

APPENDIX E
Animal study
(Environmental and Wildlife Consulting Namibia)

**VERTEBRATE FAUNA & FLORA ASSOCIATED
WITH THE URANIUM EPL 3496 – INCA AND TRS
AREA'S**

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1. Vertebrate fauna associated with the INCA and TRS EPL 3496 areas

1.1 Introduction

A field survey was conducted between 25 and 29 June 2010 to determine the vertebrate fauna (e.g. reptiles, amphibians, mammals & birds) at the INCA (INCA uranium & iron) and TRS (Tubas Red Sands uranium) EPL sites which form part of the Omahola Project run by Reptile Uranium Namibia Pty Ltd (RUN) approximately 40 to 50 km southeast of Swakopmund. The survey was preceded by a comprehensive literature (i.e. desktop study/scoping report) conducted between 9 and 12 June 2010 of vertebrate fauna expected to occur in the general area.

The general Swakopmund area is regarded as “low” in overall (all terrestrial species) diversity while the overall terrestrial endemism on the other hand is “moderate to high” (Mendelsohn *et al.* 2002). According to the literature survey an estimated (i.e. at least) 56 reptile, 5 amphibian, 31 mammal and 124 bird species (breeding residents) are known to or expected to occur in the general Swakopmund area of which a high proportion are endemics.

This field survey was conducted to confirm vertebrate fauna species at the proposed development sites – INCA & TRS – southeast of Swakopmund.

1.2 Methods

1.2.1 Field survey

According to the original TOR, fieldwork to determine the actual faunal diversity would include the following:

- Small mammal transects to determine small mammal diversity in the area
- Larger mammal observations – direct sightings, faeces, tracks, etc. – in the area
- Reptile & amphibian transects (diurnal & nocturnal) to determine reptile & amphibian diversity in the area
- Bird transects to determine avian diversity in the area

Mammals:

- Fieldwork was not only conducted at the INCA & TRS prospecting sites only, but included the greater area – i.e. EPL 3496.
- Fieldwork consisted of 1) small mammal trapping, and 2) transects throughout the general area to determine the presence of larger mammals.

1) Small mammal trapping:

- Transects for small mammal trapping were conducted along ephemeral drainage lines (part of the Tumas River drainage system) and rocky outcrops and ridges.
- Collapsible aluminium Sherman small mammal traps baited with peanut butter and oats were set just prior to sunset.
- The traps were placed between 30 and 50m apart depending on the habitats.
- Small mammals caught were identified *in situ*, photographed, measured (when applicable to facilitate identification) and released unharmed at the point of capture.
- Transect lengths and directions varied depending on terrain and perceived habitats.
- 20 Sherman traps were set each evening over a period of 4 nights (25 to 28 June 2010) with a potential maximum of 80 captures

2) Larger mammal transects:

- Transects to determine the presence of larger mammals was conducted throughout the general area, including, but not limited to INCA and TRS prospecting sites.
- Transect lengths and directions varied depending on terrain and perceived habitats.
- Direct observations of mammals encountered along these transects were made using 10 x 40 binoculars.
- All other signs of mammals were noted and identified to species level where possible. This included such signs as tracks, scats, carcasses & skulls and other signs – e.g. quills, hair/skins, dens/burrows, etc.
- All signs were photographed as evidence and/or to confirm by second opinions from other experts if required.
- Sightings included diurnal and nocturnal observations.

Reptiles & Amphibians:

- Transects to determine the presence of reptiles and amphibians was conducted throughout the general area, including, but not limited to INCA and TRS prospecting sites.
- Transects crisscrossed the entire area – i.e. not only the specific prospecting sites, but all adjacent habitat – and were not conducted in rigid straight lines, but focused on the habitat viewed as most suitable for reptiles and amphibians.
- Reptiles observed were either caught by hand or by using an active capture technique called ‘reptile noosing’ where an extendable fishing rod was fitted with a soft thread noose, positioned over the unsuspecting head of an individual and pulled tight. This technique does not result in the death or injury of the caught specimen.
- Reptiles caught were identified *in situ*, photographed and released unharmed at the point of capture.
- Sightings included diurnal and nocturnal observations. Nocturnal observations were conducted from just after sunset until 21h00 using a gas lantern.

Birds:

- Transects to determine the presence of birds was conducted throughout the general area, including, but not limited to INCA and TRS prospecting sites.
- Transect lengths and directions varied depending on terrain and perceived habitats.
- Direct observations of birds encountered along these transects were made using 10 x 40 binoculars.
- Bird calls were identified throughout and confirmed with direct observations.
- All other signs of birds were noted and identified to species level where possible. This included such signs as nests and scrapes, tracks, carcasses and other signs – e.g. feathers.
- All signs were photographed as evidence and/or to confirm by second opinions from other experts if required.
- Sightings were limited to diurnal observations only.

1.3 Results

1.3.1 Reptile Diversity

The reptile diversity known and/or expected to occur in the general Swakopmund area according to the literature study, including species actually observed (√) and confirmed (#Andrew Cunningham) during the fieldwork conducted between 25 and 29 June 2010, is presented below:

Species: Scientific name	Species: Common name	Species observed	Namibian conservation & legal status	International status
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TURTLES & TERRAPINS				
<i>Stigmochelys (Geochelone) pardalis</i>	Leopard Tortoise		Vulnerable; Peripheral; Protected Game	CITES Appendix II
<i>Pelomedusa subrufa</i>	Marsh/Helmeted Terrapin		Secure	CITES Appendix III
SNAKES				
Thread Snakes				
<i>Leptotyphlops occidentalis</i>	Western Thread Snake		Endemic; Secure	SARDB Peripheral
<i>Leptotyphlops labialis</i>	Damara Thread Snake		Endemic; Secure	
Quill Snouted Snakes				
<i>Xenocalamus bicolour bicolor</i>	Bicoloured Quill- snouted Snake		Secure	
Typical Snakes				
<i>Lamprophis fuliginosus</i>	Brown House Snake		Secure	
<i>Lycophidion capense</i>	Cape Wolf Snake		Secure	
<i>Lycophidion namibianum</i>	Namibian Wolf Snake		Endemic; Secure	
<i>Pseudaspis cana</i>	Mole Snake		Secure	
<i>Pythonodipsas carinata</i>	Western Keeled Snake		Endemic; Secure	
<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>Aspidelaps lubricus infuscatus</i>	Coral Snake		Secure	
<i>Aspidelaps scutatus</i>	Shield-nose Snake		Endemic; Secure	
<i>Naya nigricollis nigricincta</i>	Black-necked Spitting Cobra	#	Endemic; Secure	SARDB Rare
<i>Bitis arietans</i>	Puff Adder		Secure	
<i>Bitis caudalis</i>	Horned Adder	√	Secure	
<i>Bitis peringueyi</i>	Péringuey's Adder		Endemic; Secure	
LIZARDS				
Skinks				
<i>Typhlacontias brevipes</i>	FitzSimon's Burrowing Skink		Endemic; Secure	
<i>Trachylepis (Mabuya) acutilabris</i>	Wedge-snouted Skink	√	Secure	
<i>Trachylepis (Mabuya) occidentalis</i>	Western Three- striped Skink		Secure	
<i>Trachylepis (Mabuya) striata wahlbergi</i>	Striped Skink		Secure	
<i>Trachylepis (Mabuya) sulcata</i>	Western Rock Skink		Secure	
<i>Trachylepis (Mabuya)</i>	Variegated Skink		Secure	

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<i>variegata variegata</i>				
Old World Lizards				
<i>Heliobolus lugubris</i>	Bushveld Lizard		Secure	
<i>Meroles anchietae</i>	Shovel-snouted Lizard		Secure	
<i>Meroles reticulatus</i>	Reticulated Desert Lizard		Endemic; Secure	
<i>Meroles suborbitalis</i>	Spotted Desert Lizard	√	Endemic; Secure	
<i>Pedioplanis breviceps</i>	Short-headed Sand Lizard		Endemic; Secure	
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard		Secure	
<i>Pedioplanis inornata</i>	Plain Sand Lizard	#	Endemic; Secure	
<i>Pedioplanis husabensis</i>	Husab Sand Lizard		Endemic; Secure	
Plated Lizards				
<i>Cordylus subtesellatus</i>	Dwarf Plated Lizard		Endemic; Secure	
Monitors				
<i>Varanus albigularis</i>	Rock or White-throated Monitor		Vulnerable; Peripheral; Protected Game	CITES Appendix II Safe to Vulnerable
Agama				
<i>Agama planiceps</i>	Namibian Rock Agama		Endemic; Secure	
Chameleons				
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon	#	Secure	CITES Appendix II
Geckos				
<i>Afroedura africana africana</i>	African Flat Gecko		Endemic; Insufficiently known; Rare?	
<i>Chondrodactylus angulifer namibensis</i>	Giant Ground Gecko	√	Endemic; Secure	
<i>Narudasia festiva</i>	Festive Gecko		Endemic; Secure	
<i>Pachydactylus bicolor</i>	Velvety Thick-toed Gecko	√	Endemic; Secure	
<i>Pachydactylus kochii</i>	Kock's Thick-toed Gecko	√	Endemic; Secure	
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko		Secure	
<i>Pachydactylus punctatus</i>	Speckled Thick-toed Gecko	√	Secure	
<i>Pachydactylus rugosus rugosus</i>	Rough Thick-toed Gecko		Endemic; Secure	
<i>Pachydactylus weberi weneri</i>	Weber's Thick-toed Gecko		Endemic; Secure	
<i>Palmatogecko rangei</i>	Web-footed Gecko		Endemic; Secure	SARDB Peripheral
<i>Ptenopus carpi</i>	Carp's Barking Gecko	√	Endemic; Secure	
<i>Ptenopus garrulus maculatus</i>	Common Barking Gecko	√	Endemic; Secure	

<i>Ptenopus kochi</i>	Koch's Barking Gecko		Endemic; Secure	
<i>Rhoptropus afer</i>	Common Namib Day Gecko	√	Endemic; Secure	
<i>Rhoptropus boultoni</i>	Boulton's Namib Day Gecko		Endemic; Secure	
<i>Rhoptropus bradfieldi</i>	Bradfield's Namib Day Gecko		Endemic; Secure	

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

Endemic – includes Namibian & South African species (Branch 1998, 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)

#Andrew Cunningham - geologist

The overall reptile diversity and endemism in the general Swakopmund area is estimated at between 41-50 species and 21-24 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 area. Of the 56 species of reptiles expected to occur in the general Swakopmund area only 14 species were observed and/or confirmed during the fieldwork conducted between 25 and 29 June 2010.

