VERTEBRATE FAUNA AND FLORA ASSOCIATED WITH THE DESERT STAR SOUTH - PHASES 1A-C - AREA

SPECIALIST CONTRIBUTION:

Prepared by:

Peter L Cunningham

Environment and Wildlife Consulting Namibia

P. O. Box 90717
Windhoek
Namibia
Telephone: +264-61-254550
Telefax: +264-61-254550
Mobile: +264 81-3004080
E-mail: cunning@mweb.com.na; pckkwrc@yahoo.co.uk

Prepared for:

Dr Lima Maartens

LM Environmental Consulting

P. O. Box 1284
Windhoek
Namibia
Telephone: +264-61-255750
Telefax: +088-61-9004
Mobile: +264 81-2458790
E-mail: lima@iway.na

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1. Vertebrate fauna and flora associated with the Desert Star South – Phase 1 – area

1.1 Introduction

A field survey was conducted between 2 and 6 September 2010 to determine the vertebrate fauna (e.g. reptiles, amphibians, mammals and birds) and flora for Phases 1A-C on Portion 1 of Farm Komsberg and a Portion of the remainder of Farm Stolzenfels for the proposed Desert Star South Project. This area is located approximately 40km south of Ariamsvlei adjacent to the Orange River. The survey was preceded by a comprehensive literature (i.e. desktop study/scoping report – see Cunningham 2010) conducted between 8 and 12 August 2010 of vertebrate fauna and flora expected to occur in the general area. These surveys form part of an Environmental Impact Assessment (EIA) conducted in the area for the proposed Desert Star South Project.

The general Ariamsvlei/Orange River area is regarded as "low" in overall diversity (all terrestrial species), as well as "low" in overall terrestrial endemism (Mendelsohn *et al.* 2002). According to the literature survey an estimated (i.e. at least) 47 reptile, 11 amphibian, 58 mammal and 199 bird species (breeding residents) are known to or expected to occur in the general Ariamsvlei/Orange River area of which a high proportion are endemics.

Overall plant diversity (all species - "higher" plants) in the general area is viewed as "low" with an estimated at 50-99 species, increasing to 100-149 species along the Orange River; endemism is viewed as "very low" with <5 species expected from the general area (Mendelsohn *et al.* 2002). According to the literature survey an estimated (i.e. at least) 23-44 species of larger trees and shrubs and up to 47 grasses are expected to occur in the general Ariamsvlei/Orange River area.

This field survey was conducted to confirm the vertebrate fauna and flora species at the proposed development sites – i.e. Phases 1A-C for the proposed Desert Star South Project – south of Ariamsvlei.

1.2 Methods

1.2.1 Field survey

Vertebrate fauna
According to the original Terms of Reference (ToR), fieldwork to determine the actual faunal diversity would include the following:

- Small mammal transects to determine small mammal diversity in the area
- Assess larger mammal presence in the area
- Reptile and amphibian transects (diurnal and nocturnal) to determine reptile and amphibian diversity in the area
- Bird transects to determine avian diversity in the area

Mammals
Small mammal trapping was conducted by active trapping using collapsible aluminium Sherman traps baited with peanut butter and oats. Small mammals caught were identified *in situ*, photographed and released unharmed at the point of capture. Twenty traps were placed 20 to 30m apart (depending on habitat) for 1 night each (i.e. potential maximum of 60 captures) within the first proposed development sites – i.e. 1A to 1C – in various habitats

viewed as potentially suitable for small mammals in the area. See Table 1 for trapping site locations

Table 1. Small mammal trapping site locations at the proposed Desert Star South Project Phases 1A-C areas.

Date	Area	Habitat	Co-ordinates	Elevation (m)	Distance apart (m)	Traps
3/9	1C	Sandy drainage line	28°28'27.2"S; 19°49'36.9"E;	484	30	10
3/9	1C	Sandy drainage line	28°28'06.3"S; 19°50'06.1"E;	444	30	10
4/9	1A	Orange River riparian vegetation	28°27'59.5"S; 19°50'30.6"E;	431	30	5
4/9	1A	Rocky hill side	28°27'55.4"S; 19°50'31.7"E;	426	30	5
4/9	1A	Rocky hill side	28°28'05.7"S; 19°50'23.7"E;	431	30	5
4/9	1A	Orange River riparian vegetation	28°28'08.4"S; 19°50'24.6"E;	436	30	5
5/9	1B	Rocky hill side	28°28'25.4"S; 19°50'18.6"E;	431	20	10
5/9	1B	Sandy drainage line	28°28'20.7"S; 19°50'16.1"E;	422	20	10

Assessing larger mammals from the area was conducted by traversing the area on foot and included actual sightings, tracks, scats and other signs – e.g. burrows, scrapes, carcasses, etc.

Reptiles
Reptile and amphibian transects were conducted during daylight hours as well as at night using a hand held gas lantern to identify nocturnal species. Transects crisscrossed the proposed development areas – 1A to 1C – 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. Species caught were identified *in situ*, photographed and released unharmed at the point of capture.

Amphibians
Amphibians were searched for along the Orange River and other suitable habitat and recordings made of their vocalisations which were then identified to species level using the "frog call cd" by Du Preez and Carruthers (2009).

Birds
Bird transects (variable lengths, directions and times) were conducted on foot and by vehicle throughout the area following existing tracks (when in vehicle) during daylight hours using binoculars to identify and confirm species. A canoe was also used to spot and identify birds, not always visible from land, on the Orange River.

Flora
According to the original ToR, fieldwork to determine the actual floral diversity was to include the following:

- Trees and shrubs – species composition

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

Trees and shrubs
All the trees and shrubs encountered in the proposed development areas – 1A to 1C – were identified whilst conducting the fieldwork in the area – i.e. identification was not only limited to the transects.

Trees and shrubs species composition was determined along the various transects throughout the area using the step point method, i.e. the closest tree/shrub was noted and identified to species level at 10m intervals. The transect directions varied and depended on the terrain. The transect lengths were typically conducted over 1000m. All the different habitats were incorporated.

Tree and shrub densities were determined using standard quadrates of 10x10m along the transects. The number of trees/shrubs were calculated for each quadrate and converted to trees/shrubs per hectare (ha).

Grasses
All the grasses encountered in the proposed development areas – 1A to 1C – were identified whilst conducting the fieldwork in the area – i.e. identification was not only limited to the transects only.

Grass species composition was determined along the various transects throughout the area using the step point method. At 1m intervals the closest grass was noted and identified to species level. The transect directions varied and depended on the terrain. The transect lengths were typically conducted over 150m. All the different habitats were incorporated.

Other species
Other species – i.e. herbs, etc. were also identified whenever encountered.

1.3 Results

1.3.1 Reptile Diversity

Reptile diversity known and/or expected to occur in the general Ariamsvlei/Orange River area (literature study only), including species confirmed during the fieldwork (√), as well as the author's personal records from the general area but not observed during the fieldwork (√*), and species confirmed by the Farm Manager – Gert Louw – i.e. personal communication (#), is presented in Table 2.

Table 2. Reptile diversity expected and confirmed from the proposed Desert Star South Project Phases 1A-C areas.

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International status
TURTLES AND TERRAPINS				
Psammobates tentorius veroxii	Bushmanland Tent Tortoise	√*	Vulnerable; Protected Game	CITES Appendix II
SNAKES				
Blind Snakes				
Rhinotyphlops schinzi	Schinz's Beaked Blind Snake		Endemic; Secure	SARDB Peripheral

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International status
Thread Snakes				
Leptotyphlops occidentalis	Western Thread Snake		Endemic; Secure	SARDB Peripheral
Typical Snakes				
Lamprophis fuliginosus	Brown House Snake	#	Secure	
Pseudaspis cana	Mole Snake		Secure	
Prosymna bivittata	Two-striped Shovel-snout		Secure	
Prosymna frontalis	South-western Shovel-snout		Endemic; Secure	SARDB Peripheral
Dipsina multimaculata	Dwarf Beaked Snake		Endemic; Secure	
Psammophis notostictus	Karoo Sand Snake	√*	Secure	
Psammophis leightoni trinasalis	Namib Sand Snake		Secure	
Dasypeltis scabra	Common/Rhombic Egg Eater		Secure	
Telescopus semiannulatus polystictus	Eastern Tiger Snake		Endemic; Secure	
Telescopus beetzii	Beetz's Tiger Snake		Secure	
Aspidelaps lubricus lubricus	Coral Snake		Secure	
Naja nivea	Cape Cobra	√*	Endemic; Secure	
Naya (nigricollis) woodi	Black-necked Spitting Cobra	#	Endemic; Secure	SARDB Rare
Bitis arietans	Puff Adder	#	Secure	
Bitis caudalis	Horned Adder	√	Secure	
Worm Lizard				
Monopeltis infuscata	Dusky Spade-snouted Worm Lizard		Secure	
LIZARDS				
Skinks				
Acontias lineatus lineatus	Striped Legless Skink		Endemic; Secure	
Trachylepis (*Mabuya*) *capensis*	Cape Skink		Secure	
Trachylepis (*Mabuya*) *occidentalis*	Western Three-striped Skink		Secure	
Trachylepis (*Mabuya*) *spilogaster*	Kalahari Tree Skink		Endemic; Secure	
Trachylepis (*Mabuya*) *striata sparsa*	Striped Skink		Secure	
Trachylepis (*Mabuya*) *sulcata sulcata*	Western Rock Skink	√	Secure	
Trachylepis (*Mabuya*) *variegata variegata*	Variegated Skink	√	Secure	
Old World Lizards				
Heliobolus lugubris	Bushveld Lizard		Secure	
Meroles suborbitalis	Spotted Desert Lizard		Endemic; Secure	
Nucras tessellata	Western Sandveld Lizard		Endemic; Secure	

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International status
Pedioplanis lineoocellata lineoocellata	Spotted Sand Lizard		Endemic; Secure	
Pedioplanis namaquensis	Namaqua Sand Lizard	√	Secure	
Pedioplanis inornata	Plain Sand Lizard		Endemic; Secure	
Girdled Lizards				
Cordylus polyzonus	Karoo Girdled Lizard		Endemic; Secure	CITES Appendix II
Flat Lizards				
Platysaurus broadleyi	Broadley's Flat Lizard	√	Endemic; Secure	
Monitors				
Varanus niloticus	Nile or Water Monitor	√	Vulnerable; Peripheral; Protected Game	CITES Appendix II Vulnerable locally
Agama				
Agama aculeata	Ground Agama		Secure	
Agama anchietae	Anchietae's Agama		Secure	
Agama atra	Southern Rock or Knobel's Agama	√	Endemic; Secure	
Chameleons				
Chamaeleo namaquensis	Namaqua Chameleon		Secure	CITES Appendix II
Geckos				
Chondrodactylus angulifer angulifer	Giant Ground Gecko		Endemic; Secure	
Colopus wahlbergii furcifer	Kalahari Ground Gecko		Endemic; Secure	
Lygodactylus bradfieldi	Bradfield's Dwarf Gecko		Endemic; Secure	
Pachydactylus bibronii	Bibron's Thick-toed Gecko	√	Endemic; Secure	
Pachydactylus capensis	Cape Thick-toed Gecko		Endemic; Secure	
Pachydactylus rugosus rugosus	Rough Thick-toed Gecko	√	Endemic; Secure	
Pachydactylus serval onscepensis	Western Spotted Thick-toed Gecko	√	Endemic; Secure	
Ptenopus garrulus maculatus	Common Barking Gecko	#	Endemic; Secure	

Namibian conservation and legal status according to the Namibian Conservation Ordinance of 1975 (Griffin 2003).
"Endemic" include endemic to South Africa (Branch 1998)
SARDB (South African Red Data Book – mammals)
CITES (Convention on International Trade in Endangered Species of wild fauna and flora)

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

The overall reptile diversity and endemism in the general Ariamsvlei/Orange River area is estimated at between 41-50 species and 5-8 species, respectively (Mendelsohn *et al.* 2002).

