# Biodiversity scoping study for EPL 2902

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# 1 Introduction

Colin Christian & Associates cc contracted Biodata Consultancy cc to provide a biodiversity scoping study for Exclusive Prospecting Licence area 2902. The envisaged eventual development is underground lead mining. All animals, both vertebrate and invertebrate, as well as ecosystem level processes involving them, were to be included. The scope of work is:

- A desktop study of biodiversity literature pertaining to the area, supplemented by prior experience. Preparation of draft lists of expected taxa. Identification of potential taxa of concern. Enumeration of relevant legislation.
- Fieldwork in the area to provide context to and ground-truth desktop work. Determine habitat diversity and identify potential issues at the level of habitats, ecosystem services or ecological processes.
- Scoping report highlighting issues to be taken forward.

# 2 Methodology

## 2.1 Desktop study

Namibian biodiversity records are known to be patchily spread. It is therefore customary to extend the area to be covered by data searches with a broad margin around the study site. This ensures more comprehensive data coverage. In the current case, known trends in Central Namib biogeography were used to inform this margin. Since Central Namib endemic taxa tend to have narrow north-south elongated distribution ranges parallel to the coast, the margin around the EPL was made longer in the north-south direction (10 km each side) than in the east-west direction (5 km each side), and it was also orientated to be parallel to the coast. In this way we can ensure that the margin has the highest relevance to any potential Central Namib endemic taxa that might occur within it. The resultant data coverage area is depicted in Figure 1 and its edge coordinates are listed in Table 1. Also mapped in Figure 1 are the four quarter-degree squares that enter into EPL 2902: SE 2214Bc, 2214Bd, 2214Da and 2214Db. All four extend beyond the strict data coverage area and include habitats that do not have a counterpart within EPL 2902, like the Swakop River or the Atlantic Ocean. Records from quarter-degree based datasets were therefore carefully evaluated and any species that were unlikely to occur in the study area on habitat grounds were discarded. For locality-based datasets, all of the very few place names within the data coverage area, as found on official 1: 250000 topographical maps of Namibia, were used.

*Table 1. Cartesian coordinates of data coverage area.*

| | **Latitude** | **Longitude** |
|---|---|---|
| Northwestern corner | -22.40° S | 14.63° E |
| Northeastern corner | -22.36° S | 14.81° E |
| Southeastern corner | -22.60°S | 14.89° E |
| Southwestern corner | -22.65°S | 14.71° E |

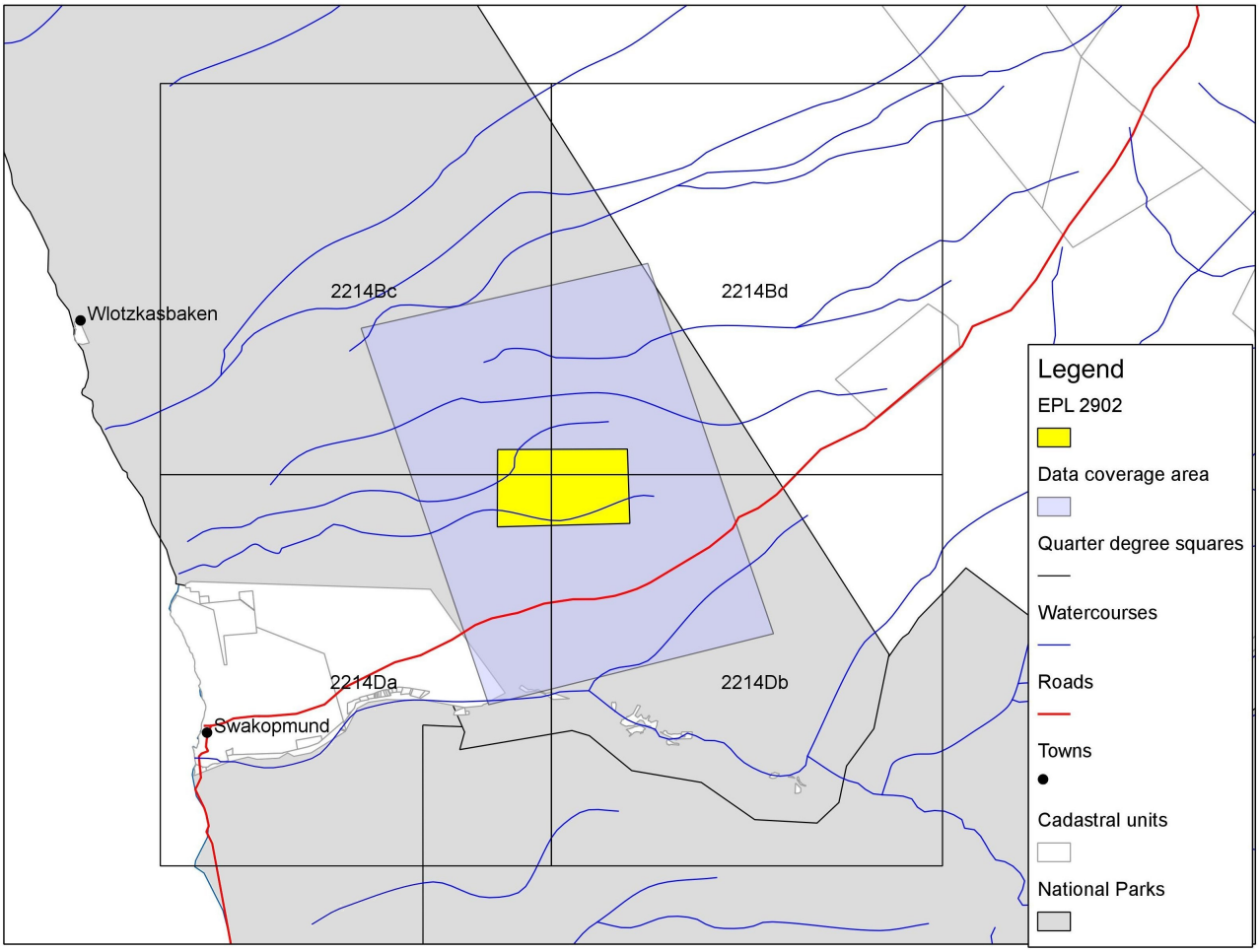


*Figure 1: Study area.*

The utilised data sources were:

