

# A preliminary survey of the aculeate wasps and the bees of the lower reaches of the Nossob River Valley, Kalahari Gemsbok National Park, South Africa

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An annotated list of aculeate wasps and of bees collected during a preliminary survey of these insects in the lower reaches of the Nossob River Valley, Kalahari Gemsbok National Park is presented. Flowers visited, and notes on provision and nest type are given. Meloid beetles collected on the flowers are listed. The species composition and geographical affinities of the community of aculeate wasps and of bees in relation to those of four sites in the Karoo Biome (in Namaqualand, in the southern Great Karoo, in the Little Karoo and in the easternmost extension of the Nama Karoo) are discussed briefly.

Key words: aculeate wasps, bees, meloid beetles, Nossob River, Kalahari Gemsbok National Park, flowers visited, provision, nest type, Karoo Biome, geographical affinities.

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## Introduction

A preliminary sampling of aculeate wasps and of bees in the Nossob River Valley, Kalahari Gemsbok National Park, was undertaken in March 1990 as an outstudy necessary for the better understanding of the geographical affinities of the aculeate wasps and the bees of the Karoo Biome as defined by Cowling (1986).

During the past fifteen years we have been sampling communities of aculeate wasps and of bees in the Succulent Karoo and the Nama Karoo as defined by Rutherford and Westfall (1986) in order to establish the community structures and geographical affinities of these insects in the Karoo Biome (Gess & Gess 1989).

The results of studies in Namaqualand, in the southern Great Karoo, in the Little Karoo and in the easternmost extension of the Nama Karoo show that the wasp and bee fauna of the southern Karoo is polarised into two main faunal groups, one centered in the west and the other in the east. It is apparent from an examination of the percentage of species in each community not common to any of the other three communities, that the figure for

the southern Great Karoo is higher than that for the Little Karoo. Those species in the southern Great Karoo not common to either the western or the eastern faunas may be derived from a northern fauna of which the southern Great Karoo probably represents the southern extremity of a north to south subtraction zone.

Clearly it is relevant to sample those areas at the interface of the Karoo Biome and the Savannah Biome lying to the north. Such an area is to be found in the southern Kalahari (Rutherford & Westfall 1986).

Aculeate wasps and bees in arid areas are active for limited periods of time following rain. The choice of collection time and sites is therefore dictated by precipitation which tends to be very localized and uncertain. In the Kalahari most precipitation occurs from October to April with a peak in March at Twee Rivieren (Van Rooyen, *et al.* 1984), hence the choice of March. Although the southern end of the park as a whole was extremely dry during the period of the sampling, 8-11 March, localized rain had fallen at two sites in the Nossob River Valley between Nossob and Twee Rivieren. It was only at these two sites that plants were in

flower and that aculeate wasps and bees were active.

The results of the sampling are presented as an annotated list. Most adult aculeate wasps and bees visit flowers, nectar being their main source of energy. Masarid wasps and most bees in addition visit flowers to collect pollen and nectar for provisioning their young. Therefore, by sampling all plants in flower at a particular site one will obtain a relatively complete sample of those aculeate wasps and bees which are active in the area at the time of sampling. Thus all plants in flower were sampled.

In addition to aculeate wasps and bees meloid beetles visiting flowers were collected and are listed in this paper. They are of interest in a study of wasps and bees as, though the larvae of the majority of species feed on the egg packets of grasshoppers, many are "parasitic" in the nests of bees and some in the nests of aculeate wasps (Gess & Gess 1983).

## Sampling sites

### Site 1

Site 1 was 11 km from Twee Rivieren on the road to Nossob. At this point the road runs along the flood plain of the Nossob River. Pools of water, resulting from rain which fell four days prior to the sampling, provided watering points for insects.

The dominant plant of the flood plain at this site was the yellow flowered, rush-like *Deverra aphylla* (Cham. & Schlecht., 1829) DC., 1830 [Apiaceae (= Umbelliferae)] which was in full flower and, typical of an umbellifer, was being visited by a great diversity of aculeate wasps and bees from mid-morning to late afternoon.

