Baseline invertebrate survey of the Trekkopje Mining Area

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Executive summary

Using standard collecting methods for Namibian desert areas, 6595 invertebrate specimens were collected in the Trekkopje Mining Area over a four week period in May-June 2008. This collection is intended to function as a pre-mining baseline for eventual use in the evaluation of the effectiveness of post-mining restoration.

At least 135 taxa (= large unspecified groups of organisms) were recorded. Material has been deposited in the National Museum of Namibia, for distribution to taxonomic experts worldwide. The actual number of invertebrate species known from the area is expected to increase as these experts subject the 135 broad taxa to a detailed identification process.

1. Introduction

The invertebrates of the Trekkopje Mining Area (EPL 2218) have been the subject of a desktop study (Irish 2007), supplemented by a brief field visit that was intended to study powerline and pipeline routes, but was used as an opportunity to observe invertebrates as well. The desktop assessment showed that there were essentially no records of invertebrates known from the Trekkopje Mining Area, and recommended that a baseline invertebrate study precede mining. The current report is the result of that.

2. Sampling sites

Since the primary objective of the study was to provide a pre-mining baseline, one main sampling site was situated within the area destined to be strip-mined. Because EPL 2218 has a relatively large (ca. 40 km) east-west extent and is located across a steep regional climatic gradient, its opposite ends were expected to have different climates and hence invertebrate assemblages compared to the centre (Table 3 below shows that this assumption was justified). Therefore, two secondary sampling sites were located respectively at the eastern and western edges of the EPL, in order to put results for the main site into wider perspective. These three sites were all that were initially planned, but a fourth site was opportunistically added when it was learned on-site that mining could possibly extend into the 'Test Pit' area in the southeast of EPL 2218, and it was realised that a baseline for that was also needed, and this area has ecological elements not present in the others sampled. Locations of sampling sites are mapped in Figure 1, and their geographical coordinates are listed in Table 1.

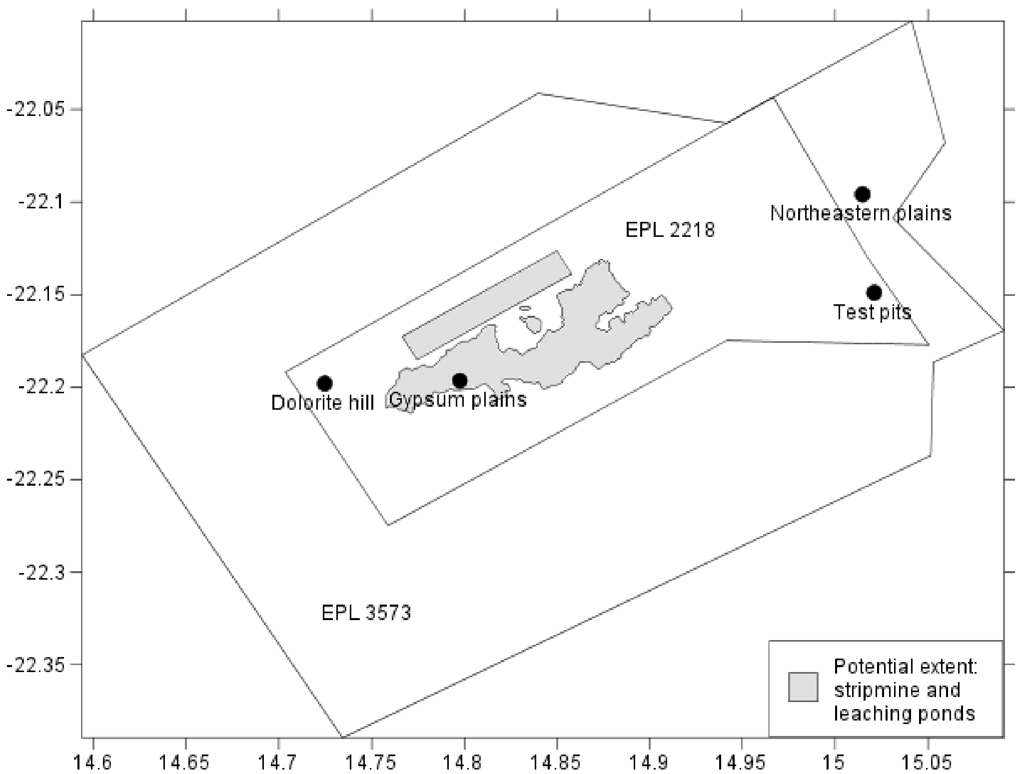

Figure 1. Trekkopje mining area, showing location of invertebrate sampling sites.

