Hymenoptera, excluding Apoidea (Apiformes) & Formicidae (Insecta)

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Representatives of 51 families of Hymenoptera were collected during an insect inventory survey of the Brandberg Massif, situated in the Namib Desert Biome in north-western Namibia. The Formicidae and Apoidea (Apiformes - six families) have been dealt with independently. Of the remaining 44 families, forty have had their constituent specimens identified to generic level and sorted to morpho-species. These forty families comprised 2447 specimens representing 431 species, a depauperate diversity relative to tropical and northern temperate regions. Species richness analyses demonstrated a highly seasonal influence on observed hymenopteran species richness, and illustrated a decline in species richness with an increase in elevation when both dry and wet season data were taken into account. Conversely, based on the relative ranking of observed species richness using equal sampling effort during the wet season, species richness was greatest at mid-elevation (1180 m), followed by 1960 m, 700 m and 2470 m. Species richness declined considerably at high altitude (2470 m) on Königstein, the highest peak of the Brandberg. At generic level degree of endemism is low with most species belonging to widespread genera. Where species identity was attained it was possible to establish that these species had a distribution that usually encompassed widespread areas, or were known from other localities, in southern Africa, although a number of endemic taxa were also collected. Several of the species that were recorded on the Brandberg expanded their known distribution ranges by 1000 to 1500 km. An assessment of sampling method efficiency showed that Malaise trapping was the most efficient method followed by yellow pan trapping, UV light trapping and lastly sweeping. The inefficiency of sweeping is a function of the arid-adapted vegetation on the Brandberg, which is not conducive to this sampling method.

INTRODUCTION

The order Hymenoptera is an extremely species rich and abundant group of insects, with only the Coleoptera and Lepidoptera, having more described species (Arnett 1985). However, the perception that the Hymenoptera is less species rich than either the Coleoptera or Lepidoptera is likely to be a function of disparate taxonomic attention, a contention supported by more recent investigations of local insect species richness. In some temperate regions the Hymenoptera is the most species rich of the insect orders (Gaston 1991) and was shown to have the highest species richness in tropical forest canopies (Stork 1991). The number of described species of Hymenoptera is estimated to be 115 000 (Gaston 1993; Grissell 1999b; LaSalle & Gauld 1993), whilst that of Coleoptera ranges from 290 000 (Wilson 1992) to 400 000 (Hammond 1992), and that of Lepidoptera ranges from 112 000 (Wilson 1992) to 150 000 (Hammond 1992). The estimated true richness of Hymenoptera ranges between 300 000 and 2.5 million species (Grissell 1999b). This fundamental lack

of knowledge of alpha-level raxonomy has probably contributed towards the fact that the Hymenoptera have been little studied from a comparative species richness perspective, particularly in the Afrotropical Region where very few rigorous quantified inventory surveys have been carried out. Other tropical areas are better known with an intensive faunal inventory having been carried out in Sulawesi (Indonesia), where hymenopteran diversity was assessed and sampling method efficiency was compared (Noyes 1989a, 1989b). The Sulawesi, Indonesia ('Project Wallace') survey recorded 4 109 species and indicated that most of the hymenopteran families, with the exception of the Symphyta and gall-forming Cynipidae were more species rich than Britain, a well studied temperate area where 6 641 species have been recorded (Fitton *et al.* 1978; Noyes 1989b). As a result of an intensive sampling programme under the auspices of the INBio programme, Costa Rica is now one of the better known tropical countries in terms of hymenopteran diversity, with an estimated species richness of around 20 000-40 000 (Gaston *et al.* 1996; Gauld & Gaston 1995). The Formicidae is probably the single hymenopteran family that has received the most attention from structured inventory investigarion. For example, efficiency of biodiversity assessment using structured inventory techniques was investigated from the results of an inventory of ants in a lowland tropical rainforest as part of the arthropods of La Selva project in Costa Rica (Longino & Colwell 1997). In the Afrotropical Region recent inventory work has focused on the Formicidae, particularly in Madagascar (Fisher 1996, 1998, 1999). These studies form part of a general recognition that approaches to field collecting need to rapidly change from traditional *ad hoc* collecting by museum scientists to rigorously structured inventory work, thereby allowing for repeatable and comparative assessments of species richness (Longino & Colwell 1997). On the African continent the Hymenoptera are currently the target of focused inventory surveys. Over the past five years a number of structured hymenopteran inventories have been conducted in South Africa, Tanzania and Gabon. As part of an ecological inventory survey of Mkomazi Game Reserve in north-eastern Tanzania (Coe *et al.* 1999), an assessment of hymenopteran species richness of this semi-arid east African savanna region was carried out (Robertson 1999; van Noort & Compton 1999; van Noort in prep.). However, the majority of this material is still in the process of being sorted and identified and hence the results are not yet available for comparative purposes. Quantitative studies such as these are scarce for Hymenoptera in Africa and hence comparative species richness data is sorely lacking within the Afrotropical Region. Compounding the lack of species richness assessments is the fact that taxonomic knowledge of afrotropical Hymenoptera, as it is on a global basis, is in its infancy at species level. An indication of just how poor this knowledge is can be gleaned from the current taxonomic status of the afrotropical Ichneumonidae, which can be used as a benchmark for the rest of the Hymenoptera. An esrimated 12 100 species of Ichneumonidae occur in the Afrotropical Region, of which only 1 815 species had been described in 1973 (Townes & Townes 1973). Subsequently, the single major revision of afrotropical ichneumonids added 70 species of Ophioninae (Gauld & Mitchell 1978), with the result that probably only 15% of the afrotropical ichneumonids are known to science, a situation indicative of global hymenopteran raxonomy. Based on estimations of the richness of Costa Rica's hymenopteran fauna in relation to estimates of global hymenopteran richness, it seems likely that around 11-13% of the world hymenopteran fauna has been described to date (Gaston *et al.* 1996), although other estimates have put the figure as low as 4-5% (Gauld & Gaston 1995; Stork 1997). In light of this the estimate that 15% of the afrotropical ichneumonid species have been described can be feasibly extrapo-

lated to the rest of the afrotropical hymenopteran fauna.

From both a taxonomic and biological perspective the Namibian Hymenoptera are poorly known (Prinsloo 1985a), with very little collecting of Hymenoptera having been undertaken in Namibia prior to the southern African expedition carried out by the British Museum (Natural History) in 1972 (Lomholdt 1985). Investigations of Namibian Hymenoptera are largely restricted to taxonomic descriptions scattered through the literature and a few isolated specific studies, with little or no collecting having been done on the Brandberg. In a revision of the speciforme tribe Miscophini (Crabronidae), a number of new taxa were described from Namibia (Lomholdt 1985). Prinsloo (1985a) reported on three families of Chalcidoidea collected during a survey of the insect fauna in the Kuiseb River bed, listed the known species of Hymenoptera from the Kuiseb (Prinsloo 1990), and earlier produced a paper specifically dealing with Namibian chalcids where five new species of Encyrtidae were described from Namibia (Prinsloo & Anneke 1976). Wharton *et al.* (1980) reported on fig wasps (Agaonidae) reared during a phenological study of *Ficus sycomorus* L. (Moraceae) in the Kuiseb River Canyon. At least 150 species of parasitic Hymenoptera were collected during the insect survey of the Kuiseb River bed, indicating that a diverse fauna is present in the Namib Desert (Prinsloo 1985a). However, although much of the material represented undescribed species, these belong to widespread cosmopolitan genera; hence in the case of chalcid wasps endemism at the generic level is probably very low in the Namib Desert (Prinsloo 1985a). In contrast other hymenopteran groups contain elements that are highly specialised and adapted to desert conditions. The tribe Miscophini of the Speciforme family Crabronidae includes a genus endemic to Namibia and a number of species from orher endemic southern African genera that are restricted to the Namib Desert area, with overall species richness equivalent to species rich areas such as the Cape Province or Zimbabwe (Lomholdt 1985). Although in other animal and plant taxa, Namibia supports numerous endemic species, concentrated in the semi-arid and arid zones, which include the Brandberg, care needs to be taken in assessments of endemism in the Hymenoptera because of the large gaps in knowledge of species distributions, a function of lack of collecting, which hinders the ability to produce qualified appraisels.

In this paper we present a preliminary assessment of hymenopteran species richness and abundance on the Brandberg Massif in northwestern Namibia from both a spatial (altitudinal gradient) and temporal (seasonal) perspective, and place the taxa collected in the broader context of existing knowledge of afrotropical hymenopteran biogeography and biology.

MATERIALS AND METHODS

Three independent inventory surveys were conducted on the Brandberg in conjunction with Raleigh International projects, where 'venturers' accompanied scientists on field expeditions. The surveys were conducted from 12-28 October 1998 (R. Butlin & J. Altringham), 3-12 November 1998 (A.H. Kirk-Spriggs), and 2-17 April 1999 (S. van Noort & S.G. Compton). During each survey Malaise traps, yellow pan traps and ultraviolet light traps were deployed. In addition, during the April survey a limited amount of quantitative sweeping (100 sweeps at each of the four sampled altitudes) and Winkler Bag extraction of leaf litter was carried out. Three main locations were sampled during each survey: Messum Valley (700 m) 21°13.29'S, 14°30.98'E; Hungorob Ravine (1200 m); 21°11.40'S, 14°31.69'E; Wasserfallfläche (1950

Table 1. Sampling methods and total effort deployed across season and elevation on the Brandberg.

Sampling method	OCTOBER 1998				NOVEMBER 1998			APRIL 1999				
	700 m	1200 m	1950 m	2000 m	1200 m	1913 m	1980 m	700 m	1180 m	1960 m	2000 m	2470 m
Malaise traps	6 trap days	6 trap days	6 trap days	6 trap days	11 trap days	2 trap days	3 trap days	30 trap days	30 trap days	8 trap days	-	8 trap days
Yellow pan traps	3 days	3 days	6 days	6 days	4 days	3 days	3 days	15 days	15 days	4 days	-	4 days
UV light traps	2 nights	2 nights	1 night	2 nights	2 nights	2 nights	1 night	1 night	-	1 night	1 night	1 night
Sweeping	-	-	-	-	-	-	-	100 sweeps	100 sweeps	100 sweeps	-	100 sweeps
Winkler extraction	-	-	-	-	-	-	-	-	5 samples	5 samples	-	-

m-2000 m) 21°10.77'S, 14°32.87'E. At Wasserfallfläche two locations were sampled; the plateau at 2000 m and the well-vegetated valley just below the plateau (1950-1980 m). In addition, during November a location at Hungorob-Mulde (1913 m), 14°31.07'S, 21°09.08'E was sampled and during April the highest peak on the Brandberg, Königstein (2470 m) 21°09.00'S, 14°34.51'E, was sampled. Sampling effort is detailed in Table 1.

The Brandberg receives most of its precipitation during March and April in the form of rainfall generated by thunderstorms. The survey in April immediately followed a period of heavy rain, with the result that standing water was available and the vegetation was relatively lush during the period of this survey, whereas the surveys in October and November were conducted during very dry conditions.

Specimens were identified to family and where possible to genus and species. For most of the families the representative specimens were identified to genus and subsequently sorted to morpho-species by the authors. A number of families were sent to specialists (listed in the acknowledgements) for identification.

Species richness was assessed by plotting species accumulation curves using the programme EstimateS (Colwell 1997). An estimate of hymenopteran species richness present at the sampled localities using the methods that were deployed during the survey and within the particular sampled season was interpreted from the results of the abundance-based coverage estimator and incidence-based coverage estimator options within the programme EstimateS. These estimators function on the principle that "... all the useful information about undiscovered classes lies in the rarer discovered classes" (Chazdon *et al.* 1998), and hence the abundance-based coverage estimator extrapolates estimates based on species with fewer than ten specimens in a sample and the incidence-based coverage estimator extrapolates estimates based on species that are present in ten or fewer sampling units (Colwell 1997). EstimateS was also used to compute the Shannon diversity index, which is based on the proportional abundance of species and combines richness with eveness (i.e. how equally abundant the species are) (Magurran 1988). The results from all the hymenopteran families, with the exception of the Bethylidae, Scelionidae, Eulophidae, Mymaridae, masarine

Vespidae, Formicidae and Apoidea (Apiformes), were included in the species richness analyses. H.G. Robertson and C. D. Eardley treat the last two mentioned taxa in separate papers in this volume respectively. The Bethylidae and Scelionidae still await identification to genus and sorting to morpho-species, and the Eulophidae, Mymaridae and Masarinae (Vespidae) have not yet been completed in this respect. Specimens resulting from all the deployed collection methods with the exception of Winkler Bag extraction of leaf litter, were included in the analyses. The Winkler Bag results were excluded because only a single species of *Ceraphron* was collected using this method.

RESULTS

FAMILY REPRESENTATION

The families of Hymenoptera that were collected on the Brandberg are listed, as are the remaining afrotropical families that have not been recorded from the Brandberg (Appendix 1). These have been included to enable an assessment of potential diversity at the family level. The 24 hymenopteran families that do not occur in the Afrotropical Region (Goulet & Huber 1993) have not been included in the table. Fifty-one of the potential 72 afrotropical families were sampled on the Brandberg during the present survey. It is likely that with further sampling an additional 18 families that are known to occur or have the potential of occurring in Namibia will also be added to the inventory list.

COMPARATIVE SPECIES RICHNESS ASSESSMENT

Two thousand four hundred and forty-seven specimens representing 431 species were included in the comparative species richness analyses. Presence of hymenopteran families, including their constituent species richness and abundance in each of the three months that were sampled is shown in Table 3. A number of families (Eucoilidae, Torymidae, Ormyridae, Perilampidae, Elasmidae and Philanthidae) were only sampled in April. The Platygastridae, Chalcididae, Tetracampidae, Plumariidae, Scoliidae, Vespidae and Sphecidae were absent in November but present in October and April. The Diapriidae and Megaspilidae were absent in October, but present in November and April. The only family that was absent in April was the Sclerogibbidae. Assessment of seasonal effect on species richness showed an expected marked disparity between the wet season (April) and the dry season (October and November). Hymenopteran species richness tripled and abundance doubled in April compared to Oc-

Table 2. Observed species richness across season on the Brandberg. Sampling effort was unequal between the different months.

Month	Species	Individuals	Shannon Index
October	120	794	2.87
November	84	273	3.70
April	341	1384	4.92

Table 3. Comparative seasonal species richness and abundance of the sampled hymenopteran families excluding the Formicidae and Apoidea (Apiformes) which are treated elsewhere in the monograph in the three surveys carried out on the Brandberg.

FAMILY	TOTAL		OCTOBER		NOVEMBER		APRIL	
	Species	Individuals	Species	Individuals	Species	Individuals	Species	Individuals
Gasteruptiidae	3	4	1	1	2	2	1	1
Evaniidae	2	62	2	10	1	23	2	29
Braconidae	48	685	15	376	13	86	37	223
Ichneumonidae	28	53	3	4	5	7	21	42
Eucoilidae	3	6	0	0	0	0	3	6
Charipidae	1	10	1	1	1	1	1	8
Diapriidae	8	28	0	0	2	2	7	26
Scelionidae (*Baeus*)	1	4	0	0	0	0	1	4
Platygastridae	10	85	5	6	0	0	7	79
Megaspilidae	2	5	0	0	1	1	2	4
Ceraphronidae	24	44	3	4	5	10	18	30
Chalcididae	15	86	4	6	0	0	16	79
Eurytomidae	12	18	0	0	0	0	12	18
Pteromalidae	31	113	4	5	2	11	28	97
Agaonidae	8	92	1	1	1	7	8	84
Torymidae	6	12	0	0	0	0	6	12
Ormyridae	4	7	0	0	0	0	4	7
Perilampidae	1	3	0	0	0	0	1	3
Eupelmidae	19	29	2	2	2	2	15	25
Encyrtidae	42	116	11	22	13	14	31	80
Aphelinidae	13	35	1	1	4	13	10	21
Signiphoridae	4	6	3	3	1	1	2	2
Tetracampidae	2	2	1	1	0	0	1	1
Eulophidae	?	?	?	?	?	?	?	?
Elasmidae	6	10	0	0	0	0	6	10
Trichogrammatidae	10	100	6	32	3	4	6	64
Mymaridae	?	?	?	?	?	?	?	?
Bethylidae	?	?	?	?	?	?	?	?
Chrysididae	26	43	14	18	3	5	14	21
Dryinidae	5	16	2	3	1	2	3	11
Plumariidae	1	85	1	66	0	0	1	19
Sclerogibbidae	1	2	1	1	1	1	0	0
Bradynobaenidae	6	10	2	2	1	1	3	7
Pompilidae	13	49	5	13	2	5	10	31
Scoliidae	2	5	1	1	0	0	1	4
Tiphiidae	9	72	2	7	2	6	8	59
Mutillidae	13	109	8	50	5	12	11	47
Vespidae	3	5	1	1	0	0	3	4
Ampulicidae	4	9	2	2	1	1	2	6
Crabronidae	28	360	14	149	10	53	24	158
Nyssonidae	6	39	2	4	0	0	4	35
Pemphredonidae	4	21	1	1	2	3	3	17
Philanthidae	1	2	0	0	0	0	1	2
Sphecidae	7	9	1	1	0	0	7	8
TOTAL	431	2447	120	794	84	273	341	1384

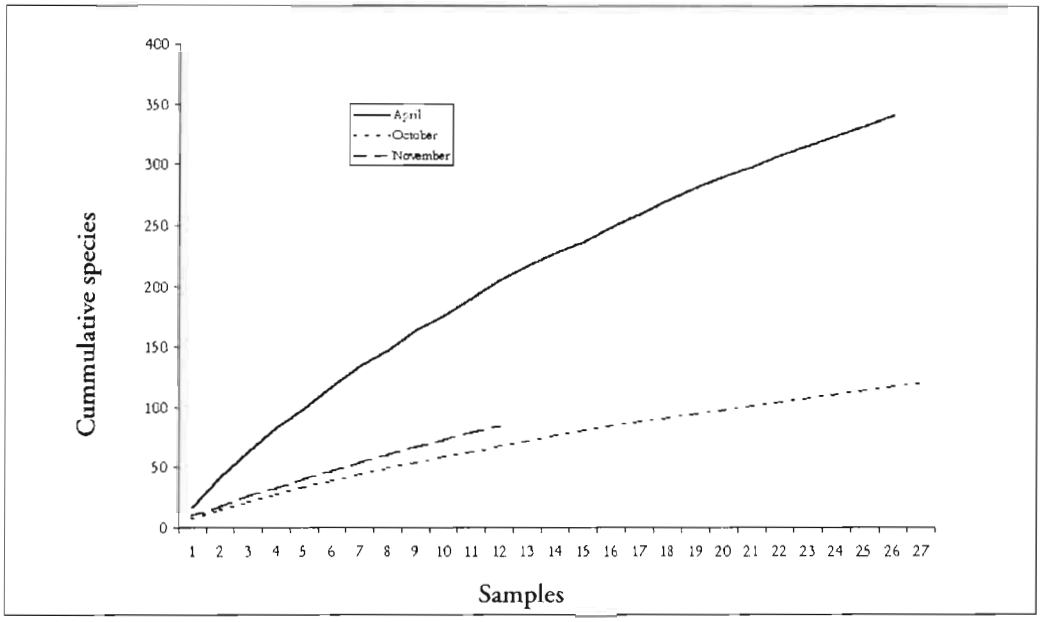

Figure 1. Observed temporal species richness patterns of Hymenoptera on the Brandberg as determined by season.

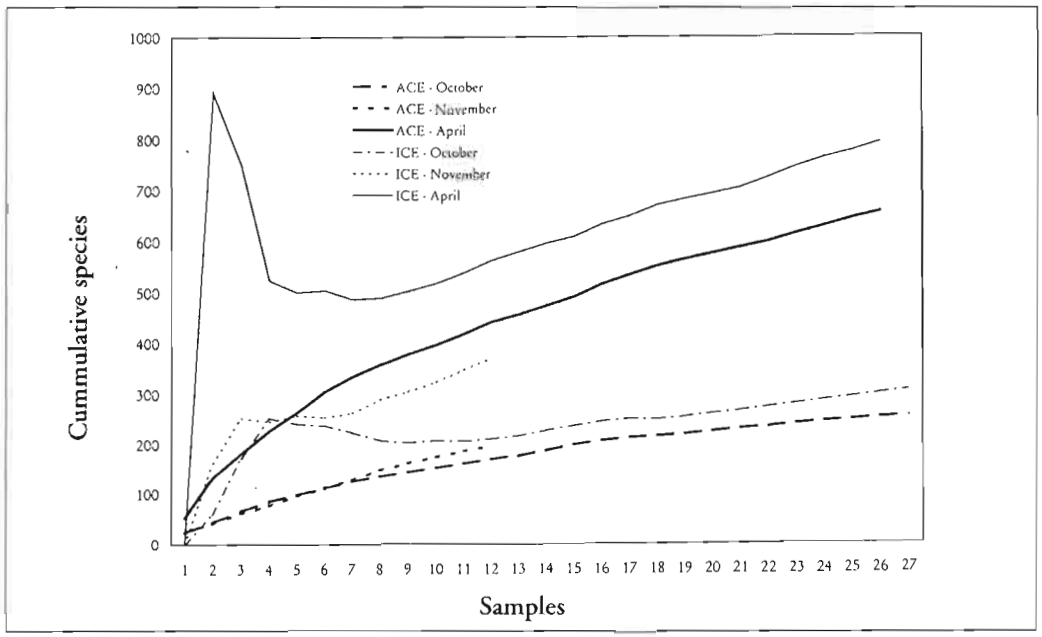

Figure 2. Species richness estimators for each of the three months that were sampled on the Brandberg. ACE = Abundance- based coverage estimator. ICE = Incidence- based coverage estimator.

tober and November (Table 2). Shannon diversity indices supported this disparity and further showed that November had higher diversity than October (Table 2). Cumulative species curves illustrated the same pattern of extreme disparity between the wet and dry seasons, and within the dry season, higher species richness per sampling effort in November than October (Figure 1). The abundance-based coverage estimator and incidence-based coverage estimator showed that the estimated species richness of Hymenoptera on the Brandberg during these seasons was at least double the observed species richness (Figure 2). Sampling in October and April collected between 40% and 50% of the estimated species richness, and that during November collected between 23% and 42% of the estimated species richness.

The altitudinal effect on species richness is depicted in Figure 3. Observed species richness declined with an increase in elevation (Table 4). The steepness (the rate of species return per sampling effort) of the species accumulation curve showed that the rate of species capture also decreased with an increase in elevation, although the rate was very similar between 1200 m and 2000 m (Figure 3). The abundance-based coverage estimator and incidence-based coverage estimator indicated that estimated species richness was greatest at 700 m per equivalent sampling effort (Figure 4). The Shannon diversity indices indicated that species diversity (species richness in relation to abundance) was highest at 1180-1200 m, followed by 700 m and lastly 1950-2000 m (Table 4). Altitudinal comparison within the wet season (April 1999), based on equal sampling effort, indicated greatest species richness and diversity at 1960 m, closely followed by 700 m, but with a marked decline at 2470 m (Table 5). The mid altitude of 1180 m was excluded from this particular assessment because a light trap was not run at this locality. The exclusion of the light trap samples from the other three localities enabled a strict quantitative comparison across all four altitudes (Table 6). This comparison indicated highest species richness and diversity at 1180 m, followed by 1960 m and 700 m, with a marked lowering of species richness at 2470 m,

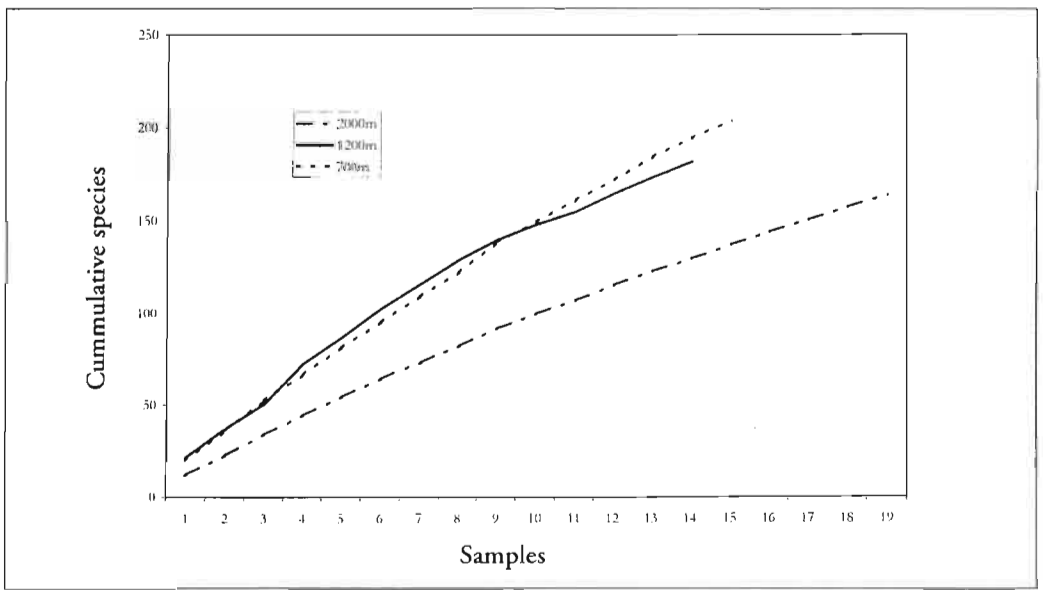

Figure 3. Observed spatial species richness patterns of Hymenoptera on the Brandberg as determined by elevation. Data was pooled from October and April.

