Tit		N-end	
<i>Parus carpi</i>	Carp's Tit	End	N-end	
<i>Parus cinerascens</i>	Ashy Tit		End	
<i>Riparia cincta</i>	Banded Martin			
<i>Hirundo albigularis</i>	White-throated Swallow			
<i>Hirundo dimidiata</i>	Pearl-breasted Swallow			
<i>Hirundo cucullata</i>	Greater Striped Swallow			
<i>Hirundo semirufa</i>	Red-breasted Swallow			
<i>Hirundo fuligula</i>	Rock Martin			
<i>Delichon urbicum</i>	Common House Martin			
<i>Pycnonotus nigricans</i>	African Red-eyed Bulbul		N-end	
<i>Sylvietta rufescens</i>	Long-billed Crombec			
<i>Eremomela icteropygialis</i>	Yellow-bellied Eremomela			
<i>Eremomela usticollis</i>	Burnt-necked Eremomela			
<i>Turdoides bicolor</i>	Southern Pied Babbler		End	
<i>Parisoma subcaeruleum</i>	Chestnut-vented Tit-Babbler		N-end	
<i>Cisticola chiniana</i>	Rattling Cisticola			
<i>Cisticola rufilatus</i>	Tinkling Cisticola			
<i>Cisticola juncidis</i>	Zitting Cisticola			
<i>Cisticola jaridulus</i>	Desert Cisticola			
<i>Prinia flavicans</i>	Black-chested Prinia			
<i>Camaroptera brevicaudata</i>	Grey-backed Camaroptera			
<i>Calamonastes fasciolatus</i>	Barren Wren-Warbler		N-end	
<i>Mirafra passerina</i>	Monotonous Lark			
<i>Mirafra africana</i>	Rufous-naped Lark			
<i>Mirafra fasciolata</i>	Eastern Clapper Lark		N-end	

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Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN (2014)
<i>Mirafraba sabota</i>	Sabota Lark			
<i>Calendulauda africanoides</i>	Fawn-coloured Lark		N-end	
<i>Pinarocorys nigricans</i>	Dusky Lark			
<i>Chersomanes albofasciata</i>	Spike-heeled Lark		N-end	
<i>Eremopterix leucotis</i>	Chestnut-backed Sparrowlark			
<i>Eremopterix verticalis</i>	Grey-backed Sparrowlark		N-end	
<i>Calandrella cinerea</i>	Red-capped Lark			
<i>Monticola brevipes</i>	Short-toed Rock Thrush			
<i>Psophocichla litsitsirupa</i>	Groundscraper Thrush			
<i>Bradornis infuscatus</i>	Chat Flycatcher		N-end	
<i>Melaenornis mariquensis</i>	Marico Flycatcher		N-end	
<i>Muscicapa striata</i>	Spotted Flycatcher			
<i>Cercotrichas leucophrys</i>	White-browed Scrub-Robin			
<i>Cercotrichas paena</i>	Kalahari Scrub-Robin			
<i>Oenanthe pileata</i>	Capped Wheatear			
<i>Cercomela familiaris</i>	Familiar Chat			
<i>Myrmecocichla formicivora</i>	Ant-eating Chat		End	
<i>Onychognathus nabouroup</i>	Pale-winged Starling		N-end	
<i>Lamprotornis nitens</i>	Cape Glossy Starling			
<i>Lamprotornis australis</i>	Burchell's Starling			
<i>Cinnyricinclus leucogaster</i>	Violet-backed Starling			
<i>Creatophora cinerea</i>	Wattled Starling			
<i>Chalcomitra amethystina</i>	Amethyst Sunbird			
<i>Chalcomitra senegalensis</i>	Scarlet-chested Sunbird			
<i>Cinnyris talatala</i>	White-bellied Sunbird			
<i>Nectarinia fusca</i>	Dusky Sunbird		N-end	
<i>Cinnyris mariquensis</i>	Marico Sunbird			
<i>Bualornis niger</i>	Red-billed Buffalo-Weaver			
<i>Sporopipes squamifrons</i>	Scaly-feathered Finch		N-end	
<i>Plocepasser mahali</i>	White-browed Sparrow-Weaver			
<i>Philetairus socius</i>	Sociable Weaver		End	
<i>Ploceus intermedius</i>	Lesser Masked-Weaver			
<i>Ploceus velatus</i>	Southern Masked-Weaver			
<i>Ploceus rubiginosus</i>	Chestnut Weaver			
<i>Quelea quelea</i>	Red-billed Quelea			
<i>Euplectes afer</i>	Yellow-crowned Bishop			
<i>Euplectes orix</i>	Southern Red Bishop			
<i>Ortygospiza atricollis</i>	African Quailfinch			
<i>Amadina erythrocephala</i>	Red-headed Finch		N-end	
<i>Estrilda erythronotos</i>	Black-faced Waxbill			
<i>Estrilda astrild</i>	Common Waxbill			
<i>Granatina granatina</i>	Violet-eared Waxbill			
<i>Uraeginthus angolensis</i>	Blue Waxbill			
<i>Pytilia melba</i>	Green-winged Pytilia			
<i>Vidua macroura</i>	Pin-tailed Whydah			
<i>Vidua paradisaea</i>	Long-tailed Paradise-Whydah			
<i>Vidua regia</i>	Shaft-tailed Whydah			
<i>Passer domesticus</i>	House Sparrow			
<i>Passer motitensis</i>	Great Sparrow		N-end	
<i>Passer melanurus</i>	Cape Sparrow		N-end	
<i>Passer griseus</i>	Southern Grey-headed Sparrow			
<i>Motacilla aguimp</i>	African Pied Wagtail			
<i>Motacilla capensis</i>	Cape Wagtail			
<i>Anthus cinnamomeus</i>	African Pipit			
<i>Anthus vaalensis</i>	Buffy Pipit			
<i>Serinus alario</i>	Black-headed Canary		End	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN (2014)
<i>Crithagra atrogulariis</i>	Black-throated Canary			
<i>Serinus flaviventris</i>	Yellow Canary		N-end	
<i>Serinus albogularis</i>	White-throated Canary		N-end	
<i>Emberiza impetuani</i>	Lark-like Bunting		N-end	
<i>Emberiza tahapisi</i>	Cinnamon-breasted Bunting			
<i>Emberiza capensis</i>	Cape Bunting		N-end	
<i>Emberiza flaviventris</i>	Golden-breasted Bunting			

