INVERTEBRATE ASSESSMENT OF THE AREA EPL 2218

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Executive summary

The area of EPL 2218 was assessed with reference to the possible effect of proposed uranium mining activities on invertebrate populations in the area.

The Central Namib Desert is an invertebrate biodiversity hotspot, with 24% of recorded species being known only from there, and 60% of species being endemic to Namibia as a whole. The areas of EPL 2218 and EPL 3573 have never before been subjected to intensive invertebrate sampling, indeed, almost no prior biological work had been done in the area.

Because of the paucity of knowledge on invertebrates in the area, coupled to high rates of endemism, there is a real possibility that mining may destroy unknown species before they are ever known to science. A plea is therefore made for invertebrate surveys to be allowed in the immediate future, since this will preserve baseline biological information on pre-mining conditions.

Recommendations are also made to address specific impacts that mining may have on insects and other invertebrates, as well as the impacts they may have on mining and mine employees.

Figure 1. ***Cauricara eburnea,*** **a range-restricted endemic Central Namib beetle that is associated with lichen fields in the area to be affected by mining. Neither the beetle nor these particular lichens are found anywhere else in the world.**

Previous work in the area

No invertebrate surveys have ever been done in the mining area; in fact, very little biological work of any kind had taken place there prior to the various specialist reports recently commissioned by Uramin for the Trekkopje project. Figure 1 shows collecting records for all taxa (not just invertebrates) as represented in the Namibia Biodiversity Database. While the database is admittedly incomplete, at ca. 235000 records it is sufficient to establish broad trends in Namibian biological survey coverage. It is clear that most previous work in the area had been done along or near the three public roads surrounding the area. (The single dot at the western border of EPL 3573 was found to represent rodent records, not invertebrates).

