NAMDEB ORM LOM EIA: INVERTEBRATE ASSESSMENT

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EXECUTIVE SUMMARY

A survey on the invertebrate fauna at Sendelingsdrift was conducted from 25 May to 29 September 2010 as well as a desktop study to compliment fieldwork. Forty pitfall traps at ten sites in and on the periphery of the mining area together with hand collecting and UV-light collecting were used to collect about 16 000 specimens of invertebrates.

A minimum of 323 terrestrial invertebrate taxa occur in the study area. Of these, 155 taxa were actually encountered on the ground, an additional 121 taxa have been recorded in other sources, and 47 more taxa were not encountered but are expected to occur anyway on grounds of habitat suitability. Some taxa are undifferentiated larger grouping or morphospecies, so the actual number of species will be much higher.

Although several of the insects are endemic to the Lower Orange River area with restricted distribution ranges, it is unlikely that any specific specie is confined exclusively to the proposed mining area. No significant difference seems to exist in the diversity or abundance of invertebrates in different habitats within the mining area and surrounding areas (the riverine woodland on the banks of the Orange River was not included in this survey). It is therefore important that the areas surrounding the mining area remains undisturbed in order to protect insect populations from where the mining area can be re-colonised during the rehabilitation phases.

The main impact of the mining operation on the invertebrate fauna is habitat destruction and it is therefore important that the landforms and soil structure should be recreated during and after the mining operations as far as possible. Assisted colonisation of the vegetation component will also accelerate the re-colonisation of invertebrate communities during the rehabilitation phase.

Invertebrates can be reasonably economically and quantifiably used for monitoring of rehabilitation success with comparable pitfall trap surveys. The occurrence or reappearance of some easily identifiable species discussed below can also indicate the reestablishment of a healthy ecosystem.

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1. INTRODUCTION

Sendelingsdrift and more specifically the proposed mining area falls on a biome border. The lower parts near the river form part of the Lower Orange River Desert Biome Outlier, grading into Arid Lowland Succulent Karoo Biome further from the river (Irish, 1994). The importance of this area as an endemicity hotspot for biodiversity has been emphasized by almost all the reports regarding the proposed mining at Sendelingsdrift; it is therefore not discussed here. Invertebrate diversity and numbers in the area is expected to be low because of sparse vegetation in general although this changes with a significant increase in rainfall during exceptional years.

This study attempts to provide a reference collection of invertebrates occurring or potentially occurring on the habitats that will be impacted by mining operations. The data from this survey can then be used as a reference for post mining rehabilitation phases. There are several methods to collect invertebrates with varying success according to effort and seasonality. Long term pitfall trapping has shown in past experience to be the most economic and successful method to collect a large diversity of invertebrates especially considering the purpose, time and effort constraints of this study. Pitfall trapping needs to be complimented by hand collection.

Information on the geomorphology, climate and vegetation structure of the area have already been provided by other specialists (e.g. Burke 1998; Mannheimer 2010) and will not be repeated in this report.

2. TERMS OF REFERENCE

The consultant was requested to:

- Conduct a baseline survey of the invertebrates in the proposed mining area including the review of other data sources.
- Provide a reference collection of the invertebrates lodged at the National Museum of Namibia.
- Provide the taxonomy of invertebrates in the mining area.
- Assess the potential impacts of the mining operations related to invertebrate fauna.

3. RELEVANT LEGISLATION

This EIA is conducted in terms of the Environmental Management Act, 7 of 2007.

The primary legislation protecting wild animals and plants in Namibia is still the Nature Conservation Ordinance (No. 4 of 1975). This is set to be replaced by the draft Parks and Wildlife Act at some unspecified future date. Terrestrial invertebrates have no special status under the Nature Conservation Ordinance. Under the Parks and Wildlife Act all invertebrates will initially have the default status of Wild Animal (Protected), until such time as specific Regulations are promulgated.