- The Namibia Biodiversity Database (NBD 2012) is a coordinate-based collation of about 270000 literature records of Namibian biodiversity. Most records from this source have been listed in the Appendix under their original source citations.
- The collection databases of the National Museum of Namibia (NMN) are normally inaccessible to the public, but the results of a one-off Central Namib data search done in 2009 were available and could be re-used here.
- The Global Biodiversity Information Facility (GBIF 2012) includes several hundred million international museum records, including some from Namibia, but relatively few are geo-referenced, and then often badly. Those that survived quality control were included here.
- The South African GBIF node (SABIF 2012) holds museum specimen data that is not duplicated on GBIF because it is in incompatible quarter-degree square format. A small number of records from the study area were included.
- The Southern African Bird Atlas Project (SABAP1) data was published as Harrison *et al*. (1997). It is in quarter-degree square format and was used as the primary source for bird data here.
- A private collection of about 81Gb of pdf-based publications concerned with Namibian biodiversity was subjected to a placename-based text search and turned up a small number of additional records.
- A number of other datasets were accessed, but did not turn up any relevant records and are not listed above.

## 2.2 Fieldwork

The area was visited on 3 and 4 May 2012. Time was spent on the ground in all major habitats, and all taxa seen were noted. Those that were not readily identifiable in the field were photographed for later determination. In order to place zoological records into habitat context, the landscape classification of Burke (2012) was used. The 11 recorded landscape types were consolidated into three functional habitat types of importance to animals, as summarised in Table 2 and mapped in Figure 2.

*Table 2: Comparison of landscape types and habitat types in the study area.*

| Landscape types | Habitat types |
|---|---|
| Gypsum plains | Gravel plains |
| Marble plains | Gravel plains |
| Plains and drainage lines | Gravel plains |
| Rocky outcrops | Rocky outcrops |
| Dolerite ridges | Rocky outcrops |
| Marble outcrop | Rocky outcrops |
| Mountain footslopes and washes | Rocky outcrops |
| Mountains | Rocky outcrops |
| Arthraerua stand | Watercourses |
| Nara field | Watercourses |
| Rivers | Watercourses |


*Figure 2: Habitat types, as derived from landscape types (Burke 2012).*

# 3 Legislation

A listing of all Namibian environmental legislation can be found on the "Environmental Law and Policy in Namibia" web site (http://www.environment-namibia.net/environmental_acts.html). Those pertinent to biodiversity include:

- The Constitution of the Republic of Namibia. Article 95 commits Namibia to the maintenance of ecosystems, essential ecological processes and biological diversity.
- The Environmental Management Act 7 of 2007 regulates this Environmental Impact Assessment process.
- The Public Health Act 36 of 1919 prohibits users of land to cause nuisances that may be injurious or dangerous to health. The definition of 'nuisance' includes the emission of environmental pollutants.
- Nature Conservation Ordinance 4 of 1975, including Nature Conservation General Amendment Act 1990 and Nature Conservation Amendment Act 5 of 1996 accords special status to defined taxa as per the following schedules:
    - Schedule 3: Specially Protected Game
    - Schedule 4: Protected Game
    - Schedule 5: Huntable Game
    - Schedule 6: Huntable Game Birds
    - Schedule 9: Protected Plants
- The Forest Act 12 of 2001 provides for the protection and control of forest areas and their biodiversity. Not relevant in the current case.
- Inland Fisheries Resources Act 1 of 2003 provides for the protection of aquatic ecosystems. Not relevant in the current case.

- The Convention of Biological Diversity of 1992 provides for the conservation of biological diversity.
- The Convention on International Trade in Endangered Species (CITES) of 1973 regulates trade in endangered species, through listing in appendices:
    - Appendix I includes species threatened with global extinction, and trade in these is subject to particularly strict regulations. It is only authorized under exceptional circumstances.
    - Appendix II includes species that are not necessarily now threatened with extinction, but may become so unless trade in them is strictly regulated to avoid utilization incompatible with their survival. It also includes any other species for which trade needs to regulated in order to effectively control trade in strict Appendix II species.
    - Appendix III includes species where trade regulation to prevent exploitation is mainly needed on the individual country or regional level. Namibia currently has no CITES Appendix III species.
- The Ramsar Convention on Wetlands of International Importance of 1971 promotes the conservation of declared wetlands. Namibia has 4 declared Ramsar sites, but none are relevant for the current case.
- The United Nations Convention on the Law of the Sea (UNCLOS) accords species listed in Annex I the status of 'Highly Migratory Species' and expects member states that have ratified it, like Namibia, to cooperate in ensuring their conservation. Not relevant for the current case.

# 4 Summary of results

## 4.1 General

No actual prior biodiversity records for EPL 2902 were traced. Within the wider data coverage area, most existing records represent incidental collecting in the vicinity of the B2 road, from which extrapolations of probable occurrence in EPL 2902 could be made. Some historical records from Rössing Mountain also exist, from which probable occurrence of the same taxa in the mountainous northeast of EPL 2902 was extrapolated. Records that lacked geolocational information more accurate than a quarter-degree square were evaluated and only those taxa for which habitat requirements could plausibly be satisfied within EPL 2902 were retained. Observations made during fieldwork partly corroborated extrapolated literature records, and partly added new records. Finally, a number of taxa that had not been previously recorded or observed during fieldwork (due to their cryptic nature, microscopical size, different seasonality or the short time span available) have been listed as being expected to occur, based on experience elsewhere in the Central Namib. The end results represent the best approximation of animal biodiversity in EPL 2902 that is possible with available information. If more or finer grained information is required, the next step would be to do faunal surveys involving trapping and preservation of selected specimens for further study by taxonomic experts.
Biodiversity highlights for the area are summarised in Table 3 below. Details for all individual taxa, as well as sources and basis for listing, may be found in the Appendix, Tables 4 and 5.

