

REPTILE & SMALL MAMMAL FAUNA ASSOCIATED WITH THE SENDELINGSDRIF MINING AREA

SPECIALIST CONTRIBUTION:

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SUMMARY

A desktop study to determine the reptile and small mammal fauna expected to occur in the general Sendelingsdrif area was conducted between 13 and 16 April 2010 while fieldwork to determine actual species presence was conducted between 22 and 27 April 2010. The fieldwork included diurnal and nocturnal transects throughout the affected area to determine reptile diversity and trapping lines using collapsible live traps to determine small mammal presence.

The general Sendelingsdrif area, is regarded as “relatively low” in overall (all terrestrial species) diversity while the overall terrestrial endemism is “average” with at least 64 reptile (58% endemic) and 55 mammal (33% endemic) species known to or expected to occur in the general/immediate Sendelingsdrif area of which a high proportion are endemics.

The fieldwork resulted in 15 reptile species confirmed from the affected area of which 6 species are classified as endemic and 1 species as vulnerable/protected game. Geckos have the highest occurrence of endemics (87%) of all the reptiles in this area with the little known *Goggia gemmula* viewed as the most important species. *Varanus niloticus* is classified as “vulnerable” and “protected game” in Namibia and together with the tortoises – *Homopus solus*, *Psammobates tentorius trimeni* & *Psammobates tentorius verroxii* – and some of the snakes – *Rhinotyphlops schinzi*, *Leptotyphlops occidentalis*, *Naya nigricollis woodi* & *Bitis xeropaga* – viewed as the most important species from the area.

Fieldwork resulted in 14 mammal species confirmed from the affected area, none of which are classified as endemic although 5 species are classified as vulnerable and 3 species as protected game. The mammal species of greatest concern include *Cistugo seabrai*, *Petromys typicus* and *Parotomys littledalei namibensis* (all endemics); *Felis nigripes* and *Aonyx capensis* (carnivores) and *Equus zebra hartmannae* (ungulate).

Recommendations to minimise the effect of the proposed development on the reptile and small mammal fauna include the collection and removal of high value species prior to the development; a “no kill” policy of all perceived dangerous species; serendipitous removal of individuals during the development phase, overall track discipline; rehabilitation of the affected environments and monitoring to confirm re-colonisation after rehabilitation.

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1 Introduction

A desktop study (i.e. literature review) was conducted between 13 April and 16 April 2010 on the reptile and small mammal fauna expected to occur in the general Sendelingsdrif area in Southern Namibia. This was followed by onsite fieldwork to determine actual species presence between 22 April and 27 April 2010. This area falls within the Skeleton Coast National Park on the northern border of the Orange River in the vicinity of the old Sendelingsdrif police station.

This literature review was to determine the actual as well as potential reptile and small mammal fauna associated with the general area commonly referred to as the Desert and Succulent Steppe (Giess 1971) or the Succulent Karoo – Succulent Steppe (Mendelsohn *et al.* 2002). The Succulent Karoo has been identified as one of 25 'biodiversity hotspots' in the world and of extreme high conservation value (Burke 2003). The lower Orange River – mainly the river mouth area – has also been identified as a site of special ecological importance in Namibia (Curtis & Barnard 1998). The Namib – of which the Desert and Succulent Steppe forms part of – is relatively well represented in the protected area network in Namibia covering 32% of the land area and 29.7% of the biome (Barnard 1998).

The general Sendelingsdrif area is regarded as "relatively low" in overall (all terrestrial species) diversity (Mendelsohn *et al.* 2002). Overall terrestrial endemism in the area on the other hand is "average" (Mendelsohn *et al.* 2002). The overall reptile diversity and endemism in the Sendelingsdrif area is estimated at between 61-70 species and 13-16 species, respectively (Mendelsohn *et al.* 2002). Griffin (1998a) presents figures of between 21-30 and 5-6 for endemic lizards and snakes, respectively, from the general area.

It is estimated that at least 64 reptile and 55 mammal species are known to or expected to occur in the general/immediate Sendelingsdrif area of which a high proportion are endemics.

2 Methods

2.1 Literature review

A comprehensive and intensive literature review (i.e. desktop study) regarding the reptiles and small mammals that could potentially occur in the general/immediate Sendelingsdrif area was conducted using as many references as manageable. A list of the references consulted can be viewed in the Reference section (Page 26).

2.2 Fieldwork

Reptiles:

- Transects, along which reptiles were searched for, were conducted during daylight hours as well as at night using a gas lantern to determine diurnal and nocturnal species. The area was traversed, with likely reptile spots (i.e. potential habitat – e.g. loose rocks/boulders, rocky outcrops, dead branches/logs, human litter, etc.) being investigated.
- Reptiles encountered were caught using active capture techniques (e.g. 'reptile noosing') and identified *in situ*, photographed, measured (when applicable to facilitate identification) and released unharmed at the site of capture.

- Transect lengths and directions varied depending on terrain and perceived habitats.
- Transects were conducted in various habitats to cover the wide spectrum of habitats in the general area.

Mammals:

- Transects, along which mammals were to be caught using collapsible aluminium Sherman small mammal traps baited with peanut butter and oats, were followed with traps set just prior to sunset.
- Small mammals caught were to be identified *in situ*, photographed, measured (when applicable to facilitate identification) and released unharmed at the site of capture.
- Transect lengths and directions varied depending on terrain and perceived habitats.
- Transects were conducted in various habitats to cover the wide spectrum of habitats in the general area.
- 20 Sherman traps were set each evening over a period of 4 nights (23 to 26 April 2010) resulting in a potential maximum of 80 captures.

3 Results

3.1 Reptile Diversity

The following table – Table 1 – indicates the reptile diversity known and/or expected to occur as well as reptiles actually encountered during the fieldwork between 22 and 27 April 2020 or confirmed (#¹ Trygve Cooper – Ministry of Environment & Tourism & #² Colleen Mannheimer – photographic evidence during previous site visit) in the general Sendelingsdrif area:

Table 1. Reptile diversity expected and confirmed from the Sendelingsdrif area.

