

DESKTOP STUDY:
**VERTEBRATE FAUNA EXPECTED ALONG THE PROPOSED
220kV TRANSMISSION LINE (OMBURU/KHAN/KUISEB)**

SPECIALIST CONTRIBUTION:

Prepared by:

Peter L Cunningham

King Khalid Wildlife Research Centre, Thumamah, Kingdom of Saudi Arabia

P. O. Box 90717

Klein Windhoek

Namibia

Telephone: +264-61-254550

Telefax: +264-61-254550

E-mail: cunning@mweb.com.na or pckkwrc@yahoo.co.uk

Prepared for:

Ms Stephanie van Zyl

Enviro Dynamics (Pty) Ltd

P. O. Box 20837

Windhoek

Namibia

Telephone: +264-61-223336

Telefax: +264-61-307437

E-mail: stephanie@envirod.com

TABLE OF CONTENTS

1. VERTEBRATE FAUNA EXPECTED ALONG THE PROPOSED 220kV TRANSMISSION LINE (OMBURU/KHAN/KUISEB).....	94
1.1 INTRODUCTION.....	94
1.2 METHODS.....	95
1.2.1 Literature review.....	95
1.3 RESULTS	95
1.3.1 Reptile Diversity	95
1.3.2 Amphibian Diversity.....	102
1.3.3 Mammal Diversity.....	103
1.3.4 Important Species.....	109
1.4 CONCLUSION	113
1.5 ENVISAGED IMPACTS	114
1.5.1 Introduction.....	114
1.5.2 Faunal destruction.....	115
2. SENSITIVE HABITATS WITH UNIQUE FAUNA	119
2.1 GRANITE DOMES	119
2.2 ESCARPMENT AND INSELBERGS.....	119
2.3 NAMIB GRAVEL PLAINS	119
2.4 DRAINAGE LINES	119
3. ACCESS ROUTE SELECTION	120
3.1 OMBURU TO KHAN.....	120
3.2 KHAN TO VALENCIA SUBSTATION.....	121
3.3 VALENCIA SUBSTATION TO HUSAB SUBSTATION.....	123
3.4 HUSAB SUBSTATION TO KUISEB SUBSTATION	124
4. REFERENCES	125

1. VERTEBRATE FAUNA EXPECTED ALONG THE PROPOSED 220kV TRANSMISSION LINE (OMBURU/KHAN/KUISEB)

1.1 INTRODUCTION

A desktop study (literature review) was conducted on the vertebrate fauna expected to occur along the proposed 220kV transmission line from the Omburu Transmission Station via the Khan Substation to the Kuiseb Transmission Station situated in the Erongo Region in the vicinity of Omaruru, Usakos and Arandis in central western Namibia. The focus was limited to the proposed transmission line(s) and associated development only. An extensive literature review of probable reptiles, amphibians and mammals (i.e. vertebrate fauna, excluding birds which will be dealt with elsewhere) that ought to occur along the proposed transmission line(s) was conducted using as many relevant literature as possible. Special emphasis was placed on rare, threatened, endangered, and endemic species expected from the general area.

This literature review was to determine the actual as well as potential vertebrate fauna associated with the general areas that the proposed transmission line would pass through and commonly referred to as the Central Desert and Semi-desert Savannah and Transition Zone [Escarpment area] (Giess 1971, Van der Merwe 1983) or the areas referred to by Mendelsohn *et al.* (2002) as the Central Desert, Western-central Escarpment and Inselbergs and Western Highlands. The Namib Desert biome is well protected with parks in this biome making up 69% of the network compared to only 7% of the Savannah biome being formally protected and the Mountain Savannah area being wholly under protected (Barnard 1998). Escarpments, mountains, and inselbergs are generally considered as sites of special ecological importance with granite domes (Omaruru district) high in biotic richness and endemism (Curtis & Barnard 1998). The †Gaingu communal conservancy is located in the Spitskoppe area and various freehold conservancies are located in the general Omaruru area (Mendelsohn *et al.* 2002, NACSO 2006).

Central western Namibia in general and the route along the proposed transmission line(s) is regarded as "relatively low to moderate" in overall (all terrestrial species) diversity (Mendelsohn *et al.* 2002). Overall terrestrial endemism in the area on the other hand is "moderate to high" (Mendelsohn *et al.* 2002). The overall diversity and abundance of large herbivorous mammals (big game) is viewed as "moderate" with 3-4 species while overall diversity and density of large carnivorous mammals

(large predators) is determined as "moderate" with 4 species expected – e.g. leopard, cheetah, spotted & brown hyena (Mendelsohn *et al.* 2002).

It is estimated that at least 81 species of reptile, 9 amphibian and 74 mammal species occur in the general/immediate proposed transmission line(s) development area of which a high proportion are endemics.

1.2 METHODS

1.2.1 Literature review

A comprehensive and intensive literature review (i.e. desktop study) regarding the reptiles, amphibians and mammals that could potentially occur in the general area including the immediate area associated with the proposed transmission line(s) was conducted using as many references as manageable. A list of the references consulted can be viewed in the Reference section (Page 21).

1.3 RESULTS

1.3.1 Reptile Diversity

The following table indicates the reptile diversity known and/or expected to occur in the general area that the proposed transmission line(s) would pass through – i.e. from the Omaruru area to the Namib-Naukluff Park area in the west:

Species: name	Scientific	Species: name	Common	Expected	Status
Tortoises & Terrapins					
	<i>Geochelone pardalis</i>	Leopard Tortoise		√	
	<i>Psammobates oculiferus</i>	Kalahari Tent Tortoise		√	
	<i>Pelomedusa subrufa</i>	Marsh/Helmeted Terrapin		√	
SNAKES					
Blind Snakes					
	<i>Rhinotyphlops lalandei</i>	Delalande's Beaked Blind Snake		√	Endemic
Thread Snakes					

Vertebrate Fauna - Cunningham

Species: name	Scientific	Species: name	Common	Expected	Status
	<i>Leptotyphlops occidentalis</i>		Western Thread Snake	√	Endemic
	<i>Leptotyphlops labialis</i>		Damara Thread Snake	√	
Pythons					
	<i>Python natalensis</i>		Southern African Python	√	
	<i>Python anchietae</i>		Anchieta's Dwarf Python	√	Endemic
Burrowing Snakes					
	<i>Atractaspis bibronii</i>		Southern/Bibron's Burrowing Asp	√	
	<i>Xenocalamus bicolor bicolor</i>		Bicoloured Quill-snouted Snake	√	
Typical Snakes					
	<i>Lamprophis fuliginosus</i>		Brown House Snake	√	
	<i>Lycophidion capense</i>		Cape Wolf Snake	√	
	<i>Lycophidion namibianum</i>		Namibian Wolf Snake	√	Endemic
	<i>Mehelya capensis</i>		Cape File Snake	√	
	<i>Mehelya vernayi</i>		Angola File Snake	√	
	<i>Pseudaspis cana</i>		Mole Snake	√	
	<i>Pythonodipsas carinata</i>		Western Keeled Snake	√	
	<i>Prosymna frontalis</i>		South-western Shovel-snout	√	
	<i>Hemirhagerthis viperinus</i>		Viperine Bark Snake	√	
	<i>Dipsina multimaculata</i>		Dwarf Beaked Snake	√	Endemic
	<i>Psammophis trigrammus</i>		Western Sand Snake	√	
	<i>Psammophis notostictus</i>		Karoo Sand Snake	√	