No Namibian invertebrates are currently CITES listed, or IUCN categorised, although studies are under way to formalise the Endangered status of some endemic Central Namib invertebrates.

4. STUDY AREA

The Sendelingsdrift area include the following habitats according to Burke, 1998: riverine woodlands, rock outcrops, sandy terraces and drainage lines, gravel terraces, gravel plains and sandy plains. For this survey, collecting effort was focused on the proposed mining area itself which includes mainly the proto and meso gravel terraces intersected by seeps and drainage lines. Some collecting were also on the periphery of the mining area on the sandy plains towards the old Sendelingsdrift Police station, on the gravel plains (also referred to as shallow soil on ridges) towards the east and on the *Euclea* hummocks (transitional area towards the riverine woodlands) close to where the proposed mining plant could be positioned. The previous survey (Irish 2002) also covered gravel plains further away towards the northwest as well as the rocky outcrops just north of the mining area.

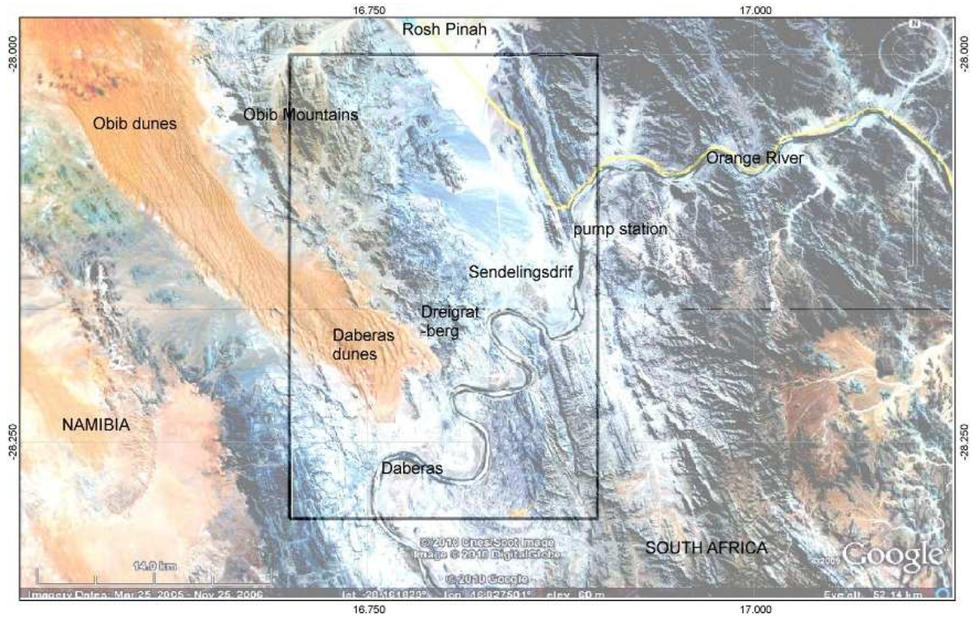
For electronic data searches a rectangular area was used, that included both Sendelingsdrift and Daberas, and the historical collecting locality of Dreigratberg, but excludes Rosh Pinah and the prolific collecting sites of Obib, Namuskluft and Lorelei (Table 1).

The southern extension of the Obib-Daberas dune field enters the study area in the west. Namib dunes and surrounding harder ground harbour mutually exclusive taxa. Since the Sendelingsdrif project as currently understood will not encroach on the dune field, exclusively dune-living taxa were not included in the rest of this report, nor were prior records from the Obib and Daberas dunes.

Table 3: Study area used for electronic data searches.