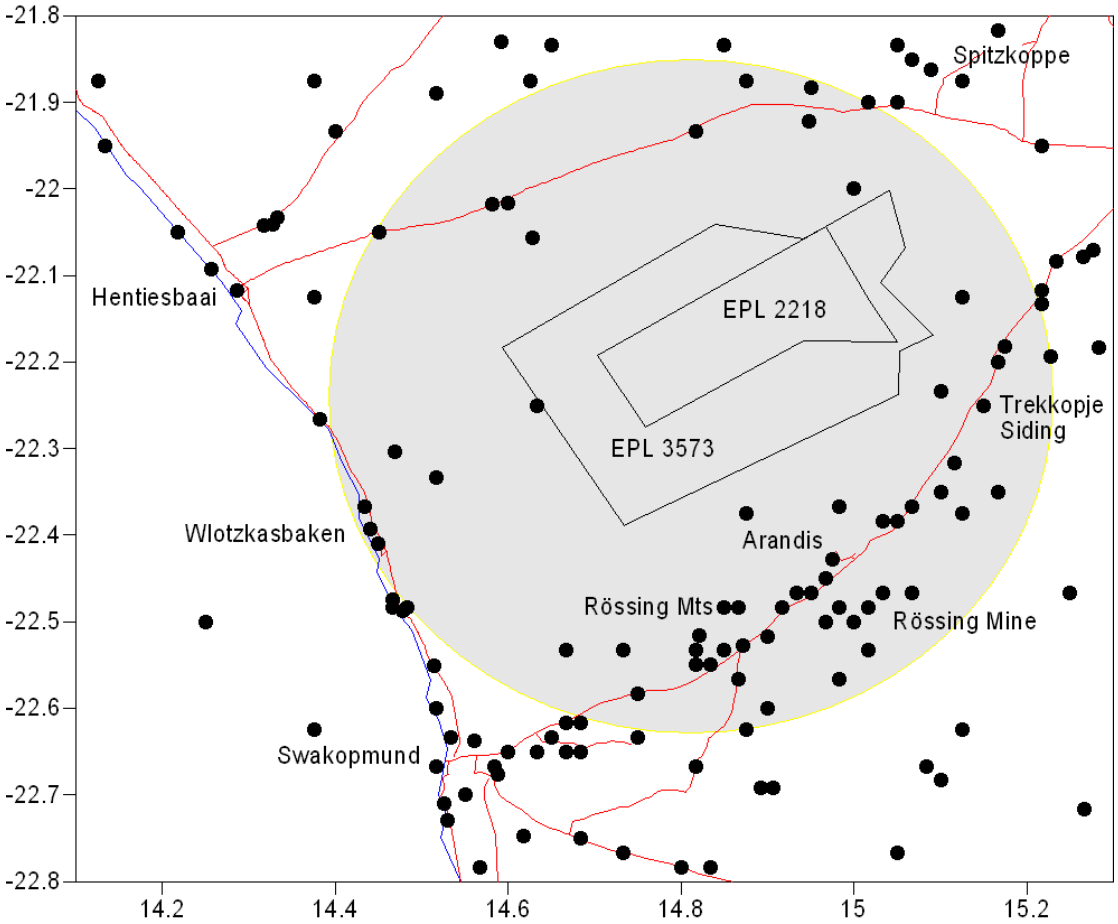

Figure 2. Public domain biological collecting records for all taxa from the study area and surroundings (source: Namibia Biodiversity Database, 2007). Each dot represents one or many species records. Grey circle represents the area considered for relevant records in the current report.

For the purposes of the current report, literature records from a circular area with a radius of about 40 km around the core proposed mining site were considered. The only extensive invertebrate survey in this area was done around Rössing Mine over an 18-month period in 1984/85 (Irish, 1987a). One of the survey sites, 6 km NE of Arandis, is comparable in character to the Uramin EPLs. The overall results of the Rössing Survey have never been formally published, but bits and pieces of the collected material have made

their way into published taxonomic revisions over the years, and have been included below.

Current work

Between 25 and 28 June 2007, the proposed power-line route from Namibfontein to the proposed plant site, as well as the power/pipeline route from there to the proposed desalination plant at Wlotzkasbaken was travelled. Within EPL 2218, random additional sites were also examined. Invertebrate aspects relevant to the power-line route have been included in the separate power-line assessment report.

All macroscopic invertebrates that were active at the time were observed and/or collected at numerous stops along the way. Readily identifiable taxa were noted. Where possible, unidentifiable taxa were photographed and subsequently identified from taxonomical literature. All collected specimens were released after examination. Since there had been no recent rains in the area, and our visit coincided with a cold snap, invertebrate activity levels were low.

Results

In order to make results as useful as possible, all invertebrates were included even though the brief called for ‘insects’ only. The following list includes all taxa known or expected to occur in the area, arranged in alphabetical sequence by taxonomic category.

For listings based on literature records, the ‘Literature’ column notes the general area from which the record or records came. Literature records of marine / beach / littoral species from the Wlotzkasbaken area were excluded as being irrelevant for current purposes. Space constraints in the column prevented citing of the source for each record, but all literature consulted has been included in the ‘References’ section at the end, and can be cross-referenced with the aid of the higher taxonomic category of the species in each case. Summary localities used are:

- Arandis. Includes both Arandis itself and the Rössing Survey locality 6 km NE of Arandis referred to above.
- Coastal. Includes taxa that have been recorded from more than one locality in the western part of the study area.
- E of Henties. Includes records along the Henties Bay – Usakos road in the northern part of the study area.
- Rössing. Includes all Rössing Survey sites except the one 6 km NE of Arandis, as well as Rössing Mountain, Rössing Mine and all unspecified ‘Rössing’ records.
- Trekkopje. Specimens labelled or published as coming from ‘Trekkopje’ generally refer to the vicinity of the railway siding of the same name, and occasionally the cadastral unit Trekkopje 120, but obviously not the mining area that did not exist till recently.

- Widespread. Includes taxa that have been recorded from several localities, implying occurrence throughout the study area.
- Wlotzkas. Includes records from the town of Wlotzkasbaken and immediate vicinity.

The 'Observed' column is ticked if the taxon was actually encountered during fieldwork. The 'Expected' column is ticked in cases where the taxon is known from surrounding areas (outside the 40 km radius core area), and my experience of the taxon elsewhere leads me to expect that it should also occur in the study area. Since this kind of conjecture can easily lead to artificially inflated species lists, only a small number of highly certain cases have been included like this.

The 'Notes' column was used to list common names for higher categories, as well as flag endemic species.