These consisted of 3 snakes, 3 lizards, 1 chameleon and 7 geckos. Of these, 9 species have some form of conservation and/or legal status – i.e. *Naya nigricollis nigricincta* (endemic; SARDB rare), *Meroles suborbitalis* (endemic), *Pedioplanis inornata* (endemic), *Chamaeleo namaquensis* (CITES Appendix 2) and with the exception of *Pachydactylus punctatus* all the geckos are classified as endemic. The reptiles expected in the general area are however not expected to be exclusively associated with the INCA and TRS areas.

Species that probably don't occur in the area due to habitat limitations – e.g. to dry, no permanent water bodies, lack of suitable sandy dunes, etc. as observed whilst conducting the fieldwork in the area (although indicated as possibly occurring in the area during the literature study) are *Stigmochelys (Geochelone) pardalis* (too dry), *Pelomedusa subrufa* (lack of water), *Bitis peringueyi* (lack of suitable sandy areas), *Pedioplanis husabensis* (lack of suitable gravel strata), and *Palmatogecko rangei* (lack of suitable sandy areas).

Although many more reptile species are expected to occur in the general INCA and TRS areas the best time to encounter reptiles is during the warmer months between September and April in Namibia.

1.3.1.1 Species accounts:

Reptiles encountered during a survey of the INCA & TRS areas:

During the fieldwork, 14 species of reptiles were confirmed either through direct observations (11 species) or as confirmed sightings (3 species – A. Cunningham pers. com.) at various locations in the INCA and TRS areas.

Of the 14 species confirmed from the INCA and TRS areas area, 9 species are classified as endemic, 1 species as rare by the SARDB and 1 species as CITES Appendix 2 (Branch 1998, Griffin 2003). These species are:

Endemic

- *Naya [nigricollis] nigricincta* (80% of taxon's range in Namibia)
- *Meroles suborbitalis* (65% of taxon's range in Namibia)

- *Pedioplanis inornata* (95% of taxon's range in Namibia)
- *Chondrodactylus angulifer namibensis* (100% & 40% of nominate taxon)
- *Pachydactylus bicolor* (100%)
- *Pachydactylus kochii* (100%)
- *Ptenopus garrulus maculatus* (70% of subspecies range in Namibia)
- *Ptenopus carpi* (100%)
- *Rhoptropus afer* (95% of taxon's range in Namibia)

Rare (SARDB)

- *Naya [nigricollis] nigricincta* (80% of taxon's range in Namibia)

CITES Appendix 2

- *Chamaeleo namaquensis* (70% of taxon's range in Namibia)

The following tables indicate the species accounts, including additional information, as actually observed during the fieldwork at INCA & TRS:

Rhoptropus afer

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
25/6/2010	10h40	INCA	Granite boulders	Gravel & sand	Specimen	S22°49'26.0" E14°54'16.4"	336
25/6/2010	11h27	INCA	Granite boulders	Gravel & sand	Specimen	S22°49'59.3" E14°54'12.3"	311
25/6/2010	13h04	INCA	Drainage line	Gravel & sand	Specimen	S22°50'50.2" E14°55'03.1"	306
25/6/2010	13h34	INCA	Drainage line	Gravel & sand	Specimen	S22°51'00.3" E14°54'54.0"	307
25/6/2010	13h43	INCA	Drainage line	Gravel & sand	Specimen	S22°51'06.5" E14°54'48.8"	307
25/6/2010	13h56	INCA	Drainage line	Gravel & sand	Specimen	S22°51'17.9" E14°54'39.8"	300
25/6/2010	14h00	INCA	Drainage line	Gravel & sand	Specimen	S22°51'19.0" E14°54'38.0"	304
25/6/2010	14h10	INCA	Drainage line	Gravel & sand	Specimen	S22°51'13.3" E14°54'38.3"	307
26/6/2010	09h45	TRS	Sheet rock	Gravel & sand	Specimen	S22°51'40.6" E14°56'14.0"	306
26/6/2010	09h50	TRS	Rocky outcrop	Gravel & sand	Specimen	S22°51'36.1" E14°56'17.7"	327
26/6/2010	10h00	TRS	Rocky	Gravel &	Specimen	S22°51'34.8"	324

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			outcrop	sand		E14°56'18.1"	
26/6/2010	10h30	TRS	Rocky outcrop	Gravel & sand	Specimen	S22°51'34.2" E14°56'14.3"	327
26/6/2010	10h39	TRS	Rocky outcrop	Gravel & sand	Specimen	S22°51'27.6" E14°56'15.7"	327
26/6/2010	11h00	TRS	Sheet rock	Gravel & sand	Specimen	S22°51'34.3" E14°55'59.0"	306
26/6/2010	09h13	TRS	Sheet rock	Gravel & sand	Specimen	S22°51'48.5" E14°55'58.0"	305
26/6/2010	15h45	TRS	Rocky outcrop	Gravel & sand	Specimen	S22°53'15.6" E14°50'49.8"	260
26/6/2010	15h48	TRS	Rocky outcrop	Gravel & sand	Specimen	S22°53'14.1" E14°50'47.2"	257
27/6/2010	16h40	TRS	Drainage line	Gravel & sand	Specimen	S22°52'19.1" E14°51'15.6"	296
28/6/2010	09h15	TRS	Granite inselberg	Rock	Specimen	S22°52'28.0" E14°51'10.2"	257
28/6/2010	09h24	TRS	Granite inselberg	Rock	Specimen	S22°52'27.7" E14°51'10.7"	263
28/6/2010	12h00	TRS	Sheet rock	Gravel & sand	Specimen	S22°56'36.1" E14°57'36.6"	351
28/6/2010	12h05	TRS	Sheet rock	Gravel & sand	Specimen	S22°56'38.5" E14°57'34.0"	358
28/6/2010	12h24	TRS	Rocky outcrop	Gravel & sand	Specimen	S22°56'46.0" E14°57'34.2"	368
28/6/2010	13h05	TRS	Sheet rock	Gravel & sand	Specimen	S22°57'08.8" E14°58'28.2"	381
28/6/2010	14h12	INCA	Boulders	Gravel & sand	Specimen	S22°49'10.8" E14°58'53.6"	331
28/6/2010	14h40	Tubas North	Boulders	Gravel & sand	Specimen	S22°46'32.3" E14°58'39.3"	424
28/6/2010	14h53	Tubas	Boulders	Gravel &	Specimen	S22°46'29.6"	427

		North		sand		E14°58'47.8"	
28/6/2010	15h15	Tubas North	Boulders	Gravel & sand	Specimen	S22°46'47.5" E14°59'50.4"	440

Status:

Endemic & Secure (Griffin 2003)

Distribution:

Coastal regions of the Namib Desert from Kuiseb River northwards to south-western Angola (Branch 1998, Griffin 2003)

Potential proportion of taxon's range:

± 95%; extralimital range to southern Angola (Griffin 2003)

Habitat:

Rocky desert & sheet rock substrate (Branch 1998, Griffin 2003)

Diet:

Mainly ants and other smaller insects (Alexander & Marais 2007)



Figure 1. *Rhoptropus afer*.

Pachydactylus bicolor

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
25/6/2010	13h04	INCA	Drainage line	Gravel & sand	Specimen	S22°50'50.2" E14°55'03.1"	306

Status:

Endemic & Secure (Griffin 2003)

Distribution:

North western and central Namibia (Branch 1998, Griffin 2003)

Potential proportion of taxon's range:

100% endemic (Griffin 2003)

Habitat:

Rocky semi desert (Branch 1998)

Diet:

Very little known (Alexander & Marais 2007)



Figure 2. *Pachydactylus bicolor*.

Pachydactylus kochii

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
25/6/2010	18h00	INCA	Gravel plains	Gravel & sand	Specimen	S22°50'00.6" E14°54'32.9"	317

Status:

Endemic & Secure (Griffin 2003)

Distribution:

Kuiseb to Hoanib Rivers in coastal Namib (Griffin 2003)

Potential proportion of taxon's range:

100% endemic (Griffin 2003)

Habitat:

Open sandy plains with scattered boulders (Branch 1998)

Diet:

Unknown

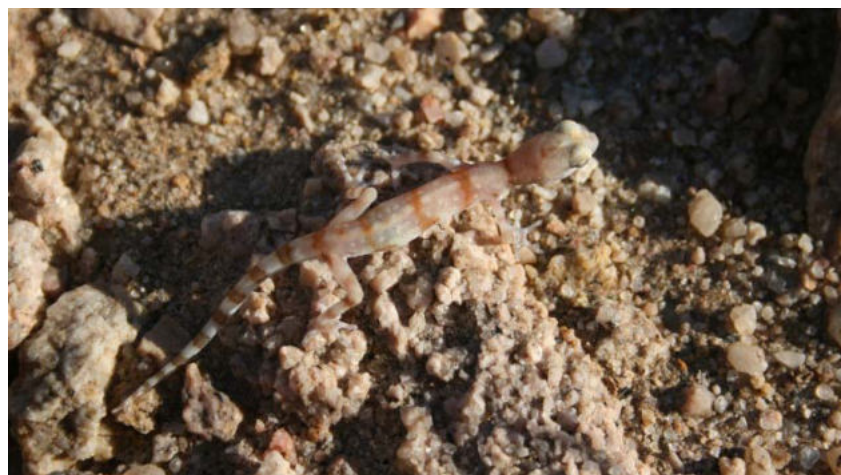


Figure 3. *Pachydactylus kochii*.

Pachydactylus punctatus

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
25/6/2010	18h45	INCA	Gravel	Gravel &	Specimen	S22°49'54.1"	319

			plains	sand		E14°54'18.5"	
26/6/2010	18h19	TRS	Gravel terrace	Gravel & sand	Specimen	S22°52'24.3" E14°54'10.2"	290

Status:

Secure (Griffin 2003)

Distribution:

Entire country except coastal desert belt (Branch, Griffin 2003)

Potential proportion of taxon's range:

Marginal, extralimital range to Angola, Botswana & South Africa (Griffin 2003)

Habitat:

Varied – arid desert to dry savannah (Branch 1998)

Diet:

Small invertebrates (Branch 1998)

Figure 4. *Pachydactylus punctatus*.***Chondrodactylus angulifer namibensis***

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
27/6/2010	19h32	TRS	Gravel plains	Gravel & sand	Specimen	S22°52'34.7" E14°55'57.6"	306
27/6/2010	19h49	INCA	Gravel plains	Gravel & sand	Specimen	S22°49'12.4" E14°54'04.3"	329

Status:

Endemic & Secure (Griffin 2003)

Distribution:

Namib Desert from Lüderitz to western Koakoveld (Branch, Griffin 2003)

Potential proportion of taxon's range:

100% endemic and 40% for the nominate taxon (Griffin 2003)

Habitat:

Gravel plains, inter-dune space and sandy flats (Branch 1998)

Diet:

Termites, moths, beetles, spiders and other smaller reptiles (Branch 1998)



Figure 5. *Chondrodactylus angulifer namibensis*.