Vertebrate Fauna - Cunningham

Species: name	Scientific	Species: name	Common	Expected	Status
	<i>Psammophis leightoni namibensis</i>	Namib Sand Snake		√	
	<i>Psammophis brevirostris leopardinus</i>	Leopard Grass Snake		√	
	<i>Philothamnus semivariiegatus</i>	Spotted Bush Snake		√	
	<i>Dasypeltis scabra</i>	Common/Rhombic Egg Eater		√	
	<i>Telescopus semiannulatus polystrictus</i>	Eastern Tiger Snake		√	
	<i>Aspidelaps lubricus infuscatus</i>	Coral Snake		√	
	<i>Aspidelaps scutatus scutatus</i>	Shield-nose Snake		√	Endemic
	<i>Naja nivea</i>	Cape Cobra		√	Endemic
	<i>Naya nigricollis nigricincta</i>	Black-necked Spitting Cobra		√	Endemic
	<i>Bitis arietans</i>	Puff Adder		√	
	<i>Bitis caudalis</i>	Horned Adder		√	
	Worm Lizards				
	<i>Zygaspis quadrifrons</i>	Kalahari Round-headed Worm Lizard		√	
	LIZARDS				
	Skinks				
	<i>Typhlosaurus braini</i>	Brain's Blind Legless Skink		√	Endemic
	<i>Typhlacontias brevipes</i>	FitzSimon's Burrowing Skink		√	Endemic
	<i>Mabuya acutilabris</i>	Wedge-snouted Skink		√	
	<i>Mabuya capensis</i>	Cape Skink		√	

Vertebrate Fauna - Cunningham

Species: name	Scientific	Species: name	Common	Expected	Status
	<i>Mabuya hoeschi</i>		Hoesch's Skink	√	
	<i>Mabuya occidentalis</i>		Western Three-striped Skink	√	
	<i>Mabuya spilogaster</i>		Kalahari Tree Skink	√	
	<i>Mabuya striata wahlbergi</i>		Striped Skink	√	
	<i>Mabuya sulcata</i>		Western Rock Skink	√	
	<i>Mabuya variegata variegata</i>		Variiegated Skink	√	
Old World Lizards					
	<i>Heliobolus lugubris</i>		Bushveld Lizard	√	
	<i>Meroles anchietae</i>		Shovel-snouted Lizard	√	
	<i>Meroles cuneirostris</i>		Wedge-snouted Lizard	√	Endemic
	<i>Meroles micropholidotus</i>		Small-scaled Desert Lizard	√	Endemic
	<i>Meroles reticulatus</i>		Reticulated Desert Lizard	√	
	<i>Meroles suborbitalis</i>		Spotted Desert Lizard	√	Endemic
	<i>Pedioplanis breviceps</i>		Short-headed Sand Lizard	√	Endemic
	<i>Pedioplanis namaquensis</i>		Namaqua Sand Lizard	√	
	<i>Pedioplanis undata</i>		Western Sand Lizard	√	
	<i>Pedioplanis inornata</i>		Plain Sand Lizard	√	Endemic
	<i>Pedioplanis husabensis</i>		Husab Sand Lizard	√	Endemic
Plated Lizards					
	<i>Cordylosaurus subtessellatus</i>		Dwarf Plated Lizard	√	

Vertebrate Fauna - Cunningham

Species: name	Scientific	Species: name	Common	Expected	Status
	<i>Gerrhosaurus validus</i>		Giant Plated Lizard	√	
Girdled Lizards					
	<i>Cordylus jordani</i>		Jordan's Girdled Lizard	√	Endemic
Monitors					
	<i>Varanus albigularis</i>		Rock Monitor	√	
Agamas					
	<i>Agama anchietae</i>		Anchieta's Agama	√	
	<i>Agama planiceps</i>		Namibian Rock Agama	√	Endemic
Chameleons					
	<i>Chamaeleo namaquensis</i>		Namaqua Chameleon	√	
Geckos					
	<i>Afroedura africana</i>		African Flat Gecko	√	Endemic
	<i>Chondrodactylus angulifer angulifer + C. a. namibensis</i>		Giant Ground Gecko	√	Endemic
	<i>Lygodactylus bradfieldi</i>		Bradfield's Dwarf Gecko	√	Endemic
	<i>Narudasia festiva</i>		Festive Gecko	√	Endemic
	<i>Pachydactylus bicolour</i>		Velvety Thick-toed Gecko	√	Endemic
	<i>Pachydactylus capensis</i>		Cape Thick-toed Gecko	√	Endemic
	<i>Pachydactylus kochii</i>		Koch's Thick-toed Gecko	√	Endemic
	<i>Pachydactylus turneri</i>		Turner's Thick-toed Gecko	√	Endemic
	<i>Pachydactylus punctatus</i>		Speckled Thick-toed Gecko	√	
	<i>Pachydactylus rugosus</i>		Rough Thick-toed Gecko	√	Endemic

Vertebrate Fauna - Cunningham

Species: name	Scientific	Species: name	Common	Expected	Status
	<i>Pachydactylus scherzi</i>		Namib Variable Gecko	√	Endemic
	<i>Pachydactylus weberi</i>		Weber's Thick-toed Gecko	√	Endemic
	<i>Palmatogecko rangei</i>		Web-footed Gecko	√	
	<i>Ptenopus carpi</i>		Carp's Barking Gecko	√	Endemic
	<i>Ptenopus garrulus garrulous</i> + <i>P. g. maculatus</i>		Common Barking Gecko	√	Endemic
	<i>Ptenopus kochi</i>		Kock's Barking Gecko	√	Endemic
	<i>Rhoptropus afer</i>		Common Namib Day Gecko	√	
	<i>Rhoptropus boultoni</i>		Boulton's Namib Day Gecko	√	
	<i>Rhoptropus bradfieldi</i>		Bradfield's Namib Day Gecko	√	Endemic

Source for literature review: Branch (1998), Branch (2008), Bonin *et al.* (2006), Boycott & Bourquin 2000, Broadley (1983), Buys & Buys (1983), Cunningham (2006a), Griffin (2003), Griffin (2005a), Hebbard (n.d.), Marais (1992).