Table 1. Invertebrates known or expected to occur in the study area. Column headings: E = expected; L = literature; O = observed.

Taxon	Notes	L	O	E
PHYLUM ARTHROPODA				
CLASS ARACHNIDA				
Order Acariformes	Mites			x
Order Araneae	Spiders			
Family Eresidae				
Seothyra anettae	Central Namib endemic	Arandis		
Seothyra fasciata		Arandis		
Seothyra henscheli	Central Namib endemic			x
Seothyra longipedata	Namibian near-endemic	Rössing		
Family Migidae				
Moggridgea eremicola	Central Namib endemic	Rössing		
Family Salticidae	Jumping spiders			x
Family Zodariidae				
Psammoduon deserticola	Namib Desert near-endemic	Rössing		
Order Opiliones	Harvestmen			
Namutonia scabra	Namibian endemic	Arandis		
Order Parasitiformes	Ticks, parasitic mites			x
Order Pseudoscorpiones	False scorpions			x
Order Scorpiones	Scorpions			
Family Buthidae				
Parabuthus namibensis	Central Namib endemic			x
Parabuthus stridulus	Namib Desert endemic	Wlotzkas		
Uroplectes gracilior		Trekkopje		
Family Scorpionidae				

Taxon	Notes	L	O	E
Opisthophthalmus holmi	Namib Desert endemic			x
Opisthophthalmus penrithorum	Central Namib endemic	Rössing		
Order Solifugae	Sun spiders			
Family Gylippidae				
Trichotoma brunnea	Central Namib endemic	Coastal		
Family Hexisopodidae				
Hexisopus aureopilosus	Namibian endemic	E of Henties		
Hexisopus moiseli	Central Namib endemic	Rössing		
Family Melanoblossidae				
Daesiella pluridens	Central Namib endemic	Arandis		
Family Solpugidae				
Solpugista bicolor	Namib endemic	Widespread		
Zeria lawrencei	Namib near-endemic	E of Henties		
CLASS CHILOPODA	Centipedes			
Family Scolopendridae				
Cormocephalus multispinosus		Widespread		
Cormocephalus oligoporus		Arandis		
Cormocephalus pontifex		Arandis		
CLASS INSECTA	Insects			
Order Anoplura	Sucking lice			x
Order Blattodea	Cockroaches			x
Order Coleoptera	Beetles			
Family Buprestidae	Jewel beetles			
Acmaeodera decemguttata		Rössing		
Acmaeodera liessnerae	Central Namib endemic	Arandis		
Acmaeodera penrithae	Namibian endemic	Arandis		
Acmaeodera swammerdami		Rössing		
Julodis namibiensis	Central Namib endemic	Rössing		
Nothomorphoides irishi	Central Namib endemic	Arandis		
Family Chrysomelidae	Leaf beetles			x
Family Curculionidae	Weevils			
Episus contractus		Widespread		
Hyomora manca	Namib near-endemic	Rössing		
Hyomora porcella	Namib Desert endemic	E of Henties		
Leptostethus spicatirostris	Central Namib endemic	Rössing		
Ocladius spp.				x
Family Dermestidae	Hide beetles			x
Family Geotrupidae				
Namibiobolbus iphicles		Widespread		
Family Glaresidae				
Glaresis koenigsbaueri	Namibian near-endemic	Rössing		
Family Melyridae				