Griffin (1998a) presents figures of between 11-20 and 3-4 for endemic lizards and snakes, respectively, from the general area. According to the literature survey, at least 47 species of reptiles are expected to occur in the general Ariamsvlei/Orange River area with 24 species (51.1%) being endemic although viewed as "secure" (Cunningham 2010). During the fieldwork conducted between 2 and 6 September 2010, 17 species were confirmed from the area of which 10 species were actually observed and 7 species were confirmed using the author's personal records from the general area and/or personal communications with the Farm Manager.

The species observed and/or confirmed from the proposed Desert Star South Project area included 1 tortoise, 6 snakes, 4 lizards, 1 monitor lizard, 1 agama and 4 geckos (see Figures 1 to 6 for some examples). Of these, 8 species are endemic – all "secure" – and 2 classified as "vulnerable" and "protected game". Three species have some form of international conservation status – e.g. 2 CITES Appendix II and 1 SARDB "rare".

Figure 1. *Bitis caudalis* (Horned Adder)

Figure 2. *Pedioplanis namaquensis* (Namaqua Sand Lizard)

Figure 3. *Agama atra* (Southern Rock Agama)

Figure 4. *Pachydactylus bibronii* (Bibron's Thick-toed Gecko)

Figure 5. *Pachydactylus rugosus rugosus* (Rough Thick-toed Gecko)

Figure 6. *Pachydactylus serval onscepensis* (Western Spotted Thick-toed Gecko)

The species observed and/or confirmed from the area and viewed as the most important are *Psammobates tentorius veroxii*, *Naya (nigricollis) woodi*, *Varanus niloticus* (Figure 7) and *Platysaurus broadleyi* (Figure 8). No *Psammobates tentorius veroxii* were observed during the fieldwork nor confirmed by G. Louw (pers. comm.) from the area although the species are known to occur in and have been sighted in the general Ariamsvlei/Orange River area. Tortoises are viewed as the group of reptiles most under threat in Namibia (Griffin 1998a) and expected to be consumed as food if encountered by labourers in the area (G. Louw pers. comm.). *Naya (nigricollis) woodi*, although classified as "rare" (SARDB) are more frequently observed – although never common – in Namibia than in South Africa. Although *Varanus niloticus* are classified as secure globally, they are viewed as vulnerable locally (Griffin 2003) and are also killed for food. *Platysaurus broadleyi* is viewed as important as the species is restricted to the Orange River and environs from Augrabies to Pella.

Figure 7. *Varanus niloticus* (Nile or Water Monitor)

Figure 8. *Platysaurus broadleyi* (Broadley's Flat Lizard)

According to G. Louw (pers. comm.), *Varanus albigularis* has also been observed in the Komsberg area although not confirmed during the fieldwork, nor expected to occur in the general area (Branch 1998; Alexander and Marais 2007). It is expected that more species may be located in the proposed development area than observed and/or confirmed during the fieldwork and that confirmed sightings should be updated throughout.

1.3.2 Amphibian Diversity

The amphibian diversity known, and/or expected and confirmed to occur in the general Ariamsvlei/Orange River area during the fieldwork (√) and species confirmed by the Farm Manager (pers. comm.) (#), is presented in Table 3.

Table 3. Amphibian diversity expected and confirmed from the proposed Desert Star South Project Phases 1A-C areas.

Species: Scientific name	Species: Common name	Species observed and confirmed	Status
Amientophrynus (Bufo) gutturalis	Guttural Toad	#	
Amietophrynus (Bufo) poweri	Western Olive Toad		
Amietophrynus (Bufo) rangeri	Raucous Toad		
Vandijkophrynus gariepensis	Karoo Toad		
Rubber Frog			
Phrynomantis annectens	Marbled Rubber Frog		Endemic
Cacos			
Cacosternum boettgeri	Boettger's Caco		
Platannas			
Xenopus laevis	Common Platanna		
River Frogs			
Amietia angolensis	Common River Frog	√	
Bullfrogs			
Pyxicephalus adspersus	Giant Bullfrog		Near Threatened
Sand Frogs			
Tomopterna cryptotis	Tremolo Sand Frog		
Tomopterna tandyi	Tandy's Sand Frog		

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

According to Mendelsohn *et al.* (2002), the overall frog diversity in the general Ariamsvlei/Orange River area is estimated at between 4-7 species. Griffin (1998b) puts the species richness in the general area at 10 species. According to the literature survey, at least 11 species of amphibians can occur in suitable habitat in the general Ariamsvlei/Orange River area, most notably the perennial Orange River (Cunningham 2010). During the fieldwork conducted between 2 and 6 September 2010, 2 species were confirmed from the area of which 1 species was actually observed – *Amietia angolensis* – and 1 species confirmed by the Farm Manager – *Amietophrynus* (*Bufo) gutturalis*. *Amietia angolensis* is "not threatened" and known to occur in the Orange and Zambezi Rivers in Namibia (Du Preez and Carruthers 2009). *Amietophrynus* (*Bufo) gutturalis* is also classified as "not threatened" and occurs in the Orange River as well as throughout northern Namibia (Du Preez and Carruthers 2009).

Both species confirmed from the area are widespread throughout suitable habitat and are not viewed as unique although the Orange River habitat serves as unique habitat in an otherwise marginal environment. The amphibians are an important source of food for a variety of fauna as observed for *Varanus niloticus* (G. Louw pers. comm.). It is expected that more species may be located in the proposed development area than observed and/or confirmed during the fieldwork and that confirmed sightings should be updated throughout.

1.3.3 Mammal Diversity

The mammal diversity known, and/or expected and confirmed to occur in the general Ariamsvlei/Orange River area during the fieldwork (√) and species confirmed by the Farm Manager (#), is presented in Table 4.

Table 4. Mammal diversity expected and confirmed from the Desert Star South Project Phases 1A-C areas.

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International status
Elephant Shrews				
Macroscelides proboscideus flavicaudatus	Round-eared Elephant-shrew		Endemic; Secure	[2]Vulnerable
Elephantulus rupestris	Western Rock Elephant-shrew		Secure	[2]Vulnerable
Elephantulus intufi	Bushveld Elephant-shrew		Secure	[1]Data Deficient
Aardvark				
Orycteropus afer	Aardvark		Secure; Protected Game	
Shrews				
Crocidura cyanea	Reddish-grey Musk Shrew		Secure	[1]Data Deficient
Hyrax				
Procavia capensis	Rock Hyrax	√	Secure; Problem animal	
Bats				
Tadarida aegyptiaca	Egyptian Free-tailed Bat		Secure	
Neoromicia capensis	Cape Serotine Bat		Secure	
Eptesicus hottentotus	Long-tailed Serotine Bat		Secure	
Nycteris thebaica	Egyptian Slit-faced Bat		Secure	

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International status
Rhinolophus fumigatus	Rüppell's Horseshoe Bat		Secure	[1]Near Threatened
Rhinolophus clivosus	Geoffroy's Horseshoe Bat		Secure	[1]Near Threatened
Rhinolophus denti	Dent's Horseshoe Bat		Secure	[1]Near Threatened; [2]Data Deficient
Hares and Rabbits				
Lepus capensis	Cape Hare	√	Secure	
Lepus saxatilis	Scrub Hare		Secure	
Rodents				
Porcupine				
Hystrix africaeaustralis	Cape Porcupine	√	Secure	
Rats and Mice				
Petromys typicus	Dassie Rat	√	Endemic; Secure	[1]Near Threatened
Pedetes capensis	Springhare		Secure	
Xerus inaurus	South African Ground Squirrel	√	Secure	
Rhabdomys pumilio	Four-striped Grass Mouse		Secure	
Thallomys paedulcus	Acacia Rat		Secure	
Thallomys nigricauda	Black-tailed Tree Rat		Secure	
Micaelamys (*Aethomys*) *namaquensis*	Namaqua Rock Mouse		Secure	
Parotomys brantsii	Brant's Whistling Rat		Secure	
Parotomys littledalei	Littledale's Whistling Rat		Secure	[1]Near Threatened
Desmodillus auricularis	Cape Short-tailed Gerbil		Secure	
Gerbillurus paeba infernus	Hairy-footed Gerbil		Endemic; Insufficiently Known	
Gerbillurus vallinus	Brush-tailed Hairy-footed Gerbil	√	Endemic; Secure	
Tatera leucogaster	Bushveld Gerbil	√	Secure	[1]Data Deficient
Tatera brantsii	Highveld Gerbil		Secure	
Saccostomus campestris	Pouched Mouse		Secure	
Malacothrix typica	Gerbil Mouse		Secure	
Petromyscus collinus	Pygmy Rock Mouse	√	Endemic; Secure	
Mus musculus	House Mouse		Invasive alien	
Primates				
Papio ursinus	Chacma Baboon	√	Secure; Problem animal	CITES Appendix II
Cercopihecus (Chlorocebus) pygerythrus	Vervet Monkey	#	Secure	CITES Appendix II
Carnivores				
Proteles cristatus	Aardwolf	#	Insufficiently known; (Vulnerable?) Peripheral	

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International status
Parahyaena (*Hyaena*) *brunnea*	Brown Hyena		Insufficiently known; (Vulnerable?) Peripheral	[1]Near Threatened; [2]Endangered
Panthera pardus	Leopard	#	Secure?; Peripheral; Protected Game	CITES Appendix I
Caracal caracal	Caracal	#	Secure; Problem Animal	CITES Appendix II
Felis silvestris/lybica	African Wild Cat	#	Vulnerable	CITES Appendix II
Felis nigripes	Black-footed Cat		Indeterminate; Rare	[2]Vulnerable; CITES Appendix I
Genetta genetta	Small Spotted Genet	#	Secure	
Suricata suricatta marjoriae	Suricate	#	Endemic; Secure	
Cynictis penicillata	Yellow Mongoose	#	Secure	
Galerella sanguinea	Slender Mongoose	√	Secure	
Atilax paludinosus	Marsh Mongoose		Indeterminate	
Otocyon megalotis	Bat-eared Fox	#	Vulnerable?; Peripheral	
Vulpes chama	Cape Fox	#	Vulnerable?	
Canis mesomelas	Black-backed Jackal	√	Secure; Problem animal	
Aonyx capensis	African Clawless Otter	√	Vulnerable ?; Peripheral; Protected Game	CITES Appendix II
Ictonyx striatus	Striped Polecat	#	Secure	
Antelopes				
Tragelaphus strepsiceros	Greater Kudu	√	Secure; Huntable Game	
Oryx gazella	Gemsbok		Secure; Huntable game	
Sylvicapra grimmia	Common Duiker		Secure	
Antidorcas marsupialis	Springbok		Secure; Huntable game	
Raphicerus campestris	Steenbok	√	Secure; Protected Game	
Oreotragus oreotragus	Klipspringer	√	Secure; Specially Protected Game	

[1]SARDB (2004); [2]International Union for Conservation of Nature - IUCN (2002, 2004)

Source for literature review: De Graaff (1981), Estes (1995), Griffin (1998c), Griffin (2005), Joubert and Mostert (1975), Skinner and Smithers (1990), Skinner and Chimimba (2005), Stander and Hansson (2003) and Taylor (2000).

The overall mammal diversity in the general Ariamsvlei/Orange River area is estimated at between 61-75 species, with 5-6 species being endemic to the area (Mendelsohn *et al.* 2002). Griffin (1998c) also puts the species richness distribution of endemics between 5-6 species in the general area, while the closest Government protected areas, Ai-Ais and Naute, have an estimated 76 and 66 species of mammals, respectively. According to the literature survey, at least 58 species of mammals are known and/or expected to occur in the general Ariamsvlei/Orange River area of which 6 species (10.3%) are classified as endemic (Cunningham 2010). Species probably underrepresented in Table 4 (general area) include the bats and rodents as these groups are not well documented from the arid south-eastern part of Namibia.