The following are the eventual four sampling sites:

2.1. Gypsum plains

The primary sampling site was located on the gypsum plains that occupy the central part of EPL 2218, on a part destined to be destroyed by strip mining. Because there was already infrastructure development underway at the time (May 2008), the sampling site could not be located more centrally in the proposed mining area, but is nevertheless typical of most of this area. The trap line was set out in a north-south direction, on the north side of the main east-west road/track through EPL 2218 as it existed at that time. Soils were of the gypsum variety, and vegetation consisted of sparse *Zygophyllum stapffii* shrubs with some *Acacia reficiens* in drainage lines (Figure 2).

Figure 2. Gypsum plains sampling site, looking northward along trap line. Note yellow traps in foreground and middle distance. Spitzkopje Mountains in background.

2.2. Dolorite hill

Traps were deployed along the crest of the first dolorite hill on the western edge of EPL 2218, on both sides of the road where it crossed a low neck that led to Uramin's gate at the time. The hill was considered representative of the dolorite hills that are a dominant part of the landscape in EPL 3573 west of here. Substrate was sandy between the dolorite boulders. The summit of the hill harbours different vegetation compared to the surrounding plains, but in the immediate vicinity of the traps this consisted of sparse grasses that had sprouted in response to recent rains only (Figure 3).

Figure 3. Dolerite hill sampling site, looking northwards from road. Traps among boulders along crest to left and behind photographer.

2.3. Northeastern plains

Traps were deployed on the eastern side of the track leading northeastwards from the mine offices towards Spitzkopje. The trap line was orientated east-west. Substrate consisted of course gravel with calcrete rubble, traversed by sandy drainage lines. The dominant vegetation was grass that had sprouted in response to recent rains in the area, with low spreading individuals of *Boscia foetida* and *Acacia reficiens* in drainage lines (Figure 4).

2.4. Test pits

Traps were deployed on the west side of the access road leading from the gate near Trekkopje railway siding to the mine offices, and just south of the turnoff marked 'test pits' at the time. The trap line was orientated east-west, and followed the bed of a drainage line. Substrate consisted of coarse riverbed sand and gravel, and the usual vegetation associated with riverbeds in the area, notably *Acacia reficiens* and *Boscia foetida*, with one each of *Acacia erioloba* and *Maerua schinzii* noted in the close vicinity of the trap line.

Figure 4. Northeastern plains sampling site, looking eastwards along trap line.

Table 1. Coordinates of endpoints of each trap line at the different sampling sites (GPS datum WGS 84).

Sampling site endpoint	Longitude	Latitude
Gypsum plains trap 1	14°47.729' E	22°11.915' S
Gypsum plains trap 20	14°47.853' E	22°11.793' S
Dolorite hill trap 1	14°43.480' E	22°11.885' S
Dolorite hill trap 15	14°43.429' E	22°11.956' S
NE plains trap 1	15°00.889' E	22°05.756' S
NE plains trap 15	15°00.741' E	22°05.751' S
Test pits trap 1	15°01.271' E	22°08.943' S
Test pits trap 15	15°01.271' E	22°09.006' S

3. Sampling methods

Traps were deployed during the first visit, from 9 to 12 May 2008, and retrieved again during the second visit from 6 to 7 June 2008. The area had good rain preceding the first visit, and 3 mm were recorded at the mining offices the week immediately preceding (J. Church, pers. comm.). As a result, vegetation had sprouted, and invertebrates were active, therefore collecting conditions were optimal. By the time of the second visit, the area was already noticeably drier and invertebrate activity was much lower.