Ptenopus carpi

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
26/6/2010	18h33	TRS	Gravel terrace	Gravel & sand	Specimen	S22°52'25.2" E14°54'17.4"	286

Status:

Endemic & Secure (Griffin 2003)

Distribution:

Coastal Namib Desert from the Kuiseb River to Rocky Point (Griffin 2003)

Potential proportion of taxon's range:

100% (Griffin 2003)

Habitat:

Flat barren gravel plains (Branch 1998)

Diet:

Termites are important prey (Alexander & Marais 2007)



Figure 6. *Ptenopus carpi*.

Ptenopus garrulus maculatus

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
27/6/2010	19h15	TRS	Drainage line	Gravel & sand	Specimen	S22°53'03.4" E14°56'09.0"	298
28/6/2010	18h11	TRS	Drainage line	Gravel & sand	Specimen	S22°52'11.7" E14°58'53.6"	334

Status:

Endemic & Secure (Griffin 2003)

Distribution:

Western, central and southern Namibia and Karoo in South Africa (Griffin 2003)

Potential proportion of taxon's range:

70% of subspecies range and 40% of the nominate taxon; extralimital range to South Africa (Griffin 2003)

Habitat:

Desert and semi-desert with sparse vegetation (Branch 1998)

Diet:

Termites, ant and small beetles (Branch 1998)



Figure 7. *Ptenopus garrulus maculatus*.

Meroles suborbitalis

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
26/6/2010	14h40	TRS	Drainage line	Gravel & sand	Specimen	S22°52'34.1" E14°54'14.3"	285
27/6/2010	10h45	TRS	Drainage line	Gravel & sand	Specimen	S22°53'15.8" E14°51'52.1"	247
27/6/2010	12h05	TRS	Drainage line	Gravel & sand	Specimen	S22°53'00.2" E14°56'27.9"	308

Status:

Endemic & Secure (Griffin 2003)

Distribution:

Central parts of the Namib Desert, southern Namibia and central Karoo and Namaqualand in South Africa (Branch 2003)

Potential proportion of taxon's range:

± 65%; extralimital range to Botswana and South Africa (Griffin 2003)

Habitat:

Varied – arid savannah to (Branch 1998)

Diet:

Bees, beetles, grasshoppers & termites (Branch 1998)



Figure 8. *Meroles suborbitalis*.

Psammophis leightoni namibensis

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
26/6/2010	12h42	TRS	Gravel plains	Gravel & sand	Specimen	S22°51'52.3" E14°58'26.5"	322

Status:

Secure (Griffin 2003)

Distribution:

South-western Angola, Namib Desert and pro-Namib escarpment and Namaqualand (Branch, Griffin 2003)

Potential proportion of taxon's range:

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

Habitat:

Varied – desert & semi-desert and entering savannah (Branch 1998)

Diet:

Small vertebrates – rodents & lizards and even other snakes (Alexander & Marais 2007, Branch 1998)

Figure 9. *Psammophis leightoni namibensis*.***Bitis caudalis***

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
27/6/2010	N/A	TRS	Drainage line	Gravel & sand	Discarded skin	S22°53'01.8" E14°56'12.7"	300

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 10. Discarded *Bitis caudalis* skin.

1.3.2 Amphibian Diversity

The amphibian diversity known and/or expected to occur in the general Swakopmund area according to the literature study, as no species were actually observed or confirmed during the field work conducted between 25 and 29 June 2010, is presented below:

Species: Scientific name	Species: Common name	Status
Toads		
<i>Amietophrynus (Bufo) poweri</i>	Western Olive Toad	
<i>Poyntonophrynus (Bufo) hoeschi</i>	Hoesch's Pygmy Toad	Endemic
Rubber Frog		
<i>Phrynomantis annectens</i>	Marbled Rubber Frog	Endemic
Sand Frogs		
<i>Tomopterna tandyi</i>	Tandy's Sand Frog	
Platannas		
<i>Xenopus laevis</i>	Common Platanna	

Source for literature review: Carruthers (2001), Channing (2001), Channing & Griffin (1993), Du Preez & Carruthers (2009), Passmore & Carruthers (1995)

According to Mendelsohn *et al.* (2002), the overall frog diversity in the general Swakopmund area is estimated at between 1-3 species. Griffin (1998b) puts the species richness in the general area at 2 species. According to the literature, at least 5 species of amphibians can occur in suitable habitat in the general Swakopmund area.

No amphibians were observed during the fieldwork conducted between 25 and 29 June 2010. The area is extremely marginal with very little rainfall (<50mm annual average) generally occurring in the area and being highly variable (>100% coefficient of variation) and sporadic of nature (Mendelsohn *et al.* 2002). During this period there was no surface water (observed & confirmed) in the Tumas River and its tributaries or any other source – e.g. temporary pools in granite hollows, etc.

However, the area undoubtedly has suitable, albeit temporary of nature, amphibian habitat during the rainy season (or where rainfall does occur) when pools could collect in Tumas River and its tributaries and more especially in rocky hollows. The amphibians expected in the general area are however not expected to be exclusively associated with the INCA and TRS areas with the 2 endemics that could potentially occur in the area occurring widespread throughout Namibia and not specifically associated with the proposed development sites.

1.3.3 Mammal Diversity

The mammal diversity known and/or expected to occur in the general Swakopmund area according to the literature study, including species actually observed (√) and confirmed (#Andrew Cunningham) during the field work conducted between 25 and 29 June 2010, is presented below:

Species: Scientific name	Species: Common name	Species observed	Namibian conservation & legal status	International Status
Moles				
<i>Eremitalpa granti</i>	Grant's Golden Mole		Endemic; Secure	^{1,2} Vulnerable
Elephant Shrews				
<i>Macroscelides proboscideus flavicaudatus</i>	Round-eared Elephant-shrew	√	Endemic; Secure	² Vulnerable
Bats				

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<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat		Secure	
<i>Cistugo seabrai</i>	Namibian Wing-gland Bat		Endemic; Rare	¹ Vulnerable ² Near Threatened
<i>Laephotis namibensis</i>	Namib Long-eared Bat		Endemic; Insufficiently known	² Endangered
<i>Nycteris thebaica</i>	Egyptian Slit-faced Bat		Secure	
<i>Rhinolophus clivus</i>	Geoffroy's Horseshoe Bat		Secure	¹ Near Threatened
Hares & Rabbits				
<i>Lepus capensis</i>	Cape Hare	√	Secure	
Rodents				
Porcupine				
<i>Hystrix africaeaustralis</i>	Cape Porcupine	√	Secure	
Rats & Mice				
<i>Petromys typicus</i>	Dassie Rat		Endemic; Secure	¹ Near Threatened
<i>Rhabdomys pumilio</i>	Four-striped Grass Mouse	√	Secure	
<i>Mastomys coucha</i>	Southern Multimammate Mouse		Secure	
<i>Aethomys chrysophilus</i>	Red Veld Rat		Secure	
<i>Micaelamys (Aethomys) namaquensis</i>	Namaqua Rock Mouse		Secure	
<i>Protomys littledalei namibensis</i>	Littledale's Whistling Rat		Endemic	¹ Near Threatened
<i>Desmodillus auricularis</i>	Cape Short-tailed Gerbil		Secure	
<i>Gerbillurus paeaba infernus</i>	Hairy-footed Gerbil		Endemic; Insufficiently Known	
<i>Gerbillurus setzeri</i>	Setzer's Hairy-footed Gerbil		Endemic	
<i>Petromyscus collinus</i>	Pygmy Rock Mouse		Endemic; Secure	
<i>Mus musculus</i>	House Mouse		Invasive alien	
<i>Rattus rattus</i>	House Rat		Invasive alien	
<i>Rattus norvegicus</i>	Brown Rat		Invasive alien	
Carnivores				
<i>Parahyaena (Hyaena) brunnea</i>	Brown Hyena	√	Insufficiently known; (Vulnerable?) Peripheral	¹ Near Threatened; ² Endangered
<i>Crocuta crocuta</i>	Spotted Hyena		Secure?; Peripheral	¹ Near Threatened
<i>Felis silvestris/lybica</i>	African Wild Cat		Vulnerable	CITES Appendix II
<i>Suricata suricatta marjoriae</i>	Suricate	#	Endemic; Secure	
<i>Otocyon megalotis</i>	Bat-eared Fox	√	Vulnerable?; Peripheral	
<i>Vulpes chama</i>	Cape Fox		Vulnerable?	
<i>Canis mesomelas</i>	Black-backed Jackal	√	Secure; Problem animal	
<i>Ictonyx striatus</i>	Striped Polecat		Secure	
Pigs				
<i>Phacochoerus africanus</i>	Common Warthog	#	Secure; Huntable	

			Game	
Antelopes				
<i>Oryx gazella</i>	Gemsbok	√	Secure; Huntable game	
<i>Tragelaphus strepsiceros</i>	Greater Kudu	√	Secure; Huntable Game	
<i>Sylvicapra grimmia</i>	Common Duiker		Secure	
<i>Antidorcas marsupialis</i>	Springbok	√	Secure; Huntable 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) & Taylor (2000)

Overall terrestrial diversity and endemism – all species – is classified as “low” and “average” respectively in the western coastal part of Namibia with the overall mammal diversity in the general Swakopmund area estimated at between 16-30 species with 3-4 species being endemic to the area (Mendelsohn *et al.* 2002). Griffin (1998c) puts the species richness distribution of endemics also between 3-4 species in the general area while the Namib-Naukluft Park has an estimated 80 species in total and the neighbouring Skeleton Coast National Park has at least 87 species of mammals. According to the literature at least 31 species of mammals are known and/or expected to occur in the general Swakopmund area of which 9 species (29%) are classified as endemic.

A total of 12 species of mammals were observed and/or confirmed during the fieldwork conducted between 25 and 29 June 2010. Evidence of 4 more mammal species not included in the original literature review – Porcupine, Warthog, Bat-eared Fox and Kudu – were encountered and/or confirmed during the fieldwork thus bringing the total for mammals expected from the general area to 35 species. However, Warthog and Kudu are species that are expected to occasionally pass through the area, depending on environmental conditions, and not thought to remain in the area throughout the year due to the overall marginal habitat for these species.