In moist areas near the fringes of the expanse of *D. aphylla* were mixed communities of low growing perennials. Notable in such communities were clumps of the yellow flowered dwarf shrub *Pentzia incana* (Thunberg, 1823) Kuntze, 1898 (Asteraceae) which was most noticeably being visited by

male scoliids and chrysidids and the purplish-violet flowered spiny dwarf shrub *Aptosimum spinescens* (Thunb., 1800) Weber., 1907 (Scrophulariaceae). It was clear that *A. spinescens* flowers and fruits abundantly, however, only a small number of flowers were open on any one day. The flowers opened late in the morning. During the four days of the sampling they were being visited regularly but in small numbers of species of *Celonites* Latreille, 1802 (Masaridae) for approximately an hour from noon. A second non-spiny species of *Aptosimum* Burch., 1824 with bluish-violet flowers was uncommon. One plant was found in flower. A few fresh flowers opened during the course of each morning. On opening their centres were white and there were indistinct "honey guides". Towards midday when species of *Celonites* were visiting the flowers the "honey guides" had become distinct. During the afternoon after masarid visits had ceased the centres of the flowers had darkened to a purplish hue.

Along the roadside banks the white flowered prostrate *Limeum aethiopicum* Burm., 1739 (Aizoaceae), a pink flowered *Tribulus cristatus* Presl. 1844 (Zygophyllaceae) and the pink flowered *Hermannia modesta* (Ehrenb., 1829) Mast., 1868 (Sterculiaceae) were in flower. The two *Limeum* species were being visited most regularly by small sphecids and bees, *T. cristatus* by sphecids and bees and *H. modesta* by bees.

In the washes were isolated plants of the wiry, bluish-violet flowered *Peliostomum leucorrhizum* E. Mey. ex Benth., 1882 (Scrophulariaceae). As with *Aptosimum* spp. only a small number of flowers opened each day. These were open by mid-morning and had collapsed before the next day. They were visited regularly and in relatively large numbers by species of *Quartinioides* Richards, 1962 (Masaridae) from about 11:00 till shortly after mid-day.

Scattered plants of *Cassia italica* (Mill., 1768) Lam. ex F.W. Andr., 1952 subsp. *arachoides* (Burch., 1862) Brennan, 1958 (Caesalpinoideae) were in flower. As would

be expected they were visited by a species of *Xylocopa* Latreille, 1802 (Anthophoridae), however, activity was at a surprisingly low level.

On the slope to the east of the river bed the white flowered shrub *Rhigozum trichotomum* Burch., 1822 (Bignoniaceae) was in flower. It did not, however, appear to be receiving visits from aculeate wasps or bees.

Also in flower, though somewhat sparsely, was the yellow flowered shrub *Grewia flava* DC., 1824 (Tiliaceae) which was receiving occasional visits from large bees.

#### Site 2

Site 2 was 20 km from Nossob on the road from Twee Rivieren to Nossob. At this point the road runs along the slope above the river bed. Little was in flower except along the road margins.

Dominant on the road banks and flowering in profusion were the showy yellow flowered *Tribulus cristatus* and the pink flowered *Limeum* species. As at site 1 *T. cristatus* was being visited regularly by sphecids and bees and the *Limeum* species by bees. At this site small meloid beetles were also not uncommon in the flowers of both plants.

Beyond the road banks a low growing shrubby pinkish-violet flowered species of *Monechma* Hochst., 1841 (Acanthaceae) was in flower. The flowers of this plant were being visited principally by species of *Ammophila* W. Kirby, 1798 (Sphecidae) and bees.

#### Annotated list of aculeate wasps and of bees

The numbers in brackets indicate sample size.

##### Chrysididae

All species are "parasitic". The majority develop within the cells of aculeate wasps and bees, more usually feeding first on the host's

egg or larva and then on the provision laid in for the latter or, less commonly, on the host's fully grown larva. Some species of *Chrysis* Linnaeus, 1761 are not associated with wasps and bees but with moths, developing upon resting caterpillars in their cocoons.

##### *Parnopes* Latreille, 1796

*Parnopes fischeri* Spinola, 1838. Visiting flowers of *Deverra aphylla* (4 females, 8 males) and *Pentzia incana* (12 males). Recorded as a "parasite" of *Bembix olivata* Dahlbom (Sphecidae) (Brauns, 1911).