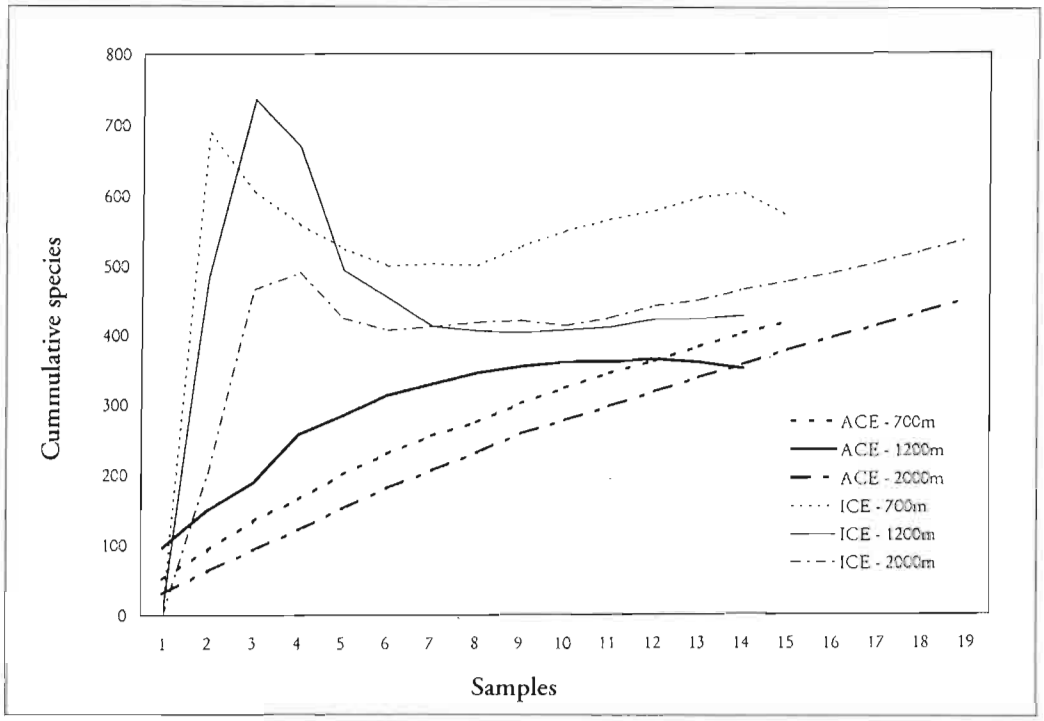

Figure 4. Species richness estimators for the three sampled elevations on the Brandberg during October and April. ACE = Abundance- based coverage estimator. ICE = Incidence- based coverage estimator.

but a far less marked disparity in species diversity between 2470 m and the lower altitudes. Species accumulation curves could not be produced for the Aptil data alone because of insufficient sample size.

A comparison of sampling efficiency between the three methods (yellow pan traps, light traps and Malaise traps), that were deployed across all three months that were surveyed, showed that Malaise trap sampling was the most efficient method, based on species richness (observed and estimated), species diversity (Shannon index) and rate of species capture per effort (steepness of the species accumulation curve), followed by yellow pan trapping and UV light trapping (Table 7; Figures 5, 6 & 7).

SPECIES RICHNESS, BIOGEOGRAPHY AND BIOLOGY OF BRANDBERG HYMENOPTERA

TENTHREDINOIDEA

No sawflies were sampled during the survey on the Brandberg. Sawfly species richness and abundance is depauperate in arid environments, with only 16 species in five genera in the families Argidae and Tenthredinidae known from Namibia, none of which have been recorded from the Brandberg (Koch 2000). An increase in collecting effort, from both a spatial and temporal perspective, could feasibly record sawflies from the Brandberg.

Table 4. Observed species richness across elevation on the Brandberg. Data was pooled from the two surveys where these three altitudes were surveyed (October and April).

Altitude	Species	Individuals	Shannon Index
700 m	204	903	4.22
1180-1200 m	182	469	4.60
1950-2000 m	164	747	3.43

Table 5. Observed species richness across elevation on the Brandberg during April from the temporally comparable sampling methods deployed at the three elevations where a light trap was run. Sampling methods included two Malaise traps and a transect of 20 yellow pan traps run for four days, 100 sweeps and a UV light trap run all night (1900 – 0700) at each elevation.

Altitude	Species	Individuals	Shannon Index
700 m	91	320	3.53
1960 m	102	250	3.91
2470 m	30	59	2.98

Table 6. Observed species richness across elevation on the Brandberg during April from the temporally comparable sampling methods deployed at each elevation. Sampling methods included two Malaise traps and a transect of 20 yellow pan traps run for four days, and a 100 sweeps at each elevation.

Altitude	Species	Individuals	Shannon Index
700 m	63	128	3.74
1180 m	98	175	4.20
1960 m	89	216	3.72
2470 m	27	37	3.13

Table 7. Observed species richness between different sampling methods on the Brandberg. Data is pooled from all three surveys (October, November and April) and comprised 97 yellow pan trap days, 132 Malaise trap days and 15 light trap nights (1900 – 0700).

Method	Species	Individuals	Shannon Index
Yellow pan trap	157	565	4.07
Light Trap	66	857	2.47
Malaise trap	279	915	4.84

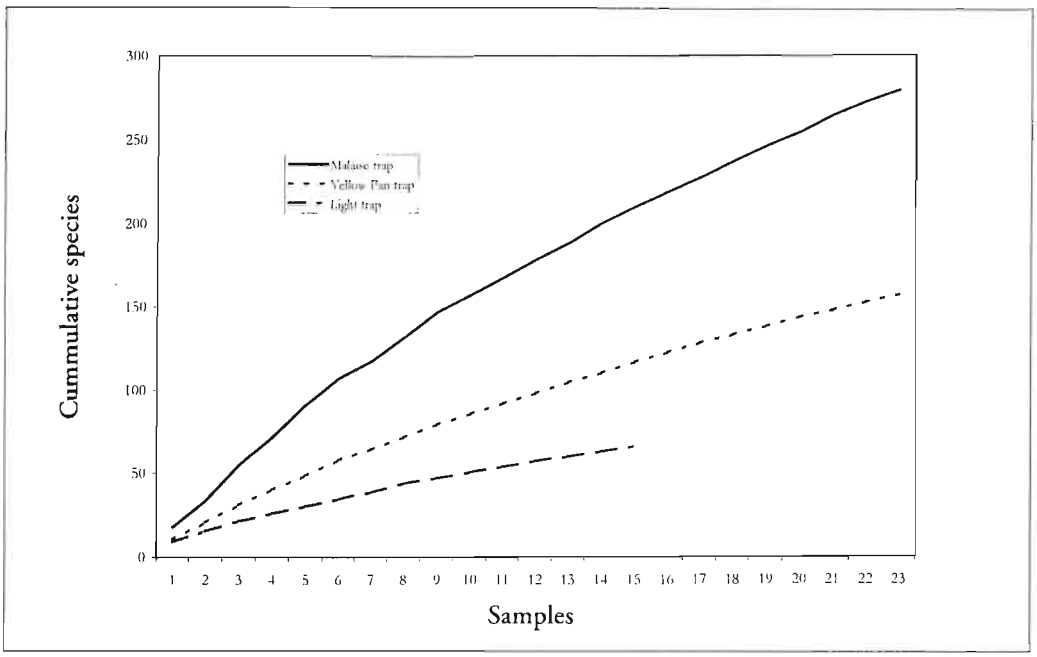

Figure 5. Observed hymenopteran species richness patterns between the different sampling methods deployed on the Brandberg per unit sampling effort.

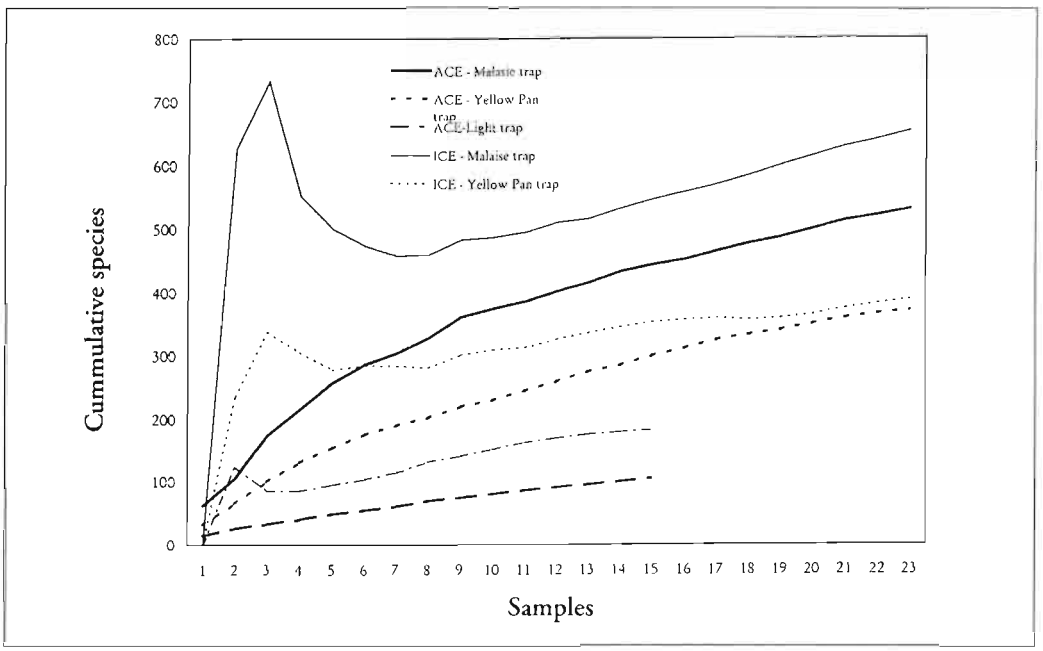

Figure 6. Species richness estimators for the different sampling methods deployed on the Brandberg. ACE = Abundance- based coverage estimator. ICE = Incidence- based coverage estimator.

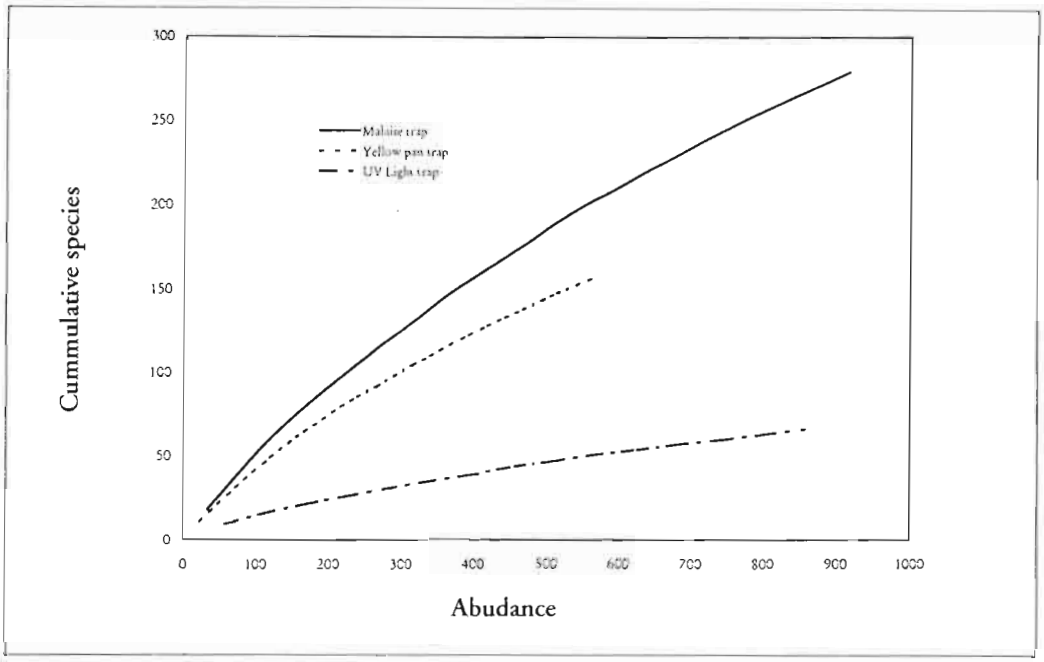

Figure 7. Observed hymenopteran species richness patterns between the different sampling methods deployed on the Brandberg in relation to abundance.

EVANIOIDEA

EVANIIDAE

The Evaniidae is a cosmopolitan family with about 14 genera and 400 described species, most of which occur in the tropics (Gauld & Bolton 1988; Mason 1993). Evaniids are predators of cockroach (Blattodea) eggs contained in the ootheca (egg-case). Females ovipositing directly into the ootheca (Mason 1993).

Genus: *Prosevania* Kieffer, 1911.

Fifty-six specimens of a *Prosevania* species were collected. Males were collected in Malaise traps sited in Messum Valley, Hungorob Ravine and Wasserfallfläche during April. Females were only collected at Wasserfallfläche during October and November in Malaise traps and yellow pan traps. *Prosevania* is a large Old World genus that is poorly known in terms of species richness (Townes 1949; M. Huben pers. comm.).

Genus: *Brachygaster* Leach, 1817.

A species of *Brachygaster*, represented by five males from Messum Valley (700 m, April) and one male from Wasserfallfläche (1950 m, Oct.), was collected in Malaise traps. *Brachygaster* is a smaller Old World genus than *Prosevania*, and as with *Prosevania*, it is also poorly known from a species perspective (M. Huben pers. comm.).

GASTERUPTIIDAE

The family comprises two subfamilies, Gasteruptiinae and Hypriogastrinae. The Hyptiogastrinae has a Gondwanan distribution and includes five genera, none of which occur in the Afrotropical Region (Jennings & Austin 1994). The Gasteruptiinae is cosmopolitan and contains the single genus *Gasteruption*.

Genus: *Gasteruption* Latreille, 1796.

Three species of *Gasteruption* were collected. A female of species 1 was collected in a Malaise trap sited in the valley below Wasserfallfläche (1950 m), during October 1998. Males of two further species of *Gasteruption* were trapped in a Malaise trap at the same site during November 1998 and a further male of one of these species was collected in a Malaise trap in the Hungorob Ravine (1180 m) during April 1999.

There are 72 species of *Gasteruption* recorded from Africa (Pasteels 1956, 1962). Approximately 40 of these occur in southern Africa, most of which are endemic to the region, with only four widespread species in Africa (Pasteels 1959). *Gasteruption ornatipes* Kieffer, 1911, was recorded from Namibia during a survey of the lower Kuiseb River course (Prinsloo 1990). Gasteruptiid species richness is much higher in the temperate region of South Africa than in tropical Africa (Pasteels 1959), contrasting with the general world trend for the family of higher species richness in the tropics (Mason 1993).

Species of *Gasteruption* are parasitoids of solitary bees and wasps that nest in wood (Pasteels 1959; Prinsloo 1985b; Skaife 1979).

ICHNEUMONOIDEA

BRACONIDAE

The Braconidae is the second largest hymenopteran family with an estimated global species richness of 40 000. The number of subfamilies recognised in the Braconidae is still unresolved, varing from 29 (Sharkey 1993) to 39 (Shaw & Huddleston 1991) and 45 (van Achterberg 1993).

BRACONIDAE: ADELIINAE

The subfamily Adeliinae (Braconidae) is cosmopolitan (van Achterberg 1993), but not yet recorded from the Oriental Region, although representatives are likely to occur there (Sharkey 1993). The subfamily is represented by two worldwide genera, *Adelius* Haliday and *Paradelius* de Saeger, and a third genus, *Sculptomyriola* Belokobyl'skij, described from the eastern Palaearctic Region. However, *Sculptomyriola* probably only delimits species with an apomorphic morphology that would be better placed in *Paradelius* (Whitfield 1997a). The Adeliinae are rarely collected (van Achterberg 1993) and poorly represented in collections; they are, however, widely distributed and may be locally common (Whitfield 1997a). This is a small subfamily with only about 20 described species in the world (Shaw & Huddleston 1991).

Genus: *Adelius* Haliday, 1833.

Three hundred and fifty specimens of a probable undescribed species of *Adelius* were collected at UV light traps on the Brandberg at all sampled altitudes in October and November, ranging from 700 m to 2000 m. Two further specimens were sampled in yellow pan traps at Hungorob-Mulde and at Wasserfall-fläche during November. Only two specimens were collected during April, one each trapped at UV light traps in the Messum Valley and at Wasserfallfläche. We are not aware of any reference to adeliines having been collected at light before.

The southern African adeliine fauna is poorly known with only a few undescribed *Paradelius* species known from South Africa. *Paradelius* is represented by a single species in the Afrotropical Region, *P. ghesquieri* de Saeger, 1942, described from the Democratic

Republic of Congo. Two further species have subsequently been described from North America (Whitfield 1989). Likewise *Adelius* is only known from a single species in the Afrotropical Region, *A. stenoculus* de Saeger, 1944, described from a single male collected at 2400 m in Rwanda. A further 20 or so described species mainly occur in the Palaearctic Region, with a few from the Nearctic and Indo-Australasian Regions (Sharkey 1993). With the lack of specimens from other localities it is impossible to predict whether this species is more widespread or a Brandberg endemic.

Current records suggest that species of Adeliinae are all solitary endoparasitoids of leaf-mining moths, possibly exclusively belonging to the family Nepticulidae (Whitfield & Wagner 1991). Based on their close phylogenetic position to the Cheloninae, adeliines are likely to be egg-larval koinobiont parasitoids (Sharkey 1993). Adeliines may have potential for biological control, with the possibility that some species may prove effective in controlling leaf-mining Lepidoptera on coffee or ornamental trees and shrubs (Whitfield 1997a). No altitudinal studies have been carried out on this group.

BRACONIDAE: ALYSIINAE

Of the two tribes in the subfamily, the Dacnusini is primarily a Northern Hemisphere tribe (Wharton 1997a) with two species recorded from the Afrotropical Region: *Coelinius duplater* Szepligeti, 1914, from Tanzania and *Neocoelinius subpetiolatus* Granger, 1949, from Madagascar (Shenefelt 1974). The Alysiini is cosmopolitan (Wharton 1997a) with numerous species in the Afrotropical Region (Shenefelt 1974).

Genus: *Dacnusa* Haliday, 1833.

A single male of a *Dacnusa* species was sampled in the Messum Valley (700 m, April). This is a Northern Hemisphere genus that has not previously been recorded from the Afrotropical Region (Shenefelt 1974). *Dacnusa* species are parasitoids of Diptera in the families Agromyzidae and Drosophilidae (Wharton 1997a).

Genus: *Dinotrema* Foerster, 1862.

A single male of a *Dinotrema* species was collected at Wasserfallfläche (1960 m, April). This is a cosmopolitan genus that is commonly collected (Wharton 1997a). Species of *Dinotrema* are endoparasitoids of the larvae of Diptera in the families Phoridae and Platypezidae, occurring in decaying organic matter (in the former case) or associated with fungi (in the latter case) (van Achterberg 1988; Wharton 1997a).

BRACONIDAE: CHELONINAE

Chelonines are endoparasitoids of lepidopteran larvae (particularly Tortricoidea & Pyraloidea) that feed in concealed situations such as tunnels and leaf rolls (Shaw 1997a). Oviposition is into the host egg and the mature wasp larva pupates in the host cocoon or pupal chamber (Shaw 1997a).

Genus: *Chelonus* Jurine, 1801.

Four species of *Chelonus* were collected on the Brandberg. Species 1 was the most common with 54 specimens emanating from the Messum Valley and Hungorob Ravine, with a single specimen from Königstein, all collected in April in Malaise traps and yellow pan traps. Species 2 and 3 were represented by single specimens collected in April in the Messum Valley and Hungorob Ravine respectively. A single specimen of species 4 was collected at Hungorob-Mulde in November. *Chelonus* species are parasitoids of a wide range of lepidopteran families.

Genus: *Phanerotoma* Wesmael, 1838.

Three species of the cosmopolitan genus *Phanerotoma* were collected. Species 1 was collected at light and by sweeping from the Messum Valley (700 m) through the two mid-altitude sampled sites right up to Königstein (2470 m), mostly during April, but one specimen from November. Species 2 was collected at UV light in the Messum Valley during October and April. Species 3 was mostly collected at UV light in the Messum Valley during October and April, with one record from Wasserfallfläche during October. Thirty-five described species are known from the Afrotropical Region, with nine of these occurring in southern Africa. Most of these species are known from South Africa, with only two species recorded from Namibia (Shenefelt 1973). Species of *Phanerotoma* are nocturnal and attracted to light, and are most abundant in arid habitats (Shaw 1997a). Species of *Phanerotoma* are parasitoids of various families of Lepidoptera.

BRACONIDAE: MICROGASTRINAE

This is a species rich subfamily with an estimated 5 000-10 000 species in the world (Mason 1981), of which only 1 400 have been described (Whitfield 1997b). Microgastrine species are endoparasitoids of a wide variery of lepidopteran larvae and many species have been used in biological control programmes.

Genus: *Diolcogaster* Ashmead, 1900.

Six specimens of a species of *Diolcogaster* were trapped at UV light in the Messum Valley (700 m, October) and an additional specimen was collected at UV light at Wasserfallfläche (1950 m, October). The genus is cosmopolitan, but more diverse in the tropics, and the species are usually not common (Mason 1981). *Diolcogaster* species are solitary or gregarious and use species of macrolepidoptera (Noctuidae, Geometridae) and some microlepidoptera (Pyraloidea) as hosts (Mason 1981; Whitfield 1997b).

Genera indet.

A further 15 specimens have not been identified to generic level, but have been separated into four morpho-species.

BRACONIDAE: MIRACINAE

A small subfamily represented by about 15 described species worldwide (Shaw & Huddleston 1991). Traditionally included in the Microgastrinae this group was raised to subfamily status by van Achterberg (1984).

Genus: *Mirax* Haliday, 1833.

A single female of a *Mirax* species was collected at UV light at Wasserfallfläche (1960 m, April). There are two described genera in this subfamily (Sharkey 1993), although only *Mirax* is usually recognised. A further four putative genera are represented by undescribed material (Whitfield 1997c). *Mirax* is cosmopolitan, with highest species richness in the tropics (Whitfield 1997c).

Miracinae are endoparasitoids of leaf-mining Lepidoptera (usually Nepticulidae or Heliozelidae) (Whitfield & Wagner 1991) and have the potential to be used in biocontrol programmes (Whitfield 1997c).

BRACONIDAE: CARDIOCHILINAE

The cardiochiline braconids consist of nearly twenty genera and are endoparasitoids of lepidopteran larvae (Whitfield & Dangerfield 1997).

Genus: *Schoenlandella* Cameron, 1904.

A single female of a species of *Schoenlandella* was collected in a Malaise trap in the Messum Valley (700 m, April). This is a cosmopolitan, fairly common genus, particularly in semi-arid subtropical and tropical habitats (van Achterberg 1993; Whitfield & Dangerfield 1997). *Schoenlandella* species are solitary parasitoids of microlepidoptera, especially Pyralidae and Noctuidae feeding in concealed situations, such as the buds of flowers (Shaw & Huddleston 1991; Whitfield & Dangerfield 1997).

BRACONIDAE: DORYCTINAE

A cosmopolitan family with highest species richness in tropical areas (Marsh 1997). Doryctine species are ectoparasitoids of wood-boring Coleoptera larvae, stem-boring Lepidoptera and sawfly larva (Hymenoptera) (Marsh 1997).

Genera indet.

The Doryctinae still await identification to generic level, but the specimens have been sorted to seven morpho-species. Species 1 was the most common being collected in the Messum Valley, Hungorob Ravine, Hungorob-Mulde and at Wasserfallfläche during October, November and April, mostly at UV light traps but also in yellow pans. Species 2 was almost as common being collected at UV light and in yellow pan traps at the same localities and months as species 1. Species 3, 4 and 5 were collected in the Messum Valley during April, at UV light traps and in Malaise traps. Species 6 was collected at Hungorob Ravine and Wasserfallfläche during October and April respectively, at UV light traps. Species 7 was collected at Wasserfallfläche during April at UV light.

BRACONIDAE: OPIINAE

This cosmopolitan subfamily includes more than 1 300 described species, a number of which are used in the biological control of fruit flies (Diptera: Tephritidae) (Wharton 1997c).

Genus: *Opius* Wesmael, 1835.

A single species of *Opius* was collected in the Messum Valley, Hungorob Ravine, Wasserfallfläche and at Königstein, mostly in yellow pan traps, but also in Malaise traps and UV light traps during April. *Opius* species are parasitoids of Diptera in the families Agromyzidae and Tephritidae (Wharton 1997c).

Genera indet.

Five morpho-species await identification to generic level. These were collected at Hungorob Ravine and Wasserfallfläche during October and April.

BRACONIDAE: ROGADINAE

The Rogadinae is a species rich cosmopolitan subfamily, whose species are endoparasitoids of lepidopteran larvae.

Genus: *Yelicones* Cameron, 1887.

A single common species of *Yelicones* was collected at all sampled sites (700 m, 1200 m, 1960 m and 2470 m), mostly at UV light during April, but also by sweeping, and during October and November. No described species are known from the Afrotropical Region; however, two new species are present among material collected in Kenya, Madagascar and West Africa (van Achterberg 1991). Species of *Yelicones* are parasitoids of Pyralidae (Lepidoptera) (Shaw 1997d).

Genera indet.

A further 10 specimens that await identification to generic level were sorted into four morphospecies.

BRACONIDAE: AGATHIDINAE

A cosmopolitan subfamily, comprising 52 known genera. Species of Agathidinae are endoparasitoids of lepidopteran larvae.

Genus: *Coccygidium* Saussure, 1892.

Fifteen specimens of a *Coccygidium* species were collected in the Messum Valley (700 m) and the Hungorob Ravine (1180 m), during April 1999; mostly in Malaise traps, but two specimens were taken at UV light. The genus is cosmopolitan in warm temperate and tropical regions (Sharkey 1997). *Coccygidium* species are parasitoids of lepidopteran larvae (Noctuidae and Arctiidae) (Sharkey 1997). Four described species are known from the Afrotropical Region, two of these from South Africa (Shenefelt 1970). Judging by the estimated number of New World species (100), most of which are undescribed (Sharkey 1997), there are undoubtedly many further species awaiting discovery in the Afrotropical Region.

Genus: *Cremnops* Foerster, 1862.

One specimen of a *Cremnops* species was collected in a Malaise trap, in the valley below Wasserfallfläche (1960 m, April). Eleven described species are known from the Afrotropical Region with four recorded from South Africa (one introduced) and none from Namibia (Shenefelt 1970). The genus is cosmopolitan, occurring in both temperate and tropical regions. *Cremnops* species are parasitoids of Pyralidae (Lepidoptera) (Sharkey 1997).

Genus indet.

Another species belonging to an unidentified genus was collected in a Malaise trap in the Messum Valley (700 m, April).

BRACONIDAE: ORGILINAE

The Orgilinae is a cosmopolitan subfamily, containing approximately 250 described species, most of which belong to the genus *Orgilus*, the greatest species richness of which occurs in the Holarctic Region (Shaw & Huddleston 1991; van Achterberg 1997b).

Genus: *Orgilus* Haliday, 1833.