Species that probably don't occur in the area due to habitat limitations – e.g. to dry, no permanent water bodies, lack of suitable sandy dunes, etc. – as observed whilst conducting the fieldwork in the area (although indicated as possibly occurring in the area during the literature study) are *Eremitalpa granti* (lack of suitable sandy areas) and the invasive alien rats – *Rattus rattus* & *Rattus norvegicus* (usually commensally with humans).

The small mammal trapping with a potential maximum capture of 80 rodents resulted in only 2 captures of 2 species – *Macroscelides proboscideus flavicaudatus* (Round-eared Elephant Shrew) & *Rhabdomys pumilio* (Four-striped Grass Mouse). The “capture success” of only 2.5% is indicative of the general marginal habitat and dry season. Rodents are typically “boom-and-bust” species with higher densities expected during the rainy season with an increase in grass cover and available food. Eagle owl pellets located in the area were analysed and also only included *Rhabdomys pumilio* remains as identified from skull/tooth structure.

Of the 12 species observed and/or confirmed from the area during the fieldwork the Round-eared Elephant Shrew (*Macroscelides proboscideus flavicaudatus*) and Bat-eared Fox (*Otocyon megalotis*) are viewed as the most important with conservation and legal status of endemic (vulnerable) and vulnerable/peripheral, respectively.

Although the bats viewed as most important from the general area – Namibian Wing-gland Bat (*Cistugo seabrai*) & Namib Long-eared Bat (*Laephotis namibensis*) – potentially occur in the area, no bats were observed during the fieldwork.

According to Griffin (1998c) habitat alteration and overutilization are the two primary processes threatening most mammals in Namibia, none of the species expected and/or observed/confirmed are expected to be exclusively associated with the INCA and TRS areas.

1.3.3.1 Species accounts:

Mammals encountered during a survey of the INCA & TRS areas:

During the fieldwork, 12 species of mammals were confirmed either through direct observations (10 species) or as confirmed sightings (A. Cunningham pers. com.) at various locations in the INCA and TRS areas.

Of the 12 species confirmed from the INCA and TRS areas area 4 species have some form of conservation and legal status of concern – i.e. 2 species are classified as endemic, 1 species as endangered, 3 species as vulnerable and 1 species as near threatened (Griffin 2005). Some species have more than 1 classification. These species are:

Endemic

- *Macroselides proboscideus flavicaudatus* (100% of subspecies range in Namibia & 50% for the species)
- *Suricata suricatta marjoriae* (100% endemic)

Endangered (IUCN)

- *Parahyaena (Hyaena) brunnea* (\pm 25%; extralimital range to Angola, Botswana & South Africa)

Vulnerable (IUCN & Namibian legislation)

- *Macroselides proboscideus flavicaudatus* (100% of subspecies range in Namibia & 50% for the species) - IUCN
- *Parahyaena (Hyaena) brunnea* (\pm 25%; extralimital range to Angola, Botswana & South Africa) - IUCN
- *Otocyon megalotis* (\pm 30%; extralimital range to all neighbouring countries) – Namibian legislation

Near threatened (SARDB)

- *Parahyaena (Hyaena) brunnea* (\pm 25%; extralimital range to Angola, Botswana & South Africa)

The location of the small mammal traps was as follows:

1. Sandy gravel drainage line dominated by *Arthroerua leubnitziae* & *Zygophyllum stapffii*.
 - 20 traps placed at 30m intervals.
 - 0 captures



Figure 11. Sherman small mammal trap set under *Zygophyllum stapfii* shrub

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
26/6/2010	N/A	INCA	Drainage line	Gravel & sand	0 captures	S22°51'52.3" E14°58'26.5"	317

2. Sandy gravel drainage line dominated by *Salsola nollothensis*, *Arthroa leubnitziae* & *Galenia africana*.

- 20 traps placed at 30m intervals.

- 1 capture (*Macroscelides proboscideus flavicaudatus*)



Figure 12. *Macroscelides proboscideus flavicaudatus*.

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
27/6/2010	N/A	TRS	Drainage line	Gravel & sand	1 capture	S22°52'45.9" E14°54'19.5"	281

3. Granite inselberg

- 20 traps placed at 30m intervals.

- 1 capture (*Rhabdomys pumilio*)



Figure 13. *Rhabdomys pumilio*.

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
28/6/2010	N/A	TRS	Granite Inselberg	Rock	1 capture	S22°52'23.1" E14°51'18.7"	249

4. Sandy gravel drainage line dominated by *Arthroerua leubnitziae*, *Zygophyllum stapffii* & *Salsola nollothensis*.
 - 20 traps placed at 30m intervals.
 - 0 captures

Date	Time	Area	Habitat	Substrate	Observation	Coordinates	Elevation (m)
29/6/2010	N/A	TRS	Drainage line	Gravel & sand	0 captures	S22°52'11.4" E14°56'08.5"	309

The following figures are evidence confirming the presence of some of the mammals observed in the INCA and TRS areas:



Figure 14. Kudu (sub-adult) horn remains.



Figure 15. Oryx tracks.



Figure 16. Adult male springbok.



Figure 17. Black-backed jackal track.



Figure 18. Bat-eared foxes.



Figure 19. Cape porcupine faeces.



Figure 20. Cape hare faeces.

1.3.4 Avian Diversity

The avian diversity known and/or expected to occur in the general Swakopmund area according to the literature study, including species actually observed (✓) during the field work conducted between 25 and 29 June 2010, is presented below. Birds previously sighted in the general area are also indicated as the author's personal observations (*). This table excludes coastal marine birds although some may occasionally occur in the area (e.g. gulls & terns), migratory birds (e.g. Petrel, Albatross, Skua, etc.) and species breeding extralimital (e.g. stints, sandpipers, etc.) and rather focuses on birds that are breeding residents or can be found in the area during any time of the year. This would imply that many more birds (e.g. Palearctic migrants) could occur in the area depending on "favourable" environmental conditions.

Species: Scientific name	Species: Common name	Species observed	Status - Namibia	Status – Southern Africa
<i>Struthio camelus</i>	Common Ostrich	✓		
<i>Pternistis adspersus</i>	Red-billed Spurfowl			Near

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				endemic
<i>Numida meleagris</i>	Helmeted Guineafowl			
<i>Dendropicos namaquus</i>	Bearded Woodpecker			
<i>Tockus monteiri</i>	Monteiro's Hornbill		Endemic	
<i>Tockus damarensis</i>	Damara Hornbill		Endemic	Near endemic
<i>Tockus leucomelas</i>	Southern yellow-billed Hornbill			Near endemic
<i>Tockus nasutus</i>	African Grey Hornbill			
<i>Upupa africana</i>	African Hoopoe			
<i>Phoeniculus purpureus</i>	Green Wood-Hoopoe			
<i>Rhinopomastus cyanomelas</i>	Common Scimitarbill			
<i>Colius colius</i>	White-backed Mousebird			Endemic
<i>Urocolius indicus</i>	Red-faced Mousebird			
<i>Poicephalus rueppellii</i>	Rüppell's Parrot		Endemic	Near endemic
<i>Agapornis roseicollis</i>	Rosy-faced Lovebird		Endemic	Near endemic
<i>Cypsiurus parvus</i>	African Palm Swift			
<i>Tachymarptis melba</i>	Alpine Swift			
<i>Apus bradfieldi</i>	Bradfield's Swift			Near endemic
<i>Apus affinis</i>	Little Swift			
<i>Apus caffer</i>	White-rumped Swift			
<i>Corythaixoides concolor</i>	Grey Go-away Bird			
<i>Tyto alba</i>	Barn Owl			
<i>Ptilopsis granti</i>	Southern White-faced Scops Owl			
<i>Bubo capensis</i>	Cape Eagle-Owl			
<i>Bubo africanus</i>	Spotted Eagle Owl	√		
<i>Bubo lacteus</i>	Verreaux's Eagle-Owl			
<i>Glaucidium perlatum</i>	Pearl-spotted Owlet			
<i>Asio capensis</i>	Marsh Owl			
<i>Columba livia</i>	Rock Dove	*		
<i>Columba guinea</i>	Speckled Pigeon			
<i>Streptopelia capicola</i>	Cape Turtle Dove			
<i>Streptopelia senegalensis</i>	Laughing Dove			
<i>Oena capensis</i>	Namaqua Dove	*		
<i>Neotis ludwigii</i>	Ludwig's Bustard			Near endemic
<i>Ardeotis kori</i>	Kori Bustard			
<i>Eupodotis rueppellii</i>	Rüppell's Korhaan	√	Endemic	Near endemic
<i>Pterocles namaqua</i>	Namaqua Sandgrouse	*		Near endemic
<i>Pterocles bicinctus</i>	Double-banded Sandgrouse			Near endemic
<i>Vanellus armatus</i>	Blacksmith Lapwing			
<i>Rhinoptilus africanus</i>	Double-banded Courser			
<i>Elanus caeruleus</i>	Black-shouldered Kite			
<i>Aegypius tracheliotos</i>	Lappet-faced Vulture	*		
<i>Circaetus pectoralis</i>	Black-chested Snake-Eagle			
<i>Melierax canorus</i>	Southern Pale Chanting Goshawk	*		Near endemic
<i>Melierax gabar</i>	Gabar Goshawk			
<i>Buteo augur</i>	Augur Buzzard			