Species: Scientific name	Species: Common name	Observed & Confirmed during fieldwork	Namibian conservation & legal status	International status
TURTLES & TERRAPINS				
<i>Homopus solus</i>	Nama Padloper		Endemic: Intermediate	CITES - Appendix II IUCN - Vulnerable
<i>Chersina angulata</i>	Angulate Tortoise	# ¹	Peripheral	CITES - Appendix II
<i>Psammobates tentorius trimeni</i>	Namaqualand Tent Tortoise		Vulnerable	CITES - Appendix II
<i>Psammobates tentorius verroxii</i>	Bushmanland Tent Tortoise		Vulnerable	CITES - Appendix II
SNAKES				
Blind Snakes				
<i>Rhinotyphlops schinzi</i>	Schinz's Beaked Blind Snake		Endemic; Secure	SARDB Peripheral
Thread Snakes				
<i>Leptotyphlops occidentalis</i>	Western Thread Snake		Endemic; Secure	SARDB Peripheral
Typical Snakes				
<i>Lamprophis fuliginosus</i>	Brown House Snake		Secure	

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Species: Scientific name	Species: Common name	Observed & Confirmed during fieldwork	Namibian conservation & legal status	International status
<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	SARDB Peripheral
<i>Dipsina multimaculata</i>	Dwarf Beaked Snake		Endemic; Secure	
<i>Psammophis trigrammus</i>	Western Sand Snake		Endemic; Secure	
<i>Psammophis notostictus</i>	Karoo Sand Snake		Secure	
<i>Psammophis leightoni namibensis</i>	Namib Sand Snake		Secure	
<i>Dasypeltis scabra</i>	Common/Rhombic Egg Eater		Secure	
<i>Telescopus semiannulatus polystrictus</i>	Eastern Tiger Snake		Secure	
<i>Telescopus beetzii</i>	Beetz's Tiger Snake		Endemic; Secure	
<i>Aspidelaps lubricus lubricus</i>	Coral Snake		Secure	
<i>Naya nivea</i>	Cape Cobra	# ¹	Endemic; Secure	
<i>Naya nigricollis woodi</i>	Black-necked Spitting Cobra	# ¹	Endemic; Secure	SARDB Rare
<i>Bitis arietans</i>	Puff Adder	# ¹	Secure	
<i>Bitis caudalis</i>	Horned Adder	√	Secure	
<i>Bitis cornuta</i>	Many-horned Adder		Secure	
<i>Bitis xeropaga</i>	Desert Mountain Adder	# ²	Endemic; Insufficiently known	SARDB Peripheral
LIZARDS				
Skinks				
<i>Acontias lineatus lineatus</i>	Striped Legless Skink		Secure	
<i>Typhlosaurus meyeri</i>	Meyers's Blind Legless Skink		Endemic; Secure	
<i>Scelotus capensis</i>	Western Dwarf Burrowing Skink		Endemic; Secure	
<i>Trachylepis (Mabuya) capensis</i>	Cape Skink		Secure	
<i>Trachylepis (Mabuya) occidentalis</i>	Western Three- striped Skink	√	Secure	
<i>Trachylepis (Mabuya) spilogaster</i>	Kalahari Tree Skink		Endemic; Secure	
<i>Trachylepis (Mabuya) sulcata</i>	Western Rock Skink	√	Secure	

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Species: Scientific name	Species: Common name	Observed & Confirmed during fieldwork	Namibian conservation & legal status	International status
<i>Trachylepis (Mabuya) variegata variegata</i>	Variegated Skink		Secure	
Old World Lizards				
<i>Meroles ctenodactylus</i>	Smith's Desert Lizard		Endemic; Secure	
<i>Meroles cuneirostris</i>	Wedge-snouted Desert Lizard		Endemic; Secure	
<i>Meroles knoxii</i>	Knox's Desert Lizard		Endemic; Secure	
<i>Meroles suborbitalis</i>	Spotted Desert Lizard		Endemic; Secure	
<i>Nucras tessellata</i>	Western Sandveld Lizard		Endemic; Secure	
<i>Pedioplanis lineoocellata pulchella</i>	Spotted Sand Lizard		Endemic; Secure	
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard	√	Secure	
<i>Pedioplanis inornata</i>	Plain Sand Lizard		Endemic; Secure	
Plated Lizards				
<i>Cordylosaurus subtessellatus</i>	Dwarf Plated Lizard		Endemic; Secure	
Girdled Lizards				
<i>Cordylus polyzonus</i>	Karoo Girdled Lizard		Secure	CITES - Appendix II
Flat Lizards				
<i>Platysaurus capensis</i>	Cape Flat Lizard		Endemic; Secure	
Monitors				
<i>Varanus niloticus</i>	Nile or Water Monitor	√	Vulnerable; Peripheral; Protected game	CITES Appendix II Safe to Vulnerable
Agama				
<i>Agama aculeata</i>	Ground Agama		Secure	
<i>Agama anchietae</i>	Anchietae's Agama		Secure	
<i>Agama atra knobelli</i>	Southern Rock Agama	# ¹	Endemic; Secure	
<i>Agama hispida</i>	Southern Spiny Agama		Endemic; Secure	
Chameleons				
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon	# ¹	Secure	CITES Appendix II
Geckos				
<i>Chondrodactylus angulifer angulifer</i>	Giant Ground Gecko		Endemic; Secure	
<i>Goggia gemmula</i>	Richtersveld Dwarf		Insufficiently	

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Species: Scientific name	Species: Common name	Observed & Confirmed during fieldwork	Namibian conservation & legal status	International status
	Leaf-toed Gecko		known; Rare Endemic	
<i>Goggia lineata</i>	Striped Dwarf Leaf-toed Gecko		Endemic; Secure	
<i>Lygodactylus bradfieldi</i>	Bradfield's Dwarf Gecko		Endemic; Secure	
<i>Narudasia festiva</i>	Festive Gecko		Endemic; Secure	
<i>Pachydactylus bibronii</i>	Bibron's Thick-toed Gecko	√	Endemic; Secure	
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko		Secure	
<i>Pachydactylus namaquensis</i>	Namaqua Thick-toed Gecko		Endemic; Secure	
<i>Pachydactylus haackei</i>	Haacke's Thick-toed Gecko		Endemic; Secure	
<i>Pachydactylus punctatus</i>	Speckled Thick-toed Gecko	√	Secure	
<i>Pachydactylus rugosus rugosus</i>	Rough Thick-toed Gecko		Endemic; Secure	
<i>Pachydactylus serval onsepeensis</i>	Western Spotted Thick-toed Gecko		Endemic; Secure	
<i>Pachydactylus weberi weneri</i>	Weber's Thick-toed Gecko		Endemic; Secure	
<i>Palmatogeecko rangei</i>	Wed-footed Gecko		Endemic; Secure	
<i>Ptenopus garrulus maculatus</i>	Common Barking Gecko	√	Endemic; Secure	

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

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

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).