*Table 3: Summary biodiversity statistics for study area.*

| | **Number of taxa** | **Number of endemic species** | **Number of Threatened species** | **Number of species with legal status** |
|---|---|---|---|---|
| Invertebrates | 152 | 33 | 0 | 0 |

| | Number of taxa | Number of endemic species | Number of Threatened species | Number of species with legal status |
|---|---|---|---|---|
| Fish and Amphibians | 0 | 0 | 0 | 0 |
| Reptiles | 20 | 14 | 0 | 1 |
| Birds | 40 | 4 | 1 | 36 |
| Mammals | 21 | 7 | 1 | 5 |
| Total: | **233** | **58** | **2** | **42** |

When interpreting Table 3, the following should be kept in mind:

- *Invertebrate numbers*. Most expected and some recorded invertebrate taxa have not been specified below family level. Each counted taxon may therefore include many species, and true invertebrate species numbers are likely to amount to thousands.
- *Invertebrate endemicity*. Endemism as recorded here is a species-level attribute. Since so few invertebrates are recorded at species level, invertebrate endemism is therefore being under recorded. For comparison, a well-studied group for which many species-level records are available, like Tenebrionidae, shows 86% endemism (18 endemics out of 21 species) for the study area. The true invertebrate endemism levels are therefore expected to be 80% + rather than the 22% (33 out of 152) indicated by current information.
- *Threatened invertebrates*. No Namibian invertebrates have formal IUCN status. A study exists (Irish 2009) that assigned informal IUCN categories to a random sample of 98 Central Namib endemic invertebrates on the basis of the same criteria as used by IUCN. Of the species considered, all were found to evaluate to Threatened, ranging from Critically Endangered to Vulnerable. Extrapolating from that study and the previous paragraph, the true number of invertebrate species of conservation concern in the study area might be close to 80% of taxa present.
- *Invertebrates with legal status*. Namibian invertebrates enjoy general protection under the legislation listed above, but there are no species with individual status. As for conservation status above, the legal *status quo* is not an accurate reflection of the biodiversity worth of invertebrates.
- *Threatened reptiles*. Very few Namibian reptiles have been evaluated by IUCN, and the zero number of Threatened species is a reflection of this, rather than a lack of threats.
- *Bird with legal status*. With the exception of a few pest species and some declared Huntable Gamebirds, all Namibian birds are Protected and the high number of species with legal status reflects this, rather than any other special circumstance. Only birds with CITES status on top of the normal Namibian Protected status were considered to be of legal concern here.

## 4.2 Taxa of concern

Taking the above into account, the taxa of concern that need to be considered in more detail are as follows:

- Invertebrates in general, but treated on a habitat level because of the difficulties with species-level identifications.
- All reptile species with endemic or legal status.
- All endemic or Threatened bird species (legal status ignored because of reasons above)
- All mammal species with endemic, Threatened or legal status.

### 4.2.1 Invertebrates

Central Namib Desert invertebrates are known for high endemicity levels, referred to above, coupled with small distribution ranges. The median distribution range of the 98 invertebrates treated in Irish (2009) was 25 $km^2$. This renders Central Namib invertebrates particularly vulnerable to habitat disruption.

Of the three habitats in the study area, gravel plains are the most sensitive to habitat disruption: the physical and biological composition of the surface layers are easily altered, e.g. by vehicle traffic, and current knowledge suggests that self-healing does not take place fast, if at all. Ox wagon tracks that remain visible more than a century after they were made attest to this fact.

The rocky outcrops are less vulnerable to physical disruption because of their more rugged nature. They also house a special subsection of biodiversity that is adapted to extracting the maximum benefit from the marginally more favourable conditions afforded by the more abundant shelter in the form of broken ground, the thermoregulatory benefits of different slope aspects, and the higher condensation rate of fog on bare rock surfaces. While rocky outcrops might be less sensitive to outright habitat disruption than gravel plains, the biodiversity affect of the impact is still significant.

Watercourses are less sensitive to physical disruption, as long as this does not affect the vegetation that is associated with watercourses. Life along watercourses is linked to the vegetation, and the substrate is of secondary importance.

It follows that each of the main habitats in the area has its own particular sensitivity, and none are more or less suitable for siting infrastructure development than any other. The ideal would be if the entire planned new development could be located on the existing disturbed footprint of the previous mine. That would disturb no additional habitat, would be appropriate for a development taking place in a National Park, and would place no additional impact on the area's invertebrates.

### 4.2.2 Reptiles

The high percentage of endemic reptiles reflects the sensitivity of the Namib reptile fauna. As for invertebrates, the best way to preserve them would be to preserve their habitats, and the same issues as in the previous section apply.

There is one reptile with legal status:

- Namaqua Chameleon, CITES listed, Appendix II. Because of their slow movement, many Namaqua Chameleons become roadkill. Speed limits on roads, and an employee education program, could prevent this.

### 4.2.3 Birds

- Lappetfaced Vulture has a conservation status of Vulnerable, and is CITES listed, Appendix II. They are unlikely to breed in the study area given the absence of larger trees, but could pass through on foraging flights. They are prone to powerline collisions, and this should be an aspect that is investigated in the EIA for any power lines to the development.
- The other raptors in the area are all also CITES listed: Augur Buzzard, Pale Chanting Goshawk, Rock Kestrel (all Appendix II) and Peregrine Falcon (Appendix I). They are expected to occur in low population sizes only, are unlikely to be directly affected by the development, and require no special treatment.
- Rüppels Korhaan is an endemic, and CITES listed (Appendix II). Korhaan are prone to both powerline collisions and road kills, and the measures already mentioned apply to them as well.
- Bradfield's Swift, an endemic, is expected to be associated with the higher mountains in the northeast of the EPL only, and is unlikely to be directly affected by the development or require any special treatment.
- Spotted Eagle Owl and Barn Owl are both CITES listed (Appendix II). Owls are prone to vehicle collisions at night and the proposed measures apply to them as well.