##### *Stilbum* Spinola, 1808

*Stilbum cyanurum* (Förster, 1771). Visiting flowers of *Deverra aphylla* (1 female). Recorded as a "parasite" of *Delta maxillosus* (De Geer, 1773) (as *Eumenes tinctor*) (Eumenidae) (Brauns, 1911) and *Delta caffer* Linnaeus, 1767 (Gess & Gess, reared from nests from Grahamstown and from Matroosberg Station).

##### *Chrysis* Linnaeus, 1761

*Chrysis meadewaldoi* Mocsáry, 1914. Visiting flowers of *Deverra aphylla* (26).

*Chrysis nasuta* Mocsáry, 1902. Visiting flowers of *Deverra aphylla* (3).

*Chrysis* prob. *alecto* Edney, 1954. Visiting flowers of *Deverra aphylla* (3).

*Chrysis* sp. D. Visiting flowers of *Deverra aphylla* (1).

##### Tiphiidae

Tiphiidae prey upon beetle larvae living in the ground, most typically of the family Scarabaeidae, less typically of the families Tenebrionidae and Cicindellidae. No nest is constructed. A prey larva, having been located, is stung, an egg is laid upon it and it is left in its own burrow.

Considering the known nature of the prey it is of interest to note that two scarab beetles *Tephraea morosa* Schaum, 1848 and *Dischista cincta* (De Geer, 1778) were present in abundance visiting, in the main, *Deverra aphylla*. They can therefore be considered as possible hosts.

*Anthobosca* Guérin, 1838

*Anthobosca* sp. Visiting flowers of *Deverra aphylla* (1 female).

*Meria* Illiger, 1807

*Meria* sp. A. Visiting flowers of *Deverra aphylla* (36 males).

*Meria* sp. B. Visiting flowers of *Deverra aphylla* (1 male).

#### Mutillidae

Mutillidae, popularly called Velvet Ants, are "parasites". They develop in the cocoons or puparia of other insects, most commonly wasps and bees but also flies, beetles and moths. The egg is introduced into the cocoon or the puparium where the mutillid larva feeds on the mature larva or pupa of the host.

*Dasylabris* Radoszkowski, 1885

*Dasylabris* sp. Visiting flowers of *Deverra aphylla* (7 males).

*Dasylabris* sp. prob. *autinoe* (Péringuey, 1899). Visiting flowers of *Deverra aphylla* (1 male).

*Dasylabroides* Er. André, 1901

*Dasylabroides* sp. prob. *simillima* Bischoff. Visiting flowers of *Deverra aphylla* (3 males).

#### Scoliidae

Scoliidae typically prey upon the larvae of beetles of the family Scarabaeidae which live

in the ground or less commonly in decaying vegetable matter. No nest is constructed. A larva, having been located, is stung, an egg is laid upon it and it is left in its own burrow.

Considering the known nature of the prey it is of interest to note that two scarab beetles *Tephraea morosa* Schaum and *Dischista cincta* (De Geer) were present in abundance visiting, in the main, *Deverra aphylla*. They can therefore be considered as possible hosts.

*Scolia* Fabricius, 1775

*Scolia* (*Scolia*) *alastor* Betrem, 1967. Visiting flowers of *Deverra aphylla* (1 male).

*Scolia* (*Scolia*) sp. A. Visiting flowers of *Deverra aphylla* (2 female, 1 male).

*Scolia* (*Scolia*) sp. B. Visiting flowers of *Deverra aphylla* (1 female) and *Pentzia incana* (1 male).

*Scolia* (*Scolia*) sp. C. Visiting flowers of *Deverra aphylla* (2 males).

*Trielis* Saussure & Sichel, 1864

*Trielis* (*Heterelis*) *braunsi* (Turner, 1912). Visiting flowers of *Deverra aphylla* (2 females, 1 male).

*Trielis* (*Heterelis*) *mima* (Buysson, 1897). Visiting flowers of *Deverra aphylla* (1 male).

*Trielis* (*Heterelis*) *stigma* (Saussure, 1859). Visiting flowers of *Deverra aphylla* (17 females, 11 males) and *Pentzia incana* (1 male).