Taxon	Notes	L	O	E
Metaphilhedonus swakopmundensis	Central Namib endemic	Rössing		
Family Ptinidae	Spider beetles			
Damarus magnus	Namib Desert endemic	Coastal		
Damarus singularis	Namib Desert endemic	Widespread		
Mezium sp.			x	
Family Scarabaeidae	Dung beetles			
Anoplocheilus namibicus	Western Namibian endemic	Rössing		
Pycnopanelus krikkeni	NW Namibian endemic	Arandis		
Family Tenebrionidae				
Brinckia debilis	Namib Desert near-endemic	Wlotzkas		
Caenocrypticus damara	Central Namib endemic	Widespread		
Cauricara brunnipes	Namib Desert endemic	Widespread		
Cauricara eburnea (Fig. 1)	Central Namib endemic	Widespread	x	
Cauricara velox	Namib Desert endemic	Widespread		
Epiphysa arenicola	Namib Desert endemic	Widespread		
Eurychora sp.			x	
Gonopus tibialis		Widespread		
Horotoma deserticola	Central Namib endemic	Arandis		
Horotoma spinipes		Rössing		
Metriopus depressus	Namib Desert near-endemic	Widespread		
Onymacris marginipennis	Namib Desert near-endemic	Coastal		
Pachynoteles machadoi		Rössing		
Pachynoteles punctipennis		Arandis		
Physadesmia globosa	Namib Desert endemic	Widespread		
Physosterna cribripes	Namib Desert near-endemic	Widespread		
Rhammatodes spp.				x
Stenocara aenescens (Fig. 9)		Rössing		
Stenocara dilaticornis	Central Namib endemic	Trekkopje		
Stenocara gracilipes		Widespread	x	
Zophosis amabilis	Namib Desert endemic	Widespread		
Zophosis balti	Central W Namibian endemic	Arandis		
Zophosis damarina	Central Namib endemic	Widespread		
Zophosis dorsata	Central Namib endemic	Rössing		
Zophosis fulgens	Namibian endemic	Rössing		
Zophosis kochi	Central Namib endemic	Arandis	x	
Zophosis lamentabilis	Central Namib endemic	Rössing		
Zophosis latisterna	Central Namib endemic	Rössing		
Zophosis mniszechi	W Namibian endemic	Widespread		
Zophosis ornatipennis	Central Namib endemic	Arandis		
Zophosis parentalis	Namibian endemic	Trekkopje		

Taxon	Notes	L	O	E
Order Diptera	Flies			
Family Asilidae	Robber flies			
Neolophonotus albus	Namib Desert endemic	Coastal		
Family Bombyliidae	Bee flies		x	
Apolysis thornei		Rössing		
Australoechus molitor	Namib Desert endemic	Rössing		
Australoechus naibensis	Namib Desert endemic	Rössing		
Crocidium immaculatum		Rössing		
Crocidium phaenochilum		Rössing		
Heterotropus apertus	Namib Desert endemic	Rössing		
Hyperusia soror	Namibian endemic	Rössing		
Parisus aurantiacus		Arandis		
Parisus damarensis	Central W Namibian endemic	Arandis		
Family Calliphoridae	Bluebottle flies			
Bengalia peuhi		Rössing		
Chrysomya albiceps		Arandis		
Chrysomya chloropyga		Rössing		
Rhyncomya hessei		Rössing		
Rhyncomya messoria		Rössing		
Rhyncomya minutalis		Rössing		
Stomorhina guttata		Rössing		
Zumba antennalis				
Family Muscidae	House flies		x	
Family Sarcophagidae	Flesh Flies		x	
Family Tephritidae	Fruit flies			
Brachydesis rivularis		Rössing		
Deroparia reticulata	Namibian endemic	Rössing		
Desmella myiopitoides		Rössing		
Euryphalara barnardi	Namibian endemic	Rössing		
Euryphalara mecistocephala	Central W Namibian endemic	Rössing		
Hyaloctoides semiater		Rössing		
Hyaloctoides superhyalinus		Rössing		
Hyalotephritis australis		Rössing		
Insizwa oblita	NW Namibian endemic	Rössing		
Leucothrix barbata	Namibian endemic	Rössing		
Leucothrix oryx		Rössing		
Metasphenisca interrupta		Rössing		
Metasphenisca longulior		Rössing		
Xenodorella mira	Namibian endemic	Arandis		
Order Hemiptera	Bugs			
Family Cicadellidae	Leafhoppers			x
Family Cydnidae				x
Family Lygaeidae				x
Family Psyllidae	Jumping plant-lice			x
Family Reduviidae	Assassin Bugs			x