Namibian (Simmons and Brown In press): E – Endangered; NT – Near Threatened; V - Vulnerable

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

IUCN (2014): E – Endangered; NT – Near Threatened; V – Vulnerable; 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), Komen (n.d.), Maclean (1985) and Tarboton (2001)

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 81-140 species estimated and no species being endemic (Mendelsohn *et al.* 2000). Simmons (1998a) suggests 1-3 endemic species and a "low" ranking for southern African endemics and "average to low" ranking for red data birds expected from the general area. Although the PEL No. 68 area is not classified as an Important Birding Area (IBA) in Namibia (Simmons 1998a) the closest such sites are located in the Bushmanland and the Waterberg. The Omatako, Tilda Viljoen and Von Bach Dams are viewed as important breeding, feeding and roosting sites for a variety of aquatic birds (Brown *et al.* 2006).

At least 206 species of terrestrial ["breeding residents"] birds occur and/or could occur in the general area at any time (Hockey *et al.* 2006, Maclean 1985, Tarboton 2001). All the migrant and aquatic species have been excluded here. Six of the 14 Namibian endemics are expected to occur in the general area (42.9% of all Namibian endemic species or 2.9% of all the species expected to occur in the area). Five species are classified as endangered, 4 as near threatened and 2 as vulnerable in Namibia (Simmons and Brown In press) while the IUCN (2014) classifies 1 species as endangered, 2 as near threatened and 3 as vulnerable.

Forty seven (22.8% of all the birds expected) species have a southern African conservation rating with 7 species classified as endemic (14.9% of southern African endemics or 3.4% of all the birds expected) and 40 species classified as near endemic (85.1% of southern African endemics or 19.4% of all the birds expected) (Hockey *et al.* 2006).

The most important species are viewed as the Namibian endemics – especially Rüppell's parrot which requires specific nesting sites – and the species classified as endangered (bateleur, black harrier, tawny eagle, booted eagle and martial eagle) – especially martial and tawny eagles which are often persecuted as stock thieves.