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<i>Aquila verreauxii</i>	Verreaux's Eagle			
<i>Polemaetus bellicosus</i>	Martial Eagle			
<i>Sagittarius serpentarius</i>	Secretarybird			
<i>Falco rupicolus</i>	Rock Kestrel	*		
<i>Falco rupicoloides</i>	Greater Kestrel	*		
<i>Falco chicquera</i>	Red-necked Falcon			
<i>Falco biarmicus</i>	Lanner Falcon	*		
<i>Falco peregrinus</i>	Peregrine Falcon			
<i>Egretta garzetta</i>	Little Egret			
<i>Ardea cinerea</i>	Grey Heron			
<i>Ardea melanocephala</i>	Black-headed Heron			
<i>Bubulcus ibis</i>	Cattle Egret			
<i>Scopus umbretta</i>	Hamerkop			
<i>Dicrurus adsimilis</i>	Fork-tailed Drongo			
<i>Nilous afer</i>	Brubru			
<i>Tchagra australis</i>	Brown-crowned Tchagra			
<i>Telophorus zeylonus</i>	Bokmakierie			Near endemic
<i>Batis pririt</i>	Pirit Batis			Near endemic
<i>Corvus capensis</i>	Cape Crow	*		
<i>Corvus albus</i>	Pied Crow	√		
<i>Lanius collaris</i>	Common Fiscal			
<i>Parus cinerascens</i>	Ashy Tit			Endemic
<i>Riparia paludicola</i>	Brown-throated Martin			
<i>Hirundo albigularis</i>	White-throated Swallow			
<i>Hirundo dimidiata</i>	Pearl-breasted Swallow			
<i>Hirundo fuligula</i>	Rock Martin	√		
<i>Pycnonotus nigricans</i>	African Red-eyed Bulbul			Near endemic
<i>Sylvietta rufescens</i>	Long-billed Crombec			
<i>Eremomela icteropygialis</i>	Yellow-bellied Eremomela			
<i>Eremomela gregalis</i>	Karoo Eremommela			Endemic
<i>Parisoma layardi</i>	Layard's Tit-Babbler			Endemic
<i>Parisoma subcaeruleum</i>	Chestnut-vented Tit-Babbler			Near endemic
<i>Zosterops pallidus</i>	Orange River White-eye			Endemic
<i>Cisticola subruficapilla</i>	Grey-backed Cisticola			Near endemic
<i>Cisticola juncidis</i>	Zitting Cisticola			
<i>Cisticola jaridulus</i>	Desert Cisticola			
<i>Prinia flavicans</i>	Black-chested Prinia			
<i>Mirafra sabota</i>	Sabota Lark			
<i>Ammomanopsis grayi</i>	Gray's Lark	√	Endemic	
<i>Certhilauda subcoronata</i>	Karoo Long-billed Lark			Endemic
<i>Eremopterix verticalis</i>	Grey-backed Sparrowlark			Near endemic
<i>Calandrella cinerea</i>	Red-capped Lark			
<i>Alauda starki</i>	Stark's Lark	*		Near endemic
<i>Bradornis infuscatus</i>	Chat Flycatcher			Near endemic
<i>Melaenornis mariquensis</i>	Marico Flycatcher			Near endemic
<i>Muscicapa striata</i>	Spotted Flycatcher			
<i>Cercotrichas paena</i>	Kalahari Scrub-Robin	*		
<i>Namibornis herero</i>	Herero Chat		Endemic	Near

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				endemic
<i>Oenanthe monticola</i>	Mountain Wheatear	*		Near endemic
<i>Oenanthe pileata</i>	Capped Wheatear			
<i>Cercomela schlegelii</i>	Karoo Chat			Near endemic
<i>Cercomela tractrac</i>	Tractrac Chat	√		Near endemic
<i>Cercomela familiaris</i>	Familiar Chat			
<i>Myrmecocichla formicivora</i>	Ant-eating Chat			Endemic
<i>Onychognathus nabouroup</i>	Pale-winged Starling	*		Near endemic
<i>Lamprotornis nitens</i>	Cape Glossy Starling			
<i>Creatophora cinerea</i>	Wattled Starling			
<i>Chalcomitra senegalensis</i>	Scarlet-chested Sunbird			
<i>Nectarinia fusca</i>	Dusky Sunbird			Near endemic
<i>Sporopipes squamifrons</i>	Scaly-feathered Finch			Near endemic
<i>Plocepasser mahali</i>	White-browed Sparrow-Weaver			
<i>Philetairus socius</i>	Sociable Weaver			Endemic
<i>Ploceus velatus</i>	Southern Masked-Weaver			
<i>Quelea quelea</i>	Red-billed Quelea			
<i>Amadina erythrocephala</i>	Red-headed Finch			Near endemic
<i>Estrilda erythronotos</i>	Black-faced Waxbill			
<i>Estrilda astrild</i>	Common Waxbill			
<i>Passer domesticus</i>	House Sparrow			
<i>Passer motitensis</i>	Great Sparrow	√		Near endemic
<i>Passer melanurus</i>	Cape Sparrow			Near endemic
<i>Passer griseus</i>	Southern Grey-headed Sparrow			
<i>Motacilla capensis</i>	Cape Wagtail			
<i>Crithagra atrogulariis</i>	Black-throated Canary			
<i>Serinus flaviventris</i>	Yellow Canary			Near endemic
<i>Serinus albogularis</i>	White-throated Canary			Near endemic
<i>Emberiza impetuani</i>	Lark-like Bunting	*		Near endemic
<i>Emberiza tahapisi</i>	Cinnamon-breasted Bunting			
<i>Emberiza capensis</i>	Cape Bunting	*		Near endemic

Source for literature review: Brown *et al.* (1998), Hockey *et al.* (2006), Komen (n.d.), Maclean (1985) & Tarboton (2001)

Endemic & near endemic (Hockey *et al.* 2006)

Bird diversity is viewed as “average” in the general Swakopmund area with 141-170 species estimated and 1-3 species being endemic (Mendelsohn *et al.* 2000). Simmons (1998a) suggests 4-6 endemic species and an “low to average” ranking for southern African endemics and “high” ranking for southern African red data birds expected from the general area. Although at least 124 species of terrestrial [“breeding residents”] birds potentially occur in the general Swakopmund area at any time (Hockey *et al.* 2006, Maclean 1985, Tarboton 2001),

very few – only 8 – species were observed during the fieldwork conducted between 25 and 29 June 2010. At least 15 other species have previously been observed in the general area (pers. obs.).

The period of observation (field work) – i.e. dry season – and general sparseness of the vegetation together with the overall marginal environment, contributes to the lack of bird observations from the area. Birds are undoubtedly affected by localised rainfall events (and the short flowering period of most of the vegetation) with many more species expected to occur in the area under more favourable conditions.

1.3.4.1 Species accounts:

Birds encountered during a survey of the INCA & TRS areas:

During the fieldwork, 8 species of birds were confirmed through direct observations in the INCA and TRS areas with another 15 species as confirmed sightings using the authors own personal records from the general area (Cunningham pers. obs.).

Of the 8 species actually observed from the INCA and TRS areas 2 species are classified as endemic (Simmons 1998a) and 3 species as near-endemic to southern Africa (Hockey *et al.* 2006). Some species have more than one classification. These species are:

Endemic

- *Eupodotis rueppellii*
- *Ammomanopsis grayi*

Near-endemic

- *Eupodotis rueppellii*
- *Cercomela tractrac*
- *Passer motitensis*

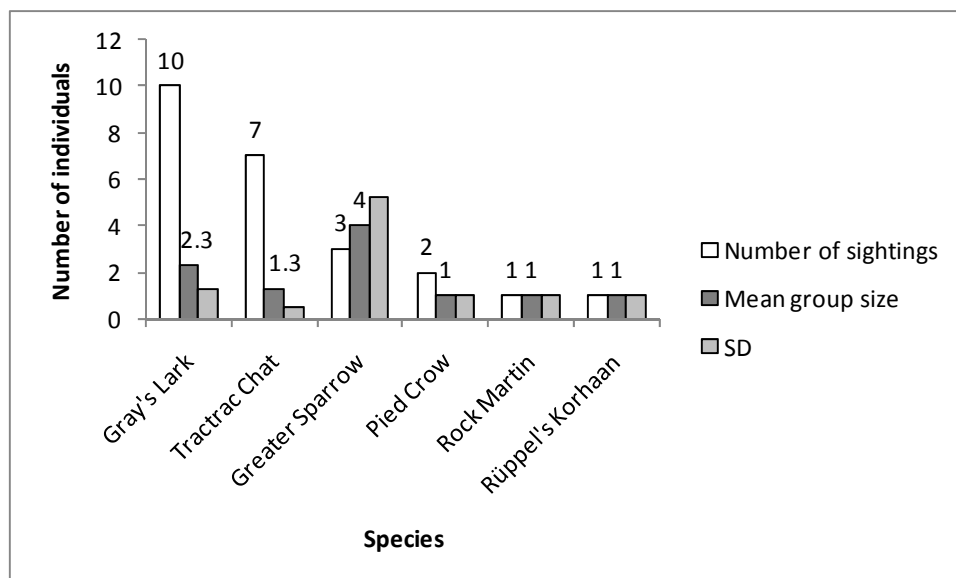


Figure 21. Birds observed at INCA & TRS during the fieldwork conducted between 25 and 29 June 2010 including mean group size and SD.

Ostrich tracks, faeces and old nesting sites (i. 22°51'34.9"S; 14°55'58.4"E & ii. 22°52'47.6"S; 14°52'34.4"E) and Eagle Owl feathers and pellets confirmed their presence in the area and are not included in Figure 21.



Figure 22. Eagle owl pellets (with prey remains) and feathers confirming their presence in the area.

1.4 Conclusion

Reptiles

Of the 56 species of reptiles expected to occur in the general Swakopmund area, of which a high percentage are viewed as endemic (55.4%), only 14 species were observed and/or confirmed during the fieldwork conducted between 25 and 29 June 2010.

All 14 species observed and/or confirmed from the area, are viewed as “secure” including the 9 endemic species (Griffin 2003). *Ptenopus carpi* (Carp’s Barking Gecko) is viewed as the most important species observed during the fieldwork as their range is limited in Namibia (Kuseb River to Rocky Point on barren gravel plains) and they are nowhere common. Other reptile species of concern and expected to occur in the general area, are the endemic *Afroedura africana africana* (African Flat Gecko), *Pedioplanis husabensis* (Husab Sand Lizard), *Leptotyphlops occidentalis* (Western Thread Snake) and *Lycophidion namibianum* (Namibian Wolf Snake). Although the endemic *Pedioplanis husabensis* potentially occurs in the area, none were observed although they are known to occur in the Valencia area towards the northeast (Cunningham 2007).

Sedentary species – e.g. most species including all geckos – will be adversely affected by the proposed mining developments, however none of the reptiles observed and/or confirmed from the area are exclusively associated with the proposed mining areas.

Amphibians

Amphibians are not viewed as important throughout the INCA and TRS areas although the ephemeral Tumas drainage lines might occasionally serve as temporary habitat. *Poyntonophrynus (Bufo) hoeschi* & *Phrynomantis annectens* are viewed as the most important although they are not exclusively associated with the proposed mining areas.

Amphibians are not expected to be detrimentally affected by mining development in the area.

Mammals

Of the 12 species observed and/or confirmed from the area during the fieldwork the Round-eared Elephant Shrew (*Macroscelides proboscideus flavicaudatus*), Bat-eared Fox (*Otocyon megalotis*) are viewed as the most important with conservation and legal status of endemic (vulnerable) and vulnerable/peripheral, respectively. Another important species is the Brown Hyena *Parahyaena (Hyaena) brunnea* which is classified as “insufficiently known” and probably “vulnerable” in Namibia (Griffin 2005), but occurs widespread throughout the coastal areas.