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 associated with the proposed transmission line(s) is estimated at between 41-70 species and 21-28 species, respectively (Mendelsohn *et al.* 2002). Griffin (1998a) presents figures of between 21-30 and 7-8 for endemic lizards and snakes, respectively, from the general central-western part of Namibia. According to Griffin (2005b) at least 76 species of reptiles are known, reported and/or expected to occur in the Valencia

Uranium Mine area. Of these, 31 are snakes (including worm, blind & pythons) and 43 are lizards (17 Gecko's, 11 old world lizards, 7 skinks, 3 plated lizards, 2 agama's and 1 each for chameleon, monitor & worm lizard) while 1 tortoise and 1 terrapin are also expected from the general area. Cunningham (2007) identified and confirmed 12 species of reptiles in the Valencia Mine area during recent fieldwork there during late 2007. According to Henschel *et al* (2000) at least 20 species of lizards (12 geckos, 5 lizards & 3 skinks) have been recorded on the gravel plains at Gobabeb (Desert Research site approximately 150km southwest of Valencia). A pilot study conducted by Kavari (2007) on the reptile diversity associated with the future expansion of the Rössing Uranium Mine (approximately 30km west of Valencia) indicated the presence of 6 reptile species (3 geckos, 1 lizard, 1 chameleon & 1 snake). A survey of the reptiles associated with the Trekkopje Uranium Mining area (approximately 40km northwest of Valencia) conducted by Cunningham (2006b) indicated the presence of 22 reptiles species (8 snakes, 1 skink, 2 lizards, 2 agamas, 1 chameleon & 8 geckos).

At least 81 species of reptiles are expected to occur along the proposed transmission line(s) from east to west with 33 species being endemic – i.e. 41% endemic. These consist of at least 30 snakes (1 blind snake, 2 thread snake, 2 python, 2 burrowing snakes & 23 typical snakes), 8 of which are endemic (27%) to Namibia, 2 tortoises, 1 terrapin, 48 lizards (1 worm lizard, 10 skinks, 11 Old World lizards, 2 Plated lizards, 1 Girdled lizard, 1 Monitor lizard, 2 Agamas, 1 Chameleons & 19 Geckos), 25 (52%) of which are endemic to Namibia. Skink's (10 species), Old World Lizards (11 species) and Gecko's (19 species) are the most numerous lizards expected from the general area. Namibia with approximately 129 species of lizards (Lacertilia) has one of the continents richest lizard fauna (Griffin 1998a). Geckos have the highest occurrence of endemics in the general area with 15 of the 19 species (79%) expected and/or known to occur in the area, being endemic to Namibia. 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.

Some of the species tabled above occur in specific habitats such as the Web-footed Gecko which inhabits the dunes further west in the Namib Naukluft Park or the tortoises and terrapin (water pools & dams as well as temporary pools in the Khan River system) which inhabit the vegetated areas further east along the proposed transmission line route.

1.3.2 Amphibian Diversity

The following table indicates the amphibian diversity known and/or expected to occur in the general area that the proposed transmission line(s) would pass through – i.e. from the Omaruru area to the Namib-Naukluft Park area in the west:

Species: name	Scientific name	Species: name	Common name	Expected	Status
Platannas					
	<i>Xenopus laevis</i>		Common Platanna	√	
Toads					
	<i>Bufo dombensis</i>		Dombe Toad	√	Endemic
	<i>Bufo hoeschi</i>		Hoesch's Toad	√	Endemic
	<i>Bufo poweri</i>		Power's Toad or Western Olive Toad	√	
Kassinias					
	<i>Kassina senegalensis</i>		Bubbling Kasina	√	
Rain Frogs					
	<i>Breviceps adspersus</i>		Common/Bushveld Rain Frog	√	
Rubber Frog					
	<i>Phrynomantis annectens</i>		Marbled Rubber Frog	√	Endemic
Bull & Sand Frogs					
	<i>Pyxicephalus adspersus</i>		Giant Bullfrog or African Bullfrog	√	
	<i>Tomopterna cryptotus</i>		Tremolo Sand Frog	√	

Source for literature review: Carruthers (2001), Channing (2001), Channing & Griffin (1993), Griffin (1998b), Passmore & 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. The diversity of amphibians closely follows patterns of average rainfall with fewer species in the dry western parts of Namibia (Mendelsohn *et al.* 2002).

The ephemeral Khan River and its tributaries such as the Ebony, Wildehond, Naab and Chouxab Rivers drain the central western region of Namibia although all of these rivers only flow sporadically after heavy local thundershowers. Other water bodies in the area include temporary pools in afore mentioned rivers as well as any other suitable natural water holding features. Man made ground dams and reservoirs hold water temporarily and could serve as a short term habitat for amphibians in the area. No permanent natural surface water exists in the general area. This lack of natural long term surface water (i.e. amphibian breeding places) affects the amphibian diversity in the area. According to Mendelsohn *et al.* (2002), the overall frog diversity in the area through which the transmission line passes is estimated at between 1-7 species.

According to the literature, at least 9 species of amphibians occur in the general area of which 3 species are endemic to Namibia. Griffin (1998b) also puts the species richness in the general area around 2-6 species. The general area is under represented, with 2 bull/sand frogs, 3 toads and 1 species each for platanna, kassina, rain and rubber frog expected (i.e. potentially could be found in the area) to occur in the general area. *Phrynomantis annectens* (Cape River Frog) is known from pools in the Naukluff Mountains to the south west and the Fish River Canyon further towards the south, but not confirmed from the area through which the proposed transmission line(s) are to pass through although could potentially occur there. *Bufo hoeschi*, *Bufo dombensis* and *Phrynomantis annectens* are endemic to Namibia (i.e. 33%).

1.3.3 Mammal Diversity

The following table indicates the mammal diversity known and/or expected to occur in the general area that the proposed transmission line(s) would pass through – i.e. from the Omaruru area to the Namib-Naukluff Park area in the west:

Vertebrate Fauna - Cunningham

Species: Scientific name	Species: Common name	Expected	Status
Shrews			
<i>Crosidura cyanea</i>	Reddish-grey Musk Shrew	√	
Hedgehog			
<i>Atelerix frontalis</i>	South African Hedgehog	√	1Near Threatened
Elephant Shrews			
<i>Macroscelides proboscideus</i>	Round-eared Elephant-shrew	√	Endemic 2Vulnerable
<i>Elephantulus rupestris</i>	Smith's Rock Elephant-shrew	√	2Vulnerable
<i>Elephantulus intufi</i>	Bushveld Elephant-shrew	√	
Bats			
<i>Sauromys petrophilus</i>	Flat-headed Free-tailed Bat	√	
<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat	√	
<i>Myotis seabrai</i>	Angola Hairy Bat	√	
<i>Cistugo seabrai</i>	Namibian Wing-gland Bat	√	Endemic 1Vulnerable
<i>Laephotis namibensis</i>	Namib Long-eared Bat	√	Endemic 2Endangered
<i>Eptesicus hottentotus</i>	Long-tailed Serotine Bat	√	
<i>Pipistrellus capensis</i>	Cape Serotine Bat	√	
<i>Nycteris thebaica</i>	Common Slit-faced Bat	√	
<i>Rhinolophus fumigatus</i>	Rüppell's Horseshoe Bat	√	1Near Threatened
<i>Rhinolophus clivus</i>	Geoffroy's Horseshoe Bat	√	1Near Threatened
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat	√	1Near Threatened
<i>Rhinolophus denti</i>	Dent's Horseshoe Bat	√	1Near Threatened