However, none of the bird species are expected to be exclusively associated with the PEL No. 68 area.

3.5 Tree and Shrub Diversity

It is estimated that at least 77-84 species of larger trees and shrubs (>1m) Coats Palgrave (1983) [44 sp.], Curtis and Mannheimer 2005 [77 sp.], Mannheimer and Curtis 2009 [84 sp.], Van Wyk and Van Wyk (1997) [57 sp.] occur in the general area.

The trees and shrubs known, and/or expected to occur in the general PEL No. 68 area (derived from Curtis and Mannheimer 2005 and Mannheimer and Curtis 2009) is presented in Table 5 below. Species indicated are known from the quarter-degree square distribution principle used and don't necessarily occur throughout the entire area.

Table 5. Tree and shrub diversity known and/or expected to occur in the general PEL No. 68 – i.e. central/eastern Namibia – area.

Species: Scientific name	Expected: Curtis and Mannheimer (2005)	Expected: Mannheimer and Curtis (2009)	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 haematoxylon</i>	√	√	Protected (F*)
<i>Acacia hebeclada</i>	√	√	
<i>Acacia hereroensis</i>	√	√	
<i>Acacia karroo</i>	√	√	
<i>Acacia luederitzii</i>	√	√	
<i>Acacia mellifera</i> subsp. <i>detinens</i>	√	√	
<i>Acacia nebrownii</i>		√	
<i>Acacia reficiens</i>	√	√	
<i>Acacia tortilis</i>	√	√	
<i>Albizia anthelmintica</i>	√	√	Protected (F*)
<i>Bauhinia petersiana</i>	√	√	
<i>Boscia albitrunca</i>	√	√	Protected (F#)
<i>Boscia foetida</i>		√	Protected (F#)
<i>Burkea africana</i>	√	√	Protected (F#)
<i>Caesalpinia rubra</i>	√	√	
<i>Catophractes alexandri</i>	√	√	
<i>Combretum apiculatum</i>	√	√	
<i>Combretum collinum</i>	√	√	
<i>Combretum engleri</i>	√	√	
<i>Combretum hereroense</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>Dichrostachys cinerea</i>	√	√	
<i>Diospyros lycioides</i>	√	√	
<i>Ehretia alba</i>	√	√	
<i>Ehretia namibiensis</i>		√	
<i>Elephantorrhiza elephantina</i>	√	√	
<i>Entada arenaria</i>	√	√	
<i>Euclea undulata</i>	√	√	
<i>Ficus burkei</i>		√	Protected (F*)

Desktop study: Vertebrate Fauna & Flora - Cunningham

Species: Scientific name	Expected: Curtis and Mannheimer (2005)	Expected: Mannheimer and Curtis (2009)	Namibian conservation and legal status
<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 olukondae</i>	√	√	
<i>Grewia villosa</i>	√	√	
<i>Gymnosporia buxifolia</i>	√	√	
<i>Gymnosporia senegalensis</i>	√	√	
<i>Lycium bosciifolium</i>	√	√	
<i>Lycium cinereum</i>	√	√	
<i>Lycium eenii</i>	√	√	
<i>Lycium villosum</i>	√	√	
<i>Maerua juncea</i>	√	√	
<i>Maerua schinzii</i>	√	√	Protected (F*)
<i>Montinia caryophyllacea</i>		√	
<i>Mundulea sericea</i>	√	√	
<i>Ochna pulchra</i>	√	√	Protected (F*)
<i>Osyris lanceolata</i>	√	√	
<i>Ozoroa insignis</i>	√	√	
<i>Ozoroa paniculosa</i>	√	√	
<i>Parkinsonia africana</i>	√	√	Protected (F*)
<i>Phaeoptilum spinosum</i>	√	√	
<i>Philenoptera nelsii</i>	√	√	Protected (F#)
<i>Rhigozum brevispinosum</i>	√	√	
<i>Rhigozum trichotomum</i>	√	√	
<i>Rothea myricoides</i>		√	
<i>Sclerocarya birrea</i>		√	Protected (F#)
<i>Searsia ciliata</i>	√	√	
<i>Searsia lancea</i>	√	√	Protected (F#)
<i>Searsia marlothii</i>	√	√	
<i>Searsia pyroides</i>	√	√	
<i>Searsia tenuinervis</i>	√	√	
<i>Securidaca longipedunculata</i>	√	√	Protected (F*)
<i>Strychnos cocculoides</i>	√	√	Protected (F*)
<i>Strychnos pungens</i>	√	√	Protected (F*)
<i>Tarchonanthus camphoratus</i>	√	√	
<i>Terminalia prunioides</i>		√	
<i>Terminalia sericea</i>	√	√	
<i>Vangueria cyanescens</i>	√	√	
<i>Vangueria infausta</i>	√	√	
<i>Ximania americana</i>	√	√	
<i>Ximania caffra</i> var. <i>caffra</i>	√	√	
<i>Ziziphus mucronata</i>	√	√	Protected (F*)