Two females of an *Orgilus* (*Orgilus*) species were collected in Malaise traps in the Hungorob Ravine (1180 m, April). Eleven described species of *Orgilus* are known from the Afrotropical Region, mostly from Madagascar, with three species known from South Africa and none from Namibia (Shenefelt 1970). Species of the subgenus *Orgilus* are solitary koinobiont parasitoids (van Achterberg 1997b) of lepidopteran larvae belonging to the families Gelechiidae, Oecophoridae, Psychidae, Pyralidae, Gracillariidae, and Tortricidae (van Achterberg 1987). *Orgilus* species have been used with varying degrees of success in biocontrol programmes (van Achterberg 1997b).

BRACONIDAE: EUPHORINAE

This is a cosmopoliran subfamily that in the strict sense contains 33 genera (Shaw 1985), however, the inclusion of the Meteorinae as a tribe within the Euphorinae adds additional genera and at least a further 174 species (Shaw 1997c). Euphorine species are endoparasitoids of Coleoptera, Lepidoptera, Hymenoptera, Neuroptera, Heteroptera and Psocoptera.

Genus: *Leiophron* Nees, 1818.

A single male of a species of *Leiophron* was collected in the Messum Valley (700 m, April). *Leiophron* is widespread throughout the world with the exception of Australia. Species of *Leiophron* are parasitoids of late instar nymphs and adults of plant bugs (Hemiptera: Miridae), and as such are of significance from a biocontrol perspective (Shaw 1985, 1997b).

Genus: *Euphoriella* Ashmead, 1900.

A male of a *Euphoriella* species was collected in the Hungorob Ravine (1200 m, Nov.). This is a widespread, common genus, whose species are often overlooked because of their small size (Shaw 1997b). Species of this genus are parasitoids of late instar nymphs and adults of Psocoptera (Shaw 1997b).

Genus: *Wesmaelia* Foerster, 1862.

Two females and a male of *Wesmaelia*, possibly a new species (S.R. Shaw pers. comm.), were collected at light in the Hungorob Ravine (1200 m, Nov.) and at Wasserfallfläche (1950 m, Oct.). *Wesmaelia* includes two described species from the Holarctic Region and another undescribed species from the Neotropical Region. Species of *Wesmaelia* are parasitoids of late instar and adult Nabidae (Hemiptera) (Shaw 1985; 1997b).

Genus: *Meteorus* Haliday, 1835.

A single specimen of a *Meteorus* species was trapped at UV light at Wasserfallfläche during November. *Meteorus* species are endoparasitoids of larval Coleoptera and Lepidoptera (Shaw 1997c).

BRACONIDAE: GNAMPTODONTINAE

The Gnamptodontinae is a small subfamily containing three genera, whose species are parasitoids of lepidopteran larvae.

Genus: *Gnamptodon* Haliday, 1833.

Three species of *Gnamptodon* were collected on the Brandberg. Four specimens of species 1 were collected in Malaise traps and yellow pan traps in the Messum Valley and Hungorob Ravine during October and April. Species 2 was represented by five specimens collected in Malaise traps and by sweeping in the Hungorob Ravine, at Wasserfallfläche and on Königstein during April. A single specimen of species 3 was collected in a yellow pan trap in the Hungorob Ravine during April. Species of *Gnamptodon* are parasitoids of Lepidoptera of the family Nepticulidae (Wharton 1997b).

BRACONIDAE: APHIDIINAE

The Aphidiinae that were collected during the Brandberg survey still await generic identification, but have been sorted to morpho-species. All Aphidiinae are solitary endoparasitoids of aphids (Hemiptera) (van Achterberg 1997a).
Genus indet.

Two species were collected. Species 1 was represented by 11 specimens collected in the Hungorob Ravine and at Wasserfallfläche during October. A single specimen of species 2 was collected at Wasserfallfläche during November.

BRACONIDAE: BRACONINAE

The Braconinae is a large cosmopolitan subfamily comprising more than 2000 species (Shaw & Huddleston 1991). Most species are ectoparasitoids of concealed lepidopteran, coleopteran, hymenopteran or dipteran larvae; a few are endoparasitic in butterfly pupae (Quicke 1997).

Genera indet.

The Braconinae still await identification to generic level, but they have been sorted into 11

morpho-species and these have been included in the species richness assessments.

ICHNEUMONIDAE

The Ichneumonidae is the largest family in the Hymenoptera with an estimated 60 000 species worldwide (Townes 1969a). The family is currently split into 35 subfamilies (Wahl 1993).

ICHNEUMONIDAE: PIMPLINAE: POLYSPHINCTINI

The Pimplinae is a cosmopolitan subfamily with 64 genera, whose species are mostly ectoparasitoids of larvae and pupae of Holometabola (Wahl 1993).

Genus: *Zatypota* Foerster, 1868.

A single male of a species, probably of the genus *Zatypota* Foerster was collected at UV light at Wasserfallfläche (1980 m, November). Species of the tribe Polysphinctini are cosmopolitan, commonest in damp habitats, and all are ectoparasitoids of spiders (Araneae) (Townes 1969a). There are six genera in the Afrotropical Region. *Zatypota* is represented by 3 species, one each from South Africa, Madagascar and the Democratic Republic of the Congo (Townes & Townes 1973). The genus is most species rich in the Northern Hemisphere (Townes 1969a).

ICHNEUMONIDAE: CRYPTINAE

The Cryptinae is a species rich cosmopolitan subfamily with 379 genera, with most species ectoparasitoids of Holometabola pupae or prepupae (Wahl 1993).

Genus: *Rhynchocryptus* Cameron, 1905.

An undescribed species of *Rhynchocryptus* was collected in a Malaise trap in the Hungorob Ravine (1180 m, April). *Rhynchocryptus* is a small afrotropical genus containing only three described species, all from South Africa (Townes & Townes 1973). The biology of the genus is currently unknown, but the usual hosts of the subtribe Hedycryptina (Ischnina *sensu* Towned) are prepupae or pupae of Lepidoptera and symphytan Hymenoptera (Townes 1969b).

ICHNEUMONIDAE: BANCHINAE: ATROPHINI

The Banchinae is a cosmopolitan subfamily with 53 genera, species of which are endoparasitoids of lepidopteran larvae (Wahl 1993).

Genus: *Syzeuctus* Foerster, 1868.

A single female of a *Syzeuctus* species was collected in a Malaise trap in the Hungorob Ravine (1180 m, April). Fourty-four species have been described from the Afrotropical Region, half of which occur in southern Africa and five are known from Namibia (the former Damaraland, Kaoko Otavi, Kamanjab, Warmbad) (Townes & Townes 1973). *Syzeuctus* is a large, cosmopolitan genus, but with highest species richness in dry habitats in tropical and subtropical areas (Townes 1969c).

Genus: *Lissonota* Gravenhorst, 1829.

A species of *Lissonota*, represented by a single male, was trapped on Königstein at 2470 m during April. Three species have been described from the Afrotropical Region, with two of these from South Africa (Townes & Townes 1973). *Lissonota* is a very large, cosmopolitan genus, with highest species richness in the Holarctic Region (Townes 1969c).

Genus: *Himertosoma* Schmiedeknecht, 1900.

A single male of a *Himertosoma* species was trapped in the Hungorob Ravine (1180 m, April). Fifty-four described species occur in the Afrotropical Region, the majority of which are

Madagascan, eight from South Africa, none recorded from Namibia (Townes & Townes 1973). *Himertosoma* is a reasonably large, Old World tropical and subtropical genus, with highest species richness in the Afrotropical Region (Townes 1969c).

Species of all three of these banchine genera are koinobiont endoparasitoids of lepidopteran larvae in concealed situations such as leaf rolls, tunnels and flower buds (Townes & Townes 1973; Wahl 1993).

ICHNEUMONIDAE: CAMPOPLEGINAE

Another cosmopolitan subfamily with 65 genera, whose species are mostly endoparasitoids of lepidopteran or symphytan (Hymenoptera) larvae (Wahl 1993).

Genus: *Hyposoter* Foerster, 1868.

Four species of *Hyposoter*, all represented by single specimens, were collected on the Brandberg at the following localities: Wasserfallfläche (2000 m, October; 1960 m, April); Hungorob Ravine (two species both April).. There are three described species from the Afrotropical Region (Kenya & Reunion) (Townes & Townes 1973). *Hyposoter* is a large, cosmopolitan genus, species of which use lepidopteran larvae as hosts (Townes 1969c).

Genus: *Eriborus* Foerster, 1868.

A single female of an *Eriborus* species was collected at UV light at Wasserfallfläche (1960 m, April). *Eriborus* is a very large, old world genus that is most species rich in the tropics. Species of *Eriborus* are parasitoids of lepidopteran larvae (Townes 1969c). Five described species are known from the Afrotropical Region, two of which have been recorded from southern Africa (Zimbabwe and South Africa) (Townes & Townes 1973).

ICHNEUMONIDAE: CREMASTINAE

A cosmopolitan subfamily with 25 genera; mostly endoparasitoids of lepidopteran larvae, although some are parasitoids of coleopteran larvae, in concealed situations (Wahl 1993).

Genus: *Trathala* Cameron, 1899.

Three species of *Trathala* were collected on the Brandberg, all of which are probably undescribed. The species trapped in the Hungorob Ravine (1180 m) during April is widespread, with specimens from throughout South Africa, and from Warmbad and Kamanyab in Namibia, present in the South African Museum collection. The second species of *Trathala* was collected at Hungorob-Mulde (1913 m) during November and the Messum Valley (700 m) during April. The third species was trapped in the Hungorob Ravine (1180 m) during April. The two last mentioned species are possibly more restricted in their distribution. The genus *Trathala* is large and cosmopolitan, being parasitoids of Lepidoptera, usually Pyraloidea (Townes 1971). There are eight described species of *Trathala* from the Afrotropical Region, most known from southern and east Africa (Townes & Townes 1973). The single Namibian species, *Trathala flavithorax* Enderlein, 1914, was described from a specimen collected in Windhoek.

Genus: *Temelucha* Foerster, 1868.

A female and a male of a *Temelucha* species were collected in the Messum Valley (700 m) during October and two males of a second species were collected in the Hungorob Ravine (1180 m) during April. Eleven species of *Temelucha* are known from the Afrotropical Region, with seven species present in southern Africa (Townes & Townes 1973). Two of these species, *Temelucha boops* Cushman, 1934, and *T. sannio* Enderlein, 1914, have been recorded from Namibia (Swakopmund, Tsumeb for the former, and

Windhoek for the latter species). *Temelucha boops* is also known from Tanzania. *Temelucha* is another large, cosmopolitan cremastine genus, whose species are parasitoids of a variety of small lepidopteran larvae that conceal themselves in leaf folds or tunnels. *Temelucha* species are commonly encountered amongst grasses or bushes, in full sunlight, often in relatively dry situations (Townes 1971).

Genus: *Pristomerus* Curtis, 1836.

Three *Pristomerus* species were collected: the first in the Messum Valley (700 m, October), the second at Wasserfallfläche (1980 m, November) and the third species both in the Messum Valley and Hungorob Ravine (1180 m) during April. *Pristomerus* is another large, cosmopolitan genus, with most species occurring in the tropics and parasitising a variety of small lepidopteran larvae that conceal themselves in tunnels, leaf rolls or buds (Townes 1971). Five species have been described from the Afrotropical Region, three of which occur in southern Africa, but none to date recorded from Namibia (Townes & Townes 1973).

ICHNEUMONIDAE: OPHIONINAE

The Ophioninae is a cosmopolitan subfamily with 32 genera; mostly endoparasitoids of Lepidoptera (Wahl 1993).

Genus: *Enicospilus* Stephens, 1835.

One specimen of *Enicospilus mnous* Gauld & Mitchell, 1978, was collected at UV light in the Messum Valley. This is a species that is restricted to the drier areas of Africa and Madagascar (Gauld & Mitchell 1978). In Africa, it has been recorded from Kenya and Namibia (Okjikoko and Okahandja). *Enicospilus mnous* is likely, however, to be more widespread within Namibia than indicated by current distribution records. The species is very closely related to *E. pacificus* (Holmgren, 1868), one of the commonest and most widely distributed *Enicopsilus* species in the Afrotropical Region (Gauld & Mitchell 1978). Host records are wanting for both of these species.

Two females and a male of *Enicospilus quietus* (Seyrig, 1935) were collected at UV light in the Messum Valley. This species is commonest in the drier areas of southern Africa, although its range extends to Zaire, Kenya and Madagascar. In Namibia, it has been recorded from Grootfontein, Gobabeb, Okahandja, Okjikoko and near Sesriem (Gauld & Mitchell 1978) and Namib-Naukluft Park (by the first author), suggesting that it is widespread within Namibia. *Enicospilus quietus* has been reared from *Prodotis stolida* (Fabricius, 1775) (Lepidoptera: Noctuidae) and *Dasychira ribrifilata* Hampson, 1905 (Lepidoptera: Lymantriidae) (Gauld & Mitchell 1978) and recorded as a parasite of *Ctenoplusia limbirena* (Guenée, 1852) (Lepidoptera: Noctuidae) by Morley (1917).

Three females of *Enicospilus grandiflavus* Townes & Townes, 1973, were collected at UV light on the open plain at Wasserfallfläche (2000 m). *Enicospilus grandiflavus* is related to the previous species, *E. quietus*, both belonging to the *E. rufus* species-group. *Enicospilus grandiflavus* has previously not been recorded from Namibia, but is known from South Africa, Zimbabwe, Democratic Republic of the Congo, and Madagascar (Gauld & Mitchell 1978). Host utilisation is unknown.

One specimen of *Enicospilus pallidus* (Taschenberg, 1875) was collected at Wasserfallfläche (1980 m) using a UV light trap. Although *E. pallidus* is another of the apparently arid-adapted species, it is widely distributed throughout the Afrotropical Region with the exception of Madagascar. In Namibia, *E. pallidus* has been recorded from Windhoek and Walvis Bay, however, this species is likely to be more widespread within the country (Gauld & Mitchell 1978).

Genus: *Afrophion* Gauld, 1979.

Rather surprisingly, a male and female of *Afrophion nubilicarpus* (Tosquinet, 1896) were trapped at UV light on Königstein peak at 2470 m. There are two species in this southern African genus, both previously thought to be restricted to the extreme southern areas of South Africa, although *A. nubilicarpus* has been collected as far north as Garies at a latitude of *c.* 30.5°S in South Africa (Gauld & Mitchell 1978). Nevertheless, the record on the Brandberg extends the known distribution of this species by 1100 km. The presence of this species in Namibia can probably be attributed to the high altitude of the Brandberg, where altitude compensates for a decrease in latitude, a distributional phenomenon characteristic of other insect groups, such as flies (Barraclough 1994) and butterflies (van Noort & Stone 1999). It is possible that *A. nubilicarpus* is restricted to the Brandberg in Namibia, although it may also occur on other high altitude outcrops, such as the Erongo Mountains, the higher lying areas just south of Windhoek, or the Groot-Karasberge, thus representing outlying, altitude restricted, allopatric populations of the South African population. Besides the two *Afrophion* species only three other species (all belonging to *Rhopalophion*) of the diverse *Ophion* genus-group occur in the Afrotropical Region. There are about 280 species (described and undescribed) in the *Ophion* genus-group (Gauld 1980). This genus-group was probably more widespread in the past and has gradually disappeared from equatorial regions leaving isolated relict groups such as *Afrophion* and *Rhopalophion* (Gauld 1985). The hosts of *Afrophion* are unknown.

ICHNEUMONIDAE: MESOCHORINAE

A cosmopolitan subfamily with ten genera, whose species are mostly hyperparasitoids of other Ichneumonidae or Tachinidae (Diptera) (Wahl 1993).

Genus: *Mesochorus* Gravenhorst, 1829.

A female of a *Mesochorus* species was collected in a yellow pan trap in Hungorob Ravine (1180 m) and a male of the same species trapped at UV light in the Messum Valley, both during April. Twelve described species are known from the Afrotropical Region with one species, *M. herero* Enderlein, 1914, recorded from Namibia, the type having been collected at Okahandja. *Mesochorus herero* is also known from South Africa, Rwanda and the Democratic Republic of the Congo (Townes & Townes 1973).

Genus: *Stictopisthus* Thomson, 1886.

Two species of *Stictopisthus* were collected in the Messum Valley (700 m), the Hungorob Ravine (1180 m), and at Wasserfallfläche (1960 m) (UV light trap; Malaise traps; yellow pan trap) during April. Fourteen described species are known from the Afrotropical Region, only three of which have been recorded from southern Africa (all in South Africa) (Townes & Townes 1973). Most of the species are only known from West Africa, with one species from Madagascar, however, the documented species richness distribution pattern may only be an artifact of insufficient collecting in the region. *Stictopisthus breviscapus* (Kerrich, 1956) was recorded as a secondary parasitoid of the Karroo caterpillar, *Loxostege frustalis* (Zeller, 1852) (Lepidoptera: Pyralidae) in South Africa (Kerrich 1956).

ICHNEUMONIDAE: METOPIINAE

The Metopiinae is a cosmopolitan subfamily with 26 genera; endoparasitoids of Lepidoptera (Wahl 1993).

Genus: *Trieces* Townes, 1946.

Two males of a *Trieces* species were trapped in the Hungorob Ravine (1180 m) during April. Seven described species are known from the

Afrotropical Region, most from the Democratic Republic of Congo (Zaire), none of which have been recorded from Namibia (Townes & Townes 1973). The only southern African representative, *Trieces capensis* Benoit, 1956, occurs in South Africa. *Trieces* is a large, cosmopolitan genus, but most species are infrequently encountered. Their favoured habitat is among shrubs in relatively dry environments (Townes 1971). Species of Metopiinae are parasitoids of Lepidoptera. The female oviposits into the larval stage and the adult wasps emerge from the pupa (Townes 1971).

ICHNEUMONIDAE: ANOMALONINAE: ANOMALONINI

A cosmopolitan subfamily with 38 genera, whose species are endoparasitoids of Lepidoptera or Coleoptera (Wahl 1993).

Genus: *Anomalon* Panzer, 1804.

A female of an undescribed *Anomalon* species was collected in a yellow pan trap in the valley below Wasserfallfläche (1960 m) during April. This is a fairly widespread species, with specimens from Vryburg, Venterstad and Grahamstown (South Africa), and Kaoko Otavi (Namibia), present in the South African Museum collection.

The Anomaloninae is a large, cosmopolitan subfamily, but the species are rather uncommon (Gauld 1976). Most species of Anomaloninae are parasitoids of Lepidoptera larvae, ovipositing into the early instars and emerging from the pupa; however, the small tribe Anomalonini are parasitoids of tenebrionid beetle larvae (Gauld 1976). The Anomalonini contains two genera, *Neogreenia* Viereck which is restricted to the New World, and the cosmopolitan *Anomalon*. Five described species of *Anomalon* are known from Africa, four of which occur in South Africa (Townes & Townes 1973). Species of *Anomalon* are most common in drier regions. Morphological modifications of the mouthparts are considered to be possible adaptations to obtain moisture from sources not available to wasps with conventional mouthpart structures (Gauld 1976).

CHALCIDOIDEA

CHALCIDIDAE

The Chalcididae comprises five subfamilies, all of which are represented in the Afrotropical Region. Three of these subfamilies were collected on the Brandberg. Of the two subfamilies that were not sampled, no described species of Epitraninae are known from Namibia, but two species have been recorded from South Africa, and with further collecting this subfamily will probably turn up in Namibia. The Smicromorphinae includes a single genus that exists only within the range of its host, weaver ants of the genus *Oecophylla* F. Smith, 1860 (Hymenoptera: Formicidae; Formicinae) (Bouček 1988). The host range excludes Namibia.

CHALCIDIDAE: HALTICHELLINAE

The Haltichellinae is a diverse, cosmopolitan subfamily containing 55 genera, 22 of which are represented by 99 species in the Afrotropical Region (Noyes 1998). Five genera were sampled on the Brandberg.

CHALCIDIDAE: HALTICHELLINAE: HALTICHELLINI

Genus: *Kriechbaumerella* Dalla Torre, 1897.

Three specimens of a *Kriechbaumerella* species were collected in a Malaise trap at Wasserfallfläche during November. The genus is centered in the Oriental Region (18 species), with representatives in the Palaearctic and Neotropical Regions. Two described species are known from the Afrotropical Region (Su-

dan and Tanzania respectively) (Noyes 1998). Species of this genus are parasitoids of lepidopteran pupae.

Genus: *Hockeria* Walker, 1834.

Five species of *Hockeria* were collected on the Brandberg. Seven specimens of the first species were collected from the Hungorob Ravine (1180 m), Wasserfallfläche (1960 m) and Königstein (2470 m), all in Malaise traps and predominately in April. One specimen was trapped in October. Single specimens trapped in April in the Hungorob Ravine and Wasserfallfläche respectively represenred species 2 and 3. Species 4 and 5 were trapped during April in the Hungorob Ravine and Messum Valley respectively. Twenty-seven described species of *Hockeria* are known from the Afrotropical Region, of which one, *H. gallicola* Prinsloo, 1984, has been recorded from Namibia (Noyes 1998). *Hockeria* species are mostly parasitoids of moth pupae (Lepidoptera).

CHALCIDIDAE: HALTICHELLINAE: HYBOTHORACINI

Genus: *Proconura* Dodd, 1915.

Two species of *Proconura* were sampled. Species 1 was represented by eight specimens collected in the Messum Valley, Hungorob Ravine and Wasserfallfläche, mostly during April. A single specimen was trapped in October. Six specimens of species 2 were collected in the same localities and seasons. *Proconura* is an Old World genus, with five described species recorded from the Afrotropical Region, but none yet known from southern Africa. Species of the genus are parasitoids of small moths (Lepidoptera: Gelechiidae; Yponomeutidae) and Bruchidae (Coleoptera) (Bouček 1988).

Genus: *Psilochalcis* Kieffer, 1905.

Two species of *Psilochalcis* were sampled, the first of which was represented by a single specimen collected in the Hungorob Ravine in April. The second species was far more common, with most of the 30 specimens being collected in the Hungorob Ravine in April, with several specimens being collected in the Messum Valley and at Wasserfallfläche during April. A single specimen was taken in the Messum Valley during October. *Psilochalcis* is a cosmopolitan genus with eight species in the Afrotropical Region. A single species, *P. capensis* (Steffan, 1948) has been recorded from Namibia and is also known from South Africa (Noyes 1998). Species of *Psilochalcis* are parasitoids of moth pupae, particularly of the family Pyralidae (Lepidoptera) (Bouček 1988).

Genus: *Steninvreia* Bouček, 1988.

A single species of *Steninvreia*, represented by five specimens, was collected in Malaise and yellow pan traps, sited in the Messum Valley, Hungorob Ravine and on Königstein, in November and April. The five described species of *Steninvreia* are only known from the Indo-Australasian Region (Noyes 1998), although an undescribed species is known to occur in Africa. The biology of the genus is unknown.

CHALCIDIDAE: DIHRININAE

The Dirhininae contains three genera, all of which are present in the Afrotropical Region. Only the cosmopoliran genus *Dirhinus* is, however, currently recorded from southern Africa.

Genus: *Dirhinus* Dalman, 1818.

Two species of *Dirhinus* were sampled on the Brandberg. The first species was represented by eight specimens, mostly collected in Malaise traps, but also in yellow pan traps in the Messum Valley and Hungorob Ravine. There was a single record from Wasserfallfläche during April. The second species, represented by a single specimen, was collected at Waserfallfläche in a yellow pan during April. Eighteen species

are known from the Afrorropical Region, with only a single described species in southern Africa (South Africa) (Noyes 1998). *Dirhinus* species are parasitoids of dipteran puparia (Calliphoridae, Sarcophagidae, Muscidae and Tephritidae).

CHALCIDIDAE: CHALCIDINAE

This cosmopolitan subfamily contains 27 genera, 14 of which occur in the Afrotropical Region, only one of which was collected on the Brandberg.

Genus: *Brachymeria* Westwood, 1829.

Two species were present on the Brandberg. The first species was collected in the Messum Valley and Hungorob Ravine during April and the second species only in the Messum Valley during April. Sixty-one described species are known from the Afrotropical Region, eight of which, are recorded from South Africa, but none to date from Namibia (Noyes 1998). Species of *Brachymeria* are mostly parasitoids of Lepidoptera pupae, but some utilise Coleoptera, Hymenoptera or Diptera as hosts.

TORYMIDAE

The Torymidae contains 65 genera in two subfamilies, the Toryminae and Megastigminae (Grissell 1995). Twenty-three torymine genera and a single megastigmine genus, *Megastigmus* Dalman, 1820, are present in the Afrotropical Region (Noyes 1998).

TORYMIDAE: MEGASTIGMINAE

This cosmopolitan subfamily contains 168 species, five of which are known from the Afrotropical Region (Grissell 1999a). No *Megastigmus* species were collected on the Brandberg during this survey. Species of *Megastigmus* are known to be phytophagous as seed feeders in drupes of *Rhus* L. (Anacardiaceae) species and the introduced Pepper trees, *Schinus molle* L. and *S. terebinthifolius* Raddi (Anacardiaceae) in southern Africa (Grissell 1999a; Grissell & van Noort pers. obs.). Two species of *Rhus* are present on the Brandberg and it is feasible that *Megastigmus* will also eventually be recorded on the massif. *Megastigmus transvaalensis* (Hussey, 1956) was swept by the first author on a planted *S. molle* tree with drupes at Uis, a town situated approximately 20 km from the Brandberg.

TORYMIDAE: TORYMINAE

A cosmopolitan subfamily containing seven tribes, members of which exhibit a diverse range of biologies (Grissell 1995). Four genera in three tribes were sampled on the Brandberg during this survey.

TORYMIDAE: TORYMINAE: TORYMINI

Genus: *Odopoia* Walker, 1871.

A single female of an *Odopoia* species was swept at Wasserfallfläche (1960 m). There are four known species of *Odopoia* present in the Afrotropical and Indo-Australasian Regions (Grissell 1995). The single afrotropical species, *O. philippiae* (Risbec, 1952), is known from Madagascar, where it was reared from flower galls on *Philippia* species (Bouček 1978; Grissell 1995). The Brandberg specimen is probably an undescribed species that may be conspecific with an undescribed species recorded from South Africa by Bouček (1978).

TORYMIDAE: TORYMINAE: TORYMOIDINI

Genus: *Torymoides* Walker, 1871.