Vertebrate Fauna - Cunningham

Species: Scientific name	Species: Common name	Expected	Status
<i>Hipposideros caffer</i>	Sundevall's Leaf-nosed Bat	√	
Monkeys & Baboons			
<i>Papio ursinus</i>	Chacma Baboon	√	
Pangolin			
<i>Manis temminckii</i>	Pangolin	√	1 Vulnerable CITES Appendix II
Hares & Rabbits			
<i>Lepus capensis</i>	Cape Hare	√	
<i>Lepus saxatilis</i>	Scrub Hare	√	
<i>Pronolagus randensis</i>	Jameson's Red Rock Rabbit	√	
Rodents			
Molerat			
<i>Cryptomys damarensis</i>	Damara Molerat	√	
Squirrels			
<i>Xerus inauris</i>	Cape Ground Squirrel	√	
<i>Xerus princeps</i>	Mountain Ground Squirrel	√	Endemic 1 Near Threatened
Porcupine, Springhare & Dassie Rat			
<i>Hystrix africaeaustralis</i>	Cape Porcupine	√	
<i>Pedetes capensis</i>	Springhare	√	
<i>Petromus typicus</i>	Dassie Rat	√	Endemic 1 Near Threatened
Rats & Mice			
<i>Graphiurus rupicola</i>	Western Rock Dormouse	√	Endemic
<i>Parotomys littledalei</i>	Littledale's Whistling Rat	√	Endemic 1 Near Threatened
<i>Rhabdomys pumilio</i>	Striped Mouse	√	

Vertebrate Fauna - Cunningham

Species: Scientific name	Species: Common name	Expected	Status
<i>Mus musculus</i>	House Mouse	√	Invasive alien
<i>Mus indutus</i>	Desert Pygmy Mouse	√	
<i>Thallomys nigricauda</i>	Black-tailed Tree Rat	√	
<i>Aethomys namaquensis</i>	Namaqua Rock Mouse	√	
<i>Aethomys chrysophilus</i>	Red Veld Rat	√	
<i>Rattus rattus</i>	House Rat	√	Invasive alien
<i>Desmodillus auricularis</i>	Short-tailed Gerbil	√	
<i>Gerbillurus paeba infernus</i>	Hairy-footed Gerbil	√	Endemic
<i>Gerbillurus setzeri</i>	Setzer's Hairy-footed Gerbil	√	Endemic
<i>Tatera leucogaster</i>	Bushveld Gerbil	√	
<i>Saccostomus campestris</i>	Pouched Mouse	√	
<i>Malacothrix typical</i>	Large-eared Mouse	√	
<i>Petromyscus collinus</i>	Pygmy Rock Mouse	√	Endemic
Carnivores			
<i>Proteles cristatus</i>	Aardwolf	√	
<i>Hyaena brunnea</i>	Brown Hyena	√	1Near Threatened 2Endangered
<i>Crocuta crocuta</i>	Spotted Hyena	√	
<i>Acinonyx jubatus</i>	Cheetah	√	Vulnerable; CITES Appendix 1
<i>Panthera pardus</i>	Leopard	√	
<i>Felis caracal</i>	Caracal	√	
<i>Felis lybica</i>	African Wild Cat	√	
<i>Otocyon megalotis</i>	Bat-eared Fox	√	
<i>Vulpes chama</i>	Cape Fox	√	
<i>Canis mesomelas</i>	Black-backed Jackal	√	
<i>Mellivora capensis</i>	Ratel or Honey Badger	√	1Near Threatened
<i>Ictonyx striatus</i>	Striped Polecat	√	

Vertebrate Fauna - Cunningham

Species: Scientific name	Species: Common name	Expected	Status
<i>Genetta genetta</i>	Small-spotted Genet	√	
<i>Suricata suricatta</i>	Suricate	√	
<i>Cynictis penicillata</i>	Yellow Mongoose	√	
<i>Galerella sanguinea</i>	Slender Mongoose	√	
<i>Galerella nigrata</i>	Black Mongoose	√	Endemic
Aardvark			
<i>Orycteropus afer</i>	Aardvark	√	
Dassie			
<i>Procapra capensis</i>	Rock Dassie	√	
Zebra			
<i>Equus zebra hartmannae</i>	Hartmann's Mountain Zebra	√	Endemic
Pig			
<i>Phacochoerus aethiopicus</i>	Warthog	√	
Antelopes			
<i>Sylvicapra grimmia</i>	Common Duiker	√	
<i>Antidorcas marsupialis</i>	Springbok	√	
<i>Oreotragus oreotragus</i>	Klipspringer	√	
<i>Madoqua kirkii</i>	Damara Dik-Dik	√	
<i>Raphicerus campestris</i>	Steenbok	√	
<i>Oryx gazella</i>	Gemsbok	√	
<i>Tragelaphus strepsiceros</i>	Kudu	√	

¹SARDB (2004)

²IUCN (2004)

Source for literature review: De Graaff (1981), Griffin (2005), Estes (1995), Joubert & Mostert (1975), Skinner & Smithers (1990) & 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*. The overall mammal diversity in the general area through which the proposed transmission line(s) would pass is estimated at between 31-75 species with 3-8 species being endemic to the area (Mendelsohn *et al.* 2002).

According to the literature at least 73 species of mammals are expected to occur in the general area of which 12 species (16%) are classified as endemic, 10 species as near threatened, and 4 species as vulnerable. Two species are viewed as potentially invasive alien species to the area - House Mouse (*Mus musculus*) and House Rat (*Rattus rattus*). Mammal species probably underrepresented in the above mentioned table for the general area are bats and rodents, as these groups have not been well documented from the arid rocky western parts of Namibia. Other species such as Cheetah, Duiker, and Spotted Hyena may not necessarily occur in the area throughout the year, but may venture into the area from time-to-time depending on rainfall, prey, and disturbance elsewhere. Species such as Hedgehog, Pangolin, and Dik-Dik would also only be found on the eastern periphery (Omaruru) and not in the true Namib part of the habitat that the proposed transmission line(s) would pass through.