During the fieldwork conducted between 2 and 6 September 2010, 26 species were confirmed of which 15 species were actually observed and 11 species confirmed (G. Louw pers. comm.) (see Figures 9 to 14 for some examples of mammals observed). Of these, 4 species (*Petromys typicus*, *Gerbillurus vallinus*, *Petromyscus collinus* and *Suricata suricatta marjoriae*) are viewed as endemic, 4 species as vulnerable (*Proteles cristatus*, *Felis silvestris/lybica, Otocyon megalotis and Aonyx capensis* – see Figures 11 and 12), 1 species as specially protected game (*Oreotragus oreotragus* – see Figure 14) and 3 species as protected game (*Panthera pardus*, *Aonyx capensis* and *Raphicerus campestris* – see Figure 13) (Griffin 2005) while 8 species have some form of international conservation status (see Table 4).

Figure 9. *Procavia capensis* (Rock Hyrax)

Figure 10. *Hystrix africaeaustralis* (Porcupine) faeces

Figure 11. *Aonyx capensis* (African Clawless Otter) tracks

Figure 12. *Aonyx capensis* (African Clawless Otter) faeces

Figure 13. *Raphicerus campestris* (Steenbok)

Figure 14. *Oreotragus oreotragus* (Klipspringer)

The small mammal trapping with a potential maximum of 60 rodents resulted in 6 captures (i.e. 10% success rate) of 3 species – *Gerbillurus vallinus* (Brush-tailed Hairy-footed Gerbil; see Figure 15), *Tatera leucogaster* (Bushveld Gerbil; see Figure 16) and *Petromyscus collinus* (Pygmy Rock Mouse; see Figure 17). No small mammals were trapped in the Orange River riparian vegetation while 4 of the captures were in the sandy vegetated drainage lines and 2 in the sparsely vegetated rocky areas (see Figure 18).

Figure 15. *Gerbillurus vallinus* captured in vegetated sandy drainage line.

Figure 16. *Tatera leucogaster* captured in vegetated sandy drainage line.

Figure 17. *Petromyscus collinus* captured in sparsely vegetated rocky areas.

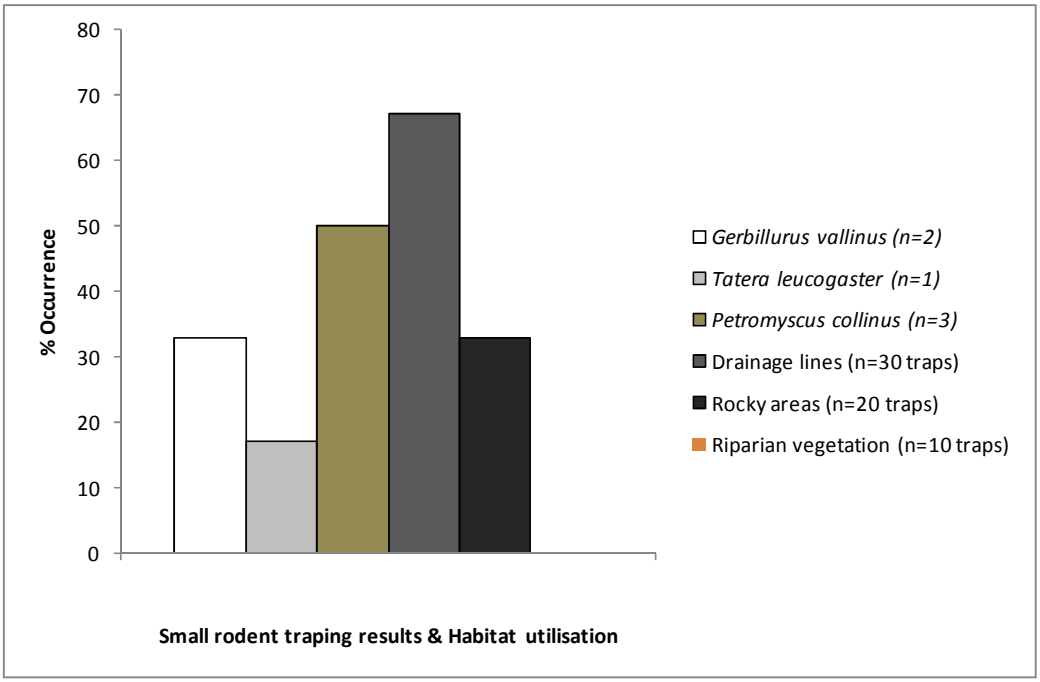

Figure 18. Small mammal trapping results – species captured and habitats utilised. (Percentage occurrence refers to the total number of times a species was caught compared to the

total number of rodents caught while the habitat utilization refers to the total number of times a species was captured in a specific habitat – e.g. no rodents were caught in the riparian vegetation).

Although no bats were caught and observed closely, at least 2 species were observed in the area with 3 important species (although not confirmed) – i.e. of conservation concern – known to occur in the general area: Rüppell's Pipistrelle (*Pipistrellus rueppellii*) [known from Augrabies Falls], the Namibian Wing-gland Bat (*Cistugo seabrai*) [known from Onseepkans area], and Darling's Horseshoe Bat (*Rhinolophus darlingi*) [known from Onseepkans area].

The most important mammal species from the general area are viewed as the various carnivores as they are often mercilessly persecuted in small stock farming areas. Species of concern (i.e. with some form of conservation status) confirmed from the area would be *Proteles cristatus*, *Felis silvestris/lybica*, *Otocyon megalotis*, *Vulpes chama* and *Aonyx capensis*. With the exception of *Aonyx capensis*, all the carnivores are either directly persecuted or indirectly succumb when poison is used to target "problem animals" such as Black-backed Jackal and Caracal. *Aonyx capensis* are often drowned in nets placed by illegally fishing operations or are directly targeted in traps set for them (G. Louw pers. comm.).

Although most of the other species of conservation concern are viewed as "secure", overall habitat alteration and overutilization are the two primary processes threatening most mammals (Griffin 1998c). Development undoubtedly would affect most mammals in the proposed development area, but by following the proposed mitigations these could be ameliorated.

1.3.4 Avian Diversity

The avian diversity known, and/or expected and confirmed to occur in the general Ariamsvlei/Orange River area during the fieldwork (√), and species confirmed by the Farm Manager (#), is presented in Table 5. This Table excludes marine birds (e.g. Gulls and Terns, etc.) and species breeding extralimital (e.g. stints, sandpipers, etc.) and rather focuses on birds that are breeding residents or can be found in the area during any time of the year. This would imply that many more birds (e.g. Palaearctic migrants and/or vagrants) could occur in the area depending on environmental conditions.

Table 5. Avian diversity expected and confirmed from the Desert Star South Project Phases 1A-C areas.

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Struthio camelus	Common Ostrich	#		
Pternistis capensis	Cape Spurfowl	√		Endemic
Coturnix coturnix	Common Quail			
Numida meleagris	Helmeted Guineafowl			
Alopochen aegyptiaca	Egyptian Goose	√		
Tadorna cana	South African Shelduck	#		Endemic
Plectropterus gambensis	Spur-winged Goose	#		
Anas capensis	Cape Teal			
Anas sparsa	African Black Duck			
Anas undulata	Yellow-billed Duck	#		
Anas smithii	Cape Shoveller			
Anas erythrorhyncha	Red-billed Teal			

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Netta erythrophthalma	Southern Pochard	√		
Indicator indicator	Greater Honeyguide			
Indicator minor	Lesser Honeyguide			
Campethera abingoni	Golden-tailed Woodpecker			
Dendropicos fuscescens	Cardinal Woodpecker	√		
Tricholaema leucomelas	Acacia Pied Barbet	√		Near endemic
Upupa africana	African Hoopoe	√		
Rhinopomastus cyanomelas	Common Scimitarbill			
Alcedo cristata	Malachite Kingfisher	√		
Megaceryle maxima	Giant Kingfisher	√		
Ceryle rudis	Pied Kingfisher	√		
Merops hirundineus	Swallow-tailed Bee-eater	√		
Merops apiaster	European Bee-eater			
Colius colius	White-backed Mousebird	√		Endemic
Urocolius indicus	Red-faced Mousebird			
Chrysococcyx caprius	Diderick Cuckoo			
Agapornis roseicollis	Rosy-faced Lovebird	√	Endemic	Near endemic
Cypsiurus parvus	African Palm Swift			
Tachymarptis melba	Alpine Swift			
Apus bradfieldi	Bradfield's Swift			Near endemic
Apus affinis	Little Swift			
Apus caffer	White-rumped Swift			
Tyto alba	Barn Owl	#		
Bubo africanus	Spotted Eagle Owl	√		
Caprimulgus tristigma	Freckled Nightjar			
Caprimulgus rufigena	Rufous-cheeked Nightjar	√		
Columba livia	Rock Dove			
Columba guinea	Speckled Pigeon	√		
Streptopelia capicola	Cape Turtle Dove			
Streptopelia senegalensis	Laughing Dove	√		
Streptopelia semitorquata	Red-eyed Dove	√		
Oena capensis	Namaqua Dove	√		
Neotis ludwigii	Ludwig's Bustard			Near endemic
Ardeotis kori	Kori Bustard	#		
Afrotis afraoides	Northern Black Korhaan			Endemic
Eupodotis vigorsii	Karoo Korhaan			Endemic
Amaurornis flavirostris	Black Crake			
Porzana pusilla	Baillon's Crake			
Porphyrio madagascariensis	African Purple Swamphen			
Gallinula chloropus	Common Moorhen			
Fulica cristata	Red-knobbed Coot	#		
Pterocles namaqua	Namaqua Sandgrouse	#		Near endemic

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Pterocles bicinctus	Double-banded Sandgrouse	√		Near endemic
Pterocles burchelli	Burchell's Sandgrouse			Near endemic
Actophilornis africanus	African Jacana			
Burhinus capensis	Spotted Thick-knee			
Himantopus himantopus	Black-winged Stilt			
Recurvirostra avosetta	Pied Avocet			
Charadrius tricollaris	Three-banded Plover			
Vanellus armatus	Blacksmith Lapwing	√		
Vanellus coronatus	Crowned Lapwing	#		
Rhinoptilus africanus	Double-banded Courser			
Cursorius rufus	Burchell's Courser			Near endemic
Elanus caeruleus	Black-shouldered Kite	√		
Milvus migrans	Black Kite	√		
Haliaeetus vocifer	African Fish-Eagle	√	Vulnerable	
Gyps africanus	White-backed Vulture			
Aegypius tracheliotos	Lappet-faced Vulture			
Circaetus pectoralis	Black-chested Snake-Eagle			
Circus maurus	Black Harrier		Endangered	Endemic
Polyboroides typus	African Harrier-Hawk			
Melierax canorus	Southern Pale Chanting Goshawk	√		Near endemic
Melierax gabar	Gabar Goshawk			
Buteo rufofuscus	Jackal Buzzard			Endemic
Aquila verreauxii	Verreaux's Eagle	√		
Aquila pennatus	Booted Eagle			
Polemaetus bellicosus	Martial Eagle		Endangered	
Sagittarius serpentarius	Secretarybird			
Polihierax semitorquatus	Pygmy Falcon	√		
Falco rupicolus	Rock Kestrel	√		
Falco rupicoloides	Greater Kestrel			
Falco chicquera	Red-necked Falcon			
Falco biarmicus	Lanner Falcon			
Falco peregrinus	Peregrine Falcon			
Tachybaptus ruficollis	Little Grebe	√		
Anhinga rufa	African Darter	√		
Phalacrocorax africanus	Reed Cormorant	√		
Phalacrocorax lucidus	White-breasted Cormorant	√		
Egretta garzetta	Little Egret			
Egretta intermedia	Yellow-billed Egret	√		
Ardea cinerea	Grey Heron	√		
Ardea melanocephala	Black-headed Heron			
Ardea goliath	Goliath Heron	√		
Ardea purpurea	Purple Heron			
Bubulcus ibis	Cattle Egret			