At each sampling site, an array of preservative pittraps were set out. A preservative pittrap consists of a plastic bucket that is buried with the rim flush to the surface of the ground (Figure 5). Ground-living invertebrates tend to fall into pittraps, and are captured thus. A small quantity of mono-ethylene glycol (commercial antifreeze) is put into each trap. Since it does not evaporate and can act as a mild preservative, it prevents captured specimens from rotting long enough for them to be retrieved and put into proper preservatives like ethanol. Ethanol is too volatile to use as a preservative in the traps from the start.

Figure 5. Pittrap (foreground) and yellow tray (centre) at northeastern plains sampling site, showing typical trap deployment. Note mono-ethylene glycol-visible in yellow tray.

During the current survey, preservative pittraps were placed out in a straight line, thirty paces apart. Twenty pittraps were deployed at the primary sampling site (gypsum plains) and 15 each at the secondary sites. The lesser number at the secondary sites are a result of needing to accommodate a fourth site (test pits) with the equipment intended for three only. Pittraps were left out for 30 days before being retrieved.

In parallel with the pittraps, yellow tray traps were deployed (Figure 5). Yellow trays are shallow plastic dishes, also with a small amount of mono-ethylene glycol in them. Yellow trays tend to sample flying insects, as opposed to pittraps that sample groundliving insects. Since yellow trays are more flimsy than pittraps, and generally do not last well if left out for prolonged periods, they were deployed only during the first visit, left in while the consultant was on site setting out the pittraps, and retrieved at the end of the visit. In addition, yellow trays were not deployed at the dolorite hill site, because of the uneven rocky terrain rendering this difficult.

In addition, observations on active insects were made throughout, and *ad hoc* hand collecting was opportunistically done of any invertebrates encountered during trap deployment. Most taxa recorded in this way were eventually found in either the pittrap en yellow tray material as well, with one exception: the corn cricket *Acanthoplus longipes* that was common and active during trap deployment at the eastern sites, was not caught in any of them.

Subsequent to retrieval, traps were closed with air-tight lids and conveyed to Windhoek. In the laboratory, collected material was removed from antifreeze, and sorted into major groups of organisms before being put into ethanol for long-term preservation. These groups were studied one at a time in order to verify the accuracy of preliminary sorting and take the identifications to the most detailed level possible without expert intervention. All samples were provided with printed labels, and the end product was deposited in the National Museum of Namibia.

It is the museum’s national responsibility to distribute material procured in this and other ways to specialists worldwide in order to improve knowledge of Namibian biodiversity. It is expected that the Trekkopje material will thus be distributed in the years to come, and eventually find their way into print, and / or be returned as specimens with species-level expert identifications in the museum collection. By the time post-mining rehabilitation becomes an issue, a useful baseline should be available. The value of the present exercise lies in it taking place under pre-mining conditions, and in its status as a permanent record of an area where little other invertebrate collecting had been done in the past (Irish 2007).

The speed and scope of museum distribution of material is subject to internal museum policies and priorities, and their capacity at any particular time to render what is essentially a non-obligatory, unpaid service. Some Arachnida had already been distributed to specialists at this time, but unfortunately the consultant has no further control over the process.

Museum material has been consistently labelled, and the museum has also been supplied with a digital copy of the label file, thus allowing them to extend the labelling consistently into the future, as the current samples get subdivided into ever smaller samples while experts produce ever more detailed identifications. By consistent labelling, the ease of future location of Trekkopje material among the multitude of specimens in the museum will be increased. Examples of labels used are shown in Figure 6

NAMIBIA; ERONGO REG.
Trekkopje Mining Area
Dolorite hill at:
22°11.920'S, 14°43.455'E
10.V.2008-6.VI.2008
Preservative pitfall traps
J. Irish

NAMIBIA; ERONGO REG.
Trekkopje Mining Area
Gravel plains at:
22°05.754'S, 15°00.815'E
09.V.2008-6.VI.2008
Preservative pitfall traps
J. Irish