The general area – especially the mountainous western part – is understudied and under collected especially regarding the bat and rodent fauna. Overall terrestrial diversity – all species – is classified as “low to medium” in the central-western parts of Namibia (Mendelsohn *et al.* 2002). The overall diversity (1-4 species) and abundance of large herbivorous mammals is “low to average” in the general area with Springbok and Oryx having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall abundance and diversity of large carnivorous mammals is relatively high (4 species) in the general area with Brown Hyena and Leopard having the highest density of the larger species (Mendelsohn *et al.* 2002). At least 30%, 23% and 19% of the mammalian fauna that occur or are expected to occur in the general area are represented by rodents (22 species), carnivores (17 species), and bats (13 species). Important habitats often not realised and/or neglected include mountains and hills (including inselbergs) as well as ephemeral rivers and drainage lines and their associated vegetation. Habitat alteration and

overutilization are the two primary processes threatening most mammals (Griffin 1998c).

1.3.4 Important Species

Reptiles

The high percentage of endemic reptile species (41%) associated with the rocky escarpment region of central western Namibia underscores the importance of this area without formal state protection (Namib Naukluft Park excluded). Reptile species of concern are the various endemic geckos (e.g. *Pachydactylus* species) and lizards associated with rocky substrates and of which very little is known about their ecological role and actual status in Namibia. The endemic Husab Sand Lizard (*Pedioplanis husabensis*) is a unique species to the region as its distribution is limited to the area between the Khan and Kuiseb Rivers. It is associated with gravel plains, but is however quite common in suitable habitat.

Snakes are often killed outright due to the "fear factor" associated with all snakes as well as local beliefs and negative folklore. The most problematic snake species is probably the endemic Anchieta's Dwarf Python. Indiscriminate killing of snakes does not bode well for rare and endemic snake species. Tortoises consumed as food has resulted in them often becoming locally extinct. Tortoises are viewed as the reptile family of greatest concern (Griffin 1998a) and the collection and eating of tortoises are of grave concern.

Afroedura africana africana (100% endemic), *Pedioplanis husabensis* (100% endemic), and *Rhoptropus bradfieldi* (100% endemic) are viewed as the most important species due to their restricted range in Namibia.

Afroedura africana africana is restricted to exfoliating granite outcrops in the Omaruru/Karibib areas and the placement of pylons on or in close proximity to such areas should be avoided especially along the first section of the transmission line.

Pedioplanis husabensis is restricted to the Central Namib Desert, between Rössing Mine and the Swakop River on stony substrates (Griffin 2003). Cunningham (2007) noted that they prefer gravel plains (67% of observations) to any other habitat. In suitable habitat they are often encountered (i.e. relatively common) although often overlooked unless fleeing at pace on approach due to their camouflage and habit of slowly moving throughout their area hunting prey.

Rhoptropus bradfieldi is restricted to the coastal and pro-Namib Desert from the Kuiseb River to the Ugab River to rocky outcrops (boulders – i.e. rupicolous behaviour) (Griffin 2003). Cunningham (2007) noted that they prefer boulder

outcrops (100% of observations) to any other habitat. In suitable habitat they are often encountered (i.e. relatively common) although often overlooked due to their camouflage and habit of motionlessly awaiting prey.

Other species known from the area and deemed important as they are all viewed as 100% endemic (or close thereto) to Namibia although not as restricted as the above mentioned three species (Griffin 2003) include:

2 Skinks

* *Typhlosaurus braini*

* *Typhlacontias brevipes*

10 Geckos

* *Afroedura africana africana*

* *Chondrodactylus angulifer namibensis*

* *Narudasia festiva*

* *Pachydactylus bicolor*

* *Pachydactylus kockii*

* *Pachydactylus weberi weneri*

* *Pachydactylus scherzi*

* *Ptenopus kochi*

* *Ptenopus carpi*

* *Rhoptropus bradfieldi*

4 Lizards

* *Meroles micropholidotus*

* *Pedioplanis breviceps*

* *Pedioplanis gaerdesi*

* *Cordylus jordani*

1 Agama

* *Agama planiceps*

1 Worm snake

* *Leptotyphlops labialis*

2 Snakes

* *Lycophidion namibianum*

* *Telescopus* sp. nov.

Of these the most restricted range species is *Pachydactylus kockii* with an expected distribution between the Hoanib River and the Kuiseb River (Griffin 2003). The other species listed above have wider ranges. The species probably least known and unstudied include the *Telescopus* sp. nov. (Damara Tiger Snake) not yet even properly classified. Snakes face direct persecution by humans throughout Namibia due to being perceived as dangerous. An increase in human activity in the general area does not bode well for this species should it occur here unless a strategy of no killing of any snake is encouraged during the construction and maintenance phases.

Other species of importance (endemics):

- * *Leptotyphlops occidentalis* – 95% of the proportion of the range falls within Namibia although it is widespread throughout the western parts (excluding far western arid desert) from south-eastern Karasburg to north-eastern Kaokoveld (Griffin 2003).
- * *Python anchietae* - 75% of the proportion of the range falls within Namibia although it is widespread throughout the western parts from about 25° south to the Kunene River in the north (Griffin 2003).
- * *Dipsina multimaculata* - 75% of the proportion of the range falls within Namibia although it is widespread throughout the western parts of Namibia (Griffin 2003).
- * *Naya nigricollis nigricincta* - 80% of the proportion of the range falls within Namibia although it is widespread throughout the western parts of Namibia (Griffin 2003).
- * *Meroles cuneirostris* - 95% of the proportion of the range falls within Namibia although it is widespread throughout the central and southern Namib Desert in sandy areas from Swakopmund to the Orange River (Griffin 2003).

- * *Meroles suborbitalis* - 65% of the proportion of the range falls within Namibia although it is widespread throughout the western parts of Namibia (Griffin 2003).
- * *Pedioplanis inornata* - 95% of the proportion of the range falls within Namibia although it is widespread from the Erongo Mountains southwards (Griffin 2003).
- * *Lygodactylus bradfieldi* - 75% of the proportion of the range falls within Namibia although it is widespread throughout Namibia (Griffin 2003).
- * *Pachydactylus turneri laevigatus* [subspecies of nominate taxon] - 95% of the proportion of the range falls within Namibia although it is widespread throughout the western parts (Griffin 2003).
- * *Pachydactylus rugosus* - 85% of the proportion of the range falls within Namibia although it is widespread throughout the western parts (Griffin 2003).
- * *Pachydactylus weberi* - a very complex species with potentially many subspecies occurring throughout Namibia although much work still has to be conducted on this group of geckos.
- * *Pachydactylus rugosus* - 85% of the proportion of the range falls within Namibia although it is widespread throughout the western parts (Griffin 2003).
- * *Ptenopus garrulous maculatus* [subspecies of nominate taxon] - 70% of the proportion of the range falls within Namibia although it is widespread throughout the western and southern parts (Griffin 2003).

The high percentage of endemic reptile species known and/or expected to occur in the general area underscores the importance of this area for reptiles. The seemingly barren gravel plains in the general area are host to a variety of reptile fauna not often expected and/or acknowledged. Development and recreation often affect these species negatively.