Endemic and Near-endemic – (Craven 1999, Curtis and Mannheimer 2005, Mannheimer and Curtis 2009)

F# – Forestry Ordinance No. 37 of 1952

F* – Curtis and Mannheimer (2005) + Mannheimer and Curtis (2009)

According to Curtis and Mannheimer (2005) and Mannheimer and Curtis (2009) between 77 and 84 species of trees and shrubs are known and/or expected to occur in the general PEL No. 68 area, respectively.

Seventeen (20.2%) species of larger trees and shrubs have some kind of protected status in the general area – i.e. protected by the Forestry Ordinance No. 37 of 1952 [7 species] and by various Forestry laws [10 species] according to Curtis and Mannheimer (2005) and Mannheimer and Curtis (2009) (See Table 5).

The most important larger trees/shrubs expected to occur in the general area are viewed as *Burkea africana* (Burkea), *Sclerocarya birrea* (Marulla), *Strychnos cocculoides* (Corky monkey-orange) and *Strychnos pungens* (Spine-leaved monkey-orange) as all are protected species and used for wood (e.g. *B. africana*) or fruit and/or potentially occur in the general area as southernmost individuals/populations (i.e. unique species in the area, but are more common in northeastern Namibia – i.e. the northern parts of Block 2219). Other important, albeit more widespread protected tree/shrub species, are: *Boscia albitrunca* (Shepherd's Tree), *Acacia erioloba* (Camelthorn), *Faidherbia albida* (Ana Tree), *Philenoptera nelsii* (Kalahari apple leaf) and *Ziziphus mucronata* (Buffalo-thorn) (See Table 5).

However, none of the larger tree and shrub species (>1m in height) are expected to be exclusively associated with the PEL No. 68 area.

3.6 Grass Diversity

It is estimated that up to 74 grasses – 46 to 74 species – (Müller 2007 [74 sp.], Müller 1984 [46 sp.], Van Oudshoorn 1999 [71 sp.]) occur in the general area.

The grasses known and/or expected to occur in the general PEL No. 68 area (¹Müller 1984, ²Van Oudtshoorn 2012, and ³Müller 2007) is presented in Table 6 below.

Table 6. Grass diversity known and/or expected to occur in the general PEL No. 68 – i.e. central/eastern Namibia – area.

Species: Scientific name	Namibian conservation and legal status	Ecological Status	Grazing Value
^{1,3} <i>Andropogon gayanus</i>		Decreaser	High
³ <i>Andropogon chinensis</i>		Decreaser	High
¹ <i>Andropogon schinzii</i>		Decreaser	High
^{1,2,3} <i>Antheophora pubescens</i>		Decreaser	High
³ <i>Antheophora schinzii</i>		?	Low
³ <i>Aristida adscensionis</i>		Increaser 2	Low
^{1,2,3} <i>Aristida congesta</i>		Increaser 2	Low
^{1,3} <i>Aristida pilgeri</i>		Increaser 2	Low
^{1,2,3} <i>Aristida stipitata</i>		Increaser 2	Low
³ <i>Aristida effusa</i>		?	Low
^{1,2,3} <i>Aristida meridionalis</i>		Increaser 3	Low
^{1,2} <i>Aristida rhiniochloa</i>		Increaser 2	Low
² <i>Aristida scabrivalis</i>		Increaser 2	Low
^{1,2,3} <i>Aristida stipitata</i>		Increaser 2	Low
³ <i>Aristida stipoides</i>		?	Low
^{1,2} <i>Brachiaria deflexa</i>		Increaser 2	Average
² <i>Brachiaria eruciformis</i>		Increaser 2	Average
³ <i>Brachiaria malacodes</i>		Increaser 2	Low
^{1,2,3} <i>Brachiaria marlothii</i>		Increaser 2	Low
^{1,2,3} <i>Brachiaria nigropedata</i>		Decreaser	High