- Gray's Lark and Stark's Lark are both endemics. They are unlikely to be directly affected by the development and need no special treatment.

### 4.2.4 Mammals

- The Brown Hyaena is Near-Threatened. No fresh sign were observed in the area, but they are likely to move through from time to time. It is important not to give them a reason to stay near the development, where they could become victims of human-wildlife conflict. To this end attention will need to be paid to refuse disposal in the EIA.
- The Namibian Wing-gland Bat and the Namib Long-eared Bat are both poorly known endemics. They are likely to occur in low numbers only, and no special treatment is proposed.
- The Namibian Pygmy Rock Mouse and the Namib Round-eared Elephant Shrew are both endemics that are associated with rocky outcrops. Avoidance of development on rocky outcrops will be needed to preserve their habitat.
- The Namaqua Brush-tailed Gerbil, Namib Brush-tailed Gerbil and Solitary Whistling Rat are all endemics that are associated with watercourses. Avoidance of development in watercourses and preservation of watercourse vegetation will be needed to preserve their habitat.
- Klipspringer are Specially Protected Game. They are only expected on the higher mountains in the northeast of the EPL (none were seen but they do occur on the adjacent Rössing Mountain). They are unlikely to be directly affected by the development and no special treatment is needed.
- Steenbok are Protected Game, while Springbok and Gemsbok have legal status as Huntable Game. The latter status is not applicable in a National Park. All three occur near the development but are unlikely to be directly affected by it. No special treatment is needed.
- Aardvark are Protected Game. Signs were seen in the area, but they are likely to be uncommon, seasonal visitors only. They are prone to vehicle collisions at night and the previous provisions also apply to them.

## 4.3 Special habitats of concern

The sensitivities of the three macrohabitats in the area were discussed above. Two microhabitats deserve special mention.

- The Nara field, centered on -22.504°S 14.759°E, was treated as a separate landscape type by Burke (2012), and included in the Watercourse habitat type above. The plants, typically associated with dunes, are far isolated from similar stands and this renders them unique. Naras are also an important food source to desert animals and the abundance of rodent and jackal tracks under and around the plants testify. This nara patch is possibly also the reason why the porcupine that was observed in the study area can survive here, as well as the normally sand-dune living lizard *Meroles reticulatus*. It follows that the Nara field is a restricted area with locally unusual biodiversity and it would be preferable if development avoided it.
- The so-called Rössing West Cave is located within EPL 2902 at -22.530°S 14.797°E. Information on it was summarised by Irish *et al*. (2000). Caves are particularly sensitive habitats, and important as bat roost sites. This particular cave is far removed from the focus of developments and unlikely to be directly affected by it, but is flagged here as a general area to be avoided. Noise, movement, vibration and woodsmoke are all known to drive bats from their roosts.

# 5 Recommendations

- Because of the high sensitivity of all habitats, attempt to limit the development footprint to the already disrupted area of the previous mine installations only.
- Impose speed limits on roads to prevent unnecessary vehicle collisions and road kills, especially after dark.
- Educate employees to respect the life forms with which they share the desert.
- Prevent scavenger-squatting and consequent human-wildlife conflict by not disposing of edible refuse on site. Suggest use Swakopmund Municipal dumping site.
- Given the absence of specific information on the nature, scope and extent of proposed development, no more than broad scoping level recommendations can be made at this time. With this in mind, it would be prudent to re-visit potential faunal and habitat sensitivities during the impact assessment stage, once more information on the developments is available.
- The nature and alignment of probable linear infrastructure associated with development (power lines, pipe lines, roads) are not known at this time, but will extend beyond EPL 2902 and may have additional issues that were not uncovered here. They will need to be assessed in own right, but two potential issues can already be referred to them: bird collisions with power lines and the ability of large diameter epigean pipe lines to disrupt movement patterns of e.g. ostriches.

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# 7 Appendix

*Table 4: Invertebrates known or expected to occur in the study area.*
*End. (Endemism): 100% = Namibian endemic, lower percentages =: Namibian near-endemics; ~ = endemism unknown; larger groups that may or may not include one or more endemic species but this information is not readily available.*
*No Namibian terrestrial invertebrates have any legal status or formal conservation status, and these aspects are not listed.*
*Habitats utilised or expected to be utilised as listed.*
*Basis for listing: source as given, or O = Observed during fieldwork, E = not observed but expected to occur on the basis of habitat compatibility with known range.*

| Phylum | Class | Order | Family | Species | Common name | End. | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|
| Arthropoda | Arachnida | Acariformes | | sp. | Mites | ~ | E | E | E |
| | | Araneae | Ammoxenidae | *Ammoxenus* sp. | Spiders | ~ | E | | E |
| | | | | *Rastellus* sp. | | ~ | E | | E |
| | | | Clubionidae | sp. | | ~ | NMN 2009 | E | E |
| | | | Eresidae | *Seothyra* sp. | | ~ | E | | O |
| | | | Gnaphosidae | *Asemesthes* sp. | | ~ | NMN 2009 | | |
| | | | Hersiliidae | sp. | | ~ | | | NMN 2009 |
| | | | Oecobiidae | sp. | | ~ | NMN 2009 | E | E |
| | | | Oonopidae | sp. | | ~ | E | E | E |
| | | | Oxyopidae | sp. | | ~ | | | NMN 2009 |
| | | | Palpimanidae | sp. | | ~ | E | E | |
| | | | Pholcidae | sp. | | ~ | | E | E |
| | | | Prodidomidae | sp. | | ~ | NMN 2009 | | |
| | | | Salticidae | *Menemerus* sp. | | ~ | O | SABIF 2012 | E |
| | | | | *Mogrus* sp. | | ~ | NMN 2009 | E | |