Taxon	Notes	L	O	E
Order Hymenoptera	Bees			
Family Apidae				
Apis mellifera			x	
Family Formicidae	Ants			
Camponotus spp.				x
Messor spp. (Fig. 3)			x	
Ocymyrmex spp.			x	
Family Mutillidae			x	
Family Sphecidae	Digger wasps			
Miscophus kriechbaumeri		Rössing		
Namiscophus pilosus		Rössing		
Family Vespidae	True wasps		x	
Order Isoptera	Termites			
Family Hodotermitidae				
Hodotermes mossambicus (Fig. 6)		Widespread	x	
Family Rhinotermitidae				
Psammotermes allocerus		Widespread		
Order Lepidoptera	Butterflies and moths			
Family Pieridae			x	
Order Mallophaga	Biting lice			x
Order Mantodea	Mantids			x
Order Neuroptera				x
Order Odonata	Dragonflies			
Family Libellulidae				
Palpopleura jucunda		Arandis		
Family Orthoptera	Grasshoppers and crickets			
Family Acrididae (Fig. 5)	Short-horned grasshoppers		x	
Family Bradyporidae	Koringkrieks			
Acanthoplus longipes	Namibian near-endemic	Arandis		
Acanthoproctus cervinus		Arandis		
Family Gryllidae	Crickets			x
Family Lathiceridae				
Crypsicerus cubicus	Central Namib endemic	Widespread	x	
Family Mogoplistidae	Pygmy crickets			x
Family Pamphagidae				
Trachypetrella anderssonii			x	
Family Schizodactylidae				
Comicus campestris	Namibian near-endemic	Arandis		
Order Thysanura	Silverfish			
Family Lepismatidae				

Taxon	Notes	L	O	E
Ctenolepisma detritus	Central Namib endemic	Rössing		
Ctenolepisma grandipalpis		Trekkopje	x	
Ctenolepisma namibensis	Central Namib endemic	Arandis		
Ctenolepisma occidentalis	Central Namib endemic	Arandis		
Ctenolepisma penrithae	Central Namib endemic	Widespread		
Ctenolepisma plusiochaeta	Namibian endemic	Arandis		
Monachina stilifera		Arandis	x	
Thermobia aegyptiaca		Rössing		
Thermobia nebulosa (Fig. 8)	Namib Desert endemic	Widespread		
PHYLUM NEMATODA	Round worms			x

Discussion

Of the 12477 animal species currently known from Namibia, 10470 (84%) are invertebrates, and of them 8064 (77%) are insects (Namibia Biodiversity Database, 2007). Yet, the majority of zoologists specialise on vertebrates. Given this imbalance, invertebrate and insect information can never be considered 'complete'. Our knowledge of Namibian invertebrates is heavily biased towards those groups that have been worked upon in the past. At the same time, other large groups of invertebrates remain virtually untouched. This is reflected in Table 1, where the detailed species lists for some families contrast strongly with those that cannot be treated at species level at all, for lack of knowledge. Given that this is a random sample ('taxa that happen to have been worked on in Namibia'), we can justify using them as a proxy to infer what we do not know about the many groups that have not yet been worked on.

With that caveat in mind, the high rate of endemism in the taxa listed is striking (Table 2). A quarter of the taxa (24%) are strict Central Namib Desert endemics, i.e., the only place in the world where they occur is somewhere in the coastal area between the Kuiseb and Ugab Rivers (or, as often, even more restricted to between the Swakop and Omaruru Rivers only). Almost half (44%) of all taxa are wider Namib Desert endemics, and about two thirds (62%) are Namibian endemics. (As is customary, species that range marginally into adjacent countries have been labelled 'near-endemic', but counted as full endemics).

Table 2. Endemism levels of invertebrates recorded from study area. Species numbers from Table 1, with only taxa identified to species level used in analysis.

Level of endemism	Number of spp.	%	Cumulative %
Central Namib endemic	28	24	24
Namib Desert endemic	23	20	44
Western Namibian endemic	7	6	50
Namibian endemic	14	12	62
Namibian indigenous, non-endemic	44	38	100
Total	116	100	

Recommendations

It is impractical to manage or mitigate mining impacts to invertebrate populations at the level of individual species, since there are simply too many of them, and we know too little of most. Mitigation should rather take the form of minimising habitat destruction and habitat disruption. The more habitats that are left intact after mining, the better the survival and recovery potential of invertebrate populations. Since many Namib species are substrate specific, habitat preservation includes substrate preservation. By managing habitats rather than species, we automatically then also preserve the very many undiscovered and undescribed invertebrate species that inhabit any given area.