Species: Scientific name	Namibian conservation and legal status	Ecological Status	Grazing Value
^{1,2,3} <i>Cenchrus ciliaris</i>		Decreaser	High
² <i>Centropodia glauca</i>		Decreaser	High
^{1,2,3} <i>Chloris virgata</i>		Increaser 2	Average
^{2,3} <i>Cymbopogon caesius</i>		Increaser 1	Low
² <i>Cymbopogon plurinodis</i>		Increaser 1	Low
^{2,3} <i>Cymbopogon pospischilii</i>		Increaser 1	Low
³ <i>Cynodon dactylon</i>		Increaser 2	High
^{1,2,3} <i>Dactyloctenium aegyptium</i>		Increaser 2	Average
² <i>Dactyloctenium giganteum</i>		Increaser 2	High
^{2,3} <i>Dichanthium annulatum</i>		Decreaser	High
^{2,3} <i>Digitaria eriantha</i>		Decreaser	High
^{1,3} <i>Digitaria seriata</i>		Decreaser	High
^{2,3} <i>Digitaria velutina</i>		Increaser 2	Low
² <i>Diplachne fusca</i>		Decreaser	High
³ <i>Echinochloa colona</i>		Decreaser	High
^{1,2,3} <i>Echinochloa holubii</i>		Increaser 2	Average
^{1,2,3} <i>Enneapogon cenchroides</i>		Increaser 2	Average
^{1,2,3} <i>Enneapogon desvauxii</i>		Intermediate	Average
¹ <i>Entoplocamia aristulata</i>		?	Average
² <i>Eragrostis aspera</i>		Increaser 2	Low
^{2,3} <i>Eragrostis bicolor</i>		?	Low
^{1,2,3} <i>Eragrostis biflora</i>		Increaser 2	Low
² <i>Eragrostis curvula</i>		Increaser 2	High
³ <i>Eragrostis dinteri</i>		Increaser 2	Average
^{1,2,3} <i>Eragrostis echinochloidea</i>		Increaser 2	Average
² <i>Eragrostis gummiflua</i>		Increaser 2	Low
³ <i>Eragrostis jeffreysii</i>		Increaser 2	Low
^{2,3} <i>Eragrostis lehmanniana</i>		Increaser 2	Average
^{2,3} <i>Eragrostis nindensis</i>		Increaser 2	Average
^{1,3} <i>Eragrostis omahekensis</i>	Endemic	Increaser 2	Low
^{1,2,3} <i>Eragrostis pallens</i>		Increaser 2	Low
^{1,3} <i>Eragrostis porosa</i>		Increaser 2	Low
^{1,2,3} <i>Eragrostis rigidior</i>		Increaser 2	Average
^{1,2,3} <i>Eragrostis rotifer</i>		?	Average
^{1,2,3} <i>Eragrostis superba</i>		Increaser 2	Average
^{1,2,3} <i>Eragrostis trichophora</i>		Increaser 2	Average
^{2,3} <i>Eragrostis viscosa</i>		Increaser 2	Low
^{1,2,3} <i>Fingerhuthia africana</i>		Decreaser	Average
^{1,2,3} <i>Heteropogon contortus</i>		Increaser 2	Average
² <i>Hyparrhenia hirta</i>		Increaser 1	Average
² <i>Hyperthelia dissoluta</i>		Increaser 1	Average
² <i>Imperata cylindrica</i>		Increaser 1	Low
^{1,2,3} <i>Melinis repens</i>		Increaser 2	Low
^{1,2,3} <i>Microchloa caffra</i>		Increaser 2	Low
^{1,3} <i>Monelytrum leuderitzianum</i>		?	Low
³ <i>Odyssea paucinervis</i>		?	Low
^{2,3} <i>Oropetium capense</i>		Increaser 2	Low
^{2,3} <i>Panicum coloratum</i>		Decreaser	High
^{1,3} <i>Panicum kalahareense</i>		Decreaser	Average
^{1,2,3} <i>Panicum maximum</i>		Decreaser	High
³ <i>Panicum novemnerve</i>		?	Low
² <i>Paspalum scrobiculatum</i>		Increaser 2	Average
³ <i>Perotis patens</i>		Increaser 2	Low
^{1,3} <i>Pogonarthria fleckii</i>		Increaser 2	Low