#### Pompilidae

Pompilids prey upon spiders. A single spider is utilized for the rearing of one of these wasps and spiders taken are therefore large in relation to the size of the wasp. The most important factors in the selection of the prey seem to be size and habitat, the wasps being better "ecologists" than "systematists".

*Cyphononyx* Dahlbom, 1845

*Cyphononyx croceicornis* (Erichson, 1844). Visiting flowers of *Deverra aphylla* (1 female). Presence of sand rakes indicates that nest is a burrow excavated in friable soil.

*Hemipepsis* Dahlbom, 1844

*Hemipepsis glabrata anchietae* (Radoszkowski, 1881). Visiting flowers of *Deverra aphylla* (12 females).

*Paraferreola* Suster, 1912

*Paraferreola melanostoma* (Cameron, 1904). Visiting flowers of *Deverra aphylla* (2 females, 8 males).

*Platyderes* Guérin, 1844

*Platyderes rhodesianus* Bischoff, 1913. Visiting flowers of *Deverra aphylla* (1 female, 2 males).

*Psammochares* Latreille, 1796

*Psammochares decipiens* Bischoff, 1913. Visiting flowers of *Deverra aphylla* (12 females, 7 males). Presence of sand rakes indicates that nest is a burrow excavated in friable soil.

*Schistonyx* Saussure, 1887

*Schistonyx umbrosus* (Klug, 1834). Visiting flowers of *Deverra aphylla* (1 female, 2 males). Presence of sand rakes indicates that nest is a burrow excavated in friable soil.

#### Eumenidae

Eumenids, as a general rule, provision their nests with paralyzed caterpillars of Lepidoptera, exceptionally larvae of Chrysomelidae (Coleoptera) are used. Species of *Delta* Saussure, provision with looper caterpillars (Geometridae) and construct aerial mud nests on plants, stones or rock faces.

*Delta* Saussure, 1855

*Delta caffer* (Linnaeus, 1767). Visiting flowers of *Deverra aphylla* (2 females).

*Delta lepeleterii* (Saussure, 1852). Visiting flowers of *Deverra aphylla* (1 female).

*Delta maxillosus* (De Geer, 1773). Visiting flowers of *Monechma* sp. (1 female).

#### Masaridae

Masariid wasps are exceptional in that the majority of species, bee-like, provision their larvae with pollen and nectar. They ingest the provision and carry it to their nests in their crops. The nests are multicellular burrows in the ground, aerial cells attached to plants or stones, or are cells constructed within pre-existing burrows.

*Celonites* Latreille, 1802 is of particular interest as the majority of species exhibit marked oligolecty (Gess & Gess 1989). *Celonites* constructs small mud cells attached to stones or twigs (Gess & Gess 1989), or in pre-existing cavities or excavated burrows in the ground (Gess & Gess, unpublished field notes).

*Celonites andrei* Brauns, 1905. Visiting flowers of *Aptosimum spinescens* (3 females).

*Celonites clypeatus* Brauns, 1913. Visiting flowers of *Aptosimum spinescens* (1 female and 1 male) and *Aptosimum* sp. (1 female).

*Quartinioides* Richards, 1962 is of particular interest as the majority of species exhibit marked oligolecty (Gess & Gess 1989). Only one instance of nesting has been recorded; the nests were burrows in friable soil (Gess & Gess 1989).

*Quartinioides tarsata* Richards, 1962. Visiting flowers of *Peliostomum leucorrhizum* (12 females, 1 male).

*Quartinioides* sp. A Visiting flowers of *Peliostomum leucorrhizum* (3 females).

*Quartinioides* sp. B. Visiting flowers of *Peliostomum leucorrhizum* (1 female).

*Quartinioides* sp. C. Visiting flowers of *Peliostomum leucorrhizum* (1 female).

## Sphecidae

Sphecids as a group prey upon a wide range of insect orders and spiders. At the specific level they specialize in prey of a single order, family, genus or even species. The nests are unicellular to multicellular burrows in the ground, in vertical banks, or in plant tissue or are aerial nests attached to plants, stones or banks.

### Sphecinae

#### *Sphex* Linnaeus, 1758

*Sphex decipiens* Kohl, 1895. Visiting flowers of *Deverra aphylla* (1 male). Provisions with long horned grasshoppers (Tettigoniidae), species of *Odontura* and *Phaneroptera* having been recorded. Up to six prey per cell have been recorded. Multi-celled nests are excavated in friable soil. (Gess & Gess, unpublished fieldnotes, Clifton, Grahamstown).