Two females of an undescribed *Torymoides* species were collected by sweeping shrubs in Hungorob Ravine during April at an altitude of 1180 m. A female of a second undescribed spe-

cies of *Torymoides* was sampled in a Malaise trap at the same locality in the Hungorob Ravine. There is only a single described species of this genus recorded from the Afrotropical Region, the South African *Torymoides latus* (Boucek, 1978), from which both the present species are distinct. Host relationships of *T. latus* are unknown. The genus is cosmopolitan, but nearly half of the world *Torymoides* species (18 of 45) occur in the Australasian Region (Grissell 1995).

Torymoides species have been reared from Cecidomyiidae (Diptera) galls on Fabaceae, Asteraceae, Chenopodiaceae and Euphorbiaceae, from unknown gall formers on Fabaceae, Chenopodiaceae and Myrtaceae, from Tephritidae (Diptera) gall formers on Asteraceae, and from Pinaceae seeds (possibly as hyperparasitoids) (Grissell 1995).

Genus: *Pseudotorymus* Masi, 1921.

A female of a *Pseudotorymus* species was collected in a Malaise trap sited in the Messum Valley at 700 m during April. Seven described species of *Pseudotorymus* are known from the Afrotropical Region (Senegal, Rwanda, Madagascar, Mali, Sudan, Nigeria, Mozambique, South Africa), but no keys are available. The afrotropical species have been reared from Bruchidae (Coleoptera), Cecidomyiidae (Diptera) and unidentified plant galls, and recorded as hyperparasitoids of Eurytomidae, Pteromalidae and Braconidae (Grissell 1995).

TORYMIDAE: TORYMINAE: PODAGRIONINI

Genus: *Podagrionella* Girault, 1913.

Two females and a male of a *Podagrionella* species were collected in Malaise traps sited in the Hungorob Ravine at 1180 m in April. Two males of the same species were collected in a Malaise trap, and one male was swept, in the well-vegetated valley below the seasonal waterfall at Wasserfallfläche at an altitude of 1960 m during April. A female and male of a second *Podagrionella* species were collected in April in a Malaise trap in the sparsely vegetated Messum Valley (700 m) and at Hungorob Ravine (1180 m) respectively. *Podagrionella* is an Old World genus, represented in the Afrotropical Region by four described species, three from Senegal and one from Malawi (Grissell 1995). A number of undescribed species are known and there is no comprehensive key to the described species, making it difficult to determine the status of the species collected on the Brandberg. *Podagrionella* species have been reared from mantid (Mantodea) egg cases (Grissell 1995).

ORMYRIDAE

Apart from the monotypic *Ormyrulus* Boucek from India, all species of Ormyridae are included in the single cosmopolitan genus *Ormyrus*, which contains 73 described species (Noyes 1998). Ormyrids are parasitoids of Diptera (Tephritidae) and Hymenoptera (Cynipidae) gall formers, and a few species develop in figs (*Ficus* spp., Moraceae), as facultative or obligatory parasitoids of fig wasps (Hymenoptera: Agaonidae).

Genus: *Ormyrus* Westwood, 1832.

Two species of *Ormyrus* were swept, and one of these plus a third species were collected in Malaise traps in the Hungorob Ravine (1180 m) during April. A fourth *Ormyrus* species was swept in the valley below Wasserfallfläche (1960 m), also during April. Thirteen species are known from the Afrotropical Region. Of these, five species have been recorded from southern Africa: three from Zimbabwe and one each from Mozambique and South Africa (Noyes 1998). The latter two species are believed to be widespread in southern Africa (Boucek 1988).

Biology of the afrotropical species is restricted to knowledge of three species, *O. flavipes* Boucek,

1981, *O. subconicus* Boučck, 1981 and *O. watshami* Boučck, 1981, reared from figs of *Ficus thonningii* Blume (Moraceae) in Zimbabwe (Boučck *et al.* 1981). A larva of *O. flavipes* was observed as an ectoparasitoid of the pupa of *Syceurytoma ficus* Boučck 1981 (Eurytomidae) in a galled fig (Boučck *et al.* 1981). Some of these species are also associated with galled leaf buds on fig trees (Compton & van Noort 1992; Watsham 1984). None of the species collected on the Brandberg belong to the fig associated *O. watshami* species-group, and hence are probably parasitoids of gall-forming Diptera and not associated with the two fig tree species, *Ficus ilicina* Sonder (Miq.) and *F. cordata cordata* Thunberg found on the Brandberg.

AGAONIDAE

This is a circumtropical family, with approximately 230 described species of an estimated 690 species in the Afrotropical Region (van Noort unpublished; see also web site at: http://www.museums.org.za/sam/collect/life/ento/simon/figwasp.htm). Fig wasps are exclusively associated with figs (*Ficus*, Moraceae). Since *Ficus* is a predominately tropical genus, the Namibian fig wasp fauna is depauperate because of the largely arid habitats in the country, with only 20 fig wasp species currently recorded. The Agaonidae has been shown to be paraphyletic with some of the constituent subfamilies (Sycoecinae, Otitesellinae and Sycoryctinae) reassigned to the Pteromalidae (Rasplus *et al.* 1998). The true taxonomic affinities of the Sycophaginae and Epichrysomallinae are, however, undecided and for the purposes of this paper we retain the old classification of Boučck (1988).

AGAONIDAE: AGAONINAE

Pollinating fig wasps gall the ovules of the florets inside the fig, the larvae thus exhibit a phytophagous life style (Verkerke 1989). Female wasps must negotiate a narrow bract-lined opening, the ostiole, situated at the apex of the fig, to gain entry into the fig cavity for oviposition and pollination. The process of squeezing through the ostiole is aided by the development of dramatic morphological adaptations (van Noort & Compton 1996).

Genus: *Ceratosolen* Mayr, 1885.

Seven females of *Ceratosolen arabicus* Mayr, 1906, were sampled with a UV light trap on Wasserfallfläche (1980 m) during November. A further 73 females were sampled using a UV light trap sited in the Messum Valley (700 m) during April. *Ceratosolen arabicus* is the pollinator of *Ficus sycomorus* L. Previously the population of *F. sycomorus* occurring in Namibia and Angola was recognised as a distinct subspecies *F. s. gnaphalocarpa* (Miq.) C.C. Berg. This form, however, diagnosed by the position of the figs, also occurs in West Africa and sympatrically with the nominate subspecies elsewhere in Africa, and hence was synonymised by Berg in Berg & Wiebes (1992). A second species of *Ceratosolen*, *C. galili* Wiebes, 1964, also breeds in *F. sycomorus*, but does not play an active rôle in pollination and is absent from Namibia (Compton *et al.* 1991). As far as we could establish *F. sycomorus* is not present on the Brandberg. The species favours riparian habitats (Berg & Wiebes 1992), and can be relatively common along the larger perennial river courses in Namibia (Compton, Prinsloo & van Noort, pers. obs.). The closest population of *F. sycomorus* to the Brandberg is probably that present along the course of the Ugab River, which runs in an east-west direction just north of the Brandberg. This means that these specimens have travelled at least 25 km to the Messum Valley and risen 1540 m to the Wasserfallfläche plateau, a feat probably aided by their nocturnal activity. Most fig wasp pollinators are dark coloured and likely to exhibit diurnal activity, such as *Elisabethiella baijnathi* Wiebes, 1989 (Ware & Compton 1994), although *Platyscapa desertorum* Compton, 1990, is dark coloured and attracted

to light (*vide infra*). *Ceratosolen arabicus* has the typical morphology of nocturnally active wasps, being yellow in colour with large eyes, and has previously been recorded at light traps (Ware & Compton 1994). Wharton *et al.*, (1980) established that specimens of *C. arabicus* arriving at receptive figs in the Kuisib River Canyon, must have travelled at least 5 km, the distance to the nearest tree that was producing wasps. Pollinating fig wasps are known to be capable of dispersing over great distances. Two pollinator species introduced to the Hawai'ian Islands, were documented as having travelled 100 km from their site of introduction, on one island, to colonise their introduced host fig tree species present on another island (Pemberton 1934).

Genus: *Platyscapa* Motschulsky, 1863.

Two females of *Platyscapa desertorum* Compton 1990, the pollinator of *Ficus cordata cordata* Thunberg, were collected at a UV light trap in the Messum Valley (700 m), and one female was collected at light at Wasserfallfläche (2000 m) during April. *Ficus cordata* was far less common on the Brandberg than *Ficus ilicina* (Sonder) Miq., with only a single mature tree located in a ravine south of Wasserfallfläche at 1800 m that had a young A-phase crop of figs. A second juvenile tree without figs was present on the Wasserfallfläche plateau (2000 m).

Genus: *Elisabethiella* Grandi, 1928.

Females and males of *Elisabethiella enriquesi* (Grandi, 1916) were reared from figs of *Ficus ilicina* at Aigab (2300 m). This was the only tree of *F. ilicina* with a fig crop that produced fig wasps. A further 40 trees were located on the Brandberg, none of which had a fig crop at the correct stage of development to release wasps. A single female of *E. enriquesi* was collected in a Malaise trap sited in the Hungorob Ravine (1180 m). The Malaise trap was sited within a population of 26 trees of the host fig *F. ilicina*. Although no ripe fig crops were located on any of these trees, there is the possibility that a fig that was releasing wasps was overlooked. Alternatively pollinators could have arrived from other areas for oviposition into receptive figs.

AGAONIDAE: OTITESELLINAE

Genus: *Otitesella* Westwood, 1883.

A female of an undescribed species of *Otitesella*, previously reared from *Ficus ilicina*, was collected at light at the pools on Wasserfallfläche during October. Three further females of the same species were collected in a Malaise trap sited in the Hungorob Ravine (1180 m) during April. Although no specimens were reared from figs these specimens were collected within a population of their host tree (*vide* discussion under *Elisabethiella enriquesi*). *Otitesella* species are phytophagous, galling the ovule, as do the pollinators (Compton & van Noort 1992). This *Otitesella* species is one of three non-pollinating fig wasps reproducing in figs of *F. ilicina*.

AGAONIDAE: SYCOPHAGINAE

Genus: *Sycophaga* Westwood, 1840.

A female of *Sycophaga sycomori* Linnaeus, 1758, was collected at UV light in Messum Valley (700 m) during April. The host tree of this non-pollinating fig wasp is *Ficus sycomorus*. *Sycophaga* species are phytophagous, galling the ovule, as do the pollinators (Compton & van Noort 1992). This specimen has probably travelled at least 25 km - *vide supra* discussion under *Ceratosolen arabicus*.

AGAONIDAE: SYCORYCTINAE: SYCORYCTINI

Genus: *Sycoryctes* Mayr, 1885.

A female of an undescribed species of *Sycoryctes*, whose host is *F. cordata cordata* was collected in a Malaise trap sited in the Hungorob Ravine

(1180 m) during April. A second *Sycoryctes* female that is associated with *F. ilicina* was collected in the same Malaise trap. *Sycoryctes* species are parasitoids utilising mainly pollinator larvae, but also larvae of other phytophagous fig wasp species that gall the ovule (Compton & van Noort 1992).

AGAONIDAE: SYCORYCTINAE: APOCRYPTINI

Genus: *Apocrypta* Coquerel, 1855.

A female of *Apocrypta longitarus* Mayr, 1906, was collected in a Malaise trap in the Hungorob Ravine (1180 m) during April. The host of *A. longitarsus* is *Ficus sycomorus* and this specimen has also travelled around 25 km – *vide supra* discussion under *Ceratosolen arabicus*. *Apocrypta* species are parasitoids, utilising phytophagous galling fig wasps as hosts (Compton & van Noort 1992).

PTEROMALIDAE

The Pteromalidae is a species rich, cosmopolitan family containing 112 genera in the Afrotropical Region (Noyes 1998).

PTEROMALIDAE: CLEONYMINAE

Genus: *Callocleonymus* Masi, 1940.

One specimen of a *Callocleonymus* species was collected in a Malaise trap in the Hungorob Ravine at 1180 m during April. Eight species of *Callocleonymus* are distributed from Africa through southern Asia and China to New Guinea (Bouček 1988; Noyes 1998). One described species, *C. pulcher* Masi, 1940, is known from the Afrotropical Region (Somalia) and also occurs in the Palaearctic Region, where it has been recorded as a parasitoid of a buprestid beetle (Dzhanokmen & Herthevtzian 1986). Other species are parasitoids of small beetles such as weevils (Curculionidae), living in twigs or bark of trees (Bouček 1988).

Genus: *Zolotarewskya* Risbec, 1956.

A male of *Zolotarewskya* was collected in a Malaise trap in the Hungorob Ravine at 1180 m during April. *Zolotarewskya* is an Old World genus with seven described species (Noyes 1998). There is only a single described species, *Z. seyrigi* Risbec, 1956, recorded from the Afrotropical Region in Madagascar (Risbec 1956), although there are at least two or possibly three undescribed species known from Africa. *Zolotarewskya* has been recorded in association with bark beetles (Scolytidae) in China (Yang 1996).

PTEROMALIDAE: HERBERTIINAE

The subfamily is monotypic, containing the single distinctive genus, *Herbertia*, with nine species that are present throughout the warmer regions of the world (Bouček 1988).

Genus: *Herbertia* Howard, 1894.

A single specimen of an undescribed species of *Herbertia* was sampled in a Malaise trap in the Hungorob Ravine at 1180 m during April. No species have been described from the Afrotropical Region, although a number of undescribed species are known. *Herbertia* species are parasitoids of leaf-mining Diptera (Agromyzidae) or hyperparasitoids of Cecidomyiidae through Pteromalidae (Noyes 1998).

PTEROMALIDAE: DIPARINAE

The subfamily Diparinae is cosmopolitan with 28 species represented by 15 genera occurring in the Afrotropical Region (Hedqvist 1969). Twelve species in 9 genera are known from South Africa (Noyes 1998). The biology of the subfamily as a whole is poorly known, with only one record of an Indian species of *Parurios* Girault, 1913, being reared from a curculionid beetle (Bouček 1988). Based on this record and the fact that the females are apterous, diparines

are likely to be parasitoids of beetles living in or near to leaf litter.

Genus: *Dolichodipara* Hedqvist, 1969.

An undescribed species of *Dolichodipara* was collected in a yellow pan trap on the plateau at Wasserfallfläche, at 1980 m during November. *Dolichodipara* is a monotypic genus represented by *D. scutellata* Hedqvist, 1969. The type specimen of *D. scutellata* was collected at Aus, and is the only described species of diparine recorded from Namibia. A further five undescribed species of *Dolichodipara* are, however, known from the western Cape (South Africa) and one from Gross Spitzkoppe in Namibia. No doubt, there are further unknown species from elsewhere in the western region of southern Africa. In the western Cape the apterous females are commonly collected in yellow pan traps and pitfall traps. The biology of this genus is unknown.

PTEROMALIDAE: ORMOCERINAE

Genus: *Systasis* Walker, 1834.

Fifty-two specimens of a single species of *Systasis* were collected on the Brandberg at all elevations that were sampled, but only in April. Four described species are known from the Afrotropical Region (Somalia, Tanzania, Cameroon and Senegal). The biology is unknown for all these species. Extra-limital species have been recorded as being phytophagous in grass seeds or parasitoids (possibly inquilines) of Cecidomyiidae (Diptera) larvae in galls (Bouček 1988).

This is the most common pteromalid on the Brandberg, conforming to the situation in the Savanna Biome, where *Systasis* can dominate the pteromalid community in terms of abundance, and where sweeping of grasses can produce hundreds of specimens in a relatively short space of time.

PTEROMALIDAE: EUNOTINAE

Genus: *Scutellista* Motschulsky, 1859.

One specimen of a *Scutellista* species was collected in a yellow pan trap in the Messum Valley (700 m), during October. A further three species, all singletons, were collected during April, two in Malaise traps in the Messum Valley and one in a Malaise trap sited in the well-vegetated valley just below Wasserfallfläche at 1960 m. Three described species are known from the Afrotropical Region with the cosmopolitan *S. caerulea* (Fonscolombe, 1832) having been recorded from southern Africa (South Africa) (Noyes 1998). *Scutellista* is an economically important genus parasitising eggs and young larvae of a number of scale insect (Hemiptera: Coccidae) pest species.

PTEROMALIDAE: PTEROMALINAE

Genus: *Pteromalus* Swederus, 1795.

Five species were collected on the Brandberg. Species 1 was collected at Messum Valley, Hungorob Ravine and at Wasserfallfläche during April. Species 2 was collected in the Messum Valley during October, species 3 and 4 in the Hungorob Ravine in April, species 5 in the Messum Valley, Hungorob Ravine and at Wasserfallfläche during October and April. Twenty-one species of this cosmopolitan genus are known from the Afrotropical Region, of which only a single described species, *Pteromalus puparum* Linnaeus, 1758, has been recorded from southern Africa (South Africa) (Noyes 1998). *Pteromalus* species attack a wide variety of hosts, including Diptera, Coleoptera, Lepidoptera and other Hymenoptera.

Genus: *Sphegigaster* Spinola, 1811.

Two species of *Sphegigaster* were sampled in Malaise traps sited in the Messum Valley at 700 m during April. One of these species was also collected in the valley just below Wasserfallfläche at 1960 m during April. *Sphegigaster* is widespread throughout the world with the exception of the Neotropical Region. The genus includes 63 described species, seven of which have been recorded from the Afrotropical Region (Burundi, Egypt, Ethiopia, Madagascar, Rwanda and Tanzania) (Noyes 1998). No described species are known from southern Africa. Species of *Sphegigaster* are parasitoids of leaf-mining flies (Diptera: Agromyzidae) (Bouček 1988).

Genus: *Mesopolobus* Westwood, 1833.

Two species were represented in the material from the Brandberg. Species 1 was collected in a Malaise trap in the Hungorob Ravine during April and species 2 in a Malaise trap in the Messum Valley during April. Five species of *Mesopolobus* have been recorded from the Afrotropical Region, none of which are known from southern Africa (Noyes 1998). *Mesopolobus* species are parasitoids of concealed larvae of Diptera, Hymenoptera and Coleoptera (Bouček 1988).

Genus: *Pachyneuron* Walker, 1833.

A single specimen of a *Pachyneuron* species was sampled in a yellow pan trap in the Messum Valley during October. Four described species are known from the Afrotropical Region, with undescribed species having been recorded in South Africa and Zimbabwe (Noyes 1998). Species of *Pachyneuron* are primary parasitoids of Syrphidae (Diptera), or secondary parasitoids of Homoptera through Hymenoptera or Diptera (Bouček 1988).

Genus: *Dinarmus* Thomson, 1878.

Sweeping collected a single species of *Dinarmus* on the Königstein during April. Fifteen species have been recorded from the Afrotropical Region, two of which, are known from South Africa (Noyes 1998). *Dinarmus* species are parasitoids of seed feeding beetles of the family Bruchidae (Bouček 1988).

Genus: *Callitula* Spinola, 1811.

One species was sampled in the Hungorob Ravine in a Malaise trap during April. Four species of this cosmopolitan genus have been recorded from the Afrotropical Region, none of which, are known from southern Africa (Noyes 1998). *Callitula* species are parasitoids of concealed larvae of the Diptera family Agromyzidae (Bouček 1988).

Genus: *Norbanus* Walker, 1843.

Three species of *Norbanus* were sampled on the Brandberg, all during April. Species 1 was collected in the Messum Valley and Hungorob Ravine, species 2 in the Messum Valley and species 3 in the Hungorob ravine. A single described afrotropical species is known from Malawi (Noyes 1998). *Norbanus* species are parasitoids of dipteran and hymenopteran larvae (Bouček 1988).

Genera indet.

Seven further pteromaline species still await generic identification, but were sorted to morpho-species and included in the species richness analyses.

EURYTOMIDAE

The Brandberg eurytomids that were sampled during this survey all belong to the nominate subfamily, which is an expected outcome,

given the dominance of the Eurytominae (123 species in 16 genera) in the Afrotropical Region. Of the two other generally recognised subfamilies, only Rileyinae is represented in the Afrotropical Region by three species, contained in two genera (Noyes 1998).

EURYTOMIDAE: EURYTOMINAE

Only two described species of Eurytominae have been recorded from Namibia, *Ficomila curtivena* Bouček, 1981 and *Sycophila naso* Bouček, 1981, both reared from galls or figs of *Ficus thonningii* Blume at Gross Otavi (Bouček *et. al.* 1981).

Genus: *Eurytoma* Illiger, 1807.

Seven species of *Eurytoma*, most represented by singletons, were collected across all three sampled altitudes (1180-2470 m) on the Brandberg. Ninety-five described species are known from the Afrotropical Region, with 12 of these recorded from southern Africa (South Africa, Malawi, Mozambique) (Noyes 1998). The majority of *Eurytoma* species are parasitoids, attacking gall-formers, concealed lepidopteran and coleopteran larvae, or are primary or secondary parasitoids of Hymenoptera. A few are phytophagous, developing as seed feeders or stem borers (Bouček 1988).

Genus: *Bruchophagus* Ashmead, 1888.

Two species of *Bruchophagus*, each represented by a single female, were collected at Hungorob Ravine and Wasserfallfläche respectively. Five described species of *Bruchophagus* are known from the Afrotropical Region, but none of these have been recorded from southern Africa (Noyes 1998). *Bruchophagus* species are all phytophagous, feeding on legume seeds (DiGuilio 1997). Some species of both *Tetramesa* and *Bruchophagus* are serious pests of agricultural crops (Bouček 1988; DiGuilio 1997).

Genus: *Tetramesa* Walker, 1848.

A single male of a *Tetramesa* species was collected in the Hungorob Ravine. *Tetramesa* is most specious in the Northern Hemisphere, but there are five described species in the Afrotropical Region, none recorded from southern Aftica (Noyes 1998), and there are at least eight further undescribed species in Africa. Species of *Tetramesa* are phytophagous, developing as gall-formers in grass stems (Bouček 1988).

Genus indet.

Two species each belonging to an unidentified genus were collected in the Messum Valley. A number of males were unplaced and excluded from the analysis.

EUPELMIDAE

Representatives of two eupelmid subfamilies were collected on the Brandberg. The third subfamily (Calosotinae), represented by four genera in the Afrotropical Region, was absent from the Brandberg samples.

EUPELMIDAE: NEANASTATINAE

Twenty-three species of Neanastatinae, contained in the genera *Metapelma* Westwood and *Neanastatus* Girault, are present in the Afrotropical Region.

Genus: *Neanastatus* Girault, 1913.

Two females of a *Neanastatus* species were sampled in Malaise traps sired in the Hungorob Ravine (1180 m, April). Eleven species of *Neanstatus* have been described from the Afrotropical Region, six of which have been recorded from South Africa, none from Namibia (Noyes 1998). One of these, *Neanastatus africanus* Ferrière, 1938, has been reared from

Asphondylia sesmai Felt, 1916 (Diptera: Cecidomyiidae) (Herting 1978).

Genus: *Metapelma* Westwood, 1835.

This genus was not recorded from the Brandberg during this survey, but *M. riparia* Prinsloo, 1985, was described from specimens collected in Namibia during a survey of the lower Kuiseb River course (Prinsloo 1990), and it is likely that representatives of this genus are present on the Brandberg.

EUPELMIDAE: EUPELMINAE

Sixteen eupelmine genera are known from the Afrotropical Region (Gibson 1995), of which seven, represented by females, were sampled during the Brandberg survey. A number of males were also sampled, but they are difficult to identify and to associate with their respective females and as such, were excluded from the species richness analyses.

Genus: *Eupelmus* Dalman, 1820.

Five species of *Eupelmus* (*Episolindelia*) Girault, 1914, were collected on the Brandberg during April. The first four species were all collected in Malaise traps and at light traps in the Messum Valley (700 m) and the Hungorob Ravine (1180 m). Species 3 was also collected at Wasserfallfläche (1960 m). Species 5 was collected in yellow pan traps at Hungorob Ravine and in a Malaise trap in the Messum Valley. Two species of *Eupelmus* (*Macroneura*) Walker, 1837, were collected, one from the Hungorob Ravine and the second from Königstein (2470 m). Two species of *Eupelmus* (*Eupelmus*) Dalman, 1820, were swept, one each from the Hungorob Ravine and Wasserfallfläche.

All three subgenera of *Eupelmus* are cosmopolitan, with *E.* (*Episolindelia*) most specious in the Old World. The majority of *Eupelmus* species are primary or secondary parasitoids of holometabolous insects. A wide range of orders are attacked, but within these groups it is usually species that are concealed in a plant gall, seed, pod, or a cocoon (Gibson 1995).

Genus: *Anastatus* Motschulsky, 1859.

Two species of *Anastatus (Anastatus)* Motschulsky, 1859, were collected, one in the Messum Valley and the other at Wasserfallfläche. Twenty-five described species of *Anastatus* are known from the Afrotropical Region, of which, one is known from South Africa and one from Mozambique, but with none yet recorded from Namibia (Noyes 1998). The majority of species of the nominare subgenus are endoparasitoids of a broad range of insect eggs. A few species have been reared as hyperparasitoids of lepidopteran eggs through Hymenoptera and as parasitoids of Coleoptera larvae and Diptera pupae (Gibson 1995).

Genus: *Arachnophaga* Ashmead, 1896.

A female of an *Arachnophaga* (*Parasolindenia*) Brues, 1907, species was collected at Wasserfallfläche (1980 m, Nov.) in a yellow pan trap. Two species of *Arachnophaga* (*Parasolindenia*) have been described from the Afrotropical Region: *Arachnophaga aptera* (Brues, 1907), from South Africa and *A. platycephala* (Risbec, 1952), from Madagascar (G.A.P. Gibson pers. comm.; Noyes 1998). The subgenus *Parasolindenia* is represented by 11 species occurring in Africa and western Europe (Gibson 1995). Two species of *Eupelmella* described from the Afrotropical Region also belong to *Arachnophaga* (*Parasolindenia*) and await transfer (G.A.P. Gibson pers. comm.). In addition to the two described species, at least another three undescribed species are known from the Afrorropical Region. Species of this subgenus are parasitoids of Mantodea oothecae, gall-forming lepidopteran pupae, and dipteran puparia (Gibson 1995).

Genus: *Reikosiella* Yoshimoto, 1969.