Amphibians

Of the nine species of amphibians that potentially could occur in the general area, 3 species (i.e. 33%) are classified as endemic to Namibia. With the exception of *Bufo hoeschi*, *Bufo dombensis* and *Phrynomantis annectens* and due to the fact that the rivers in the area are ephemeral and don't hold water for very long after showers (including man made farm dams), amphibians are not viewed as very important in the general area.

Mammals

Endemic mammals expected to occur in the general area make up a relatively large percentage (16%) of the mammals expected from the area. Mammal species of concern are most often predators e.g. Cheetah (*Acinonyx jubatus*) – classified internationally as Vulnerable (CITES Appendix 1) and the Dassie Rat and Mountain Ground Squirrel, both of which are endemic and classified as near threatened (SARDB 2004).

The Black Mongoose (*Galerella nigrata*) is probably the most important small carnivore species from the general area due to it being almost exclusively endemic to Namibia (Griffin 2005a). It is known from the Erongo Mountains and Spitskope areas and probably also occurs in the Khan River drainage line although this still has to be confirmed. The Black Mongoose is viewed as being 100% endemic to Namibia (Griffin 2003).

Other species of concern include the Pangolin which is classified as vulnerable (SARDB 2004) and listed as CITES Appendix II, Hedgehog – near threatened (SARDB 2004) and the various endemic bats. Pangolin and Hedgehog are however not common in the general area, finding the harsh environment rather marginal habitat.

Bats are unfortunately often viewed with undeserved revulsion and exterminated for such reasons. The most important bat species are *Cistugo seabrai* and *Laephotis namibensis*, both being endemic and also classified as vulnerable and/or endangered.

1.4 CONCLUSION

It is estimated that at least 81 species of reptile, 9 amphibian and 74 mammal species occur in the general/immediate proposed transmission line(s) area of which a large proportion are endemics. Endemics include at least 41% of the reptiles, 33% of the amphibians, and 16% of the mammals known, or estimated to occur in the general area. Although endemics are known to occur from the general area, it is currently not clear if any of these are associated with the proposed development areas. The relatively small areas envisaged for development – i.e. $\pm 20\text{m}^2$ per pylon – makes the effect on the faunal diversity negligible at each site. Access and maintenance routes would have the most impact on the surroundings although these would also be negligible if constructed properly, avoided sensitive habitats and track discipline (including no killing/poaching along these routes) is adhered to and/or enforced.

The reptile diversity is varied in the area with a high percentage of unique and/or endemic species (41%). Species such as the various endemic *Pachydactylus* geckos

and Anchieta's Dwarf Python, often associated with rocky substrates, are important in the general area.

Due to the lack of permanent surface water, amphibians are not well represented in the general area although will emerge after rains and be associated with rock pools and other temporary water bodies in the area – e.g. Bull, Rain and Sand Frogs. Important species are the three endemics – *Bufo hoeschi*, *Bufo dombensis* and *Phrynomantis annectens*.

Mammals, especially small mammals (bats and rodents) and carnivores are well represented in the area although only 16% is classified as endemic to Namibia. Due to the farmer persecution, fencing, and competition with domestic stock over years, very few larger mammal species, especially bigger carnivores, abound. Mountain zebra (endemic) are often also persecuted as “fence destroyers” in the mountainous areas of central western Namibia.

The western escarpment parts of Namibia are generally viewed as particularly important areas from a faunal perspective, with numerous endemic species. This signifies the ecological importance of the area. Deserts, and more specifically rocky areas, are viewed as marginal farming habitats, but extremely important from a biodiversity perspective.

All development have potential negative environmental consequences, but identifying the most important faunal species including high risk habitats beforehand, coupled with environmentally acceptable mitigating factors, lessens the overall impact of such development. The eventual actual development area and associated infrastructure (e.g. access route, etc.) would be relatively small and thus only have localised negative implications on the environmental and associated fauna. The overall impact on the local fauna (e.g. reptiles, amphibians & mammals) and associated habitat destruction would be relatively small. Good planning prior to development (including associated infrastructure development) and access route(s) development as well as adhering to proposed mitigation measures would minimise the overall effect on the local fauna along the proposed transmission line(s).

1.5 ENVISAGED IMPACTS

1.5.1 Introduction

All developments change or are destructive to the local fauna 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 development – i.e. development, once initiated, may have a different effect on the fauna as originally predicted. Thus continuing monitoring of such impacts during the development phase(s) is imperative.

1.5.2 Faunal destruction

Faunal destruction is difficult to predict as the development associated with the transmission line(s) would be localised i.e. specific to each site (depending on the placement of the individual pylons) and depend on the access and maintenance routes. The following table indicates the potential/envisaged impacts expected regarding faunal destruction (which is obviously closely linked to habitat destruction):

Description	Faunal destruction will vary depending on the scale/intensity of the development operation and associated and inevitable infrastructure.
Extent	<ol style="list-style-type: none"> 1. Access routes - Localised disruption/destruction of the habitat and thus consequently fauna associated directly with the actual routes. This however, would be a relatively small area with localised implications. 2. Pylon sites - Localised disruption/destruction of the habitat and thus consequently fauna associated directly with the actual sites. This however, would be a relatively small area with localised implications.
Duration	<ol style="list-style-type: none"> 1. Access routes - The duration of the impact is expected to be permanent along the routes. This however, would be a relatively small area with localised implications. 2. Pylon sites - The duration of the impact is expected to be temporary at each site. This however, would be a relatively small area with localised implications.
Intensity	<ol style="list-style-type: none"> 1. Access routes - The actual construction of the routes would be permanently altered. This however, would be a relatively small area with localised implications. 2. Pylon sites - The actual pylon construction sites would be temporarily altered. This however, would be a relatively small area with localised implications. <p>The adjacent sites associated with the routes and pylon sites and other associated infrastructure would not be affected. This however, would depend on control over the contractors during the construction phase, but should be limited to localised implications.</p> <p>Areas not directly affected by the route and pylon construction and associated infrastructure although within the immediate area would be affected minimally. This would include dust, noise & other associated disturbances in the area, but be limited to the construction period.</p>