*Sphex lanatus* Mocsáry, 1883. Visiting flowers of *Deverra aphylla* (6 females, 8 males). Most probably provisions with long horned grasshoppers (Tettigoniidae) and excavates burrow in friable soil.

#### *Prionyx* Van der Linden, 1827

*Prionyx viduatus* (Christ, 1791). Visiting flowers of *Deverra aphylla* (17 females, 1 male). Almost certainly provisions with grasshoppers (Acrididae) and excavates burrows in friable soil.

#### *Parapsammophila* Taschenberg, 1869

*Parapsammophila* sp. Visiting flowers of *Deverra aphylla* (4 females, 4 males).

#### *Podalonia* Fernald, 1927

*Podalonia canescens* (Dahlbom, 1843). Visiting flowers of *Deverra aphylla* (5 females). Provisions with a single large hairless cutworm - type caterpillar (Noctuidae). A simple single-celled burrow is excavated in friable soil after prey capture.

#### *Ammophila* W. Kirby, 1798

*Ammophila bonaespei* Lepageletier, 1845. Visiting flowers of *Deverra aphylla* (1 female) and *Monechma* sp. (2 females, 5 males). Known to provision with hairless caterpillars of Geometridae (Gess 1981) and American Boll Worm (Noctuidae) (Weaving, unpublished fieldnotes, Mountain Zebra Park, Cradock). A single-celled burrow is excavated in friable soil before prey capture.

*Ammophila dolichodera* Kohl, 1884. Visiting flowers of *Deverra aphylla* (2 males) and *Monechma* (1 male). Provisions mainly with hairy caterpillars of Arctiidae and Lasiocampidae which it "shaves". A single-celled burrow is excavated in friable soil after prey capture. (Weaving 1984).

### Larrinae

#### *Liris* Fabricius, 1804

*Liris rufoscapa* (Cameron, 1905). Visiting flowers of *Deverra aphylla* (2 females). Most probably provisions with crickets (Gryllidae) and nests in pre-existing cavities.

*Tachysphex* Kohl, 1883 as a genus provisions with various families of Orthoptera. All species for which nesting is known excavate multi-celled burrows in friable soil.

*Tachysphex sericeus* (F. Smith, 1856). Visiting flowers of *Deverra aphylla* (3 females).

*Tachysphex* sp. A. Visiting flowers of *Limeum aethiopicus* (2 males). (3 females; without flower visiting data).

*Tachysphex* sp. B. (1 male, without flower visiting data).

*Tachysphex* sp. C. Visiting flowers of *Deverra aphylla* (2 females, 2 males).

*Tachysphex* sp. D. Visiting flowers of *Deverra aphylla* (1 male).

*Parapiagetia* Kohl, 1896

*Parapiagetia capensis ferox* Arnold, 1922. Visiting flowers of *Deverra aphylla* (1 female). The biology of the genus is virtually unknown. Arnold (1945) recorded immature Tetrigidae as prey of *P. longicornis* Arnold, 1945.

*Palarus* Latreille, 1802

*Palarus pentheri* Brauns, 1898. Visiting flowers of *Deverra aphylla* (1 female, 1 male). Most probably provisions with Hymenoptera and excavates burrows in friable soil.

*Palarus latifrons* Kohl, 1884. (1 female, without flower visiting data). Provisions with Hymenoptera, most usually honey-bees, *Apis mellifera* Linnaeus, 1758 (Apidae) hence its common name, the Banded Bee Pirate. Excavates uni-cellular burrows in friable soil (Gess 1981).

Crabroninae

*Oxybelus* Latreille, 1796

*Oxybelus* sp. Visiting flowers of *Deverra aphylla* (1 female, 6 males). Almost certainly provisions with flies (Diptera) and excavates burrows in friable soil.

Nyssoninae

*Stizus* Latreille, 1802

*Stizus imperialis* Handlirsch, 1892. Visiting flowers of *Deverra aphylla* (1 female). Provisions with grasshoppers; families recorded: Pygomorphidae, Pamphagidae, Lentulidae and Acrididae (Weaving 1989). Excavates burrows in friable soil, in vertical banks. Recorded as excavating burrows in the roofs of old animal burrows in a vertical bank by Weaving (1989).