At least 64 species of reptiles are expected to occur in the general Sendelingsdrif area with 37 species being endemic – i.e. 57.8% endemic. Three species expected to occur in the area (*Psammobates tentorius verroxii*, *P. t. trimeni* & *Varanus niloticus*) are classified as vulnerable, 2

species with a status of as insufficiently known (*Bitis xeropaga* & *Goggia gemmula*) of which *G. gemmula* is also viewed as rare. Seven species have an international conservation status and 5 species furthermore classified under the South African Red Data Base. The 64 species expected to occur in the general area consist of at least 20 snakes (1 Blind snake, 1 Thread snakes & 18 typical snakes) of which 9 species (45%) are endemic, 4 tortoises all with a conservation status, 19 lizards of which 12 species classified as endemic (63.2% endemic), 1 monitor, 4 agamas (2 endemic), 1 chameleon and 15 geckos of which 13 species classified as endemic (i.e. 86.6% endemic).

Lizards (19 species with 12 species being endemic), Gecko's (15 species with 13 species being endemic) and Tortoises (4 species all with a conservation status) are the most important groups of reptiles expected from the Sendelingsdrif area. Namibia with approximately 129 species of lizards (Lacertilia) has one of the continent's richest lizard fauna (Griffin 1998a).

Geckos expected and/or known to occur in the Sendelingsdrif area have the highest occurrence of endemics (87%) of all the reptiles in this area. Griffin (1998a) confirms the importance of the gecko fauna in Namibia.

The *Rhinotyphlops schinzi* (Schinz's Beaked Blind Snake), *Leptotyphlops occidentalis* (Western Thread Snake), *Naya nigricollis woodi* (Black Spitting Cobra) and *Bitis xeropaga* (Desert Mountain Adder) are the snakes viewed as the most important in the area.

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 Sendelingsdrif area than presented above.

3.1.1 Species Accounts

Reptiles encountered during a survey of the Sendelingsdrif area:

During the fieldwork, 15 species of reptiles were confirmed either through direct observations (8 species) or as confirmed sightings (T. Cooper pers. com.; C. Mannheimer pers.com.) at various locations in the Sendelingsdrif area. Some species, e.g., *Chersina angulata*, are more commonly encountered further westwards or inland (Obib Mountain area) or mainly associated with the riparian vegetation along the Orange River, e.g., *Bitis arietans* (T. Cooper pers. com.).

Of the 15 species confirmed from the Sendelingsdrif area, 6 species are classified as endemic and 1 species as vulnerable/protected game (Branch 1998, Griffin 2003).

These species are:

Vulnerable

- *Varanus niloticus*

Endemic

- *Naya nivea* (25% of taxon's range in Namibia)
- *Naya nigricollis woodi* (75% of taxon's range in Namibia)
- *Bitis xeropaga* (90% of taxon's range in Namibia)
- *Agama atra knobelli* (subspecies apparently 100% endemic)

- *Pachydactylus bibronii* (marginal range in Namibia)
- *Ptenopus garrulus maculates* (70% of subspecies range in Namibia)

The following tables indicate the species accounts, including additional information, as actually observed during the fieldwork at Sendelingsdrif.

Bitis caudalis

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
26/4/2010	N/A	Gravel terraces	Rocky Hill; <i>Euphorbia</i> dominated	Gravel & sand	Discarded skin	S28°09'46.6" E16°51'31.6"	56
26/4/2010	N/A	Gravel terraces	Sandy gully	Gravel & sand	Tracks	S28°09'54.6" E16°52'00.0"	77

Status:

Secure (Griffin 2003)

Distribution:

Throughout the western & central regions of Namibia excluding the sandy northeast (Branch 1998, Broadley 1983, Griffin 2003, Marais 1992)

Potential proportion of taxon's range:

± 30%; extralimital range to southern Angola, Botswana & South Africa (Griffin 2003)

Habitat:

Sandy mesic & xeric savannah (Branch 1998)

Diet:

Mainly small lizards, but also small mammals & amphibians (Branch 1998, Marais 1992)



Figure 1. *B. caudalis* skin remains after shedding.

Trachylepis (Mabuya) occidentalis

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
25/4/2010	16h00	Gravel terraces	Sandy drainage line	Sand	Specimen	S28°08'58.7" E16°52'37.9"	50

Status:

Secure (Griffin 2003)

Distribution:

Throughout the western, central & southern regions of Namibia excluding the sandy northeast (Alexander & Marais 2007, Branch 1998, Griffin 2003)

Potential proportion of taxon's range:

± 60%; extralimital range to Botswana & South Africa (Griffin 2003)

Habitat:

Arid savannah, karroid veld & desert (Branch 1998)

Diet:

Insects and other lizards (Alexander & Marais 2007)

Trachylepis (Mabuya) sulcata

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
24/4/2010	11h15	Gravel terraces	Exploration pit	Rocky boulders	Specimen	S28°09'20.3" E16°50'30.5"	49
24/4/2010	15h30	Hill	Quartz outcrop	Sandy & gravel	Specimen	S28°09'40.1" E16°52'28.0"	107
26/4/2010	13h30	Gravel terraces	Sandy gully	Sand	Specimen	S28°09'45.1" E16°51'34.9"	57

Status:

Secure (Griffin 2003)

Distribution:

Throughout the north western, western, central & southern regions of Namibia excluding the sandy northeast (Alexander & Marais 2007, Branch 1998, Griffin 2003)

Potential proportion of taxon's range:

± 60%; extralimital range to Angola & South Africa (Griffin 2003)

Habitat:

Arid savannah, karroid veld & desert (Branch 1998)

Diet:

Invertebrates and other lizards (Branch 1998, Alexander & Marais 2007)



Figure 2. *T. sulcata* specimen basking within grass tuft.

Pedioplanis namaquensis

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
24/4/2010	10h30	Gravel plain	Gravel plain	Gravel & sand	Specimen	S28°09'29.2" E16°50'33.6"	48

Status:

Secure (Griffin 2003)

Distribution:

Throughout the north western, western, central & southern regions of Namibia excluding the sandy northeast (Alexander & Marais 2007, Branch 1998, Griffin 2003)

Potential proportion of taxon's range:

± 30%; extralimital range to Botswana & South Africa (Griffin 2003)

Habitat:

Arid savannah, karroid veld & desert (Branch 1998)

Diet:

Invertebrates (Branch 1998)

Varanus niloticus

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
26/4/2010	09h30	Orange River	Riparian floodplain	Gravel & sand	Specimen & Tracks	S28°10'13.9" E16°51'34.7"	29

Status:

Vulnerable, peripheral, protected game (Griffin 2003)
CITES Appendix I, safe to vulnerable (IUCN 2004)

Distribution:

Along major rivers – Kunene, Okavango, Kwando, Zambezi & Orange – in Namibia (Alexander & Marais 2007, Branch 1998, Griffin 2003)

Potential proportion of taxon's range:

Marginal; extralimital range to all neighbouring countries (Griffin 2003)

Habitat:

Rivers, pans & major lakes (Branch 1998)

Diet:

Crabs, mussels, amphibians, fish, birds & eggs (Branch 1998)



Figure 3. Juvenile *V. niloticus* foraging along the water's edge.