Other important species expected to occur in the general area, although not confirmed during the fieldwork, are the Namibian Wing-gland Bat (*Cistugo seabrai*), Namib Long-eared Bat (*Laephotis namibensis*) and Littledale's Whistling Rat (*Protomys littledalei namibensis*). *Protomys littledalei namibensis* is known from the better vegetated areas in the Swakop and Kuiseb River mouth areas and probably only occurs in the Tumas drainage lines under exceptionally wet periods. However, very little is known of this subspecies.

Sedentary species – e.g. rodents – will be adversely affected by the proposed mining developments, however none are exclusively associated with the proposed development areas. Bat-eared Fox and Brown Hyena are also expected to move out of the area with increased mining activities.

Birds

Although 7 of the 14 endemics to Namibia are expected to occur in the general area very few birds were observed during the fieldwork conducted between 25 and 29 June 2010. Although more birds are expected to occur in the area during favourable environmental conditions (e.g. rains and associated vegetative growth spurts), the extremely marginal environment limits the numbers and diversity. The most important species confirmed and/or expected to occur in the general area are *Ammomanopsis grayi* (Gray's Lark), *Namibornis herero* (Herero Chat) and *Eupodotis rueppellii* (Rüppell's Korhaan). *Ammomanopsis grayi* is viewed as the most important species from the area although not threatened and well represented in protected areas throughout coastal Namibia (Dean 1997). No *Namibornis herero* were observed during the fieldwork and they are known to favour the rocky areas towards the northeast – e.g. Spitskoppe, etc. *Eupodotis rueppellii* occurs widespread throughout the western regions of Namibia.

Bird species most likely to be adversely affected by the proposed mining developments in the INCA and TRS areas are the ground nesting species associated with gravel plains such as Gray's Lark and Rüppell's Korhaan. However, none are exclusively associated with these areas and are expected to vacate the area with increased mining activities.

Sensitive areas

The general area is sparsely vegetated and typical of the Central Namib Desert with *Arthroerua leubnitziae* and *Zygophyllum stapffii* shrubs dominating the vegetation strata.

The areas of most concern would be:

i) Drainage lines & associated vegetation

The drainage lines in the INCA and TRS areas are tributaries of the ephemeral Tumas River which drains the general area west towards the coast. These drainage lines are the lifeline for most of the shrubs in the area which is otherwise dominated by sparsely vegetated and/or bare gravel plains. The drainage line terraces and often broken terrain including the associated vegetation serve as habitat to a wide variety of reptiles – e.g. Namib Day Geckos. The few bigger trees – e.g. *Acacia erioloba* (individuals) and *Tamarix usneoides* (main Tumas River channel) – also serve as habitat to a variety of species (e.g. nesting/roosting sites for birds and bark/cavity roosting bats) are also associated with drainage lines.

ii) Rocky outcrops/ridges & inselbergs

Ridges, outcrops and inselbergs are generally viewed as unique habitat for vegetation and fauna not necessarily associated with the surrounding areas. Various geckos are rock and crevasse dwelling species associated with these landforms. Caves and crevasses also serve as roosting site to bats and owls – e.g. Eagle Owl.

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 loss

Faunal loss with the proposed mining development would be localised. The following table indicates the potential/envisaged impacts expected regarding faunal loss (which is obviously closely linked to habitat destruction):

a) Construction Phase

Environmental aspect		Fauna				Phase	Construction
Description: Certain habitats are viewed as sensitive with unique species.							
Mitigation: Sensitive habitats – i.e. drainage lines & rocky outcrops/ridges + inselbergs should be avoided. Off road driving should be prohibited throughout the area. Illegal collection of veld foods, poaching and killing of fauna viewed as dangerous – e.g. snakes & carnivores – should be prohibited. Destruction of habitat – e.g. larger trees – should be avoided.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	2	2	4	24
Potential for irreplaceable loss of resources		yes	Cumulative impacts		additive	Reversibility	probably

b) Operational Phase

Environmental aspect		Fauna				Phase	Operation
Description: Certain habitats are viewed as sensitive with unique species.							
Mitigation: Sensitive habitats – i.e. drainage lines & rocky outcrops/ridges + inselbergs should be avoided. Off road driving should be prohibited throughout the area. Illegal collection of veld foods, poaching and killing of fauna viewed as dangerous – e.g. snakes & carnivores – should be prohibited. Destruction of habitat – e.g. larger trees – should be avoided.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	3	2	4	28
Potential for irreplaceable loss of resources		no	Cumulative impacts		no	Reversibility	yes

c) Decommissioning/Rehabilitation Phase

Environmental aspect		Fauna				Phase	Decommissioning
Description: Certain habitats are viewed as sensitive with unique species.							

Mitigation: Recreate habitats that are favourable to unique species should these have been damaged and/or destroyed during the construction and operational phases – i.e. replant vegetation to recreate the original habitat to lure species (colonisers).

Confidence level	Mitigation required	Evaluation of impacts					Significance
		Nature	Extent	Duration	Intensity	Probability	
high	yes	positive	1	3	3	4	28
Potential for irreplaceable loss of resources		no	Cumulative impacts		no	Reversibility	yes

2. Flora expected in the INCA and TRS EPL 3496 area

2.1 Introduction

A field survey was conducted between 25 and 29 June 2010 to determine the flora (e.g. trees, shrubs & grass) at the INCA (INCA uranium & iron) and TRS (Tubas Red Sands uranium) EPL sites which form part of the Omahola Project run by Reptile Uranium Namibia Pty Ltd (RUN) approximately 40 to 50 km southeast of Swakopmund. The survey was preceded by a comprehensive literature (i.e. desktop study/scoping report) conducted between 9 and 12 June 2010 of flora expected to occur in the general area.

The average plant production is bare ground and extremely low with “very low” (0-5%) variation in green vegetation biomass (Mendelsohn *et al.* 2002). The overall plant diversity (all species - “higher” plants) in the general area is low and estimated at <50 species while the plant endemism is also low with between 1-5 species expected (Mendelsohn *et al.* 2002). Simmons (1998b) puts the plant endemism at between 1 and 30 species depending on the locality.

This field survey was conducted to confirm flora species at the proposed development sites – INCA & TRS – southeast of Swakopmund.

2.2 Methods

2.2.1 Field survey

According to the original TOR, fieldwork to determine the actual floral diversity would include the following:

- Trees & shrubs – species composition
- Trees & shrubs – densities
- Grasses – species composition
- Other species

- All the trees & shrubs encountered in the proposed INCA & TRS development areas were identified whilst conducting the fieldwork in the area – i.e. identification not only limited to transects only.

- Trees & shrubs species composition was conducted along various transects – on foot – throughout the area. The transect directions varied and depended on the terrain. The transect lengths were typically conducted over 2000m. All the different habitats were incorporated.

- Shrub densities (too few trees in area to be included) were determined using standard quadrates of 10x10m along transects in major ephemeral drainage lines. The quadrates were located at 10m intervals along the transects. The number of shrubs were calculated for each quadrate and eventually converted to shrubs per hectare – i.e. “most productive areas” – for drainage lines only.

- All the grasses encountered in the general INCA & TRS areas were identified whilst conducting the fieldwork in the area – i.e. identification not only limited to transects only.

- Other species – i.e. forbs & bulbs, etc. – were also identified whenever encountered.

2.3 Results

2.3.1 Tree & Shrub Diversity

The larger trees & shrubs known and/or expected to occur in the general Swakopmund area (Curtis & Mannheimer 2005, Mannheimer & Curtis 2009), including species actually observed (√) in the INCA & TRS areas during the fieldwork conducted between 25 and 29 June 2010, is presented below:

Species: Scientific name	Species observed	Expected: Curtis & Mannheimer (2005)	Expected: Mannheimer & Curtis (2009)	Status
<i>Acacia erioloba</i>	√	√	√	Protected (F)
<i>Acacia reficiens</i>	√	√	√	
<i>Acacia tortilis</i>		√	√	
<i>Acanthosicyos horridus</i>	√	√	√	Endemic; Protected (F)
<i>Adenia pechuelii</i>		√	√	Endemic; Near threatened
<i>Adenolobus garipensis</i>	√	√	√	
<i>Adenolobus pechuelii</i>			√	
<i>Aloe dichotoma</i>		√	√	Near-endemic; NC, C2
<i>Boscia albitrunca</i>		√	√	Protected (F)
<i>Boscia foetida</i>	√	√	√	
<i>Cadaba aphylla</i>		√	√	
<i>Capparis hereroensis</i>	√		√	Endemic
<i>Combretum imberbe</i>		√	√	Protected (F)
<i>Commiphora dinteri</i>		√	√	Endemic
<i>Commiphora glaucescens</i>		√	√	Near-endemic
<i>Commiphora oblanceolata</i>		√	√	Near-endemic; Near threatened
<i>Commiphora saxicola</i>	√	√	√	Endemic
<i>Commiphora virgata</i>		√	√	Endemic
<i>Commiphora wildii</i>		√	√	Endemic
<i>Cordia sinensis</i>			√	
<i>Euclea pseudebenus</i>	√	√	√	Protected (F)
<i>Euphorbia damarana</i>	√	√	√	Endemic; C2
<i>Euphorbia virosa</i>		√	√	C2
<i>Faidherbia albida</i>		√	√	Protected (F)
<i>Ficus cordata</i>			√	Protected (F)
<i>Ficus sycomorus</i>		√	√	Protected (F)
<i>Gossypium herbaceum</i>			√	
<i>Grewia tenax</i>		√	√	
<i>Gymnosporia senegalensis</i>			√	
<i>Hyphaene petersiana</i>		√	√	
<i>Lycium bosciifolium</i>		√	√	
<i>Lycium cinereum</i>	√	√	√	
<i>Lycium pumilum</i>			√	
<i>Lycium tetrandrum</i>			√	
<i>Maerua juncea</i>		√	√	
<i>Maerua schinzii</i>		√	√	Protected (F)

<i>Parkinsonia africana</i>	√	√	√	Protected (F)
<i>Pechuel-Loeschea leubnitziae</i>	√		√	
<i>Salvadora persica</i>		√	√	
<i>Searsia (Rhus) marlothii</i>		√	√	
<i>Salsola</i> sp. <i>S. aphylla</i> , <i>S. nollothensis</i>	√	√	√	
<i>Tamarix usneoides</i>	√	√	√	Protected (F)
<i>Tetragonia schenckii</i>		√	√	Endemic
<i>Welwitschia mirabilis</i>	√	√	√	Near-endemic; NC, C2
<i>Zygophyllum stapffii</i>	√		√	Endemic

Endemic & Near-endemic (Craven 1999, Curtis & Mannheimer 2005, Mannheimer & Curtis 2009, Mannheimer *et al.* 2008)

F – Forestry Ordinance No. 37 of 1952 and/or Forest Act No. 72 of 1968 (Curtis & Mannheimer 2005)

NC – Nature Conservation Ordinance No. 4 of 1975 (Curtis & Mannheimer 2005)

C2 – CITES Appendix 1 or 2 (Curtis & Mannheimer 2005)

The area is typical of the Central Namib Desert with *Arthroa leubnitziae* and *Zygophyllum stapffii* shrubs dominating the vegetation strata, especially in the ephemeral drainage lines.