*Stizus* sp. Visiting flowers of *Deverra aphylla* (4 females).

*Stizoides* Guérin, 1844

*Stizoides fenestratus* (Smit, 1856). Visiting flowers of *Deverra aphylla* (2 males). Bohart and Menke (1976) state that it seems reasonably certain that *Stizoides* species are cleptoparasites of Sphecinae.

*Bembecinus* A. Costa, 1859

*Bembecinus* sp. (*rhopalocerus* species group). Visiting flowers of *Limeum aethiopicum* (5 males). Provisions with small bugs (Homoptera). Excavates burrows in friable soil.

*Bembix* Fabricius, 1775.

*Bembix capensis* Lepeletier, 1845. Visiting flowers of *Deverra aphylla* (5 females, 5 males). Provisions with flies (Diptera); families recorded: Tabanidae, Glossinidae, Calliphoridae, Sarcophagidae and Tachinidae (Gess 1986). Excavates burrows in friable soil.

*Bembix intermedia* Dahlbom, 1845. Visiting flowers of *Deverra aphylla* (27 females, 21 males). Strikingly abundant at site 1. No prey recorded, most probably flies (Diptera). Excavates burrows in friable soil.

*Bembix zinni* Gess, 1986. Visiting flowers of *Deverra aphylla* (1 male), *Pentzia incana* (1 female), *Limeum aethiopicum* (2 females, 2 males) and *Tribulus cristatus* (1 female). No prey recorded, most probably flies (Diptera). Excavates burrows in friable soil.

*Bembix* sp. A. Visiting flowers of *Tribulus cristatus* (1 female).

*Bembix* sp. B. Visiting flowers of *Pentzia incana* (1 female).

Philanthinae

*Philanthus* Fabricius, 1790

*Philanthus triangulum diadema* (Fabricius, 1781). Visiting flowers of *Deverra aphylla* (3 males). Provisions with honey-bees, *Apis*



*mellifera* Linnaeus, 1758 (Apidae). Excavates nests in friable soil.

#### *Cerceris* Latreille, 1802

*Cerceris curvitaris* Schletterer, 1887. (3 females, without flower visiting data). Provisions with Coleoptera; Tenebrionidae: a species of *Zophosis* Latreille, 1802 (Gess & Gess, unpublished field notes, Little Karoo). Almost certainly excavates burrow in friable soil.

*Cerceris multipicta* F. Smith, 1873. Visiting flowers of *Deverra aphylla* (8 females, 2 males). Provisions with Coleoptera; Curculionidae (Gess 1980). Almost certainly excavates burrow in friable soil.

*Cerceris nigrifrons* F. Smith, 1856. Visiting flowers of *Deverra aphylla* (6 females, 7 males). Provisions with Coleoptera; Buprestidae (Brauns, 1926, Zimbabwe); and Buprestidae: *Anthaxia sexualis* Obenberger, 1928 and *Anthaxia splendida* Chevrolat, 1838 (Gess & Gess, unpublished field notes, Alexandria, Eastern Cape). Excavates multicellular burrow in friable soil (Gess & Gess, unpublished field notes).

*Cerceris* sp. A. Visiting flowers of *Deverra aphylla* (12 females).

*Cerceris* sp. B. Visiting flowers of *Deverra aphylla* (1 male).

*Cerceris* sp. C. Visiting flowers of *Deverra aphylla* (1 male).

#### Colletidae

Colletids are short-tongued and primitive bees. Though most species carry pollen for provision externally on the hind legs some ingest it and carry it in the crop. They are solitary nesters in burrows in the ground or in plant tissue. They differ from all other bees in that they line their cells with a celophane-like substance.

#### *Colletes* Latreille, 1802

*Colletes* sp. Visiting flowers of *Deverra aphylla* (2 males).

#### Andrenidae

Andrenids are short-tongued bees. Pollen for provision is carried on the hind legs. Nearly all of the species excavate their nests in the ground. Most are solitary nesters although a few species live in colonies.