Pachydactylus turneri laevigatus

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
24/4/2010	22h00	Orange River	Sendelings drif house	Artificial	Specimen	S28°10'10.8" E16°52'54.3"	53

Status:

Secure (Griffin 2003)

Distribution:

P. t. laevigatus occurs from the Kaokoveld south to central and southern Namibia (Griffin 2003)

Potential proportion of taxon's range:

Endemic ±95%; extralimital range of species to all neighbouring countries (Griffin 2003)

Habitat:

Semi-desert & arid savannah (Branch 1998)

Diet:

Probably the same as for *P. bibronii* with which it is often confused – i.e. arthropods & smaller lizards (Branch 1998)



Figure 4. *P. turneri* specimen caught in the old German police station at Sendelingsdrif.

Pachydactylus punctatus

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
24/4/2010	21h30	Rocky terrace	Rocky terrain	Rocky	Specimen	S28°09'42.8" E16°52'02.1"	91
25/04/2010	19h00	Rocky hills	Rocky terrain	Rocks & sand	Specimen	S28°09'34.2" E16°52'28.9"	106
26/04/2010	18h25	Rocky hills	Rocky terrain	Rocks & sand	Specimen	S28°08'57.4" E16°51'43.0"	97
26/04/2010	18h32	Gravel plains & <i>S. obtusa</i>	Gravel plains	Sand & gravel	Specimen	S28°08'56.7" E16°51'40.0"	96
26/04/2010	18h36	Rocky terrace	Sandy drainage line	Sand	Specimen	S28°08'58.6" E16°51'40.9"	94
26/04/2010	19h09	Rocky terrace	Rocky terrain	Rocks & sand	Specimen	S28°09'10.9" E16°51'33.2"	84

Status:

Secure (Griffin 2003)

Distribution:

Entire country except the Namib Desert and Kavango and Caprivi (Griffin 2003)

Potential proportion of taxon's range:

Marginal: extralimital range to south western Angola, Botswana and South Africa (Griffin 2003)

Habitat:

Varied – arid desert preferring dry savannah (Branch 1998)

Diet:

Small invertebrates (Branch 1998)



Figure 5. *P. punctatus* photographed the morning after capture.

Ptenopus garrulus maculatus

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
25/04/2010	18h15	Rocky terrace	Rocky terrain	Rocks & sand	Specimen	S28°10'19.1" E16°52'46.5"	57
25/04/2010	18h30	Rocky terrace	Rocky terrain	Rocks & sand	Specimen	S28°10'17.6" E16°52'42.1"	60
25/04/2010	19h40	Sandy gravel hills	Sandy terrain	Gravel & sand	Specimen	S28°09'35.1" E16°52'19.3"	89
25/04/2010	19h47	Sandy gravel hills	Sandy terrain	Gravel & sand	Specimen	S28°09'33.1" E16°52'24.4"	88
26/04/2010	18h12	Hills	Rocky terrain	Rocks & sand	Specimen	S28°09'02.4" E16°51'46.6"	99

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26/04/2010	18h42	Gravel plain	Sandy gravel terrain	Gravel & sand	Specimen	S28°09'00.4" E16°51'38.2"	93
26/04/2010	18h45	Gravel plain	Sandy gravel terrain	Gravel & sand	Specimen	S28°09'01.4" E16°51'40.6"	91
26/04/2010	18h49	Gravel plain	Sandy gravel terrain	Gravel & sand	Specimen	S28°09'02.1" E16°51'43.9"	95

Status:

Secure (Griffin 2003)

Distribution:

Entire western and southern Namibia (Griffin 2003)

Potential proportion of taxon's range:

± 70%: extralimital range to South Africa (Griffin 2003)

Habitat:

Varied – desert to semi desert preferring flat, stable sandy soils with sparse vegetation (Branch 1998)

Diet:

Small invertebrates especially termites (Alexander & Marais 2007, Branch 1998)

3.2 Mammal Diversity

The following table – Table 2 – indicates the mammal diversity known and/or expected to occur as well as mammals actually encountered during the fieldwork between 22 and 27 April 2020 or confirmed (#¹ Trygve Cooper – Ministry of Environment & Tourism & #² Godfried Grobbelaar – geologist previously working at Sendelingsdrif & Daberas) in the general Sendelingsdrif area:

Table 2. Mammal diversity expected and confirmed from the Sendelingsdrif area.

Species: Scientific name	Species: Common name	Observed & Confirmed during fieldwork	Namibian conservation & legal status	International Status
Elephant Shrews				
<i>Macroscelides proboscideus flavicaudatus</i>	Round-eared Elephant-shrew		Endemic; Secure	² Vulnerable
<i>Elephantulus rupestris</i>	Western Rock Elephant-shrew		Secure	² Vulnerable
Shrews				
<i>Crociodura cyanea</i>	Reddish-grey Musk Shrew		Secure	¹ Data Deficient

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Species: Scientific name	Species: Common name	Observed & Confirmed during fieldwork	Namibian conservation & legal status	International Status
Hyrax				
<i>Procavia capensis</i>	Rock Hyrax		Secure; Problem animal	
Bats				
<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat		Secure	
<i>Neoromicia capensis</i>	Cape Serotine Bat		Secure	
<i>Cistugo seabrai</i>	Namibian Wing-gland Bat		Endemic; Rare	¹ Vulnerable ² Near Threatened
<i>Eptesicus hottentotus</i>	Long-tailed Serotine Bat	√	Secure	
<i>Nycteris thebaica</i>	Egyptian Slit-faced Bat		Secure	
<i>Rhinolophus fumigatus</i>	Rüppell's Horseshoe Bat		Secure	¹ Near Threatened
<i>Rhinolophus clivosus</i>	Geoffroy's Horseshoe Bat		Secure	¹ Near Threatened
<i>Hipposideros caffer</i>	Sundevall's Roundleaf Bat		Secure	¹ Data Deficient
Hares & Rabbits				
<i>Lepus capensis</i>	Cape Hare	√	Secure	
<i>Pronolagus rupestris</i>	Smith's Red Rock Rabbit		Secure	
Rodents				
Porcupine				
<i>Hystrix africaeaustralis</i>	Cape Porcupine	√	Secure	
Rats & Mice				
<i>Petromys typicus</i>	Dassie Rat		Endemic; Secure	¹ Near Threatened
<i>Graphiurus platyops/rupicola</i>	Western Rock Dormouse		Endemic; Secure	
<i>Rhabdomys pumilio</i>	Four-striped Grass Mouse		Secure	
<i>Thallomys paedulus</i>	Acacia Rat		Secure	
<i>Thallomys nigricauda</i>	Black-tailed Tree Rat		Secure	
<i>Micaelamys (Aethomys) namaquensis</i>	Namaqua Rock Mouse		Secure	
<i>Parotomys brantsii</i>	Brant's Whistling Rat		Secure	
<i>Parotomys littledalei namibensis</i>	Littledale's Whistling Rat		Endemic; Secure	¹ Near Threatened
<i>Desmodillus auricularis</i>	Cape Short-tailed Gerbil		Secure	
<i>Malacothrix typica</i>	Gerbil Mouse		Secure	
<i>Petromyscus collinus</i>	Pygmy Rock Mouse		Endemic; Secure	
<i>Mus musculus</i>	House Mouse		Invasive alien	
Primates				
<i>Papio ursinus</i>	Chacma Baboon	√	Secure; Problem animal	CITES - Appendix II
<i>Cercopithecus (Chlorocebus) pygerythrus</i>	Vervet Monkey		Secure	CITES - Appendix II