	Longitude	Latitude
NW Corner	16.70	-28.00
SE Corner	16.90	-28.30

Figure 1: Study area for Invertebrate electronic data searches indicated on a satellite image of the Sendelingsdrift area



5. DATA SOURCES

5.1 Desktop study

What invertebrate data is available for any particular part of Namibia depends on the cumulative effect of three factors:

Collecting coverage of the study area
Some parts of the country have been extensively studied, others not at all. The best-known areas tend to be in the immediate vicinity of larger towns, tourist attractions and major roads, or in places where large-scale surveys had been undertaken in the past. The less accessible an area is, the less likely it is that there will be significant data available for it. Large parts of the country are also biogeographically homogeneous and collecting coverage here tends to be sparser than in the biogeographically more diverse parts. The Sendelingsdrif area is biogeographically very diverse, but not particularly well collected.

Level of taxonomic knowledge on the taxon of interest
Some groups have been extensively studied and comprehensive revisions with relatively complete distribution data allow one to say with some certainty what occurs where. Other groups have barely been touched in Namibia, and one can usually say little more than that they occur in the country, while the single locations whence they are known tell us little about their overall distribution and abundance. Distribution extrapolations have been made where possible, but often were not.

Availability of existing knowledge

Information on Namibian invertebrates is scattered throughout literally tens of thousands of scientific publications. It may exist, but that does not always mean it is available. Sometimes it is locked up in obscure foreign publications that are unknown or unavailable in Namibia. No single unified data source exists for Namibian invertebrates, but the Namibia Biodiversity Database (NaBiD 2010) has gone a long way towards consolidating various disparate data sources and making them locally accessible. Still, although some 250000 records for 17000 species are currently included, this is still only the tip of the iceberg.

Electronic data sources have recently come online, but Namibian coverage is still sparse and plagued by insufficient and inaccurate geo-referencing. The following useful records were found in the various sources:
NaBiD – 49 literature records of 32 taxa (NaBiD 2010).
GBIF – 7 records (GBIF 2010)
SABIF – 351 records, but since this is based on quarter degree squares (QDS), the search had to include all of QDS 2816Ba-Bd, and may be overrepresented.
NMN – 45 records. The National Museum of Namibia's collection databases are normally inaccessible, but fortuitous circumstances allowed partial access during the current study.

Prior work
A specialist study on terrestrial arthropods for the same project was previously done by Irish (2002). Unfortunately, project deadline constraints at the time dictated that it had to take place at a very dry time, and fieldwork consisted of only 3 days of manual sampling plus 10 concurrently running preservative pit traps. As a result relatively few taxa (a total of 109, including literature references) were recorded. These were referred to where relevant below. The desktop study in 2002 covered a slightly wider area than the current one, and some taxa recorded there were excluded by the narrower study area used here.

Another study treated aquatic taxa in the Orange River, and the current study was expected to treat terrestrial invertebrates only. Such a clear-cut distinction is not always possible. Some aquatic taxa, notably large numbers of Ephemeroptera, were captured in pit traps some distance from the river, while utilised data sources sometimes included an undifferentiated mix of aquatic and non-aquatic taxa. In such cases the general approach here was to rather include too much than too little.

5.2 Field collecting

Pitfall traps (one litre yogurt containers with 250 ml ethylene glycol as preservative) were placed on 25 May 2010 at 10 trap sites with four traps each (spaced linear at 20m intervals), therefore a total of 40 pitfall traps. These traps were serviced (thus the container with collected material removed and a new container with preservative placed in the same position) on 14 July 2010 and again on 21 August 2010. All the traps were removed on 29 September 2010 (a total period of 126 days). Additional hand collecting took place on 21 – 22 August 2010 when thirty minutes of searching and collecting were spend at each of the ten trap sites. Further collection took place on the night of 21 August 2010 and 28 September 2010 when 2 – 4 hours respectively were spend searching for scorpions with a UV-light. All the traps were carefully sorted to retrieve all invertebrates which were counted and identified as far as possible.

Table 4. Coordinates for invertebrate collecting and pit trap sites at Sendelingsdrift.