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Ixobrychus minutus	Little Bittern			
Scopus umbretta	Hamerkop	#		
Bostrychia hagedash	Hadeda Ibis	√		
Threskiornis aethiopicus	African Sacred Ibis			
Ciconia nigra	Black Stork		Endangered	
Ciconia ciconia	White Stork			
Leptoptilos crumeniferus	Marabou Stork			
Dicrurus adsimilis	Fork-tailed Drongo			
Nilaus afer	Brubru			
Laniarius atrococcineus	Crimson-breasted Shrike			Near endemic
Telophorus zeylonus	Bokmakierie	√		Near endemic
Batis pririt	Pririt Batis	√		Near endemic
Corvus capensis	Cape Crow			
Corvus albus	Pied Crow			
Lanius collaris	Common Fiscal	√		
Anthoscopus minutes	Cape Penduline Tit			Near endemic
Parus cinerascens	Ashy Tit			Endemic
Riparia paludicola	Brown-throated Martin	√		
Hirundu albigularis	White-throated Swallow			
Hirundo dimidiata	Pearl-breasted Swallow			
Hirundo cucullata	Greater Striped Swallow	√		
Hirundo fuligula	Rock Martin	√		
Pycnonotus nigricans	African Red-eyed Bulbul	√		Near endemic
Stenostira scita	Fairy Flycatcher			Endemic
Sylvietta rufescens	Long-billed Crombec	√		
Eremomela icteropygialis	Yellow-bellied Eremomela			
Eremomela gregalis	Karoo Eremomela			Endemic
Acrocephalus baeticatus	African Reed Warbler			
Acrocephalus gracilirostris	Lesser Swamp-Warbler			
Parisoma layardi	Layard's Tit-Babbler			Endemic
Parisoma subcaeruleum	Chestnut-vented Tit-Babbler	√		Near endemic
Zosterops pallidus	Orange River White-eye	√		Endemic
Cisticola subruficapilla	Grey-backed Cisticola			Near endemic
Cisticola tinniens	Levaillant's Cisticola			
Cisticola juncidis	Zitting Cisticola			
Prinia flavicans	Black-chested Prinia	√		
Prinea maculosa	Karoo Prinia			Endemic
Phragmacia substriata	Namaqua Warbler			Endemic
Malcorus pectoralis	Rufous-eared Warbler			Endemic

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Euryptila subcinnamomea	Cinnamon-breasted Warbler			Endemic
Mirafra apiata	Cape Clapper Lark			Endemic
Mirafra fasciolata	Eastern Clapper Lark			Near endemic
Mirafra sabota	Sabota Lark			
Calendulauda africanoides	Fawn-coloured Lark			Near endemic
Chersomanes albofasciata	Spike-heeled Lark			Near endemic
Certhilauda subcoronata	Karoo Long-billed Lark			Endemic
Eremopterix australis	Black-eared Sparrowlark			Endemic
Eremopterix verticalis	Grey-backed Sparrowlark			Near endemic
Calandrella cinerea	Red-capped Lark			
Alauda starki	Stark's Lark			Near endemic
Spizocorys conirostris	Pink-billed Lark			Near endemic
Spizocorys sclateri	Sclater's Lark			Endemic
Galerida magnirostris	Large-billed Lark			Endemic
Monticola brevipes	Short-toed Rock Thrush			
Turdus smithi	Karoo Thrush			Endemic
Bradornis infuscatus	Chat Flycatcher	√		Near endemic
Melaenornis mariquensis	Marico Flycatcher			Near endemic
Sigelus silens	Fiscal Flycatcher			Endemic
Muscicapa striata	Spotted Flycatcher			
Cossypha caffra	Cape Robin-Chat	√		
Cercotrichas paena	Kalahari Scrub-Robin			
Cercotrichas coryphoeus	Karoo Scrub-Robin	√		Endemic
Oenanthe monticola	Mountain Wheatear	√		Near endemic
Oenanthe pileata	Capped Wheatear			
Cercomela sinuata	Sickle-winged Chat			Endemic
Cercomela schlegelii	Karoo Chat			Near endemic
Cercomela tractrac	Tractrac Chat			Near endemic
Cercomela familiaris	Familiar Chat	√		
Myrmecocichla formicivora	Ant-eating Chat			Endemic
Onychognathus nabouroup	Pale-winged Starling	√		Near endemic
Lamprotornis nitens	Cape Glossy Starling			
Creatophora cinerea	Wattled Starling			
Nectarinia famosa	Malachite Sunbird			
Cinnyris chalybeus	Southern Double-collared Sunbird			Endemic
Cinnyris fuscus	Dusky Sunbird	√		Near endemic
Sporopipes squamifrons	Scaly-feathered Finch	#		Near endemic
Plocepasser mahali	White-browed Sparrow-Weaver			
Philetairus socius	Sociable Weaver	√		Endemic
Ploceus capensis	Cape Weaver			Endemic
Ploceus velatus	Southern Masked-Weaver	√		

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Quelea quelea	Red-billed Quelea			
Euplectes orix	Southern Red Bishop			
Amadina erythrocephala	Red-headed Finch			Near endemic
Estrilda astrild	Common Waxbill	√		
Lagonosticta senegala	Red-billed Firefinch			
Vidua macroura	Pin-tailed Whydah			
Passer domesticus	House Sparrow	√		
Passer motitensis	Great Sparrow			Near endemic
Passer melanurus	Cape Sparrow			Near endemic
Passer griseus	Southern Grey-headed Sparrow			
Motacilla aguimp	African Pied Wagtail	√		
Motacilla capensis	Cape Wagtail	√		
Anthus cinnamomeus	African Pipit			
Anthus similes	Long-billed Pipit			
Anthus pseudosimilis	Kimberley Pipit			Endemic
Serinus alario	Black-headed Canary			Endemic
Crithagra atrogulariis	Black-throated Canary			
Serinus flaviventris	Yellow Canary			Near endemic
Serinus albogularis	White-throated Canary	√		Near endemic
Emberiza impetuani	Lark-like Bunting			Near endemic
Emberiza tahapisi	Cinnamon-breasted Bunting			
Emberiza capensis	Cape Bunting			Near endemic

Source for literature review: Anderson (2006), Brown *et al.* (1998), Hockey *et al.* (2006), Komen (n.d.), Maclean (1985) and Tarboton (2001).
Endemic – Namibia (Simmons 1998).
Vulnerable and endangered – Namibia (Simmons and Brown 2009).
Endemic and near endemic – southern Africa (Hockey *et al.* 2006).

Bird diversity is viewed as "low" in the general Ariamsvlei/Orange River area with 51-80 species estimated and none being endemic (Mendelsohn *et al.* 2000). Simmons (1998) supports the lack of Namibian endemics from the area and a "low" ranking for southern African endemics and red data birds expected from the general area. According to the desktop study (Cunningham 2010) at least 199 species of terrestrial ("breeding residents") birds occur and/or could occur in the general Ariamsvlei/Orange River area at any time (Maclean 1985, Tarboton 2001, Hockey *et al.* 2006) of which 1 endemic species (i.e. the Rosy-faced Lovebird) is expected to occur in the general area. This represents 7.1% of all the Namibian endemic species (14 species in total), or 0.5% of all the species expected to occur in the area. Three other species are classified as endangered and 1 species as vulnerable from Namibia (Simmons and Brown 2009).

During the fieldwork conducted between 2 and 6 September 2010, 70 species were confirmed of which 59 species were actually observed and 11 other species confirmed (G. Louw pers. comm.). The only Namibian endemic expected to occur in the area – Rosy-faced Lovebird – was observed in the area during the fieldwork. One species, the White-fronted Bee-Eater (*Merops bullockoides*), was observed feeding from the *Phragmites* reeds along

the Orange River during the canoe surveys of the riparian vegetation throughout the fieldwork. The species is not expected to occur in the general area, but is known from north-eastern Namibia (Maclean 1985; Hockey *et al.* 2006). According to G. Louw (pers. comm.) they have been in the area for at least the last two years and have even been observed breeding in sand banks in the area. This sighting is viewed as a new record for this part of Namibia and has been submitted to the Namibian Bird Rarities Committee (Cunningham In Press).

The most important species confirmed from the proposed Desert Star South Project area are the endemic Rosy-faced Lovebird (although it occurs widespread throughout Namibia), African Fish Eagle ("vulnerable" - Simmons and Brown 2009) and Cape Spurfowl (limited distribution – south-eastern Orange River area – in Namibia). Other important species include various raptors (e.g. vultures and eagles – previously observed in the area) which face persecution as livestock predators throughout their range and also succumb to poisoned bait set for problem carnivores in Namibia.

Figure 19. Cape Spurfowl captured on camera trap, confirming its presence in the area.

Figure 20. Verreaux's Eagle was frequently observed during the field work and is known to prey on Rock Hyrax and Klipspringer lambs in the area.

Many species expected to occur in the general area have marginal distributions in Namibia and are mainly found in South Africa, e.g. Kimberley Pipit. Other species, such as the Black Harrier, is classified as globally vulnerable (BirdLife International 2004) and migrate to Namibia although their main breeding grounds are found in South Africa. As very little ringing/recording occurs in the far south-eastern corner of Namibia, little is known about the

distribution and ecology of many species from the general area and many more species are expected to occur. However, none of the above-mentioned unique species are exclusively associated with the proposed development area.

1.3.5 Tree and Shrub Diversity

The trees and shrubs known and/or expected to occur in the general Ariamsvlei/Orange River area (literature study only – Curtis and Mannheimer 2005 and Mannheimer and Curtis 2009), including species actually observed (or confirmed) during the fieldwork conducted between 2 and 6 September 2010 (√), is presented in Table 6.

Table 6. Tree and shrub diversity expected and confirmed from the Desert Star South Project Phases 1A-C areas.

Species: Scientific name	Species observed and confirmed	Expected: Curtis and Mannheimer (2005)	Expected: Mannheimer and Curtis (2009)	Status
Acacia erioloba	√	√	√	Protected (F)#
Acacia hebeclada		√		
Acacia karroo	√	√	√	
Acacia mellifera detinens	√	√	√	
Acacia tortilis		√		
Adenolobus garipensis	√	√		
Aloe dichotoma	√	√	√	NC, C2
Antherothamnus pearsonii		√		
Boscia albitrunca	√	√	√	Protected (F) #
Boscia foetida	√	√	√	Protected (F)#
Cadaba aphylla	√	√	√	
Ceraria namaquensis	√	√		
Commiphora glandulosa	√	√		
Commiphora gracilifrondosa	√	√	√	Near-threatened; Near-endemic
Commiphora namaensis		√		Near-endemic
Commiphora pyracanthoides		√	√	
Diospyros acocksii		√		
Ehretia alba		√		
Euclea pseudebenus	√	√	√	Protected (F) #
Euphorbia gregaria	√	√	√	Near-endemic; C2
Euphorbia hottentotta			√	
Euphorbia virosa	√	√	√	C2
Gaillonia crocyllis			√	
Lycium bosciifolium	√	√		
Lycium horridum			√	
Lycium pumilum			√	
Maerua gilgii	√	√	√	Near-endemic
Montinia caryophyllacea		√	√	
Ozoroa namaensis		√		
Pappea capensis	√	√	√	Protected (F)*
Parkinsonia africana	√	√	√	Protected (F)*
Phaeoptilum spinosum		√	√	
Rhigozum trichotomum	√	√	√	
Schotia afra	√	√		Protected (F)*
Searsia (Rhus) burchellii		√		
Searsia (Rhus) pendulina	√	√		
Searsia (Rhus) populifolia	√	√		

Species: Scientific name	Species observed and confirmed	Expected: Curtis and Mannheimer (2005)	Expected: Mannheimer and Curtis (2009)	Status
Sisyndite spartea	√	√		
Tamarix usneoides	√	√	√	Protected (F) #
Ziziphus mucronata	√	√		Protected (F)*

Endemic and Near-endemic (Craven 1999, Curtis and Mannheimer 2005, Mannheimer and Curtis 2009).
Near-threatened (Craven and Loots 2002).
F# – Forestry Ordinance No. 37 of 1952
F* – Curtis and Mannheimer (2005) + Mannheimer and Curtis (2009)
NC – Nature Conservation Ordinance No. 4 of 1975 (Curtis and Mannheimer 2005).
C2 – CITES Appendix 2 (Curtis and Mannheimer 2005).