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Species: Scientific name	Species: Common name	Observed & Confirmed during fieldwork	Namibian conservation & legal status	International Status
Carnivores				
<i>Proteles cristatus</i>	Aardwolf		Insufficiently known; (Vulnerable?) Peripheral	
<i>Parahyaena (Hyaena) brunnea</i>	Brown Hyena	# ¹	Insufficiently known; (Vulnerable?) Peripheral	¹ Near Threatened; ² Endangered
<i>Crocuta crocuta</i>	Spotted Hyena		Secure?; Peripheral	¹ Near Threatened
<i>Acinonyx jubatus</i>	Cheetah	# ¹	Vulnerable; Protected Game	¹ Vulnerable; ² Vulnerable; CITES - Appendix 1
<i>Panthera pardus</i>	Leopard		Secure?; Peripheral; Protected Game	CITES - Appendix 1
<i>Caracal caracal</i>	Caracal	# ²	Secure; Problem Animal	CITES - Appendix 2
<i>Felis silvestris</i>	African Wild Cat	√	Vulnerable	CITES Appendix II
<i>Felis nigripes</i>	Black-footed Cat		Indeterminate (Rare)	² Vulnerable; CITES - Appendix 1
<i>Genetta genetta</i>	Small Spotted Genet		Secure	
<i>Suricata suricatta marjoriae</i>	Suricate		Endemic; Secure	
<i>Cynictis penicillata</i>	Yellow Mongoose		Secure	
<i>Galerella pulverulenta</i>	Cape Grey Mongoose		Indeterminate (Rare)	
<i>Atilax paludinosus</i>	Marsh Mongoose		Indeterminate	
<i>Otocyon megalotis</i>	Bat-eared Fox		Vulnerable?; Peripheral	
<i>Vulpes chama</i>	Cape Fox	# ¹	Vulnerable?	
<i>Canis mesomelas</i>	Black-backed Jackal	√	Secure; Problem animal	
<i>Aonyx capensis</i>	African Clawless Otter	√	Vulnerable?; Peripheral; Protected Game	CITES - Appendix 2
<i>Mellivora capensis</i>	Honey Badger/Ratel	# ²	Secure; Protected Game	¹ Near Threatened
<i>Ictonyx striatus</i>	Striped Polecat		Secure	
Zebra				
<i>Equus zebra hartmannae</i>	Hartmann's Mountain Zebra		Endemic; Secure; Specially	¹ Endangered ; ² Endangered

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Species: Scientific name	Species: Common name	Observed & Confirmed during fieldwork	Namibian conservation & legal status	International Status
			Protected Game	; CITES - Appendix 2
Antelopes				
<i>Tragelaphus strepsiceros</i>	Greater Kudu		Secure; Huntable 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>Raphicerus campestris</i>	Steenbok		Secure; Protected Game	
<i>Oreotragus oreotragus</i>	Klipspringer		Secure; Specially Protected Game	

¹SARDB (2004); ²IUCN (2002, 2004)

Source for literature review: De Graaff (1981), Griffin (2005), Estes (1995), Joubert & Mostert (1975), Skinner & Smithers (1990), Skinner & Chimimba (2005), Stander & Hanssen (2003) & 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 1998b). According to Griffin (1998b) 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 “average” in the south western part of Namibia (Mendelsohn *et al.* 2002). The overall diversity (3-4 species) and abundance of large herbivorous mammals is “average” in the general Sendelingsdrif area with Oryx and Springbok having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall abundance and diversity of large carnivorous mammals is “average” (3 species) in the general area with Leopard having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall mammal diversity in the Sendelingsdrif area is estimated at between 61-75 species with 7-8 species being endemic to the area (Mendelsohn *et al.* 2002). Griffin (1998b) puts the mammals of the neighbouring Ai-Ais/Richtersveld Transfronteir Park at 76 species with rodents (22 species) and carnivores (20 species) being the dominant groups.

According to the literature at least 55 species of mammals are known and/or expected to occur in the general Sendelingsdrif area of which 9 species (16.4%) are classified as endemic. The Namibian legislation classifies 6 species as vulnerable; 3 species as rare; 2 species as specially protected game; 5 species as protected game, 3 species as huntable game and 4 species as problem animals. At least 34.5% (19 species) of the mammalian fauna that occur or are

expected to occur in the Sendelingsdrif area are represented by carnivores of which 1 species (5.3%) is endemic. This is followed by rodents 27.3% (15 species) with 26.7% (4 species) being endemic.

Twenty one species have international conservation status of which 2 species are classified as endangered; 5 species as vulnerable; 8 species as near threatened, 9 species as CITES Appendix 1 or 2 and 2 species as data deficient. 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.

Habitat alteration and overutilization are the two primary processes threatening most mammals (Griffin 1998b) with species probably underrepresented in Table 2 for the general area being the bats, as this group has not been well documented from the arid south western part of Namibia.

3.2.1 Species Accounts

Mammals encountered during a survey of the Sendelingsdrif area:

During the fieldwork, 14 species of mammals were confirmed either through direct observations (8 species) or as confirmed sightings (T. Cooper pers. com.; G. Grobbelaar pers.com.) at various locations in the Sendelingsdrif area. Some species – e.g. *Acinonyx jubatus* – are highly nomadic and only occasionally pass through the area (T. Cooper pers. com.).

Of the 14 species confirmed from the Sendelingsdrif area, none are classified as endemic although 5 species are classified as vulnerable (2 species are also classified as protected game) and 3 species classified as protected game (Griffin 2005).