NAMIBIA; ERONGO REG.
Trekkopje Mining Area
Gypsum plains at:
22°11.854'S, 14°47.791'E
10.V.2008-12.V.2008
Yellow pan traps
J. Irish

NAMIBIA; ERONGO REG.
Trekkopje Mining Area
Gypsum plains at:
22°11.854'S, 14°47.791'E
10.V.2008-6.VI.2008
Preservative pitfall traps
J. Irish

NAMIBIA; ERONGO REG.
Trekkopje Mining Area
Ephemeral riverbed at:
22°08.975'S, 15°01.201'E
09.V.2008-6.VI.2008
Preservative pitfall traps
J. Irish

NAMIBIA; ERONGO REG.
Trekkopje Mining Area
Gravel plains at:
22°05.754'S, 15°00.815'E
09.V.2008-12.V.2008
Yellow pan traps
J. Irish

Figure 6. Style of printed labels used to identify Trekkopje material in National Museum of Namibia collections.

4. Results

Table 2 lists the invertebrates recovered from the traps, per sampling site. In total 6595 specimens belonging to 135 higher taxa were recorded. Most of these higher taxa (those listed with 'indet.[erminate]' in the Family or Genus column), include more than one to many species. The designation 'sp.' in the species column indicates that the material seems to represent a single indeterminate species, but 'spp.' indicates multiple indeterminate species. It follows that the numbers of taxa quoted here are minimum numbers, and the eventual count of species actually occurring will be much higher.

Table 2. Invertebrates recorded during Trekkopje baseline survey. Identifications to lowest level possible without expert assistance. Numbers refer to number of specimens collected at each sampling site.

CLASS or Order	Family	Genus	species	Gypsum plains	Dolorite hill	NE plains	Test pits
INSECTA							
Blattodea	Blattellidae	indet.	sp.	6	4		6
Blattodea	Blattidae	indet.	sp.			2	3
Coleoptera	Anobiidae	indet.	sp.			8	
Coleoptera	Anthicidae	indet.	spp.	3	4	4	1
Coleoptera	Buprestidae	Acmaeoderini	spp.	32	24	196	25
Coleoptera	Buprestidae	*Sternocera*	sp.				1
Coleoptera	Carabidae	indet.	spp.	3			3
Coleoptera	Catopidae	indet.	sp.		1		
Coleoptera	Chrysomelidae	indet.	sp.			1	15
Coleoptera	Coccinellidae	indet.	sp.		1		2
Coleoptera	Curculionidae	*Hyomora*	sp.			2	
Coleoptera	Curculionidae	*Siderodactylus*	sp.			1	8
Coleoptera	Curculionidae	indet.	spp.			18	6
Coleoptera	Dermestidae	indet.	spp.	4	3	4	
Coleoptera	Glaresidae	*Glaresis*	sp.			1	
Coleoptera	Histeridae	indet.	spp.			3	4
Coleoptera	indet.	indet.	spp.				8
Coleoptera	Malachiidae	indet.	sp.	4		1	
Coleoptera	Meloidae	indet.	spp.	1		80	48