A single female of *Reikosiella* (*Hirticauda*) Boucek, 1988, was collected in a Malaise trap sited in the Hungorob Ravine (1180 m). A single species, *Reikosiella (Capreocauda) tsaratananae* (Risbec, 1952), has been described from the Afrotropical Region (Madagascar), with no described species of the subgenus *Hirticauda* recorded from the region. Three described Madagascan eupelmids need, however, to be transferred to this subgenus (G.A.P. Gibson pers. comm.). The biology of the genus is virtually unknown, although a few reared individuals suggest that lepidopteran larvae are the hosts (Gibson 1995).

Genus: *Calymmochilus* Masi, 1919.

A species of *Calymmochilus* was recorded from a Malaise trap at Wasserfallfläche (1960 m). There are nine described species of *Calymmochilus* known from the Indo-Australasian and Palaearctic Regions (Noyes 1998). No described species have been recorded, although at least one undescribed species is known from the Afrotropical Region (Gibson 1995). Biology of the genus is largely unknown. The two known host records indicate that concealed scolytid beetle larvae and pseudoscorpions (Arachnida) living under rocks are used as hosts (Austin *et al.* 1998; Gibson 1995).

Genus: *Brasema* Cameron, 1884.

Three species of *Brasema* were collected, two at Wasserfallfläche (1960 & 2000 m) and one at Hungorob Ravine (1180 m). *Brasema* is a cosmopolitan genus with a single described species, *B. seyrigi* (Risbec, 1952), known from the Afrotropical Region (Madagascar). The genus is most specious in the New World. Species of *Brasema* are primary or hyperparasitoids of a wide range of holometabolous insects that conceal themselves in a gall or cocoon. A few species are parasitoids of insect eggs (Gibson 1995).

Genus: *Mesocomys* Cameron, 1905.

A single female of a *Mesocomys* species was collected in the Hungorob Ravine (1180 m). A single species, *M. pulchriceps* Cameron, 1905, is known from the Afrotropical Region (South Africa), where it has been reared from the eggs of a number of species of saturniid moths. The remaining six species are found in the Oriental and Palaearctic Regions (Noyes 1998).

ELASMIDAE

The family is represented by a single cosmopolitan genus, *Elasmus*, with 29 species recorded from the Afrotropical Region (Noyes 1998).

Genus: *Elasmus* Westwood, 1833.

Six species, represented by females were sampled on the Brandberg (Messum Valley, Hungorob Ravine and Wasserfallfläche all in April – one male was collected in October). Two males were also collected, but because it is difficult to associate the sexes, the males were excluded from the analysis. Four species of *Elasmus* occur in southern Africa, three in South Africa, and one in Zimbabwe (Noyes 1998). Most species of *Elasmus* are gregarious, ectoparasitoids of the larvae or prepupa of Lepidoptera that conceal themselves in leaf mines, leaf rolls, webs or cases; some species are hyperparasitoids of Ichneumonoidea species that are parasitoids of Lepidoptera (Coote 1997).

ENCYRTIDAE

The Encyrtidae is one of the largest families of the Chalcidoidea, comprising more than 3 500 species in about 470 genera worldwide (Noyes 1998). The family has its highest diversity in tropical and subtropical areas and is known from the Afrotropical Region, from some

719 described species and 140 genera. Very few of these genera are endemic to this region, the majority being either cosmopolitan or widespread throughout the Old World. Likewise, many of the species found within the Afrotropical Region are widely distributed and also found in other parts of the world, especially the Palaearctic and Oriental Regions. These distributional trends are also evident among the specimens collected on the Brandberg, many of which represent well-known cosmopolitan genera, and species that are widely distributed in southern Africa and further afield.

The Encyrtidae, the species of which are mostly internal parasitoids of other insects, spiders, mites and ticks, includes two subfamilies, the Encyrtinae and Tetracneminae. Both these subfamilies are found in the Afrotropical Region and are also represented by the 28 genera and numerous species from the Brandberg that are recorded here.

ENCYRTIDAE: ENCYRTINAE: ANTHEMINI

Genus: *Anthemus* Howard, 1896.

This Old World genus of armoured scale insect parasitoids comprises 20 species, 11 of which have been recorded from the Afrotropical Region. The genus appears to be especially well represented in southern Africa, from where nine species have been described, including *A. affinis* Prinsloo & Neser, 1989, and *A. aiaisanus* Prinsloo & Neser, 1989, from Namibia (Prinsloo & Neser 1989). A single female specimen, the identity of which could not be determined because of insufficient study material, is here recorded from the Hungorob Ravine.

ENCYRTIDAE: ENCYRTINAE: APHYCINI

Genus: *Aphycus* Mayr, 1876.

This genus, which is found in all zoogeographic regions except the Neotropics, includes a single afrotropical species, namely *A. comperei* (Annecke, 1963), from the Kalahari sandveld in South Africa. An unknown species is here recorded from a single female specimen collected at Wasserfallfläche and is one of several undescribed species found in southern Africa and other parts of the continent. Where hosts are known, species of *Aphycus* are all primary parasitoids of mealybugs (Hemiptera: Pseudococcidae).

Genus: *Homalotylus* Mayr, 1876.

A female specimen of a single species, which is here tentatively identified as *H. africanus* Timberlake, 1919, was collected in the Messum Valley. *Homalotylus* has a worldwide distribution and comprises some 40 species, two of which, namely *H. africanus* and *H. flaminius* (Dalman, 1820), are known from southern Africa. Both these species have previously been recorded from Namibia (Prinsloo 1985a), from Gobabeb in the central Namib Desert. As in other species of the genus, *A. africanus* is a primary parasitoid of Coccinellidae (Coleoptera) larvae.

Genus: *Metaphycus* Mercet, 1917.

More than 70 species of this extensive cosmopolitan genus are known from the Afrotropical Region, including southern Africa, from where, a large number of species have been described. Included in the southern African fauna are seven species from Namibia (Annecke & Mynhardt 1981; Prinsloo 1985a). The specimens from the Brandberg appear to represent three different species of *Metaphycus*, none of which could be

identified to species level because of inadequate material. The majority of the species of this genus are parasitic in soft scale insects (Hemiptera: Coccidae), although several other scale insect families, such as Diaspididae, Kerriidae, Eriococcidae and Asterolecaniidae, are also attacked (Prinsloo 1997).

ENCYRTIDAE: ENCYRTINAE: BOTHRIOTHORACINI

Genus: *Cerchysiella* Girault, 1914.

A female specimen of an apparently undescribed species of this genus was collected at Wasserfallfläche. Approximately 20 species of this cosmopolitan genus are currently known four of which have been recorded from the Afrotropical Region, but none from Namibia. Although species of this genus are commonly encountered, only two have thus far been described from southern Africa (Subba Rao 1972). Where hosts are known, species of *Cerchysiella* are parasitic in the larvae of the coleopteran families Nitidulidae, Erotylidae and Silvanidae and apparently also fruit flies (Diptera: Tephritidae).

ENCYRTIDAE: ENCYRTINAE: CERAPTEROCERINI

Genus: *Cerapterocerus* Westwood, 1833.

This genus is represented in the Brandberg material by a single undescribed species, collected in the Hungorob Ravine and at Wasserfallfläche. This species closely resembles the widely distributed *C. mirabilis* Westwood, 1833, the only other species of the genus recorded thus far from the Afrotropical Region. *Cerapterocerus*, which is almost cosmopolitan in distribution, includes 10 species, all of which are probably hyperparasitoids *via* other species of Encyrtidae. Secondary hosts include various coccoids of the families Coccidae, Pseudococcidae and Aclerdidae (Prinsloo 1997).

ENCYRTIDAE: ENCYRTINAE: CHEILONEURINI

Genus: *Cheiloneurus* Westwood, 1833.

This large cosmopolitan genus of hyperparasitoids includes nine described afrotropical species, four of which are known from southern Africa. One of these, namely *C. kuisebi* Prinsloo, 1985, was described from the Kuiseb River in the central Namib desert and is the only species of the genus recorded so far from Namibia (Prinsloo 1985a). *Cheiloneurus kuisebi* is here recorded from the Brandberg from a large number of specimens collected in the Messum and Hungorob Ravines and at Wasserfallfläche. Apart from having been collected in the Kuiseb River canyon on the grass *Cladoraphis spinosa* (L. f.) (Poaceae), the host of this species remains unknown.

A second species of *Cheiloneurus*, which appears to be undescribed but closely resembling *C. obscurus* Silvestri, 1915, from East Africa, is represented by a single female specimen collected at Wasserfallfläche.

Genus: *Prochiloneurus* Silvestri, 1915.

Included in the material from the Brandberg, is an undetermined species of *Prochiloneurus* that was collected in the Hungorob Ravine and at Wasserfallfläche. The two available female specimens closely resemble *P. aegyptiacus* (Mercet, 1929), and may in fact belong to that species, although further study material is required in order to confirm their identity. *Prochiloneurus aegyptiacus* is known from many other parts of the world, including elsewhere in Africa, Europe and Asia and has also been previously recorded from Namibia, from the Kuiseb River canyon in the central Namib Desert (Prinsloo 1985a). Species of *Prochiloneurus* are hyperparasitoids of other Encyrtidae; secondary

hosts are mainly species of mealybugs, but also soft scale insects (Coccidae) and immature stages of Coccinellidae (Coleoptera) (Prinsloo 1997).

ENCYRTIDAE: ENCYRTINAE: COPIDOSOMATINI

Genus: *Copidosoma* Ratzeburg, 1844.

Several female specimens of an unidentified species of *Copidosoma* were collected in the Messum and Hungorob Ravines and at Wasserfallfläche. Although commonly encountered, as polyembryonic parasitoids of Lepidoptera larvae, little is known about the afrotropical fauna of this large cosmopolitan genus, which includes more than 200 described species. Apart from *C. koehleri* Blanchard, 1940, which was introduced into South Africa for the biological control of the potato tuber moth, *Pthorimaea operculella* (Zeller, 1873), (Lepidoptera: Gelechiidae) the genus is otherwise known only from a number of unidentified species, and it has not been previously recorded from Namibia.

Genus: *Paratetracnemoidea* Girault, 1915.

An undescribed species of *Paratetracnemoidea* was recorded from the Messum and Hungorob Ravines. This small genus, which includes only four described species, is known from the Nearctic, Palaearctic, Oriental, Australasian and Afrotropical Regions. The genus has not been recorded from Namibia before and is known from a single afrotropical species, namely *P. cornis* Prinsloo, 1986, which was described from South Africa (Prinsloo 1986). The biology of the genus is unknown.

ENCYRTIDAE: ENCYRTINAE: ENCYRTINI

Genus: *Encyrtus* Latreille, 1809.

A single species, namely *E. fuliginosus* Compere, 1940, was recorded from both sexes from the Hungorob Ravine. Apart from the Brandberg, *E. fuliginosus* has also been recorded from Windhoek in Namibia (Prinsloo 1991) and is otherwise known as a widespread primary parasitoid of species of *Saissetia, Coccus* and other soft scale insects in southern Africa, while also occurring in East Africa and Madagascar. *Encyrtus*, a well known cosmopolitan genus of coccid parasitoids, is known from 14 afrotropical species that were revised by Prinsloo (1991).

ENCYRTIDAE: ENCYRTINAE: ECHTHROPLEXIELLINA

Genus: *Mayridia* Mercet, 1921.

Mayridia includes approximately 30 species and although most of these are from the Palaearctic Region, the genus is found throughout the world. The afrotropical fauna is still poorly known and the only described species from the region are *M. arida* Prinsloo & Annecke, 1976 and *M. maryae* Prinsloo, 1985, both of which are known only from Gobabeb in the central Namib Desert (Prinsloo & Annecke 1976; Prinsloo 1985a). A third species from Namibia, which is undescribed and closely allied to *M. arida*, is here recorded from two female specimens from the Messum Valley. Species of *Mayridia* are parasitoids of Pseudococcidae and Aclerdidae (Hemiptera: Homoptera).

ENCYRTIDAE: ENCYRTINAE: HABROLEPIDINI

Genus: *Adelencyrtus* Ashmead, 1900.

A female specimen of an unidentified species of *Adelencyrtus* was sampled at Wassefallfläche. Further study material is required to determine the identity of the Brandberg material, which probably belongs to *A. inglisiae* Compere & Annecke, 1961, a widespread afrotropical species previously recorded from Namibia from the Kuiseb River canyon in the central Namib Desert (Prinsloo 1990). *Adelencyrtus inglisiae*, as in other

species of this cosmopolitan genus, is parasitic in various species of armoured scale insects of the family Diaspididae (Hemiptera: Homoptera) (Annecke & Mynhardt 1970a).

Genus: *Habrolepis* Foerster, 1856.

Habrolepis occidua Annecke & Mynhard, 1970, is here recorded from a single female specimen, sampled at Wasserfallfläche. This widespread southern African species was originally described from South Africa and Namibia and was previously recorded from the latter country from Windhoek, as a parasitoid of a species of *Pseudotargionia* Lindinger, 1912 (Homoptera: Diaspididae) on *Acacia hebeclada* DC. (Fabaceae) (Annecke & Mynhardt 1970a). *Habrolepis*, the species of which are all parasitic in armouted scale insects (Diaspididae), has a cosmopolitan distribution and is commonly encountered throughout the Afrotropical Region, from where 11 species have been recorded. Apart from *H. occidua*, two further species, namely *H. namibensis* Prinsloo & Annecke, 1976, and *H. obscura* Compere & Annecke, 1961, are also known from Namibia. *Habrolepis namibiensis* was described from southern Namibia as a parasitoid of *Namaquea simplex* Munting, 1969 (Homoptera: Diaspididae) (Prinsloo & Annecke 1976) whereas *H. obscura* is a widespread southern African parasitoid of various species of Diaspididae (Annecke & Mynhardt 1970b).

ENCYRTIDAE: ENCYRTINAE: MICROTERYINI

Genus: *Ooencyrtus* Ashmead, 1900.

Ooencyrtus is a large, commonly encountered cosmopolitan genus, comprising more than 150 species, the 33 sub-Saharan species of which were revised by Prinsloo (1987). Although many of the African species are widely distributed on the continent, the genus has not been previously recorded from Namibia. Five species, all of which appear to be undescribed, are included among the encyrtid material from Wasserfallfläche and the Hungorob and Messum Valleys. The majority of *Ooencyrtus* species are parasitic in eggs of Hemiptera, Lepidoptera and Coleoptera, some also attack the larvae and pupae of various insect groups whereas others are hyperparasitoids (Prinsloo 1987).

Genus: *Syrphophagus* Ashmead, 1900.

This cosmopolitan genus comprises about 70 species, five of which have been documented from the Afrotropical Region. Although four of these species are known from southern Africa, the genus has not been previously recorded from Namibia. Included in the material from the Hungorob and Messum Valleys, are a number of female specimens of an undetermined species closely allied to *S. nigrocyaneus* Ashmead, 1904, a widespread parasitoid of Syrphidae (Diptera), known from South Africa and also Japan (Annecke 1969).

ENCYRTIDAE: ENCYRTINAE: TRECHNITINI

Genus: *Psyllaephagus* Ashmead, 1900.

Psyllaephagus is represented in the Brandberg material by a single undescribed species that closely resembles *P. callainus* Prinsloo, 1981, from South Africa. Of the 20 southern African species of this large cosmopolitan genus, only *P. vastus* Prinsloo, 1981 and *P. io* Prinsloo, 1985, both of which are from the central Namib desert, are known from Namibia (Prinsloo 1981, 1985a). All species of *Psyllaephagus* are parasitic in the nymphs of Psyllidae (Homoptera), some being hyperparasitoids.

ENCYRTIDAE: TETRACNEMINAE: AENASIINI

Genus: *Aenasius* Walker, 1846.

A single female specimen, representing an undescribed species near *Aenasius comperei* (Kerrich, 1967), was collected at Wasserfallfläche. The aforementioned species, which is widely distributed in Africa and known from Namibia from Karibib, is one of four afrotropical species of this genus (Prinsloo 1988). *Aenasius*, the species of which are all endoparasitoids of mealybugs, is also found in many other regions, especially the New World.

ENCYRTIDAE: TETRACNEMINAE: ANAGYRINI

Genus: *Anagyrus* Howard, 1896.

Three species of this well-known cosmopolitan genus are here recorded from the Brandberg. The identity of one of these species remains unknown, the remaining two being: *A. rubellus* (Annecke, 1974) and *A. subflaviceps* (Girault, 1915). *Anagyrus rubellus*, a parasitoid of the mealybug *Oxyacanthus chrysocomae* (Brain, 1915) (Homoptera: Pseudococcidae), was previously known only from South Africa. *Anagyrus subflaviceps*, which is commonly associated with grasses and probably parasitic in grass-inhabiting mealybugs, is very widely distributed, having previously been recorded from South Africa and Zimbabwe, as well as several countries in the Palaearctic and Indo-Pacific Regions. Other species of *Anagyrus*, known from Namibia include *A. siccus* (Prinsloo & Annecke, 1976), which was described from Otavi, and *A. amnicus* Prinsloo, 1985, from the central Namib Desert (Prinsloo 1998).

Genus: *Anomalicornia* Mercet, 1921.

Several female specimens of an undetermined species of *Anomalicornia* were collected in the Hungorob Ravine and at Wasserfallfläche. Although their identity could not be determined with certainty, they probably belong to *A. tenuicornis* Mercet, 1921, the only known species of this genus. *Anomalicornia tenuicornis* is found throughout the Old World and also in North America and previously recorded from southern Africa from Zimbabwe by Noyes & Hayat (1994). This encyrtid is commonly associated with grasses and has been recorded as a parasitoid of *Eriococcus* Targioni, 1868, an eriococcid genus that is also found in southern Africa.

Genus: *Apoleptomastix* Kerrich, 1982.

This genus, which is distributed throughout the Afrotropical, Oriental and Australasian Regions, is known from two afrotropical species (Kerrich 1982), one of which, namely *A. bicoloricornis* (Girault, 1915), is here recorded from Messum Valley. Although not previously recorded from Namibia, this species is widely distributed thoughout Africa and also found in Australia and the Oriental Region (Noyes & Hayat 1994). Species of *Apoleptomastix*, including *A. bicoloricornis*, are commonly associated with grasses (Poaceae) and known to be parasitic in grass-inhabiting mealybugs.

Genus: *Callipteroma* Motschulsky, 1863.

Two species of this Old World genus, namely *C. sexguttata* Motschulsky, 1863, and *C. testacea* Motschulsky, 1863, were found: the former from Wasserfallfläche, the latter from the Hungorob Ravine. Both these species are commonly found throughout the Afrotropical Region (including

southern Africa) and many other parts of the Old World, with *C. testacea* having been recorded from Namibia before (Noyes & Hayat 1994). Although little is known about the biology of the genus, species of *Callipteroma* are usually associated with grasses and are probably all parasitic in grass-inhabiting mealybugs, as in the case of the two species mentioned above.

Genus: *Leptomastidea* Mercet, 1916.

An undescribed species, which was collected in the Hungorob Ravine, is one of several new afrotropical species of this Old World genus. Although the genus is commonly encountered throughout southern Africa, where it is represented by several undescribed species, the only described species from the area is *L. abnormis* (Girault, 1915). This species is a Mediterranean parasitoid that was introduced to South Africa for the biological control of the vine mealybug, *Planococcus ficus* (Signoret, 1875). As in the case of *L. abnormis*, all species of *Leptomastidea* are parasitic in mealybugs (Noyes & Hayat 1994).

Genus: *Leptomastix* Foerster, 1856.

Three species of the cosmopolitan genus *Leptomastix* are here recorded from the Brandberg. The specific identity of two of these species remains unknown while the third, which was collected in the Messum Valley and at Königstein, has been identified as *L. tsukumiensis* Tachikawa, 1963, a widespread species found throughout Africa and in various other regions of the Old World (Anga & Noyes 1999). Of the 11 afrotropical species of *Leptomastix*, eight are known to occur in southern Africa. Apart from *L. tsukumiensis*, the only other species that has thus far been recorded from Namibia is *L. nigra* Compere, 1938, which was collected at Helmeringhausen and Otavi (Anga & Noyes 1999). These two species are, as in all other species of the genus, exclusively parasitic in mealybugs.

Genus: *Rhopus* Foerster, 1856.

This genus is represented by two brachypterous female specimens, one from the Hungorob Ravine, the other from Wasserfall-fläche. They probably represent two distinct undescribed species, but additional specimens are required in order to determine their specific identity. *Rhopus* is a cosmopolitan genus containing about 50 species, eight of which were described by Prinsloo (1989) from southern Africa. Although these are the only species thus far recorded from Africa, the genus is known to occur throughout the continent. Included among the southern African fauna is one species from Namibia, namely *Rhopus adustus* Prinsloo, 1989, that was described from Khorixas as a parasitoid of mealybugs (probably *Paracoccus mutabilis* De Lotto, 1964) on *Welwitschia mirabilis* Hook f (Welwitschiaceae). As in the case of *R. adustus*, all species of *Rhopus* are endoparasitoids of mealybugs especially those associated with Poaceae.

ENCYRTIDAE: TETRACNEMINAE: CHARITOPIDINI

Genus: *Charitopus* Förster, 1856.

This Old World genus, which is known mainly from Europe and Asia, comprises about 15 species, of which only one, namely *C. fulviventris* Foerstet, 1860, is known from the Afrotropical Region. This species was originally described from Europe and, apart from having been recorded from South Africa, is also known from the Oriental Region (Prinsloo 1979). The genus is here recorded for the first time from Namibia, from two species collected at Wasserfallfläche. One of these species is undescribed, the other probably representing *C. fulviventris*, although further taxonomic study is required to determine the true identity of the Brandberg specimens. The hosts of species of

Charitopus are unknown, but are thought to be mealybugs, especially those species that are associated with Poaceae and shrubs.

Genus: *Clausenia* Ishii, 1923.

Clausenia is known from the Palaearctic, Oriental, Pacific and Afrotropical Regions and comprises only 11 species, seven of which are from the last mentioned region, mainly from southern and West Africa (Annecke & Mynhradt 1970b; Kerrich 1967). The genus is here recorded for the first time from Namibia from three undetermined species, two of which were collected in the Hungorob Ravine and at Wasserfallfläche, the third from Königstein. Further matertial is required in order to determine their specific identity, but it would appear that at least one is undescribed. Species of *Clausenia* are exclusively parasitic in mealybugs.

ENCYRTIDAE: TETRACNEMINAE: TETRACNEMINI

Genus: *Tetracnemus* Westwood, 1837.

Although the genus *Tetracnemus* occurs in all the zoogeographical regions of the world, it is known from southern Africa and the remainder of the Afrotropical Region, from underermined and unrecorded material only. The Brandberg material is represented by a single apparently undescribed species (collected at Wasserfallfläche), which is also known from South Africa. Little is known about the biology of this genus although all species are probably parasitic in mealybugs.

APHELINIDAE

The Aphelinidae is one of the smaller families of the Chalcidoidea, comprising only about 34 genera and 1100 species worldwide. The afrotropical fauna comprises 18 genera (260 species), the majority of which are cosmopolitan, or at least found in various other parts of the world. The species collected on the Brandberg are represenred by seven genera, all of which are cosmopolitan and commonly encountered rhoughout the African continent, including southern Africa. Although the specific identity of most of these species remains unknown because of insufficient study material they are, as in the case of the majority of other aphelinid species, known from southern Africa, probably nor being endemic to the area.

Aphelinids are primary or secondary internal and external parasitoids with a preference for hosts belonging to the Homoptera. The family comprises six subfamilies (Hayat 1998), three of which, namely the Aphelininae, Azotinae and Coccophaginae, are represented by the seven genera recorded from the Brandberg.

APHELINIDAE: APHELININAE: APHYTINI

Genus: *Aphytis* Howard, 1900.

Aphytis is an extensive cosmopolitan genus of about 130 species, 41 of which are known from the Afrotropical Region. The taxonomy and biogeography of the afrotropical fauna was recently reviewed by Prinsloo & Neser (1994), who recorded two species from Namibia, namely *A. vastus* Prinsloo & Neser, 1994, from Hochfelt in the eastern part of the country, and *A. cercinus* Compere, 1955, a widespread southern African species. The genus is here recorded from the Brandberg from a single male specimen of an apparently undescribed species collected at Wasserfallfläche. Species of *Aphytis*, many of which play an important rôle in biological control, are all primary endoparasitoids of armoured scale insects (Prinsloo & Neser 1994).

Genus: *Marietta* Motschulsky, 1863.

This cosmopolitan genus is known from eight southern African species (Annecke & Insley

1972) of which two, namely *M. leopardina* Motschulsky, 1863 and *M. connecta* Compere, 1936, have previously been recorded from Namibia, from the central Namib Desert (Prinsloo 1985a). Both these species, in addition to *M. marchali* Mercet, 1929, were not previously known from Namibia, are here recorded from the Brandberg, where they were all collected at Wasserfallfläche. *Marietta leopardina* has an almost cosmopolitan distribution and is, apart from southern Africa, also known from the Palaearctic, Oriental, Nearctic and Neotropical Regions, while *M. marchali* appears to be widely distributed in the Afrotropical Region. *Marietta connecta* has to date been only recorded from southern Africa, where in addition to Namibia, it is also found in South Africa, Zimbabwe and Mozambique. Species of *Marietta* are hyperparasitoids that are commonly associated with mealybugs and various groups of scale insects, as well as psyllids. Their primary hosts often include encyrtids and other species of Aphelinidae.

APHELINIDAE: APHELININAE: ERETMOCERINI

Genus: *Eretmocerus* Haldeman, 1850.

The Brandberg material is represented by a single female specimen of an unidentified species of this genus that was collected in the Messum Valley. *Eretmocerus,* which has a worldwide distribution, is known from the Afrotropical Region from fewer than ten species and has not been previously recorded from Namibia (Noyes 1998). Species of *Eretmocerus* are exclusively parasitic in white flies (Homoptera: Aleyrodidae) and play an important rôle in the biological control of these pests.

APHELINIDAE: AZOTINAE

Genus: *Ablerus* Howard, 1894.

Several specimens of both sexes of *Ablerus capensis* (Howard, 1907), were collected in the Hungorob Ravine and at Wasserfallfläche. This species, which is one of six species of *Ablerus* that are known from southern Africa, is widespread in the sub-region and has also previously been documented from Namibia, from the Kuiseb River in the central Namib Desert (Prinsloo 1985a). *Ablerus capensis* is parasitic in a variety of armoured scale insects (Diaspididae), lack insects (Kerriidae) and wax scales (Coccidae) (Annecke & Insley 1970). These coccoids probably serve as secondary hosts since species of *Ablerus* are, as far as is known, hyperparasitoids.