These species are:

Vulnerable

- *Parahyaena (Hyaena) brunnea*
- *Acinonyx jubatus*
- *Felis silvestris*
- *Vulpes chama*
- *Aonyx capensis*

Protected game

- *Acinonyx jubatus*
- *Aonyx capensis*
- *Mellivora capensis*

Although the aim of this survey was to determine small mammals – rodents – from the Sendelingsdrif mining area, the overall dry conditions (according to T. Cooper, Pers. com. the area received below average rainfall during the previous two rainy seasons) resulted in very few sightings.

Twenty Sherman small mammal traps were set over 4 nights – i.e. a potential maximum of 80 rodents) – without any success. The traps were set in the following areas during the survey:

Site 1 – Friday 23/04/2010 (S28°10'13.1"; E16°52'51.7"; 5 4m)

Habitat: Gravel terrace & *Stipagrostis obtusa* dominated area

Distance apart: 30m

Traps: 20

Site 2 – Saturday 24/04/2010 (S28°10'08.2"; E16°53'01.8"; 37m)

Habitat: Orange River bank & *Prosopis* sp./*Euclea pseudebenus*/*Eucalyptus* sp. dominated area

Distance apart: 20m

Traps: 20

Site 3a – Sunday 25/04/2010 (S28°08'42.5"; E16°51'17.2"; 8 5m)

Habitat: Quartz gravel plains & *Euphorbia* sp. dominated area

Distance apart: 50m

Traps: 5

Site 3b – Sunday 25/04/2010 (S28°09'00.5"; E16°51'45.3"; 1 27m)

Habitat: Rocky hill

Distance apart: 20m

Traps: 5

Site 3c – Sunday 25/04/2010 (S28°09'03.3"; E16°52'37.6"; 5 2m)

Habitat: Drainage line & *Gomphocarpus filiformis* dominated area

Distance apart: 20m

Traps: 10

Site 4 – Monday 26/04/2010 (S28°09'18.1"; E16°50'37.1"; 4 5m)

Habitat: Drainage line & *Euclea pseudebenus* dominated area

Distance apart: 40m

Traps: 20

The fact that no rodents were caught over a period of 4 days with a maximum potential of 80 traps, is not only disappointing and unusual, but probably indicative of a very low rodent biomass currently in the general mining area due to the overall dry conditions. Other such rodent trapping sessions by the author in central and north western Namibia during the same period – i.e. early/mid 2010 – resulted in a capture success of between 30-50%. However, these areas were well vegetated and not comparable to the current conditions at Sendelingsdrif. Under different environmental conditions a better capture success rate would be expected.

Rodents are a typical *boom and bust* group of mammals with environmental conditions directly affecting their population numbers. The lack of rodent predators such as snakes and raptors observed throughout the survey period in the Sendelingsdrif mining area furthermore confirm the low rodent biomass currently in the area. Rodents are known to bounce back under favourable conditions and the area is expected to potentially have at least 12 small rodent species (See Table 2).

Other small mammal species expected from the area, but not observed although potential habitat scoured include *Procavia capensis*, *Petromys typicus*, *Cynictis penicillata* and *Suricata suricatta marjoriae*. However, the hills in the immediate Sendelingsdrif area were viewed as marginal habitat for the rock dwelling species, i.e., *Procavia capensis* & *Petromys typicus*, due to the absence of suitable crevices with no signs of faeces and distinctive urine traces indicating that these areas probably have never been suitable. Neighbouring larger hills, e.g., Jakkalsberg

across the Orange River on the South African side and mountains further westwards towards the Daberas mining area, had evidence of *P. capensis*. The overall dry conditions and lack of potential prey, e.g., arthropods, probably account for the absence of *Cynictis penicillata* with *Suricata suricatta* often known to be negatively affected by drought/dry conditions by vacating such habitat or prone to die-off (Pers. obs.)

4 Important Species

Reptiles

The high percentage of endemic reptile species (58%) known and/or expected to occur in the general Sendelingsdrif area underscores the importance of this area for reptiles.

The rugged inhospitable terrain along the Orange River supports a wide variety of reptiles of conservation concern. Very little is known regarding the majority of these species including their role in the greater ecology of the area. Most geckos expected in the general area are endemic (87%) with the most important being the various *Goggia* and *Pachydactylus* species.

Lizards also have a high endemism in the area (63%) with the various *Meroles* and *Pedioplanis* species as well as *Varanus niloticus* (Nile Monitor Lizard) being the most important.

The *Rhinotyphlops schinzi* (Schinz's Beaked Blind Snake), *Leptotyphlops occidentalis* (Western Thread Snake), *Naya nigricollis woodi* (Black Spitting Cobra) and *Bitis xeropaga* (Desert Mountain Adder) are the snakes viewed as the most important in the area.

Mammals

Endemic mammals expected to occur in the general area make up a relatively small percentage (33%) of the mammals known and/or expected from the area. Endemic mammal species of concern include the Namibian Wing-gland Bat (*Cistugo seabrai*), Dassie Rat (*Petromys typicus*), Littledale's Whistling Rat (*Parotomys littledalei namibensis*), various carnivores with the Black-footed Cat (*Felis nigripes*) and African Clawless Otter (*Aonyx capensis*) being the most important while the Hartmann's Mountain Zebra (*Equus zebra hartmannae*) being the most important ungulate in the general area.

5 Impacts and Mitigation

As all development has potential negative environmental consequences, 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 Sendelingsdrif mining activities are to be limited to the gravel terraces only. The most important impacts and mitigations suggested are described below for:

- Habitat destruction – reptiles
- Habitat destruction – small mammals

5.1 Impact description: Habitat destruction – reptiles

Mining the gravel terraces in the Sendelingsdrif area will affect the reptiles associated with these terraces, since total destruction of this specific habitat is expected during the mining operation. The terraces vary with a combination of rounded rocks, gravel and sand interspersed with sandy drainage lines. Vegetation cover is sparse overall and dominated by *Stipagrostis obtusa* tufts, but better vegetated – shrubs e.g. *Euphorbia* sp. – on the north western terraces. The sandy bottomed drainage lines – deeply incised – are generally devoid of much vegetation although a drainage line towards the south west of the existing Oryx processing plant is better vegetated (e.g. *Cyperus* sp. & *Euclea pseudobenus*) due to a natural water seep in the area. The rocky/sandy substrate combination potentially serves as habitat to a variety of species – e.g. *Bitis* sp., *Meroles* sp., *Pedioplanis* sp., *Psammophis* sp., *Trachylepis* sp., etc.