| Phylum | Class | Order | Family | Species | Common name | End. | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|
| | | | Selenopidae | sp. | | ~ | | E | |
| | | | Sicariidae | *Sicarius* sp. | | ~ | NMN 2009 | | |
| | | | Sparassidae | sp. | | ~ | E | | E |
| | | | Thomisidae | sp. | | ~ | | | E |
| | | Parasitiformes | | sp. | Parasitic mites, ticks | ~ | E | E | E |
| | | Pseudoscor-piones | | sp. | False scorpions | ~ | | E | E |
| | | Scorpiones | Buthidae | *Parabuthus namibensis* | Scorpions | 100 % | E | | |
| | | | | *Parabuthus stridulus* | | 100 % | E | | |
| | | | | *Parabuthus villosus* | | | E | O | E |
| | | | | *Uroplectes* spp. | | ~ | E | E | E |
| | | | Scorpionidae | *Opisthophthalmus coetzeei* | | 100 % | E | | |
| | | | | *Opisthophthalmus penrithorum* | | 100 % | E | NMN 2009 | |
| | | Solifugae | Daesiidae | *Blossia falcifera* | Sun spiders | 100 % | E | | |
| | | | Hexisopodidae | *Hexisopus moiseli* | | 100 % | Wharton 1981 | | E |
| | | | Solpugidae | *Solpugista bicolor* | | 100 % | Wharton 1981 | | |
| | | | | *Zeria lawrencei* | | 75 % | E | | |

| Phylum | Class | Order | Family | Species | Common name | End. | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|
| | Chilopoda | | | sp. | Centipedes | ~ | | E | |
| | Insecta | Anoplura | | sp. | Sucking lice | ~ | E | E | E |
| | | Blattodea | | sp. | Cockroaches | ~ | E | E | E |
| | | Coleoptera | Buprestidae | sp. | Jewel beetles | ~ | E | E | E |
| | | | Carabidae | sp. | Ground beetles | ~ | E | E | E |
| | | | Chrysomelidae | sp. | Leaf beetles | ~ | | | E |
| | | | Coccinellidae | sp. | Ladybird beetles | ~ | | | E |
| | | | Curculionidae | *Episus contractus* | Weevils | | Louw 1986 | E | |
| | | | | *Hyomora manca* | | 75 % | E | | Louw 1981 |
| | | | | *Leptostethus spicatirostris* | | 100 % | | | Thompson 1988 |
| | | | | *Neocleonus sannio* | | | SABIF 2012 | E | |
| | | | | *Ocladius* sp. | | ~ | | E | |
| | | | Dermestidae | sp. | Museum beetles | ~ | E | E | E |
| | | | Glaresidae | *Glaresis koenigsbaueri* | | 75 % | E | | Scholtz 1983 |
| | | | Histeridae | sp. | Hister beetles | ~ | | E | E |
| | | | Meloidae | sp. | Blister beetles | ~ | | | E |
| | | | Melyridae | sp. | Flower beetles | ~ | | | E |
| | | | Ptinidae | *Damarus singularis* | Spider beetles | 100 % | | | Irish 1996 |
| | | | Scarabaeidae | sp. | Dung beetles | ~ | E | E | E |
| | | | Staphylinidae | sp. | Rove beetles | ~ | | E | E |

| Phylum | Class | Order | Family | Species | Common name | End. | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|
| | | | Tenebrionidae | *Brinckia debilis* | | 75 % | | | Penrith 1986 |
| | | | | *Caenocrypticus damara* | | 100 % | | | Endrödy-Younga 1996 |
| | | | | *Cauricara eburnea* | | 100 % | Penrith 1979 | | |
| | | | | *Cauricara velox* | | 100 % | Penrith 1979, O | E | |
| | | | | *Epiphysa arenicola* | | 100 % | | Penrith 1979 | |
| | | | | *Eurychora* sp. | | ~ | E | E | E |
| | | | | *Metriopus depressus* | | 75 % | Penrith 1979, O | E | |
| | | | | *Pachynotelus machadoi* | | | | | Penrith & Endrödy-Younga 1994 |
| | | | | *Physadesmia globosa* | | 100 % | Penrith 1979 | E | E |
| | | | | *Physosterna cribripes* | | 75 % | Penrith 1979 | E | E |
| | | | | *Stenocara aenescens* | | | Penrith 1979 | E | |
| | | | | *Zophosis amabilis* | | 75 % | Penrith 1977 | O | |
| | | | | *Zophosis balti* | | 100 % | Penrith 1977 | | |
| | | | | *Zophosis damarina* | | 100 % | Penrith 1977 | E | |

| Phylum | Class | Order | Family | Species | Common name | End. | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Zophosis dorsata* | | 100 % | Penrith 1977 | | |
| | | | | *Zophosis fulgens* | | 100 % | Penrith 1977 | | |
| | | | | *Zophosis kochi* | | 100 % | Penrith 1977 | E | E |
| | | | | *Zophosis latisterna* | | 100 % | Penrith 1977 | | |
| | | | | *Zophosis mniszechi* | | 100 % | Penrith 1977 | | |
| | | | | *Zophosis ornatipennis* | | 100 % | Penrith 1977 | | |
| | | | | *Zophosis parentalis* | | 100 % | Penrith 1977 | | |
| | | Collembola | | sp. | Springtails | ~ | E | E | E |
| | | Diptera | Acroceridae | *Pterodontia misella* | Humpbacked flies | ~ | SABIF 2012 | | |
| | | | Asilidae | sp. | Robber flies | ~ | E | E | E |
| | | | Bombyliidae | sp. | Bee flies | ~ | E | O | E |
| | | | Calliphoridae | *Hemigymnochaeta varia* | Bluebottles | | SABIF 2012 | E | E |
| | | | Chloropidae | sp. | Shootflies | ~ | E | E | E |
| | | | Hippoboscidae | sp. | Louse flies | ~ | E | E | E |
| | | | Muscidae | sp. | Typical flies | ~ | E | E | E |
| | | | Phoridae | sp. | | ~ | E | E | E |
| | | | Sarcophagidae | sp. | Flesh flies | ~ | E | O | E |