Mitigation

1. Limit the development and avoid rocky outcrops, especially granite domes, throughout the entire area.
2. Avoid development & associated infrastructure in sensitive areas – e.g. in/close to drainage lines, cliffs, boulder and rocky outcrops in the area, etc. This would minimise the negative effect on the local environment especially unique features serving as habitat to various species.
3. Avoid placing access routes (roads & tracks) through sensitive areas – e.g. over rocky outcrops/ridges and along drainage lines. This would minimise the effect on localised potentially sensitive habitats in the area.
4. Avoid driving randomly through the area (i.e. “track discipline”), but rather stick to permanently placed roads/tracks – especially during the construction phase. This would minimise the effect on localised potentially sensitive habitats in the area.
5. Stick to speed limits of maximum 30km/h as this would result in fewer faunal road mortalities. Speed humps could also be used to ensure the speed limit.
6. Remove (e.g. capture) unique fauna and sensitive fauna before commencing with the development activities and relocate to a less sensitive/disturbed site if possible.
7. Prevent and discourage the setting of snares (poaching), illegal collecting of veld foods (e.g. mushrooms, etc.), indiscriminate killing of perceived dangerous species (e.g. snakes, scorpions, etc.) and collecting of wood as this would diminish and negatively affect the local fauna – especially during the development phase(s).
8. Attempt to avoid the removal of bigger trees during the development phase(s) – especially with the development of access routes – as these serve as habitat for a myriad of fauna.
9. Prevent and discourage fires – especially during the development phase(s) – as this could easily cause runaway veld fires affecting the local fauna, but also causing problems (e.g. loss of grazing & domestic stock mortalities, etc.) for the neighbouring farmers.
10. Rehabilitation of the disturbed areas – i.e. initial development access route “scars” and associated tracks as well as temporary accommodation sites. Preferably workers should be transported in/out to the construction sites on a daily basis to avoid excess damage to the local environment (e.g. fires, wood collection, poaching, etc.). Such rehabilitation would not only confirm the company’s environmental integrity, but also show true local commitment to the environment.
11. Implement erosion control. The area(s) towards & adjacent the drainage line(s) are easily eroded and further development may exacerbate this problem. Avoid construction within 20m of the main drainage line(s) to minimise erosion problems as well as preserving the riparian associated fauna.

Vertebrate Fauna - Cunningham

	<p>12. Conduct a thorough investigation on the fauna associated with the proposed development site(s).</p> <p>13. Prevent the number of domestic pets – e.g. cats & dogs – accompanying the workers during the construction phase as cats decimate the local fauna and interbreed & transmit diseases to the indigenous African Wildcat found in the area. Dogs often cause problems when bonding on hunting expeditions thus negatively affecting the local fauna. The indiscriminate and wanton killing of the local fauna by such pets should be avoided at all costs.</p> <p>14. Avoid “overnighting” at the construction sites during the construction phase as this could lead to problems such as the killing/poaching/collection of local fauna.</p>
Frequency of occurrence	<p>Expected to be a “once off” issue affecting the selected access routes and specific pylon sites.</p> <p>Maintenance visits along the access routes could result in issues such as killing/poaching/collection of local fauna and/or fires. These are however conducted infrequently and could be controlled.</p>
Probability	<p>Definite (100%) negative impact on fauna is expected in the actual access route construction sites. This however, would be much localised and cover only a small area and avoid sensitive areas.</p> <p>Highly Probable (75%) negative impact on fauna is expected in the general areas especially during the construction phase(s) as a result of noise, increased activities, etc.</p> <p>Probable (50%) negative impact on fauna is expected from the infrastructure (roads/tracks). Precautionary principle (e.g. avoid unique habitat features as well as adhering to the proposed mitigating measures would minimise this) would decrease the significance of these potential impacts.</p>
Significance	<p>Before mitigation: High</p> <p>After mitigation: Medium to Low</p>
Status of the impact	<p>Negative</p> <p>Localised unique habitats (e.g. rocky outcrops, drainage lines & ridges, etc.) with associated fauna would bear the brunt of this proposed development, but be limited in extent and only permanent along the access routes.</p>
Legal requirements	<p>N/A</p>

Vertebrate Fauna - Cunningham

Degree of confidence in predictions	As an ecologist I am sure of the above mentioned predictions made and would suggest that the mitigation measures be implemented to minimise potentially negative aspects regarding the local fauna in the area.
--	---

2. SENSITIVE HABITATS WITH UNIQUE FAUNA

2.1 GRANITE DOMES

Granite domes, especially in the Omaruru to Usakos area should be avoided as these are viewed as sites of special ecological importance with unique fauna (e.g. Black Mongoose & African Flat Gecko).

2.2 ESCARPMENT AND INSELBERGS

The western or Namib escarpment areas are sensitive and are areas with high endemism (e.g. Anchietae's Dwarf Python).

2.3 NAMIB GRAVEL PLAINS

Although often viewed as barren plains devoid of any life these seemingly empty plains are sensitive to off-road driving, including any construction rich in biotic diversity and faunal endemism (e.g. Husab Sand Lizard).

2.4 DRAINAGE LINES

Ephemeral drainage lines are associated with water retention and consequently unique flora and related fauna with habitat (cliffs, boulders, etc.) suitable to a variety of faunal species (e.g. Dassie Rat).

3. ACCESS ROUTE SELECTION

3.1 OMBURU TO KHAN

The first part of the proposed transmission line follows the existing transmission line and should thus have a negligible "new" impact on the fauna along the route.

Sensitive areas along this route that should be avoided – i.e. no/limited development to be conducted - would include the following:

- * Granite outcrops/inselbergs

Species of concern expected on these granite outcrops would include the following:

Reptiles

- * African Flat Gecko
- * Jordan's Girdled Lizard
- * Various Thick-toed Gecko species
- * Anchietae's Dwarf Python
- * Western-barred Spitting Cobra

Amphibians

- * Hoesch's Toad
- * Marbled Rubber Frog

(In temporary pools often associated with such granite outcrops)

Mammals

- * Black Mongoose
- * Hedgehog
- * Pangolin
- * Dassie Rat

- * Pygmy Rock Mouse

3.2 KHAN TO VALENCIA SUBSTATION

The proposed Valencia Substation would be in close proximity to the Valencia Uranium Mine. The Khan to Valencia Substation transmission line route has 4 proposed routes – east (KVA2), central east (KV), central west (KVA) & west (KVM) – all of which have to cross the Khan River.

Sensitive areas along this route that should be avoided – i.e. no/limited development to be conducted - would include the following:

- * Rocky ridges/outcrops/inselbergs
- * Khan River crossing & associated drainage lines

Species of concern expected would include the following:

Reptiles

- * Jordan's Girdled Lizard
- * Various Thick-toed Gecko species
- * Anchietae's Dwarf Python
- * Namibian Wolf Snake
- * Dwarf Beaked Snake
- * Western-barred Spitting Cobra

Amphibians

Probably the same toad species as for the Omburu to Khan section although this area is usually poorly represented by amphibians due to a lack of standing water although could be associated with the Khan River and associated drainage lines including temporary pools after localised rain showers or after the occasional flooding of the Khan River.

Mammals

- * Black Mongoose
- * Dassie Rat

- * Pygmy Rock Mouse
- * Mountain Ground Squirrel

The following alternative routes – various Khan River crossing sites – would have similar species of concern as for the above mentioned Khan to Valencia Substation route:

1. East (KVA2)

This proposed transmission line route is ranked **2nd** on “least” potential negative implications and overall effect on unique habitats such as drainage lines, rocky outcrops, cliffs, etc. and the associated fauna.