Coleoptera	Mordellidae	indet.	sp.			1	
Coleoptera	Ptinidae	*Mezium*	sp.	1			
Coleoptera	Ptinidae	*Stethomezium*	sp.				1
Coleoptera	Scarabaeidae	*Peritrichia*	sp.			1	6
Coleoptera	Scarabaeidae	Scarabaeinae	sp.			1	1
Coleoptera	Staphylinidae	indet.	spp.	1	2		1
Coleoptera	Tenebrionidae	*Cauricara*	*eburnea*	10			
Coleoptera	Tenebrionidae	*Cauricara*	*velox*			3	
Coleoptera	Tenebrionidae	Cryptochilini	sp.		1		
Coleoptera	Tenebrionidae	Drosochrini	sp.			2	2
Coleoptera	Tenebrionidae	*Epiphysa*	sp.	1			
Coleoptera	Tenebrionidae	*Eurychora*	sp.	2	3	12	
Coleoptera	Tenebrionidae	*Eustolopus*	*octoseriatus*	1			2
Coleoptera	Tenebrionidae	*Geophanus*	sp.		1	7	7
Coleoptera	Tenebrionidae	*Gonopus*	sp.	7			
Coleoptera	Tenebrionidae	Molurini	sp.	3			
Coleoptera	Tenebrionidae	*Pachynotelus*	sp.			1	
Coleoptera	Tenebrionidae	*Parastizopus*	sp.	24	9	1	51
Coleoptera	Tenebrionidae	*Periloma*	sp.		1		
Coleoptera	Tenebrionidae	*Physadesmia*	*globosa*	1	31	2	10
Coleoptera	Tenebrionidae	*Physosterna*	*cribripes*	4	10	28	151
Coleoptera	Tenebrionidae	*Rhammatodes*	sp.	10	24	10	4
Coleoptera	Tenebrionidae	*Somaticus*	sp.		2	19	33
Coleoptera	Tenebrionidae	*Stenocara*	*aenescens*	3	3		1
Coleoptera	Tenebrionidae	*Stips*	*dohrni*	16	6	11	119
Coleoptera	Tenebrionidae	Tenebrioninae	indet.	1			
Coleoptera	Tenebrionidae	*Trachynotidus*	sp.	3	1		
Coleoptera	Tenebrionidae	indet.	sp.	5	5	1	2
Coleoptera	Tenebrionidae	*Zophosis*	*amabilis*	3			
Coleoptera	Tenebrionidae	*Zophosis*	spp.	4	19	27	24
Diptera	Asilidae	indet.	sp.	1		2	3
Diptera	Calliphoridae	indet.	sp.			1	
Diptera	Cyclorrhapha	indet.	spp.	186	3	206	209
Diptera	Mythicomyiidae	indet.	sp.	7	36	10	
Diptera	Muscidae	indet.	spp.	8	9	10	7
Diptera	Nematocera	indet.	spp.	1	4	9	
Diptera	Asilidae	*Stiphrolamyra*	sp.	11	5	4	
Diptera	Sarcophagidae	indet.	spp.	2	12		8
Diptera	Tachinidae	indet.	spp.	1	1	4	
Diptera	Tephritidae	indet.	spp.	5	1	7	9
Hemiptera	Aphididae	indet.	spp.	1			
Hemiptera	Cicadellidae	indet.	sp.	23	2	47	21
Hemiptera	Cydnidae	indet.	sp.	1			11
Hemiptera	Fulgorioidea	indet.	sp.	3		1	7
Hemiptera	Lygaeidae	indet.	sp.	81	28	20	39
Hemiptera	Miridae	indet.	sp.			1	1
Hemiptera	Pentatomidae	indet.	sp.		1	1	1
Hemiptera	Reduviidae	indet.	spp.	6			1
Hemiptera	Reduviidae	Piratinae	sp.	1		3	7
Hemiptera	Saldidae	indet.	sp.	1		1	1
Hemiptera	Tingidae	indet.	sp.			1	