Pit trap sites: May - September 2010		
Site name	*Coordinates*	
Control site	28°08.59.0'S	16°52.09.5'E
Meso gravel terrace	28°09.24.4'S	16°50.45.3'E
NW rocky ridge	28°08.40.5'S	16°50.44.6'E
Proto Gravel Terrace N	28°09.13.0'S	16°51.09.8'E
Proto Gravel Terrace S	28°09.11.9'S	16°51.34.4'E
Riverbed	28°08.54.6'S	16°55.50.8'E
Riverbed drainage	28°09.28.0'S	16°50.37.8'E
Sandy Plains	28°10.08.0'S	16°52.23.0'E
Seepage valley	28°09.43.3'S	16°51.47.8'E
Euclea hummocks	28°09.44.7'S	16°50.34.4'E
Collecting & trap sites: October 2002		
Seepage	28°08.63'S	16°51.10'E
Malaise trap/Riverine Woodlands	28°09.71'S	16°50.23' E
Gravel Plains	28°08.54'S	16°50.14'E
Rocky Outcrops	28°08.61'S	16°51.24'E
Gravel Terraces	28°09.15'S	16°51.37'E
Sandy Plains	28°09.12'S	16°52.39'E
Sandy Terraces	28°10.01'S	16°51.47'E

Figure 2: Locations of invertebrate collecting and trap sites indicated on a satellite image of the Sendelingsdrift area

Definition for the trapping periods in Appendix B:
Period 1: 25 May to 14 July 2010 (50 days)
Period 2: 14 July to 21 August 2010 (38 days)
Period 3: 21 August to 29 September 2010 (38 days)

6. RESULTS

A total of almost 16000 specimens representing at least 204 morphospecies were collected. Pit trap results are discussed below and summarised in Appendix B. The basis for differentiating unnamed morphospecies is given in Appendix C.

Invertebrate taxa encountered during fieldwork, or recorded from literature or database sources, including those not recorded but expected to occur on grounds of habitat suitability, are listed in Appendix A and summarized in Appendix D. In all, 323 taxa are treated. Of these, 155 taxa were actually collected, an additional 121 taxa have been recorded in other sources, and 47 more taxa were not encountered but are expected to occur on habitat suitability grounds. Some taxa are undifferentiated larger grouping or morphospecies, so the actual number of species is much higher.

With few exceptions, noted in Appendix A, hand collecting at the trap sites turned up the same taxa as the pit traps. When compared to the 2002 study, which yielded only 73 collected taxa, the difference made by more prolonged trapping in a marginally more favourable season can be clearly seen.

7. DISCUSSION

The current study has recorded more than three times as many taxa as the 2002 one. This is attributed to a longer sampling period, more traps, and fortuitous rain early in the sampling period (11 – 20 mm of rain during May and June). In 2002 it was particularly dry and very few invertebrates were active. The effect of rainfall can be seen in the fact that about half of all the invertebrates recorded during this survey were encountered during the first trapping period (25 May to 14 July 2010), following the rain during May and June. In each of the subsequent two sampling periods (July to September), half less invertebrates were encountered. The rainfall for the 2010 winter period were below average (only 20 – 25 mm compared to an expected annual average of 60 mm) and the sampling period is thus described as relatively dry, which means that in an average to above average rainfall season many more invertebrates could be collected, possibly including the taxa that are now listed as "expected to occur".

It is expected that many of the recorded invertebrates will be endemic to the Lower Gariep Region of Endemism, but Appendix D lists only 11 Namibian endemics. Sadly, lack of information about invertebrate endemism (or more accurately, lack of national capacity to synthesize existing information on invertebrate endemism) currently inhibits more detailed analysis.

Faced with such taxonomical uncertainty, the best way to ensure survival of even those taxa that are currently still unknown is to concentrate on habitat preservation, rather than species preservation.

Limiting the footprint of developments to the minimum possible remains one of the best ways to preserve habitats.