| Phylum | Class | Order | Family | Species | Common name | End. | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|
| | | | Syrphidae | sp. | Hover flies | ~ | E | E | E |
| | | Hemiptera | Aphididae | sp. | Aphids | ~ | | E | E |
| | | | Berytidae | sp. | Stilt bugs | ~ | E | | E |
| | | | Cicadellidae | sp. | Leafhoppers | ~ | | | E |
| | | | Cicadidae | sp. | Cicadas | | O | | |
| | | | Cydnidae | sp. | Burrowing bugs | ~ | | | E |
| | | | Lygaeidae | sp. | Ground bugs | ~ | | E | E |
| | | | Miridae | sp. | | ~ | | E | E |
| | | | Pentatomidae | sp. | Stink bugs | ~ | | E | E |
| | | | Reduviidae | sp. | Assassin bugs | ~ | O | E | E |
| | | Hymenoptera | Apidae | *Amegilla calens* | Honey Bees | | SABIF 2012 | E | E |
| | | | | *Amegilla velutina* | | | SABIF 2012 | E | E |
| | | | | *Anthophora albitomentosa* | | | SABIF 2012 | E | E |
| | | | | *Apis mellifera* | | | | E | E |
| | | | | *Braunaspis albipennis* | | | SABIF 2012 | E | E |
| | | | | *Ceratina* sp. | | ~ | SABIF 2012 | E | E |
| | | | Bethylidae | sp. | | ~ | E | E | E |
| | | | Bradynobaenidae | sp. | | ~ | E | | |
| | | | Colletidae | *Colletes rufotibialis* | | | SABIF 2012 | E | E |
| | | | | *Hylaeus* sp. | | ~ | SABIF 2012 | E | E |
| | | | | *Scrapter* | | | SABIF 2012 | E | E |

| Phylum | Class | Order | Family | Species | Common name | End. | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *aureiferus* | | | | | |
| | | | Fideliidae | *Fidelia* sp. | | | SABIF 2012 | E | E |
| | | | Formicidae | *Anoplolepis steingroeveri* | Ants | | | O | E |
| | | | | *Camponotus fulvopilosus* | | ~ | O | O | E |
| | | | | *Lepisiota* sp. | | ~ | O | E | E |
| | | | | *Messor* sp. | | ~ | E | O | E |
| | | | | *Monomorium* sp. | | ~ | E | E | E |
| | | | | *Ocymyrmex* sp. | | ~ | O | E | E |
| | | | | *Tetramorium* sp. | | ~ | E | E | E |
| | | | Halictidae | *Cellariella* sp. | | ~ | SABIF 2012 | | |
| | | | | *Ceylalitus* sp. | | ~ | SABIF 2012 | | |
| | | | | *Halictus* sp. | | ~ | SABIF 2012 | | |
| | | | | *Nomioides* sp. | | ~ | SABIF 2012 | | |
| | | | | *Pseudapis cinerea* | | | SABIF 2012 | | |
| | | | Masaridae | sp. | | ~ | E | E | E |
| | | | Megachilidae | *Afranthidium hamaticauda* | | | SABIF 2012 | E | E |
| | | | | *Afranthidium minutulum* | | | SABIF 2012 | E | E |
| | | | | *Megachile niveofasciata* | | | SABIF 2012 | E | E |
| | | | Melittidae | *Capicola micheneri* | | 100 % | Michez *et al*. 2007 | E | E |

| Phylum | Class | Order | Family | Species | Common name | End. | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Melitta* sp. | | ~ | SABIF 2012 | E | E |
| | | | Mutillidae | sp. | Velvet ants | ~ | O | E | E |
| | | | Plumariidae | sp. | | ~ | E | E | E |
| | | | Pompilidae | sp. | Spider wasps | ~ | E | E | E |
| | | | Sphecidae | sp. | Mud wasps | ~ | O | E | E |
| | | | Vespidae | *Belonogaster lateritius* | Paper wasps | | GBIF 2012 | E | |
| | | Isoptera | Hodotermitidae | *Hodotermes mossambicus* | Termites | | Coaton & She asby 1975 | O | E |
| | | | Rhinotermitidae | *Psammotermes allocerus* | | | Coaton & She asby 1973 | | E |
| | | Lepidoptera | | spp. | Butterflies, moths | ~ | E | E | E |
| | | | Lycaenidae | sp. | | ~ | | O | E |
| | | | Nymphalidae | *Cynthia cardui* | | | O | E | E |
| | | Mallophaga | | sp. | Biting lice | ~ | E | E | E |
| | | Mantodea | | sp. | Mantids | ~ | E | E | E |
| | | Neuroptera | Myrmeleontidae | sp. | Antlions | ~ | E | O | E |
| | | Orthoptera | Acrididae | *Acrotylus* sp. | Grasshoppers | ~ | O | E | E |
| | | | | *Lithidium* sp. | | ~ | E | O | E |
| | | | | *Schistocerca gregaria* | | | E | O | E |
| | | | Bradyporidae | *Acanthoplus longipes* | Corn crickets | 75 % | | | E |
| | | | | *Acanthoproctus cervinus* | | | | | E |

| Phylum | Class | Order | Family | Species | Common name | End. | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|
| | | | Lathiceridae | *Crypsicerus cubicus* | | 100 % | E | | |
| | | | Mogoplistidae | sp. | Pygmy crickets | ~ | E | E | E |
| | | | Schizodactylidae | *Comicus campestris* | | 75 % | E | | E |
| | | | Thericleidae | sp. | | ~ | | E | E |
| | | Psocoptera | | sp. | Booklice | ~ | E | E | E |
| | | Siphonaptera | | sp. | Fleas | ~ | E | E | E |
| | | Thysanoptera | | sp. | Thrips | ~ | | | E |
| | | Thysanura | Lepismatidae | *Ctenolepisma detritus* | Fishmoths | 100 % | Irish 1987 | | E |
| | | | | *Ctenolepisma namibensis* | | 100 % | Irish 1987 | | E |
| | | | | *Ctenolepisma penrithae* | | 100 % | Irish 1987 | | |
| | | | | *Thermobia* sp. | | ~ | | E | |
| Mollusca | Gastropoda | Stylommato-phora | Subulinidae | *Namibiella herero* | | | | GBIF 2012 | |