Hymenoptera	Apoidea	indet.	spp.	18	3	9	9
Hymenoptera	Chalcidoidea	indet.	spp.	10	1	42	20
Hymenoptera	Chrysididae	indet.	sp.			1	
Hymenoptera	Formicidae	indet.	spp.	4			
Hymenoptera	Formicidae	*Anoplolepis*	*custodiens*			89	8
Hymenoptera	Formicidae	*Camponotus*	*maculatus*	2		12	107
Hymenoptera	Formicidae	*Camponotus*	sp.			14	
Hymenoptera	Formicidae	*Lepisiota*	sp.	11		5	59
Hymenoptera	Formicidae	*Messor*	sp.	31	46		43
Hymenoptera	Formicidae	*Pheidole*	sp.	2	2	1	1
Hymenoptera	Formicidae	cf. *Monomorium*	sp.	368	75	1547	528
Hymenoptera	Formicidae	*Tetramorium*	sp.			134	1
Hymenoptera	indet.	indet.	spp.	5		6	9
Hymenoptera	Masaridae	indet.	spp.	5	4		
Hymenoptera	Mutillidae	indet.	spp.	5		3	13
Hymenoptera	Plumariidae	indet.	sp.	5	5		12
Hymenoptera	Pompilidae	indet.	spp.	24	7	13	47
Hymenoptera	Scoliidae	indet.	sp.		1	8	5
Hymenoptera	Sphecidae	indet.	spp.	7	1	3	37
Isoptera	Hodotermitidae	*Hodotermes*	*mossambicus*		4	2	3
Isoptera	Termitidae	*Trinervitermes*	*trinervoides*			11	
Lepidoptera	indet.	indet.	spp.	110	64	54	100
Lepidoptera	Acraeidae	*Acraea*	sp.				1
Lepidoptera	Nymphalidae	*Cynthia*	*cardui*			1	
Lepidoptera	Pieridae	*Belenois*	*aurota*			1	
Mantodea	indet.	indet.	spp.	3			1
Neuroptera	Chrysopidae	indet.	sp.			1	
Neuroptera	Myrmeleontidae	indet.	larva	1		1	5
Orthoptera	Acrididae	Lithidiinae	spp.	20		18	
Orthoptera	Acrididae	indet.	spp.				12
Orthoptera	Bradyporidae	*Acanthoplus*	*longipes*				
Orthoptera	Gryllidae	indet.	sp.				1
Orthoptera	Lathiceridae	*Crypsicerus*	*cubicus*			3	
Orthoptera	Mogoplistidae	indet.	spp.			3	
Orthoptera	Schizodactylidae	*Comicus*	sp.	8	5	7	8
Thysanoptera	indet.	indet.	sp.			1	12
Thysanura	Lepismatidae	*Ctenolepisma*	spp.	24	23	20	17
Thysanura	Lepismatidae	*Thermobia*	sp.		7		
ARACHNIDA							
Araneae	Ammoxenidae	*Ammoxenus*	*coccineus*	9		9	1
Araneae	Caponiidae	indet.	sp.	3		2	3
Araneae	Gnaphosidae	indet.	spp.	4		24	12
Araneae	Hersiliidae	indet.	sp.			1	
Araneae	Mygalomorpha	indet.	sp.			1	
Araneae	Oonopidae	Gamasomorphinae	sp.			1	
Araneae	Oxyopidae	indet.	sp.				2
Araneae	Palpimanidae	indet.	sp.	2		2	
Araneae	Philodromidae	indet.	sp.	2		3	
Araneae	Salticidae	indet.	spp.	44		6	10
Araneae	Scytodidae	indet.	sp.			1	
Araneae	Segestriidae	indet.	sp.			1	

Araneae	Sicariidae	*Loxosceles*	sp.			12	
Araneae	Sparassidae	*Leucorchestris*	sp.			1	
Araneae	Zodariidae	*Parfuria*	*panner*			1	
Solifugae	Daesiidae	*Biton*	*striatus*			2	
Solifugae	Daesiidae	*Biton*	*browni*			2	
Solifugae	Daesiidae	*Blossia*	cf. *schulzei*	1		1	1
Solifugae	Daesiidae	*Blossia*	*falcifera*	3			
Solifugae	Daesiidae	indet.	sp.			12	
Solifugae	Hexisopidae	*Hexisopus*	sp.	2			
Solifugae	Melanoblossidae	indet.	sp.			1	
Solifugae	Solpugidae	indet.	sp.			5	1
Solifugae	Solpugidae	*Solpugista*	*bicolor*			7	
CRUSTACEA							
Isopoda	indet.	indet.	sp.	4		5	12
MYRIAPODA							
Chilopoda	indet.	indet.	sp.			2	1
MOLLUSCA							
Gastropoda	indet.	indet.	sp.		1		

5. Discussion

Comparing the current sampling results with the list of minimum taxa expected to occur in the area as prepared by Irish (2007) on the basis of mainly a desktop study, the following correspondences and differences are noted. Taxa listed by Irish (2007) from the wider surrounding area were not considered here.