Specific actions that could be taken to maintain invertebrate populations in habitats immediately adjacent to actual mine workings include:

- Restrict substrate disruption to the minimum. Vehicles, and especially heavy machinery, are the main source of substrate disruption. Restrict movement to defined roads and tracks, or already disrupted substrates. One-off movements across previously undisrupted substrates should be avoided. There should be adequate penalties in place for operators of earthmoving machinery and other vehicles that disregard this. (This will also help the lichens).
- Mining produces dust. Dust settles on the adjacent environment and progressively renders it less suitable as invertebrate habitat. Sources of dust include vehicular traffic, uncovered conveyor belts, crushers, ore stockpiles and the unconsolidated soil left after open cast mining. Remedies include speed limits on vehicles, watering or paving busy roads, covering conveyor belts, enclosing crushers and stockpiles, and rapid consolidation and rehabilitation of mined-out areas. (This will also help Uramin employees breathe easier).
- Mining typically uses an array of chemicals that are toxic or at least unfriendly to the environment. Leakage and spillage should be prevented. (This will also be beneficial to the health of people on the site).
- Open water in a desert environment will attract invertebrates. Honeybees in particular may suddenly turn up in aggressive swarms when water is made available, and then tend to sting people. The presence of open water on the mining site should be avoided: leaks should be fixed promptly. (This will also reduce the water bill).
- Night-flying insects are attracted to light. While normally present in low numbers only, episodic rainfall events or strong east winds can result in large numbers of flying insects being present in the area at times. Insects around lights are a nuisance. They may also pose safety hazards (distracting machinery operators), or health hazards (poisonous scorpions are also attracted to light). The problem may be avoided by using yellow instead of white exterior lights wherever possible. Insects cannot see light in the red part of the spectrum, and are les attracted to yellow. Red lights would be even more suitable since it is quite invisible to most insects, but humans don’t see well in red light either.

However, the basic constraint on giving effective management guidelines at present is lack of comprehensive data on the invertebrate fauna in the area (Fig. 1). The current document, based as it is on one linear visit at an inappropriate time of year, can highlight but not alleviate the situation. There is concern that in an area of high endemism and range-restricted distributions such as the Central Namib, mining would destroy species before they were known to science. It would be a very positive gesture if Uramin supported pre-mining invertebrate collecting in areas to be mined. This would at least result in a permanent record of the prior existence of any such taxa, if they do occur.

Pertinent information regarding such a possible venture would be:

- Sampling need not be prolonged (and hence expensive). In another similar case in Namibia, a single 72-hour sampling event yielded 36391 specimens that now represent a priceless record of a since destructed habitat (Irish & Bird, 2004).
- The first sampling event should take place as soon as possible, before mining, and associated habitat disruption, commences in earnest.
- Because it is highly unlikely that it will rain in the area soon, a second sampling event should take place soon after the next significant rainfall event. This would be necessary so that the sample can also include the many taxa that remain dormant and only emerge after rain. At that time, which may be years away, sampling may be sited on whatever part of the area is still best suitable for it.
- Collected material should eventually be deposited in the collections of the National Museum of Namibia. Ideally, the museum would actively disseminate the material to relevant experts worldwide for identification. Given their current resource constraints, this is likely to be a more passive process for the foreseeable future.
- There is a global scarcity of taxonomists. Those that can identify species do so in addition to their other tasks, out of their personal research interest, on their own time. It is a thorough, but slow, process. There is no reason to believe material collected now at Trekkopje will be processed any faster. It will probably take decades to be fully identified.
- The certainty that collected material will not be identified soon should not be seen as a reason not to collect. Identification can take place at any future time, but the window of opportunity for sampling is severely limited.
- Invertebrate sampling could be extended to include other biota as well.
- Uramin should not underestimate the potential positive environmental PR it could spin from such a venture.

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Examples of insect activity during site visit.

Figure 3. Foraging paths of *Messor* ants.

Figure 4. *Zophosis* sp.

Figure 5. Acrididae sp.

Figure 6. *Hodotermes mossambicus* termites.

Figure 7. Bat-eared foxes foraging on *Hodotermes*.

Figure 8. *Thermobia* sp.

Figure 9. *Stenocara aenescens*.