2. Central East (KV)

This proposed transmission line route is ranked **1st** on “least” potential negative implications and overall effect on unique habitats such as drainage lines, rocky outcrops, cliffs, etc. and the associated fauna. From a vertebrate faunal perspective this route would potentially have the least negative effect.

3. Central West (KVA)

This proposed transmission line route is ranked **5th** on “least” potential negative implications and overall effect on unique habitats such as drainage lines, rocky outcrops, cliffs, etc. and the associated fauna.

4. West (KVM)

This proposed transmission line route is ranked **6th** on “least” potential negative implications and overall effect on unique habitats such as drainage lines, rocky outcrops, cliffs, etc. and the associated fauna.

5. West (001-025)

This proposed transmission line route is ranked **4th** on “least” potential negative implications and overall effect on unique habitats such as drainage lines, rocky outcrops, cliffs, etc. and the associated fauna.

6. Far West (Vergenoeg Farm area)

This proposed transmission line route is ranked **3rd** on “least” potential negative implications and overall effect on unique habitats such as drainage lines, rocky outcrops, cliffs, etc. and the associated fauna.

[The Khan River crossing sites with the least expected impact on the vertebrate fauna are the Transmission Lines ranked 1-3 – See above. Although all the Khan River crossings are problematic it is expected that the above mentioned 3 sites would be the most acceptable from an environmental point of view]

3.3 VALENCIA SUBSTATION TO HUSAB SUBSTATION

This part of the proposed transmission line passes mainly over gravel plains and avoids any significant drainage lines and mountains and ridges. The Husab Mountain and other outcrops and ridges should be avoided for least negative effect on local fauna.

Sensitive areas along this route that should be avoided – i.e. no/limited development to be conducted - would include the following:

- * Rocky ridges/outcrops/inselbergs
- * Husab Mountains

Species of concern expected would include the following:

Reptiles

- * Husab Sand Lizard
- * Short-head Sand Lizard
- * Plain Sand Lizard
- * Various Thick-toed Gecko species
- * Delalande's Beaked Blind Snake (Known from the Rossing Mining Area – Griffin 2003)
- * Namibian Wolf Snake
- * Dwarf Beaked Snake

Amphibians

Not many amphibians expected in this extremely dry and marginal area.

Mammals

- * Dassie Rat

- * Pygmy Rock Mouse
- * Mountain Ground Squirrel

3.4 HUSAB SUBSTATION TO KUISEB SUBSTATION

This part of the proposed transmission line passes mainly over gravel plains and avoids any significant drainage lines and mountains and ridges.

Sensitive areas along this route that should be avoided – i.e. no/limited development to be conducted - would include the following:

- * Rocky ridges/outcrops/inselbergs

Species of concern expected would include the following:

Reptiles

- * Various Thick-toed Gecko species
- * Various *Meroles* Lizard species (e.g. Wedge-snouted, Small Scaled & Spotted)
- * Short-head Sand Lizard
- * Plain Sand Lizard
- * Husab Sand Lizard

Amphibians

Not many amphibians expected in this extremely dry and marginal area.

Mammals

- * Dassie Rat
- * Pygmy Rock Mouse
- * Hairy-footed Gerbil
- * Setzer's Hairy-footed Gerbil
- * Mountain Ground Squirrel

4. REFERENCES

- Barnard, P. 1998.** *Underprotected habitats.* In: Barnard, P. (ed.). *Biological diversity in Namibia: a country study.* Windhoek: Namibian National Biodiversity Task Force.
- Bonin, F., Devaux, B. & Dupré, A. 2006.** *Turtles of the World.* Johns Hopkins University Press, Baltimore, USA.
- Boycott, R. C. & Bourquin, O. 2000.** *The Southern African Tortoise Book.* O Bourquin, Hilton, RSA.
- 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.
- Broadley, D.G. 1983.** *Fitzsimons' Snakes of southern Africa.* Jonathan Ball & AD. Donker Publishers, Parklands, RSA.
- Buys, P.J. & 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. & Griffin, M. 1993.** *An annotated checklist of the frogs of Namibia.* *Madoqua* 18(2): 101-116.
- Channing, A. 2001.** *Amphibians of Central and Southern Africa.* Protea Bookhouse, Pretoria, RSA.
- Cunningham, P.L. 2006a.** *A Guide to the Tortoises of Namibia.* Polytechnic of Namibia, Windhoek, 19pp.
- Cunningham, P.L. 2006b.** *Vertebrate fauna of the Trekkopje area: Reptiles, Amphibians, Mammals & Birds.* Unpublished Report, Enviro Dynamics Environmental Management Consultants, Windhoek.
- Cunningham, P.L. 2007.** *Reptiles associated with the Valencia Uranium Mine area.* Unpublished Report, Digby Wells & Associates, Randburg, RSA.

Curtis, B. & Barnard, P. 1998. *Sites and species of ecological, economic and archaeological importance.* In: Barnard, P. (ed.). *Biological diversity in Namibia: a country study.* Windhoek: Namibian National Biodiversity Task Force.

De Graaff, G. 1981. *The rodents of southern Africa.* Buterworths, 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. 2005a. *Annotated checklist and provisional national conservation status of Namibian mammals.* Ministry of Environment and Tourism, Windhoek.

Griffin, M. 2005b. *Annotated checklist and provisional national conservation status of amphibians, reptiles & mammals known, reported or expected to occur in the Valencia Uranium Mine area.* Unpublished Report, Westport Resources, Windhoek.

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

Henschel, J., Pallet, J., Parenzee, L., Makuti, O., Mutaleni, V. Seely, M. 2000. *Fauna and Flora of Gobabeb with a description of the long term trapping project.* Unpublished Report, Desert Research Foundation of Namibia.

IUCN, 2004. IUCN, Gland, Switzerland. In: Griffin, M. 2005. *Annotated checklist and provisional national conservation status of Namibian mammals.* Ministry of Environment and Tourism, Windhoek.

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

Kavari, R. 2007. *A comparison of lizard diversity between disturbed and undisturbed areas within the gravel plains at Gobabeb. Unpublished Report, Department of Nature Conservation, Polytechnic of Namibia.*

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

NACSO, 2006. *Namibia's communal conservancies: a review of progress and challenges in 2005. NACSO, Windhoek.*

Passmore, N.I. & Carruthers, V.C. 1995. *South African Frogs - A complete guide. Southern Book Publishers, Witwatersrand University Press, Johannesburg, RSA.*

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.*

Simmons, R. E. 1998b. *Areas of high species endemism. In: Barnard, P. (ed.). Biological diversity in Namibia: a country study. Windhoek: Namibian National Biodiversity Task Force.*

Skinner, J.D. & Smithers, R.H.N. 1990. *The mammals of the southern African subregion. University of Pretoria, RSA.*

Taylor, P.J. 2000. *Bats of southern Africa. University of Natal Press, RSA.*

Van der Merwe, J.H. 1983. *National Atlas of South West Africa (Namibia). National Book Printers, Cape Town, South Africa.*