Source for literature review: Coats Palgrave (1983), Curtis and Mannheimer (2005), Mannheimer and Curtis (2009), Steyn (2003), Van Wyk and Van Wyk (1997)

Although the general area is typical of the Dwarf Shrub Savannah (Giess 1971) or the Karas Dwarf Shrubland (Mendelsohn *et al.* 2002) the proposed development areas – Phases 1A to 1C (Figures 21 to 23) – differ in vegetation composition. Phases 1A and 1B are adjacent the Orange River with very dense riparian vegetation while Phase 1C is more sparsely vegetated and comprises two ephemeral drainage lines (north and west) draining towards the Orange River.

Figure 21. Phase 1A (north) – Resort Housing – adjacent the Orange River is dominated by dense stands of *Tamarix usneoides* trees on sandy loam soils.

Figure 22. Phase 1B (south) – Resort Housing – adjacent the Orange River is dominated by dense stands of mixed *Phragmites australis* reeds, *Searsia* (*Rhus*) *pendulina* and *Salix mucronata* subsp. *capensis* trees on rocky substrate.

Figure 23. Phase 1C (Golf Course of the Stars) includes two sandy vegetated ephemeral drainage lines dominated by *Stipagrostis* species (*S. ciliata* and *S. namaquensis*) and *Centropodia glauca* grasses; *Calicorema capitata* and *Sisyndite spartea* shrubs and individual *Acacia erioloba* and *Schotia afra* trees.

Although between 23 and 36 species of larger trees and shrubs are known, and/or expected to occur in the general Ariamsvlei/Orange River area (Curtis and Mannheimer 2005, Mannheimer and Curtis 2009), 32 species (including 7 other tree/shrub species not included in Table 6 – i.e. *Calicorema capitata*, *Dyerophytum africanum*, *Monechma spartioides*, *Ephedra* sp., *Ficus cordata* [F*], *Salix mucronata* subsp. *capensis* [F*], *Searsia – Rhus – lancea* [F#]) were identified at the proposed development sites during the fieldwork conducted between 2 and 6 September 2010. Another 14 species of herbs were also confirmed from the area and are presented in Table 7.

Table 7. Herbs confirmed from the Desert Star South Project Phases 1A-C areas.

Species: Scientific name	Status
Asperagus capensis var. *capensis* *Blepharis spinifex* *Cleome foliosa* var. *lutea*	
Cyperus marginatus *Forsskaolea hereroesis*	Near-endemic
Hermania minutiflora	Near-endemic

Species: Scientific name	Status
Jamesbrittenia ramosissima	Near-endemic
Mesembryanthemum barklyi	Near-endemic
Monsonia umbellata *Psilocaulon junceum* *Tribulus terrestris* *Tripteris microcarpa* subsp. *microcarpa* *Zygophylum cretaceum*	Near-endemic
Zygophylum microcarpum	Near-endemic

[Near-endemic - Mannheimer *et al.* 2008]

Many more species – especially annual herbs – are expected to occur in the general area becoming visible after rains although the rainfall in this part of Namibia is highly variable and unpredictable.

Although the Aizoaceae (succulents or commonly referred to as "vygies") are common in southern Namibia, especially south-western Namibia, with many species being protected (see Nature Conservation Ordinance 4 of 1975), none were encountered in the proposed development area during the fieldwork. The sandy drainage lines typical of the proposed development areas are not viewed as suitable habitat for most succulents (pers. obs.) with more species expected in the gravel plains, plateau and mountainous areas to the north. The overall dry conditions during the field visit could also have influenced encountering species occurring at low densities and typically cryptic although the Farm Manager (G. Louw pers. comm.) confirmed that few succulents occurred in the immediate area and that for example, no Lithops were observed in the last two years on site. After periods of localised rains would however be the best time to confirm the presence of these plants on site as flowering typically gives them away. A general rule could be to relocate all "vygies" encountered during the construction phase and/or include patches of such plants into the overall landscaping.

Fourteen (43.8%) species of the larger trees and shrubs observed in the area have some kind of protected status in the general area. This excludes 6 species indicated as protected by various Forestry laws according to Curtis and Mannheimer (2005) and Mannheimer and Curtis (2009) although not officially protected according to the Forestry Ordinance No. 37 of 1952. One species (3.2%) is classified as near threatened, 2 species (6.4%) as near-endemic, 6 species (18.8%) are protected by the Forestry Ordinance No. 37 of 1952, 1 species (3.2%) is protected by the Nature Conservation Ordinance No. 4 of 1975 and 2 species (6.4%) are classified as CITES Appendix II species. Most of the protected species have only a few specimens present in the proposed development areas; are widespread throughout Namibia; are not exclusively associated with the Desert Star South Project development areas and could easily be avoided during the construction phase(s). According to the Forest Act 12 of 2001, no tree may be removed with 100m from a river and drainage line. Although the new Forest Act is currently under review it is recommended that the developers still obtain the relevant permits to remove any such species should this become necessary.

Seventeen, 22 and 16 species of larger trees, shrubs and herbs were identified in Phases 1A to 1C, respectively (Table 8).

Table 8. Tree and shrub species observed at Desert Star South Project Phases 1A-C areas.

Phase 1A	Phase 1B	Phase 1C
Acacia erioloba	*Acacia erioloba*	*Acacia erioloba*
	Acacia karroo	
Acacia mellifera detinens		*Acacia mellifera detinens*

Phase 1A	Phase 1B	Phase 1C
	Adenolobus garipensis	
	Blepharis spinifex	
	Boscia albitrunca	*Boscia albitrunca*
Boscia foetida		*Boscia foetida*
		Cadaba aphylla
Calicorema capitata∆		*Calicorema capitata*
Ceraria namaquensis∆		
Cleome foliosa var. *lutea*		
	Cyperus marginatus	
Euclea pseudebenus	*Euclea pseudebenus*	
	Ficus cordata∆	
	Forsskaolea hereroesis	
	Hermania minutiflora	
	Jamesbrittenia ramosissima	
Lycium bosciifolium	*Lycium bosciifolium*	*Lycium bosciifolium*
Maerua gilgii	*Maerua gilgii*	*Maerua gilgii*
Mesembryanthemum barklyi		
		Monechma spartioides
		Monsonia umbellata
		Pappea capensis
		Parkinsonia africana
Salix mucronata subsp. *capensis*	*Salix mucronata* subsp. *capensis*	
		Schotia afra
Searsia (Rhus) pendulina	*Searsia (Rhus) pendulina*	
	Searsia (Rhus) populifolia∆	*Searsia (Rhus) populifolia*
Sisyndite spartea	*Sisyndite spartea*	*Sisyndite spartea*
Tamarix usneoides	*Tamarix usneoides*	
Tribulus terrestris	*Tribulus terrestris*	
	Tripteris microcarpa subsp. *microcarpa*	
	Ziziphus mucronata	
Zygophylum cretaceum		
Zygophylum microcarpum	*Zygophylum microcarpum*	*Zygophylum microcarpum*

∆ Rocky areas only

Six invasive alien plant species – *Argemone ochroleuca*, *Datura stramonium*, *Eucalyptus* sp., *Nicotiana glauca*, *Prosopis* sp. and *Ricinus communis* – were observed at the proposed development sites (Figures 24 and 25). No invasive alien plants were observed in the Phase 1C area with aliens only observed in the flooded areas along the Orange River (Table 9).

Table 9. Alien species observed in each of the three proposed development sites at Desert Star South Project Phases 1A-C areas.

Phase 1A	Phase 1B	Phase 1C
Argemone ochroleuca		
	Datura stramonium	
Eucalyptus sp.	*Eucalyptus* sp.	
Nicotiana glauca	*Nicotiana glauca*	
Prosopis sp.		
Ricinus communis	*Ricinus communis*	

No alien species observed in the Phase 1C area.

Figure 24. Invasive alien *Eucalyptus* species on the banks of the Orange River surrounded by indigenous species such as *Lycium bosciifolium* and *Ziziphus mucronata*.

Figure 25. Invasive alien *Ricinus communis* on the banks of the Orange River. Trees and shrubs species in the Phase 1A and 1B areas were dominated by dense impenetrable stands of *Tamarix usneoides*, *Phagmites australis* reeds and *Searsia (Rhus) pendulina*. No formal % species composition was attempted in these areas due to the dense impenetrable habitat.

Fifteen species of trees and shrubs were encountered along two transects totalling 2,000m in the Phase 1C (Golf Course of the Stars) area. *Acacia mellifera* (20%), *Sisyndite spartea* (19.5%) and *Lycium bosciifolium* (17%) were the most dominant tree and shrub species observed during the fieldwork in this area (Figure 26).

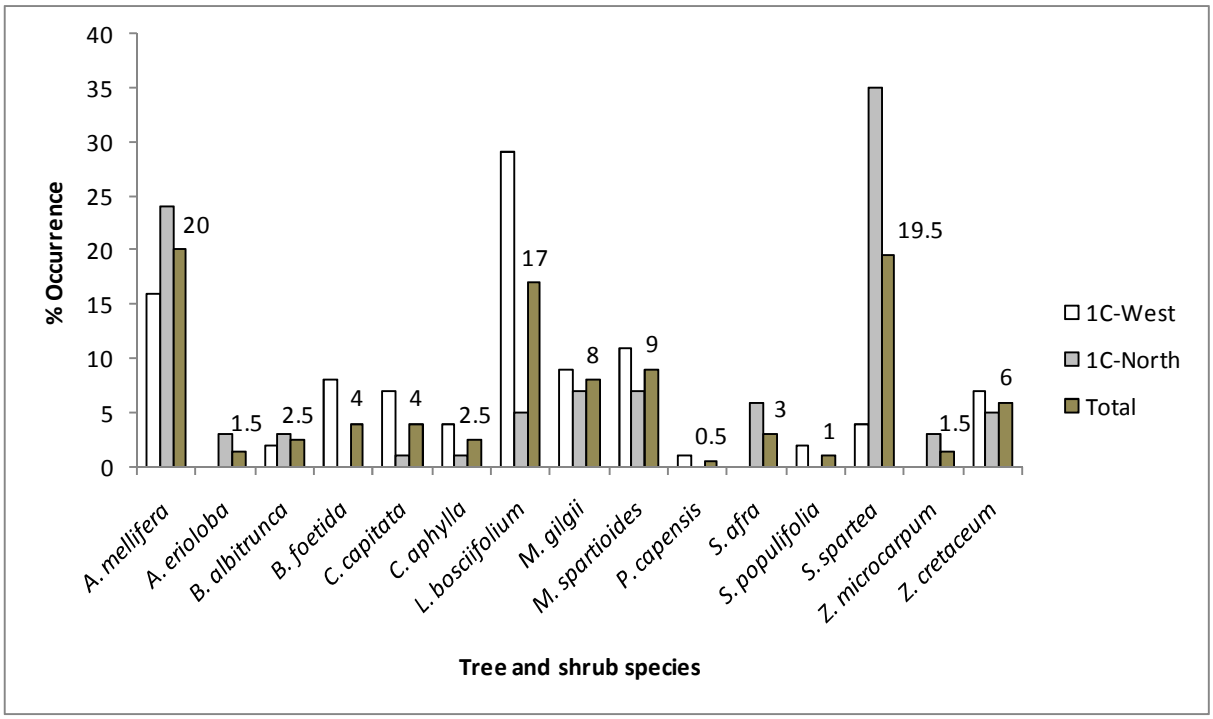

Figure 26. Tree and shrub % species composition as determined for Phase 1C (drainage line west and north) over 2,000m (1,000m for each drainage line).

Of the most important species in the proposed developments areas, only a few specimens of *Commiphora gracilifrondosa* (near-threatened and near-endemic) were observed, mainly in the Phase 1D area currently not within this scope of this report. Steyn (2003) views the restricted range *Commiphora gracilifrondosa* as the most important Commiphora species in the general area. No *Commiphora namaensis* (near-endemic) specimens were observed in the area while *Euphorbia gregaria* (near-endemic and C2) is ubiquitous especially in the Phases 1C and 1D and plateau areas. However, the last-mentioned areas are not within the scope of this study.