It was found that the diversity amongst the different habitats, e.g. proto and meso gravel plains, drainage lines, seepage areas, sandy plains and *Euclea* hummocks, did not differ much within the same sampling periods, rather as mentioned above that the rainfall influenced the diversity and abundance significantly. The species composition was also fairly similar between the habitats. It is therefore from an invertebrate perspective with the lack of information about endemism not possible to indicate one habitat as more important than another.

To assess the sensitivity of the habitats to disturbance within the mining area seems rather unnecessary since the mining process will almost completely destroy the existing habitats. Therefore mining operations and management should aim to minimize the footprint of disturbance and rehabilitate or rather attempt to recreate the landforms and soil structure as far as possible. Assisted colonisation of the vegetation component will accelerate the re-colonisation of invertebrate communities during the rehabilitation phase. Significant rainfall which is beyond human control will also accelerate re-colonisation of fauna and flora provided that the landforms and soil structure allow for this.

8. IMPACT DESCRIPTION

Since very little information were provided regarding the intended mining methods and activities, it is assumed that the proto and meso gravel terraces (including seepage valleys intersecting these terraces) will be excavated and therefore completely destroyed. The riverbed or drainage lines within the mining area where roads and the mining plant will be constructed will also be almost completely cleared and environmental processes in these areas will cease.

The sandy plains to the south of the mining area will assumingly only be partially affected by excavation and dumping of overburden and tailings. The gravel plains (shallow soil on ridges) and rocky ridges to the north and east, and the riverine woodland along the Orange River should not be significantly disturbed if the environmental management plan specifies these areas as no-go areas outside of the mining area and limit any activities or unnecessary roads.

9. IMPACT ASSESSMENT

Table 3: Explanation of terms for impact assessment in Table 4

Description	The type of effect that a proposed activity will have on the environment. A narrative of the impact.
Extent	Geographic area. Whether the impact will be within a limited area (on site where construction is to take place, LIM)), locally (within the site; L), regionally (R), nationally (N) or internationally (I).
Duration	Whether the impact will be temporary (during construction only; T), short term (1-5 years; ST), medium term (5-10 years; MT), long term (longer than 10 years, but will cease after operation LT) or permanent (P).
Intensity	Quantify the magnitude of the impact and outline the method(s) used in the quantification process. Low (L) where no environmental functions and processes are affected, Moderate (M) where the environment continues to function but in a modified manner or High (H) (environmental functions and processes are altered) VH Environmental processes cease completely. May also be measured in accordance with International standards, applicable conventions, best practice policy, levels of social acceptance, etc.
Mitigation	Discusses mitigation options, and whether such options would lessen the impact to an acceptable level.
Frequency of occurrence	A description of any repetitive, continuous or time-linked characteristics of the impact(s). Continuous (C), Intermittent - occurring from time to time, without specific periodicity (I), Periodic – occurring at more or less regular intervals (P), Time-linked – occurring only or mostly at specific times of the day or week (T).
Probability	The probability that a certain impact will in fact realise; Uncertain (U), Improbable (I), Probable (P); Highly Probable (HP); Definite (D). If the probability is uncertain, then there is not sufficient information to determine its probability. Because the precautionary principle is followed, this increases the significance of the impact. Attempt to quantify the probability in statistical terms (e.g. >75% certain)
Significance	Significance is given before and after mitigation. **Low** if the impact will not have an influence on the decision or require to be significantly accommodated in the project design, **Medium** if the impact could have an influence on the environment which will require modification of the project design or alternative mitigation (the route can be used, but with deviations or mitigation) **High** where it could have a "no-go" implication regardless of any possible mitigation (an alternative route should be used).
Status of the impact	A statement of whether the impact is positive (a benefit), negative (a cost), or neutral. Indicate in each case who is likely to benefit and who is likely to bear the costs of each impact.
Legal requirements	An identification and list of specific legislation and permit requirements related to the specialist study that potentially could be infringed upon by the proposed project or which is required to enable the project to proceed. Reference to the proper procedures required to obtain appropriate permits should also be provided.
Degree of confidence in predictions	A statement of the degree of confidence in the predictions, based on the availability of information and the specialist's knowledge and expertise.