5.1.1 Impact assessment: Habitat destruction – reptiles

The area to be processed is limited in size and, although a species such as the endemic/insufficiently known *Bitis xeropaga* (Griffin 2003) has previously been documented on these terraces (C. Mannheimer Pers. com), it is not their preferred habitat which includes rocky hillsides and mountain slopes. Densities of these snakes are furthermore expected to be very low, especially in such a marginal environment.

Most other important (i.e. endemic, etc.) reptile species (e.g. *Goggia* sp., *Meroles* sp., *Pachydactylus* sp. & *Pedioplanis* sp.) are widespread and not specifically associated with the gravel terraces in question. It is unknown, although unexpected, if a species such as *Goggia gemmula* occurs in the Sendelingsdrif area – none were observed during the recent fieldwork – as they are only known from the McMillan pass in the Rosh Pinah area in Namibia (Griffin 2003) whilst associated with rocky outcrops in the Richtersveld in South Africa.

Other species of concern are the tortoises (e.g. *Homopus solus* [endemic] & *Psammobates* sp. [vulnerable]) and Nile monitor lizard, *Varanus niloticus* (vulnerable & protected game) although *H. solus* is a crevice dwelling outcrop/mountain species (Cunningham & Simang 2007) while *V. niloticus* is associated with the Orange River and riparian vegetation thus not expected to occur on the gravel terraces.

The overall impact on unique (i.e. endemic, etc.) reptile species is thus expected to be low.

Table 3. Impacts: Habitat destruction – reptiles.

Nature of impact: Gravel terrace mining will affect reptile habitat	
Extent	Local
Duration	Long-term
Intensity	High
Probability	Highly probable
Status of impact	Negative
Degree of confidence	High
Significance (without mitigation)	Medium
Significance (with mitigation)	Low

5.1.2 Impact mitigation: Habitat destruction – reptiles

- It is recommended that a thorough sweep be conducted through the area before the mining activities commence so as to remove and relocate all high value reptile species – e.g. all tortoises (*Homopus solus* & *Psammobates* sp.), *Bitis xeropaga* and various endemic *Meroles*, *Pachydactylus* & *Pedioplanis* species. Relocation would however have to be to suitable similar habitats elsewhere.
- All reptiles – especially high value species (see above) – serendipitously encountered during the operational phase should be removed to similar suitable habitat.
- A “no kill” policy should be implemented during the operational phase. Snakes are always viewed as problematic and often indiscriminately killed when encountered. Most snake species would move out of the area of their own accord if left to do so.
- Track discipline should be adhered to (and enforced) and be limited to the proposed mining area only as off road driving not only results in reptile mortalities, but more importantly destroys reptile habitat. Track discipline would minimise the overall effect on the surrounding area.
- Habitat rehabilitation after mining is imperative to recreate the existing or similar conditions – i.e. rocky/sandy habitat – which would assist in the recovery and colonising of the area from the surroundings. The colonisation of the area by burrowing species such as *Ptenopus garrulus maculatus* would further assist the overall rehabilitation process by “churning” the soil and creating water and seed traps.
- Monitoring should be ongoing after the rehabilitation process to determine the value of rehabilitation for reptiles as well as to determine the rate of colonisation. These results could then assist with similar projects in future.

5.1.3 Mitigation monitoring

- To determine the success of the rehabilitation process, monitoring of “colonisers”, e.g., burrowing species (*Ptenopus garrulus maculates*), should be made regularly, i.e., 1 month, 6 months and 12 months after the completion of the rehabilitation process; thereafter on a yearly basis.
- The presence of diurnal colonising species, e.g., Lacertids, established through diurnal searching for reptiles through the rehabilitated area - direct observations, tracks (sandy areas) and burrows.
- The presence of nocturnal colonising species, e.g., Geckos, established through nocturnal searching for reptiles through the rehabilitated area - direct observations using a gas lantern.

5.2 Impact description: Habitat destruction – small mammals

Mining the gravel terraces in the Sendelingsdrif area will affect the small mammals associated with these terraces, since total destruction of this specific habitat is expected during the mining operation. The terraces vary with a combination of rounded rocks, gravel and sand interspersed with sandy drainage lines. Vegetation cover is sparse overall and dominated by *Stipagrostis obtusa* tufts, but better vegetated, such as shrubs, e.g. *Euphorbia* sp., on the north western terraces. The sandy bottomed drainage lines, deeply incised, are generally devoid of much vegetation although a drainage line towards the south west of the existing Oryx processing plant is better vegetated, e.g., *Cyperus* sp. and *Euclea pseudobenus*, due to a natural water seep in the area. The rocky/sandy substrate combination potentially serves as habitat to a variety of species, e.g., *Macroscelides proboscideus flavicaudatus*, *Elephantulus rupestris*, *Desmodillus auricularis*, *Petromyscus collinus*, etc.

5.2.1 Impact assessment: Habitat destruction – small mammals

Although species such as the endemic *Macroscelides proboscideus flavicaudatus* and *Petromyscus collinus* are expected from the general area, they are not exclusively associated with the proposed mining site. *M. p. flavicaudatus* is found throughout the southern third of Namibia, while *P. collinus* is found in rocky areas throughout Namibia (Griffin 2005).

Most other important, i.e., endemic, etc., small mammal species, e.g., *Petromys typicus* (rock crevice dwelling), *Graphiurus platyops/rupicola* (rocky areas), *Parotomys littledalei namibensis* (riparian association) and *Suricata suricatta marjoriae* (gravel plains) are widespread and not specifically located with the gravel terraces in question.

Other species of concern are *Felis silvestris* (widespread), *Felis nigripes* (widespread), *Vulpes chama* (widespread) and *Aonyx capensis* (Orange River). These species however, are not exclusively associated with the gravel terraces at Sendelingsdrif, as they are widespread throughout Namibia or associated with the Orange River habitat, e.g., *Aonyx capensis*.

Bats are not expected to be adversely affected by the terrace mining activities as the terraces are not expected to serve as suitable habitat. The rocky outcrops in the immediate vicinity of the Sendelingsdrif gravel terraces are also viewed as marginal habitat. The Orange River riparian vegetation, such as bark dwelling species, and larger mountains in the area (cave/crevice dwelling species), e.g., Dreigratberg (east) and Obib Mountains (north) as well as the old German police outpost buildings, are viewed as the most important potential bat habitat in the general area.

Larger mammals although not within the scope of this study, are more mobile than rodents and thus not expected to be adversely affected by the gravel terrace mining operations.

The Orange River and associated riparian vegetation are not expected to be affected by the gravel terrace mining operations and consequently species associated with this habitat, e.g., *Aonyx capensis* are not expected to be affected.

The overall impact on unique (i.e. endemic, etc.) small mammal species is thus expected to be low.