Species: Scientific name	Namibian conservation and legal status	Ecological Status	Grazing Value
^{1,2,3} <i>Pogonarthria squarrosa</i>		Increaser 2	Low
^{2,3} <i>Schizachyrium sanguineum</i>		Increaser 1	Low
^{1,2} <i>Schmidtia kalahariensis</i>		Increaser 2	Low
^{1,2,3} <i>Schmidtia pappophoroides</i>		Decreaser	High
² <i>Setaria incrassata</i>		Decreaser	High
² <i>Setaria pallide-fusca</i>		Increaser 2	Average
^{2,3} <i>Setaria verticillata</i>		Increaser 2	Average
² <i>Sporobolus festivus</i>		Increaser 2	Low
^{1,2,3} <i>Sporobolus fimbriatus</i>		Decreaser	High
² <i>Sporobolus ioclados</i>		Increaser 2	Average
² <i>Sporobolus panicoides</i>		Increaser 2	Low
² <i>Sporobolus pyramidalis</i>		Increaser 2	Low
² <i>Stipagrostis hirtigluma</i>		Increaser 2	Low
³ <i>Stipagrostis hochstetteriana</i>		Decreaser	High
^{1,2,3} <i>Stipagrostis uniplumis</i>		Increaser 2	Average
^{1,2,3} <i>Themeda triandra</i>		Decreaser	High
^{2,3} <i>Tragus berteronianus</i>		Increaser 2	Low
³ <i>Tragus racemosus</i>		Increaser 2	Low
^{2,3} <i>Tricholaena monachne</i>		Increaser 2	Average
² <i>Trichoneura grandiglumis</i>		Increaser 2	Low
^{1,3} <i>Triraphis purpurea</i>		Increaser 1	Low
³ <i>Triraphis ramosissima</i>		?	High
^{1,3} <i>Triraphis schinzii</i>		Decreaser	High
¹ <i>Urochloa bolbodes</i>		Decreaser	High
³ <i>Urochloa brachyura</i>		?	Average
² <i>Urochloa oligotricha</i>		Decreaser	High
² <i>Urochloa panicoides</i>		Increaser 2	High
³ <i>Urochloa trichopus</i>		?	Low
³ <i>Willkommia sarmentosa</i>		?	High

Endemic – Müller (2007)

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

Up to 74 grasses are expected in the general PEL No. 68 area of which 1 species is viewed as endemic (*Eragrostis omahekensis*). *Eragrostis omahekensis* is virtually only found on disturbed soils – e.g. close to watering points.

However, none of the grass species are expected to be exclusively associated with the PEL No. 68 area.

3.7 Important Species

Reptiles

Endemic reptile species known and/or expected to occur in the general area make up 22.9% of the reptiles and although not as high as endemism elsewhere – for example the western escarpment areas of Namibia – still makes up a large portion of the reptiles.

Reptiles of greatest concern are probably the two species classified as insufficiently known and rare (*Mehelya vernayi* and *Psammophis jallae*) and the tortoises (*Stigmochelys pardalis* and *Psammobates oculiferus*) which are often consumed by humans; *Python natalensis* which is indiscriminately killed throughout its range and *Varanus albigularis* (food) as well as the

various *Pachydactylus* species geckos of which 71.4% are viewed as endemic. Other important species would be the 3 Blind snakes (*Rhinotyphlops* species of which 2 species are endemic) and little known and endemic *Hemirhagerrhis viperrinus* (viperine bark snake).

However, none of the reptiles are exclusively associated with PEL No. 68.