Figure 23. Typical scenery with *Arthroa leubnitziae* and *Zygophyllum stapffii* shrubs dominating the vegetation in the drainage lines.

According to Curtis & Mannheimer (2005) and Mannheimer & Curtis (2009) between 35 and 45 species of bigger trees and shrubs are known and/or expected to occur in the general Swakopmund area, respectively. During the fieldwork conducted between 25 and 29 June 2010 16 species of larger trees and shrubs were identified of which 10 have some form of protective status (some species have more than one protective status – see above table). Of these, 5 species are viewed as endemic, 1 species as near-endemic, 5 species protected by Forestry legislation, 1 species protected by Nature Conservation legislation and 2 species with an international status – i.e. CITES Appendix II.

Another 22 species of plants not included in Curtis & Mannheimer (2005) and Mannheimer & Curtis (2009) were also identified in the area:

- *Aloe asperifolia* (NC)
- *Arthroa leubnitziae* (Endemic)
- *Asperagus personii*
- *Blepharis obmitrata*

- *Calicorema capitata*
- *Citrullus ecirrhosus* (Near-endemic)
- *Cotyledon orbiculata*
- *Cyperus marginatus*
- *Euphorbia phylioclada*
- *Galenia africana*
- *Gomphocarpus filiformis*
- *Heliotropium tubulosum*
- *Hexacyrtis dickiana* (Near-endemic)
- *Hoodia pedicellata*
- *Indogophera* sp.
- *Jamesbrittenia maxi*
- *Kleinia longiflora*
- *Radyera urens*
- *Sarcocaulon marlothi*
- *Searsia (Rhus) burchellii*
- *Sesuvium sesuvoides*
- *Trichodesma africanum*

[NC – Nature Conservation Ordinance No. 4 of 1975; Near-endemic – Mannheimer *et al.* 2008]

Aloe asperifolia is widespread throughout the central Namib Desert and often forms dense stands – all Aloe species are protected in Namibia (Rothmann 2004). Although *Arthroa leubnitziae* is viewed as endemic with a limited range and limited to the fog zone of the central Namib it is common throughout this area (Burke 2003a).

Lichens are a notoriously difficult group of organisms to identify with many species visually very similar and often only identifiable with chemical analysis and specific microscopically traits. At least 7 species were observed in the area:

- *Acarospora* sp.
- *Buellia* sp.
- *Caloplaca elegantissima*
- *Caloplaca namibensis*
- *Caloplaca rubelliana*
- *Neofuscelia gr. dregeana*
- *Paraparmelia* sp.



Figure 24. *Paraparmelia* sp. (foliose, grey), *Neofuscelia gr. dregeana* (foliose, dark brown), the placoid and orange *Caloplaca elegantissima* or *C. namibensis* (the two species differ in

small details), *Acarospora* sp. (crustose, yellow), *Caloplaca rubelliana* (reddish) and *Buellia* sp. (crustose, grey).

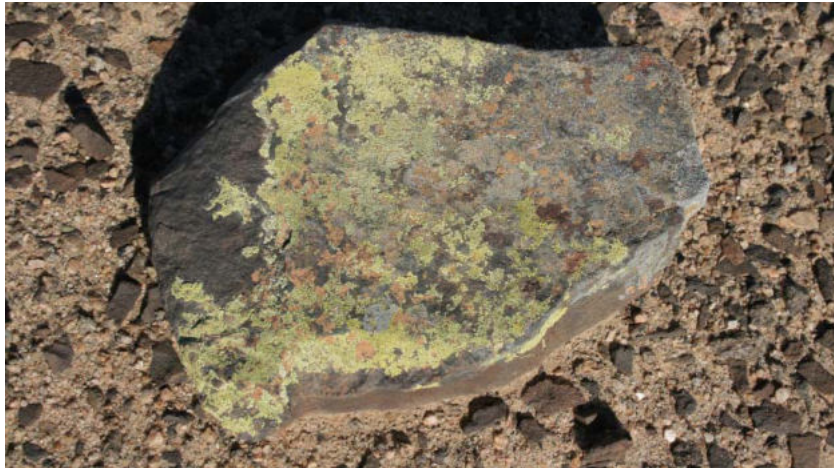


Figure 25. *Acarospora* sp. (crustose, yellow), *Caloplaca rubelliana* (reddish) and *Buellia* sp. (crustose, grey).

One invasive alien species – *Prosopis* spp. – was also observed in the area with 2 specimens (22°53'06.3"S, 14°52'36.8"E & 22°53'04.8"S, 14°52'41.5"E) encountered in the main Tumas River drainage channel in the TRS area.



Figure 26. *Prosopis* spp. in the Tumas River, TRS area.

The most important bigger tree/shrubs observed in the area are viewed as *Capparis hereroensis* (endemic) and *Welwitschia mirabilis* (near-endemic, Nature Conservation ordinance protection & CITES Appendix II).



Figure 27. The endemic *Capparis hereroensis* observed in drainage line in the TRS area.



Figure 28. *Welwitschia mirabilis* (near-endemic, Nature Conservation ordinance protection & CITES Appendix II) located throughout the INCA and TRS areas.

Although *Adenia pechuelii* (endemic & near-threatened) and *Commiphora oblancoolata* (near-endemic & near-threatened) were not observed in the area during the fieldwork they potentially could occur in the area and are also viewed as important species.

2.3.3 Shrub Densities

A mean density of 5.37 ± 2.3 shrubs/10m² (range: 2 to 11 shrubs per 10m²) was determined for the most densely populated areas (i.e. 530 shrubs/ha in the drainage lines) which were the various ephemeral drainage lines dominated by *Arthroa leubnitziae*, *Galenia africana*, *Salsola nollothensis* and *Zygophyllum stapffii* shrubs.

The dominant shrubs observed in the various Tumas River drainage lines throughout the INCA and TRS areas were *Galenia africana* (26.7%), *Zygophyllum stapffii* (22.4%) and *Salsola nollothensis* (18.6%) (Figure 29).

Other areas were very sparsely vegetated with most of the area barren gravel plains.

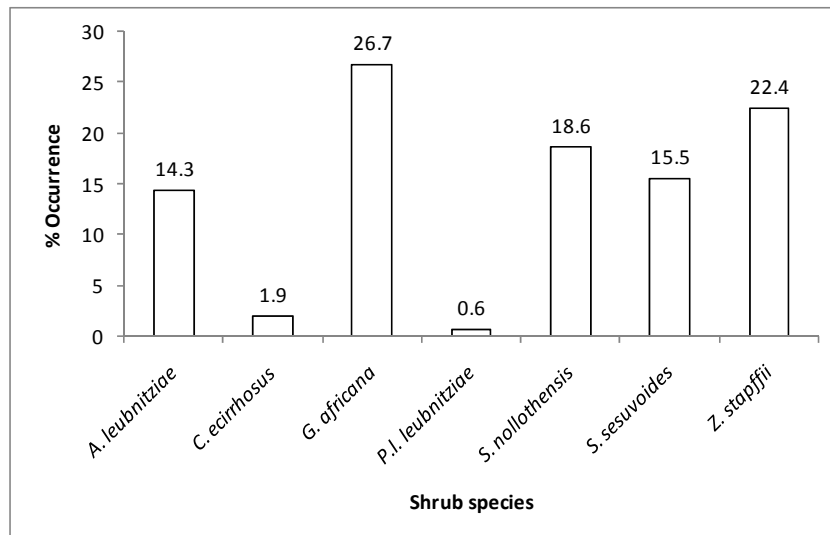


Figure 29. Shrub species composition along various transects (total length - 300m at 10m intervals and included all species within a 10x10m² quadrat) in drainage lines in the INCA & TRS areas.

2.3.3 Grass Diversity

The grasses known and/or expected to occur in the general Swakopmund area (¹Müller 1984, ²Van Oudtshoorn 1999, ³Burke 2003a, ⁴Burke 2003b & ⁵Müller 2007) including species actually observed (✓) in the INCA & TRS areas during the fieldwork conducted between 25 and 29 June 2010, is presented below:

Species: Scientific name	Species observed	Status	Ecological Status	Grazing Value
^{1,2,5} <i>Antheophora pubescens</i>			Decreaser	High
⁵ <i>Antheophora schinzii</i>			?	Low
² <i>Aristida congesta</i>			Increaser 2	Low
⁵ <i>Brachiaria deflexa</i>			Increaser 2	Average
^{1,5} <i>Brachiaria glomerata</i>			?	Average
^{2,3,5} <i>Cenchrus ciliaris</i>			Decreaser	High
^{1,2,3} <i>Centropodia glauca</i>			Decreaser	High
^{2,5} <i>Chloris virgata</i>			Increaser 2	Average
^{2,4} <i>Cladoraphis spinosa</i>			Increaser 1	Average
^{1,2,5} <i>Cynodon dactylon</i>			Increaser 2	High
^{1,2,5} <i>Dactyloctenium aegyptium</i>			Increaser 2	Average
² <i>Enneapogon cenchroides</i>			Increaser 2	Average
^{2,3} <i>Enneapogon desvauxii</i>			Intermediate	Average
^{1,2} <i>Enneapogon scaber</i>			?	Low
² <i>Enneapogon scoparius</i>			Increaser 3	Low
^{1,5} <i>Entoplocamia aristulata</i>			?	Average
^{1,5} <i>Eragrostis annulata</i>			?	Low
² <i>Eragrostis cilianensis</i>			Increaser 2	Low
^{1,2,5} <i>Eragrostis echinochloidea</i>			Increaser 2	Average
² <i>Eragrostis lehmanniana</i>			Increaser 2	Average
^{2,3,5} <i>Eragrostis nindensis</i>			Increaser 2	Average
¹ <i>Eragrostis omahekensis</i>		Endemic		
¹ <i>Eragrostis porosa</i>			Increaser 2	Low
² <i>Eragrostis rotifer</i>			?	Average
^{2,5} <i>Eragrostis superba</i>			Increaser 2	Average
^{2,5} <i>Fingerhuthia africana</i>			Decreaser	Average
² <i>Melinis repens</i>			Increaser 2	Low