Table 4. Impacts: Habitat destruction – small mammals.

Nature of impact: Gravel terrace mining will affect small mammal habitat	
Extent	Local
Duration	Long-term
Intensity	High
Probability	Highly probable
Status of impact	Negative
Degree of confidence	High
Significance (without mitigation)	Medium
Significance (with mitigation)	Low

5.2.2 Impact mitigation: Habitat destruction – small mammals

- It is recommended that a thorough trapping session be conducted through the area before the mining activities commence so as to remove and relocate all high value small mammal species, e.g., *Macroscelides proboscideus flavicaudatus* and *Petromyscus collinus*. Relocation would however have to be to suitable similar habitats elsewhere. Medium and large mammals are not expected to be affected as much by the development as they are more mobile with larger home ranges, etc.
- Track discipline should be adhered to (and enforced) and be limited to the proposed mining area only, as off road driving not only results in small mammal mortalities but, more importantly, destroys mammal habitat. Track discipline will minimise the overall effect on the surrounding area.
- Habitat rehabilitation after mining is imperative to recreate the existing or similar conditions, i.e., rocky/sandy habitat, which would assist in the recovery and colonising of the area from the surroundings. The colonisation of the area by burrowing species such as *Desmodillus auricularis* would further assist the overall rehabilitation process by “churning” the soil and creating water and seed traps.
- Monitoring should be ongoing after the rehabilitation process to determine the value of rehabilitation for small mammals as well as to determine the rate of colonisation. These results could then assist with similar projects in future.

5.2.3 Mitigation monitoring

- To determine the success of the rehabilitation process, monitoring of “colonisers”, e.g., burrowing species (*Desmodillus auricularis*) should be made regularly, i.e., 1 month, 6 months and 12 months after the completion of the rehabilitation process; thereafter on a yearly basis.
- Small mammal trapping, e.g., Sherman collapsible aluminium traps, should be conducted throughout the rehabilitated area. Fixed transects and a placement of traps at 30 m intervals over a period of 5 nights should be sufficient to confirm the presence of small mammals.

- Random searching of evidence of other small/medium mammals, e.g., hare droppings, fox faeces, scrapes, tracks & burrows, etc., throughout the rehabilitated area should further confirm the re-colonising of the area. This could follow the same time frame as small mammal trapping.

6 Conclusion

It is estimated that at least 64 reptile and 55 mammal species are known to or expected to occur in the general/immediate Sendelingsdrif area of which a large proportion are endemics. Endemics include at least 58% of the reptiles and 33% of the mammals expected to occur in the general area.

Species most likely to be adversely affected by this mining development would be the reptiles specifically associated with this area. The very high percentage of unique and/or endemic species (58%) underscores the importance of the general area for reptiles. Most species, e.g., *Goggia* species and *Homopus solus*, are understudied and their presence in and importance to the general ecology are not well understood.

Mammals, especially small mammals (bats and rodents) and carnivores are well represented in the area with 33% classified as endemic to Namibia. The only small mammals expected to be affected by the gravel terrace mining operations are the endemic *Macroscelides proboscideus flavicaudatus* and *Petromyscus collinus*, which potentially occur in the area, although they are not exclusively associated with the proposed development area.

The most important impact to the reptiles and small mammals in the area is the total destruction of the gravel terraces which serve as habitat to a variety of species. However, these species are not exclusively limited to the Sendelingsdrif gravel terraces with the overall impact expected to be low.

Mitigation measures suggested would undoubtedly lessen the overall impacts, especially for the reptiles which are expected to be most affected by the proposed development.

Monitoring during/after the rehabilitation phase could serve as a benchmark for similar developments in future and are encouraged. Recommended monitoring of mitigation measures is presented in the Appendix.

Other impacts such as increased dust and noise levels, destruction of the existing water seep in the gravel terraces and impact on the greater surrounding area including the Orange River are viewed as negligible. Dust levels are naturally high in the general area although seasonally of nature with species adapted accordingly. Mining activities have been ongoing in the general area, namely South African side of the Orange River and Daberas, for years with animals becoming accustomed to the associated noise, e.g., springbok and gemsbok graze unconcerned close to mining activities. The potential destruction of the existing water seep within the gravel terraces is unfortunate, but most desert-adapted most species are water independent and water is furthermore freely available in the Orange River. The proposed gravel terrace mining is also not expected to impact on the Orange River and associated reptile and small mammal fauna.

7 References

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APPENDIX

Table A.1 Monitoring of Recommended Mitigation Actions - Reptiles

No.	Mitigation Recommendation	Monitoring Responsibility	Action Required	Monitoring Method	Frequency
1.	Reptile sweep through the proposed affected area to collect/remove high value species	Namdeb Environmental Section (could also use scholars & interested people to assist)	Sweep to collect/remove unique species	Confirmation that this was conducted	Prior to actual mining operations
2.	Serendipitous removal of high value reptile species	All Namdeb personal	Remove unique species when encountered during operational phase	Incident report of such activities to be submitted to the Environmental Section	Randomly
3.	No kill policy	Namdeb Environmental Section	Ensure that personnel do not intentionally kill reptiles encountered	Random interview of personnel during the operational phase	Randomly
4.	Track discipline	Namdeb Environmental & Security Sections	Ensure that personnel adhere to track discipline – e.g. speed & off-road driving	Random site visits & interviews with personnel	Randomly
5.	Habitat rehabilitation	Namdeb Environmental Section	Rehabilitation of the terraces according to the rehabilitation plan	Diurnal & nocturnal searching for reptiles in the rehabilitated area to confirm the effectiveness of the rehabilitation – i.e. re-colonising by reptiles	1 month, 6 months & 12 months after the rehabilitation process and thereafter annually

Table A.2 Monitoring of Recommended Mitigation Actions – Small mammals

No.	Mitigation Recommendation	Monitoring Responsibility	Action Required	Monitoring Method	Frequency
1.	Small mammal trapping to collect/remove high value species	Namdeb Environmental Section (could also use scholars & interested people to assist)	Small mammal trapping	Confirmation that this was conducted	Prior to actual mining operations. Four nights using fixed transects with traps placed 30m apart
2.	Track discipline	Namdeb Environmental & Security Sections	Ensure that personnel adhere to track discipline – e.g. speed & off-road driving	Random site visits & interviews with personnel	Randomly
3.	Habitat rehabilitation	Namdeb Environmental Section	Rehabilitation of the terraces according to the rehabilitation plan	Small mammal trapping & searching the area for signs of small mammal activity to confirm the effectiveness of the rehabilitation – i.e. re-colonising by small mammals	1 month, 6 months & 12 months after the rehabilitation process and thereafter annually