Amphibians

Of the 11 species of amphibians expected to occur in the general area, *Pyxicephalus adspersus*, is viewed as near threatened (Du Preez and Carruthers 2009). However, *Pyxicephalus adspersus* is widespread throughout Namibia and not exclusively associated with the PEL No. 68 area. The Omatako, Hardap and Tilda Viljoen Dams as well as the various ephemeral rivers (e.g. Black and White Nossob, etc.) in the general area and their tributaries and ephemeral pans – e.g. Aminuis area – are viewed as important amphibian habitat in the general area.

However, none of the amphibians are exclusively associated with PEL No. 68.

Mammals

Of the 93 species of mammals expected to occur in the general area, only 2% are endemic and 30% are classified under international conservation legislation. The most important species under Namibian legislation are those classified as rare (Namibian wing-gland bat, Woosnam's desert mouse, hedgehog and black-footed cat), endemic and vulnerable (especially eland) species. Other important species are pangolin (which are used for traditional medicinal purposes) and the African wild dog that occasionally occurs in the general area.

However, none of the mammals are exclusively associated with PEL No. 68.

Birds

The high proportion of endemics – 6 of the 14 endemics to Namibia (i.e. 43% of all endemics) – expected to occur in the general area underscore the importance of this area. Furthermore 14.9% are classified as southern African endemics (or 3.4% of all the birds expected) and 85.1% are classified as southern African near-endemics (or 19.4% of all the birds expected). The most important species known/expected – although not exclusively associated with the general area – are viewed as the Namibian endemics – especially Rüppell's parrot which requires specific nesting sites – and the species classified as endangered – especially martial and tawny eagles which are often persecuted as stock thieves. The birds classified as endangered, near threatened and vulnerable by the IUCN (2014) – Kori bustard, white-backed vulture, bateleur, black harrier, martial eagle and secretarybird – are also viewed as important.

However, none of these birds are exclusively associated with PEL No. 68.

Trees/shrubs and Grasses

The most important larger trees/shrubs expected to occur in the general area are *Burkea africana*, *Sclerocarya birrea*, *Strychnos cocculoides* and *Strychnos pungens* as all are protected species and used for wood (e.g. *B. africana*) or fruit and the most important grass expected in the area is the endemic *Eragrostis omahekensis* associated with disturbed areas.

However, none of these larger tree and shrub species (>1m in height) are exclusively associated with PEL No. 68.

Other

Aloes are protected throughout Namibia with 3 aloe species not included in Table 5, but which potentially occur in the general area, and also viewed as important are *Aloe hereroensis*, *A.*

littoralis and *A. zebrina* (Rothmann 2004). *Aloe zebrina* can form dense stands, especially under trees, in some parts.

Other species with commercial potential that could occur in the general area include *Harpagophytum procumbens* (devil's claw) – harvested for medicinal purposes and often over-exploited – and *Citrullus lanatus* (tsamma melon) which potentially has a huge economic benefit (Mendelsohn *et al.* 2002). Devils' claw and tsamma melons are usually associated with sandy soils throughout their range.

At least 64 species of ferns, of which 13 species being endemic, occur throughout Namibia. Ferns in the general area include at least 6 indigenous species (*Cheilanthes dinteri*, *Marselia coromandelina*, *M. farinosa*, *M. vera*, *Ophioglossum polyphyllum* and *Pellaea calomelanos*) and no endemics (Crouch *et al.* 2011). The general area is undercollected with more species probably occurring in the general area than presented above.

The overall diversity of lichens is poorly known from Namibia, especially the coastal areas and statistics on endemism is even sparser (Craven 1998). More than 100 species are expected to occur in the Namib Desert with the majority being uniquely related to the coastal fog belt. Lichen diversity is related to air humidity and generally decreases inland from the Namibian coast (Schults and Rambold 2007). Off road driving is the biggest threat to these lichens which are often rare and unique to Namibia. 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 BIOTA surveys in the early/mid 2000's were new to science (i.e. new species), is a case in point. Lichens are expected to occur in the general PEL No. 68 area – especially rocky outcrops and on southern side of larger trees – but what and how many species in currently unknown.

Although the focus during this literature survey was on the more visible trees, shrubs, grasses and more important other species potentially occurring in the general area, many more species – e.g. herbs – occur throughout the area and are viewed as important.

However, none of these “other” plant species presented above are exclusively associated with PEL No. 68.