Maerua gilgii (near-endemic) is found throughout the area although not in large numbers with it comprising 8% of the species composition in the Phase 1C area (see Figure 26). *Schotia afra* also occurs in low numbers in the Phase 1C area (3% - see Figure 26) where some big specimens were observed. Furthermore, *S. afra* was observed to be well-utilised (browsed) by ungulates – e.g. kudu – in the area. The three above-mentioned species are viewed as the most threatened by the proposed developments as they have restricted distributions and/or are rare throughout their range in Namibia.

Figure 27. *Schotia afra* in an ephemeral drainage line in the Phase 1C area.

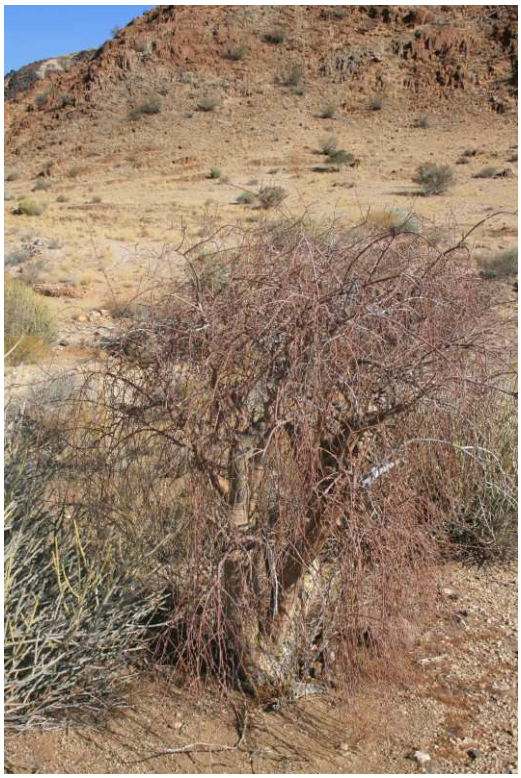

Figure 28. *Commiphora gracilifrondosa* in a rocky area in the Phase 1D area.

Figure 29. *Maerua gilgii* in sandy loam in the Phase 1B area.

The proposed developments at the Desert Star South Project Phase 1 are not expected to adversely affect any unique trees/shrubs should the mitigations be adhered to (see Section 4.2). For example, including the sensitive areas, protected species and individual bigger trees into the overall landscaping of the area would undoubtedly minimise the overall effect of the proposed development(s).

1.3.6 Tree and Shrub Densities

Thirty 10x10m quadrates to determine tree and shrub densities were placed along transects in the Phase 1C area, but not the Phases 1A and 1B as the impenetrable stands of riparian vegetation made this impossible. The mean number of trees/shrubs per 10m² was 3.7±1.6 with a range between 1 and 8 trees/shrubs 10m². This can be converted to approximately 370 trees/shrubs per hectare indicating that the area is sparsely vegetated.

1.3.7 Grass Diversity

The grasses known, and/or expected to occur in the general Ariamsvlei/Orange River area (derived from [1]Müller 1984, [2]Van Oudtshoorn 1999 and [3]Müller 2007), including species actually observed (or confirmed) during the fieldwork conducted between 2 and 6 September 2010 (√), is presented in the Table 10.

Table 10. Grass diversity expected and confirmed from Desert Star South Project Phases 1A-C areas.

Species: Scientific name	Species observed and confirmed	Status	Ecological Status	Grazing Value
[3]*Anthephora pubescens*			Decreaser	High
[1]*Anthephora ramosa*			Decreaser	High
[2,3]*Aristida adscensionis*			Increaser 2	Low
[2,3]*Aristida congesta*			Increaser 2	Low
[2,]*Aristida meridionalis*			Increaser 3	Low
[1,3]*Brachiaria glomerata*			?	Average
[2]*Cenchrus ciliaris*	√		Decreaser	High
[2]*Centropodia glauca*	√		Decreaser	High
[2,3]*Chloris virgata*			Increaser 2	Average
[2]*Dactyloctenium aegyptium*			Increaser 2	Average
[2]*Dichanthium annulatum*			Decreaser	High
[2]*Digitaria eriantha*			Decreaser	High
[1,2,3]*Enneapogon cenchroides*	√		Increaser 2	Average
[1,2,3]*Enneapogon desvauxii*			Intermediate	Average
[1,2,3]*Enneapogon scaber*	√		?	Low
[2]*Eragrostis bicolor*			?	Low
[3]*Eragrostis brizantha*			Increaser 2	Average
[3]*Eragrostis cylindriflora*	√		Increaser 2	Low
[2]*Eragrostis echinochloidea*			Increaser 2	Average
[3]*Eragrostis homomalla*			?	?
[2,3]*Eragrostis lehmanniana*			Increaser 2	Average
[2]*Eragrostis nindensis*			Increaser 2	Average
[3]*Eragrostis porosa*			Increaser 2	Low
[2,3]*Eragrostis rotifer*			?	Average
[2,3]*Eragrostis trichophora*			Increaser 2	Average
[2]*Eragrostis viscosa*			Increaser 2	Low
[2]*Fingerhuthia africana*			Decreaser	Average
[2,3]*Melinis repens*			Increaser 2	Low
[1,3]*Odyssea paucinervis*			?	Low
[2]*Oropetium capense*			Increaser 2	Low
[1,3]*Panicum arbusculum*			Decreaser	High
[2]*Polypogon monspeliensis*			Introduced	Average
[1]*Rhynchelytrum villosum*			Increaser 2	Average
[1,2,3]*Schmidtia kalahariensis*	√		Increaser 2	Low
[2]*Schmidtia pappophoroides*			Decreaser	High
[2]*Setaria verticillata*	√		Increaser 2	Average
[2]*Sorghum bicolor*			?	High
[1]*Stipagrostis anomala*			?	Low
[1]*Stipagrostis brevifolia*			Decreaser	High
[1,2,3]*Stipagrostis ciliata*	√		Decreaser	High
[1,3]*Stipagrostis fastigiata*			?	High

Species: Scientific name	Species observed and confirmed	Status	Ecological Status	Grazing Value
[3]*Stipagrostis hochstetteriana*			Decreaser	High
[2]*Stipagrostis namaquensis*	√		?	Average
[2]*Stipagrostis obtusa*	√		Decreaser	High
[2,3]*Stipagrostis uniplumis*	√		Increaser 2	Average
[2,3]*Tragus berteronianus*			Increaser 2	Low
[3]*Triraphis ramosissima*	√		?	High

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

Although up to 47 grasses are expected to occur in the general Ariamsvlei/Orange River area, only 14 species were observed during the fieldwork (including 2 other species – *Cynodon dactylon* and *Phagmites austalis* (reed) not included in Table 10). None of the species expected and/or observed in the area are endemic or particularly unique although the grass biomass was high due to the lack of grazers and stock farming activities. Phase 1C is dominated by *Stipagrostis* species (8 species in total) while Phases 1A and 1B adjacent the Orange River have a larger variety of species (10 and 11 species, respectively). The differences in grass species composition are presented in Table 11.

Table 11. Grass species observed in each of the three proposed development sites at Desert Star South Project Phases 1A-C areas.

Phase 1A	Phase 1B	Phase 1C
Cenchrus ciliaris	*Cenchrus ciliaris*	
Centropodia glauca	*Centropodia glauca*	*Centropodia glauca*
Cynodon dactylon	*Cynodon dactylon*	
	Enneapogon cenchroides	*Enneapogon cenchroides*
Enneapogon scaber	*Enneapogon scaber*	*Enneapogon scaber*
	Eragrostis cylindriflora	
Phagmites australis	*Phagmites australis*	
Schmidtia kalahariensis	*Schmidtia kalahariensis*	*Schmidtia kalahariensis*
Setaria verticillata	*Setaria verticillata*	
Stipagrostis ciliata		*Stipagrostis ciliata*
	Stipagrostis namaquensis	*Stipagrostis namaquensis*
		Stipagrostis obtusa
Stipagrostis uniplumis	*Stipagrostis uniplumis*	*Stipagrostis uniplumis*
Triraphis ramosissima		

Grass species in the Phase 1A and 1B areas, although more varied than Phase 1C, were dominated by *Cynodon dactylon* and *Phagmites australis* reeds. No formal species composition was attempted in these areas due to the dense impenetrable habitat and overall low grass biomass.

Seven species of grasses were encountered along two transects – 150m each in the western and northern drainage lines – totalling 300m in the Phase 1C (Golf Course of the Stars) area. *Stipagrostis ciliata* (24.6%), *Stipagrostis uniplumis* (18.7%) and *Centropodia glauca* (16%) were the most dominant grass species observed during the fieldwork in this area. The sparseness of the area can be observed in the high percentage occurrence of bare ground (28.3%) (see Figures 30 and 31).

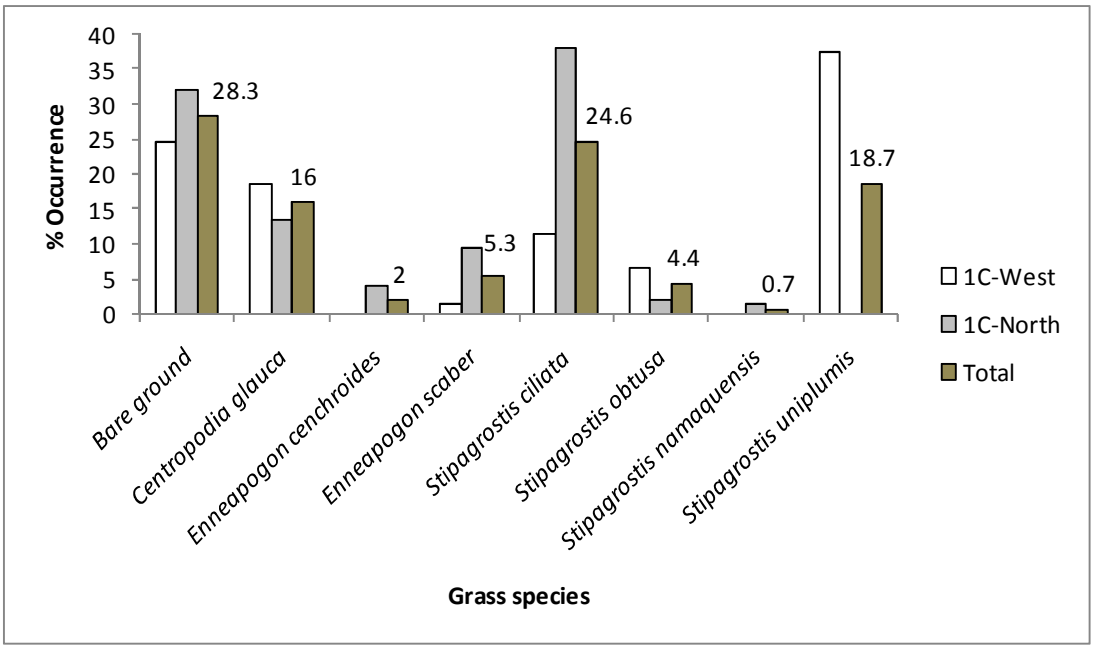

Figure 30. Grass percentage (%) species composition as determined for Phase 1C (drainage line west and north) over 300m (150m for each drainage line).

Figure 31. Grass cover dominated by *Stipagrostis* species in Phase 1C (drainage line west and north).

It is recommended that – *Cynodon dactylon* – be used for the greens/roughs for the Golf Course of the Stars as it is an indigenous grass which already occurs in the area (see Table 11). Furthermore, it requires less water and overall maintenance (i.e. fungal and pest treatment) and is utilised by grazers as a source of food. Species such as *Pennisetum clandestinum* (Kikuyu) and *Stenotaphrum secundatum* (Buffalo Turf Grass) should be avoided as they do not occur naturally in Namibia, require much water use and overall maintenance and could become invasive, especially along the Orange River. The artificial greens/roughs would serve as an additional habitat in the area and would be expected to attract a legion of birds (e.g. various Lapwings, Egyptian Goose, Hadeda Ibis, etc.), reptiles (e.g. Bushmanland Tent Tortoise) and mammals (e.g. Rock Hyrax and various ungulates). These species could add to the overall attraction and ambiance, but would also require additional maintenance – e.g. burrowing species (Aardvark, Ground Squirrels, mongoose species, etc.) and grazers (Baboon) as well as ungulates and Rock Hyrax would damage the greens, etc.