#### *Meliturgula* Friese, 1903

*Meliturgula flavida* (Friese, ) Visiting flowers of the pink flowered *Limeum* sp. (33 females). Seen nesting in burrows in sandy soil in the vicinity of the forage plants.

*Meliturgula* sp. B. Visiting flowers of the bluish-violet flowered *Aptosimum* sp. (1 female).

*Meliturgula* sp. C. Visiting flowers of *Tribulus cristatus* (1 female).

#### Halictidae

Halictids are short-tongued bees. Pollen for provision is carried on the hind legs by the majority of species, that is those which make their own nests. Some species are solitary nesters whereas others are semi-social and others again are eusocial. They nest in burrows in the ground or less commonly in plant tissue. Some species neither collect provision nor construct nests. They are "parasitic" in the nests of other species.

#### *Halictus* Latreille, 1804

*Halictus* sp. A. Visiting flowers of *Deverra aphylla* (1 female and 1 male).

*Halictus* sp. B. Visiting flowers of *Deverra aphylla* (1 female and 1 male).

#### *Nomioides* Schenck, 1866

*Nomioides* sp. A. Visiting flowers of *Deverra aphylla* (12 females) and



*Aptosimum spinescens* (1 female). Extremely abundant on *D. aphylla*. Almost certainly excavates burrows in friable soil.

*Nomioides* sp. B. Visiting flowers of *Deverra aphylla* (10 females, 4 males). Extremely abundant on *D. aphylla*. Almost certainly excavates burrows in friable soil.

*Pseudapis* W.F. Kirby, 1900

*Pseudapis cinerea* (Friese, 1930). Visiting flowers of *Deverra aphylla* (15 females) and *Pentzia incana* (2 females). Most probably excavates burrows in friable soil.

### Megachilidae

Megachilids are long-tongued bees. Pollen for provision is carried on the underside of the abdomen by the majority of species, that is those which make their own nests. They are solitary nesters. Most species do not make their own burrows but construct cells in pre-existing cavities or aerially. Materials used for the construction of cell walls include leaves, petals, plant down, leaf pulp, resin, pebbles and earth. Some species neither collect provision nor construct nests. These species are "parasitic" in the nests of other megachilids.

*Chalicodoma* Lepeletier, 1841

*Chalicodoma (Maximegachile) maxillosa* (Guérin, 1845). Visiting flowers of *Monechma* sp. (1 female). Most probably constructs mud-cells in pre-existing cavities.

*Chalicodoma* sp. Visiting flowers of *Deverra aphylla* (1 female). Most probably constructs mud-cells in pre-existing cavities.

*Megachile* Latreille, 1802 was surprisingly uncommon, only three specimens, each of a different species, having been captured during the sampling. *Megachile* species nest in pre-existing cavities in which they construct cells from discs cut from leaves or petals.

*Megachile* sp. A. Visiting flowers of *Deverra aphylla* (1 female).

*Megachile* sp. (1 female, without flower visiting data).

*Megachile* sp. Visiting flowers of *Monechma* sp. (1 female).

*Oranthidium* Pasteels, 1969

*Oranthidium folliculosum* (Buysson, 1897). Visiting flowers of *Limeum* sp. (2 females), *Hermannia modesta* (1 female, 4 males) and *Deverra aphylla* (1 female, 1 male). Nesting not recorded.

*Serapista* Cockerell, 1904

*Serapista rufipes* Friese 1904 (1 female, 1 male, without flower visiting data). Constructs aerial nests attached to twigs. These are bag-like and are constructed from plant fibers and occasionally the fur of small mammals.

### Fideliidae

Fideliids are long-tongued bees. Pollen for provision is carried on the underside of the abdomen. Their nests are burrows in the ground. They are solitary nesters although they may form large colonies.

*Parafidelia* Brauns, 1926

*Parafidelia friesei* Brauns, 1926. Visiting flowers of *Monechma* sp. (1 female). Most probably excavates burrows in friable soil.

### Anthophoridae

Anthophorids are long-tongued bees. Pollen for provision is carried on the hind legs by the majority of species, that is those which make their own nests. Some species are solitary whereas others are semi-social and others again are eusocial. Their nests are burrows in the ground or in plant tissue. Some species neither collect provision nor construct nests.