Table 4: Impact assessment

Nature of Impact: habitat destruction for invertebrate fauna in mining area			
	Construction	***Operations***	***Decommissioning***
Extent	L	L	-
Duration	MT	LT	MT
Intensity	VH	VH	M
Probability	HP	HP	U
Status of Impact	Negative	Negative	-
Degree of Confidence	90%	90%	80%
Significance (without mitigation)	Low	Low	Low
Significance (with mitigation)	Low	Low	Low

10. IMPACT MITIGATION

Since the impact on the invertebrate fauna in the mining area involves eradication of individuals as well as habitat destruction through excavation and processing of the gravel terraces and trampling/clearing on the roads and plant site, little can be done to mitigate the negative impact in these areas during construction and mining operations. Focus for mitigation should rather be to minimize disturbance in the surrounding areas and therefore protecting the invertebrate populations that will re-colonize the mining area in the rehabilitation phase. General environmental practices should be implemented such as:

- Limit roads and prohibit off-road driving outside the mining area.
- Educate excavator and truck operators/drivers to stay within disturbed areas and not drive over undisturbed areas.
- Minimize harmful effluents and pollution.
- All outside lights should be yellow instead of white since most insects are attracted to white lights.

11. MITIGATION MONITORING

Invertebrates, especially ants (Formicidae) have been proven to comply with most criteria for successful indicators of environmental change (disturbance and rehabilitation) since they are diverse and abundant, functionally important at all trophic levels and easily randomly sampled (Andersen 1990). It is therefore suggested that invertebrates can also be used in the monitoring of rehabilitation for the Sendelingsdrift mine. Pitfall trapping similar to the methodology used in this survey or adapted with more traps per site can be repeated in future and the ant species composition and abundance be compared, keeping in mind that the climatic conditions (season and rainfall) plays a significant role. Other invertebrate species which may be of interest as indicators are:

- *Cauricara phalangium*. A Namibian endemic, easily recognisable and relatively common in the area, but at the absolute eastern margin of its distribution range and therefore expected to be highly sensitive to environmental change. Pitfall trap surveys will be quantifiably representative for this species.
- *Calognathus chevrolati*. A Namibian dune-endemic, large and unmistakable. Recorded in windblown sand patches at Sendelingsdrif in 2002, which were not sampled in 2010. Since its presence is dependent upon sand streams staying intact and delivering substrate and detritus, it will be highly susceptible to any disruption in this ecosystem service. It will most likely be eradicated from the mining area during operation and its reappearance after rehabilitation could indicate a significant success of the rehabilitation process. It may take some time though since it will depend on the reformation of the windblown sand dunes in the area.
- Pompilidae. Spider wasps are super predators. Their presence indicates a sufficient supply of spiders, that are themselves predators and imply a sufficient supply of prey, which implies a healthy underlying ecosystem. Pompilidae diversity can be taken as a proxy for invertebrate diversity and health. Unfortunately Pompilidae are less well studied in Namibia and their use as indicator species presupposes taxonomical research about them being done first.

Monitoring during the mining operation within the mining area is not feasible. It is suggested that long term pitfall trapping (at least 24 months) outside the mining area i.e. at the "control site" or "sandy plains" of this survey would deliver valuable information on the normal fluctuation of invertebrate diversity and abundance. The recording of prevailing weather conditions in order to indicate the influence of weather conditions on invertebrate abundance and diversity is imperative to run parallel with such long term pitfall trapping. This information can then be used to compare later surveys on the rehabilitated areas. Such surveys can be conducted by environmental officers of Namdeb, initially with assistance from the National Museum of Namibia or independent consultants to learn how to sort and identify specimens or it can be conducted by independent consultants. It could also form part of a M.Sc. project for an environmental student from any university.

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