The proposed developments at Desert Star Studios Phase 1 are not expected to adversely affect any unique grasses should the mitigations be adhered to (see Section 4.3). For

example, including the sensitive areas into the overall landscaping of the area would undoubtedly minimise the overall effect of the proposed development(s).

2 Conclusion

Vertebrate fauna
It is estimated that at least 47 reptile, 11 amphibian, 58 mammal and 199 bird species (breeding residents) are known to or expected to occur in the general Ariamsvlei/Orange River area of which a large proportion are endemics. Endemics include at least 51% of the reptiles, 9.1% of the amphibians, 10.3% of the mammals and 7.1% (1 of the 14 Namibian endemics) of all the breeding and/or resident birds known and/or expected to occur in the general area. During the fieldwork conducted between 2 and 6 September 2010, 17 reptiles, 2 amphibians, 26 mammals and 70 bird species were identified and confirmed.

The very high percentage of unique and/or endemic species (51%) underscores the importance of the general area for reptiles, with most species being understudied and their importance to the general ecology not being well understood. The species observed and/or confirmed from the area and viewed as the most important are *Psammobates tentorius veroxii*, *Naya (nigricollis) woodi*, *Varanus niloticus* and *Platysaurus broadleyi* although none is exclusively associated with the proposed development areas.

Amphibians of unique conservation value include 1 endemic and 1 near threatened species of which very little is currently known except that they occur in the general area. Both species observed and/or confirmed from the area – *Amietia angolensis* and *Amietophrynus* (*Bufo) gutturalis* – are not viewed as threatened and are not exclusively associated with the proposed development areas. Although the actual importance of the Orange River for amphibians is unknown it is viewed as a prime habitat for amphibians in an otherwise marginal area.

Mammals, especially small mammals (rodents) and carnivores are well-represented in the area. The bats are probably underrepresented in the area due to a lack of formal surveying of the area. The most important mammal species from the general area are viewed as the various carnivores as they are often mercilessly persecuted in small stock farming areas. Species of concern (i.e. with some form of conservation status) confirmed from the area would be *Proteles cristatus*, *Felis silvestris/lybica*, *Otocyon megalotis*, *Vulpes chama* and *Aonyx capensis*. However, none of the mammals observed and/or confirmed from the area are exclusively associated with the proposed development areas.

Although Namibian endemic birds are not well-represented in the general area (1 species or 7.1% of all Namibian endemics), the high proportion of southern African endemics (15.6%) and near-endemics (18.6%) makes this an important area. The most important species confirmed from the general area are the endemic Rosy-faced Lovebird, African Fish Eagle and Cape Spurfowl. Sightings of White-fronted Bee-Eater (*Merops bullockoides*) in the area have increased their known range in Namibia although their status in the area is unknown and should be investigated further. Other important species include various raptors (e.g. vultures and eagles – previously observed in the area) which face persecution as livestock predators throughout their range and also succumb to poisoned bait set for problem carnivores in Namibia. However, none of the birds observed and/or confirmed from the area are exclusively associated with the proposed development areas.

Flora
Although the average plant production (higher plants) in the general area is viewed as “low to very low” and the overall plant diversity (all species - “higher” plants) is “low” and estimated at 50-99 species, it does increase to 100-149 species along the Orange River. Plant endemism is also viewed as “very low” with <5 species expected from the general area. According to the literature survey an estimated 23-44 species of larger trees and at least 13-

32 (approximately 44 species) of grasses occur in the general Ariamsvlei/Orange River area. During the fieldwork conducted between 2 and 6 September 2010, 32 species of larger trees and shrubs, 14 herbs and 14 grasses were identified and confirmed.

The most important species, due to their restricted ranges and/or they are uncommon in Namibia, are viewed as *Commiphora gracilifrondosa* (near-threatened and near-endemic), *Commiphora namaensis* (near-endemic), *Euphorbia gregaria* (near-endemic and C2), *Maerua gilgii* (near-endemic) and *Schotia afra* (restricted range). *Euphorbia gregaria* is abundant in suitable habitat in the general area while no *Commiphora namaensis* were observed during the fieldwork. Only a few specimens of *Commiphora gracilifrondosa* were observed in rocky habitat. *Maerua gilgii* and *Schotia afra* are nowhere common, but found in the drainage lines in the area. None of these species are however exclusively associated with the proposed development areas.

Except for their grazing value and ecological importance, none of the grasses expected and/or observed/confirmed in the proposed development areas are viewed as unique and/or particularly important. None of these grass species are exclusively associated with the proposed development areas.

Although the general area is well protected in its overall isolation with very little development, the Orange River riparian vegetation is being denuded in areas which are deemed suitable for vineyards, especially export grapes. The Orange River area is in places heavily infested with invasive alien species – e.g. *Prosopis* (various species and hybrids) – and further development and/or soil disturbance may exacerbate this infestation, except if a concerted effort is made to eradicate these aliens.

Sensitive areas
The general area is typical of the Orange River valley with rugged rocky areas and sandy ephemeral drainage lines. The areas of most concern would be:

a) Orange River riparian vegetation
The dense Orange River riparian vegetation belt not only protects the river bank from general erosion processes, but also serves as unique habitat for various species. Important tree species mainly associated with the riparian forests in Namibia are *Searsia (Rhus) pendulina* and *Salix mucronata* subsp. *capensis*. Birds use the area for roosting/perching/foraging and breeding sites; amphibians for cover; while reptiles and mammals use the area for cover and foraging. Much of this habitat is infested with invasive alien species while the less rugged areas are transformed for agricultural purposes.

b) Rocky outcrops/mountains and associated vegetation
These areas are habitat to interesting and unique species for example *Ceraria namaquensis*, *Commiphora gracilifrondosa* and *Euphorbia virosa*. Interesting and unique rock dwelling mammals include Elephant Shrews, cave and crevice dwelling bats, Dassie Rat, various smaller carnivores and Klipspringer.

c) Ephemeral drainage lines
These areas, although sandy and leached are habitat to various interesting and unique trees such as *Acacia erioloba*, *Boscia albitrunca*, *Maerua gilgii* and *Schotia afra* which serve as shelter and food to a variety of fauna species. *Schotia afra* are a restricted range species in Namibia and only observed in some ephemeral drainage lines in the area.

3 Recommendations

To conform to the principles of environmental management regarding the Desert Star South Phases 1A-C developments, the following general recommendations are made:

i) Implement a "no kill" policy of fauna (e.g. poaching for meat (snares); killing of snakes, etc.) throughout the area, especially during the construction phase.

ii) Implement a policy of no collecting of "veld foods" and fire wood on site as this often results in over exploitation of natural resources.

iii) Implement and maintain "green spaces" which are linked – i.e. can serve as corridors for the movement of fauna – e.g. Orange River and associated drainage lines.

iv) Protect the larger tree specimens, especially protected species (i.e. *Acacia erioloba*, *Boscia albitrunca*, *B. foetida*, *Euclea pseudebenus*, *Searsia (Rhus) lancea* and *Tamarix usneoides* [Forestry Ordinance No. 37 of 1952) and interesting and restricted range species (i.e. *Commiphora gracilifrondosa* and *Schotia afra*) as well as larger tree specimens as these often have cavities, dead branches, loose bark, etc. which serve as habitat to a variety of cavity and bark dwelling fauna – e.g. bats and birds.

v) Limit development in the sensitive areas – i.e. Orange River riparian vegetation, rocky outcrops and mountains and ephemeral drainage lines with unique/interesting vegetation.

vi) Encourage future residents to not introduce domestic cats to the area; domestic cats kill large numbers of indigenous fauna and may breed with the African Wild Cats in the area and cause genetic pollution (e.g. interbreeding) of the Namibian population.

vii) Avoid off-road driving as this result in the destruction of fauna and flora.

4 Envisaged impacts

4.1 Introduction

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

4.2 Faunal loss

Habitat loss associated with the proposed Desert Star South Phases 1A-C developments would be localised. The following table summarises the potential/envisaged impacts expected to occur (faunal loss is closely linked to habitat loss):

Description	Faunal loss will vary depending on the scale/intensity of the development operation and associated and inevitable infrastructure. As this development is currently limited to Phases 1A-C on Portion 1 of Farm Komsberg and a Portion of the remainder of Farm Stolzenfels, the impact is contained and limited.
Extent	Localised disruption/destruction of the habitat and thus consequently fauna associated directly with this habitat and the actual development sites. This however, would be a relatively small area with localised implications. Further developments and road construction (e.g. Phase 1D, Desert Star City and International Airport, etc.) throughout the area would however increase the extent.

Duration	The duration of the impact is expected to be permanent over most of the proposed development sites except the areas designated as "green spaces and corridors" and Golf Course of the Stars once established. Most species (e.g. various birds and smaller mammals) are expected to re-colonise the area after completion of the development(s) – i.e. duration viewed as short- to medium-term – while other species are not expected to return depending on the scale (e.g. various secretive carnivores such as leopard) – i.e. duration viewed as long-term. This, however, would be a relatively small area with localised implications.
Intensity	The actual development sites would be permanently altered with the intensity of faunal loss depending on the species involved – e.g. slow-moving and sedentary species will succumb to development while the more mobile species will vacate the area. This however, would be a relatively small area with localised implications. The areas adjacent the development sites should not be significantly affected. This, however, would depend on control over the contractors during the construction phase(s), but should be limited to localised implications. Areas not directly affected by the development, although within the immediate vicinity, would be affected minimally. This would include dust, noise and other associated disturbances in the area, but be limited to the construction period(s). The effect that the eventual shooting of films may have on the fauna is difficult to determine beforehand although increased disturbance associated with increased activities are expected. This would however be limited to the filming periods.
Mitigation	**1.** Limit development and associated infrastructure in sensitive areas – e.g. Orange River riparian vegetation, rocky outcrops and mountains, ephemeral drainage lines, etc. This would minimise the negative effect on the local environment especially unique features serving as habitat to various species. **2.** Implement and maintain track discipline with maximum speed limits (e.g. 30km/h) as this would result in fewer faunal road mortalities and associated dust pollution problems. Temporary speed humps could also be used to limit the speed at which people travel. **3.** Avoid off-road driving and unnecessary nocturnal driving in the area as this result in the destruction of slow moving fauna – e.g. various reptiles and other nocturnal species. **4.** Avoid and/or limit the use of lights during nocturnal construction as this influence and/or affects various nocturnal species – e.g. bats and owls, etc. Use focused lighting for least effect. **5.** Prevent and discourage the setting of snares (poaching), illegal collecting of veld foods (e.g. tortoises, etc.), indiscriminate killing of perceived dangerous species (e.g. snakes, etc.) and the collection of wood as this would diminish and negatively affect the local fauna – especially during the construction phase(s). **6.** Initiate a suitable and appropriate refuse removal policy as littering could result in certain animals becoming accustomed to humans and associated activity and result in typical problem animal scenarios – e.g. baboon, jackal, etc.