APHELINIDAE: COCCOPHAGINAE: COCCOPHAGINI

Genus: *Coccophagus* Westwood, 1833.

More than 200 species of the commonly encountered cosmopolitan genus have been described, about 60 of which are known to occur in the Afrotropical Region (Annecke & Insley 1974). Many of these species are widely distributed throughout southern Africa and are also found in Namibia, but they have not been documented in the literature from the latter country. Three species, all collected at Wasserfallfläche, are here recorded from the Brandberg, but additional specimens are required to determine their specific identity. Species of *Coccophagus* are endoparasitic in coccoids of various families, with a preference for soft scale insects. Males are generally hyperparasitoids, some even developing on the females of their own species.

APHELINIDAE: COCCOPHAGINAE: PHYSCINI

Genus: *Coccobius* Ratzeburg, 1852.

Coccobius is found throughout the world and includes more than 70 species, nine of which are known from southern Africa. Prinsloo (1995), documented a single species from Namibia, namely *C. pullus* Prinsloo, 1995, and revised the fauna from the sub-region. It was recorded from *Welwitschia* as a parasitoid of an

armoured scale insect on *Catophractes alexandri*. The Brandberg material has yielded a second species from Namibia. It is represented by one female specimen, from Wasserfallfläche, that probably belongs to *C. binotatus* Prinsloo, 1995, previously known from the Western Cape Province of South Africa as a parasitoid of the diaspidid *Entaspidiotus lounsburyi* (Marlatt, 1908). Further specimens are, however, required in order to determine the specific identity of the Brandberg specimens with certainty. Species of *Coccobius* have unusual host relationships in that females develop as primary endoparasitoids of coccoids, while males are either ectophagous or endophagous hyperparasitoids of their own or other hymenopterous species (Prinsloo 1995).

APHELINIDAE: COCCOPHAGINAE: PTEROPTRICINI

Genus: *Encarsia* Foerster, 1878.

Encarsia is one of the largest and most common aphelinid genera, comprising more than 200 species worldwide. Although the genus is also commonly encountered throughout Africa it is still very poorly known from this region, including southern Africa where the identity of the many species that occur in this area remains unknown. Included among the material from the Brandberg are three unidentified species, two of which are from the Hungorob Ravine, the third from Wasserfallfläche. As far as is known, species of this extensive genus are all endoparasitoids of armoured scale insects (Diaspididae) or white flies (Aleyrodidae).

EULOPHIDAE

The Eulophidae is divided into four subfamilies, all of which are represented in the Afrotropical Region, where a diverse, but largely unknown fauna is to be found.

Genera indet.

At least fifty specimens still await generic identification and sorting to morpho-species. Hence all the Eulophidae have been excluded from the species richness analyses.

EULOPHIDAE: ENTEDONINAE

Genus: *Omphale* Haliday, 1833.

A good series of males and females of an *Omphale* species were reared from *Ficus ilicina* leaf galls. Species of this cosmopolitan genus are endoparasitoids of gall midges (Diptera: Cecidomyiidae), suggesting that midges are the primary gallers on the leaves. Unfortunately, the parasitism rate was 100% with no midges emerging, preventing confirmation of the host. Only a single described species, *O. gallicola* Risbec, 1952, has been recorded from the Afrotropical Region (Madagascar) (Noyes 1998).

Genus: *Pediobus* Walker, 1846.

At least one species of *Pediobius* was collected on the Brandberg at Wasserfallfläche during November. Forty-nine species of this cosmopolitan genus are known from the Afrotropical Region, with none yet recorded from Namibia. *Pediobius* species are primary or hyperparasitoids of a range of insect orders, but mainly the Lepidoptera, Coleoptera, Diptera and Hymenoptera (Bouček 1988).

EULOPHIDAE: TETRASTICHINAE

Genus: *Tamarixia* Mercet, 1924.

At least three species of *Tamarixia* were collected in the Hungorob Ravine and at Wasserfallfläche during October and November. *Tamarixia* species are parasitoids of Psylloidea (Bouček 1988). Three species of this cosmopolitan genus are known from the Afrotropical Region, all of which are present in

southern Africa, but none yet specifically recorded from Namibia (Noyes 1998).

PERILAMPIDAE

The Perilampidae contains three subfamilies, Chrysolampinae, Perilampinae and Philomidinae, which are represented by eight genera and 39 species in the Afrotropical Region (Noyes 1998). Only representatives of the Perilampinae were sampled on the Brandberg.

PERILAMPIDAE: PERILAMPINAE

Genus: *Perilampus* Latreille, 1809.

A male and female of a *Perilampus* species were swept in the valley below Wasserfallfläche (1960 m) during April. A second female of the same species was collected in a Malaise trap sited in the Hungorob Ravine (1180 m) during April. *Perilampus* is a cosmopolitan genus, comprising 144 described species, 20 of which occur in the Afrotropical Region. Five species are known from southern Africa, all recorded from South Africa and one also from Zimbabwe (Noyes 1998).

Species of *Perilampus* use a wide diversity (representatives of at least eight orders) of insect taxa as hosts and are both primary and hyperparasitoids (Darling 1997). Eggs are laid on vegetation and the first instar larva, which is a mobile planidium, has to locate the host itself (Darling 1997). A South African species, *Perilampus rostratus* Kerrich, 1954, develops as a hyperparasitoid through four species of ichneumonoid wasps that attack the Karoo caterpillar, *Loxostege frustalis* (Zeller) (Prinsloo 1980). *Perilampus maurus* Walker, 1852 (South Africa, Zimbabwe), is a parasitoid of *Carcella* (*Senometopia) evolans* (Wiedemann, 1830) (as *Senometopia*) (Diptera: Tachinidae) (Thompson 1958).

TETRACAMPIDAE

The Tetracampidae are very poorly known from the Afrotropical Region, with four genera and five described species recorded from Africa and Madagascar. *Cassidocida* is represented by a single described species from Senegal (Risbec 1951); *Tetracampe* by two species from Senegal and Uganda (Ferrière 1938; Risbec 1951); *Platynocheilus* by an extra-limital species from Algeria and Egypt; *Epiclerus* by a single species from Madagascar (Risbec 1952). The family is divided into two subfamilies, the Tetracampinae including the previously mentioned genera and with the following genera also present in Africa: *Foersterella* Dalle Torre (at least two undescribed species) and *Diplesiostigma* Girault (two undescribed species) (Boucek 1988). The subfamily Platynocheilinae has only been recorded from Africa by unpublished records (Prinsloo 1980).

Genus: *Epiclerus* Haliday, 1844.

A female of an *Epiclerus* species was collected in a yellow pan trap 500 m SW of Hungorob mouth at an altitude of 700 m during October. A female of a second species of *Epiclerus* was collected in a Malaise trap in the Messum Valley at 700 m during April. *Epiclerus* is represented by at least five undescribed species in Africa. Species of *Epiclerus* are parasitoids of dipteran leaf miners (Agromyzidae) (Bouček 1988). The species of *Epiclerus* from Madagascar has been reported to be a parasitoid of the pupae of Diptera mining in the leaves of *Plectronia* DC (=*Canthium* Lam., Rubiaceae) (Prinsloo 1980).

SIGNIPHORIDAE

This is a small cosmopolitan family, whose species range in size from 0.5-2.0 mm, many of which are infrequently collected (Woolley 1988).

Genus: *Signiphora* Ashmead, 1880.

Four species of *Signiphora*, represented by six specimens were collected on the Brandberg during this survey. Two females of species 1 (probably belonging to the *S. coleoptratus* species-group), were trapped in yellow pans, one on the north-east side of the Hungorob Ravine at 1200 m during October and the other at Wasserfallfläche (1980 m) during November. Two females of species 2 (*S. flavopalliata* species-group), were sampled in yellow pans, one on the plateau at 1960 m during October and the other in Hungorob Ravine at 1180 m during April. A male of species 3 (*S. flavopalliata* species-group) was sampled in a yellow pan on the Wasserfallfläche plateau at 1960 m during October. One male of species 4 (*S. flavopalliata* species-group), was collected in a yellow pan trap in the Messum Valley (700 m, April). One species of *Signiphora* has been recorded from Tanzania, one of only five described species of this family known from the Afrotropical Region (Noyes 1998). The remaining four species belong to the genus *Chartocerus* Motschulsky, 1859. Species of the *S. coleopterous* species-group are hyperparasitoids of Pseudococcidae (Homoptera) and those of the *S. flavopalliata* species-group are mostly primary or secondary parasitoids of Diaspididae and Aleyrodidae (Homoptera) (Woolley 1997).

MYMARIDAE

Twenty-seven genera represented by 129 species of this species rich, cosmopolitan family are known from the Afrotropical Region (Noyes 1998). No described species have been recorded from Namibia, but this is simply a function of lack of collecting. Fifteen species are known from South Africa. A proportion of the specimens from this survey have been identified to generic level and currently five genera are present, but because the identification is incomplete the Mymaridae have been excluded from the species richness analyses.

Genus: *Alaptus* Westwood, 1839.

This genus is represented by a single species on the Brandberg, trapped at Wasserfallfläche 1980 m, during November and Königstein (2470 m) during April. Five described species of *Alaptus* are known from the Afrotropical Region, none of which have yet been recorded from southern Africa (Noyes 1998). Species of *Alaptus* have been recorded as egg parasitoids of Cicadellidae (Hemiptera) and Psocoptera (Noyes 1998).

Genus: *Anagrus* Haliday, 1833.

A single species has so far been recorded from the Brandberg at Messum Valley (700 m), Hungorob Ravine (1180 m) and at Wasserfallfläche (1960 m). Fourteen described species of this genus are known from the Afrotropical Region, two of which have been recorded from South Africa (Noyes 1998). *Anagrus* species are egg parasitoids of the hemipteran families Cercopidae, Cicadellidae, Delphacidae, Diaspididae and Tingidae (Noyes 1998).

Genus: *Stephanodes* Enock, 1909.

A single species was collected on the Brandberg, with the majority of specimens trapped at Hungorob Ravine (1180 m) during April, but also at Messum Valley (700 m) and Wasserfallfläche (1960 m). There are five described species of *Stephanodes* known from the Palaearctic, Nearctic, Neotropical and Oriental Regions (Noyes 1998). None have yet been described from the Afrotropical Region. Host biology is unknown.

Genus: *Erythmelus* Enock, 1909.

A single species of *Erythmelus* was collected on the Brandberg in the Messum Valley and on Königstein (2470 m). Two species of this genus have been recorded from the Afrotropical

Region, one of which is from South Africa (Noyes 1998). *Erythmelus* species have been recorded as egg parasitoids of the hemipteran families Cicadellidae, Miridae and Tingidae, and the moth families Tortricidae, Pyralidae, Lymantriidae and Lasiocampidae, and of the hymenopteran family Tenthredinidae (Noyes 1998).

Genus: *Gonatocerus* Nees, 1834.

Approximately 10 species of the *Gonatocerus litoralis* species-group were collected on the Brandberg at all elevations. Twenty-nine species have been recorded from the Afrotropical Region, none of which are yet known from southern Africa. *Gonatocerus* species are egg parasitoids of homopterans, particularly Cicadellidae; and less commonly flies (Diptera), moths (Lepidoptera) and sawflies (Hymenoptera) (Noyes 1998).

Genus: *Dicopus* Enock, 1909.

A single species of *Dicopus* was collected at Wasserfallfläche (1960 m). This is a small (11 species worldwide) cosmopolitan genus with only a single described species, *D. lilliput* Mathot, 1972, known from the Democratic Republic of the Congo in the Afrotropical Region (Noyes 1998).

Genus: *Chaetomymar* Oglobin, 1946.

A single species was collected at Wasserfallfläche (1960 m) and in the Messum Valley (700 m). *Chaetomymar* is another small, cosmopolitan genus with seven described species. Two species, *C. gracile* Prinsloo, 1986, and *C. lepidum* Annecke & Doutt, 1961, have been described from the Afrotropical Region (both South Africa). Species of *Chaetomymar* are egg parasitoids of Cicadellidae (Hemiptera) and Lepidoptera (Noyes 1998).

Genus: *Polynema* Haliday, 1833.

A single specimen was collected at Wasserfallfläche. *Polynema* is a species rich, cosmopolitan genus with 25 described species known from the Afrotropical Region, of which only one, *P. brevicarina* Annecke & Doutt, 1961, is known from southern Africa (South Africa) (Noyes 1998). *Polynema* species are egg parasitoids of a wide range of families in a number of insect orders (Hemiptera, Diptera, Lepidoptera and Hymenoptera).

TRICHOGRAMMATIDAE

Sixty-seven species, representing 22 genera, have been described from the Afrotropical Region (Noyes 1998). No described species have been recorded from Namibia, although with 14 species known from South Africa undoubtedly some of these species will be present in Namibia. The lack of records is a function of under collecting and past absence of inventory surveys. Seven genera represented by 10 species were recorded on the Brandberg during this survey.

Genus: *Tumidiclava* Girault, 1911.

Two males and 24 females of species 1 were collected in yellow pan traps at Hungorob Ravine (1200 m, Oct.); Hungorob-Mulde (1980 m, Nov.); Wasserfallfläche (1980 m, Oct., Nov.); and the Messum Valley 700 m, Oct.). One female of species 2 was collected in a yellow pan trap at Hungorob Ravine (1200 m, Oct.). *Tumidiclava* is a cosmopolitan genus with a single species, *T. nowickii* Viggiani, 1996, recorded from the Afrotropical Region (Cape Verde Islands). Extra-afrotropical species have been recorded as moth (Pyralidae, Cossidae, Noctuidae) egg parasitoids (Noyes 1998).

Genus: *Paracentrobia* Howard, 1897.

Paracentrobia species 1 was represented by 24 females collected in yellow pan traps and two

females collected in Malaise traps during April across all sampled elevations: Messum Valley (700 m); Hungorob Ravine (1180 m); Wasserfallfläche (1960 m); Königstein (2470 m). Two males and three females of species 2 were sampled in yellow pan traps at Wasserfallfläche (1960 m) during April, at Wasserfallfläche (1980 m) during November and Messum Valley (700 m) during October. A male and female of species 3 were collected in Hungorob Ravine (1200 m) and Wasserfallfläche (2000 m) during October. *Paracentrobia* species are cosmopolitan, with two species described from the Afrotropical Region (Egypt and Uganda) (Noyes 1998). The biology of the African species is unknown, but elsewhere, species of *Paracentrobia* have been recorded as egg parasitoids of Cicadellidae and Membracidae (Hemiptera), Diopsidae (Diptera) and Noctuidae (Lepidoptera) (Noyes 1998).

Genus: *Aphelinoidea* Girault, 1911.

Twenty-three females of an *Aphelinoidea* species were collected in yellow pan traps and Malaise traps during April at Messum Valley 700 m; Hungorob Ravine (1180 m); Wasserfallfläche (1960 m) and one female was collected in a yellow pan trap during October at Hungorob Ravine (1200 m). Only undescribed species of this cosmopolitan genus have been recorded from the Afrotropical Region. *Aphelinoidea* species are egg parasitoids of Hemiptera and Coleoptera (Noyes 1998).

Genus: *Oligosita* Walker, 1851.

Nine females of an *Oligosita* species were collected during April in Malaise traps, yellow pan traps and sweep samples at Messum Valley (700 m); Hungorob Ravine (1180 m) and Königstein (2470 m). *Ologosita* is a species rich, cosmopolitan genus with ten species described from the Afrotropical Region. A single described species is known from southern Africa (South Africa), where it has been recorded as an egg parasitoid of Tropiduchidae (Hemiptera) (Noyes 1998).

Genus: *Ufens* Girault, 1911.

One male and two females of an *Ufens* species were collected at Hungorob Ravine (1200 m October) and Wasserfallfläche (1980 m, November). Another cosmopolitan genus centered in the Indo-Australasian Region, with a single described species recorded from the Afrotropical Region (Egypt). *Ufens* species are egg parasitoids of the insect orders Hemiptera, Coleoptera, Lepidoptera and symphytan Hymenoptera (Noyes 1998).

Genus: *Mirufens* Girault, 1915.

Three males of a *Mirufens* species were collected in Malaise traps at Wasserfallfläche (1960 m) during April. This is an Old World genus, not previously recorded from the Afrotropical Region, although a specimen has been collected in South Africa and one in Madagascar (J. Pinto pers. comm.). The genus has seven described species worldwide, which are egg parasitoids of Cicadellidae (Hemiptera) (Noyes 1998).

Genus indet.

A single female of an unknown genus was collected in a Malaise trap at Wasserfallfläche (1960 m) during April.

CYNIPOIDEA

EUCOILIDAE

This cosmopolitan family contains 21 genera and at least 161 species in the Afrotropical Region (Quinlan 1986, 1988). Two genera and three species were collected on the Brandberg. Eucoilids are endoparasitoids of larvae (emerging from the puparia) of cyclorrhaphous Diptera (Quinlan 1986; Ritchie 1993).

Genus: *Nordlanderia* Quinlan, 1986.

Two males and two females of an undescribed species of *Nordlanderia* were collected in the

Hungorob Ravine (1180 m, April) and at Wasserfallfläche (1960 m, April). A female of a second undescribed species of *Nordlanderia* was collected at Wasserfallfläche (1960 m, April). *Nordlanderia* is restricted to the Afrotropical Region with three described species. *Nordlanderia acis* Quinlan, 1986, has been recorded from Namibia (Swakopmund) and South Africa. The remaining two species are more widespread, ranging from South Africa to West Africa, although neither has been recorded from Namibia (Quinlan 1986). The biology of *Nordlanderia* species is unknown.

Genus: *Glauraspidia* Thomson, 1862.

A single female of an undescribed species of *Glauraspidia* was collected in the Messum Valley (700 m, April). Two species of *Glauraspidia* have been recorded from the Afrotropical Region with three species present in Europe (Quinlan 1988). *Glauraspidia casca* Quinlan, 1988, is only known from the Seychelles and *G. scyphus* Quinlan, 1988, has been recorded from Ivory Coast, Zaire, Zambia and Zimbabwe (Quinlan 1988). The biology of *Glauraspidia* species is unknown.

CHARIPIDAE

The Charipidae contains two subfamilies, Alloxystinae and Charipinae, with five genera and approximately 200 species (Menke & Evenhuis 1991). Only representatives of the Charipinae were collected on the Brandberg.

CHARIPIDAE: CHARIPINAE

Two genera, *Apocharips* Fergusson and *Dilyta* Förster and eight species are presently known in this subfamily. Two species have been recorded from the Afrotropical Region. *Apocharips peraptera* (Silvestri, 1915), is known from Eritrea and Ethiopia and *Dilyta africana* (Benoit, 1956), is known from the Democratic Republic of the Congo (formerly Zaire).

Genus: *Dilyta* Förster, 1869.

Ten specimens of a *Dilyta* species were mostly collected at Wasserfallfläche (1950-1980 m, October, Nov., April), with one specimen from the Hungorob Ravine (1180 m, April). Eight of the specimens were collected during April indicating that the species is more abundant during the wet season. Collection data indicates that the species is usually restricted to the higher lying areas (1950-1980 m) of the Brandberg, but the species appears to expand its distribution range to lower altitudes (1180 m) under more favourable conditions during the wet season.

Species of Charipinae are hyperparasitoids of Psylloidea (Homoptera) through Encyrtidae (Chalcidoidea) (Hérard 1986; Menke & Evenhuis 1991).

PROCTOTRUPOIDEA

DIAPRIIDAE

As there are no modern keys to world genera, Kieffer's (1916) key being obsolete, and with no taxonomic work having been undertaken on the afrotropical fauna since then, it is futile to attempt a generic identification on the Brandberg fauna. Eight species were sampled, the majority of specimens collected in yellow pan traps during April, with a number procured in Malaise traps and a few at light and in sweep samples. Species 1 was collected at Messum Valley, Hungorob Ravine and Wasserfallfläche during April. Species 2 was collected at Messum Valley and Hungorob Ravine (November, April). Species 3 to 6 were collected at Messum Valley and Hungorob Ravine (April). Species 7 and 8 were collected at Wasserfallfläche (April and November respectively).

PLATYGASTROIDEA

PLATYGASTRIDAE

The family contains two cosmopolitan subfamilies Sceliotrachelinae and Platygastrinae

(Masner 1993a). Very little work has been undertaken on the afrotropical fauna with the majority of species undescribed. Many of the genera are insufficiently delimited, making it difficult to identify specimens even to generic level. *Synopeas bicolor* Sundholm, 1970, and *S. nigerrimus* Sundholm, 1970, were recorded from Namibia during a survey of the lower Kuiseb River course (Prinsloo 1990). Most of the Sceliotrachelinae are parasitoids of coleopteran and homopteran eggs, whilst the species of Platygastrinae are parasitoids of Cecidomyiidae (Diptera) (Masner 1993a).

PLATYGASTRIDAE: PLATYGASTRINAE

Genus: *Inostemma* Haliday, 1833.

Two species, represented by three specimens, of this genus were collected on the Brandberg. Species 1 was trapped in the Messum Valley during October and April; species 2 was collected at Wasserfallfläche during April. *Inostemma* is a cosmopolitan genus with numerous undescribed species that are parasitoids of gall midges (Cecidomyiidae) (Masner & Huggert 1989).

Genera indet.

A further eight species still await generic identification. These were collected at Messum Valley, Hungorob Ravine and at Wasserfallfläche during October and April. A number of males were not placed to species, because the sexes are difficult to correlate, and hence these specimens were excluded from the species richness analyses.

SCELIONIDAE

Scelionids were well represented in the Brandberg samples. Only the single genus, *Baeus*, has so far been identified. *Breviscelio crenatus* Sundholm, 1970, *Gryon fulviventre* (Crawford, 1912), and *G. saxatile* (Kieffer, 1910) were recorded from Namibia during a survey of the lower Kuiseb River course (Prinsloo 1990), and it is likely that these genera are also represented in the samples collected on the Brandberg. *Nixonia pretiosa* Masner, 1958, an archaic scelionid, was described from a single female collected at Okahandja (Masner 1958).

Genus: *Baeus* Haliday, 1833.

Four females of a species of the cosmopolitan genus *Baeus* were collected in yellow pan traps in the Hungorob Ravine (1180 m, April). Species of *Baeus* are extremely sexually dimorphic, with winged males that have a normal body shape, and females that are always apterous with a compact, rounded body form. All species are parasitoids of spider eggs and females have been observed riding on egg sacs carried by females of *Pardosa* Koch, 1847 (Araneae: Lycosiidae) in California (Masner 1976). The morphological form of the female is an adaptation to facilitate movement in leaf litter or soil (Austin 1988), and has been hypothesised also to be an adaptation to penetrate the silk egg sacs of their host spiders (Austin 1985).

Genera indet.

More than 500 specimens of Scelionidae still await generic identification and sorting to morpho-species. These were excluded from the species richness analyses.

CERAPHRONOIDEA

MEGASPILIDAE

This is a cosmopolitan family containing about 450 described species with an estimated species richness of 1000 species (Masner 1993b).

Genus indet.

Two species, not yet identified to genus level, were sampled on the Brandberg. The first species was represented by four specimens collected at Messum Valley, Hungorob Ravine and

Wasserfallfläche during November and April. A single specimen of a second species was collected in the Messum Valley during April. The biology of this family is not well known; some species are parasitoids of Homoptera, Neuroptera, or Diptera and others are hyperparasitoids of Aphidiidae (Homoptera) through Aphidiinae (Braconidae) (Masner 1993b).

CERAPHRONIDAE

The Ceraphronidae is a cosmopolitan family with about 360 described species, although species richness of the family is estimated to be closer to 1000 species (Masner 1993b). Two genera were sampled during this survey on the Brandberg, although it is doubtful whether *Aphanogmus* is distinct from *Ceraphron* (Sundholm 1970).

Genus: *Aphanogmus* Thomson, 1858.

Aphanogmus was represented by 19 species. The majority of *Aphanogmus* specimens were collected at Wasserfallfläche (1960 m), with a number also from the Messum Valley (700 m) and a few from Hungorob-Mulde (1913 m) and Hungorob Ravine (1180 m).

Genus: *Ceraphron* Jurine, 1807.

Five species of *Ceraphron* were collected in the Mesum Valley, Hungorob Ravine and at Wasserfallfläche. Yellow pan traps were the most effective method followed by Malaise traps. A few specimens were collected at light traps, during sweeping and from Winkler bag extraction of leaf litter.

CHRYSIDOIDEA

PLUMARIIDAE

Four genera are contained in this family, two from South America and two in southern Africa, with less than a total of 20 described species (Brothers 1974; Day 1977; Finnamore & Brothers 1993). Species of Plumariidae only occur in arid regions, with the described genera mostly known from winged male specimens (Day 1977). The apterous females are only known in the South American genus *Plumarius* Philippi, 1873 (Brothers 1974; Day 1977).

Genus: *Myrmecopterina* Bischoff, 1914.

Numerous specimens, all males, of *Myrmecopterina filicornis* Bischoff, 1914, were collected at UV light traps and in Malaise traps in the Messum Valley (700 m), at Wasserfallfläche (1960-2000 m) and at Königstein (2470 m). *Myrmecopterina filicornis* is known from both Namibia (Asab, Aus, Gobabeb and Okahandja) and South Africa. It was surmised by Day (1977), that the southern African plumariids are diurnal. This was based on the premise that *Myrmecopterinella okahandja* Day, 1977, was only sampled during the day and that no plumariids were taken at light during more than two months of trapping in Namibia by the British Museum (Natural History) southern African expedition, 1972. The abundance of specimens collected from light traps during the present survey, in conjunction with an older record of specimens from light traps run at Gobabeb, is compelling evidence for the nocturnal habits of this species.

Genus: *Myrmecopterinella* Day, 1977.

This is a monotypic genus, with no specimens of *Myrmecopterinella okahandja* Day, 1977, collected on the Brandberg. The genus is included as it is endemic to Namibia, being known only from specimens sampled at Okahandja by the British Museum (Natural History) southern African Expedition, 1972 (Day 1977). Specimens were collected in Malaise traps during the day and thus, in contrast to the evidence of nocturnal behaviour of *Myrmecopterina filicornis*, gained during the present survey, are surmised to be diurnal (Day 1977).