4 Conclusion

It is estimated that at least 74 reptile, 13 amphibian, 93 mammal, 206 bird species (breeding residents), 77-84 larger trees and shrubs and up to 74 species of grass are known to or expected to occur in the general/immediate PEL No. 68 area of which a moderate proportion are endemics. Groups with the highest proportion of endemics are reptiles (23%) and birds (6 of the 14 Namibian endemics). Although these endemics are known to occur from the general area, it is currently not clear if any of these are associated with the proposed development area(s) or how exactly they will be affected by this development. However, none of these species are exclusively associated with PEL No. 68.

The very high percentage of unique and/or endemic species (23%) underscores the importance of the general area for reptiles with the most important species viewed as those classified as rare (*Mehelya vernayi* and *Psammophis jallae*) and species usually negatively affected by humans and associated development (i.e. Tortoises: *Stigmochelys pardalis* and *Psammobates oculiferus*; Python: *Python natalensis* and Monitor Lizard: *Varanus albigularis*).

The general area is not viewed as very important as amphibian habitat although the occurrence of the Giant Bullfrog (*Pyxicephalus adspersus*), of which little is currently known from the area, except that they are observed after localised rains.

Mammals, especially small mammals (rodents and bats) and carnivores are well represented in the area. The little known bats are probably underrepresented in the area due to a lack of active surveying. Carnivores are often also indiscriminately killed with the black-footed cat probably one of the most threatened carnivore species from the area.

Endemic birds are well represented in the general area (6 of the 14 endemics) which also includes a high proportion of southern African endemics (3.4% of all species expected) and near-endemics (19%). The most important endemic species is probably Rüppells parrot which requires specific breeding habitat and is easily disturbed.

It is estimated that at least 77-84 species of larger trees and shrubs and at least 74 species of grasses occur in the general area. 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 herbs and lichens, etc. is also acknowledged.

The most important tree/shrub species occurring in the general area are viewed as those classified as protected by the Forestry Ordinance No. 37 of 1952 (especially *Burkea africana* and other fruit trees) and the most important grass expected in the area is the endemic *Eragrostis omahekensis* associated with disturbed areas. Other important species expected to occur in the area are the Aloes, devil’s claw, tsamma melon and various ferns and lichens.

Species most likely to be adversely affected by exploration activities in the general area would be the variety of unique reptiles and birds specifically associated with the proposed exploration areas – e.g. especially species associated with rocky outcrops/ridges – as well as the potential effect such development may have on carnivores.

However, none of the vertebrate fauna and larger trees/shrubs and grasses presented in this report is expected to be exclusively associated with PEL No. 68.

5 Recommendations

All human induced activities (including surveying) 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 surveying activities in the PEL No. 68 – Blocks 2219 and 2319 – realise in future:

Vehicles and Tracks:

1. Avoid unnecessary affecting areas viewed as important habitat – i.e. ephemeral rivers (e.g. Black and White Nossob, etc.); pans; rocky outcrops; clumps of protected tree species;
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 surveying 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 and pans; 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 Surveying Sites:

8. Select camp sites and other temporary lay over sites with care – i.e. avoid important habitats;
9. Use portable toilets to avoid faecal pollution around camp and surveying 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. black-backed jackal, 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) and unique plants (e.g. various *Aloes*) 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 area;
16. Avoid the removal and/or damaging of protected flora potentially occurring in the general area – e.g. various *Aloe* species, etc.;
17. Avoid introducing ornamental plants, especially potential invasive alien species, as part of the landscaping of the camp sites, 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 plant species encountered throughout the area. 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 surveying activities and monitor for compliance thereof throughout;
20. Rehabilitate all areas disturbed by the surveying activities – i.e. camp sites, etc.;
21. Implement a policy of replacing 2 tree species (preferably the same species) for every 1 protected tree species having to be removed (if necessary);
22. 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;
23. Employ an independent environmental auditor to ensure compliance, especially of the rehabilitation of all the affected areas.

It is not expected that limited surveying/exploration activities throughout the PEL No. 68 – Blocks 2219 and 2319 – area will adversely affect any unique vertebrate fauna and flora, especially if the proposed recommendations (mitigation measures) are incorporated.

However, should the specific exploration site(s) within these Blocks become known and viewed as feasible to pursue in future, fieldwork is recommended to determine species actually affected at these site(s).

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