^{1,5} <i>Odyssea paucinervis</i>			?	Average
² <i>Oropetium capense</i>			Increaser 2	Low
⁵ <i>Panicum repens</i>			Decreaser	High
⁵ <i>Pennisetum foermeranum</i>		Endemic	?	Low
^{1,5} <i>Pogonarthria fleckii</i>			Increaser 2	Low
² <i>Polypogon monspeliensis</i>			Exotic	Average
² <i>Schmidtia kalahariensis</i>			Increaser 2	Low
^{1,2} <i>Schmidtia pappophoroides</i>			Decreaser	High
¹ <i>Setaria appendiculata</i>			?	Average
² <i>Setaria megaphylla</i>			Decreaser	High
² <i>Setaria verticillata</i>			Increaser 2	Average
² <i>Sporobolus festivus</i>			Increaser 2	Low
^{1,2,3,4,5} <i>Stipagrostis ciliata</i>	√		Decreaser	High
⁴ <i>Stipagrostis geminifolia</i>			?	Average
^{2,5} <i>Stipagrostis hirtigluma</i>			Increaser 2	Low
^{1,5} <i>Stipagrostis hochstetteriana</i>			Decreaser	Low
^{1,2,5} <i>Stipagrostis namaquensis</i>			?	Average
^{3,4} <i>Stipagrostis sabulicola</i>		Endemic	?	?
^{1,2} <i>Stipagrostis obtusa</i>	√		Decreaser	High
^{1,2,5} <i>Stipagrostis uniplumis</i>	√		Increaser 2	Average
^{2,5} <i>Tragus berteronianus</i>			Increaser 2	Low
^{2,5} <i>Tricholaena monachne</i>			Increaser 2	Low
⁵ <i>Triraphis ramosissima</i>			?	High

Endemic & near-endemic – Mannheimer *et al.* (2008)

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

Grass cover is extremely sparse throughout the area and only limited to some of the sandy drainage lines. Although up to 50 grasses are expected in the general Swakopmund area, of which 3 species are viewed as endemic, only 4 species of grass – 3 *Stipagrostis* species (see above table) and *Eragrostis biflora* (not expected to occur in the area according to the literature review) – were observed in the INCA and TRS areas during the fieldwork.

None of the expected endemics – *Eragrostis omahekensis*, *Pennisetum foermeranum* and *Stipagrostis sabulicola* – were observed and/or are expected to occur in the proposed development areas due to the available habitats. Localised rainfall will undoubtedly result in more grass species (especially annuals) encountered, increasing the grass species diversity from the area, although such events are limited.

2.4 Conclusion

Trees/shrubs

Of the estimated 20-45 species of larger trees and shrubs (>1m) expected to occur in the general area (Coats Palgrave 1983, Curtis & Mannheimer 2005, Mannheimer & Curtis 2009 & Van Wyk & Van Wyk 1997) only 16 species were confirmed during the fieldwork. Very few trees were observed in the INCA and TRS areas and limited to individuals in the Tumas River drainage channels.

The most important plant species confirmed from the INCA and TRS areas during the fieldwork were *Capparis hereroensis* (endemic) and *Welwitschia mirabilis* (near-endemic, Nature Conservation ordinance protection & CITES Appendix II).

Other endemics found in the area include *Acanthosicyos horridus*, *Arthroerua leubnitziae*, *Commiphora saxicola*, *Euphorbia damarana* and *Zygophyllum stapffii* although all are common throughout their range (e.g. *Arthroerua leubnitziae*) or only occur as individual plants in the area (e.g. *Acanthosicyos horridus*).

None of the larger trees and shrubs observed and/or confirmed from the area is exclusively associated with the proposed mining areas.

Grass

The grass cover is extremely sparse throughout the area with perennials limited to some drainage lines only. Although up to 50 species of grass are expected to occur in the general area only 4 species were confirmed during the fieldwork none of which are endemic and except for their grazing value, none are viewed as particularly important grasses.

None of the endemics expected to occur in the general area were observed with the available habitat not deemed suitable either. None of the grasses observed and/or confirmed from the area is exclusively associated with the proposed mining areas.

Other species

Other than the 16 species of larger trees/shrubs observed in the area and presented in the trees/shrubs table, another 22 species of plants were confirmed during the fieldwork. Species with some form of conservation status included: *Aloe asperifolia*, *Arthroa leubnitziae*, *Citrullus ecirrhosus* and *Hexacyrtis dickiana*.

All the aloes are protected in Namibia (Rothmann 2004) and although *Aloe asperifolia* occurs in the area they are common, often forming dense stands, throughout their range.

Lichens are poorly known from Namibia (Craven 1998, Schults & Rambold 2007, Schultz *et al.* 2009) with more than 100 species – many unique – expected to occur in the Namib Desert, especially associated with the coastal fog belt. Although only 7 species were observed during the fieldwork, many more are expected to occur. With many species requiring chemical analysis or microscopic detail to determine differences, makes this group very difficult to deal with. However, the gravel plain lichens are threatened *en mass* by off road driving.

Sensitive areas

The general area is sparsely vegetated and typical of the Central Namib Desert with *Arthroa leubnitziae* and *Zygophyllum stapffii* shrubs dominating the vegetation strata.

The areas of most concern would be:

j) Drainage lines & associated vegetation

The drainage lines in the INCA and TRS areas are tributaries of the ephemeral Tumas River which drains the general area west towards the coast. These drainage lines are the lifeline for most of the shrubs in the area which is otherwise dominated by sparsely vegetated and/or bare gravel plains. Although most of the smaller drainage lines are dominated by *Arthroa leubnitziae*, *Galenia africana* and *Zygophyllum stapffii* shrubs, the most important plant species viewed from the areas during the fieldwork – i.e. *Capparis hereroensis* (endemic) and *Welwitschia mirabilis* – are also associated with these drainage lines. The few bigger trees – e.g. *Acacia erioloba* (individuals) and *Tamarix usneoides* (main Tumas River channel) – which serve as habitat to a variety of species (e.g. nesting/roosting sites for birds and bark/cavity roosting bats) are also associated with drainage lines.

- a) Drainage line – 22°52'42.7"S, 14°51'12.6"E, 240m
- *Welwitschia mirabilis* hotspot (±30 individuals)
- b) Drainage line/Terrace – 22°52'33.4"S, 14°54'15.9"E, 290m
- Lichen hotspot (various species)
- c) Drainage line/Terrace – 22°52'56.9"S, 14°54'43.4"E, 243m
- Lichen hotspot (various species)
- d) Drainage line/Terrace – 22°52'37.6"S, 14°51'18.5"E, 244m
- Lichen hotspot (various species)

iii) Rocky outcrops/ridges & inselbergs

Ridges, outcrops and inselbergs are generally viewed as unique habitat for vegetation not necessarily associated with the surrounding areas. The following such landforms are viewed as sensitive areas from a floristic perspective in the INCA and TRS areas:

- a) Rocky ridge – 22°50'03.8"S, 14°54'15.6"E, 310m
 - Lichen hotspot (various species)
- b) Rocky ridge – 22°50'41.8"S, 14°55'07.6"E, 309m
 - Lichen hotspot (various species)
- c) Rocky outcrop – 22°51'36.1"S, 14°56'17.7"E, 327m
 - *Hoodia* hotspot (also: Lichens & *Welwitschia mirabilis*)
- d) Rocky outcrop – 22°53'16.5"S, 14°50'49.9"E, 259m
 - *Welwitschia mirabilis* hotspot (±50 individuals)
- e) Granite inselberg – 22°52'26.5"S, 14°51'07.9"E, 250m
 - Floristic hotspot (*Aloe asperifolia*, *Commiphora saxicola*, *Cotyledon orbiculata* & *Euphorbia damarana*)
- f) Rocky outcrop – 22°56'44.4"S, 14°57'30.3"E, 368m
 - Floristic hotspot (*Aloe asperifolia*, *Commiphora saxicola*, *Hoodia pedicellata* & various lichens)

[Many more such areas occur in the INCA and TRS areas although not visited, but avoiding rides/outcrops and inselbergs in general would protect these areas]

iv) Species specific hotspots

Throughout the area there are specimens with a variety of conservation statuses – e.g. *Acacia erioloba*, *Acanthosicyos horridus*, *Aloe asperifolia*, *Arthroa leubnitziae*, *Capparis hereroensis*, *Commiphora saxicola*, *Euclea pseudebenus*, *Euphorbia damarana*, *Parkinsonia africana*, *Tamarix usneoides*, *Welwitschia mirabilis* and *Zygophyllum stapffii* – most of which occur as individual or few specimens throughout the area only. The majority of these specimens (excluding species which are numerous and widespread throughout the area – e.g. *Arthroa leubnitziae* and *Zygophyllum stapffii*) could be protected (or included in the overall landscaping) as these serve as habitat for a variety of fauna. Some species transplant well – e.g. *Aloe asperifolia* – and could also be removed and relocated or returned to the eventual landscape.

2.5 Envisaged impacts

2.5.1 Introduction

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

2.5.2 Floral loss

Floral loss with the proposed mining development would be localised. The following table indicates the potential/envisaged impacts expected regarding floral loss (which is obviously closely linked to habitat destruction):

a) Construction Phase

Environmental aspect	Flora	Phase	Construction
Description: Certain habitats are viewed as sensitive with unique species.			
Mitigation: Sensitive habitats – i.e. drainage lines & rocky outcrops/ridges + inselbergs should be avoided. Off road			

driving should be prohibited throughout the area. Illegal collection of veld foods, plants and dead wood should be prohibited. Destruction of habitat – e.g. larger trees – should be avoided.

Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	1	2	3	6	36
Potential for irreplaceable loss of resources		probably	Cumulative impacts		yes	Reversibility	probably

b)Operational Phase

Environmental aspect	Flora	Phase	Operational				
Description: Certain habitats are viewed as sensitive with unique species.							
Mitigation: Sensitive habitats – i.e. drainage lines & rocky outcrops/ridges + inselbergs should be avoided. Off road driving should be prohibited throughout the area. Illegal collection of veld foods, plants and dead wood should be prohibited. Destruction of habitat – e.g. larger trees – should be avoided.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	1	3	3	4	28
Potential for irreplaceable loss of resources		yes	Cumulative impacts		yes	Reversibility	probably

c)Decommissioning/Rehabilitation Phase

Environmental aspect	Flora	Phase	Decommissioning				
Description: Certain habitats are viewed as sensitive with unique species.							
Mitigation: Recreate habitats that are favourable to unique species should these have been damaged and/or destroyed during the construction and operational phases – i.e. replant and reseed vegetation to recreate the original habitat. Provide water after replanting and reseeding operations to stimulate growth and kick-start rehabilitation processes.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	positive	1	1	2	4	16
Potential for irreplaceable loss of resources		no	Cumulative impacts		no	Reversibility	yes

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