SCLEROGIBBIDAE

This small cosmopolitan family is represented by eleven species in eight genera distributed in arid and semi-arid habitats (Argaman 1988; Finnamore & Brothers 1993; Koch 1995). Five species in five genera are known from the Afrotropical Region, two of which have been recorded from southern Africa: *Tanynotus rufithorax* Cameron, 1904 (South Africa) and *Neosclerogibba uhligi* Koch, 1995 (Argaman 1988; Koch 1995). Sclerogibbidae are ectoparasitoids of Embioptera nymphs, with pupation occurring in the host web (Argaman 1988; Finnamore & Brothers 1993).

Genus: *Lithobiocerus* Bridwell, 1919.

Two male specimens that have putatively been identified as *Lithobiocerus vagabundus* Bridwell, 1919, were collected at UV light traps on the Brandberg, one sited at Hungorob-Mulde (1913 m, Nov.) and the other in the Messum Valley (700 m, Oct.). *Lithobiocerus vagabundus* is known from Ceylon, Hawai'i, India, Israel, and Togo, but only Somalia in the Afrotropical Region (Argaman 1988). Because of the extreme sexual dimorphism (males are winged and females are apterous) in this family, there is the possibility that these males are congeneric with the female of *Neosclerogibba uhligi* Koch, 1995 (*vide infra*).

A number of sclerogibbid species that formerly had a localised distribution are now widespread as a result of the transport of their host species throughout the tropics. Two such species are *Oligotoma saundersii* Westwood, 1837, and *O. nigra* Hagen, 1866, originally from the Indian subcontinent (Argaman 1988). The latter is a recorded host of *L. vagabundus*.

Genus: *Neosclerogibba* Koch, 1995.

No specimens of this endemic Namibian genus were collected during the present survey. This is a monotypic genus with the species, *Neosclerogibba uhligi* Koch, described from a single female collected in the Kaokoveld at Ogongo Falls.

DRYINIDAE

A cosmopolitan family with 58 genera and about 1000 species contained in 11 subfamilies, seven of which are present in the Afrotropical Region (Finnamore & Brothers 1993). *Bocchus bini* Olmi, 1984, *Gonatopus johnsi* Olmi, 1984, and *Tridryinus ampuliciformis* (Turner, 1928), were recorded from Namibia during a survey of the lower Kuiseb River course (Prinsloo 1990). Dryinids are parasitoids of Homoptera, particularly the families Cicadellidae, Delphacidae and Flatidae (Finnamore & Brothers 1993).

Genera indet.

Five species, represented by females, were collected on the Brandberg. A number of species of males were also collected, but because it is not possible to correlate the sexes these were excluded from the species richness analyses. Three specimens of species 1 were sampled in the Hungorob Ravine at UV light traps in October and November. Five specimens of species 2 were sampled with a UV light trap run at Wasserfallfläche during April. A single specimen of species 3 was collected in a yellow pan trap at Wasserfallfläche during April. Four specimens of species 4 were trapped in Malaise traps, or swept in the Messum Valley, Hungorob Ravine and at Wasserfallfläche during April. Species 5 was represented by two specimens collected in Malaise traps at Wasserfallfläche and Königstein during April.

BETHYLIDAE

More than 100 specimens of Bethylidae were collected on the Brandberg. These still await generic identification and sorting to morpho-species, and hence have been excluded from the species richness analyses.

CHRYSIDIDAE

The Chrysididae includes four subfamilies of which two - Amiseginae and Chrysidinae - are present in the Afrotropical Region (Finnamore & Brothers 1993). Only members of the Chrysidinae were collected on the Brandberg during this survey, which produced forty-six specimens belonging ro the two tribes Elampini and Chrysidini.

CHRYSIDIDAE: ELAMPINI

Genus: *Hedychridium* Abeille, 1878.

This is an almost cosmopolitan genus (only absent from the Australasian Region) with highest diversity in the arid areas of southern Africa and the Holarctic Region, and is the second largest chrysidid genus (Kimsey & Bohart 1990). Six species of *Hedychridium*, represented by eight specimens were collected in yellow pan traps and Malaise traps in the Messum Valley (700 m) during October, November and April. No specimens were collected at any of the higher altitudes on the Brandberg. Forty-six described species are known from the Afrotropical Region (Kimsey & Bohart 1990). Five of these species have been recorded from Namibia namely, *Hedychridium arnoldi* Arnold, 1940 (Okahandja); *H. desertorum* Kimsey, 1988 (Namib-Naukluft Park); *H. fulgidum* Kimsey, 1988 (Namib-Naukluft Park); *H. lomholdti* Kimsey, 1988 (Kuiseb River); *H. namibianum* Kimsey, 1988 (Namib-Naukluft Park). The biology of rhis genus is poorly documented. Known records include ground nesting Sphecidae (*sensu lato*) (Hymenoptera) and bees (Kimsey & Bohart 1990).

Genus: *Omalus* Panzer, 1801.

Omalus is another widespread genus that occurs in all regions, with the exception of the Australasian Region, with highest species richness in the Holarctic Region. Three specimens of a single species were collected in Malaise traps sited in the Hungorob Ravine during April. Of the twenty described species in the world, two occur in the Afrotropical Region (Democratic Republic of the Congo, Uganda and Madagascar) with no species previously recorded from Namibia. Species of *Omalus* are parasitoids of wasps in the family Pemphredonidae (Kimsey & Bohart 1990).

CHRYSIDIDAE: CHRYSIDINI

Genus: *Chrysis* Linnaeus, 1761.

The genus *Chrysis* is the largest in the Chrysididae, containing as many species as the resr of the Chrysididae combined (Kimsey & Bohart 1990). One hundred and seventy-six species are known from the Afrotropical Region, with at least 13 species known from Namibia, although many of the widespread species will undoubtedly also occur there (Kimsey & Bohart 1990). *Chrysis delicatula* Dahlbom, 1854, and *C. stilboides* Spinola, 1838, were recorded from Namibia during a survey of the lower Kuiseb River course (Prinsloo 1990). Nineteen species, represented by 33 specimens, were sampled in Malaise traps and yellow pan traps on the Brandberg. There appears to be a degree of seasonal emergence with six species only being collected in October and seven species only in April. Species that were represented by a number of specimens showed a range of altitude tolerances, although none were spread across the entire elevational scope. Host biology is unknown for the majority of species, but Sphecidae (*sensu lato*), vespids and megachilids have been recorded as hosts (Kimsey & Bohart 1990).

Genus: *Praestochrysis* Linsenmaier, 1959.

Praestochrysis contains 44 species, of which 27 are known from the Afrotropical Region. None are known from Namibia, but no doubt some of the 11 recorded southern African species shall also occur in Namibia. A single species, repre-

sented by two specimens was collected in Malaise traps at Wasserfallfläche and Hungorob Ravine during November and April respectively. The majority of host records are of limacodid moths, although two species parasitise sphecids and eumenids respectively (Kimsey & Bohart 1990).

VESPOIDEA

RHOPALOSOMATIDAE

This is a widespread family, with the exception of the Palaearctic Region, containing approximately 34 species in four genera (Brothers & Finnamore 1993). Rhopalosomatids are ectoparasitoids of crickets (Orthoptera: Gryllidae) (Townes 1977). Two of the four known genera are present in the Afrotropical Region: *Olixon* Cameron, 1887, and *Paniscomima* Enderlein, 1904 (Townes 1977). No rhopalosomatids were collected on the Brandberg during this survey, but the family is included here because a species has previously been recorded from Namibia.

Genus: *Paniscomima* Enderlein, 1904.

Paniscomima erlangeriana Enderlein, 1904, a widespread afrotropical species was recorded from Otavifontein in Namibia.

BRADYNOBAENIDAE

The Bradynobaenidae includes four subfamilies, only one of which is present in the Afrotropical Region.

BRADYNOBAENIDAE: APTEROGYNINAE

The Apterogyninae also occur in the Palaearctic and Oriental Regions and currently includes about 80 species (Brothers & Finnamore 1993). Eleven described species of Apterogyninae are currently known from Namibia with a further 15 new species under description (G. Pagliano pers. comm.). The hosts of Apterogyninae are unknown.

Genus: *Micatagla* Argaman, 1994.

An undescribed species of *Micatagla* was the most common species collected. All five specimens were males and were collected in Malaise traps sited in the Messum Valley (700 m), Hungorob Ravine (1180 m) and at Wasserfallfläche (1960 m) during April. This species is only known from one other specimen collected on Ameib Farm, 19 miles NW of Karibib (G. Pagliano pers. comm.), which places the locality in the Erongoberge, approximately 100 km south west of the Brandberg. A female of an undetermined *Micatagla* species was collected in a yellow pan in the Messum Valley (700 m, October). *Micatagla schultzei* (André, 1909), was recorded from Namibia during a survey of the lower Kuiseb River course (Prinsloo 1990). Six other described species and seven undescribed species are known from Namibia (G. Pagliano pers. comm.).

Genus: *Gynecaptera* Skorikov, 1935.

A female of an undescribed species of *Gynecaptera* was collected in a yellow pan trap in the Messum Valley (700 m, October). This species of *Gynecaptera* is only known from one other female collected at Bethanien (G. Pagliano pers. comm.), which is almost on the southern border of Namibia, about 600 km south east of the Brandberg. A male of a possible new species of *Gynecaptera* (G. Pagliano pers. comm.) was collected in Malaise traps in the Messum Valley (700 m, April). A further undescribed species is also known from Namibia represented by a single male collected at Aus (G. Pagliano pers. comm.).

Genus: *Apterogyna* Latreille, 1809.

A male of a possible new species of *Apterogyna* nr. *nadezdae* Invrea, 1965 (G. Pagliano pers.

comm.) was collected in Malaise traps in the Messum Valley (700 m, April). *Apterogyna nadezdae* is known from Cameroun and Senegal. A further three described and five undescribed species are known from Namibia (G. Pagliano pers. comm.).

Genus: *Macroocula* Panfilov, 1954.

The fourth genus *Macroocula* was not collected during this survey. This genus is represented by a single species in Namibia, *M. meridiooccidentalis* (Bischoff, 1920), that is widespread in southern and western Namibia (G. Pagliano pers. comm.).

POMPILIDAE

The Pompilidae is a cosmopolitan family containing three subfamilies: Pepsinae, Pompilinae and Ceropalinae (Brothers & Finnamore 1993). Over 60 genera are known from southern Africa (Brothers 1985). Twenty-four species contained in 13 genera were recorded from Namibia during a survey of the lower Kuiseb River course (Prinsloo 1990). Eleven species of Pompilinae and two species of Ceropalinae were trapped on the Brandberg during this survey.

POMPILIDAE: PEPSINAE

This cosmopolitan subfamily contains some of the largest pompilids. Representatives were observed on the Brandberg, but no specimens were collected by hand net or trapped. Species of the genus *Hemipepsis* Dahlbom, 1844, are conspicuous in flight as many produce a rattling noise, are large, and usually black with orange wings. *Hemipepsis* species attack baboon spiders (Araneae: Theraphosidae) and rain spiders (Araneae: Heteropodidae), paralysing the spider, dragging it to a suitable site for nest excavation in the soil and then ovipositing on the prey before concealment in the burrow.

POMPILIDAE: POMPILINAE

The Pompilinae is another cosmopolitan subfamily that is as species rich as the Pepsinae. Two species dominate the Brandberg fauna. Thirteen specimens of species 1 were trapped in Malaise and yellow pan traps sited in the Messum Valley, Hungorob Ravine and at Wasserfallfläche during October, November and April. Species 2 was represented by 20 specimens collected in Malaise traps and yellow pans, mostly from the Hungorob Ravine in April, but there were also representatives from Messum Valley and Wasserfallfläche and a few collected during October. The remaining 9 species were mostly represented by single specimens trapped either in the Messum Valley, Hungorob Ravine, or at Wasserfallfläche. One species was collected on Königstein at 2470 m. Most species of Pompilinae utilise paralysed spiders concealed in burrows for the development of their offspring; a few are ectoparasitoids of living spiders.

POMPILIDAE: CEROPALINAE

This is a small cosmopolitan subfamily. Two species, each represented by a single specimen, were collected in Malaise traps sited in the Messum Valley during October and April. The majority of ceropaline species are kleptoparasites, ovipositing on the paralysed prey of other pompilids; a few are ectoparasitoids of living spiders (Brothers 1985; Brothers & Finnamore 1993).

TIPHIIDAE

The Tiphiidae is a cosmopolitan family that is most species rich in the tropics, including approximately 1500 species in seven subfamilies (Brothers & Finnamore 1993). Four of these, subfamilies - Anthoboscinae, Myzininae, Methochinae, Tiphiinae - are present in the Afrotropical Region (Brothers 1985). Repre-

sentatives of the Anthoboscinae, Myzininae and Tiphiinae were sampled on the Brandberg.

TIPHIIDAE: ANTHOBOSCINAE

This is a worldwide subfamily with the exception of the Oriental Region. Larvae are probably ectoparasitoids of beetle larvae (Coleoptera: Scarabaeoidea) (Brothers & Finnamore 1993).

Genus indet.

A single species represented by six females was collected in the Messum Valley and Hungorob Ravine during April.

TIPHIIDAE: MYZININAE

This cosmopolitan family includes 12 genera, whose larvae usually parasitise Scarabaeoidea larvae, but also Cicindelinae (Carabidae) or Cerambycidae larvae (Brothers & Finnamore 1993).

Genus indet.

Five species represented by males and one species represented by females were trapped. Sexual dimorphism is usually extreme in this subfamily, hence it was not possible to associate the female with any of the males. Consequently the collection data represented by the female has been excluded from the species richness analyses. Species 1 was collected in Malaise traps in the Hungorob Ravine during October, Wasserfallfläche during October and November. Species 2 was collected in Malaise traps in the Hungorob Ravine and Wasserfallfläche during October, November and April. Species 3 was collected in the Hungorob Ravine during April. Species 4 was collected at Messum Valley, Hungorob Ravine and Wasserfallfläche during April. Species 5 was collected in the Messum Valley during April. The last species represented by females was collected in the Messum Valley, Hungorob Ravine and at Wasserfallfläche during October, November and April.

TIPHIIDAE: TIPHIINAE

A cosmopolitan family represented by 9 genera. Larvae of tiphiine species are ectoparasitoids of beetle larvae (Coleoptera: Scarabaeoidae) (Brothers & Finnamore 1993).

Genus indet.

Three species, two represented only by females, were collected. Sexual dimorphism is slight which made it possible to correlate the males with one of the species represented by a female. The first species was collected at Wasserfallfläche in Malaise traps (numerous males), yellow pan trap (single female) and by sweeping (single male) during April. Two females of the second species were collected in yellow pans in the Messum Valley. The third species, represented by a single female, was trapped in a yellow pan at Königstein during April.

SCOLIIDAE

A cosmopolitan family that has highest species richness in tropical areas. There are around 300 species contained in the subfamilies Scoliinae and Proscoliinae. Only the Scoliinae are represented in the Afrotropical Region, the Proscoliinae being palaearctic in distribution (Brothers & Finnamore 1993).

SCOLIIDAE: SCOLIINAE

Genus indet.

Two species were collected. A single specimen of species one was collected in a Malaise rrap sited at Wasserfallfläche during October. The second species, represented by four specimens was collected in Malaise traps and yellow pans in the Hungorob Ravine during April. Spe-

cies of the Scoliinae are ectoparasitoids of beetle larvae in the superfamilies Scarabaeoidea and Curculionoidea (Brothers & Finnamore 1993).

MUTILLIDAE

MUTILLIDAE: TICOPLINAE

The Ticoplinae is an afrotropical (excluding Madagascar), palaearctic (restricted to the Iberian peninsula and southern shores of the Mediterranean) and oriental (India) subfamily, and is represented by four genera (Brothers 1975), including less than 100 species (Brothers & Finnamore 1993). There is essentially no life history or host relationship information available for the Ticoplinae (Brothers 1975).

Genus: *Smicromyrmilla* Suárez, 1965.

Smicromyrmilla species 1 (represented by six males), was collected in both the Messum Valley (700 m) and at Wasserfallfläche (1950-2000 m) during October and November, but only in the Messum Valley during April. A single male of species 2 was collected in the Messum Valley (700 m) during April. *Smicromyrmilla* is the most specialised of the ticopline genera and is the most widespread, occurring in Spain, India and Africa (Brothers 1975).

Genus: *Nanomutilla* André, 1901.

Nanomutilla species 1 (represented by 13 males), was only sampled at Wasserfallfläche (1913-2000 m), during October, November and April. Species 2 (represented by five males), was sampled at 700 m in the Messum Valley during April and at Wasserfallfläche (1960-2000 m) during October, November and April. These species are nocturnal, both having been collected at UV light traps on the Brandberg.

MUTILLIDAE: RHOPALOMUTILLINAE

This is an afrotropical and oriental subfamily, containing four described genera and less than 50 species (Brothers 1975; Brothers & Finnamore 1993).

Genus: *Rhopalomutilla* André, 1901.

A single male of a *Rhopalomutilla* species was sampled in the Hungorob Ravine (1180 m) during April.

Genus nov.

Three males of a new genus of Rhopalomutillinae were sampled in a Malaise trap in the Messum Valley (700 m) during April.

MUTILLIDAE: SPHAEROPTHALMINAE: DASYLABRINI

Genus: *Tricholabiodes* Radoszkoweski, 1885.

Four species of *Tricholabiodes* were collected on the Brandberg. Ten specimens of *T. thisbe* (Péringuey, 1898), were all collected at a high altitude, between 1913-2000 m, at Wasserfallfläche and Hungorob-Mulde during October, November and April at UV light traps. In contrast, six specimens of *T. lividus* André, 1909, were only collected in the Messum Valley (700 m, October & April - light trap and Malaise trap). The remaining two species are both undescribed. Eight specimens of the first new species were collected in the Messum Valley (700 m, Oct.), Hungorob Ravine (1180 m, Oct., April) and Wasserfallfläche (1950-2000 m, Oct., Nov.) at UV light and in a Malaise trap. Fifty-eight specimens of the second new species were collected across all sampled altitudes from the Messum Valley (700 m), Hungorob Ravine (1200 m) to Wasserfallfläche at 2000 m, all at UV light.

Two specimens were collected in Malaise traps sited in the Messum Valley and Hungorob Ravine during April, which is an unusual capture method for the genus. The remaining 80 specimens were all collected using UV light traps. The predominance of specimens from light traps is consistent with the previous experience of other collectors (Bayliss & Brothers 1996). Of several genera of nocturnal Mutillidae, *Tricholaboides* is the only one recorded from southern Africa (Bayliss & Brothers 1996) (but see *Nanomutilla* above for a new record). The genus occurs in the semi-arid and arid regions of Africa and the palaearctic. In southern Africa the genus is restricted to the Nama-karoo, Succulent Karoo, Desert and arid Savanna Biomes in the western half of the sub-region. Females are apterous and often associated with dry riverbeds, where they search cracks and crevices during the night, and hide in pre-existing burrows during the day. Although fully winged the males prefer running with their wings folded and when they do fly it is in hops, landing every few meters. A comprehensive account of the biology and habits of *T. thisbe* and *T. livida* is provided by Bayliss & Brothers (1996).

MULTILLIDAE: MYRMILLINAE

Genera nov.

Representatives of two puratively undescribed genera of Myrmillinae were collected on the Brandberg. The firsr genus was represented by four males of a species collected in the Messum Valley (700 m) during April and the second genus was represented by a single male of a species collected in the Hungorob Ravine (1180 m) during April.

MUTILLIDAE: MUTILLINAE

This is the second largest subfamily, after the Sphaeropthalminae, containing around 32 genera. The Mutillinae is a cosmopolitan subfamily, but is most species rich in the Old World (Brothers 1975).

Genus: *Odontomutilla* Ashmead, 1899.

Three females of *Odontomutilla,* probably *notata bifasciata* Bischoff, 1920, were collected by hand at Wasserfallfläche (2000 m) and Snake Rock (2140 m) during April. These females were walking over large bare expanses of rock when collected, and may have simply been more visible in their traversing of these open areas, rather than specifically searching for hosts in rock fissures.

Genus: *Ronisia* Costa, 1858.

A single male of a *Ronisia* species was collected ar Wasserfallfläche (2000 m) during October.

VESPIDAE

VESPIDAE: MASARINAE

Masarines are world wide in distribution, but concentrated in Mediterranenan and temperate to hot, semi-arid to arid areas (Gess 1996). The Masarinae are represented in the Afrotropical Region by six genera all belonging to the subtribe Masarina of the tribe Masarini. All of which [*Celonites* (one species), *Ceramius* (one species), *Jugurtia* (two species), and the *Quartinia* group (*Quartinia* Ed. André, 1884, *Quartinoides* Richards, 1962, *Quartiniella* Schulthess, 1929) (14 species)] have been recorded from Namibia (Gess 1996).

Genus: *Quartinoides* Richards, 1962.

Numerous specimens of *Quartinoides* were collected in yellow pan traps at all sampled altitudes. These represent three or four species that could not be separated to morpho-species with any degree of confidence. The masarines have therefore been excluded from the comparative species richness assessments. Adult female masarines in the *Quartinia* group visit flowers for nectar and to gather pollen to provision their nests with. Species in the following boranical

families are visited, in decreasing order of utilisation: Asteraceae, Campanulaceae and Schrophulariaceae (Gess 1996).

VESPIDAE: EUMENINAE

Another cosmopolitan subfamily, with about 121 species in 13 genera in southern Africa (Eardley 1985).

Genus indet.

Three species represented by five specimens were sampled on the Brandberg. Species 1 was trapped at Hungorob valley and Wasserfallfläche during April; species 2 at Hungorob Ravine and Wasserfallfläche during April and October respectively; species 3 in the Messum Valley during April. Eumenine species construct mud nests, which they provision with larvae of Lepidoptera or Coleoptera.

FORMICIDAE

See separate contribution by Hamish Robertson (this volume).

APOIDEA (SPHECIFORMES)

AMPULICIDAE

The Ampulicidae is a circumtropical family comprising two subfamilies, the Ampulicinae and Dolichurinae, with a total of 167 described species (Finnamore & Michener 1993).

AMPULICIDAE: AMPULICINAE

Of the two subfamilies the Ampulicinae is the most species rich, with about 118 species contained in the single genus *Ampulex* Jurine. As far as is known, all species prey on cocktroaches (Blattodea) (Bohart & Menke 1976).

Genus: *Ampulex* Jurine, 1807.

Two species each represented by a single specimen were collected on the Brandberg. Species 1 was collected in a Malaise trap at Wasserfallfläche during October and species 2 in the Hungorob Ravine during April.

AMPULICIDAE: DOLICHURINAE

The Dolichurinae contain five genera with about 50 species in total (Finnamore & Michener 1993). Only one of these, the cosmopolitan genus *Dolichurus*, is present in the Afrotropical Region. The few available records suggest that species in this subfamily also prey on cockroaches (Blattodea) (Bohart & Menke 1976).

Genus: *Dolichurus* Latrielle, 1809.

Two species were recorded from the Brandberg. A single specimen of *Dolichurus* species 1 was collected in a yellow pan trap in the Messum Valley during October. Species 2 was represented by six specimens collected in Malaise traps in Hungorob Ravine and at Wasserfallfläche during November and April. Nine species are known from the Afrotropical Region, with none yet recorded from Namibia (Bohart & Menke 1976).

CRABRONIDAE

The cosmopolitan family Crabronidae is the most species rich of the spheciform families with about 3400 species contained in two subfamilies (Finnamore & Michener 1993).

CRABRONIDAE: CRABRONINAE

More than 1300 species are contained in this cosmopolitan subfamily (Finnamore & Michener 1993). Representatives of two of the 43 world genera were collected on the Brandberg.

Genus: *Belomicrus* A. Costa, 1871.

Species of *Belomicrus* are most abundant in warm, arid habitats in the Palaearctic, Nearctic and Afrotropical Regions. There are sixty-three described species of which 12 occur in the Afrotropical Region with 11 of these from southern Africa (Bohart & Menke 1976). *Belomicrus minutissimus* Arnold, 1936, was described from Namibia. Two specimens of a *Belomicrus* species were collected in yellow pans in the Messum Valley during October. Prey consists of beetles (Coleoptera: Melyridae) or immature and adult Miridae (Hemiptera) (Bohart & Menke 1976).

Genus: *Belomicroides* Kohl, 1899.

The genus is restricted to the Palaearctic and Afrotropical Regions, and includes eight described species, three of which are known from the Afrotropical Region (South Africa & Zimbabwe) (Bohart & Menke 1976). A single species represented by two specimens was collected in the Messum Valley and Hungorob Ravine during April. Biology is unknown.

Genus: *Entomognathus* Dahlbom, 1844.

The genus contains 42 species spread throughout the world, with the exception of the Australasian Region, of which 17 are known from the Afrotropical Region, with none yet recorded from Namibia (Bohart & Menke 1976). Two species were recorded on the Brandberg. Species 1, represented by two specimens, was collected in Malaise traps sited in the Messum Valley and Hungorob Ravine during April. A single specimen of species 2 was collected in a Malaise trap sited in the Hungorob Ravine during April. Species of *Entomognathus* provision their nests with small flies (Diptera) usually of the family Chloropidae; or often Miridae (Hemiptera); and on occasion Hymenoptera (Chalcidoidea, Braconidae and Formicidae) (Bohart & Menke 1976).

CRABRONIDAE: LARRINAE

A cosmopolitan subfamily that contains more than 2000 species (Finnamore & Michener 1993).

CRABRONIDAE: LARRINAE: LARRINI

With more than 1100 species this is the largest tribe in the subfamily (Finnamore & Michener 1993).

Genus: *Prosopigastra* A. Costa, 1867.

This is an Old World genus, with the exception of a single species found in the Nearctic Region, containing 36 species, four of which occur in the Afrotropical Region (South Africa, Zimbabwe, Malawi and Zambia) (Bohart & Menke 1976). A single common species was collected on the Brandberg, mostly in the Messum Valley, but also from Hungorob Ravine and at Wasserfallfläche. Specimens were collected in yellow pan traps and Malaise traps, mostly during April, but a few from October and November. The few available records concerning the biology of the genus indicate that pre-existing vertical burrows are used as nests and provisioned with adult Hemiptera (Bohart & Menke 1976).

Genus: *Larra* Fabricius, 1793.