These species are "parasitic" in the nests of other bees.

*Braunsapis* Michener, 1969

*Braunsapis otavica* (Cockerell, 1939). Visiting flowers of *Deverra aphylla*. (1 female, 2 males).

*Ceratina* Latreille, 1802

*Ceratina* sp. Visiting flowers of *Deverra aphylla* (1 female). Most probably excavates burrows in dry pithy stems.

*Thyreus* Panzer, 1806. Some species have been recorded as parasitic in the nests of species of *Anthophora* Latreille, 1803 and *Amegilla* Friese, 1897.

*Thyreus pica* (Strand, 1911). Visiting flowers of *Monechma* sp. (1 male).

*Xylocopa* Latreille 1802

*Xylocopa* sp. Visiting flowers of *Cassia italica*. Sight record only.

Apidae

Apids are long-tongued bees. Included in the family are honey bees and stingless bees which occur in southern Africa and bumble bees which do not. The southern African apids are all eusocial. They nest in pre-existing cavities.

*Apis* Linnaeus, 1758

*Apis mellifera* Linnaeus, 1758 (the Honey-bee). Visiting flowers of *Deverra aphylla*.

**List of meloid beetles collected on flowers**

Meloidae

Adult meloid beetles are flower feeders. The larvae of in excess of 76 species are known to feed on grasshopper or locust egg packets and those of in excess of 34 species, including species of Lyttini and Mylabrini (Crowson,

1981; Krombein *et al.*, 1979; MacSwain, 1956) feed on the provision laid in by bees. Gess & Gess (1976, 1980) recorded the larvae of two species from the nests of aculeate wasps, *Lytta enona* Peringuey (Lyttini) from the nests of *Parachilus insignis* (Sussure) (Eumenidae) and *Ceroctis groendali* (Billberg) (Mylabrini) from the nests of *Ceramius lichtensteinii* (Klug) (Masaridae).

Meloidae

Mylabrini

*Ceroctis* Marseul, 1870

*Ceroctis exclamationis* (Marseul, 1872). Eating corolla of *Aptosimum spinescens* and *Aptosimum* sp.

*Ceroctis trifurca* (Gerstaecker, 1854). On flowers of *Tribulus cristatus*.

*Mylabris* Fabricius, 1775

*Mylabris* sp. On flowers of *Monechma* sp.

*Coryna* Billberg, 1813

*Coryna pilosa* Fahraeus, 1870

*Coryna argentata* (Fabricius, 1792). On flowers of *Limeum* sp.

*Actenodia* Laporte, 1840

*Actenodia chrysomelina* Erichson, 1843. On flowers of *Tribulus cristatus*.

Lyttini

*Prionotolytta* Péringuey, 1909

*Prionotolytta eremita* Kaszab, 1954. On flowers of *Tribulus cristatus*, *Limeum* sp. and *Deverra aphylla*.

**Discussion**

It should be noted that, when comparing the assemblages of species collected at various localities in order to establish whether individual species are present or absent, all that is needed is that one is able to recognise and distinguish the species. Consequently, the

fact that some of the species in the list above are distinguished from their congeners simply by alphabetical letter does not preclude our making inter-locality comparisons.

An analysis of the assemblage of the aculeate wasps and the bees obtained from our sampling in the Nossob River Valley shows a 50% representation of species occurring in the combined assemblages obtained from the study areas in Namaqualand, in the southern Great Karoo, in the Little Karoo and the easternmost extension of the Nama Karoo.

Amongst the species not represented in our Karoo samples there is a high representation of species known to have more northerly distributions, in the most part transcontinental, and though mostly occurring in the Savannah Biome not being restricted to it.

Application of Sorensen's coefficient of overall similarity indicates a relatively low overall similarity with any of our Karoo sites; the greatest similarity being with the southern Great Karoo, followed by the Little Karoo, and a marginally greater similarity with the western fauna than with the eastern fauna.

As stated in the introduction the present study is preliminary in its nature. More extensive sampling after rains from spring through to autumn would be required in order to obtain a more complete assemblage of the aculeate wasps and the bees of the southern Kalahari. Only then could one present a definitive analysis of the geographical affinities of the southern Kalahari aculeate wasp and bee faunas.

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