5.1. ARACHNIDA – arachnids

5.1.1. Acariformes – mites

No mites were collected. Since these animals are microscopically small, general collecting methods such as those employed here collect them by chance only. They are still expected to occur

5.1.2. Araneae – spiders

Spiders from only two families were expected to occur, but 15 families were collected.

5.1.3. Parasitiformes – ticks, parasitic mites

None were collected. These animals are parasitic on vertebrates, and are usually only collected when their hosts are collected. Collection of vertebrates was outside the domain of this study. They are still expected to occur.

5.1.4. Pseudoscorpiones – false scorpions

None were collected. False scorpions are not susceptable to the trapping methods used here. They are still expected to occur.

5.1.5. Scorpiones – scorpions

Expected to occur and collected. Not listed in Table 1, because collected material is still under study by an expert, Dr. Lorenzo Prendini of New York, and not scheduled for return any time soon.

5.1.6. Solifugae – sun spiders

None were specifically expected to occur, but 10 taxa were collected nevertheless.

5.2. CHILOPODA – centipedes

None were specifically expected to occur, but some were collected.

5.3. CRUSTACEA – crustaceans

Were not expected to occur. The collected isopods are unusual for such an arid environment, and could eventually turn out to represent an endemic species.

5.4. INSECTA – insects

5.4.1. Anoplura – sucking lice

Not collected. Ectoparasites of vertebrates, which were not sampled. Still expected to occur.

5.4.2. Blattodea – cockroaches

Expected to occur, and collected.

5.4.3. Coleoptera – beetles

Only 9 taxa were expected to occur, but at least 46 taxa were collected.

5.4.4. Diptera – flies

Only 3 taxa were expected to occur, but at least 10 were collected.

5.4.5. Hemiptera – bugs

Five taxa were expected, but at least 11 were collected.

5.4.6. Hymenoptera – bees

Six taxa were expected, but at least 19 were collected.

5.4.7. Isoptera – termites

Only one taxon was expected, but two were collected.

5.4.8. Lepidoptera – butterflies and moths

Only one taxon was expected, but at least four were collected.

5.4.9. Mallophaga – biting lice

Expected but not collected. Ectoparasites of vertebrates, which were not sampled. Still expected to occur.

5.4.10. Mantodea – mantids

Expected to occur, and confirmed by collecting.

5.4.11. Neuroptera – lacewings

Expected to occur, at least two taxa collected.

5.4.12. Orthoptera – grasshoppers and crickets

Five taxa were expected, at least seven were collected.

5.4.13. Thysanoptera – thrips

Not expected to occur, but collected nevertheless.

5.4.14. Thysanura – silverfish

One taxon expected, at least two collected.

5.5. MOLLUSCA – mollusks

None were expected to occur, as they are not usually found in such arid environments, therefore the tiny shell found in one pittrap is highly interesting.

5.6. NEMATODA – roundworms

Expected to occur but none were collected. Nematodes need specialised collecting procedures that were not covered by the general methods employed here. They are still expected to occur.

Considering the above, it is clear that Irish (2007) was generally conservative in his estimates, as many more taxa than expected were collected in almost all cases. It also shows once again that **desktop studies are a particularly ineffective way to get baseline data for invertebrates**, especially in undercollected areas.

Comparing results for the different sampling sites (Table 3), an east to west decrease in both number of species and number of specimens encountered can be seen. This is to be expected, since diversity and abundance usually decrease with increasing aridity, and in the study area, aridity increases westwards.

Table 3. Summary of collected material per sampling site.

Sampling site	Number of taxa	Number of specimens
NE plains	97	2888
Test pits	77	1972
Gypsum plains	73	1229
Dolerite hill	48	506
Total	135	6595

6. Summary

At least 135 higher taxa of invertebrates were recorded. This number is expected to increase as heterogenous higher groups that are currently lumped together as one taxon enjoy study from taxonomic specialist.

7. Acknowledgements

Tharina Bird, National Museum of Namibia, is thanked for identifying spiders and solifuges. Lorenzo Prendini, American Museum of Natural History, is thanked in advance for identifying scorpions.

8. REFERENCES

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