The genus *Larra* is predominantly circumtropical and includes 65 described species, of which 16 species are known from the Afrotropical Region, but none yet from Namibia (Bohart & Menke 1976). A single species of *Larra* represented by 9 specimens was trapped at Messum Valley, Hungorob Ravine and at Wasserfallfläche during October, November and April. Mole crickets (Orthoptera: Gryllotalpidae) comprise the prey of *Larra*.

Genus: *Liris* Fabricius, 1804.

Liris is a cosmopolitan, species rich genus containing over 260 species, of which 63 have been recorded from the Afrotropical Region, but none yet from Namibia. A single specimen of a species of *Liris* was collected at Wasserfallfläche during April. Species of *Liris* prey upon crickets (Orthoptera: Gryllidae, Gryllacrididae) to provision their nest with (Bohart & Menke 1976).

Genus: *Gastrosericus* Spinola, 1838.

This is an Old World genus, comprising 42 species centred in the Afrotropical and Palaearctic Regions, four species in the Oriental Region, but absent from the Australasian Region (Bohart & Menke 1976). Twenty species are known from the Afrotropical Region, mostly from southern Africa, although none have yet been recorded from Namibia. Four species were sampled on the Brandberg. Six specimens of species 1 were sampled in the Messum Valley during October and April. Species 2 and 3 were represented by single specimens collected in the Messum Valley during April. Five specimens of species 4 and seven specimens of species 5 were trapped in the Messum Valley and Hungorob Ravine during April. Species of *Gastrosericus* prey on pygmy mole crickets (Orthoptera: Tridactylidae) for provisioning their nests that are constructed in sandy soil (Bohart & Menke 1976).

Genus: *Ancistromma* W. Fox, 1893.

Only a single species of *Ancistromma* has so far been recorded from the Afrotropical Region (South Africa), a genus that is most species rich in the Neartic Region (Bohart & Menke 1976). A single specimen of a species of *Ancistromma* was collected in a Malaise trap in the Messum Valley during April. Species of *Ancistromma* prey on crickets (Orthoptera: Gryllidae, Gryllacrididae) (Bohart & Menke 1976).

Genus: *Tachytes* Panzer, 1806.

Tachytes is a cosmopolitan genus with 268 species, of which 95 species have been recorded from the Afrotropical Region (Bohart & Menke 1976). A single specimen of a *Tachytes* species was collected in a yellow pan trap in the Hungorob Ravine during April. Most species of *Tachytes* provision their nest with crickets and grasshoppers (Orthoptera: Acrididae, Tettigonidae, Tetrigidea and Tridactylidae) (Bohart & Menke 1976).

Genus: *Tachysphex* Kohl, 1883.

This is a large, cosmopolitan genus with 351 described species, of which 92 species have been recorded from the Afrotropical Region (Bohart & Menke 1976). Four species of *Tachysphex* were recorded from the Brandberg. Species 1 and 3 were sampled in the Messum Valley, Hungorob Ravine and at Wasserfallfläche during October, November and April. Species 2 was sampled in the Hungorob Ravine and at Wasserfallfläche during October and November and species 4 was trapped in yellow pans in the Messum Valley during October. *Tachysphex* species prey on a number of orthopteran families (Bohart & Menke 1976).

CRABRONIDAE: LARRINAE: MISCOPHINI

Genus: *Saliostethoides* Arnold, 1924.

Saliostethoides is a monotypic genus endemic to southern Africa (Bohart & Menke 1976; Lomholdt 1985). *Saliostethoides saltator* Arnold, 1924, was collected in yellow pan traps (14 specimens) at Wasserfallfläche between altitudes of 1950-2000 m during October and November. One specimen was collected from the gravel plain at the base of the Brandberg near the Messum River (640 m) during November. This is the first time *S. saltator* has been recorded

from Namibia. Previously this species was known only from the area (100 km radius) around Bulawayo in Zimbabwe (Arnold 1924, 1962; Lomholdt 1985). This is one of the smallest speciformes, averaging 2-4 mm in length (Bohart & Menke 1976). Biology is unknown (Lomholdt 1985).

Genus: *Saliostethus* Brauns, 1896.

Thirteen species are known in this endemic southern African genus, of which six are known from Namibia (Lomholdt 1985). Until fairly recently, *Saliostethus* was poorly known from a taxonomic perspective, with Bohart & Menke (1976) only listing five species. Although Lomholdt (1985) described an additional eight species, the genus is still likely to include a number of further undiscovered species as was confirmed during the Brandberg survey. Three males of an undescribed species of *Saliostethus* (*Saliostethus*) Brauns, 1896, were collected in yellow pan traps in the Messum Valley at an altitude of 700 m during October and April. The biology of these wasps is poorly known, but their colouration and wing pattern suggests that they mimic ants or mutillids (Bohart & Menke 1976), and the desert species are hypothesised to be morphologically adapted to hunt for subterranean spiders (Lomholdt 1985). Most of the Namibian species are strongly specialised and confined to the Namib Deserr area, with species richness in this area equivalent to that from South Africa or Zimbabwe (Lomholdt 1985).

Genus: *Miscophus* Jurine, 1807.

Miscophus has an almost worldwide distribution, with the exception of the Australasian Region and is most species rich in the Mediterranean area and the Afrotropical Region (Bohart & Menke 1976). Fifty-five described species of *Miscophus* are known from southern Africa, of which 12 have so far been recorded from Namibia (Lomholdt 1985). Seven specimens of an undescribed species of *Miscophus* were collected in Malaise traps in the Messum Valley and Hungorob Ravine during April, and a single specimen at Wasserfallfläche during November. A second species of *Miscophus* was collected in yellow pans and Malaise traps in the Hungorob Ravine and at Wasserfallfläche during October, November and April. A third species was trapped in the Messum Valley during April. The biology of *Miscophus* species is poorly known. Documented records based mostly on the Nearctic subgenus *Nitelopterus* suggest that in general, small, immature spiders are used to mass provision nests dug in loose sandy soil (Bohart & Menke 1976). *Miscophus* species tend to walk around on the ground with their wings held close to the gaster rather than fly, and in the process they resemble ants, which they probably mimic (Bohart & Menke 1976).

Genus: *Solierella* Spinola, 1851.

Solierella occurs in all regions, with the exception of the Palaearctic and Australasian Regions, but has highest species richness in the New World (Bohart & Menke 1976). Four species are known from the Afrotropical Region, two each from Madagascar and southern Africa. *Solierella scrobiculata* Arnold, 1923, and *S. rhodesiana* Arnold, 1923, have both been recorded from Gobabeb in Namibia, as well as South Africa and Zimbabwe (Lomholdt 1985). Four specimens of an unidentified *Solierella* species were collected in yellow pan traps at Wasserfallfläche during October and another specimen in the Messum Valley during April. Species of *Solierella* use existing cavities, such as hollow twigs or old galls or abandoned burrows in the ground and provision their nests with Orthoptera, Hemiptera or Psocoptera (Bohart & Menke 1976).

Genus indet.

Four specimens of an unidentified genus were collected in Malaise traps in the Messum Valley and Hungorob Ravine during April.

CRABRONIDAE: LARRINAE: TRYPOXYLONINI

A cosmopolitan tribe with highest diversity in the Neotropical Region, containing five genera, two of which are present in the Afrotropical Region (Bohart & Menke 1976).

Genus: *Pison* Jurine, 1808.

This is a cosmopolitan genus containing 145 described species with highest species richness in the Australasian Region (Bohart & Menke 1976). Twenty species are known from the Afrotropical Region. A single common species of *Pison* was collected on the Brandberg, mainly at Wasserfallfläche during October and November and in the Hungorob Ravine during April, but also at Messum Valley and Wasserfallfläche during April. Species of *Pison* use existing cavities or construct mud nests that they provision with spiders (Bohart & Menke 1976).

Genus: *Trypoxylon* Latrielle, 1796.

Trypoxylon is a cosmopolitan genus with around 360 species, of which 75 have been recorded from the Afrotropical Region (Bohart & Menke 1976). Two species of *Trypoxylon* were collected on the Brandberg. Both species were only collected in the Hungorob Ravine and at Wasserfallfläche, the first during October, November and April and the second only during April. Species of *Trypoxylon* nest in pre-existing cavities or construct free mud nests in sheltered places and prey on spiders (Bohart & Menke 1976).

PEMPHREDONIDAE

This cosmopolitan family contains about 860 species placed in the two subfamilies, Pemphredoninae and Pseninae (Finnamore & Michener 1993). Only representatives of the nominate subfamily were collected on the Brandberg.

PEMPHREDONIDAE: PEMPHREDONINAE

Genus: *Ammoplanus* Giraud, 1869.

The genus is most diverse in the Palearctic Region, but is also present in the Nearctic and Afrotropical Regions. Three species have been described from South Africa, with none yet recorded from Namibia (Bohart & Menke 1976). A single species, represented by seven specimens, was collected in Malaise traps and yellow pan traps in the Messum Valley and Hungorob Ravine in April. Biology is unknown.

Genus: *Ammoplanellus* Gussakovskij, 1931.

Four of the 14 described species are from southern Africa (South Africa, Zimbabwe) and three from Madagascar, with three from the Palaearctic Region and four from the Nearctic Region (Bohart & Menke 1976). A single species, represented by five specimens, was trapped in Malaise traps sited in the Hungorob Ravine and at Wasserfallfläche during April. Biology is poorly known. *Ammoplanellus rhodesianus* Arnold, 1924, was observed nesting in sandy banks (Arnold 1924).

Genus: *Spilomena* Shuckard, 1838.

This is a cosmopolitan genus represented by nine afrotropical species, of which a single species, *S. ausiana* Leclercq, 1959, is known from Namibia (Bohart & Menke 1976). Two species of *Spilomena* were collected on the Brandberg. The first species was represented by eight specimens collected in yellow pans and Malaise traps, mostly in the Hungorob Ravine during October, November and April, but with two specimens from Wasserfallfläche during April. A sin-

gle specimen of the second species was collected in a light trap at Wasserfallfläche during Novemebr. Species of *Spilomena* nest in twigs and decayed wood (Bohart & Menke 1976), and in the case of afrotropical species, provision their nests with immature Coccidae (Hemiptera) (Arnold 1923).

NYSSONIDAE

The family contains about 1500 species in seven families, five of which are present in the Afrotropical Region (Finnamore & Michener 1993). Representatives of two subfamilies were collected on the Brandberg.

NYSSONIDAE: STIZINAE

A cosmopolitan subfamily containing over 300 species (Finnamore & Michener 1993), in three genera, *Bembecinus* A. Costa, 1859, *Stizus* Latrielle, 1802-1803, *Stizoides* Guérin-Méneville, 1844, all of which occur in the Afrorropical Region (Bohart & Menke 1976). Only one of these was recorded from rhe Brandberg.

Genus: *Bembecinus* A. Costa, 1859.

Bembicinus is a large, cosmopolitan genus, most species rich in the Afrotropical Region (35 species), of which three species have been specifically recorded from Namibia, but other widespread species are no doubt also present (Bohart & Menke 1976). Two species were collected on the Brandberg. Twenty-two specimens of species 1 were collected in Malaise traps and yellow pan rraps in the Messum Valley and Hungorob Ravine during April. Three specimens of species 2 were collected in a Malaise trap in the Messum Valley during April. Species of *Bembecinus* usually make nests in sandy areas, where the larvae are fed progressively on leafhoppers (Cicadellidae) and related families in the Homoptera (Bohart & Menke 1976).

NYSSONIDAE: BEMBICINAE

Another cosmopolitan subfamily with over 460 species contained in fifteen (mostly New World) genera, only one of which is present in the Afrotropical Region (Bohart & Menke 1976).

Genus: *Bembix* Fabricius, 1775.

This cosmopolitan genus is the most species rich (329 species) in the subfamily, with 90 species recorded from the Afrotropical Region, at least one of which is known from Namibia (Bohart & Menke 1976). Four species of *Bembix* were recorded from the Brandberg. Species 1 was trapped in Malaise traps in the Messum Valley and Hungorob Ravine during October. Four and six specimens of species 2 and species 3, respectively, were collected in Malaise traps in the Messum Valley during April. A single specimen of species 4 was trapped in the Messum Valley during October. *Bembix* species nest in sandy areas and provision the larval cells with flies (Diptera), particularly of the families Muscidae, Tabanidae, Syrphidae, Dolichopodidae and Therevidae (Bohart & Menke 1976).

PHILANTHIDAE

The family contains six subfamilies only two of which are represented in the Afrotropical Region, the Cercerinae and Philanthinae (Finnamore & Michener 1993). No philanthines were collected during this survey on the Brandberg.

PHILANTHIDAE: CERCERINAE

There are about 900 species in this cosmopolitan subfamily. Species mostly prey on adult beetles (Coleoptera), although a few prey on adult Hymenoptera (Finnamore & Michener 1993).

Genus: *Cerceris* Latreille, 1802-1803.

Two specimens of a *Cerceris* species were collected in a Malaise trap in the Hungorob Ravine during April. Approximately 200 species are known from the Afrotropical Region, at least 10 of which have been recorded from Namibia (Bohart & Menke 1976).

SPHECIDAE

A cosmopolitan family of 660 species contained in three subfamilies, the Ammophilinae, Sceliphrinae and Sphecinae, all of which are present in the Afrotropical Region (Finnamore & Michener 1993). Only representatives of the Ammophilinae were collected on the Brandberg.

SPHECIDAE: AMMOPHILINAE

This is the largest of the three subfamilies, containing around 300 species (Finnamore & Michener 1993), in six genera, three of which, *Parapsammophila* Taschenberg, 1869, *Podalonia* Fernald, 1927, and *Ammophila* W. Kirby 1798, are present in the Afrotropical Region (Bohart & Menke 1976).

Genus: *Ammophila* W. Kirby, 1798.

Ammophila is an extremely species rich, cosmopolitan genus, containing 187 species, of which 25 have been recorded from the Afrotropical Region (Bohart & Menke 1976). Six species of *Ammophila* were collected on the Brandberg. Species 1 was represented by three specimens collected in Malaise traps in the Messum Valley during October and April. Species 2 to 6 were all represented by single specimens trapped in the Messum Valley during April. Species of *Ammophila* are generally solitary nesters, provisioning the nest with larvae of Lepidoptera and sawflies (Hymenoptera: Symphyta) (Bohart & Menke 1976).

Genus: *Podalonia* Fernald, 1927.

A cosmopolitan genus with highest species richness in the Mediterranean area and south-west Asia. Three species are known from the Afrotropical Region (Bohart & Menke 1976). A single specimen of a species of *Podalonia* was collected in a yellow pan trap in the Messum Valley during April. Species of this genus provision their nests with caterpillars (Lepidoptera), particularly of the family Noctuidae (Bohart & Menke 1976).

APOIDEA (APIFORMES)

See separate contribution by C.D. Eardley (this volume)

DISCUSSION

The results from the current survey must be seen as an extremely preliminary investigation of the Hymenoptera of the Brandberg Massif. The sampling effort of a total of 43 days encompassing only three months of the year is woefully inadequate in assessing hymenopteran species richness and abundance on the Brandberg. In the context of current knowledge of Namibian Hymenoptera, however, this survey is an important initial input addressing the lack of information on hymenopteran species richness and distribution in Namibia, and provides essential baseline information that can be built on over the years to come. Staff of the National Museum of Namibia are actively deploying quantified sampling programmes at widespread localities in Namibia, and, at the time of writing, a postgraduate student (University of Leeds) is currently continuing the inventory survey on the Brandberg. Already representatives of 51 families (including the Formicidae and Apoidea – Apiformes), comprising in excess of 500 species, of a likely potential of 69 families that occur in Namibia, have been collected on the Brandberg. In comparison, sur-

veys over a total of 44 days of the lower Kuiseb River course in the central Namib Desert recorded 40 families represented by 300 species (Prinsloo 1990). Sampling methods approximated those deployed on the Brandberg and included sweeping and beating of vegetation, Malaise trapping, light trapping, yellow pan trapping, pitfall trapping and Berlese funnel extraction of leaf litter. To place the recorded Namibian family richness in perspective, the intensive ten year long INBio survey, including a total of 150 Malaise trap years, of Costa Rican Hymenoptera has recorded 61 families, comprising an estimated total of 20 000 species, of a potential 62 families that occur in the country (Gaston *et al.* 1996). The interpretation of family richness must be treated with caution as the Apoidea Spheciformes were treated as the single family Sphecidae in Prinsloo (1990) and Gaston *et al.* (1996), whereas in the current paper the higher hierarchical treatment of splitting the Sphecidae into eight families (Goulet & Huber 1993) was followed. The Brandberg rally would be lowered to 47 families if the former classification was adhered to.

This survey produced the first putative record of the sclerogibbid species, *Lithobiocerus vagabundus*, from Namibia and southern Africa. *Lithobiocerus vagabundus* appears however, to be a 'tramp' species, having been introduced along with its embiopteran host in many parts of the world (Argaman 1988), and is likely to be more widespread in southern Africa than the current record suggests. The distribution range of the crabronid, *Saliostethoides saltator* was increased by 1 450 km and that of the ichneumonid, *Afrophion nubilicarpus* by 1100 km. These dramatic extensions serve to illustrate the large gaps in our knowledge of species distribution records in the Afrotropical Region, as is the case in other biogeographical realms, such as the Cosra Rican survey where tiphiids were recorded as having distribution extensions of 2 000-3 000km (Gaston *et al.* 1996).

The Braconidae and Crabronidae dominated the recorded abundance on the Brandberg, comprising 27.9% and 14.7% of the total hymenopteran abundance respectively. The large number of braconid specimens can be ascribed to a single species of *Adelius* (Adeliinae) that was attracted to UV light traps in large numbers, comprising 51.7% of the total braconid specimens. The Crabronidae proliferate in arid and semi-arid areas, but a single species of *Pison*, that was commonly collected in yellow pan traps and Malaise traps dominated the crabronid abundance, comprising 36.7% of the total for the family. Two uncommonly collected families, the Plumariidae and Bradynobaenidae, were fairly well represented in the samples from the Brandberg. The Encyrtidae, Pteromalidae and Trichogrammatidae dominated the Chalcidoidea, from both a species richness and abundance point of view. In the context of global ichneumonid species richness and abundance, the Ichneumonidae is extremely depauperate on the Brandberg with a recorded 28 species represented by 53 specimens, which from an abundance point of view comprised 2.2% of the sorted hymenopteran specimens. This is an inflated percentage because four families are not included in the current specimen total. A rough count indicates that a further 600-800 specimens still need to be processed and added to the total, pushing the constituent percentage of the Ichneumonidae down to 1.6-1.7%. This is in stark contrast to the situation in the Northern Hemisphere, where ichneumonids comprise around 15-20% of the hymenopteran fauna in north temperate samples; for example 19.4% in a study in Spain (Segade *et al.* 1997). The Namibian ichneumonid component is more in line with that of tropical studies, such as the 7.4% recorded in Sulawesi (Noyes 1989a) and even more so with a study of a tropical area in the Afrotropical Region, where Ichneumonidae comprised 2.4% of the total hymenopteran abundance in a survey of Mkomazi Game Reserve in north-eastern Tanzania (S. van Noort in prep.). In an inventory survey of a temperate

Southern Hemisphere locality that comprised fragmented Afromontane forest and adjoining moist upland grassland in Kwazulu-Natal (South Africa), the Ichneumonidae comprised 32.5% of the total hymenopteran abundance (Fisher & van Noort in prep.). This may be a consequence of the inventory having been carried out along a river course in the dry season, when there is a concentration effect, possibly disparate among the different hymenopteran families, in moist refugia (Janzen 1973).

The disparity in species richness and abundance between the sampled dry season months of October and November and the sampled wet season month of April, conforms to expections of an elevated adult insect emergence correlating with an increase in precipitation, or onset of the rainy season in the afrotropical Savanna Biome. Hymenopteran species richness almost tripled in the wet season compared to either of the two surveys conducted in the dry season.

Based on observed species richness patterns across the altitudes (700 m, 1180-1200 m, 1950-2000 m) that were equally sampled during the October and April surveys, relative ranking of species richness declined with an increase in elevation, and exhibited a decline in species capture rate with an increase in elevation. Conversely, when abundance is taken into account, the Shannon indices point to greatest diversity at mid altitude (1180-1200 m) followed by 700 m, with lowest diversity at 1950-2000 m. During the wet season (April) where sampling effort was standardised over all four sampled altitudes the most species rich altitudes were the two mid-elevation sites (1180 & 1960 m) followed by the low altitude site (700 m), with the high altitude (2470 m) site having the lowest species richness. Species diversity was greatest at 1180 m. Because of insufficient sample size these results need to be treated with caution. In the Venezuelan Andes, hymenopteran species richness was highest at low (200 m) and mid elevation (1600 m) with at least a 60% decrease in species richness at high altitude (3550-3600 m), and abundance declined with an increase in elevation (Janzen *et al.* 1976). The results from a survey of Hymenoptera in Sulawesi (Noyes, 1989b) showed a general pattern of decline in Aculeate diversity with an increase in altitude, whereas the Parasitica appeared to have a peak of diversity at mid elevation (700-1000 m), with a far lower diversity at high altitude (1765 m) than at low altitude (220 m). These two general patterns of species richness as determined by elevation, i.e. either a decrease in species richness with an increase in altitude, or higher species richness at mid-altitude, have been documented in a number of other studies on the effect of elevation on insect species richness, cited in Gaston & Williams (1996). The preliminary results of the Brandberg survey fit with both of these two predictions depending on season and whether species richness or species diversity is taken into account. With the lack of comprehensive spatial and temporal data, however, it is premature to postulate the determinants of the observed elevational species richness patterns on the Brandberg. The altitudinal decline in species richness may be the result of reduced temperature and a consequent lowering of productivity as elevation increases, but there could be other determinants, such as area effect and variation in precipitation across elevation, that should also be taken into account when proposing underlying mechanisms (Rahbek 1995).

The comparison between sampling method efficiency showed that Malaise trapping was the most efficient method in terms of sampling effort, with a higher species return per sampling unit than either yellow pan trapping or light trapping. In terms of sample processing efficiency (species richness return per number of individuals requiring sorting and identification), the same order of efficiency was illustrated. In a hymenopteran inventory study in Sulawesi, Noyes (1989) compared the efficiency of five methods used to collect Hymenoptera. This survey established that sweeping was the single most

efficient method followed by Malaise trapping. Sweep sampling on the Brandberg was very difficult due to the paucity and thorny nature of vegetation in this very arid habitat, and hence it is not surprising that this was not an effective method in the current survey. In a survey of the ant fauna of a tropical rain forest in Cost Rica, Berlese extraction of leaf litter, Malaise trapping and canopy fogging were found to be equally efficient (Longino & Colwell 1997), but this was a taxon restricted study and the efficiency between these methods will probably be more disparate when the whole hymenopteran fauna is under consideration.

No asymptote or flattening out to a plateau was approached in any of the species accumulation curves indicating that the hymenopteran fauna is still very undersampled using the same methods during the same seasons that were sampled. This under sampling is confirmed by the species richness estimators, which in all cases illustrated that 50% or less of the estimated species present in the sampled environments had actually been captured. These results indicate that a considerable increase (over time and trap replication) in sampling effort is required to sufficiently inventory the Hymenoptera on the Brandberg.

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Appendix 1. Family representation of afrotropical Hymenoptera in the collections from the Brandberg.

SUPERFAMILY	FAMILY	BRANDBERG	COMMENTS
Orussoidea	Orussidae	Absent	Eight rare species present in southern Africa.
Siricoidea	Siricidae	Absent	Northern Hemisphere family, one introduced pest species in South Africa.
Tenthredinoidea	Argidae	Absent	Depauperate in arid regions.
	Tenthredinidae	Absent	Depauperate in arid regions.
Evanioidea	Aulacidae	Absent	Rarely collected.
	Gasteruptiidae	Present	
	Evaniidae	Present	
Stephanoidea	Stephanidae	Absent	Rarely collected.
Megalyroidea	Megalyridae	Absent	Not recorded from Namibia. Two monotypic genera present in the south Western Cape (South Africa).
Trigonalyoidea	Trigonalyidae	Absent	Rarely collected.
Ichneumonoidea	Braconidae	Present	
	Ichneumonidae	Present	
Cynipoidea	Liopteridae	Absent	Single species known from southern Africa.
	Figitidae	Absent	Depauperate in southern Africa.
	Eucoilidae	Present	
	Charipidae	Present	
	Cynipidae	Absent	Predominately a Northern Hemisphere family, one species present in South Africa.
Proctotrupoidea	Proctotrupidae	Absent	Only three species recorded from mesic habitats in southern Africa.
	Diapriidae	Present	
Platygastroidea	Scelionidae	Present	
	Platygastridae	Present	
Ceraphronoidea	Megaspilidae	Present	
	Ceraphronidae	Present	
Chalcidoidea	Chalcididae	Present	
	Leucospidae	Absent	Infrequently collected
	Eurytomidae	Present	
	Pteromalidae	Present	
	Agaonidae	Present	
	Torymidae	Present	
	Ormyridae	Present	
	Perilampidae	Present	
	Eucharitidae	Absent	
	Eupelmidae	Present	
	Tanaostigmatidae	Absent	Rare family
	Encyrtidae	Present	
	Aphelinidae	Present	
	Signiphoridae	Present	
	Tetracampidae	Present	
	Eulophidae	Present	
	Elasmidae	Present	
	Trichogrammatidae	Present	
	Mymaridae	Present	
Chrysidoidea	Bethylidae	Present	
	Chrysididae	Present	
	Dryinidae	Present	
	Embolemidae	Absent	Infrequently collected
	Plumariidae	Present	
	Sclerogibbidae	Present	

	Scolebythidae	Absent	Only one species known from South Africa
Vespoidea	Bradynobaenidae	Present	
	Pompilidae	Present	
	Rhopalosomatidae	Absent	Infrequently collected
	Sapygidae	Absent	Infrequently collected
	Scoliidae	Present	
	Tiphiidae	Present	
	Mutillidae	Present	
	Vespidae	Present	
	Formicidae	Present	
Apoidea			
(Spheciformes)	Ampulicidae	Present	
	Astatidae	Absent	Depauperate in southern Africa.
	Crabronidae	Present	
	Heterogynaidae	Absent	Rare family.
	Nyssonidae	Present	
	Pemphredonidae	Present	
	Philanthidae	Present	
	Sphecidae	Present	
Apoidea (Apiformes)	Andrenidae	Present	
	Apidae	Present	
	Colletidae	Present	
	Halictidae	Present	
	Megachilidae	Present	
	Melittidae	Present	