	7. Attempt to avoid the removal of bigger trees (especially protected species – i.e. *Acacia erioloba*, *Boscia albitrunca*, *B. foetida*, *Euclea pseudebenus*, *Searsia (Rhus) lancea* and *Tamarix usneoides* [Forestry Ordinance No. 37 of 1952) – during the construction phase(s) – including the development of access routes – as these serve as habitat for a myriad of fauna. **8.** Maintain "green spaces and corridors" – e.g. along the Orange River and associated ephemeral drainage lines – to ensure the natural movement of fauna and to create a "natural" ambiance throughout. **9.** Prevent and discourage fires – especially during the construction phase(s) – as this could easily cause runaway veld fires (especially as the area currently has a good grass biomass due to the lack of stock farming activities) affecting the local fauna, and also cause problems (e.g. loss of grazing and domestic stock mortalities, etc.) for the neighbouring farms and home owners. **10.** Rehabilitation of the disturbed areas – i.e. initial development access route "scars" and associated tracks, as well as temporary accommodation sites. Preferably workers should be transported in/out to the construction sites on a daily basis to avoid excess damage to the local environment (e.g. fires, wood collection, poaching, etc.). Such rehabilitation would not only confirm the company's environmental integrity, but also show true local commitment to the environment. **11.** Implement erosion control. The area(s) towards and adjacent to the drainage line(s) are easily eroded and further development may exacerbate this problem. Avoid construction within 20m of the Orange River and main drainage line(s) to minimise erosion problems, as well as to preserve the associated riparian fauna. **12.** Prevent (do not allow) domestic pets – e.g. cats and dogs – accompanying the workers during the construction phase as well as future residents as pets can cause considerable damage to the local fauna. Cats also interbreed and transmit diseases to the indigenous African Wildcat found in the area. The indiscriminate and wanton killing of the local fauna by such pets should be avoided at all cost. **13.** Initiate a policy of capture and removal of fauna encountered serendipitously within the construction areas. Such fauna should be removed to other areas of similar habitat in the area. **14.** Investigate the possibility of declaring the area a private nature reserve similar to NamibRand or Gondwana Private Nature Reserves or biosphere. This would enhance and maintain the natural ambiance of the area. **15.** Investigate the reintroduction of fauna that originally occurred naturally in the area, but since extirpated – e.g. Springbok, Oryx, Eland, Red Hartebeest, Black Rhino, etc. This should further enhance and maintain the natural ambiance of the area. **16.** Investigate the idea of employing a qualified ecologist/reserve manager to ensure the appropriate management of the wildlife and ecological processes. This would ensure proper management.
Frequency of occurrence	Expected to be "once off" and only affecting the selected site(s).

Probability	Definite (100%) negative impact on fauna is expected in the various development areas as well as the access route construction sites including the future (i.e. planned) developments. Highly Probable (75%) negative impact on fauna is expected in the general areas especially during the construction phase(s) as a result of noise, increased activities, etc. Probable (50%) negative impact on fauna is expected from the infrastructure (roads/tracks). Precautionary principle (e.g. avoid unique habitat features as well as adhering to the proposed mitigating measures would minimise this) would decrease the significance of these potential impacts.
Significance	Before mitigation: **High** After mitigation: **Medium** to **Low**
Status of the impact	Negative Localised unique habitats (e.g. Orange River riparian vegetation, rocky outcrops and mountains, drainage lines, etc.) with associated fauna would bear the brunt of this proposed development, but be limited in extent and only permanent at the actual development sites and access routes.
Legal requirements	Fauna related: Nature Conservation Ordinance No. 4 of 1975, CITES, IUCN and SARDB Habitat – Flora related: Forestry Ordinance No. 37 of 1952, Forest Act No. 72 of 1968, Nature Conservation Ordinance No. 4 of 1975, CITES
Degree of confidence in predictions	As an ecologist I am sure of the above-mentioned predictions made and would suggest that the mitigation measures be implemented to minimise potentially negative aspects regarding the local fauna in the area.

4.3 Floral loss

Habitat loss associated with the proposed Desert Star South Project Phases 1A-C areas would be localised. The following table summarises the potential/envisaged impacts expected to occur (floral loss is closely linked to habitat loss):

Description	Floral destruction will vary depending on the scale/intensity of the development operation and associated and inevitable infrastructure. As this development is currently limited to Phases 1A-C on Portion 1 of Farm Komsberg and a Portion of the remainder of Farm Stolzenfels, the impact is contained and limited.
Extent	Localised disruption/destruction of the habitat and thus consequently flora associated directly with this habitat and the actual development sites. This however, would be a relatively small area with localised implications. Further developments and road construction (e.g. Phase 1D, village and international airport, etc.) throughout the area would however increase the extent.

Duration	The duration of the impact is expected to be permanent over most of the proposed development sites except the areas designated as "green spaces and corridors" and Golf Course of the Stars once established. If the overall onsite landscaping/gardening is to be indigenous of nature then some species would re-colonise (e.g. seeds of various species remain viable in soil for long periods). This however, would be a relatively small area with localised implications.
Intensity	The actual development sites would be permanently altered with the intensity of floral loss depending on the scale of site clearing for construction purposes. This however, would be a relatively small area with localised implications. The areas adjacent the development sites should not be significantly affected. This, however, would depend on control over the contractors during the construction phase(s) – e.g. fire wood collection, etc., but should be limited to localised implications. Areas not directly affected by the development, although within the immediate vicinity, would be affected minimally.
Mitigation	**1.** Limit development and associated infrastructure in sensitive areas – e.g. Orange River riparian vegetation, rocky outcrops and mountains, ephemeral drainage lines, etc. This would minimise the negative effect on the local environment especially unique features and trees/shrubs serving as habitat to various species. **2.** Identify (e.g. mark – red and white tape) protected and unique species (i.e. *Acacia erioloba*, *Boscia albitrunca*, *B. foetida*, *Euclea pseudebenus*, *Searsia (Rhus) lancea* and *Tamarix usneoides* [Forestry Ordinance No. 37 of 1952] and *Commiphora gracilifrondosa* and *Schotia afra*]) before the commencement of construction activities. **3.** Prevent and discourage the collecting of firewood as dead wood has an important ecological role – especially during the development phase(s). Such collecting of firewood, especially for economic reasons, often leads to abuses – e.g. chopping down of live and/or protected tree species such as *Acacia erioloba* which is a good quality wood. **4.** Attempt to avoid the removal of bigger trees (especially the protected species – i.e. *Acacia erioloba*, *Boscia albitrunca*, *B. foetida*, *Euclea pseudebenus*, *Searsia (Rhus) lancea* and *Tamarix usneoides* [Forestry Ordinance No. 37 of 1952] during the construction phase(s) – especially with the development of access routes – as these serve as habitat for a myriad of fauna. **5.** Attempt to avoid the removal of interesting and unique trees (especially restricted range species – i.e. *Commiphora gracilifrondosa* and *Schotia afra*). **6.** Initiate a policy of replacing 2 indigenous tree species (preferably the same species) for each protected species having to be removed. An onsite nursery propagating indigenous species could be established to facilitate this. **7.** Prevent and discourage fires – especially during the construction phase(s) – as this could easily cause runaway veld fires (especially as the area currently has a good grass biomass due to the lack of stock farming activities) causing problems (e.g. loss of grazing and domestic stock mortalities, etc.) for the neighbouring home owners and farmers.

	8. Implement erosion control. The area(s) towards and adjacent to the drainage line(s) are easily eroded and further development may exacerbate this problem. Avoid construction within 20m of the Orange River and main drainage line(s) to minimise erosion problems, as well as to preserve the associated riparian flora. **9.** Prevent the planting of potentially alien invasive plant species (e.g. *Tecoma stans*, *Pennisetum setaceum*, etc.) for ornamental purposes as part of the landscaping. Alien species often "escape" and become invasive causing further ecological damage. **10.** Implement a policy of "no tolerance" towards the existing invasive alien plant species (i.e. *Argemone ochroleuca*, *Datura stramonium*, *Eucalyptus* sp., *Nicotiana glauca*, *Prosopis* sp. and *Ricinus communis*) in the area. This should include the removal and destruction of these species throughout the proposed development areas. Such activity would be beneficial to the overall ecology of the Orange River basin. **11.** Incorporate indigenous vegetation (especially the protected species – i.e. *Acacia erioloba*, *Boscia albitrunca*, *B. foetida*, *Euclea pseudebenus*, *Searsia (Rhus) lancea* and *Tamarix usneoides*) into the overall landscaping of the area. This would create a natural ambiance while indigenous species require less water and overall maintenance. **12.** Use the indigenous *Cynodon dactylon* grass for the greens/roughs of the proposed Golf Course of the Stars. This is an indigenous grass; fairly drought resistant; requires relatively little maintenance (i.e. fungal, insect, etc.) and less water compared to other grasses traditionally used on golf courses and is utilised by various wildlife. **13.** Rehabilitation of the disturbed areas – i.e. initial development access route "scars" and associated tracks, as well as temporary accommodation sites. Preferably workers should be transported in/out to the construction sites on a daily basis to avoid excess damage to the local environment (e.g. fires, wood collection, etc.). Such rehabilitation would not only confirm the company's environmental integrity, but also show true local commitment to the environment. **14.** Initiate a policy against the removal of unique flora (e.g. various Crassulaceae, Mesembryanthemoideae, Portulacaceae, etc. that may be encountered prior to and during construction) within the proposed construction areas. Such flora should be removed to other areas of similar habitat in the area or stored (cared for in onsite nursery conditions) and replanted as part of the overall natural landscaping. **15.** Investigate the possibility of declaring the area a private nature reserve similar to NamibRand or Gondwana Private Nature Reserves. This would enhance and maintain the natural ambiance of the area. **16.** Investigate the idea of employing a qualified ecologist/reserve manager to ensure the appropriate management of the vegetation and ecological processes. This would ensure proper management.
Frequency of occurrence	Expected to be a "once off" issue affecting the selected site(s).
Probability	Definite (100%) negative impact on flora is expected in the actual development areas as well as the access route construction sites. This however, would be much localised and cover limited areas.

	Highly Probable (75%) negative impact on fauna is expected from the infrastructure (roads/tracks). Precautionary principle (e.g. avoid unique habitat features as well as adhering to the proposed mitigating measures would minimise this) would decrease the significance of these potential impacts.
Significance	Before mitigation: **High** After mitigation: **Medium** to **Low**
Status of the impact	Negative Localised unique habitats (e.g. Orange River riparian vegetation, rocky outcrops and mountains and ephemeral drainage lines, etc.) would bear the brunt of this proposed development, but be limited in extent and only permanent at the actual development sites and access routes.
Legal requirements	Flora related: Forestry Ordinance No. 37 of 1952, Forest Act No. 72 of 1968, Nature Conservation Ordinance No. 4 of 1975, CITES
Degree of confidence in predictions	As an ecologist I am sure of the above mentioned predictions made and would suggest that the mitigation measures be implemented to minimise potentially negative aspects regarding the local flora in the area.

4.4 Impacts – Construction and Operational Phases

Construction Phase:

Project							
Impact Code	**Potential Impact**	**Aspect**	**Importance of Condition (A1)**	**Magnitude of Change/Effect (A2)**	**Permanence (B1)**	**Reversibility (B2)**	**Cumulative (B3)**
BE 1	Loss of fauna	Construction	1	-2	2	3	2
BE 2	Loss of flora	Construction	1	-2	3	3	2
BE 3	Loss of habitat for fauna	Construction	1	-2	3	3	2
BE4	Loss of sensitive habitat	Construction	1	-2	3	3	2
BE 5	Golf Course	Construction	1	-2	3	3	2
No project							
Impact Code	**Potential Impact**	**Aspect**	**Importance of Condition (A1)**	**Magnitude of Change/Effect (A2)**	**Permanence (B1)**	**Reversibility (B2)**	**Cumulative (B3)**
BE 1	Loss of fauna	Construction	0	0	1	1	1
BE 2	Loss of flora	Construction	0	0	1	1	1
BE 3	Loss of habitat for fauna	Construction	0	0	1	1	1
BE4	Loss of sensitive habitat	Construction	0	0	1	1	1
BE 5	Golf Course	Construction	0	0	1	1	1

Operational Phase:

Project							
Impact Code	**Potential Impact**	**Aspect**	**Importance of Condition (A1)**	**Magnitude of Change/Effect (A2)**	**Permanence (B1)**	**Reversibility (B2)**	**Cumulative (B3)**
BE 1	Golf Course	Operational	2	+2	3	3	2
No project							
Impact Code	**Potential Impact**	**Aspect**	**Importance of Condition (A1)**	**Magnitude of Change/Effect (A2)**	**Permanence (B1)**	**Reversibility (B2)**	**Cumulative (B3)**
BE 1	Golf Course	Operational	0	0	1	1	1

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