*Table 5: Vertebrates known or expected to occur in the study area.*
*End. (Endemism): 100% = Namibian endemic, lower percentages =: Namibian near-endemics; ~ = endemism unknown; larger groups that may or may not include one or more endemic species but this information is not readily available.*
*IUCN status: NE = Not Evaluated; LC = Least Concern; NT = Near-Threatened; VU = Vulnerable*
*CITES: Appendix I or II as listed*
*Legal status as per Nature Conservation Ordinance 4 of 1975: PG = Protected Game; HG = Huntable Game; SG = Specially Protected Game*
*Habitats utilised or expected to be utilised as listed*
*Basis for listing: source as given, or O = Observed during fieldwork, E = not observed but expected to occur on the basis of habitat compatibility with known range.*

| Order | Family | Species | Common Name | End | IUCN | CITES | Legal | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|---|
| **REPTILES** | | | | | | | | | | |
| Squamata | Colubridae | *Boaedon fuliginosus* | Brown House Snake | | NE | | | NMN 2009 | | |
| | | *Lycophidion namibianum* | Namibian Wolf Snake | 100% | NE | | | | E | |
| | | *Dipsina multimaculata* | Dwarf Beaked Snake | 75% | NE | | | E | | |
| | | *Psammophis namibensis* | Namib Sand Snake | 75% | NE | | | GBIF 2012, NMN 2009 | | |
| | | *Psammophis notostictus* | Karoo Sand Snake | | NE | | | E | E | E |
| | | *Psammophis trigrammus* | Western Sand Snake | 80% | NE | | | E | E | E |
| | | *Pythonodipsas carinata* | Western Keeled Snake | 80% | NE | | | E | E | E |
| | Viperidae | *Bitis caudalis* | Horned Adder | | NE | | | NMN 2009, O | E | E |
| | Chamaeleonidae | *Chamaeleo namaquensis* | Namaqua Chameleon | | LC | II | | GBIF 2012 | | E |
| | Gekkonidae | *Chondrodactylus* | Giant Ground | | LC | | | E | | E |

| Order | Family | Species | Common Name | End | IUCN | CITES | Legal | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *angulifer* | Gecko | | | | | | | |
| | | *Pachydactylus rangei* | Palmatogecko | 80% | NE | | | | | Haacke 1976 |
| | | *Pachydactylus scherzi* | Scherz's Thick-toed Gecko | 100% | NE | | | | E | |
| | | *Ptenopus carpi* | Carp's Barking Gecko | 100% | NE | | | NMN 2009 | | |
| | | *Rhoptropus afer* | Common Namib Day Gecko | 95% | NE | | | GBIF 2012, Haacke & Ode ndaal 1981 | NMN 2009, O | |
| | | *Rhoptropus bradfieldi* | Bradfield's Namib Day Gecko | 100% | NE | | | GBIF 2012; Haacke & Odendaal 1981 | NMN 2009 | |
| | Lacertidae | *Meroles reticulatus* | Reticulated Desert Lizard | 80% | NE | | | E | | O |
| | | *Meroles suborbitalis* | Spotted Desert Lizard | | NE | | | GBIF 2012, NMN 2009 | | E |
| | | *Pedioplanis breviceps* | Short-headed Sand Lizard | 100% | NE | | | x | | |
| | Scincidae | *Trachylepis acutilabris* | Wedge-snouted Skink | 75% | NE | | | E | | E |
| | | *Trachylepis hoeschi* | Hoesch's Skink | 75% | NE | | | | E | |
| **BIRDS** | | | | | | | | | | |
| Apodiformes | Apodidae | *Apus bradfieldi* | Bradfield's Swift | 80% | LC | | PG | | Harrison et al. 1997 | |
| Charadriiformes | Charadriidae | *Vanellus* | Crowned Lapwing | | LC | | PG | Harrison et al. | | Harrison et al. |

| Order | Family | Species | Common Name | End | IUCN | CITES | Legal | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *coronatus* | | | | | | 1997 | | 1997 |
| | Glareolidae | *Rhinoptilus africanus* | Double-banded Courser | | LC | | PG | Harrison et al. 1997 | | Harrison et al. 1997 |
| | Pteroclididae | *Pterocles namaqua* | Namaqua Sandgrouse | | LC | | HG | Harrison et al. 1997 | | Harrison et al. 1997 |
| Coliiformes | Coliidae | *Colius colius* | White-backed Mousebird | | LC | | | | | Harrison et al. 1997 |
| Columbiformes | Columbidae | *Columba guinea* | Rock Pigeon | | LC | | HG | | Harrison et al. 1997 | |
| | | *Oena capensis* | Namaqua Dove | | LC | | PG | | | Harrison et al. 1997 |
| | | *Streptopelia capicola* | Cape Turtle Dove | | LC | | HG | | | Harrison et al. 1997 |
| | | *Streptopelia senegalensis* | Laughing Dove | | LC | | HG | | | Harrison et al. 1997 |
| Coraciiformes | Meropidae | *Merops hirundineus* | Swallow-tailed Bee-eater | | LC | | PG | | | Harrison et al. 1997 |
| Falconiformes | Accipitridae | *Aegypius tracheliotus* | Lappet-faced Vulture | | VU | II | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | | *Buteo augur* | Augur Buzzard | | LC | II | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | | *Melierax canorus* | Pale Chanting Goshawk | | LC | II | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | Falconidae | *Falco peregrinus* | Peregrine Falcon | | LC | I | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | | *Falco rupicolus* | Rock Kestrel | | NE | II | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |

| Order | Family | Species | Common Name | End | IUCN | CITES | Legal | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|---|
| Gruiformes | Otididae | *Eupodotis rueppellii* | Rüppell's Korhaan | 80% | LC | II | PG | Harrison et al. 1997 | | Harrison et al. 1997 |
| Passeriformes | Alaudidae | *Ammomanopsis grayi* | Gray's Lark | 80% | LC | | PG | Harrison et al. 1997 | | Harrison et al. 1997 |
| | | *Certhilauda subcoronata* | Karoo Long-billed Lark | | LC | | PG | Harrison et al. 1997 | | Harrison et al. 1997 |
| | | *Eremopterix verticalis* | Grey-backed Finchlark | | LC | | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | | *Spizocorys starki* | Stark's Lark | 80% | LC | | PG | Harrison et al. 1997 | | Harrison et al. 1997 |
| | Cisticolidae | *Prinia flavicans* | Black-chested Prinia | | LC | | PG | | | Harrison et al. 1997 |
| | Corvidae | *Corvus albus* | Pied Crow | | LC | | | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | Fringillidae | *Emberiza impetuani* | Lark-like Bunting | | LC | | PG | | Harrison et al. 1997 | |
| | Hirundinidae | *Hirundo fuligula* | Rock Martin | | LC | | PG | | Harrison et al. 1997 | |
| | Laniidae | *Lanius collaris* | Fiscal Shrike | | LC | | PG | | Harrison et al. 1997 | |
| | Malaconotidae | *Telophorus zeylonus* | Bokmakierie | | LC | | PG | | Harrison et al. 1997 | |
| | Motacillidae | *Motacilla capensis* | Cape Wagtail | | LC | | PG | | | Harrison et al. 1997 |
| | Muscicapidae | *Bradornis infuscatus* | Chat Flycatcher | | LC | | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | | *Cercomela familiaris* | Familiar Chat | | LC | | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |

| Order | Family | Species | Common Name | End | IUCN | CITES | Legal | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Cercomela schlegelii* | Karoo Chat | | LC | | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | | *Cercomela tractrac* | Tractrac Chat | | LC | | PG | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | | *Monticola brevipes* | Short-toed Rock-Thrush | | LC | | PG | | Harrison et al. 1997 | |
| | | *Oenanthe monticola* | Mountain Chat | | LC | | PG | | Harrison et al. 1997 | |
| | Nectariniidae | *Cinnyris fuscus* | Dusky Sunbird | | LC | | PG | | | Harrison et al. 1997i |
| | Passeridae | *Passer melanurus* | Cape Sparrow | | LC | | | Harrison et al. 1997 | Harrison et al. 1997 | Harrison et al. 1997 |
| | Pycnonotidae | *Pycnonotus nigricans* | Red-eyed Bulbul | | LC | | | | | Harrison et al. 1997 |
| | Sturnidae | *Onychognathus nabouroup* | Pale-winged Starling | | LC | | PG | | Harrison et al. 1997 | |
| Strigiformes | Strigidae | *Bubo africanus* | Spotted Eagle Owl | | LC | II | PG | | Harrison et al. 1997 | |
| | Tytonidae | *Tyto alba* | Barn Owl | | LC | II | PG | | Harrison et al. 1997, O | |
| Struthioniformes | Struthionidae | *Struthio camelus* | Ostrich | | LC | | PG | Harrison *et al*. 1997 | | O |
| **MAMMALS** | | | | | | | | | | |
| Chiroptera | Molossidae | *Mormopterus petrophilus* | Flat-headed Free-tailed Bat | | LC | | | | E | |
| | Vespertilionidae | *Cistugo seabrai* | Namibian Wing-gland Bat | 80% | LC | | | | E | |

| Order | Family | Species | Common Name | End | IUCN | CITES | Legal | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Laephotis namibensis* | Namib Long-eared Bat | 100% | LC | | | E | E | E |
| Lagomorpha | Leporidae | *Lepus capensis* | Cape Hare | | LC | | | O | O | E |
| Rodentia | Muridae | *Petromyscus collinus* | Namibian Pygmy Rock Mouse | 90% | LC | | | | GBIF 2012 | |
| | | *Gerbillurus paeba* | Pygmy gerbil | | LC | | | GBIF 2012 | | E |
| | | *Gerbillurus vallinus* | Namaqua Brush-tailed Gerbil | 80% | LC | | | E | | E |
| | | *Gerbillurus setzeri* | Namib Brush-tailed Gerbil | 95% | LC | | | GBIF 2012, NBD 2012 | | E |
| | | *Desmodillus auricularis* | Short-tailed Gerbil | | LC | | | E | | E |
| | | *Rhabdomys pumilio* | Three-striped Mouse | | LC | | | | | E? |
| | | *Parotomys littledalei* | Solitary Whistling Rat | 75% | LC | | | | | Niethammer 1 975 |
| | Hystricidae | *Hystrix africaeaustralis* | Porcupine | | LC | | | | O | E |
| Carnivora | Herpestidae | *Suricata suricatta* | Suricate | | LC | | | Meester 1962 | | O |
| | Hyaenidae | *Hyaena brunnea* | Brown Hyaena | | NT | | | E | E | O |
| | Canidae | *Canis mesomelas* | Black-backed Jackal | | LC | | | E | E | O |
| Artiodactyla | Bovidae | *Antidorcas marsupialis* | Springbok | | LC | | HG | O | | E |
| | | *Raphicerus campestris* | Steenbok | | LC | | PG | E | O | E |
| | | *Oryx gazella* | Gemsbok | | LC | | HG | E | | E |

| Order | Family | Species | Common Name | End | IUCN | CITES | Legal | Gravel plains | Rocky outcrops | Watercourses |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Oreotragus oreotragus* | Klipspringer | | LC | | SP | | E | |
| Tubulidentata | Orycteropidae | *Orycteropus afer* | Aardvark | | LC | | PG | | | E |
| Macroscelidea | Macroscelididae | *Macroscelides flavicaudatus* | Namib Round-eared Elephant Shrew | 100% | NE | | | | O | |